

Sustainable development of the nuclear energy in the Republic of Belarus: challenges and first steps

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Results of the analysis of the energy balance of Belarus are presented. It is proved that dependence on a single supplier - Russia- undermines the energy safety of the country. Showing results of using methodology INPRO (the International Project on Innovative Nuclear Reactors and Fuel Cycles) for assess nuclear energy system in Belarus. The results of opinion polls are presented. Stages of nuclear power development in the country are presented. Basic characteristics of the NPP in Belarus are described .



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INTRODUCTION

The Republic of Belarus is building a nuclear power plant capacity of 2000 MW. The first unit is scheduled for commissioning in 2018, the second - in 2020. The article presents a study and analysis of the development of the nuclear energy in Belarus.

RATIONALE FOR THE DEVELOPMENT OF NUCLEAR ENERGY IN BELARUS

In Belarus, the share of imported energy is now about 85%. Almost all the gas consumed in the country, and most of the oil imported from one country - the Russian Federation. Dependence on a single supplier undermines the energy safety of the country. According to the Energy Strategy 2011-2020, Belarus is seeking to reduce its dependence on Russia as a major energy supplier. The plan calls for the construction of coal-fired power capacity of 1,000 MW, nuclear power capacity of 2400 MW and four hydropower plants with total capacity of 120 MW of wind facilities by 300 MW. If these plans are fully implemented, the share of electricity generated with the use of Russian gas will be reduced to 55% by 2020, compared with more than 80% in 2009. Gas demand should be reduced by a third. According to the calculations of the National Academy of Sciences of Belarus, the introduction of nuclear power in the energy balance of the total electrical capacity of 2 thousand. MW will satisfy about 25% of the country's electricity needs and will reduce its cost by 13% due to the reduction in fuel costs. Upon cancellation of the nuclear power de-

velopment focus to meet the growing needs of the economy in power have to do to build power plants and the construction of hydroelectric power plants. And this will inevitably lead to more air pollution by harmful substances accumulate in her excessive amounts of carbon dioxide, a significant increase in financial expenses. Belarus uses a methodology INPRO (the International Project on Innovative Nuclear Reactors and Fuel Cycles) to assess nuclear energy systems, including the economy, infrastructure, waste management, protection against proliferation, physical protection, the environment and safety, to confirm that the investment decision (intention) . The results showed that nuclear energy is a very competitive one-day value in 1960 dollars. / KWh and total present value of electricity 5.81 cents / kWh (compared to coal - in 1175 dollars. / KWh and 6.52 cents / kWh of gas - 805 USD. / kWh and 6.76 cents / kWh). The original "one-day" cost of the two units will be 6.135 bln. dollars.

Belarus - the country most affected by the consequences of Chernobyl disaster. 29 years gone after a man-made disaster at the Chernobyl nuclear power plant. The prices for hydrocarbons are increased of many times. World nuclear power has reached a new, much higher level of development and safety.

These factors have led to a change in people's attitudes to the development of nuclear energy.

According to a survey in 2014, 41.6% of respondents believe that the country can not provide its own energy safety without development of

nuclear energy, and 58.6% consider the option of using nuclear fuel for energy development in Belarus are very promising. 48.2% agree that the construction of the Belarusian nuclear power plant will lead to an increase in the competitiveness of domestic goods (as the nuclear electricity is cheaper). 64.3% of respondents believe that in the case of the construction of nuclear plant situation in the fuel and energy complex of the country little or substantially improved. To the question "Subject to any of these conditions would you support the idea of building nuclear power plants in the country?" 48% said "should be the most modern and safe reactors." This view is fully consistent with the state policy in the field of nuclear energy development.

MILESTONES OF THE CONSTRUCTION OF THE BELARUSIAN NPP

2007:

- Decree of the President of the Republic of Belarus N°565 "On some measures for the construction of a nuclear power plant" was issued with the purpose of organizing the preparatory works for the construction of a nuclear power plant in Belarus, ensuring nuclear and radiation safety in accordance with the recommendations of the International Atomic Energy Agency;
- Directorate construction of a nuclear power plant as part of the Department of Energy was created to carry out the functions of the customer to implement a complex of preparatory and design and survey works on the construction of a nuclear power plant;
- Department of Nuclear and Radiation Safety of the Ministry of Emergency Situations (GAN) was created in order to ensure state regulation and licensing for the safe use of nuclear energy, ionizing radiation, safe management of radioactive waste.

2008:

- final political decision on the construction of its own nuclear power plant in Belarus was made at a meeting of the Security Council of the Republic of Belarus, which was chaired by the Head of State Alexander Lukashenko;
- resolution N°1 "On the development of nuclear energy in the Republic of Belarus" was adopted by the Security Council ;
- State training program for Nuclear Energy was approved by the Council of Ministers of the Republic of Belarus;
- Belarusian universities have announced a set of five specialties in the field of nuclear power: "The construction of thermal and nuclear power plants," "Steam turbine installation of nuclear power plants", "Physics of nuclear reactors and nuclear power plants", "Nuclear and Radiation Safety", "Electronic control systems and management at the nuclear power plant.";
- Ministry of Natural Resources and Environmental Protection of Belarus sent a letter with a notice of intention to build a nuclear power plant to the Secretariat of the UNECE Convention on environmental impact assessment in a Transboundary Context;
- Ministry of Energy of Belarus established the Department of Nu-



Figure 1. Belarusian NPP-project

clear Energy. Among the tasks of the Department - implementation of the state policy in the field of nuclear power engineering in Belarus, providing safe location, design, construction, commissioning, operation and decommissioning of nuclear power plants in accordance with the requirements of the legislation. An important area in the work of the Department is to prepare programs for the development of nuclear power and control over their execution, ensuring the development of normative legal acts, organization and supervision of the activities of nuclear and radiation safety, advocacy on all aspects of the establishment and operation of nuclear power;

- The State Commission for the choice of location of the land plot for construction of NPP in Belarus decided to build a nuclear power plant in Ostrovets in Grodno region;
- General contractor of the construction of NPP in Belarus-companies "Rosatom" was selected.

2009:

- Agreement between the Government of Russia and the Government of Belarus on cooperation in the field of nuclear energy for peaceful purposes was signed;
- Resolution of the Council of Ministers N°1116 "On approval of the State program" Scientific support of nuclear power development in the Republic of Belarus for 2009-2010 and for the period till 2020 " was adopted. Parent organization, carries out scientific support of works on the program, determined by the Joint Institute for Power and

Nuclear Research "Sosny" of NAS. The approved state program defines conditions for the fulfillment of all stages of the project to build nuclear power plants in Belarus - the preparatory work, construction, commissioning, operation of the future nuclear power plant.

2011:

- put into operation the first stage of the production base of the Belarusian nuclear power plant, the so-called launch pad with administrative building;
- Belarus and Russia signed an intergovernmental agreement to provide the Government of Belarus state export credit for the construction of a nuclear power plant, providing for the allocation of up to \$ 10 billion. Financing 90% of the contract value for the construction of nuclear power plants.

2012:

- a contract for the implementation of the priorities of the preparatory period before the "first concrete" of the Belarusian nuclear power plant was signed. The document was signed from the Belarusian side - the customer, GU "Management of the construction of a nuclear power plant," from the Russian side - the general contractor JSC "Atomstroyexport";
- a general contract for the construction of the Belarusian nuclear power plant was signed. General contract defines the obligations and responsibilities of the parties, the terms of the project, its estimated cost for the period until 2020, payment terms, supply of equipment, construction management, inspec-



Figure 2. The author, dean, head of department and the first graduates of the nuclear specialty visited the construction site. The inscription on the stone: "Here will be built first in Belarus nuclear power plant "

tion units and other conditions. It is envisaged commissioning of the first unit of nuclear power plant in November 2018, the second - in July of 2020. The underlying principle in the drafting of the general contract as a contractual agreement, is that the formation of the cost of the Belarusian nuclear power plant will be based on domestic prices at similar pricing conditions as in the construction of nuclear power plants in Russia using the base-index method. The value of the Belarusian nuclear power plant should not exceed the cost of the Baltic at comparable conditions;

- Public Information Centre of environmental safety in the construction and operation of nuclear power plants started in Belarus. One of the priorities of the community center is to monitor the work at the construction site accident. Experts conducted seminars, visited the construction site, get acquainted with the materials that appear in the public domain. Contacts with the Ministry of Energy, Ministry of Natural Resources and Environmental Protection installed;
- JSC "Saint-Petersburg Research and Design Institute" AEP "began to develop project documentation of the Belarusian nuclear power plant in Ostrovets. The responsibility of the St. Petersburg designers are the most important objects of the station - the nuclear island, turbine island and the physical pro-

tection of the station. In addition, subcontracting SPbAEP develop design and working documents for the first Belarusian nuclear power plant cooling towers.

2013:

- Belarus has completed the necessary preparatory work for the start of construction of nuclear power, including in the framework of its international obligations. The region is placing the necessary infrastructure, project documentation, which was approved by the Council of Ministers of the Republic of Belarus of 30 September 2013 N°457, the customer - GU "Management of the construction of a nuclear power plant" - received a license to carry out activities in the field of nuclear energy and sources of ionizing radiation of the work on the construction of nuclear installations. General contractor - JSC "Atomstroyexport" (Russian Federation) - started the construction of the Belarusian nuclear power plant.

2014:

- on the construction of the Belarusian nuclear power plant started construction of the second unit;
- construction of the Belarusian NPP turned into a stage above ground. Completed concreting of the first tier of the inner containment of the reactor building of the Belarusian NPP first unit with a mark of 25 cm to 1 m below sea

level to the level of 6 meters 75 cm above sea level. Height concreted tier is 8 m, the volume of poured concrete - about 1,500 cubic meters.

2015:

- approximately 1.29 billion dollars have already been spent. That's about 15% of the total financing the construction of the power plant. Since the beginning of the construction is mounted about 55 thousand tons of reinforcement - about 36 percent of the total. And put 370,000 cubic meters of concrete, this is also the order of 34-35 percent." Total price of the construction of the nuclear power plant will be about 11 billion dollars. At this stage, the Russian government has allocated a loan that was supposed to cover 90% of the construction of the Belarusian NPP;
- currently under the third phase of construction: construction of buildings and structures of the Belarusian NPP. From the second half of 2015 on a platform of the station began delivery of the main equipment of the reactor installation of the first unit.

MAIN FEATURES OF THE BELARUSIAN NPP

Belarusian NPP selected Russian project "NPP-2006" with pressurized water reactors (WWER) generation "three plus".

Total electrical capacity is up to 2 400 MW with the commissioning of the first power unit in 2018, the second - in 2020.

NPP-2006 project has elevated security features, technical and economic parameters, and fully complies with international standards and recommendations of the IAEA on nuclear and radiation safety.

The main target of technical and economic characteristics of the NPP-2006:

- The rated capacity of power - 1194 MW;
- the number of units - 2;
- design life of power - 60 years;
- efficiency - 36,56% (gross);
- Consumption of electricity for its own needs the station - no more than 7.15% of the nominal power.

CONCLUSION

The government of the Republic of Belarus is putting a lot of funds and effort into the development of the Nuclear Energy program, which has so far been very successful and it is expected to yield good results in the long-term also. ■