Chapter

# Does Russia Have the Possibilities to Diversify Its Export Potential to Manage the Power Engineering (For Example, Nuclear Power Development)?

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## Abstract

The article analyzes the current state of power engineering, nuclear power, and their role in ensuring energy independence of Russia. According to the author, the creation of large high-tech integrated companies with active innovation state practice can bring the Russian economy to a higher level of development. To maintain Russia's leading role in the construction of nuclear power plants abroad, according to the author, it is necessary to optimize cost and terms of construction of projects, improve designs, increase scopes and quality of specialists' training, and fight corruption.

**Keywords:** improvement of management structure, national security, energy independence, import substitution, structural transformation, large integrated structures

## 1. Introduction

The situation in which turned out to be power engineering of Russia in the first decade of the twenty-first century has generated heated debate about the causes of the crisis, which turned out to be a domestic machine building, as well as ways to overcome it [1–4].

The fact that the structural transformation in the Russian machine-building complex, which took place at the time, was associated with a number of assumptions and trends largely determines the prospects for the formation of new and operation of the existing large integrated structure.

Meeting the challenges, which national engineering faces, is impossible with outraising capital in the sector, experiencing an investment "hunger." This applies to power engineering as well—a relatively prosperous industry, which was in the period of sharp decline in the domestic demand for machinery and equipment to go out of the crisis of the 1990s due to export orders with less losses than other engineering enterprises. However, the chronic underinvestment caused reducing the technical level of its production facilities.

It is necessary to focus on all resources—financial, industrial, and intellectual ones for implementation of large-scale tasks by the industry, and that in turn will require improving the management structure.

In the 1980s of the last century, the equipment supplies by power engineering provided the annual commissioning of at least 10 million kWh of electric power.

However, since 1991, there has been a sharp production decline in the industry, as evidenced by the data on manufacture of steam turbines and boilers, commissioning of generating facilities at the thermal power plants of Russia in 1990–2000, and the lack of orders for manufacturing NPP and HPP equipments [5].

"The strategy of development of power engineering of Russia," elaborated on the basis of the "Russian Energy Strategy till 2030" approved by the Government of the Russian Federation (hereinafter—the Energy Strategy), reflects the fundamental directions of development of power engineering in Russia and contains the practical measures for their effective implementation.

## 2. The current problems

The availability in Russia of its own effective power engineering is one of the pillars of its national security, power independence.

According to the official data, the equipment in the power industry is currently worn by almost 60%. This means that more than half of the thermal and hydropower plants operate under high risk. Given the strategic line of the state for import substitution, it is necessary to organize the process of updating the equipment in the way when orders are placed with the Russian companies, and that is possible if there are investments into domestic engineering.

Describing power engineering competitiveness, we note the peculiar feature of the domestic energy sector, which consists in the fact that almost all power plants in Russia (and CIS) are equipped with the equipment of domestic production. However, modernization and mobilization of resources in the sector can only be based on the policy of concentrating resources, pooling of capital, and formation of the effective management system. In other words, it is about solving the problem of creation of modern organizational structures.

Industrial policy in power engineering should be focused on the process of system management of its activities. Products of this sector meet the needs of other sectors of the economy as a technological component of such specific product as energy. This means that manufacture of machines and mechanisms in the power engineering industry is inseparably linked with construction and engineering works, which provide the necessary conditions for its operation.

The volume of this work is significant even in cases when the equipment is supplied for modernization of the existing facilities, rather than for equipping of new construction projects. And the technological chain of "design—manufacture—construction—installation—commissioning—operation" implies such requirements for all participants of the process of equipment commercial commissioning, the specifics of which do not allow "third-party" participants to participate in this chain (except for civil works at the facilities of power infrastructure).

Thus, the logic of the process of improving quality of the products and activities related to design, manufacture, installation, and commissioning of the equipment, as well as reducing the time for putting power units in operation requires co-operation of specialists of different branches within the same structure.

In fact, this principle was previously implemented in the framework of the branch management system. Within the USSR Ministry of Energy, about half the staff was engaged in the manufacture of power equipment, the other half—in the construction of power facilities. However, in the period of market reforms, the branch management system was destroyed, and privatized enterprises became independent market participants. But no one, even a very large factory, is able to meet the needs in power engineering products, given the specificity of these high-tech goods.

The thing is that high technologies require coordination of activities of representatives of different trades, professions, and industries. Especially in the frame of globalization when the tone is set precisely by those companies that represent a major conglomerate that combines research and production structures, as well as structures promoting products on the world market, global high-tech companies. Exactly these companies are able to bring the Russian economy to a different path of development, when export of high-tech products will be no less weighty than export of mineral resources. But none Russian factory, no matter how large it may be, is a global company; therefore, it is not competitive in world markets. Therefore, effective restructuring of production and management is necessary in the conditions of independence of market agents under insufficiency of the branch coordination system.

The process of integration of these structures, allowing to centralize development strategies and improve management and technological cooperation, will be inevitably hampered by problems of redistribution of property, as the system of securing property rights existing in Russia can be effective only if the owner is really controlling activities of all participants of the association, provided by significant proportion of ownership of assets. Given the fact that in the process of mass privatization there was no task to create an effective management system of high-tech industries, which are characterized by a high degree of co-ordination and co-operation of complex productions, formation of global companies will inevitably affect the property interests, resulting in a secondary redistribution of property. Thus, corporate conflicts are inevitable in structural transformation.

Structural transformations in the Russian machine-building complex are linked with a number of assumptions and trends, largely determining the prospects for formation of new and operation of the existing large integrated structures.

First, the experience of formation of large associated industrial structures accumulated in the Soviet times, unfortunately, was not properly developed further. However, foreign large industrial conglomerates were formed not only based on the experience of the Soviet industry but also based on the methodological basics that had been tested in the USSR.

Second, the Soviet machinery represented a hypertrophied form of simple cooperation of the universal enterprises but with huge potential unique possibilities for development. However, this potential was not even used, but, in fact, lost, in connection with the influence of accelerated privatization and breaking of the state management.

Third, the breach of economic ties and collapse of the industry management system in the process of privatization caused dominance of partnerships as a protective reaction, which are based on informal contract practices, affecting not only the process of exchange of goods but also property relations.

Fourth, the property relations established under incomplete legal frame work, regulating property relations, formed a specific model of partnership based on a system of trust relationships with contractors and the state authorities. At the same time, there were quite wide spread manifestations of economic self-interest in all aspects of the economic life, including the processes of disintegration (integration) of industrial enterprises. The new management was formed, which core competence were take over and redistribution of property.

Fifth, the dynamics of development was influenced not only by selfish holders of economic power but also by competitive strategies of foreign companies who sought to oust domestic producers from the world markets using domestic managers. However, where the owners could find a common language, a new type of engineering companies appeared, which competitiveness was high enough not only in the domestic but also in the foreign markets. As for the numerous cases of collapse of structures, those, as a rule, were associated with numerous contradictions just due to the system of partnership [6].

Thus, the corporate conflicts cannot be considered solely from a negative point of view: they are unavoidable in the process of consolidation of the technological chains belonging to different owners; moreover, replacing the owner does not always result in changing mismanagement by even more inefficient.

Implementation of major projects in the Russian power sector solves a whole range of important social and economic problems, provides employment, increases filling of regional budgets, allows to solve strategic tasks of further increase of the installed generating capacity, and increases global competitiveness of Russian equipment in particular and of Russian high-tech in general.

Large integrated structures should be active participants in the process of implementation of integrated innovations. In a sense, they act both as mechanisms of social partnership, on the one hand, expressing consolidated opinion of a large group of people involved in the manufacture of industry products, and on the other—as structures that implement decisions of the central government concerning the interests of large social groups. In addition, the large integrated structures are able to participate in development of complex innovation programs, including initiation of consideration of a number of issues by the state.

In the years 2004–2005 GAZPROM, following the recommendations of the higher state authorities acquired shares of ATOMSTROYEXPORT, actual monopoly in NPP construction abroad, and of the Incorporated Engineering Company (until 2004, a controlling stake in these companies was in the hands of K. Bendukidze, private entrepreneur). These actions of the state demonstrated that the corporation model, similar to that of the firm AREVA (France) was selected, with a majority stake owned by the state, as opposed to the corporation "General Electric," USA, which is owned by private capital [3, 7].

When Sergei Kiriyenko (1998—Prime Minister) came to ROSATOM of RF in 2005, the Agency elaborated a program of accelerated development of nuclear power in Russia [8]. This program was submitted to the government on May 18, 2006, and reported to Vladimir Putin, President of the Russian Federation, who approved the program and plan of priority measures for its implementation in June 2006.

In the development of these solutions, more than 6 billion dollars for implementation of this program were allocated in the budget. In accordance with this program, Russian NPPs should produce about 25% of the total electric power by 2030.

The nuclear industry can play an important role in solving the energy problem both in Russia and in the world. It is necessary to build and put into operation 40 GW of nuclear power units on the territory of the Russian Federation by 2030, and in other states, the Russian nuclear specialists will be able to claim the orders of 40–60 GW in the same period of time.

According to the forecasts of ROSATOM of RF by 2030, nuclear power in the world will grow up to 300–600 GW. Up to half of this promising market will be closed for external players, and the Russian nuclear specialist scan actually qualifies for 20–25% of orders (40–60 GW) of the remaining 200–300 GW of available access.

In the global nuclear fuel market, the share of Russia is now 45%. The Russian should be 50% in the markets of the USA and Canada, 42% in Europe, 35% in South Korea, 30% in Latin America, and 10% in China and Japan. To maintain its leadership, Russia has to increase capacities and implement market reforms in the sector [4].

## 3. Main problems that complicate the industry activities

### 3.1 Personnel policy and personnel training

There is no enough qualified personnel for safe operation of commissioned NPPs. The today's current system of personnel training and consolidation in the nuclear industry is clearly insufficient for its large-scale development. Working pensioners make about 25%, young workers and specialists—about 10%. Acquisition of knowledge and skills should be ahead of programs for designing and development of technologies, construction of nuclear facilities, and their commissioning. The current situation with the staff can be considered critical. With a general decline in the number of researchers (the driving force of innovation development), the share of researchers over the age of 60 years increases. The average age of leading industry experts (PhD) and university professors of "nuclear" profile is higher than the average male life expectancy in the country. Although over the past 6 years, ROSATOM has done much to address the deficiencies in training. The corporate university of 20 schools was formed on the basis of MEPI [9, 10].

### 3.2 Long-term construction of nuclear power plants and unreasonably overpriced construction

The long-term construction period further increases the cost and opportunities for corruption. Building "from scratch" actually takes at least 7 years, indicating shortcomings in designing and imperfect work organization.

ROSATOM stated its desire to achieve the construction time of 4–4.5 years. To do this, it is necessary to unify designs and implement innovative construction techniques based on large-block equipment supplies to construction sites.

The declared cost of 1 GW of nuclear generation has already reached $4 billion (or $4.6 billion for power unit of 1.15 GW) and continues to grow. Today the cost of NPP construction in Russia is two times higher than in China and for 30–40% higher than in Europe.

In the current environment, the economically justified cost of construction of one VVER unit of 1.15 GW capacity is not more than $2.5 billion with the construction term not more than 5 years. If ROSATOM is not able to meet these indicators, the NPP construction in the country is not competitive compared with modernization of steam turbine power units to combined cycle ones at the existing gas TPP according to the main criteria—volume of replaced gas per year during electricity generation and its net cost. The unreasonably high cost of NPP construction includes not less than 40% of the corruption component.

### 3.3 Electricity tariffs

The current regulated price of electricity at the Russian NPPs on the whole sale market is 3.2 US cents per kW/h (for comparison, in the USA—1.87 cents, in France and Germany—2–2.2 cents in 2008 prices). The price of electricity for economic entities in Russia is 2–3 rubles or 7–10 cents, and a new connection of consumers reaches 4.5–5 rubles or 15–17 cents (for comparison, in the USA—6.5–7.5 cents, the average price in the EU—12 cents, in China—8–9 cents). With regard to nuclear engineering, the situation is ambiguous. On the one hand, at the moment, there is possibility of producing the necessary long lead equipment for no more than three nuclear power units per year, which is obviously not enough for realization of the ambitious plans to build nuclear power plants in Russia and abroad. On the other hand, the large-scale modernization is currently carried out at the key enterprises of the energy sector of the country [6, 11].

In general, our analysis shows that in order to achieve its goals by 2030 at home and abroad, ROSATOM of RF needs to complete all the plans to modernize the machine-building enterprises in a relatively short period of time. This will allow achieving the range and scope of manufactured products to the desired level of 4–5 sets of key equipment for NPP units per year. However, given the fact that currently active negotiations are held or bidding procedures are already ongoing concerning construction of a large number of nuclear power units in a number of countries (Czech Republic, Saudi Arabia, South Africa, Kazakhstan, Nigeria, and others), more significant increase of national nuclear engineering capabilities may be required in the medium term.

To perform such wide-ranging task, it is necessary for ROSATOM of RF, at least, first of all to eliminate the disadvantages mentioned above and to pay special attention to three main areas.

The first main area is the completion of the package of administrative documents, which provide activities of enterprises of the industry and regulate the relations between the industry and the state authorities. The package of administrative documents also includes a set of more than 20 departmental purpose-oriented programs, and, of course, it includes improvement of ROSATOM structure.

The second key area is the knowledge management. It is clear that it is the high-tech industry in that all technological solutions are based on a sufficiently large block of scientific, engineering, and methodological knowledge. And various kinds of dysfunctions and failures take place without some technologization of knowledge generation, handling, and storage. For example, the knowledge is not standardized—it means that different participants of the process are based on different data. The knowledge was generated but not used in practice—hence, there is necrosis of investments in R&D. Developments were made but not commercially used—hence, there are losses in the financial sector and lack of a sufficient set of secondary developments, in which the results of major research programs are applied that have been made previously.

The third major area is the cost management. ROSATOM has been traditionally occupied in collecting data on the economy of enterprises in the industry, their processing, analysis both for planning of ROSATOM activities and in the interests of monitoring economic, financial activities of the enterprises, preparation of balance commissions, and so on. At present, this work must be carried out consistently for a radical reduction in the construction cost.

### 3.4 Another important

Substantiation of NPP construction calculation based on needs in power capacities, including the regional context, analysis of the grid condition in order to justify NPP connection to the general layout of power facilities by 2030.

## 4. Findings

The state of the national economy significantly affects the nature and methods of corporate management. This suggests the existence of specific corporate management models for each country. Thus, the formation of the corporate management national model in Russia takes place under conditions of incomplete development of the legal framework and uncertainty of ownership of privatized property, with nonexecution of the existing laws on protection of property rights and dominance of the insider control model in joint stock companies.

Thus, the problem of corporate management, which is not a purely national one, is of particular importance in the global trends. That is because the integration processes in the national high-tech sectors are characterized by the tendency of "winding-down" of internal competition in order to accumulate resources for external expansion. Therefore, the national integrated structures are involved in global competition, in which those benefit who are able to provide customers with the most comprehensive volume of services in comparison with competitors.

## 5. Conclusion

With regard to the real possibilities of the modern Russian nuclear power, it must be noted that over the past 15 years, five power units were constructed and put in operation abroad—in China, India, and Iran. After the long years of suspension in construction of nuclear power plants, ATOMSTROYEXPORT became the first company among its competitors, which handed over high power nuclear units complying with all safety requirements to a foreign customer. Thus, ATOMSTROYEXPORT proved to the world that the companies and organizations that make up the core of the nuclear power industry in Russia have sufficient potential and real resources to implement the most complex and demanding nuclear power projects [6].

In 2016, the assets of ASE Group companies (ATOMSTROYEXPORT)—the Engineering division of the State Atomic Energy Corporation ROSATOM, a leading player in the global market for the design and construction of nuclear energy facilities, were finally integrated. The Engineering division is well known to our foreign partners. Since its foundation, it has a reputation as an effective provider of the engineering services and has gained trust in the global market.

## 6. In 2018, the foreign portfolio exceeded 90 billion US dollars

By decision of the State Atomic Energy Corporation ROSATOM, the Engineering division became the Industry competence center for the management of capital construction projects.

For several years, the project management practice has been successfully implemented by ASE. The unique Multi-D technology continues to develop, being a main tool of the project management platform, which allows shortening construction time and improving labor productivity, work quality, and safety while reducing project costs. In 2016, this technology received international recognition as a winner in the WNEAWARDS competition (Le Bourget, France) presenting the "Project Management System Based on Multi-D Technologies," and that is a witness of great recognition from the world energy community. The "Multi-D® Project Management System at the Rostov NPP" won the international CEL AWARD-2016 contest in the "Megaproject" nomination, announced by FIATECH, one of the most respected industrial associations worldwide.

In addition, ASE Group companies became the first Russian company to receive an international certificate of conformity with the third competency class in the field of project, program, and portfolio management according to the International Project Management Association (IPMA Delta) model. This is another achievement internationally. Currently, certification in the field of project management according to the international IPMA standards has been passed by all top managers of the company. The division will continue to implement its strategic goals in the difficult situation of growing competition both in the NPP construction market and in the market for construction management services for the complex engineering facilities, using all resources to increase competitiveness.

Based on the successfully constructed five power units (in China, India, and Iran), the following areas of cooperation abroad are being implemented.

### 6.1 China

The second phase of the Tianwan NPP (TAES-2), which also includes two units with VVER-1000 reactors under the NPP-91 design, is being constructed in accordance with the General Contract for units 3 and 4 of TAES-2, signed in 2010, and entered into force in 2011. The Russian side has obligations to develop the complete engineering and operation designs of the Nuclear Island (NI) for TAES-2 units 3 and 4, providing the related services. ASE JSC also undertakes the overall technical responsibility for the design of units 3 and 4, is responsible for managing interfaces throughout the project, and provides warranty obligations.

The General Contract provides for commissioning of unit 3 in February 2018 and unit 4 in December 2018. All activities were going on schedule.

On December 30, 2017, power was launched at unit 3.

It is planned to bring the number of Russian power units in China to 8.

### 6.2 Iran

The implementation of the Bushehr-1 NPP project made it possible to sign the Protocol to the Intergovernmental Agreement of 08.25.1992 in 2014, which provides for the possibility to construct eight NPP units in Iran.

At the same time, on November 11, 2014, the Contract was signed under which ATOMSTROYEXPORT will construct the second and third power units of the Bushehr NPP. On September 10, 2016, the solemn laying of the "first stone" took place. The start of activities under the Contract was scheduled on December 28, 2016, when the Russian side received an advance from the Iranian customer.

During 2017, work was carried out to prepare the site. On March 14, 2001, the earthworks were started on the Bushehr-2 NPP site. On October 31, 2017, a ceremony was held to begin activities at the foundation pit of the main buildings of power unit 2. In 2018, engineering and geological surveys of the marine area and the site for spillway facilities were planned.

It was planned to coordinate the Bushehr-2 NPP design with the Customer and begin procedures related to the examination and obtaining a license for construction from the Iranian regulator. For 2018, completion of the pit for power unit 3 was scheduled, and for 2019—the "first concrete" at power unit 2. In accordance with the Contract, provisional acceptance of unit 2 is planned in 2026, of unit 3—in 2027.

### 6.3 India

Under the Agreement between the Government of the Russian Federation and the Government of the Republic of India on cooperation in the construction of additional nuclear power units at the Kudankulam site, as well as in the construction of nuclear power plants under the Russian designs at new sites in the Republic of India, dated December 5, 2008, the parties started the project realization plan for construction of power units 3 and 4 of the Kudankulam NPP with VVER-1000 MW reactor units each.

On October 4, 2014, the General Framework Agreement (GFA) was signed for construction of the Kudankulam NPP power units 3 and 4. In June 2017, the first concrete was poured at the second phase of the Kudankulam NPP unit 3, in October 2017—unit 4.

The planned start date for warranty operation of power units 3 and 4 is 2023 and 2024, respectively.

On June 1, 2017, ATOMSTROYEXPORT JSC and the Indian Atomic Energy Corporation signed the General Framework Agreement for the construction of the third phase of the Kudankulam NPP, and the Intergovernmental Credit Protocol necessary for implementation of the project was also signed. The Agreement provides for the construction of the third phase of the Kudankulam NPP power units 5 and 6 under the Russian design. On July 31, 2017, Contracts were signed between ATOMSTROYEXPORT JSC and the Indian Atomic Energy Corporation (IAEC) for the priority design activities and detailed design and supply of basic equipment for the third phase of the Kudankulam NPP. The planned first concrete for power units 5 and 6 is 2019 and 2020, respectively. Planned dates for the start of warranty operation of power units 5 and 6 are 2025 and 2026, respectively.

### 6.4 Bangladesh

On December 25, 2015, ATOMSTROYEXPORT JSC and the Bangladesh Atomic Energy Commission signed the General Contract for the construction of the Ruppur NPP consisting of 1200 MW two power units under NPP-2006 design, including a number of Appendices thereto. The signing of the General Contract was a fundamental event that allowed to start activities at the main stage of the plant construction.

In accordance with the agreement of the parties, the entry into force of the General Contract depended from fulfillment of a number of conditions. The first was signing of a credit intergovernmental agreement for the main construction period of the Ruppur NPP, then signing of Appendices to the General Contract, obtaining a license by the Bangladesh party for the NPP site and approval of the selected NPP design by the Bangladesh regulatory body.

On July 26, 2016, the Intergovernmental Agreement was signed on allocation of the state loan to finance, the main stage of the Ruppur NPP construction.

Simultaneously with the fulfillment of the conditions for the entry into force of the General Contract, in 2016 significant work was done to coordinate and prepare for signing the related integration Contracts for the Ruppur NPP project, in particular, the Contract for supply of nuclear fuel, the Contract for technical assistance for operation, service, and technical maintenance, and repair of the Ruppur NPP.

In March 2017, the parties agreed and initialed the Intergovernmental Agreement Draft on spent nuclear fuel management at the Ruppur NPP. It was planned to prepare an agreement for signing as soon as possible.

ATOMSTROYEXPORT JSC is completing the construction and installation activities at the preliminary facilities and construction and installation base. In 2016, under the General Contract, the working documentation for the main construction period was developed, as well as the materials justifying the licenses for location and construction of power units 1 and 2 of the Ruppur NPP. The first concrete is planned for 2017. Commissioning of the first unit of the Ruppur NPP is scheduled for 2022, and of the second unit—for 2023.

### 6.5 Hungary

History: The Hungarian-Russian cooperation in the field of nuclear energy has more than 60 years. It began in 1955 with signing of the Agreement to make a research reactor in Budapest. On December 28, 1966, the Intergovernmental Agreement was signed between Hungary and the Soviet Union on construction of the first nuclear power plant in Hungary. Currently, the Paks NPP with four VVER-440 units is successfully operating, providing more than 50% of the country's electricity.

On January 14, 2014, the Intergovernmental Agreement between Russia and Hungary was signed in Moscow on cooperation in the field of the peaceful uses of nuclear energy, which envisages the construction of two new Paks-2 NPP units.

On December 9, 2014, the Hungarian MVM Paks-2 JSC and the Russian NIAEP JSC (ASE EC JSC since December 2016) signed three Agreements regarding the construction of two NPP units with VVER-1200 Russian reactors:

- EPC—the Contract (engineering, equipment supply, and construction) for two new power units, in which the tasks for the next 10 years are fixed, taking into account the physical launch of the first unit in 2023, of the second—in 2025;

- the Contract that governs the terms of service for future power units; and

- the Contract on the conditions of long-term fuel supply.

In April 2015, the approval procedure by the EURATOM Commission for the Contract on supply of nuclear fuel for new units of the Paks-2 NPP was successfully completed.

On February 17, 2015, during the visit of the President of the Russian Federation Vladimir Putin to Hungary, the Memorandum of Understanding was signed between the State Atomic Energy Corporation ROSATOM and the Ministry of Social Resources of Hungary on training of personnel in the field of nuclear energy and related areas. According to the document, the parties will carry out cooperation in the field of education and training of personnel, educational, and scientific activities, as well as in joint educational programs in nuclear energy and related fields.

In June 2015, NIAEP JSC (ASE EC JSC since December 2016) and MVM Paks-2 JSC signed all necessary Appendices for opening financing for the EPC Contract, which stipulate the time schedule, procedure and terms of payments, and insurance conditions.

Hungary, as a member of the European Union, was obliged to carry out a total of five notification and conciliation procedures with the European Commission in connection with implementation of the Paks-2 NPP expansion project. In November 2016, the European Commission completed the expertise of the Paks-2 nuclear power plant construction project, removing all obstacles to its further development. In March 2017, construction of the new Paks-2 nuclear power units in Hungary was approved by the European Commission (EC).

The parties are developing the construction time schedule. It is planned that the license for construction of the Paks-2 NPP will be ready in 2019, and the first concrete will be poured in 2020. The peak of construction work is expected in 2021–2022. The nuclear island and the primary circuit are the responsibility of the General Contractor, while other works are carried out on procurement.

The main task of 2017 was preparation for the Paks-2 NPP construction. The scope of tasks includes preparation of engineering documentation, cooperation with suppliers, and application for a building license. As a part of the activities related to preparation of the documentation necessary to obtain licenses for the Paks-2 NPP construction, the technical design for 5 and 6 units, the preliminary safety analysis report (PSAR), and the probabilistic safety analysis reports are being prepared.

ATOMPROEKT JSC, the General Designer is completing work on the conceptual design documents that precede development of the design documentation and is also completing adaptation of the VVER-1200 base design, agreed with the Paks-2 MVM Customer, to the specific conditions of the Paks site. The process of developing chapters of the PSAR and sections of the technical design is ongoing.

The announcement of the first tender procedures has begun. Competitive information will be available on the specialized platform for ROSATOM tenders. Tender notices will also be widely published on the relevant Hungarian and international sites. All tender documentation will be posted in English. The Hungarian and other European companies can take part in procurement related to almost the entire process of the NPP construction, from design and construction to equipment supplies (except for the primary equipment that requires very specific knowledge and competencies) and related services (legal, translation, etc.).

*Prospects for cooperation*. In the future, when implementing the project for the Paks-2 NPP construction, all purchases of the necessary equipment and services will be carried out openly and transparently in accordance with European Union standards. As potential suppliers of equipment and services, all interested companies, including those from EU countries, can equally participate in tenders. The Russian side expects significant participation of the firms from Hungary, so that the level of localization, i.e., local industry participation, will amount to 40%.

Requirements for suppliers are different, depending on what they supply or what services they provide.

### 6.6 Egypt

The El Dabaa NPP (Egypt), which includes four units with VVER-1200 reactors, is being constructed in accordance with the EPC Contract, which was signed between ATOMSTROYEXPORT JSC and the Department of Nuclear Plants of the Arab Republic of Egypt on December 31, 2016 and entered into force on December 11, 2017. The project provides for construction of four power units of 1.2 GW capacity with VVER-1200 MW reactor (water-to-water power reactor) according to the Russian design. The Russian side will also assist the Egyptian partners in developing nuclear infrastructure, supply the Russian nuclear fuel for the entire life cycle of the nuclear power plant, build a special storage facility and supply containers for storing spent nuclear fuel, increase the level of localization, provide training for national personnel, and support the Egyptian partners in operation and maintenance of the El Dabaa NPP during the first 10 years of the plant's operation.

In accordance with the EPC Contract, the first power unit of the El Dabaa NPP will be commissioned in 2026.

### 6.7 Turkey

The Intergovernmental Agreement of the Russian Federation and Turkey on cooperation in the field of construction and operation of the nuclear power plant on the Akkuyu site in the Mersin province on the south coast of Turkey was signed on May 12, 2010.

The Akkuyu NPP project includes four power units of the Russian VVER-1200 3+ generation reactors. The capacity of each NPP unit will be 1200 MW. The design solutions of the Akkuyu NPP meet all modern requirements of the world nuclear community and established by the IAEA safety standards, the International nuclear security advisory group, and the requirements of the EUR Club.

The start of commercial operation of the Akkuyu NPP units 1–4 was tentatively scheduled for April 2023, 2024, 2025, and 2026, respectively.

### 6.8 Finland

On October 5, 2011, the construction site of a new nuclear power plant in Finland was announced: it will be Hanhikivi Cape in the community (municipality) of the Pyhäjoki Province, Northern Ostrobothnia (on the coast of the Gulf of Bothnia, about 100 km south of Oulu). In the media, there are various names of this plant—the Pyuhäjoki NPP, the Hanhikivi NPP, the Hanhikivi-1 NPP, but the official name is the Hanhikivi-1 NPP. It was originally planned that construction of the plant would begin in 2015, and the plant would be launched in 2020, and its maximum capacity would be 1800 MW. Initially, the negotiations were held with the companies Areva and Toshiba.

On July 3, 2013, the Finnish company Fennovoima Oy and Rusatom Overseas CJSC, a subsidiary of the Russian State Corporation ROSATOM, signed the Agreement to develop the design in order to prepare for signing of the Contract for the plant construction. It was planned that this Contract would be signed before the end of 2013. In September 2014, the Finnish government approved the NPP construction project with the participation of Russia, envisaging the use of the Russian VVER-1200 reactor. The plant should be built by 2024.

### 6.9 Belarus

In the Republic of Belarus, at the Ostrovets site near the city of Grodno, the construction of the Belarusian NPP consisting of VVER-1200 two power units with the total capacity of up to 2400 (2 × 1200) MW is underway. The obligations of the General Contractor are assigned to ASE JSC. It is envisaged that the Belarusian NPP is being constructed on the basis of the full "turnkey" responsibility of the General Contractor. The "NPP-2006" design, the General Designer is ATOMPROEKT JSC, was chosen for construction of the first Belarusian NPP.

The Belarusian NPP design complies with all international standards and IAEA recommendations and is characterized by the enhanced safety characteristics, technical, and economic indicators.

The main advantages of the Russian design are a high degree of security provided through the use of the independent channels of active and passive safety systems, the melt trap, and other systems. Unit 1 of the plant is planned to be commissioned in 2019, unit 2—in 2020.

The great prospects imply an even greater responsibility. The previous story, now of the ASE Group companies, allows to hope for successful implementation, I am not afraid of the word, of the grandiose tasks, by the nuclear power industry of Russia!

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