LEAD STORY

Experts: “ROSATOM considers safety a matter of the highest priority”

Energy & Power, a Bangladeshi industry magazine, published an article by Alexander Bychkov, former IAEA Deputy Director General and Head of IAEA Department of Nuclear Energy, and Yanko Yanev, Head of the Vienna-based Nuclear Knowledge Management Institute. The article explains how safety is ensured at all the Rooppur NPP project implementation stages.

Nowadays each country interested in using nuclear power makes the decision to build its first NPP taking into account numerous factors. The International Atomic Energy Agency (IAEA) even recommends that extensive research is conducted prior to making this decision and during the preparatory stage before the first reactor's construction is started. The issues relating to the choice of a reliable partner and reference technologies are of great importance to the countries taking the decision to build a nuclear power plant (NPP). The safety requirements for a nuclear power plant at all stages of its lifecycle, including design and construction, operation and decommissioning are set out in the IAEA fundamental documents, serving as reference to the nuclear industry worldwide.

Russia, China, France, the USA, India and other nuclear-power promoting countries are well aware that inexpensive and emission-free nuclear power provides undeniable advantages for the successful social and economic development of a particular region and a country as a whole. At this point, common sense and practical planning prevail in the modern economy. Under such circumstances, all countries opt for cooperation with

appropriate vendors, as Rosatom did with Bangladesh and neighboring India.

Fifty Years of Safety

Light-water reactors, using normal water under pressure have been developed and constructed in Russia and are known as VVER type reactors. In such reactors, water serves both as a neutron moderator and as a reactor coolant. The VVER-type reactors are considered to be some of the safest reactors worldwide and form the basis of the Russian nuclear industry development program and export expansion. The experience of successfully operating NPPs with VVER-type reactors has already exceeded 1,400 accident-free reactor-years.

Nuclear power plants with VVER-type reactors built in cooperation with Russian specialists in Finland, the Czech Republic, Hungary, Bulgaria, Slovakia and other countries are safe and economically efficient. For example, in Slovakia and Ukraine, NPPs with VVER-type reactors provide almost 50% of the electricity generated in those countries. According to IAEA specialists, the Loviisa NPP in Finland is one of the most efficient and environmentally safe nuclear power plants in the world. At the symposium of participants in the construction of the Tianwan NPP, which took place in Lianyungang (China) in August 2010, the Chinese party stated that, at the Tianwan NPP, a record of continuous operation during the first fuel cycle was set among nuclear power plants operating in China.

For more than 50 years of operation, nuclear power plants with VVER-type reactors (VVER-440, VVER-1000) have been proved to be safe, reliable and competitive on the international power market, ensuring sustainable development of the nuclear power industry, and highlighting the necessity of its further steady promotion.

From the modern point of view, power generation units with VVER-type reactors maintain an acceptable safety level. Improvements made in the reactors' design, safety systems configuration, fuel cycle, radioactive waste management technologies and systems, and operational practices allow nuclear power plants to meet current safety and economical operation standards.

The solutions incorporated into NNP projects, their long-term accident-free operation experience, design development, and nuclear fuel and thermo-physics research have allowed a decision to be made concerning the possibility of operating power generation units at capacity of up to 104%.

According to background radiation measurements performed on a regular basis at the sites of operating NPPs with VVER-type reactors, the radiation level is always consistent with the natural background radiation level, which confirms the environmental safety of VVER facilities.

The Metsamor NPP is another important example of the safety of VVER plants. A major earthquake hit the north of Armenia in December 1988, resulting in massive collapse and the death of 25,000 people. The epicenter was 83 kilometers away from the Armenian NPP operating with two VVER-440 units. An examination showed that no damage or deviation was detected at the plant. Today, the Metsamor NPP in Armenia is a facility that is capable of withstanding up to a

magnitude 9 earthquake, yet the safety level of its back-up units is much higher.

Another good example is the Kudankulam NPP in India. The safety systems incorporated in the power plant project have met the standards of the IAEA and other regulatory agencies in Russia and India from the very beginning. Nevertheless, after the accident at the Fukushima NPP, an additional safety examination was conducted.

According to the results, the Kudankulam NPP showed an extremely high degree of endurance. Even if all the power and water supply systems failed for an extended period of time, the plant would be capable of stopping the fission reaction, removing the heat and securing the necessary safety, all in autonomous mode.

Of particular note is the fact that experts conduct a thorough examination of the nuclear power plant's area and construction site at the initial investigative stage and while drafting design documentation. The topographical, meteorological, geological, hydrogeological, seismic, seismotectonic and other settings of the region and the prospective NPP construction site undergo detailed scrutiny. All natural and man-made factors that may affect nuclear power plant safety are identified, and measures are worked out to reduce or eliminate their impact.

New Generation in Bangladesh

The Rooppur NPP power generation units will be constructed on the basis of VVER-1200 reactors of 3 + generation technology. The innovative power generation units have improved technical and economic parameters that ensure absolute safety of operation and fully meet the post-Fukushima requirements of the IAEA.

The unique technology was originally applied at the Novovoronezh NPP in Russia, where on August 5, 2016 the first power generation unit that represents the transition to reactors of the 3+ generation technology has been installed.

In addition, the first Russian-designed nuclear power plant with a VVER-1200 water-to-water reactor of the 3+ generation, consisting of two power generation units with a total capacity of 2400 MW, is under construction in Belarus.

Similar power generation units with VVER-1200 reactors are now at various stages of implementation at the Russian Leningrad NPP-2 site, and also in Turkey, Finland, Egypt and Hungary.

Today, the VVER-1200 is a powerful reactor, and it has three key advantages: it has a high-performance, it is durable and safe. The VVER-1200 reactor has 20% higher power capacity compared to the VVER-1000 of the previous generation. Its core equipment also has an extended 60-year design life, compared to the 30 years of previous generation reactors. A number of design solutions were adopted to minimize capital costs.

The project gives us the opportunity to build reference nuclear power plants across areas with diverse natural and geographical conditions and technogenic impacts. It can be built on sites with nine different foundations, from rocks to soft soils. If an NPP is constructed on a site where more intense external influences are needed, it will be possible to strengthen the construction without changing layout solutions of buildings and structures.

The main feature of the VVER-1200 project is its unique combination of active and passive safety systems that provides

maximum resistance against external and internal influences.
A full range of technological solutions implemented during the project guarantees the NPP's safety and excludes radioactive emission into the environment. In particular, the nuclear power unit is equipped with two protective shells with a ventilated space between them. The internal protective shell ensures that the space where the reactor is placed is hermetic. The external shell is able to resist any natural (tornadoes, hurricanes, earthquakes, floods, etc.), technogenic and anthropogenic (explosions, plane crash, etc.) impacts on the NPP.

The passive safety systems are capable of functioning even in the event of a complete loss of power supply. They can provide full safety without the active systems and an operator.
For example, the passive heat removal system (PHRS) that is installed at the Novovoronezh NPP in Russia, among other NPPs, ensures long-term heat removal from the reactor core section if all the other power supply sources fail. If necessary, the system can switch on without external interference and function under the influence of purely natural factors.

Due to first and second level hydraulic reservoirs, in case of an emergency, when the pressure in the primary circuit drops to a certain level, fluid is supplied to the reactor and it cools the core. Thus, a nuclear reaction is quenched by a great amount of boron-containing water that absorbs neutrons.
A passive filtration system for the space between the internal and the external shells is elaborated in the VVER-1200 project. The system excludes radioactive emission in the environment through the external shell in any cases associated with the failure of the active special ventilation system.

According to the project, a core melt localization device (CMLD), or a "core catcher," is installed at the bottom of the station's protective shell. It is designed to localize and cool the molten core material in case of a hypothetical accident that could lead to damage to the core. The "core catcher" allows the integrity of the protective shell to be preserved and thus excludes radioactive emission in the environment, even if the hypothetical accident is serious.
The construction of the Rooppur NPP in Bangladesh with the assistance of Russia is the largest joint Russian-Bangladeshi project in the energy field. The preparatory stage of construction of the power generation units is now underway. The first Rooppur NPP unit is expected to go into operation in 2022, and the second in 2023. Safety provisions at all stages of Rooppur NPP project implementation are one of ROSATOM's priorities. The construction of this NPP is set to become one of the most important steps in the country's development.
As part of the cooperation between Bangladesh and Russia in the peaceful use of nuclear power, delegations are sent to the Russian nuclear facilities on a regular basis to exchange experience and learn about state-of-the-art scientific and technological developments. Both Russia and Bangladesh use IAEA mechanisms to support the project and ensure the conduct of the necessary examination and personnel training.
Thus, a VVER NPP will be built in Bangladesh using the most modern technologies that ensure safety at all project implementation stages. ROSATOM considers safety a matter of the highest priority!

COOPERATION

Modernization of Armenian Nuclear Plant Kicks Off in 2018

In mid-April, the Armenian NPP life extension steering committee held a meeting to discuss the project status. More details on the meeting and its results can be found in our article.

The Armenian Nuclear Power Plant was built in Soviet times near the town of Metsamor in the Armenian Soviet Socialist Republic and consists of two VVER-440 reactor units. Life extension of Unit 2 is Rosatom's key project in Armenia. The service contract was signed in June 2015 for a total price of 300 million US dollars. The Armenian NPP life is to be extended for 10 years.

The committee meeting was devoted to the scheduled maintenance and repair activities at the nuclear plant in 2016, and discussion of plans for 2017. Last year's maintenance and repair program included assessment of steel condition and welding seams of the reactor vessel, piping, and steam generators. Other activities planned for 2016, including equipment audit and remaining life assessment, were completed on schedule. (*For more details, please read our report http://rosatomnewsletter.com/armenian-npp-life-to-be-extended-for-10-years.html*).

The committee discussed steps to obtain an operation permit for Unit 2 of the Armenian Nuclear Power Plant, and retrofit plans for 2017. The plans provide for nuclear engineering companies, service integrators and other contractors to be engaged in the reactor unit modernization project.

"First of all, we need to focus on the preparations for maintenance and repairs scheduled for 2017 to fulfill all the tasks on time and in the most efficient way,"

said Kirill Komarov, Rosatom's First Deputy CEO for Corporate Development and International Business, who headed the Russian delegation. He also noted that the 2017 activities would involve examination and repair of the plant equipment.
Following the request of the Armenian State Committee on Nuclear Safety Regulation, the scope of equipment to be examined was extended earlier this year to include 150 equipment categories versus 100 categories in the previous year. According to Vladimir Bredov, a project manager from the Russian side, maintenance activities will be supported by engineers from the Kola and Novovoronezh nuclear plants, which are twinned with the Armenian facility.

Significant local input
Large-scale modernization will begin at the cooling tower later this year. A great contribution is expected to be made by Armenian companies. According to Evgeny Salkov, CEO of Rusatom Service, supply contracts have been signed for almost all components with long lead times. This means that the plant equipment retrofit can start already in 2018. Following the meeting, decision were taken to update the licensing schedule for Armenian NPP Unit 2, develop a master schedule for life extension preparation activities, and draft an investment plan for the project. The parties also agreed to expand cooperation in workforce training and facilitation of nuclear awareness.

EVENTS

Irradiation Technologies on a Broader Scale

Rosatom workshop on non-energy applications of nuclear technologies and social benefits and development in Latin America took place in Rio de Janeiro.

The workshop was organized by Rosatom International Network, through its regional office Rosatom America Latina. Led by Rosatom's representatives, the discussions were focused on the development of irradiation technologies in Latin America and their use in industry, healthcare and agriculture. The workshop brought together representatives of Brazil's nuclear industry leaders, such as Electronuclear, Eletrobras, Nuclep, Amazul, Tecnatom, etc. and public organizations, including the Brazilian National Nuclear Energy Commission (CNEN), Brazilian Agricultural Research Corporation (EMBRAPA), Brazilian Association for the Development of Nuclear Activities (ABDAN), Brazilian Institute for Nuclear Quality (IBQN), Brazilian Society of Nuclear Medicine (SBMN), and Brazilian Federation of Hospitals (FBH). It also attracted students from the Federal University of Rio de Janeiro (UFRJ).
Sergei Krivolapov, Vice-President of Rosatom América Latina introduced Rosatom's unique capabilities, integrated offer, and updates on the company's cooperation throughout the region. He recalled Memorandum of Understanding signed between the United Innovations Corporation (UIC) and the Brazilian company CK3, in the end of 2016, on the construction of an Irradiation Center in Brazil. "This Center is another very interesting project for us, since it will allow combining Russian competences and achievements in the radiation

technology field with the experience of the Brazilian company CK3 in the domestic market."
Leading companies of Rosatom Group shared their extensive experience in the sphere of irradiation technologies with their Latin American colleagues. Rosatom's subsidiary Rusatom Healthcare, which specializes in promoting Russian nuclear technologies in medicine, and the Scientific Research Institute of Technical Physics and Automation (NIITFA), presented a wide range of products offered by Rosatom in this area. In particular, Konstantin Panin, a representative of Rusatom Healthcare, highlighted the construction of multi-functional facilities for radiation processing of food and medical products, from which the countries can experience economic benefits and improvement of the population's health. Furthermore, Aleksandr Zykin, Head of NIIFTA Laboratory, presented its areas of competences and stressed, "For all task under the laws of physics there is an engineering solution available waiting to be set. This is what we have been doing for more than 60 years."
From Brazilian side, CK3's advisor Arminak Cherkezian provided an overview of Rosatom–CK3 joint project for the development of an irradiation plant for sterilization of medical materials. In his speech, he presented prospects of this venture, which aims to be a quality and viable option for the market that today relies only on one supplier "After today's workshop, I'm even more convinced of the necessity of this plant. This project is going to be a great remark of Rosatom in Brazil."
Moreover, presentations on the multiple applications and benefits of irradiation technologies in agriculture, medicine, industry, science and geology were made by representatives of the Nuclear and Energy Research Institute (IPEN), the Brazilian National Nuclear Energy Commission (CNEN), Latin American Association of Irradiation Technologies (ALATI), the secretariat of the Regional Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL). During its presentation, the ARCAL expressed interest in building strategic alliances with Rosatom.

"Our activities on the Latin American market show that irradiation technologies for agricultural, medical and industrial use are very much in demand in South America. According to the IAEA, it is South America where irradiation technologies will gain the most traction in the years to come," Ivan Dybov, President of Rosatom America Latina, told the media. "This forecast is what prompted the idea of a regional workshop. We are very pleased to see that it brought together many colleagues from across South America. They presented the market situation and spoke much of the need to use irradiation technologies on a broader scale. We are very grateful to Rosatom Healthcare for its support because the workshop gave us an opportunity to present our vision of doing business in the region, share experience, show advantages over the competition, and answer a lot of technology-related questions. It should be noted that right after the workshop we received requests for equipment, and we are already working on them."
As Mr. Dybov said, Rosatom made detailed presentations of its technologies and approach to doing business. "We presented our reference projects in Russia, Peru and other countries and discussed a possibility of expanding joint projects in isotope supplies. Izotop is now

the largest supplier of medical isotopes to Brazil," Ivan Dybov noted in an interview to RN.
According to him, this was the first event where industry experts were demonstrated a joint project of Rosatom and Brazil's CK3 to construct a medical irradiation facility in Brazil. "As set out in the memorandum signed earlier, we are working on establishing a joint venture. We have completed a market analysis. We are about to finish a business plan and drafting a shareholders' agreement for the new JV. This is a very important and long-awaited project for Brazil, where this industry is monopolized by a single supplier," Mr. Dybov said.

IN BRIEF

AEM Report Wins International Award

The League of American Communications Professionals (LACP) announced winners of its Vision Awards Annual Report Competition.

The framework agreement was signed on the The jury gave 97 out of 100 points to AEM's integrated annual report for 2015. The report was ranked 33rd globally among the Top 50 annual reports of award-winning companies, which included Panasonic Corp. (ranked 4th), Hyundai E&C (26th) and Korea Hydro & Nuclear Power Co. (46th). Other Rosatom Group companies on the Top 50 list include ASE EC (ranked 6th) and TENEX (9th). Vision Awards is a global corporate communication competition held annually since 2001 and attracting about 1,000 participants from more than 20 countries. The 2015/16 Vision Awards brought together an unprecedented number of contestants from across the globe to represent almost all industries.

Steam Generators Installed at Belarus Unit 1

Steam generators have been finally installed at Unit 1 of the Belarusian Nuclear Power Plant.

The four steam generators were placed in their permanent position in the reactor building. Each of the 330-ton generator bodies was lifted onto the transport gantry, moved by rail through the airlock and emplaced at Level +26.00 inside the reactor building with a polar crane. At the moment, preparations are ongoing to start welding at the main circulation pipeline.