

Ecodefense

Dreams and reality of the Russian reactor export

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(Foreword by Vladimir Milov)

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Note:

The following analysis is based solely on publicly available sources. In most cases, these are publicly available documents and news releases of the Russian State Atomic Energy Corporation Rosatom. Other sources used for this analysis are media reports and materials posted on the websites of the World Nuclear Association and the Russian information agency PProAtom.

This text is the English translation of an analysis originally written and compiled in Russian; fragments, quotes, titles etc. that were originally available in English-language sources follow the English originals.

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Foreword

Rosatom loves to boast of its enormous portfolio of foreign orders. The state corporation is one of the largest recipients of subsidies from the Russian state budget and it needs to be constantly trying to prove that – as the memorable line from the old TV ads goes – it is “not a freeloader, but a partner,” that it does not just spend taxpayer money, but earns its keep as well. The nuclear industry’s executives are always stressing the importance of the revenue that flows into Russia from its export contracts.

On a closer look, however, the significance of that “foreign order portfolio” turns out to be greatly inflated, and rather than enjoying the much-touted hard currency proceeds from the construction of nuclear power plants abroad, Russia, instead, itself pays for many projects. Including with subsidies from the National Wealth Fund (which, mind you, is designed to finance the country’s beleaguered pension system) or by extending other countries ultracheap credits at interest rates our own citizens and businesses could only dream of.

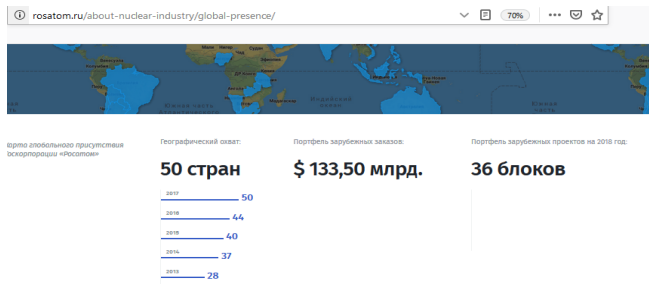
Ecodefense carried out a brilliant analysis of how things truly stand with Rosatom’s foreign contracts and shows in all its obviousness the bubble that has emerged in this sphere: All is not so rosy as the nuclear bosses tell us, and it is the Russian citizens who for the most part are left to foot the bill for this expansion.

One hopes this report will help push forward a broad national debate on the merits of the Russian public’s continued sponsorship of a risky nuclear expansion whose effectiveness and benefits for the country are very much in question.

Vladimir Milov
former Deputy Energy Minister of Russia

I. General information: current status

According to Rosatom’s official website, as of November 2018, the nuclear corporation’s foreign project portfolio included 36 reactors, and the total value of its foreign orders was \$133.50 bn¹:



Rosatom has since changed the infographics on its website (see Attachment to this report). In the picture titled “International relations” on its Infographics page², 35 foreign reactors are reported as being built in 11 countries, and the total value of the foreign order book is given at over \$133 bn. But the picture under the heading “About us” lists 36 reactors under construction abroad, and the same number is given on Rosatom’s main page as of late February 2019³.

According to official statements, in 2018, construction work started at the site of Reactor Unit 1 of Kursk-2 NPP in Russia, Reactor Unit 2 of Rooppur in Bangladesh, and Reactor Unit 1 of Akkuyu in Turkey.

Of the results of the year 2018, Rosatom notes especially the contract, valued at over \$1 bn, between its company TENEX, the exporter of the corporation’s nuclear fuel cycle products, and France’s Électricité de France SA (EDF) for the recycling of EDF’s reprocessed uranium. Noted also is its continued cooperation with China: deals were signed for cooperation in the construction of Reactor Units 7 and 8 at Tianwan and two units at Xudabao, and Rosatom’s participation in a fast reactor pilot project.⁴

Additionally, several agreements were inked in 2018 for the development of projects involving research reactors and floating NPPs – including with countries that had earlier rejected Rosatom’s large nuclear power plants for economic reasons (see Chapter IV of this report).

¹ Rosatom official website, <http://rosatom.ru/about-nuclear-industry/global-presence> The screenshot below was made of a fragment of the page on Rosatom’s Russian website on November 6, 2018. The corporation has since changed its presentation of the relevant statistics on its website, and no screenshot of an equivalent page on its English-language website is available. The Russian screenshot captures three highlighted figures under a map, with a line, on the left, saying “Map of the State Corporation Rosatom’s Global Presence,” and presented in three columns, listing, from left to right: Geographical Reach: 50 Countries (with a bar chart showing the number of countries in a particular year); Foreign Order Book: \$133,50 bn; Foreign Order Book for 2018: 36 reactor units.

² Rosatom official website, <https://rosatom.ru/en/press-centre/infographics/>, <https://rosatom.ru/en/global-presence/international-relations/>.

³ Rosatom official website, <https://rosatom.ru/en/about-us/>, <https://rosatom.ru/en/>.

⁴ Interfax, Jan.4, 2019, <https://www.interfax.ru/business/644029> (in Russian); Rosatom official website, May 25, 2018, https://rosatom.ru/en/press-centre/news/spief-2018-emphasizes-momentum-to-franco-russian-cooperation-in-field-of-nuclear-fuel-cycle/?sphrase_id=604161; Rosatom official website, June 8, 2018, https://rosatom.ru/en/press-centre/news/russia-china-sign-several-major-nuclear-contracts-in-nuclear-sphere-/?sphrase_id=604168.

II. A brief summary of the results of 2017

The most recent document detailing Rosatom's activities that is currently available to the public is the corporation's Public Annual Report for 2017 – Performance of State Atomic Energy Corporation Rosatom in 2017 (from here on, Rosatom Report⁵). Presented in the report, along with data and descriptions of Rosatom's other fields and aspects of activity, is information on the corporation's foreign projects.

According to the report, Rosatom's foreign construction project portfolio, as of the end of 2017, included 33 reactor units in 12 countries; the total value of its foreign orders was \$133.5 bn. In 2017, Rosatom concluded 11 intergovernmental agreements and 16 major interdepartmental agreements.

Information on Rosatom's international activities is mostly concentrated in the report's Chapter 3. Contribution to Global Development. This chapter begins with an overview of Rosatom's target markets and its share in them, including the markets for natural uranium, uranium conversion and enrichment services, nuclear fuel fabrication, construction, operation, and decommissioning of nuclear power plants, etc. Further, section 3.2. International Cooperation presents, listed by country, information on the development of the legal and contractual framework (intergovernmental and interdepartmental agreements, memoranda, roadmaps etc.), as well as information on agreements reached with various countries as part of "political support for major projects, particularly for the construction of NPPs and Nuclear Research and Technology Centers abroad" (3.2.2. Support for long-term international projects). The latter, combined with Rosatom's press releases, may help in putting together a picture of the current state of development of projects in a given country.

Finally, section 3.3. International Business gives information on Rosatom's foreign order book as per 2017. Of note here are subsections 3.3.3. Changes in the portfolio of overseas orders and revenue from overseas orders, 3.3.4. Construction of NPPs abroad, and, to an extent, 3.3.9. Plans for 2018, specifically Construction of NPPs abroad.

⁵ Rosatom official website, <https://rosatom.ru/upload/iblock/29c/29c061878dad37c189db341648c964b3.pdf>. This and Rosatom's previous annual reports are available at <https://rosatom.ru/en/about-us/public-reporting/>.

Changes in the portfolio of overseas orders and revenue from overseas orders⁶:

3.3.3. Changes in the portfolio of overseas orders and revenue from overseas orders

In the reporting year, ROSATOM continued to build up its portfolio of overseas orders, which reached USD 133.5 billion.

Table. Portfolio of overseas orders, USD billion

	2015	2016	2017
10-year portfolio of overseas orders, including:	110.3	133.4	133.5
Construction of NPPs abroad	75.9	97.6	97.0
Uranium products	21.1	19.9	15.0
Nuclear fuel assemblies and other activities	13.3	15.9	21.5

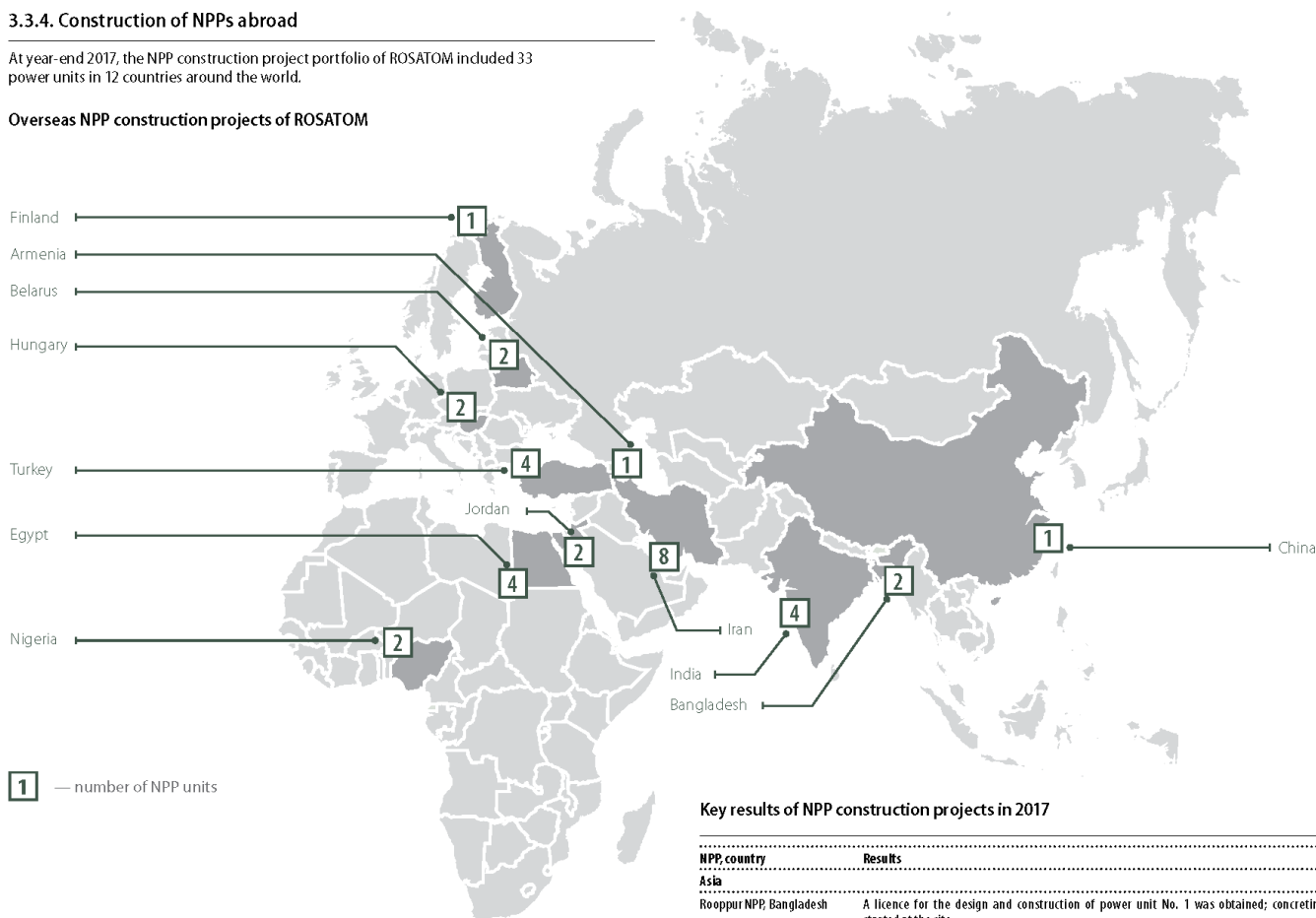
⁶ Rosatom Report, fragment of Page 28.

Construction of NPPs abroad⁷:

3.3.4. Construction of NPPs abroad

At year-end 2017, the NPP construction project portfolio of ROSATOM included 33 power units in 12 countries around the world.

Overseas NPP construction projects of ROSATOM



1 — number of NPP units

Portfolio of overseas orders for NPP construction by global market player, power units



Key results of NPP construction projects in 2017

NPP, country	Results
Asia	
Rooppur NPP, Bangladesh	A licence for the design and construction of power unit No. 1 was obtained; concreting was started at the site.
Kudankulam NPP, India	Concreting was started at power units No. 3 and 4. The Master Framework Agreement on the construction of power units No. 5 and 6 was signed.
Tianwan NPP, China	Power start-up of power unit No. 3 was completed. Cold tests of power unit No. 4 were completed.
Europe	
Paks II NPP, Hungary	The European Commission approved the construction of new power units of Paks II NPP in Hungary; the possibility of starting the construction was officially confirmed. The Hungarian Atomic Energy Agency (HAEA) approved the application for a licence for the construction site.
Belarusian NPP, Belarus	Equipment of the reactor island of power units No. 1 and 2 was installed.
Hanhikivi 1 NPP, Finland	Preparatory construction work continued at the NPP site. A workers' camp for 1,000 people, administrative and amenity buildings continued to be built.
Middle East and North Africa	
El Dabaa NPP, Egypt	Acts on enacting commercial contracts for NPP construction were signed, including life cycle contracts (provision of fuel, servicing and SNF handling).
Akkuyu NPP, Turkey	An official ceremony was held to mark the start of construction and installation of the 'non-nuclear' part of the NPP as part of the preparatory stage of the project under the limited licence for construction issued by the Turkish Atomic Energy Authority.
Bushehr-2 NPP, Iran	Works of the second stage were started on the construction site, and the main part of engineering designs of the NPP were handed over to the customer.

According to the report:

Rosatom also continued to take measures to secure new orders for NPP construction abroad:

- Preparation was underway for the signing of a package of intergovernmental and contract documents for the construction of power units No. 7 and 8 of Tianwan NPP, mass construction

⁷ Rosatom Report, Page 29.

of Russian-design NPPs at a new site in China and delivery of equipment for a Chinese-design fast neutron NPP;

– An Agreement on the Development of an NPP Construction Project and a Road Map for Cooperation were signed by JSC Rosatom Overseas and the Nigeria Atomic Energy Commission;

– An Agreement on the Development of an NPP Construction Project was signed by JSC Rosatom Overseas and the Ministry of Water Resources, Irrigation and Electricity of the Republic of the Sudan.

In addition, Rosatom filed its proposal for participation in a competitive tender for an NPP construction project in Saudi Arabia.

As Rosatom Report demonstrates in the table detailing the changes in the ten-year portfolio of overseas orders, the total value of the corporation's foreign orders in 2017 was \$133.5 bn, and the same amount was given on Rosatom's official website as of early November 2018. However, the number of NPPs under construction abroad was stated as 36, or three more than in 2017; one of the graphic representations posted on Rosatom's infographics page shows 35 reactors in 11 countries.

Furthermore, it follows from the table that foreign reactor construction per se only accounts for \$97 bn of the overall amount (\$0.6 bn less than in 2016). Given the total stated value of overseas orders for NPP construction at \$97 bn and an estimated market price of \$5 bn to \$7 bn per reactor, Rosatom's foreign construction orders would have had to be limited to less than 20 units at best. The likely reason for the number 33 as given in the year-end results for 2017 is that, for instance, in certain projects, Rosatom's role is limited participation, rather than that of the primary builder of reactor units (for details, see the section on China). On the whole, though, the exact correspondence between the overall value of the construction portfolio and the number of reactor projects under implementation is difficult to ascertain. Considerations such as the ten-year estimation range – which is based on the ten-year completion timeframes for projects – and the particular criteria for including projects in this portfolio may factor in, so other explanations are possible.

Information on the specific projects in the 12 countries where, according to Rosatom's 2017 report, the nuclear corporation is carrying out NPP construction, is given in the next chapter.

III. Rosatom's reactor construction projects abroad

1. Armenia

August 2010 saw the signing of an intergovernmental agreement between Russia and Armenia that was to lead to the construction of a third reactor unit in that country. Construction was supposed to start already in 2013, and the cost of the new reactor was expected at \$5 bn.⁸ A number of sources have reported – with references to Armenian officials, for the most part – Russia's pledge to finance 12% to 90% of the overall amount. For the duration of 2018 and in early 2019, Armenia was present in Rosatom's documents as a country where a new reactor project was under implementation. At the same time, no substantive actions were observed in this regard as of the beginning of 2019. The only Rosatom project being implemented in Armenia to date is the modernization of Reactor Unit 2 of Armenian NPP at Metsamor. Two VVER-440/V-270 units were built at the plant, of which one was shut down in 1989. The other is undergoing upgrades to extend the unit's operating lifetime.

Contract for the new unit: No

Active construction: No

Cost: \$5 bn (presumed)

2. Bangladesh

In early 2019, concrete work was completed on the turbine hall foundation slab of Rooppur's Reactor Unit 1, as well as soil stabilization operations at the site.⁹ Construction of Rooppur NPP began in the fall of 2017. The site is located in Pabna District, some 160 km from the country's capital, Dhaka. The plant will have two power units with 1200 MW VVER reactors (AES-2006 design). Reactor Unit 1 is expected to be commissioned in 2023, Reactor Unit 2 in 2024.¹⁰

Contract: Yes

Active construction: Yes

Cost: around \$13 bn, including Russian export credit of around \$11.4 bn

3. Belarus

On September 21, 2018, Belarusian President Alexander Lukashenko said Russia had failed to stay on schedule with construction of Belarusian NPP in Ostrovets and that Minsk, accordingly, expects an extension on the Russian loan's due date as well as a reduction of the interest rate to 3%. The plant's commissioning, he said, was delayed by a year.¹¹

Earlier, the first unit was planned to be taken online in November 2019, and the second in 2020. Several problems had occurred in the course of the construction, including an incident in the summer of 2016 when a 330-ton reactor pressure vessel fell from a height of 2 to 4 meters during preparations for installation. Rosatom nonetheless still promises to take the plant online in 2019. The line of credit covering the construction of Belarusian NPP expires in 2035.

Under the terms of the credit agreement, Belarus is to commence repaying the Russian state credit six months after the NPP commissioning date, but no later than April 1, 2021. The following interest is charged daily, starting on the date each loan amount is drawn: at an annual rate of 5.23% for the first

⁸ WNA, Country Profiles: Armenia, <http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/armenia.aspx>.

⁹ Rosatom official website, Jan. 31, 2019, <https://rosatom.ru/en/press-centre/news/end-of-concrete-works-for-the-unit-no-1-turbine-hall-foundation-slab-and-of-soil-stabilization-works/>.

¹⁰ RIA Novosti, March 1, 2018, <https://ria.ru/20180301/1515547628.html> (in Russian).

¹¹ Interfax, Sept. 22, 2018, <https://www.interfax.ru/business/630229> (in Russian).

50% of each portion of the credit drawn, and at the LIBOR rate set for six-month deposits in US dollars plus a margin in the amount of 1.83% per annum for the remaining 50% of the portion of credit drawn.¹²

Contract: Yes

Active construction: Yes

Cost: over \$11 bn, including Russian credit of \$10 bn

4. Hungary

Four VVER-440 reactors are in operation at Hungary's Paks NPP, built by Soviet engineers in 1974 to 1987. Rosatom is currently participating in upgrading the units. In late 2014, Russia and Hungary signed documents envisioning construction of two reactor units of VVER-1200 design. As a result, Hungary found itself subject to several inquiries initiated by the European Commission. The inquiries – which halted the project, though did not stop it – concerned the legality of state subsidies, certain issues regarding the tender process, the exclusive right to supply fuel to the plant, etc.

Active construction work is planned for 2018, but Rosatom was unable to secure the necessary permits in time. The documentation required to apply for the construction license is expected to be completed by mid-2019.¹³

Contract: Yes

Active construction: No

Cost: €12.5 bn, including Russian credit of up to €10 bn

5. Egypt

On November 19, 2015, Russia and Egypt signed an intergovernmental agreement – and in December 2017 in Cairo, the two sides inked notices to proceed with the contracts – for the construction of El Dabaa NPP. Rosatom is to complete the four VVER-1200 reactors planned at El Dabaa by 2029; construction is expected to start in 2020. Russia, as previously reported, will extend a \$25 bn credit on favorable terms: Russian President Vladimir Putin stated as much in October 2018.¹⁴

It is not entirely clear where Russia will find the funding for the construction of El Dabaa. Russian Finance Minister Anton Siluanov earlier suggested that the money might be drawn from the Russian National Wealth Fund. The yearly credits starting in 2020-2021 are expected to amount to between \$3 bn and \$4 bn. At the same time, the investment guidelines of the National Wealth Fund dictate that countries where its assets can be invested must have a credit rating of AA- or higher on the scale of the rating agencies Fitch or S&P, or Aa3 or higher on the scale used by Moody's. Egypt's credit rating is lower, but the Russian government may make an exception.¹⁵

In 2018, Rosatom's engineering company Atomstroieksport hired the international law firm of Gowling WLG to "render legal services within the law of England and Wales (and, if required, Egyptian law) in a dispute with the Nuclear Power Plants Authority of Egypt." The dispute with the Egyptian agency

¹² "On the results of the joint control activity of the Accounts Chamber of the Russian Federation and the State Control Committee of the Republic of Belarus to assess the fulfilment of obligations of the parties as per the Agreement between the Government of the Russian Federation and the Government of the Republic of Belarus on cooperation in the construction on the territory of the Republic of Belarus of a nuclear power plant, signed on March 15, 2011" (in Russian), November 2016.

¹³ Interfax, Jan. 4, 2019, <https://www.interfax.ru/business/644029> (in Russian).

¹⁴ Interfax, Dec. 29, 2018, <https://www.interfax.ru/business/644565> (in Russian); Rosatom official website, Dec. 11, 2017, <https://rosatom.ru/en/press-centre/news/notices-to-proceed-contracts-for-el-dabaa-npp-construction-signed-in-the-presence-of-r/>.

¹⁵ RBC, Oct. 18, 2018, <https://www.rbc.ru/economics/18/10/2018/5bc862fe9a79470ecbe623cf> (in Russian).

stems from the “unforeseen soil conditions discovered at the NPP construction site,” procurement documents said.¹⁶

Contract: Yes

Active construction: No

Cost: \$30 bn, including Russian credit of \$25 bn

6. India

Rosatom is currently carrying out construction of Reactor Units 3 and 4 (VVER-1000/412 design) at Kudankulam NPP, on the shore of the Indian Ocean. Active construction work began in June and October 2017. The plant is being built in a seismic hazard zone. Construction of the first two units was accompanied by mass protests, including a blockade that preceded the plant’s commissioning and gathered some 10,000 protesters.

Preparatory works are under way for the construction of the plant’s Reactor Units 5 and 6.¹⁷ Active construction of these units is assumed to commence in 2019 and 2020 and conclude in 2024 and 2025, respectively. The Indian government also said in November 2018 that it was searching for sites for additional nuclear power plants but was encountering difficulties in that regard.

Contract: Yes

Active construction: Yes for Reactor Units 3 and 4; No for Reactor Units 5 and 6

Cost: \$6.4 bn for Reactor Units 3 and 4, including Russian credit of \$3.4 bn; over \$5 bn for Reactor Units 5 and 6, including Russian credit of \$4.2 bn

7. Iran

In November 2018, Russia and Iran signed a number of documents “opening the possibility of construction in Iran of up to eight power units under Russian technologies.” The contract for the construction of Reactor Units 2 and 3 at Bushehr was signed then as well. The two VVER-1000 units are to have a combined capacity of 2100 MW. According to Rosatom, the project is being implemented with Iranian funding. In early May 2018, soil stabilizations work commenced under the reactor building of Reactor Unit 2 at the Bushehr-2 NPP site.¹⁸

Construction was officially started in September 2016¹⁹, but active construction work is yet to begin at the second unit. According to Rosatom’s official information, first concrete pouring is planned for the third quarter of 2019. Reactor Unit 2 is scheduled for completion in 2024, Reactor Unit 3 in 2026²⁰. The plant is being built in a seismic hazard zone.

According to Valery Limarenko, president of Rosatom’s engineering division, ASE Group of Companies, VVER-1000s are the “previous reactor generation,” and no more units of this type will apparently be built in Russia.²¹

¹⁶ RBC, Oct. 22, 2018, <https://www.rbc.ru/business/22/10/2018/5bc9ff2d9a7947769ef820dc> (in Russian).

¹⁷ RIA, Dec. 13, 2018, <https://ria.ru/20181213/1547914520.html> (in Russian).

¹⁸ Rosatom official website, May 3, 2018, <https://www.rosatom.ru/en/press-centre/news/priority-works-have-commenced-at-bushehr-npp-2-2-iran-site-for-ensuring-first-concrete-pouring/>.

¹⁹ Rosatom official website, Sept. 13, 2016, https://www.rosatom.ru/en/press-centre/news/the-foundation-stone-ceremony-held-on-the-bushehr-phase-ii-construction-site-iran/?sphrase_id=607359.

²⁰ Rosatom official website (Interfax stated as source), Sept. 19, 2017, https://www.rosatom.ru/journalist/smi-about-industry/ase-nachala-raboty-po-proektu-sooruzheniya-ii-ocheredi-aes-busher/?sphrase_id=607366 (in Russian).

²¹ RIA Novosti, May 16, 2018, <https://ria.ru/20180516/1520619782.html> (in Russian).

As for the remaining six units of the eight specified on the map in Rosatom's performance report for 2017, data posted on the information resource of the World Nuclear Association – which tracks nuclear energy development in countries across the world – is limited, as of April 2018, by the type of reactor for Reactor Units 5 and 6 at Bushehr (VVER) and four other units at a site yet to be determined (presumably, VVER). There is no data on these units' capacity or year of the expected start of construction and start of commercial operation.²²

Contract: Yes

Active construction: No

Cost: \$10 bn (for Reactor Units 2 and 3 of Bushehr-2).

8. Jordan

In 2013, Rosatom won a bid for NPP construction in Jordan, and an intergovernmental agreement was signed two years later. Outside investors were expected to be involved in the project. Rosatom was likewise willing to participate in financing the plant. By late 2017, though, negotiations had still not produced any commercial contracts. Jordan was unable to secure the funding for the \$10 bn NPP and canceled the project.²³ In Rosatom's report for 2017, however, Jordan was still present on the map of overseas projects as a site of two reactor units under construction.

In late May 2018, the Jordan Atomic Energy Commission and Rusatom Overseas – a Rosatom company responsible for promoting comprehensive services in the construction and operation of NPPs and Centers of Nuclear Science and Technologies in foreign markets – signed a project development agreement for a Russian-designed small modular reactor construction project in Jordan. The agreement envisions carrying out a feasibility study for the project.²⁴

Contract: No

Active construction: No

Cost: \$10 bn (project canceled; prospects slim for the new project).

9. China

In the summer of 2018, Russia and China signed a package of contracts envisioning joint construction of Reactor Units 7 and 8 of Tianwan NPP, construction of two reactor units at Xudabao NPP, and cooperation in the implementation of a fast neutron reactor pilot project.²⁵ Rosatom does not disclose the cost of these reactors, but according to Rosatom's Director General Alexei Likhachev, equipment deliveries under the contracts signed will total \$5 bn in the first stage alone; the four units at the two NPPs will be fully financed by the Chinese side.²⁶

There are grounds, meanwhile, to believe that the contracts concluded with Rosatom were only for a limited portion of the works: just the designing and delivery of the main equipment of the reactor building. Works on much the same scale had earlier been offered for implementation in the case of Reactor Units 3 and 4 of Tianwan NPP (these units are already completed). Rosatom was paid about

²² WNA, Country Profiles: Iran, <http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/iran.aspx>.

²³ Interfax, Jan.4, 2019, <https://www.interfax.ru/business/644029> (in Russian).

²⁴ Rosatom official website, May 27, 2018, <https://www.rosatom.ru/en/press-centre/news/russia-and-jordan-to-focus-their-nuclear-cooperation/>.

²⁵ Interfax, Jan.4, 2019, <https://www.interfax.ru/business/644029> (in Russian); Rosatom official website, June 8, 2018, https://rosatom.ru/en/press-centre/news/russia-china-sign-several-major-nuclear-contracts-in-nuclear-sphere-/?sphrase_id=604168.

²⁶RBC, June 8, 2018, <https://www.rbc.ru/business/08/06/2018/5b1a434c9a79471058fccc> (in Russian).

€1.3 bn for this work.²⁷ The deal on the new units may have presumably been concluded following the same pattern.

Contract: Yes

Active construction: No

Cost: probably, around \$5 bn

10. Nigeria

At the end of October 2017, Russia and Nigeria signed agreements on developing projects for construction and operation of an NPP and a center with a multipurpose research reactor. The agreements encompassed conducting feasibility studies for the projects, including site selection, capacity, timeframes, and financing schemes. An intergovernmental agreement on cooperation in the field of peaceful use of nuclear technologies was signed by Russia and Nigeria in 2009.²⁸

In 2015, a number of media outlets reported that sites were allegedly already selected for future NPPs in Nigeria, and sources in the government claimed that agreements were almost reached for construction of four reactor units. It remained unclear, however, how Nigeria intended to finance the construction.²⁹ A Rosatom representative later refuted the information of any such agreements signed with Nigeria.

Despite an absence of clarity with regard to many of the putative project's parameters, including its financing, Rosatom placed Nigeria on its map of overseas NPP construction projects in its performance report for 2017, with a mark made for two reactor units in that country. In early 2019, Nigeria was also still present on Rosatom's Global Presence map as a country with an NPP construction project (see Attachment).

Contract: No

Active construction: No

Cost: presumably, \$20 bn

11. Turkey

An intergovernmental agreement between Russia and Turkey on cooperation in the field of construction and operation of a nuclear power plant at the Akkuyu site, Mersin Province, was signed on May 12, 2010. Four VVER-1200 units are planned for construction. On April 3, 2018, a high-profile ceremony marked the pouring of "first concrete" at the site.³⁰ The total investment in the project was estimated by Russian President Vladimir Putin at \$22 bn³¹; other estimates, of about \$20 bn³² to up to \$25 bn, have also been cited³³. The first unit is scheduled for launch in 2023, the year of the 100th anniversary of the Republic of Turkey.

²⁷ Strategy-2018: A Mix of Quackery and Opportunistic Collusion. On the Project of the Russian Nuclear Energy Development Strategy of up 2100. Bulat Nigmatulin, General Director of Institute of Energy Problems. PRoAtom, Dec. 25, 2018, <http://proatom.ru/modules.php?name=News&file=article&sid=8364> (in Russian).

²⁸ Rosatom official website, Oct. 30, 2017, https://www.rosatom.ru/en/press-centre/news/russia-and-nigeria-signed-nuclear-project-development-agreements/?sphrase_id=608267.

²⁹ Reuters (on Yahoo! News), June 20, 2015, <https://news.yahoo.com/nigeria-selects-two-sites-nuclear-power-plants-122001531--finance.html>.

³⁰ Rosatom official website, April 4, 2018, <https://www.rosatom.ru/en/press-centre/news/presidents-of-russia-and-turkey-vladimir-putin-and-recep-tayyip-erdo-an-kicked-off-large-scale-const/>.

³¹ RBC, Feb. 6, 2018, <https://www.rbc.ru/business/06/02/2018/5a7843899a79471f3a00b7f4> (in Russian).

³² Rosatom official website, April 2, 2018, <https://www.rosatom.ru/en/press-centre/news/jsc-akkuyu-nuclear-designated-strategic-investor-in-turkey/>.

³³ WNA, Country Profiles: Turkey, <http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/turkey.aspx>.

Compared to the earlier plans, the Akkuyu project is four years behind schedule. In May 2013, construction was reportedly to commence in 2015, and commercial operation in 2019.³⁴ In October that year, the start of construction was already reported to be scheduled for 2016, with commercial launch in 2020.³⁵ In October 2014, a presentation by Roman Tyurin, a representative of Akkuyu Nuclear – the company implementing the Akkuyu NPP project – already featured the years 2017 and 2021 as the timeframe for the start and launch of the first unit.³⁶

In November 2015 (at this time, the first unit's launch year mentioned in the media was already 2020), a Turkish fighter jet shot down a Russian attack aircraft, and Russia-Turkey relations worsened dramatically until August 2016.³⁷ ³⁸ It is not clear just how badly that crisis affected the project's implementation: The year 2023 as the first unit's completion date – the same as stated today – featured in Rosatom's publicly available documents even before the conflict.³⁹

The project is fully financed by Russia. In February 2013, a report citing Akkuyu General Director Alexander Superfin said that “the total investment into the construction will amount to \$20 bn, of which \$7.5 bn will be invested by the Turkish side.”⁴⁰ In February 2018, three Turkish companies – Cengiz Holding, Kolin Insaat, and Kalyon Insaat, the prospective buyers of 49% in Akkuyu, which signed in June 2017 a term sheet with Rosatom – opted out of the project.⁴¹ In April 2018, Russian Energy Minister Alexander Novak said: “Some \$3 bn has already been invested. [...] This is quite sufficient for the construction to proceed. [...] If no [foreign investor] is found, then Akkuyu Nuclear's funding will be employed.”⁴²

In mid-January 2018, Interfax, citing a source in Rosatom, said the state corporation was looking to close the deal in that year to fulfil the agreement of commissioning the first unit in 2023.⁴³ In March, Rosatom head Alexei Likhachev said the deal to sell 49% of Akkuyu was being pushed to 2019. Six months later, he said, regarding the plans for 2019, that “there was no such task” before Rosatom. And in December, Likhachev announced Rosatom planned to sell in 2019 a small share in Akkuyu to a Turkish company “not of those three.”⁴⁴

Contract: Yes

Active construction: Yes (one reactor unit)

Cost: \$22 bn (under the Build, Own, Operate model, Rosatom provides the construction funding, owns the completed plant, and sells the energy produced at a fixed price)

12. Finland

The papers envisioning the implementation of Hanhikivi NPP, with a VVER-1200 reactor, in Finland, were signed in 2013, and in 2018, construction was to be in full swing. But the necessary licenses are

³⁴ Reuters, May 3, 2013, <https://www.reuters.com/article/turkey-nuclear-deal/update-1-turkey-japan-sign-22-bln-nuclear-power-plant-deal-idUSL6N0DK3A820130503>.

³⁵ Hürriyet Daily News, Oct. 25, 2013, <http://www.hurriyetdailynews.com/first-reactor-of-turkeys-first-nuclear-plant-to-go-online-by-2020-56799>.

³⁶ Internal Control System of the BOO project of Akkuyu NPP. R. P. Turin, director for internal control and audit, Akkuyu Nuclear. Conference “Internal Control and Audit in Russia: New Prospects and Opportunities,” Feb. 27, 2015; the URL of the presentation, posted on the conference's website, indicates October 2014 as the document's likely date: <http://conf-audit.ru/wp-content/uploads/2014/10/Tyurin.pdf> <http://conf-audit.ru/wp-content/uploads/2014/10/Tyurin.pdf> (in Russian).

³⁷ Interfax, Nov. 26, 2015, <https://www.interfax.ru/business/481761> (in Russian).

³⁸ RIA Novosti, Aug. 9, 2016, <https://ria.ru/20160809/1473985214.html> (in Russian).

³⁹ Modern concepts of construction of NPP power units abroad. Alexander Nemtinov, Rusatom Overseas. The Second Annual Research-to-Practice Conference on New Trends in Construction Technologies for Sites of Application of Nuclear Energy “AtomStroiStandart-2015,” Sept. 25, 2015, http://atomsro.ru/wp-content/uploads/file/0PORTAL/AtomStroyStandart_2015/Nemtinov_atstst_2015.pdf (in Russian).

⁴⁰ Atomic-Energy.Ru (ProNedra.Ru stated as source), Feb. 18, 2013, <http://www.atomic-energy.ru/news/2013/02/18/39869> (in Russian).

⁴¹ RBC, Feb. 6, 2018, <https://www.rbc.ru/business/06/02/2018/5a7843899a79471f3a00b7f4> (in Russian).

⁴² TASS, April 6, 2018, <https://tass.ru/ekonomika/5100935> (in Russian).

⁴³ Interfax, Feb. 6, 2018, <https://www.interfax.ru/business/598714> (in Russian).

⁴⁴ Interfax, Dec. 12, 2018, <https://www.interfax.ru/russia/641996> (in Russian).

yet to be obtained. Rosatom does not just plan to build the plant but has also purchased a 34% share in Finland's Fennovoima OY, the project owner in Hanhikivi. Earlier, funding for the Hanhikivi project had been budgeted out of the Russian National Wealth Fund. The decision to provide around €2.4 bn of the fund's money to Rosatom was made in early 2015. Last year, Fennovoima OY announced the construction license was to be expected in 2021, and commercial operation would start in 2028.⁴⁵ The project is currently four years behind schedule.

Contract: Yes

Active construction: No

Cost: €7 bn, Russian investment of €2.4 bn (out of the National Wealth Fund).

⁴⁵ Interfax, Jan. 4, 2019, <https://www.interfax.ru/business/644029> (in Russian).

IV. Other presumable reactor projects abroad

Argentina

In early December 2018, a strategic document on the Russian-Argentinian partnership in the field of peaceful use of nuclear energy was signed on the margins of the G20 summit in Buenos Aires. The main areas of cooperation outlined in the document include projects of large and small capacity NPPs in Argentina. According to the document, the parties will also consider the possibility of joint operation of a fleet of floating NPPs.⁴⁶ As of today, Rosatom does not have a fleet of floating NPPs – with the exception of the first such plant, which does not yet produce energy and has not yet even been towed to its permanent deployment site.

Bulgaria

In 2006, Russia and Bulgaria signed an agreement on construction of Belene NPP, but six years later, Bulgaria backed out of the project. Rosatom filed a lawsuit, demanding €1 bn in damages for the cost of the works already executed and equipment produced. An arbitration court in Geneva awarded Rosatom €620 m in damages, which was paid in late 2016. At the end of May 2018, at a press conference following Russian-Bulgarian negotiations, Russian President Vladimir Putin said Russia was willing to return to the Belene NPP project on fair-market terms, if Bulgaria so wished. On June 27, the Bulgarian cabinet rescinded its 2012 decision to close down the Belene NPP construction project. Bulgaria, which has started preparations for a tender process and a search for a strategic investor, estimates the project is to be kept within a cost limit of €10 bn, with the construction timeframe not exceeding 10 years.⁴⁷

Vietnam

On November 19, 2018, Rosatom received a certificate of approval by the prime minister of Vietnam of a preliminary feasibility study for a Center of Nuclear Science and Technologies. A memorandum of understanding on the plan of construction of the Center of Nuclear Science and Technologies had been signed by Rosatom and the Ministry of Science and Technology of Vietnam in June 2017.⁴⁸

Earlier, Vietnam had abandoned plans for NPP construction to a Russian project for reasons of excessive costs, even though the Russian side had offered a credit that would cover most of the expenditure in the project.

Zambia

On May 15, 2018, Rosatom and Zambia signed a general contract for the construction of a Center of Nuclear Science and Technologies. The center will be located in 10 kilometers off Zambia's capital, Lusaka, and will comprise a nuclear research facility based on a multipurpose water-cooled reactor with a capacity of up to 10 MW, a laboratory complex, a multipurpose irradiation center, and a cyclotron-based nuclear medicine center. The project will be implemented in several stages within three to six years from the start of works as outlined in the contract.⁴⁹

Congo

On February 13, 2018, Rosatom and the Ministry of Scientific Research and Technological Innovation of the Republic of Congo signed a Memorandum of Understanding on cooperation in the field of peaceful use of atomic energy. The document provides for “developing approaches to constructing

⁴⁶ Rosatom official website, Dec. 3, 2018, <https://www.rosatom.ru/journalist/news/rossiya-i-argentina-pridayut-novyy-impuls-sotrudnichestvu-v-oblasti-mirnogo-ispolzovaniya-atomnoy-en/>.

⁴⁷ Interfax, Jan. 4, 2019, <https://www.interfax.ru/business/644029> (in Russian).

⁴⁸ Rosatom official website (RIA Novosti stated as source), Nov. 19, 2018, <https://www.rosatom.ru/journalist/news/vetnam-peredal-rossii-obosnovanie-tsentra-yadernoy-nauki/> (in Russian).

⁴⁹ Rosatom official website, May 18, 2018, <https://www.rosatom.ru/journalist/news/rosatom-i-respublika-zambiya-podpisali-generalnyy-kontrakt-na-sooruzhenie-tsentra-yadernoy-nauki-i-t/>.

such facilities as a Center for Nuclear Science and Technology with Russian-designed research reactor at its core on the territory of the Republic of Congo.”⁵⁰

Mongolia

On February 28, 2018, in Moscow, a Memorandum of Intent was signed with the Nuclear Energy Commission of Mongolia. It envisions the development in Mongolia of a Centre of Nuclear Science and Technology construction project.⁵¹

Rwanda

On December 5, 2018, an intergovernmental agreement on cooperation in the field of peaceful use of atomic energy was signed during a visit to Moscow of the Minister of Infrastructure of the Republic of Rwanda, Claver Gatete. The agreement provides a basis for cooperation including in the development of construction projects for a Center for Nuclear Science and Technology and a nuclear power plant in the Republic of Rwanda.⁵²

Saudi Arabia

In February 2018, Rosatom submitted a bid for the construction of a two-unit NPP in Saudi Arabia. In October that year, Rosatom head Alexei Likhachev said the tendering process will be completed in 2020.⁵³ Later, Likhachev said the winning bid may be announced in 2019.⁵⁴ In the end of 2017, Rosatom and King Abdullah City for Atomic and Renewable Energy had signed a roadmap for cooperation in the field of peaceful use of atomic energy. Russia and Saudi Arabia intend to cooperate in the field of small- and medium-capacity reactors that could be used for both power generation and water desalination.⁵⁵ In 2016, Russia had offered Saudi Arabia to build 16 new reactors over 20 years at a cost of \$100 bn. The idea has apparently not found approval, and Rosatom was forced to participate in the tender on the same terms as the bidders from other countries.⁵⁶

Serbia

On January 17, 2019, during a visit of Russian President Vladimir Putin to the Republic of Serbia, an intergovernmental agreement was signed on cooperation in the field of peaceful use of atomic energy. It mentions, in part, designing, construction, and modernization of nuclear research reactors, application of radiation technologies in agriculture, etc.⁵⁷

Sudan

On May 15, 2018, Rosatom and the Ministry of Water Resources, Irrigation and Electricity of the Republic of the Sudan signed a memorandum on cooperation in personnel training in the field of nuclear energy of the Republic of the Sudan and a memorandum on the development of positive

⁵⁰ Rosatom official website, Feb. 13, 2018, https://www.rosatom.ru/en/press-centre/news/rosatom-and-the-ministry-of-scientific-research-and-technological-innovations-of-the-republic-of-con/?sphrase_id=608881.

⁵¹ Rosatom official website, Feb. 28, 2018, https://www.rosatom.ru/en/press-centre/news/rosatom-and-nuclear-energy-commission-of-mongolia-signed-memorandum-of-cooperation-on-centre-of-nucl/?sphrase_id=608885 (in Russian), https://www.rosatom.ru/en/press-centre/news/rosatom-and-nuclear-energy-commission-of-mongolia-signed-memorandum-of-cooperation-on-centre-of-nucl/?sphrase_id=608885.

⁵² Rosatom official website, Dec. 5, 2018, https://www.rosatom.ru/en/press-centre/news/russia-and-the-republic-of-rwanda-develop-cooperation-in-the-field-of-peaceful-use-of-atomic-energy/?sphrase_id=608890.

⁵³ TASS, Oct. 3, 2018, <https://tass.ru/ekonomika/5633339> (in Russian).

⁵⁴ Vesti, Dec. 18, 2108, <https://www.vestifinance.ru/articles/111992> (in Russian).

⁵⁵ Rosatom official website, Dec. 14, 2017, https://www.rosatom.ru/en/press-centre/news/russia-and-saudi-arabia-signed-a-roadmap-for-cooperation-in-peaceful-use-of-nuclear-energy/?sphrase_id=608893.

⁵⁶ Global Construction Review, Sept. 7, 2016, <http://www.globalconstructionreview.com/news/russia-offers-build-saudi-arab-100bn-nucle7ar/>.

⁵⁷ Rosatom official website, Jan. 17, 2019, https://www.rosatom.ru/en/press-centre/news/russia-and-serbia-sign-a-package-of-agreements-on-cooperation-in-nuclear-energy-use-for-peaceful-pur/?sphrase_id=608935.

public opinion on nuclear energy in the Sudan. Earlier, a project development agreement had been signed for the construction of a floating nuclear power plant in Sudan.⁵⁸

Uzbekistan

An intergovernmental agreement between Russia and Uzbekistan was inked in late 2017. The Concept of Atomic Energy Development for up to 2029 was adopted in Uzbekistan in early 2019. The document states that the construction of the country's first nuclear power plant will proceed in three stages. The first stage, from 2019 to 2020, will determine the site of the future NPP, the project's feasibility study is planned to be carried out in 2020 to 2021, and construction is scheduled to start in 2022, to be completed in 2029.⁵⁹ Uzbekistan and Russia are expected to jointly finance the project, but no decision on a Russian credit has been made yet. In preliminary estimates, the cost of an NPP with two VVER-1200 reactors in Uzbekistan could amount to \$11 bn.⁶⁰

Chile

On May 14, 2018, Rosatom America Latina (regional branch of Rosatom International Network) and the Chilean Nuclear Energy Commission signed a memorandum of understanding on a broad range of issues, from peaceful use of nuclear energy to application of lithium production technologies in Chile. The memorandum mentions, in part, the modernization and lifetime extension of the research reactor in Chile, technologies for lithium brine extraction and manufacturing of lithium products, etc.⁶¹

⁵⁸ Rosatom official website, May 16, 2018, https://www.rosatom.ru/en/press-centre/news/rosatom-and-the-ministry-of-water-resources-irrigation-and-electric-power-of-the-republic-of-sudan-s/?sphrase_id=608938.

⁵⁹ Ozodlik, Feb. 9, 2019, <https://rus.ozodlik.org/a/29759873.html> (in Russian).

⁶⁰ Interfax, Jan. 4, 2019, <https://www.interfax.ru/business/644029> (in Russian).

⁶¹ Rosatom official website, May 14, 2018, https://www.rosatom.ru/en/press-centre/news/rosatom-america-latina-and-chilean-commission-of-nuclear-energy-sign-a-memorandum-of-understanding-t/?sphrase_id=608951; the Russian version of this press statement (<https://www.rosatom.ru/journalist/news/rosatom-latinskaya-amerika-i-chiliyskaya-komissiya-po-atomnoy-energii-podpisali-memorandum-o-vzaimop/>) mentions Chile's research reactor in the plural.

V. Conclusion

In Rosatom's official performance report for 2017, published in August 2018, the total value of the state corporation's overseas order book is stated at \$133.5 bn; of this amount, the share of NPP construction per se is \$97 bn. Summarizing the results of 2017, Rosatom claimed it was building 33 new nuclear reactors in other countries.

In 2018, various Rosatom documents mentioned either 35 or 36 reactor units in the context of building new NPPs abroad. At the same time, the overall value of overseas orders remained close to \$133 bn (see Attachment).

Meanwhile, a closer look at the situation with NPP construction in the countries mentioned in Rosatom's openly available documents, public statements, and press releases, reveals a different picture. As of early 2019, only seven reactors were in the stage of active construction. These are one reactor in Turkey and two each in Bangladesh, Belarus, and India. The overall cost of these reactors, if one is to count based on official estimates, comes to around \$36 bn.

Of the 35 or 36 new reactors which Rosatom claims it is building in other countries, only 26 are covered by officially formalized deals, including the seven under active construction. Of these, five are in China, where Rosatom's role is that of limited participation.

Russia continues to use state credits in order to stimulate demand for its reactors in other countries. The total volume of credits and other means of financing to cover new NPPs abroad – in those estimates that appear in official statements – amounts to around \$90 bn. With the exception of Belarus, the state credits' interest rate does not exceed 3%, providing for significantly more favorable terms than with loans offered by commercial banks.

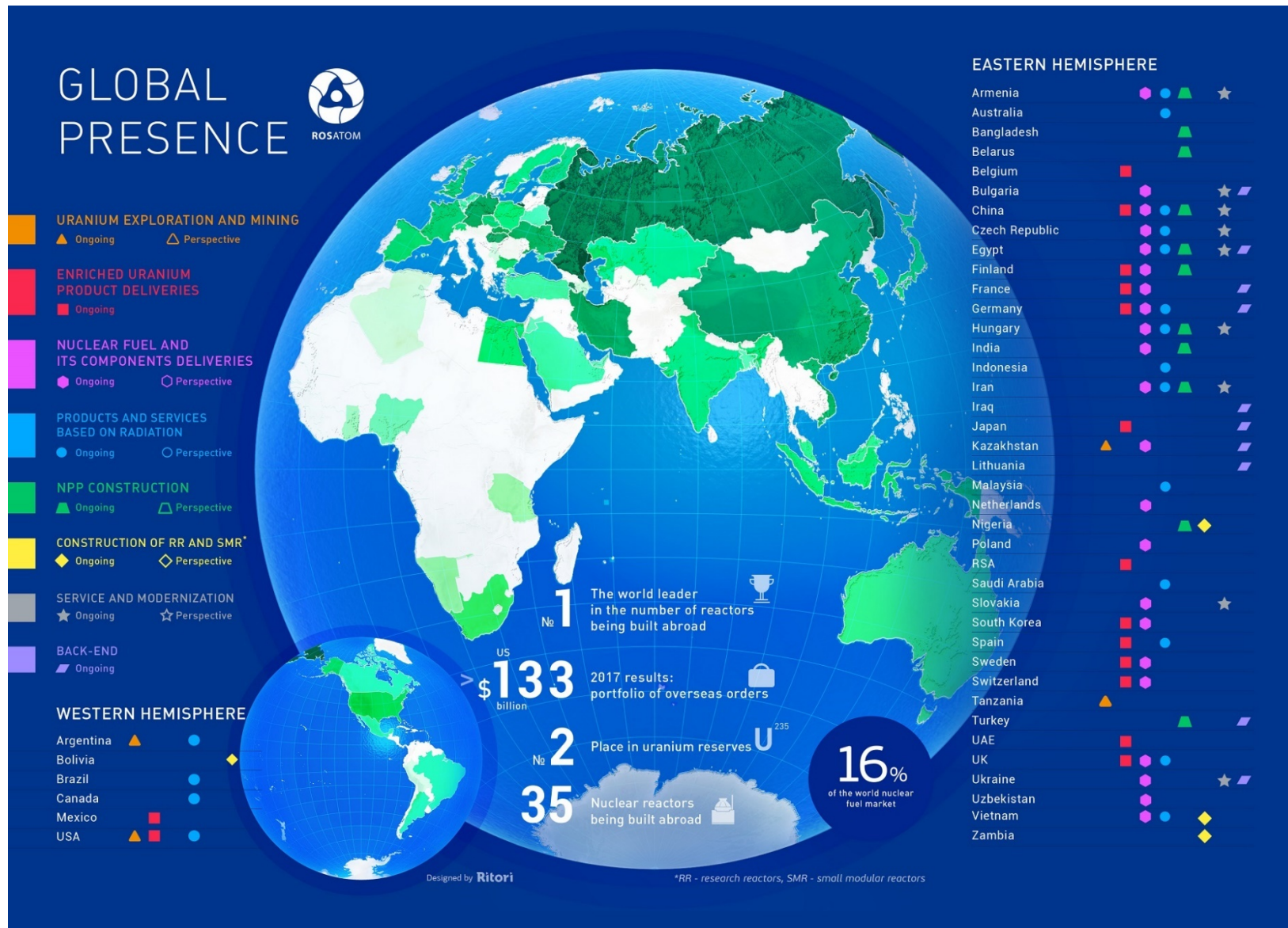
In 2018, Jordan disappeared from Rosatom's map of NPPs under construction abroad. One of the reasons for that country abandoning its NPP plans was the prospect of seeing the project's cost rise due to having to raise loan capital from private banks. It remains unclear why Rosatom was unable to secure Jordan a government credit to cover up to 90% of the project's cost, the way it happened in Bangladesh or India. In the case of Turkey, Rosatom's efforts to attract additional investment in its Akkuyu project have been failing despite continuing negotiations.

Rosatom has at least two NPP projects in European Union countries (where no active construction, it must be said, is under way), but the bulk of the corporation's activity is concentrated in developing countries whose economic indicators are not among the strongest. For instance, Egypt's credit ratings are far from attractive, but Russia plans to extend Egypt a \$25 bn credit for construction of four reactors in that country.

In the majority of cases, Rosatom's new foreign NPP projects become possible thanks to the cheap loans provided by Russia. Frequently, these credits extended by the Russian government cover amounts nearing the full cost of the project. In the conditions of a less than perfect economic situation in Russia itself, the government is forced to reach into the National Wealth Fund. Earlier, funding from this source was used to finance the deal in Finland, now a similar plan is under discussion for the deal with Egypt. The National Wealth Fund is part of the mechanism by which the Russian state maintains pension coverage for its citizens, and risky investments involving this fund may adversely affect the Russian pension system.

Attachment

Rosatom's infographic showing 35 reactors being built abroad:⁶²



⁶² Rosatom official website, <https://www.rosatom.ru/en/global-presence/international-relations/>; verified March 6, 2019.

Rosatom's infographic showing 36 reactors being built abroad:⁶³



⁶³Rosatom official website, <https://www.rosatom.ru/en/about-us/>; verified March 6, 2019.