



**LEAD STORY**

## Rosatom Goes Africa

**Last week was rich in new international agreements for Rosatom. Russia's state owned nuclear corporation signed a memorandum of cooperation in building irradiation centers in Morocco. Rosatom will also help Algeria with training local workforce for the national nuclear industry. For more details read our report.**

Rosatom's subsidiary Rusatom Healthcare and Regional Center for the Middle East and North Africa have signed a memorandum of understanding with CMI Développement and the Regional Council of Morocco's province Marrakesh-Safi. The document provides for long-term cooperation in establishing multi-purpose irradiation centers in Marrakesh-Safi and organizing isotopes supplies to the country's medical institutions. The

memorandum was signed on the margins of Morocco-Russia Business Forum held by the Russian Export Center in Rabat.

The parties agreed on a road map to join efforts in food irradiation. Rusatom Healthcare's CEO Denis Cherednichenko stressed the importance of the memorandum as it opens up new opportunities for mutually beneficial cooperation between the Russian Federation and the Kingdom of Morocco. "We see great potential in Morocco's irradiation market and are convinced that our isotope products will be in demand with the kingdom's medical institutions," Mr. Cherednichenko added.

While commenting on the memorandum, Abdelaziz Gaouji, Head of Marrakesh-Safi's Commission for Economic and Social Development, Environmental Protection and Education, noted, "Marrakesh-Safi's Regional Council and CMI Développement are pleased to start working together with such a prominent organization as Rosatom, which has

competencies in the use of irradiation technologies both in agriculture and medicine. I am certain that our cooperation will create much added value in these segments both on the local and regional levels.”

One more memorandum was signed with Morocco. Rosatom International Network through its regional center Rosatom Middle East and North Africa and the National Center of Nuclear Energy, Science and Techniques of the Kingdom of Morocco (hereinafter referred to as CNESTEN) signed a memorandum of understanding on cooperation in peaceful uses of atomic energy. The memorandum opens wide areas of bilateral cooperation in the peaceful application of atomic energy, such as: basic and applied research, use of radioisotopes and radiation technologies in industry, agriculture, medicine etc., nuclear fuel cycle products and services supply, assistance in developing of the Kingdom’s nuclear infrastructure, maintenance and equipment supply for the needs of the national atomic program of Morocco.

The document also embraces assistance in education, training of administrative and scientific personnel for the needs of national atomic programme, as well as support in raising of public awareness and acceptance of nuclear energy in the Kingdom.

Our readers should remember that last year Rosatom signed an agreement with India at the BRICS summit in New Delhi to develop a network of integrated radiation treatment centers. The network will be

managed by a joint Russian-Indian venture. The first phase of the project includes construction and commissioning of seven irradiation centers in India.



## Workforce Training in Algeria

Last week, Rosatom and the Algerian Atomic Energy Commission (COMENA) signed a memorandum of understanding to cooperate in workforce training for the national nuclear industry. The document was signed at a meeting between two Prime Ministers – Dmitri Medvedev and Ahmed Ouyahia. In September 2014, Russia and Algeria signed an intergovernmental agreement on peaceful uses of nuclear energy. It was noted that the core project of the two countries might be construction of a Russian-designed VVER reactor unit in Algeria.

In October 2014, Rosatom’s former CEO Sergei Kirienko said at a press conference that Rosatom started project consultations with its Algerian partners. Algeria plans to build its first nuclear plant by 2025 and subsequently commission a new power unit every five years. The country has sufficient resources to sustain operations of nuclear facilities. Its uranium reserves of almost 29,000 tons will suffice for 60 years’ operation of two nuclear plants with a 1,000 MW capacity each. At present, Algeria operates only two – 3 MW and 15 MW – research reactors.

## FUEL CYCLE

### Fuel for Reactors of the Future

**Russia has successfully tested MOX fuel components to be used in the BN-800 fast reactor.**

In October, Public Joint-Stock Company Mashinostroitelny Zavod (a subsidiary of Rosatom's TVEL Fuel Company) based in Elektrostal near Moscow successfully completed acceptance tests of fuel assembly components to be used in the BN-800 fast neutron reactor at Beloyarsk Unit 4. These components are wrapper tubes, which serve as fuel assembly structural parts, and bottom nozzles.

“The commission confirmed the possibility of using MSZ products in mixed nitride fuel assemblies designed for fast neutron reactors. MSZ is thus given a green light to start commercial production of these components,” noted Mikhail Egorov, Lead Engineer at MSZ Production Planning Department.

Since the BN-800 sodium-cooled breeder is meant for refining the MOX-based fast-breeder technology, experts believe that the expertise gained by MSZ is of extreme importance for the Russian and global nuclear power industry.



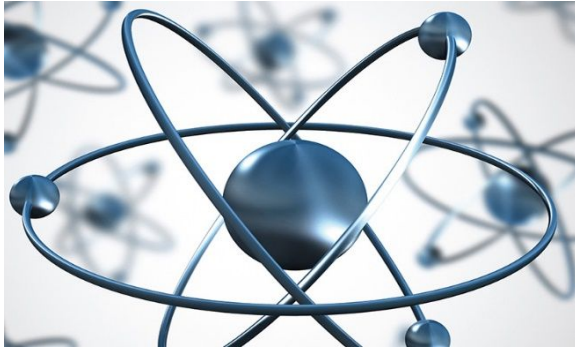
The fuel components will be sent to Rosatom's Mining and Chemical Plant (MCP) in Krasnoyarsk Krai for the final assembly. MCP is a manufacturer of MOX fuel for the BN-800 reactor. The use of MOX fuel turns uranium-238 into an energy carrier and paves the way towards waste-free technology in the nuclear power industry. Fast neutron reactors operating on mixed nitride fuel make it possible to re-use nuclear materials multiple times and reduce nuclear materials in circulation hundredfold. This fuel also makes a substantial contribution to safety improvement by cutting down civil plutonium reserves.

The MOX fuel project involves over 20 industry companies, including subsidiaries of TVEL Fuel Company. The MOX production process is based on the pilot technology devised by VNIINM, which played the main role in designing MOX fuel pellets and assemblies and developing the MOX manufacturing process.

According to experts, Russia is a global leader in fast reactor technologies. Its BN-800 based Beloyarsk Unit 4 was put in commercial operation in 2016. The BN-800 reactor is a prototype of BN-1200, a more powerful fast neutron reactor. The decision to construct a BN-1200 reactor unit will depend on BN-800's operation experience.



## NUCLEAR MEDICINE



### **Nuclear Medicine Goes International**

**A high-tech radiopharmaceutical production facility is to be established at a Rosatom Group research institute.**

“The Institute of Reactor Materials (a part of Rosatom’s research division) will receive a RUB 100m loan to start production of radioactive substances for medical applications. At present, the Institute is in the process of setting up a production unit to fabricate lutetium-177 trichloride. The project opens the door to a new segment of the global nuclear medicine market.

In Western countries, lutetium-177 is used in the treatment of neuroendocrine tumors. Targeted delivery of the isotope to cancer cells makes it possible to kill both metastases and primary malignancies, thus increasing the chance of success even at advanced stages of the disease. In 2013, the Institute of Reactor Materials fabricated its pilot batch of pile-produced Lutetium-177 for a European pharmaceutical company. The substance was produced using an in-house reactor, and the customer confirmed the high quality of the isotopes supplied. By the end of 2013, the Institute was ready to start mass production of feedstock for the fabrication of lutetium-177 used as a

precursor in nuclear medicine. Exports have been steadily growing since then, having increased from 40 Ci of lutetium-177 in 2014 to 650 Ci in 2016. “To be successful on the global market, the Institute of Reactor Materials maintains the quality of its products and strives to be a reliable and fast international supplier,” a representative of the Institute said.

### **Meeting 20% of global demand**

In addition to lutetium-177, the Institute will produce iodine-125, a widely used source of radiation in brachytherapy, mostly in prostate cancer treatment. The Institute of Reactor Materials will also supply iridium-192 for high dose-rate brachytherapy. Iridium-192 is now pile-produced in the IVV-2M reactor. According to the Institute, it satisfies up to 20% of the global demand for iridium-192, and its products meet all international quality standards. Plans to start production of iodine-125 have been discussed since 2013.

Now, with the loan obtained, the Institute has proceeded to procure necessary equipment, particularly special-purpose shielding chambers and boxes for safe handling of ionizing radiation sources, and instrumentation for quality and process control. The Institute will also purchase auxiliary plumbing, electric and ventilation equipment, materials to renovate the facility, and expendables.

Radiopharmaceuticals produced by the Institute of Reactor Materials will be distributed by Izotop, another Rosatom’s subsidiary and an authorized supplier of most isotopes produced by Rosatom Group. The company operates in Russia and 35 other countries.

## IN BRIEF

### **German Company to Help Rosatom Produce Wind Farm Components**

Aero Dynamik Consult GmbH, a German provider of integrated wind generator solutions, will design a wind turbine blade from carbon and glass fiber composite materials for Rosatom's subsidiary KhimPromEngineering. This blade to be designed by the spring of 2018 will be used in 2.5 MW wind turbines manufactured by Lagerwey (Netherlands). In 2016, Rosatom's subsidiary VetroOGK won a contract to construct three wind farms with a total capacity of 610 MW in the Russian regions of Adygea and Krasnodar. The first of them having a capacity of 150 MW will be built in Adygea (Shovgenovsky and Giaginsky districts). The farm will consist of 60 wind turbines. A Portuguese company Megajoule will design an optimum layout of the turbines and calculate their generation rate. Some wind turbine components will be manufactured at Rosatom's facility Atom mash (Volgodonsk, Rostov Region) with Lagerwey's technology. In June, OTEK (VetroOGK management company and Rosatom's subsidiary specializing in wind generation projects) and Lagerwey signed a license agreement on the transfer of the Dutch wind generator technology. The agreement includes an obligation to produce at least 65% of wind generator components in Russia.

### **Rosatom Expects Czech Companies to Participate in New Projects**

On Russia's Business Day at the 2017 International Engineering Fair (MSV) held in Brno (the Czech Republic) last week, Zdeněk Šíma heading Rosatom Central Europe took the floor to present

Rosatom's international projects and opportunities for Czech companies. Mr. Šíma noted that Czech suppliers were long-standing, reliable partners of Rosatom in many projects both in and outside Russia. According to him, Rosatom expects Czech partners to participate in new projects, including Hanhikivi-1, Paks-2 and Akkuyu. All these nuclear plants will be equipped with the most advanced Generation 3+ units based on VVER-1200 reactors. "Rosatom closely cooperates with the Czech Energy Alliance that unites leading nuclear engineering companies of the Czech Republic. This cooperation is based on the memorandum of understanding signed by Rosatom and the Alliance last June. The Alliance is able to make a comprehensive offer for equipment supplies from the Czech Republic to Rosatom's facilities and, more importantly, assist in providing export finance for such deliveries," Mr. Šíma noted.

### **Containment Dome Installed at Belarus Unit 2**

The dome forms part of the unit's double-walled containment structure - a major component for protecting the reactor and preventing the release of radioactive materials into the environment in the event of a serious accident. The containment system is able to withstand both internal pressure (5 kg per sq cm) and external impacts such as air shock waves creating the pressure of 30 kPa or a plane crash. The total weight of steel structures exceeds 230 tons. The inner base diameter of the containment is 44 m. "Once the dome is in its permanent position, the installation of steel structures of the internal reactor containment dome is over," noted Sergei Olontsev, ASE Senior Vice President for

Russian Projects. “In a few days, the construction team will start reinforcing and concreting the steel structures of the internal containment.” The design of Belarus Unit 2 provides for a double (internal and external) containment dome to be placed on the reactor building. This dome houses the core reactor equipment. The containment dome is the most important safety component of every nuclear power plant as it forms an ultimate physical barrier that curbs radioactive emissions and ionizing radiation from inside.

### **Armenian NPP Life Extension Discussed in Yerevan**

The Armenian NPP life extension steering committee held a meeting in early October. The meeting was attended by representatives of Rosatom, Armenia’s Ministry of Energy and Natural

Resources, State Nuclear Safety Regulatory Committee of the Armenian Government, Rusatom Service and Haykakan Atomayin Elektrakayan. Key machinery and equipment for the turbine island, including turbine generator, main transformer, etc., will be delivered to the site later this year. It was noted at the meeting that the infrastructure around the facility would be revived for the purpose of the project. The railroad line from Armavir to Arshaluys has already been restored. The plans are to reconstruct infrastructure facilities, including hotels in Armavir to accommodate the staff working at the plant, and landscape the plant’s premises. Other important topics covered at the meeting were cooperation in education, staff training and measures to raise public acceptance of nuclear energy.