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RUSSIAN NUCLEAR TECHNOLOGY: EFFICIENCY, SAFETY, RELIABILITY

Peaceful Atom Strategy

Russian nuclear power is today not only as the largest power generator, but also one of the leading innovative leaders in a global context. Russian nuclear technology is deservedly are the safest and most reliable in the world. The Russian leadership sees in the nuclear industry, represented by Rosatom, technological and innovative leader who is able not only to act as a universal locomotive of the economy, but also to be a good example of a good work investment. The key principles of Rosatom at the present stage are formulated in the first place at the meetings of the President of Russia Vladimir Putin and the head of ROSATOM Sergey Kiriyenko. This is particularly important given that the Russian nuclear industry celebrated its 70th anniversary.

CEO of Rosatom State Corporation Sergei Kiriyenko told to Vladimir Putin, that the civilian sector showed record electricity production last year, setting a new milestone in the nuclear energy sector's history: «Our nuclear power stations are producing more than 10 billion kilowatt-hours of electricity more than year before, which was also a record year. They will produce more than 190 billion kilowatt-hours of electricity.

More efficient work at the existing power plants enables us to carry out the important programme you set to bring new units on line. The Rostov nuclear power plant, as I reported earlier, started operation two months earlier than planned, and is already in industrial operation. This has also added to electricity production capacity.

The fact that we are successfully building nuclear power plants here in our own country makes our foreign partners much more interested in us. We now have orders for 30 nuclear power plant units in 12 different countries. These are contracts already signed and with firm guarantees. We are in talks on another 10 projects. This is the biggest orders portfolio in the world in this sector. The orders are worth a total value of more than $300 billion.

New generation technology is especially important now. Under the federal targeted programme Nuclear Energy Technology of the New Generation, which you approved, we are using reliable and tested benchmark technology of the 'post-Fukushima' type – fast breeder reactors. We are completing the launch of operations at the BN-800 unit at Beloyarsk nuclear power plant in Sverdlovsk Region. What is important here is that we are doing this as a comprehensive project now, because the power plant is there, but we need the full technological fuel cycle.

Industrial operation has begun at a new MOX fuel (uranium-plutonium fuel) production plant, the first such plant in history. Our American partners have still not managed to finish the plant they were building. They have already spent $7.7 billion on it and, as Congress informs, they are now going to suspend the project because no one knows how much more money it will cost. We built our plant in 2.5 years at a cost of a little over $200 million, or 9.6 billion rubles. The plant is working and is now reaching industrial capacity.

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Rosatom: National and Global Leadership

In the world nuclear energy one of the largest players remains corporation Rosatom — Russian Federation national nuclear company bringing together circa 400 nuclear companies and R&D institutions that operate in the civilian and defense sectors. With 70 years' expertise in the nuclear field, Rosatom is a global leader in technologies and competencies offering cutting-edge industry solutions. Russian corporation works on a global scale to provide comprehensive nuclear services that range from uranium enrichment to nuclear waste treatment. The total share of Russian NPPs in the country's energy mix increased to 18.6%. Due to an increase in the scope of work under contracts signed earlier, overseas revenue in 2015 year increased to USD 6.3 billion (as against USD 5.2 billion in 2014). It is objectively a good positive result, which consists of many components…

International portfolio

Rosatom continues to expand its portfolio of overseas orders. At 2015 year end, the 10-year order portfolio amounted to USD 110.3 billion (in 2014 — USD 101.4 billion), while the project portfolio comprised 34 power units of NPPs worldwide.

For example, Russia and Egypt signed an intergovernmental agreement on construction and operation of a nuclear power plant equipped with four power units with a capacity of 1,200 MW each in Egypt. Cooperation in the field of nuclear energy between Russia and India continues successfully.

The start-up of unit No. 2 of Kudankulam NPP is scheduled for 2016. An EPC contract for NPP construction in Bangladesh was signed. A Russian-Indonesian consortium won the tender for the preliminary engineering design of a multi-purpose experimental reactor in Indonesia. The share of ROSATOM on the NPP service market is growing steadily.

Three years ago, ROSATOM started off with five power units with VVER reactors abroad, whereas now the company provides service for 18 out of 37 Russiandesign units currently in operation. In 2015, a contract for the extension of service life of unit No. 2 of Armenian NPP was signed. NPP construction cost management remains an important prerequisite for competitiveness. In 2015, the introduction of a special incentive system for design engineers enabled ROSATOM to reduce the cost of construction of Hanhikivi NPP in Finland by 11% without detriment to design solutions.

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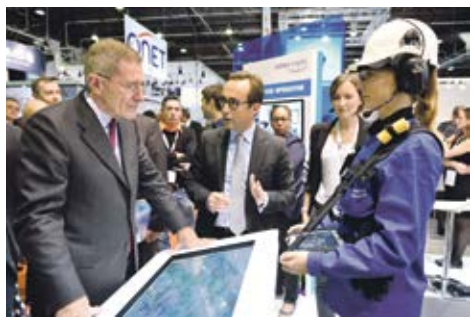

Industrial Weekly
UNIQUE TECHNOLOGIES AND PROJECTS
Summer 2016

IN BRIEF

FINANCIAL STATEMENTS

JSC "TENEX" released its consolidated financial statements for 2015 prepared in accordance with International Financial Reporting Standards (IFRS). According to IFRS, revenues reached ~ $ 2.9 billion, exceeding the previous year figures, including by partial resumption of exports to Japan, implementation of a number of options and additional sales in the spot market. The share of profits from the sale of uranium products in the structure of revenues is 99.4%. In 2015 gross and net profit of the TENEX group of companies amounted to $ 1.3 billion and $ 977.7 million respectively.

INTERNATIONAL NETWORK

Private institution of Atomic Energy Power Corporation "Rusatom International Network" and Moser Architekten Ziviltechniker, signed a Memorandum of understanding. The Parties are planning to start their cooperation in design, construction and management within the projects of nuclear medicine centers. The Memorandum emphasizes the interest of the Parties in their bilateral cooperation in the peaceful use of nuclear energy in such areas as design, construction and operation of the infrastructure for such areas as nuclear medicine and radiation safety, including environment impact assessment. The reached agreements provide the basis for the improvement of ROSATOM companies' competence in the nuclear medicine.

MANY YEARS OF COOPERATION

During "ATOMEXPO-2016" International Forum the talks were held between the top executives of JSC TVEL and the Director General of JSC "Aikakai Atomaiin Electakayan" (Republic of Armenia) Mr. Movses Vardanjan. During the meeting the prospects for future cooperation were reviewed, in particular the possibility of additional supply of Russian nuclear fuel to the reserve. Mr. Movses Vardanjan has noticed that for nearly forty years Armenian Nuclear Power Plant (ANPP) operates using Russian nuclear fuel. Many years of cooperation with JSC TVEL allows to speak about the Russian company as a reliable supplier. "Tight and mutually beneficial cooperation has always been the feature of Russian and Armenian nuclear power industry workers, — the Director General of ANPP has stressed. — During all years of operation ANPP has been exclusively utilizing Russian nuclear fuel, which has demonstrated its high performance. I hope that during further operation we'll have the opportunity to utilize nuclear fuel of such high quality.»

WORKING TRIP TO INDIA

Deputy Director General for International Relations of ROSATOM Nikolai Spasskiy made May 22-24 a working trip to India. Nikolai Spasskiy paid a visit to the construction site of Kudankulam NPP where he chaired a meeting of the Group of Companies ASE and the Indian directorate for the plant construction. The parties discussed issues of the final acceptance of Unit 1, achievement of the maximum controlled power at Unit 2, and preparation for the first concrete at construction sites of Units 3 and 4. In Mumbai, in the Headquarters of the Department of Atomic Energy of the Government of India, Nikolai Spasskiy held negotiations with Head of the Department for Atomic Energy of the Government of India and Chairman of the Atomic Energy Commission of India Sekhar Basu. The issues of drafting the general framework agreement concerning the construction of Units 5 and 6 of Kudankulam NPP were in the focus of the discussion. The parties have an understanding of the next steps. The interaction will be continued.

World Nuclear Exhibition 2016

Exclusive interview with Gérard Kottmann

Shortly before the opening of the World Nuclear Exhibition (WNE-2016) in Paris Gérard Kottmann, WNE and AIFEN Chairman, gave an exclusive interview to Industrial weekly, which is the official information partner of the exhibition WNE-2016.

— WNE's first edition is very positive. How can you explain this success?

— First of all, it was an international exhibition resolutely business-oriented and covering the whole nuclear supply chain. This dual strategic orientation meets the industrials needs: business meetings between and suppliers and clients rather than a conference and not only for the "new build" but also for component companies, civil works, waste management, radiation protection, controls etc. The mutual effort of organisers, exhibitors, major groups, politics personalities, nuclear counsellors etc. is the key of the success. Everybody work together in the same direction. The large number of international visitors coming from 50 countries is one of the results of this strong cooperation.

We showed that all the experts participate to the supply chain excellence. We exceed our objectives: 495 exhibitors, more than 7,200 international highly qualified including institutional and decision-makers and a global participation record satisfaction rate of 98%.

— What are the WNE 2016 prospects?

— Further to 2014 success, we have been very ambitious targeting 50% more of the exhibition area as well as visitors upon 2014 results. And we are on track to reach these goals! 90% of the exhibition were booked at 3 months before the show.

2014 exhibitors are renewing their participation and we already registered a 30% of international exhibitors. 2 years ago we had 10 international pavilions: we expect 15 pavilions this year including a bigger Russian one. ROSATOM, GOLD Sponsor, will chair a Panel Discussion on Tuesday, June 28th in the afternoon: "Safety, Quality and Project Delivery Certainty – Key Ingredients for any Successful Major Project".

— What's new in 2016 WNE edition?

— This edition is full of new developments. First of all we switch for another bigger and more suitable exhibition hall. The show will start with an Opening Ceremony in which international institutional and politic recognised personalities will take part.

Moreover, we defined a central theme «The nuclear industry in the global energy mix» that fits in with the current thinking on energy needs worldwide. The future is also in the projection of the nuclear industry, which places progress at the heart of the discussions. Panel discussion pilots will develop this theme through various issues. The whole Panel Discussions programme is available and updated on www.world-nuclear-exhibtion.com

4 awards will be given in order to highlight Innovation, Nuclear Safety, Operational Excellence and Knowledge Management. These awards are open to every exhibitor and I strongly invite Russian exhibitors to send us their participation file before April 18th. The rules are available on www.world-nuclear-exhibition.com.

Furthermore, Innovation and Training will be highlighted on two new areas.

On the one-hand the Innovation Planet that offers to start-ups and innovative newly created companies the opportunity to exhibit and meet clients and investors.

On the other-hand the Training Planet that emphasis training, knowledge transfer and development for countries that will introduce their needs whether they are already equipped or newcomers, and institutes that will present their programs during Training Opportunities sessions.

— What are the main problems the international nuclear industry is facing and how will these problems be reflected at the exhibition?

— One of the main problems to my view is the recently falling price of the fossil energies. Nuclear energy has to confront today at the same time the usual high investment costs compared to a boiler burning coal or gas and kWh prices that are in the doldrums because of these low fossil fuel prices plus the subsidized renewable energy sources. Short term low electricity prices are hindering long term decisions in favor of nuclear power plants. At the same time, this pushes our industry to work on reducing our costs while still increasing the safety level. Nice challenge for the R&D experts of all nuclear industries worldwide! These issues will be addressed during the Panel Discussions as the main theme of WNE is: "Nuclear energy in the global energy mix". But it will be also supporting the messages of our exhibitors especially at the Innovation Planet section.

— How will WNE help to link the resources and the needs?

— From the very first edition of WNE, we noticed that some countries wish to explain their nuclear plan, regardless of their nuclear development stage, in order to initiate or expand partnerships.

In 2014, international organizations including the IAEA (Vienna), Turkey, ENEC (UAE), the UKTI (UK) and ITER presented their projects and their needs during a dedicated session. In 2016, we will multiply these Business Opportunities sessions aiming them to be a real forum for these countries.

Furthermore, Business Meetings that are designed to link together exhibitors or exhibitors with visitors, have been so successful in 2014 that we expect twice more appointments in 2016: 4,000 business meetings should be organized. These meetings are free to visitors and exhibitors, targeted and pre-programmed by a company specialized in connecting purchasers and project leaders and suppliers and solution holders. You can register from WNE website.

Peaceful Atom Strategy

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Our efforts to guarantee safety are absolutely crucial. We have had no problems over this entire time. It is also important that we have started dealing with the accumulated waste that has built up. When the nuclear sector project began, the big priority was saving the country, but of course, over these 70 years, waste volumes have built up and been kept in long-term storage. And now we have started making sure this waste is in a safe state, so that nothing can 'explode' there. We are starting to treat and process it all now.

Work on de-assembling and processing the nuclear submarines transferred to us is nearly finished now. Of 201 submarines, 197 have been de-assembled and processed, and we have made sure they are in a safe condition. Last year, we completed in full the removal of spent nuclear fuel from the Far East and built a storage facility at the Mining and Chemicals Combine (GKhK), where the fuel has been put into safe and monitored storage.

We have collected all of the RTG (radioisotope thermoelectric generator) isotope sources that were scattered along the Northern Sea Route and in the Arctic and Antarctic regions. The last four RTGs were brought back from Antarctica last summer. In other words, we are systematically working our way through everything that has built up over these 70 years.»

There is no doubt that the Russian nuclear industry in the face of the famous ROSATOM will continue to actively increase the company's performance for all lines of business, increasing not only the efficiency and profitability, but also guaranteed security. In this very specific branches all most appreciate the reliability, stability, efficiency and safety. This is famous for all the 70 years of the Russian nuclear energy complex.

Rosatom: National and Global Leadership

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Power generation

In 2015, 35 power units of 10 operating NPPs generated a record amount of electricity in the entire history of Russian nuclear power generation: 195.2 billion kWh. This electricity output is comparable to electricity consumption in Moscow and the Moscow Region for two years. By the end of 2015, the total share of Russian NPPs in the country's energy mix increased to 18.6% (compared to 17.2% in 2014).

Power generation at NPPs exceeded the target set by the Federal Tariff Service of Russia (189.15 billion kWh) by over 6 billion kWh and made a significant contribution to the annual revenue of ROSATOM. The record power generation in 2015 was made possible by an improvement in operating efficiency of power units at NPPs: a shorter duration of repairs enabled additional generation totalling 2 billion kWh; an increase in the capacity of units currently in operation accounted for 2.5 billion kWh; power unit No. 3 of Rostov NPP was launched ahead of schedule and generated 1.3 billion kWh.

ROSATOM actively continued serial construction of new NPPs in Russia: at the end of the year, 8 power units were being constructed simultaneously. In the future this will make it possible to meet the energy needs of the country's economy and population without making any negative impact on the environment. A high-priority task for the Power Engineering Division of ROSATOM, which operates NPPs, is to enter new markets, including 'non-nuclear' markets.

In 2015, JSC Rosenergoatom Concern reached an agreement with PJSC Rostelecom on construction of Russia's largest data centre which will host important state information systems. The centre will be located in the vicinity of Kalinin NPP, which will provide it with an independent and cheap source of uninterrupted power supply.

Nuclear and radiation safety

The basic condition of ROSATOM's operations is to ensure the safety of nuclear facilities. The industrial automated radiation monitoring system (ARMS) enables real-time monitoring of the radiation environment in the areas with facilities and manufacturing plants of ROSATOM posing nuclear and radiation hazards.

The key achievement of the year consisted in successful completion of the federal target programme on nuclear and radiation safety for the period from 2008 through 2015 (FTP NRS) and approval of a new programme for the period from 2016 through 2030 by the Government of the Russian Federation. The final level of performance against the targets set in FTP NRS amounted to 109.7%, despite a reduction in public funding.

A high level of performance against the targets set in FTP NRS was achieved through overall efficiency: the unit cost of remediation of contaminated areas was reduced fourfold during the implementation of the programme; the unit cost of removal of one spent fuel assembly was reduced by a factor of 3.2; the cost of decommissioning of facilities posing nuclear and radiation hazards was reduced by a factor of 2.5.

A storage facility for liquid radioactive process waste on Lake Karachay in the Chelyabinsk Region was completely buried and eliminated. Thus, we solved one of the most important environmental problems in the region. For the first time in history, an EI-2 industrial uranium graphite reactor was decommissioned in Seversk: additional engineering barriers made of specially designed material were built, and a site for long-term storage of special RAW was developed. Like in recent years, in 2015 no events rated at level 2 or higher on the international INES scale were detected at nuclear facilities of ROSATOM (level 1 and 0 deviations do not pose a risk to employees operating the facilities, local residents or the environment).

«We reached the targets that the government of the country had set for us. Moreover, we managed to exceed the targets for some indicators considerably. We successfully accomplished the following key tasks of the year: increase of ROSATOM's share on international markets, continued growth of the portfolio of overseas orders; reduction of the cost of our products and lead time; development of new products for the domestic and international markets».

Sergey Kirienko
CEO of ROSATOM

Nuclear engineering

The Mechanical Engineering Division of ROSATOM produces complete sets of equipment for nuclear and thermal power generation, gas and petrochemical industries, shipbuilding and the special steel market. In 2015, the Atommash industrial complex in Volgodonsk was revived and integrated into the production and process chain of ROSATOM.

Today, Atommash is the only Russian plant producing complete sets of equipment for the nuclear island of NPPs: it can produce up to 4 sets of equipment per year. The aggregate capacities of the Mechanical Engineering Division enable manufacturing of up to 7 sets of reactor equipment a year at the enterprises of ROSATOM and related enterprises.

In 2015, the first reactor and certain items of key equipment for the Belarusian NPP were delivered. This is the first reactor vessel produced by Atommash after a nearly 30-year break and the first one produced by an enterprise forming part of ROSATOM. Deliveries of steam generators to the construction site of power unit No. 4 of Tianwan NPP in China were completed, and a contract for the delivery of a complete set of equipment for the reactor building of power units No. 3 and 4 of Kudankulam NPP in India was signed.

Two reactor vessels of the RITM200 power unit were assembled for the world's largest new-generation Russian nuclear icebreaker, Arktika, which is now under construction. In 2015, performance of the Mechanical Engineering Division continued to improve. JSC NPO TsNIITMASh developed and implemented a new technology for sectional forging and stamping of bottoms of steam generators. This will make it possible to reduce metal consumption by up to 40% and to reduce labour input and power costs.

In May and June 2015, the parent organization of the division, JSC Atomenergomash, conducted a unique logistical operation to deliver oversized steam generators from the production site in Podolsk to the construction site of Leningrad NPP-2 in Sosnovy Bor. A new method of delivery involving transportation by water enabled significant financial savings and helped reduce the delivery time (which totalled about three months).

Innovative products

ROSATOM actively develops new business areas and made efforts to enter new markets, including non-nuclear markets. The plant's annual capacity totals 1.7 thousand tonnes of carbon fibre per year with a potential to 2 thousand tonnes per year.

The ALABUGA-VOLOKNO plant designed to produce carbon fibre was opened in the Alabuga special economic zone in the Republic of Tatarstan (the plant was built by order of ROSATOM). Carbon fibre is a composite material used in high-tech industries.

The plant's annual capacity totals 1.7 thousand tonnes per year with a potential for a ramp-up to 2 thousand tonnes per year. It fully meets the needs of the Russian market, which used to be covered largely by import; in the future, this project will enable Russia to hold at least 2% of the global carbon fibre market. First surgical operations for treatment of cancer were performed using domestically produced micro-sources manufactured by ROSATOM which use the iodine-125 isotope.

A high-tech product was produced in Russia whose quality is comparable with its foreign analogues and which is 2.5 to 4 times cheaper. This development has a significant export potential. The first test sample of Russian beryllium was obtained using laboratory equipment of Tomsk Polytechnic University. Future plans include creation of a pilot plant at JSC SCC (an organization forming part of ROSATOM).

The production capacity of the plant to be created will depend on the needs of the market. Under the agreement with OJSC Rosneft Oil Company, the first sets of equipment for geological exploration, automated management systems, monitoring systems, pumping equipment and security systems were delivered.

Nuclear fuel cycle

The Mining and Fuel Divisions of ROSATOM produce and enrich uranium and manufacture nuclear fuel for nuclear power plants. Uranium-based fuel is one of the most efficient types of fuel in the world: one uranium pellet the size of a 10 kopek coin contains energy equivalent to 2.24 barrels of oil or 441 kg of coal.

In 2015, the enterprises of ROSATOM produced 7,849 tonnes of uranium: Russian enterprises of the Mining Division produced 3,055 tonnes of natural uranium; uranium production at overseas deposits in Kazakhstan and the USA totalled 4,794 tonnes.

The key uranium mining company of the Mining Division, JSC PIMCU, managed to reduce the cost of uranium production by 12%. A promising domestic uranium mining company, JSC Khiagda, launched a sulphuric acid production plant with a capacity of 110 thousand tonnes per year. It will fully meet the demand of JSC Khiagda for sulphuric acid, which is required for uranium extraction.

ROSATOM accounts for 17% of the global nuclear fuel market, as it supplies fuel to 78 power units at NPPs in 15 countries worldwide and to research reactors in 9 countries. In 2015, all contractual obligations towards Russian and foreign customers were met. A new generation fuel, TVSA-12, was delivered to Kozloduy NPP in Bulgaria; starting from 2016, the use of this fuel will help improve the economic efficiency of the plant.

The world's largest uranium enrichment enterprise, JSC UEIP, put two new ninth-generation gas centrifuge units into operation. Tenth-generation centrifuges are currently being tested. These achievements will significantly improve the efficiency of the uranium enrichment process.

BN–800

BN-800 is the world's most powerful fast neutron reactor running on MOX fuel (a mixture of oxides of plutonium and uranium). In 2015, ROSATOM started industrial production of MOX fuel for power unit No. 4 of Beloyarsk NPP. On December 10, 2015, power unit No. 4 of Beloyarsk NPP equipped with a BN-800 reactor was connected to the grid and started electricity generation for the power system of the Urals region and Russia.

BN-800 and other fast neutron reactors are a new technological platform for transition to a closed nuclear fuel cycle in the nuclear power industry. A closed nuclear fuel cycle will significantly improve the efficiency of fuel usage and will help to solve the problem of nuclear waste and secure a reliable long-term source of clean energy. Power start-up of BN-800 helped strengthen the leading position of Russia and ROSATOM in the field of closed fuel cycle technologies and makes it possible to examine the economic efficiency of fast neutron reactors and to start their large-scale commercial construction in the future.

Other important achievements in 2015 aimed at closing the nuclear fuel cycle: Experimental REMIX fuel was developed, and its production was started. This unique fuel will help reduce the consumption of natural uranium in nuclear power generation, since it reuses not only plutonium contained in spent fuel but also residual amounts of uranium-235; Researchers from ROSATOM and the Russian Academy of Sciences created the technology for americium recovery from spent nuclear fuel, which is planned to be burnt in fast neutron reactors, thus helping solve the problem of radioactive waste.

According to the materials of the Corporation ROSATOM

ROSATOM highlights:

- No. 1 globally in number of nuclear reactors under simultaneous construction (8 in Russia and 34 abroad)
- No. 2 globally in uranium reserves and No.3 globally in annual uranium extraction
- No. 2 globally and No. 1 in Russia in terms of nuclear power generation (about 18% of total power generated in Russia)
- 36% of the global uranium enrichment market
- 17% of the global nuclear fuel market
- the world's only nuclear icebreaker fleet

ROSATOM is a proponent of the uniform national policy and best management practices in nuclear power utilization, the nuclear weapons industry, and nuclear safety. ROSATOM is responsible for meeting Russia's international commitments regarding peaceful uses of nuclear energy and nuclear non-proliferation. Other — ROSATOM lines of business include nuclear medicine and composite materials.

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The World's Largest Arktika

Russia owns the world's only nuclear icebreaker fleet and has a long track record in construction and operation of nuclear icebreakers. Icebreakers equipped with a nuclear power unit enable the use of the Northern Sea Route and help Russia maintain a presence in the Arctic Region. In 2015, nuclear icebreakers conducted 195 vessels with a total gross tonnage of 2.04 million tonnes along the Northern Sea Route. Enterprises of the United Shipbuilding Corporation (Russia) engaged in the development and production of unique icebreakers.

On the 16th of June 2016 the Baltijskiy Zavod – Sudostroenie (shipbuilding) (part of the United Shipbuilding Corporation) has launched the pilot nuclear icebreaker Arktika (Project 22220), which is built to the order of ROSATOM. The ceremony was attended by Chairwoman of the Council of Federation of the Federal Assembly of the Russian Federation Valentina Matvienko; Plenipotentiary Representative of the President of Russia in North-West District Vladimir Bulavin; Governor of Murmansk Region Marina Kovtun; CEO of ROSATOM Sergey Kirienko; General Director of FSUE Atomflot Vyacheslav Ruksha; and others.

In the presence of several thousands of spectators, Valentina Matvienko smashed the traditional bottle of champagne on the board, launching the largest and most powerful nuclear icebreaker in the world. "Today, the nuclear industry of Russia has the important day. The world's largest and most powerful nuclear icebreaker Arktika has left the slipway. For many polar explorers, it is the meaning of life to develop the Arctic. I am certain the icebreaker Arktika will give the new impetus to the development of the Arctic," she said in her welcoming speech.

In his welcoming speech, Sergey Kirienko noted: "The today's event is an enormous victory in all senses! Large work has been done; there are no analogues of the icebreaker such as the Arktika in the world. Thanks to the team of the Baltijskiy Zavod, everything has been done on schedule and the Arktika will come on-stream. This icebreaker is most up-to-date by its parameters; all technical capabilities which have never been used on other vessels are implemented here. The icebreaker Arktika means real new opportunities for our country!"

"The first series-made icebreaker is already on the slipway and in September this year the keel of the second series icebreaker will be laid," General Director of FSUE Atomflot Vyacheslav Ruksha said. "We are facing the task of commissioning the pilot nuclear icebreaker Arktika by the end of December 2017. This is due date laid down in the contract terms. We hope our partners will be reliable and fulfill their obligations," he said.

The universal nuclear icebreaker of Project 22220 is on, FSUE Atomflot's major task will be the support of all-year-round navigation along the entire Northern Sea Route: delivery of hydrocarbons to the Pacific Asia markets.

The pilot nuclear icebreaker of Project 22220 is built to the class of the Russian Marine Register of Shipping (RS) at the Baltijskiy Zavod — Sudostroenie by order of ROSATOM (the keel was laid on November 5, 2013). It will be the largest and most powerful nuclear icebreaker in the world. The icebreaker is designed for independent steering of ships (including large tonnage ones) and leading caravans in the West Arctic all-year-round. The double-draft design of the ship makes possible to use her both in the Arctic and in estuaries of the Polar rivers (in particular, in shallow water of the Yenissei River (Dudinka) and the Gulf of Ob). The icebreaker can be also used for towing ships and other vessels in the ice and open water, rendering assistance to ships, and carrying out rescue operations in the ice and open water. The maximum thickness of solid even fast ice the icebreaker can overcome is 2.9 meters.

Contracts have been concluded with Russian shipbuilders for the construction of five port vessels for the port of Sabetta as part of the Yamal LNG strategic gas production project. This will help diversify the operations of the nuclear icebreaker fleet and create new jobs. In addition, as part of the Yamal LNG project, a contract for conducting liquefied natural gas tankers has been signed; the contract is valid until 2040. The world's only nuclear LASH carrier, Sevmorput, has been restored; its service life has been extended by 15 years at the least.

Izhorskiye Zavody : Experience and Prospects

This June, Izhorskiye Zavody (IZ), being a part of the OMZ Group, signed a Contract for manufacture of equipment for the fourth Unit of the Kudankulam Nuclear Power Plant second stage (India) that is now being constructed.

Under this Contract, Izhorskiye Zavody are to manufacture the reactor vessel of VVER-1000 with internals and upper unit — the heart of the nuclear power plant unit where the nuclear fission process and massive energy release take place to be further turned into electric power. Moreover, IZ will manufacture the suppor ring and thrust ring, main sealing parts, surveillance specimens and other critical equipment for the reactor unit of the plant.

It will be the fourth reactor vessel manufactured by Izhorskiye Zavody for Kudankulam Nuclear Power Plant. The first Unit of the plant with IZ's reactor and other reactor equipment was placed in operation in 2013 and has operated successfully since then. The second Unit is now being prepared for the energetic start-up and the third one is being under manufacture in IZ's workshops.

The successful cooperation between IZ and its Indian partners in the sphere of nuclear power industry has begun in 2002 and continues up to the present moment. This is a solid proof of high quality and reliability of nuclear power equipment produced by Izhorskiye Zavody.

Izhorskiye Zavody established in 1722 by the Decree of Peter the Great stood at the origin of the Russian nuclear power industry development in the middle of the 20th century and now IZ are one of the leaders in nuclear power plant engineering. These are not just big words. In 1961, IZ manufactured the vessel for the first Russian nuclear power reactor VVER of 210 MW power for the first Russian Novovoronezh Nuclear Power Plant. In 1979, the first reactor VVER-1000 for the fifth Unit of Novovoronezh Nuclear Power Plant was manufactured. In 2011, the second stage of Novovoronezh Nuclear Power Plant, constructed under the NPP-2006 project , wassupplied with the first VVER-1200 reactor of increasedpower and service life increased to 60 years. These are just the main milestones of the Russian nuclear power engineering development and nuclear power business development of the oldest and largest Russian industrial enterprise — Izhorskiye Zavody.

For almost six decades of nuclear power engineering experience, Izhorskiye Zavody have manufactured more than 200 reactors of various powers for research, transportation and fixed nuclear installations.

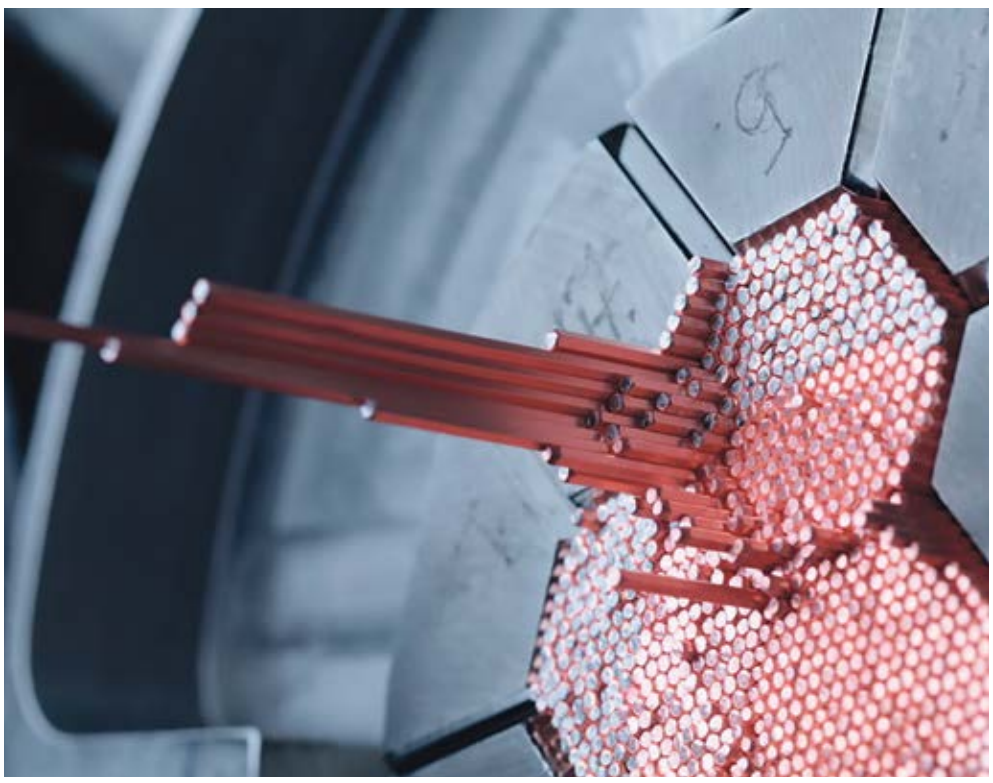
It is safe to say that there is no nuclear power plant in Russia and CIS countries that is not supplied with equipment produced by Izhorskiye Zavody. The IZ's reactors are successfully operated at Novovoronezh, Kola, Balakovo, Kalinin, Leningrad Nuclear Power Plants and other nuclear power plants in Russia, and also at nuclear power plants in Bulgaria, Hungary, Slovakia, Czech Republic, Iran, China and Finland. Loviisa Nuclear Power Plant in Finland is worth mentioning as a separate point, because it has the reputation of the best eco-friendly nuclear power plant in Europe.

The manufacture of nuclear power equipment has always been one of the most promising business directions of IZ. The great operation experience of nuclear power reactors produced by Izhorskiye Zavody proves their reliability and safety. Thus, the fault free operating time of VVER-1000 reactors is around 200 reactor-years long. The quality is conditioned not only by the modern high-technology equipment and highly qualified stuff, but also by means of strict system of monitoring, research and testing. The current system of nuclear power plant equipment quality assurance is fully compliant with International Atomic Energy Agency standards.

The projects performed by Izhorskiye Zavody have a rather vast geography. The manufacture of reactors and other reactor vessel equipment for Novovoronezh NPP-2 (Units 1 and 2) and second stage of Leningrad NPP-2 (Units 1 and 2) was completed. These plants are being constructed under the new Russian NPP-2006 project with reactors of increased power VVER-1200. The equipment produced by Izhorskiye Zavody will be operated at Rostov and Baltic Nuclear Power Plants. The production of the equipment for Belarusian Nuclear Power Plant is being completed. The main plant units (reactor vessels with internals) for power Units 3 and 4 of Tianwan Nuclear Power Plant in Chine have been shipped, and the production of other equipment is also being completed.

Kudankulam Nuclear Power Plant is the main object of cooperation between Russia and India in the sphere of nuclear power industry. Our Indian partners have no doubts that Izhorskiye Zavody will fulfil their contract obligations to a good quality and in due time.

An International Development Impetus



Due to joint efforts of Rosatom State Corporation, TVEL Fuel Company and JSC CMP Russia managed to resurrect unique technologies and implement a project for the industrial production of high-conductive strands for magnetic system of the International Thermonuclear Experimental Reactor being now constructed in France (Cadarache). Competencies gained by domestic companies while performing obligations undertaken by Russia push the boundaries for the development of the national nuclear industry.

In terms of its intellectual and financial potential, the ITER project surpasses the International Space Station. The reactor being developed differs from the existing nuclear reactors in its operating principle. In the existing reactors, heat is generated due to breaking up of heavy uranium or plutonium nuclei. In the thermonuclear reactor, fusion energy of light nuclei (hydrogen isotopes) is utilized. In the core of thermonuclear reactor, a continuous temperature of 150 million degrees (for comparison, the temperature inside the Sun is 20 million °C) will be maintained. Isotopes burn out without leaving any radioactive wastes. Furthermore, 10 times more energy is generated per unit of thermonuclear fuel as compared to the combustion of organic fuel and 100 times more as compared to the uranium nuclear fission in NPPs' reactors. The main problem of the new technology is holding plasma inside the reactor. It is intended to be held using the superconductor-based magnetic system.

A superconductor system is the most complex and the most expensive component in the ITER. At the construction stage, almost one fourth of the Russia's contribution in the international project will be represented namely by the superconductor technology. Solving the mission on production of superconductor materials in Russia was charged with the TVEL Fuel Company.

A unique set of requirements made towards the manufacture of the equipment for the ITER reactor, assigned a number of the hardest tasks before the developers of superconductors for the magnetic system, which are to be solved for the first time ever.

Research and Development Establishments included into the State Corporation and the Fuel Company were involved into the development of designs and technologies for manufacture of composite superconductors having the required properties (JSC All-Russian Scientific Research Institute for Inorganic Materials, RDE Kurchatov Instutute, JSC Research Institute of Electrophysical Apparatus). Fundamental and applied research in materials science and diagnostics of superconductor materials (SCM), vacuum melting, hot and cold deforming, mechanical and thermal treatment of initial (high-purity niobium and copper, highly homogeneous niobium-titanium alloy, high-tin alloyed bronze) and the most complex composite materials were held. The novelty of the developed technical decisions, their relevancy and practical value are confirmed by 18 patents obtained in the progress of works.

To unconditionally fulfil the Russia's obligations for the manufacture of SCM in the full scope, Rosatom decided to organize production of superconductors at Cherepovets Mechanical Plant (Udmurt Republic, Glazov). JSC CMP possessing metallurgical, pressing and rolling facilities was selected as an enterprise capable of launching a unique science-driven, technically and technologically intensive production. In total, to organize the production of superconductor materials for ITER, more than 100 units of the cutting-edge advanced equipment were procured by the plant. Actual costs for its development amounted to approximately RUB 2.4 billion.

From the technology viewpoint, the project is unique. The superconductor for ITER is a unique cable consisting of a thousand of individual superconductor wires, each of them containing more than 10 thousand of thin (2-6 micron) superconducting filaments. For comparison, the thickness of a human hair is from 40 to 110 micron. For niobium-titanium conductor, composites shall have the diameter of 0.73 mm and contain niobium-titanium filaments of 5-7 microns in a copper matrix. Nb3Sn compound-based composites are even more complex. They contain approximately 19 thousand niobium filaments in a high-tin bronze matrix, separated from the copper stabilization with a niobium barrier with tantal inserts. The length of such products may exceed 30 km and the diameter is 0.82 mm.

To obtain long composites whose heterogeneous components are of micron size, high demands are placed on the initial materials. In this connection, the production technologies were developed for: high-purity copper, niobium, tin bronze, Nb-Ti alloy and their semi-products with the strictly controlled composition and structure.

During implementing the project, the tasks of immense complexity were solved such as:

- on development and assimilation of a large-scale niobium production technology. Works on the manufacture, installation and mastering of special equipment were carried out.
- on development and assimilation of a large-scale high-purity niobium and niobium-titanium alloy technology. Construction and installation works were performed along with the works on launching and mastering of unique furnaces: - electron-beam furnace for the production of high-purity niobium and skull furnace.
- for construction, development, manufacture and mastering of special equipment The strand manufacturing technology demanded large amounts of special equipment never produced before, provision of clean premises.

As a result of the work performed at JSC Chepetsky Mechanical Plant, a Russian manufacture of low-temperature superconductor materials of almost closed production cycle was developed. The developed production is equipped with specialized control and measurement as well as analytical equipment, including a unique set for performing electro-physical measurements at the temperatures approaching the absolute zero. This is the only place in Russia, where the most complex cryogenic measurements of such parameters as: critical current value, hysteresis losses, RRR parameter are performed on an industrial scale counted in hundreds of measurements per month.

The multiple audits by the representatives of the ITER international organization at JSC CMP approved the high level of technology and quality of the output product complying with the requirements made. The CMP's niobium-titanium strand was acknowledged the reference for all the ITER project participants.

PRODUCING ENERGY OF FUTURE

In five years, JSC CMP has produced more than 200 t or 61 thousand km of superconductors — the wire, whose length would be enough to wrap around the Earth 1.5 times. The last batch of the product was shipped by JSC CMP late in 2014.

Many directions of the company's activity are presently connected with the high-tech domain. The competencies accumulated along with the unique equipment allow participating in other international projects connected with the use of superconductors.

Already in 2012 JSC CMP jointly with JSC All-Russian Scientific Research Institute for Inorganic Materials participated in the tender for supply of superconductor strands for the FAIR (Facility for Antiproton and Ion Research) project. In 2013 a contract with the Joint Institute for Nuclear Research was signed in Dubna for supply of superconductor materials for the booster accelerator of the NICA (Nuclotron-based Ion Collider Facility) project, and in 2015 it was fulfilled. In 2015, works with the Joint Institute for Nuclear Research were continued with signing an agreement for supply of superconductor strands for the NICA acceleration complex. In parallel with this work, the qualification with a foreign customer of superconductor wire for the MRI is underway.

Negotiations are being held with the European Centre for Nuclear Research (CERN) on participation in the project for modernization of LHC (Large Hadron Collider) regarding the increase of its beam luminosity (HL LHC - Hi Luminisoty LHC). In 2014, the CERN representatives visited Chepetsk Mechanical Plant and expressed their appreciation for the developed production. In 2015, the design and technology for manufacture of superconductor wire for modernization of the LHC (HL LHC) and the Future Circular Collider has been initiated jointly with JSC All-Russian Scientific Research Institute for Inorganic Materials.

Production of superconductor materials makes it possible to use the existing high-tech potential of Chepetsky Mechanical Plant for new knowledge-intensive projects and within the country in various application fields: space, medicine, railway transport, power industry, geological survey, water and air transport. Superconductor materials may be used in powerful pulsed magnetic kickers for the scientific and industrial application, in contact wire for high-speed railway transport. Nanostructural conductors are necessary for developing the electronic and electrical devices operating in the extremely heavy conditions of aerospace and nuclear power industries. The most important application of low-temperature superconductors are superconductor magnets, which are used as components of medical imaging machines, diagnostic equipment, energy accumulators and current limiters.

Today, based on the CMP's superconductor production, welding wire of titanium alloys is produced. It is applied for the needs of aviation and rocket technology, sea shipbuilding. Also, wire manufacturing technology based on titanium alloy for the spring manufacture in motor industry is being mastered at CMP. As compared to the competitor's products, springs manufactured of wire samples produced by CMP demonstrate superior indicators of permanent strain after load removal.

PROFILE

On April 23, 2009 the industrial production of superconductor materials was officially launched at JSC CMP.

Production Purpose:

Fulfilment of the Russia's international obligations regarding supply of superconductors for the magnetic system of the International Thermonuclear Experimental Reactor.

Project participants:

The State Customer (Rosatom SC), the Technology Developer (JSC All-Russian Scientific Research Institute for Inorganic Materials), the Customer and Co-Investor (JSC TVEL), the Co-Contractor (JSC CMP), the Designers (JSC GSPI and JSC CMP).

Output product - low-temperature superconductors (LTSC) used for manufacture of ITER toroidal and poloidal magnetic field windings:

- superconductor strands based on the Nb3Sn compound (niobium-tin);
- superconductor strands based on NbTi alloy (niobium-titanium) alloy.

SUPERCONDUCTOR MATERIALS PRODUCED BY JSC CMP:

- Niobium-titanium (NbTi) and niobium-tin (Nb3Sn) strands of various designs;
- High-purity oxygen-free copper bars (RRR>200), products of various forms manufactured of high-purity copper (bars, wire, rolled products);
- Tin bronze bars with the tin content of 14% and more and bronze products;
- NbTi bars and products of them (bars, rolled products);
- titanium welding wire (diam. 0.8 — 7 mm);
- nanostructural electrical and tomographic wires;
- low-temperture superconductor materials.

Industrial Weekly

UNIQUE TECHNOLOGIES AND PROJECTS

Summer 2016

Regional Office in China

ROSATOM's Regional Office in China was opened in Beijing (China) within the framework of International exhibition Nuclear Industry China 2016. ROSATOM has similar regional representative offices in Latin America, Western Europe, Central Europe, Eastern Europe, Central Asia, Southeast Asia, countries of the Middle East and North Africa.

The objective of the China's regional office is to strengthen ROSATOM's current standing on the national market, search for and develop new opportunities for international business of Rosatom's divisions based on the win-win partnership with China companies in the energy and other sectors.

«China has been traditionally among our key foreign partners: at present there are two Russian VVER-design units operated at Tianwan NPP site, while two more units are under construction at present. The Office in Beijing will make it possible to join the efforts and improve efficiency of the nuclear enterprises in Eastern Asia,» noted Alexander Merten, President of Rusatom International Network.

The International exhibition Nuclear Industry China 2016 became a meeting venue for leading international nuclear energy organizations. Rosatom's engineering and machine-building divisions, ASE Group and OKB Gidropress, were presented on ROSATOM's united stand. ASE demonstrated its new technologies, competences and experience in cooperation with China within the framework of the Tianwan NPP construction project. All VVER plants are constructed by ROSATOM according to the design of OKB Gidropress that is a member of the machine-building division of Atomenergomash, JSC.

The representatives of the company told to the exhibition visitors about the facilities under operation and under construction, as well as about perspective projects all over the world. Various engineering solutions and modern design techniques make OKB Gidropress a reliable and credible partner for China and other countries.

Mr. Liu Qi, Deputy General Director of the National Energy Administration of the People's Republic of China and Mr. Sun Qin, Chairman of the Board of China National Nuclear Corporation (CNNC) visited ROSATOM's stand during the tour around the exposition. They thanked the representatives of the Russian nuclear industry for cooperation in the Tianwan NPP construction project.

The PRC and Russia have been developing cooperation in the nuclear sector for years. The PRC is implementing the Tianwan NPP project with the involvement of ROSATOM. The first stage of Tianwan NPP (Lianyungang, China) was commissioned in 2007 (units 1 and 2 with VVER-1000). The second stage is under construction at present (units 3 and 4 with VVER-1000). The General Contractor of the project is ASE group of companies. Besides, with the assistance of Russian nuclear specialists, the PRC has constructed the Chinese Experimental Fast Reactor (CEFR) and four trains of the gas centrifugal plant.

Power Machines: Portrait in Nuclear Power Frame

Power Machines is a global power engineering company — one of the world's top-ten industry leaders in terms of installed-equipment volume. We boast a wealth of experience and expertise in the engineering-design, manufacturing and supply of equipment sets for thermal, nuclear and hydro power plants. The company's core competency and competitive advantage lie in its handling of complex turn-key projects in the electrical power field. The story of the creation and evolution of Power Machines is the story of the consolidation of Russia's foremost power-machine-building enterprises.

Today, Power Machines has the necessary competence for producing all the main types of power equipment for NPP turbine halls: high-speed and low-speed turbines of any capacity; completely water-cooled generators (including fire-proofed versions) that are not manufactured by any other company.

Power Machines' equipment has been installed at 27 nuclear power plants throughout the world. Many years of successful operation have proven the high performance characteristics of the equipment, its operational stability and compliance with strict reliability requirements.

The list of the company's products encompasses cutting-edge, highly-efficient solutions for thermal, nuclear and hydro power plants, integrated power grids, industry and transport.

The high-speed turbines produced by Power Machines for nuclear power plants boast high efficiency and proven operational reliability. Power Machines is the only Russian company offering a packaged supply of basic thermal and mechanical equipment for NPP turbine islands and a leader among the world's producers of 800, 1000 and 1200 MW high-speed turbines for NPP power units. The turbines have a number of design features increasing their reliability and lifetime.

The low-speed steam turbine for nuclear power plants is our new product. Power Machines has developed a design for a low-speed steam turbine and 1255 MW turbogenerator for the WWER TOI project (standard optimized design for a two-unit NPP with a light water reactor). This innovative design is based on the requirements that apply to new units of nuclear power plants in the Russian Federation and abroad.

In the future, the capacity of the low-speed turbine unit by Power Machines may be increased to 1800 MW. One of the design features of this steam turbine is the use of 1760-mm-long steel blades at the last LPC rotor stage. Depending on customer requirements, the 1200-1255 MW turbine units for NPP units developed by Power Machines can be produced in either high-speed or slow-speed versions. Today, the company has all the necessary resources to launch the production cycle for the primary components of a pilot low-speed turbine set.

Among the active projects in this area include, for example, the Belorusskaya NPP (Belorussia). Manufacture and delivery of two complete turbine plants, including high-speed steam turbines with a capacity of 1200 MW each, condensers and auxiliary turbine-plant equipment, including two complete turbogenerators with a capacity of 1200 MW each with auxiliary equipment.

The second project — Leningradskaya NPP-2 (Russia). Manufacture and delivery of two complete turbine plants, including high-speed steam turbines with a capacity of 1200 MW each, condensers and auxiliary turbine-plant equipment, including two complete turbogenerators with a capacity of 1200 MW each with auxiliary equipment.

Also the third to represent an example — Novovoronezhskaya NPP-2 (Russia). Manufacture and delivery of two complete turbine plants, including high-speed steam turbines with a capacity of 1200 MW each, condensers and auxiliary turbine-plant equipment, including two complete turbogenerators with a capacity of 1200 MW each with auxiliary equipment.

Power Machines produces high-speed steam turbines for NPPs with a capacity of 200 MW to 1200 MW. The high reliability and cost-effectiveness of the turbines has been proven by more than twenty-five years' worth of operation at nuclear-power facilities. The design and production of turbine units for nuclear power plants at Power Machines is concentrated at Leningradsky Metallichesky Zavod (LMZ) (Leningrad Metal Plant), which has extensive experience in the successful development, research and production of high-capacity steam turbines/

Power Machines has developed highly-efficient explosion-proof completely water-cooled 1200 MW generators for high-capacity nuclear power plants. This equipment, boasting a high level of protection, has no comparables in the global nuclear-power industry. Power Machines' turbogenerators are manufactured at the Electrosila factory. The main features of these turbogenerators are high cost-effectiveness, control response, reliability, simplicity and ease-of-use in various climatic conditions.

In addition to its basic equipment, Power Machines also produces and supplies its own heat-exchanging and various auxiliary turbine-unit equipment, such as condensers, heaters, oil coolers, ejectors, valves, etc. The condenser is one of the key elements in any nuclear power plant. The thermal performance of the power unit as a whole has been enhanced thanks to the use of an original tube system in the condensers produced by Power Machines. Power Machines has commenced the production of condensers with titanium heat-exchanging tubes. The use of titanium increases the reliability and service life of condensers regardless of cooling-water quality, while also reducing operating and repair costs. What's more, the use of heat-exchanging tubes made of titanium and stainless steel instead of copper alloy tubes enhances the reliability of all NPP second circuit equipment. The condenser is delivered to the NPP construction site as separately-assembled high-quality modules, which reduces the time of its installation at the plant.

Power Machines supplies generating equipment complete with control and automation systems. The company offers the automation of the turbine building, including power unit and auxiliary equipment control systems, protection systems (both hydromechanical and electrical) and vibration control systems. The production of steam-drive turbine equipment is concentrated at Kaluga Turbine Works, which is part of the Power Machines OJSC group of companies. 62 steam-drive turbines for the feedwater pumps of nuclear units have been supplied to NPPs in Russia, Ukraine, India.

Remix-fuel: a Strategic Objective

The SCC employees participate in the new investment project with the considerable results anticipated by Rosatom

In the middle of the last 2015, a task was assigned to the team of Chemical Metallurgical Plant — manufacturing fuel elements employing a new fuel type — REMIX. It should be noted that several Rosatom's companies are involved into the project: the master mixture was manufactured by the V.G.Khlopin Radium Institute, fuel pellets were manufactured of the master mixture by the All-Russian Scientific Research Institute for Inorganic Materials; the SCC, in turn, manufactured fuel elements, which have already been sent to the NCCP for placing into the combined fuel assemblies. Within the framework of preventive maintenance repair 2016, three fuel assemblies additionally equipped with fuel elements containing the REMIX-fuel are planned to be charged in the VVER-1000 reactor of the third unit of Balakovskaya NPP for pilot production.

Direct process participants tell about the unparalleled work: Yevgeniy Lachkanov, Project Manager for the development of experimental and pilot production of dense fuel and Vladimir Pogulyayev, Process Engineer of the Chemical and Metallurgical Plant SCC.

The Endless Circle

"The essence of the REMIX fuel consists in the combined separation of uranium and plutonium from the spent nuclear fuel of thermal reactor. As a result, the uranium-plutonium reclaim separated from the spent nuclear fuel of thermal reactor and purified from other actinides and fission products, may be returned into the thermal reactor fuel cycle. The REMIX-fuel may be considered as the initial stage of mastering the MOX-fuel for the VVER with the subsequent transfer to the two-component nuclear energy system comprising VVER and FNR operating in a closed nuclear fuel cycle. Thus, immense quantities of tried-and-tested materials may be directed for peacful applications, to produce energy and considerably minimize the amount of radioactive wastes", Yevgeniy Lachkanov explained.

His colleague, Vladimir Pogulyayev, provided even more comprehensible explanation: "REMIX-fuel will give us a possibility to use the spent nuclear fuel for multiple times. After operating in the nuclear reactor core, fuel from the fuel assemblies may be subsequently reprocessed and reused.

The role of the researcher is assigned to the third power unit of Balakovskaya NPP, where fuel assemblies containing the REMIX-fuel will be installed into VVER-1000 reactor.

The Unprecedented Solutions

To manufacture experimental fuel elements containing the REMIX-fuel, extensive production preparation activities were performed at the SCC's Chemical and Metallurgical Plant. "A big challenge was represented by the butt resistance welding; in Russia it is used when working with uranium only; and the REMIX-fuel implies the presence of plutonium", Yevgeniy Lachkanov said hinting that the level of radiation safety for the plant personnel should have been provided at the respective level as well.

The task was very challenging. It was necessary to develop technical solutions for localizing the manual loading process as well as the fuel element welding in a sealed box with ensuring the equipment operability and maintainability at the same time. Therefore, after a fuel element butt resistance welding machine had been transferred from the Machine Building Plant in Electrostal to the Chemical-Metallurgical Plant, the SCC specialists had to develop the design of a shelter box along with equipping it with the utility systems. The box walls were manufactured of polycarbonate panels. Polycarbonate is a transparent material, therefore complex manipulations with fuel and components of fuel elements inside the box were more convenient for the experts and provided better observation.

The SCC installation personnel managed to implement the designers' idea; and the technologists of Chemical-Metallurgical Plant, on their part, elaborated the welding technology within the shelter box conditions, where the work was intended to be performed using chamber gloves with performing tiniest operations such as loading, installation of retainers, plugs and directly welding of experimental fuel elements.

It should be considered that very stringent requirements are made for this work. Pressure inside the cladding shall be at least 19 atm. and the helium content under the clad shall be minimum 98%. Therefore, the developed and accepted design solutions were unprecedented. Production preparation activities for the manufacture of fuel elements containing the REMIX-fuel were fulfilled under the supervision of the Chief Specialist of the Chemical-Metallurgical Plant Aleksey Tsyngalov in cooperation with many Combine's subdivisions.

Record–Breaking Deadlines

Let's be proud of our colleagues! They have performed a unique work in record time. We obtained the products from JSC All-Russian Scientific Research Institute for Inorganic Materials (fuel pellets manufactured of a specialized master mixture. Editorial comment) on April 4 and on April 18 the acceptance testing was performed", Yevgeniy Lachkanov said. - There is a huge contribution from the personnel in it, which has not only quickly learned working on simulators but also performing operations with the ready product. All was faultless and defectless. We had no right for a mistake. All was well done!"

Technologists, designers, experts in many areas rigorously calculated different options, outlined production processes considering the NCCP's and MBP's experience. Further, the skills were sharpened using simulators, control operations were held, the necessary adjustments were introduced. "Only after that we realized that we would be successful in managing live fuel elements", summed up Yevgeniy Lachkanov.

An Unfussy Pellet

For the Chemical-Metallurgical Plant, breaking-up records in uniqueness, is probably a historical tradition laid by veterans, the participants of the first Nuclear Project. Today a new generation of the "Putilovsky's" workers continue manufacturing products unparalleled anywhere in the world. The experimental fuel elements and assemblies with the mixed nitride uranium-plutonium fuel for the new-generation nuclear power industry - fast neutron reactors were manufactured here. Fuel elements containing REMIX-fuel for VVER were produced here as well. Now the masters are capable to compare the results of their own work with the good reason. For example, a REMIX-pallet, as opposed to the MNUP-fuel, is completely different. "For us as fuel element assemblers it is of primary importance that this pellet is much less temperamental, less prone to chipping", Vladimir Pogulyaev said.

After the technologists had assembled and welded the fuel element, a number of control operations were performed at the plant: leak tightness and alignment control, non-destructive radiographic inspection of the welded joint and position of the fuel column and components inside the fuel element as well as destructive testing regarding the contents of internal fuel-element gas (helium).

In April, a commission visited the plant to accept the order; it consisted of 20 top-ranked experts. Fuel elements passed the acceptance testing and will undoubtedly be used as intended.

The pilot operation of a new Russian experimental nuclear REMIX-fuel is planned to be started in summer this year at Balakovksaya NPP. This strategic investment project of Rosatom State Corporation is anticipated to produce important high results.

Written by Aleksandr Kuznetsov
Finalized for publication
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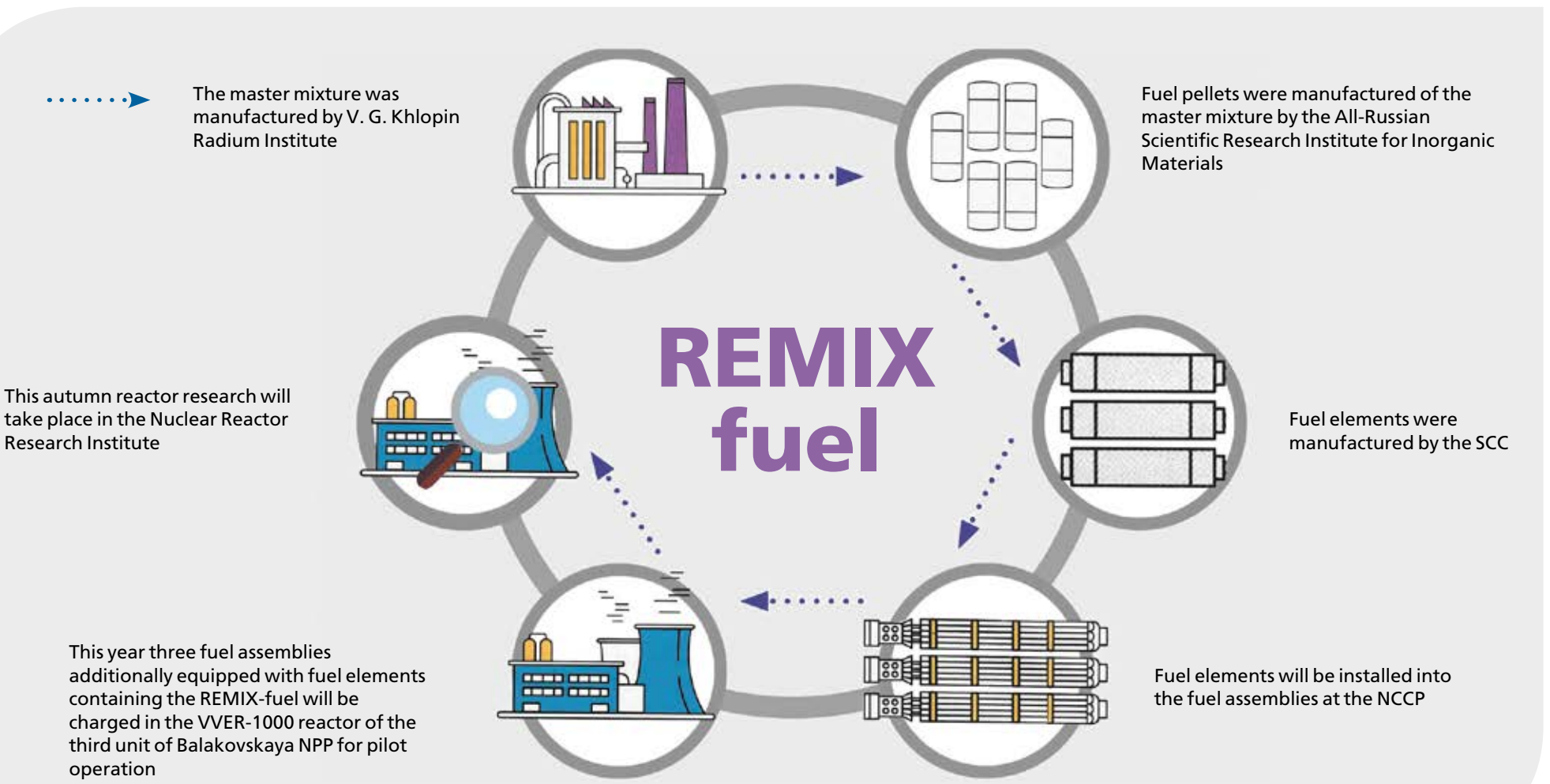

The Future Of Nuclear Energy. New Players

One of the key events of the VIII International Forum ATOMEXPO 2016 was the plenary session titled "The future of nuclear energy. New players". The forum took place in Gostiny Dvor, Moscow. The session was dedicated to general issues relating to the development of the international nuclear power, as well as cooperation with countries that are planning to develop nuclear energy and the main aspects of Rosatom's integrated offer. The moderator of this session was World Nuclear Association's (WNA) director general Agneta Rising.

“I am certain that ATOMEXPO 2016 will provide an excellent opportunity to identify and focus on solution-oriented responses and seek to unite the whole nuclear community – from research, government, regulation, design, operation, decommissioning and waste management – to play their respective roles towards a common goal to ensure that nuclear energy can contribute to a reliable, affordable and clean electricity generation mix," Agneta Rising noted in her welcoming address to forum participants.

A welcoming speech to ATOMEXPO 2016 participants by director general of ROSATOM, Sergey Kiriyenko, was also planned for the plenary session. Participants in the discussion were to include: Rosatom's first deputy director for corporate development and international business Kirill Komarov; IAEA deputy director general Mikhail Chudakov; Bolivian deputy minister for electricity and alternative energy Joaquin Rodriguez Gutierrez; director general of the Atomic Energy Commission of Nigeria Franklin Osaysay; director general of the Jordan Nuclear Power Company Ahmad Hiyasat; Ghana's deputy minister of power John Abdulai Jinapor; deputy director general of Cambodia's Ministry of Environment Tin Ponlok and others.

The Global Energy Prize 2016

One of the key events of the St. Petersburg international economic forum is traditionally the awarding ceremony of global energy prize. On behalf of the President of the Russian Federation this year the prize was awarded laureate of the President and the Chairman of the management Board of Rosneft and the head of presidential Commission for strategic development of fuel and energy Igor Sechin.

This year The Prize acknowledges RAS academician, scientific advisor of The Institute of Catalysis under The Siberian branch of RAS Valentin Parmon (Russia).

"Being awarded The Global Energy Prize is a great honor for me. It's truly remarkable that for the first time the prize is awarded to a chemist. It's very important that GEP acknowledges achievements in the sphere of catalysis — the most demanded segment of chemistry. The scientists who work in catalysis make a huge contribution into the development of petrochemical industry, also in perspective technologies like shale oil and gas refining," — said Valentin Parmon. The scientist added that the he would use the prize's monetary fund to support young scientists and their research. This year the amount if the prize is RUB 39 million.

Igor Sechin noted that the research in the sphere of catalysis done under the leadership of Valentin Parmon allowed making a real breakthrough in the petrochemical industry. "This is extremely important in today's conditions. There are fewer states in the world that use full potential of catalysis than the ones that have advanced nuclear technologies,” – said Sechin.

Valentin Parmon is the author of many breakthrough inventions which brought a significant commercial effect. In 2003-2006 new generation catalysts for production of motor fuels, in particular, diesel, complying with the Euro-4 and Euro-5 standards, were designed and industrially introduced under his supervision. Within these 3 years the scientist received RUB 500 million from the state for the project research, and introduction of new catalysts at the enterprises gave additional products — super-gasoline — for almost RUB 10 billion, i.e. 17 times more than was invested. He also develops methods of fuel production from plant raw materials: wood substance, rice. Valentin Parmon has also mastered a technology of transforming solar energy into chemical one. A number of solar catalytic reactors were designed and tested under his supervision. Their efficiency of solar energy conversion in to chemical fuel reaches 43% at 2 kW of available capacity (this indicator has not been surpassed yet).

The Global Energy Prize is an independent award for outstanding scientific research and technological developments in the energy field, which contribute to the benefit of humanity. Since 2003, The Global Energy Prize has been awarded to 34 Laureates from 10 countries: Canada, Germany, France, Iceland, Japan, Russia, Sweden, Ukraine, the UK and the US. The final choice of the laureates is made by The Global Energy Prize International Award Committee, which consists of 20 respected scientists from 13 countries. The nominating pool of the Global Energy Prize is represented by 3000 scientists from 83 countries. The 2016 Prize endowment sum is RUB 39 million (around $ 600 000).

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