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ROSATOM NEWS

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2022: The Year in Review

The year 2022 was quite a challenge, both for Rosatom and for the entire world. Despite the difficulties, the Russian nuclear corporation kept building nuclear power plants and other nuclear facilities, supplying nuclear fuel and equipment for mega science projects, developing the Northern Sea Route, constructing wind farms, and generating electricity. Here is our revision of last year's key events that have gone down in the history of the Russian and global nuclear industry.

Construction sites abroad

In 2022, first concrete was poured four times — for Xudabao 4 in China, Akkuyu 4 in Turkey, and El Dabaa Units 1 and 2 in Egypt. In addition, Rosatom obtained a construction license for Hungary's Paks II in August. In the same month, a pre-clinical cyclotron facility and a multi-purpose irradiation center were put into pilot operation at the nuclear research and technology center constructed by Rosatom in Bolivia.

Finland's Fennovoima Oy broke a construction contract for the Hanhikivi NPP and refused to accept the work done by the EPC contractor RAOS Project Oy (part of Rosatom). The Dispute Review Board, an independent expert body, ruled the termination by Fennovoima was wrongful and RAOS Project Oy had the right to seek damages for the breach of contract by Fennovoima Oy.

Construction sites in Russia

In Russia, Rosatom is building large and small nuclear power plants, and a research reactor. Construction works continue at Kursk II, which will feature two new power units with VVER-TOI reactors. The reactor pressure vessel was installed at Unit 1; construction of Russia's highest cooling tower was finished in the autumn of 2022. Earthworks began at the Leningrad and Smolensk nuclear power plants to prepare for the construction of another two units.

In China, hulls were laid down for two arctic floating power units with RITM-200 reactors for Baimsky GOK (a mining and processing facility at one of Russia's largest gold deposits). A total of four units with two RITM-200 reactors each will be built to supply electricity to the mineral deposit.

The Republic of Sakha (Yakutia) commissioned the development of an onshore small nuclear power plant with a RITM-200 reactor. A positive opinion on the project was obtained following an environmental impact assessment. Rosatom plans that an installation permit for the facility will be issued in early 2023.

The work continues to build a power unit with a BREST-OD-300 reactor. This unparalleled lead-cooled reactor will run on nitride fuel. In September, a support plate for the equalization of foundation loads was delivered to the site by the Northern Sea

Route. Comprehensive equipment tests are underway at the nuclear fuel fabrication/re-fabrication facility.

A multi-purpose fast-neutron research reactor MBIR is also under construction. In December, the reactor was placed into an auxiliary positioning mechanism. MBIR will be the heart of a new international research center for in-pile and post-irradiation studies, technology validation, heating and power production.

In 2022, the Russian nuclear power plants generated 223.371 billion kWh of electricity. This made it possible to save over 109 million tons of CO2-equivalent emissions.

NSR development

On November 22, 2022, the third Project 22220 icebreaker Ural hoisted the flag, while the fourth icebreaker of the same design, Yakutia, was put afloat. In December, Ural set off for its first convoy. Also in 2022, a new division — Northern Sea Route Chief Directorate — was established to take responsibility for issuing navigation permits, informing of ice conditions, and providing

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route guidance. Year-round navigation on the Northern Sea Route will begin in 2024. In 2022, cargo traffic on the NSR reached more than 34 million tons, down from nearly 35 million tons in the previous year but up from the estimate of 32 million tons.

Wind power

Rosatom completed construction and installation works at the 60 MW Berestovskaya Wind Farm. It is already connected to the power grid and planned to be put in operation in January 2023. Kuzminskaya and Trunovskaya Wind Farms are under construction (all the three are situated in the Stavropol Krai). Rosatom has obtained construction permits for another two wind farms (160 and 95 MW) in the same region. Total capacity of Rosatom's wind power plants will reach 1.7 GW by 2027. In July 2022, Rosatom signed a cooperation agreement with Vietnam's An Xuan Energy to carry out joint wind energy projects.

Science

Rosatom's Nuclear Energy Technology and Research Development in the Russian Federation program was extended from 2024 till 2030. The program provides for the construction of a tokamak on the basis of high-temperature superconductors and a molten-salt research reactor.

Rosatom continues to take part in international projects. In early November, a PF1 poloidal field coil manufactured with input from Rosatom for the ITER international nuclear fusion project was shipped to France. The coil will be used in the magnetic plasma confinement system.

The Joint Institute for Nuclear Research (JINR, an international organization) and Rosatom signed a contract for the development and production of a superconducting cyclotron MSC-230 for the nuclotron-based ion collider facility (NICA) in the JINR High Energy Physics Laboratory.

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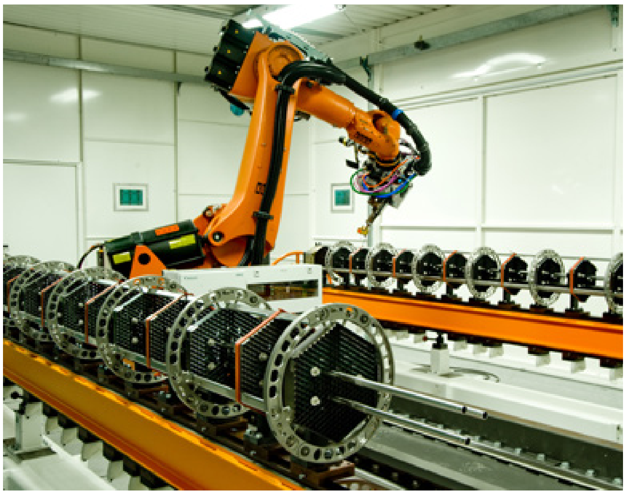


Nuclear Fuel: So New, So Different

Rosatom's TVEL Fuel Company puts great effort into developing new types of nuclear fuel. They are needed to improve cost efficiency of the existing nuclear stations and run new reactors. Researchers and engineers recapped their work in 2022 at the New Generation of NPP Fuel: Developments, Operating Practices and Prospects conference.

Assembled by robots

The headline of the conference was, perhaps, an announcement that TVEL would manufacture the first three TVS-5 fuel assemblies and load them into one of the reactors at the Novovoronezh NPP in 2023. What makes the new technology distinctive is a fully automated production that requires no human intervention. First, the technology will be tested to make sure that robots can manufacture fuel assemblies as well as humans do. If yes, a pilot production line will be launched in 2025 to manufacture TVS-5 assemblies containing a uranium-plutonium mix (this is the fuel mix for which the new technology was developed). Until then, robots will assemble less sophisticated fuel rods made of ordinary zirconium claddings and a uranium oxide fuel composition.

The fully automated line for the production of TVS-5 fuel assemblies will be built at the Siberian Chemical Plant in Seversk. The plant is gradually turning into a fuel hub for the closed nuclear fuel cycle as a fuel reprocessing unit and a fuel fabrication/re-fabrication unit for the BREST-OD-300 fast neutron reactor are built on the same site as part of the Proryv (Breakthrough) Project.

"The Kurchatov Institute studied several options of the uranium-plutonium mix for TVS-5, including three REMIX fuels differing in plutonium content, and one MOX fuel composition. In-pile tests on REMIX fuel began in 2021 as six pilot assemblies were loaded in the reactor of Balakovo Unit 1. This year [2022 — ed's note] we are working to make MOX fuel assemblies for the MIR reactor. This is how we will ensure maximum flexibility and stand-by for optimizing nuclear fuel cycles in response to customers' needs," Senior Vice President for Research and Development at TVEL Alexander Ugryumov explains.

Closing the nuclear fuel cycle

Rosatom is heading for a closed nuclear fuel cycle, which needs a special fuel. Uranium extracted from irradiated fuel assemblies is processed into fuel that has been used at Kola NPP Unit 1 and some units of the Smolensk, Kursk and Leningrad nuclear power plants since the 2000s. TVEL has confirmed the possibility and expediency of using reprocessed uranium in VVER-1000 reactors. **"We are working with RosEnergoAtom [Russian NPP operator] to extend its application to VVER-1000 and VVER-1200 reactors,"** Alexander Ugryumov said at the conference.

Konstantin Kurakin, Head of Fuel Cycles at the Kurchatov Institute, noted that fuel reprocessing could save up to 20% of natural uranium depending on the cycle length.

New materials for accident tolerant fuel

TVEL conducts tests on a number of fuel compositions and cladding materials to create accident tolerant fuel. Researchers study 42CrNiMo (chromium, nickel and molybdenum) alloy, chromium coatings for zirconium claddings, and silicon carbide claddings. Alexander Ugryumov considers this material to be the most promising although it is hard to produce.

TVEL develops two fuel compositions, uranium-molybdenum and uranium silicide, for its accident tolerant fuel. They have high thermal conductivity, thus posing lower risk

of fuel overheating and melting in loss-of-coolant accidents. Besides, they have a higher density and uranium content, which leads to a longer refueling interval. However, there are drawbacks, too. **"The uranium-molybdenum technology has been validated, and relevant solutions tested in a research reactor. Costs of this technology are higher, though, than that of making conventional ceramic fuel. This is what we will work on,"** Alexander Ugryumov pointed out.

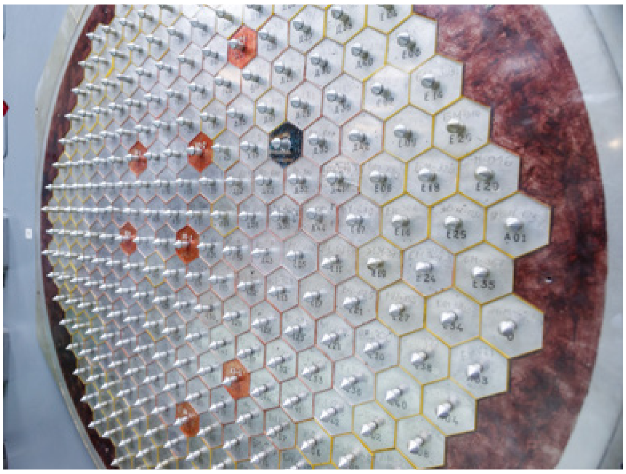
The next step in the study of silicon carbide claddings is to verify the possibility of using uranium-molybdenum and uranium disilicide fuels with this cladding material.

Precise geometry

Work is ongoing to develop MUPN fuel (MUPN stands for mixed uranium-plutonium nitrides). According to Mikhail Skupov, Deputy Director of the Russian Research Institute of Inorganic Materials (VNIINM, part of Rosatom), detailed design of the fuel assembly for the first loading of BREST-OD-300 was upgraded in 2021, and engineers are working to identify and mitigate burn-up decreasing factors. VNIINM has developed schematic designs of fuel rods for BN-1200 and BR-1200 reactors and made a number of fuel rod improvement proposals, such as making side recessions to decrease the volume of fuel pellets, fuel microalloying with aluminum nitride to increase shrinkage and decrease creep, and introducing a liquid-metal sublayer to increase burnup.

Minor actinides doomed

Curium, americium and neptunium are the most active elements in irradiated nuclear



fuel. It is planned that these elements will be extracted, curium will be placed in storage while americium and neptunium will be loaded into a fast reactor and burnt up there.

The concept of burning americium and neptunium in the lateral blanket of a fast neutron reactor has been already developed, says Alexander Tuzov, Director of the Research Institute of Atomic Reactors (RIAR). Fuel rods containing americium and neptunium oxides (the so-called minor actinide burning rods, MABRs) are made through remote vibration compaction. Experimental MABRs were loaded into the BOR-60 reactor core slots with different neutron spectra. The first post-irradiation analysis results have been obtained but irradiation continues. Engineers have also developed detailed designs of MABR assemblies.

Reliability of TVS-Kvadrat

One of the conference sessions was dedicated to nuclear fuel for foreign-designed light-water reactors. Its participants said that square fuel assemblies TVS-Kvadrat had passed qualification tests in the european-designed PWR-900 reactor. After post-irradiation analysis results were published by an independent research center, TVS-Kvadrat fuel assemblies have enjoyed commercial success in the global market. This is the world's only PWR nuclear fuel that is fully independent from the developers of the original reactor technology in terms of intellectual property rights and manufacturing processes and that has proved reliable and cost efficient.

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Lead-Bismuth: Natural Circulation

This article starts a new series titled Reactor Technologies. Throughout this year, we will tell you about new peculiar types of nuclear reactors developed by Rosatom researchers and engineers. We will begin with lead-bismuth fast neutron reactors. Known for quite a long time, the lead-bismuth technology was initially used in submarine reactors but now is applied by Russian engineers to develop different-capacity reactor designs.

Coolant specifics

Lead-bismuth eutectic has advantageous thermal properties. This alloy has a relatively low melting temperature of 123 °C (to compare, lead melts at 327 °C), so there is no need in creating heat-resistant structural materials. By contrast, its boiling temperature is high (1,670 °C), enabling it to obtain superheated steam at a relatively low pressure (high pressure in the primary coolant loop has to be taken into account in the design of pressurized water reactors, including VVER). The higher the steam temperature, the higher is the efficiency of a power plant. And, unlike sodium, lead-bismuth eutectic does not react with air or water, excluding the possibility of hydrogen-emitting explosions or fires.

Little bit of history

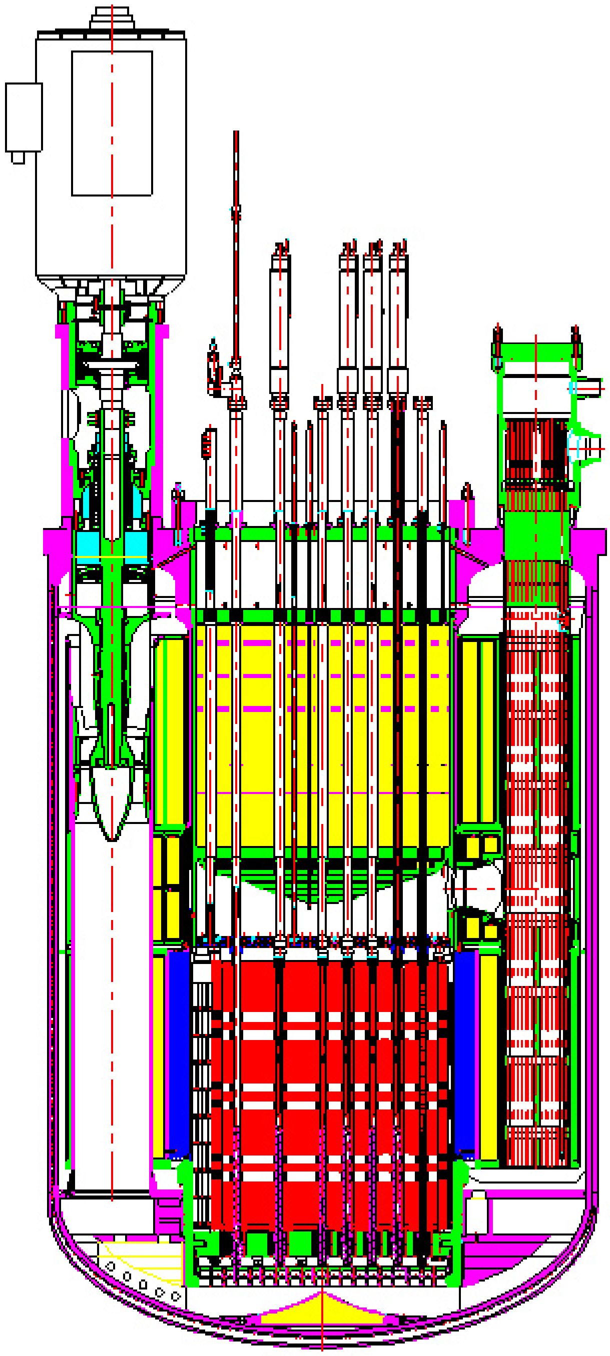
Initially, fast neutron reactors were intended to fabricate plutonium as nuclear fuel was meant to be renewable even at the dawn of the Soviet nuclear industry. The reason was mundane — there were no large uranium deposits discovered in the USSR at that time, and the country strove for a strategic goal of sufficient power generation. Lead-bismuth eutectic 'lost the competition' to sodium as a coolant for fast neutron reactors because plutonium was produced faster with sodium. However, lead-bismuth was not forgotten. Alexander Leipunsky, one of the fathers of the Soviet nuclear project and a chief researcher of the fast reactor development program, proposed to use the alloy in nuclear reactors for submarines.

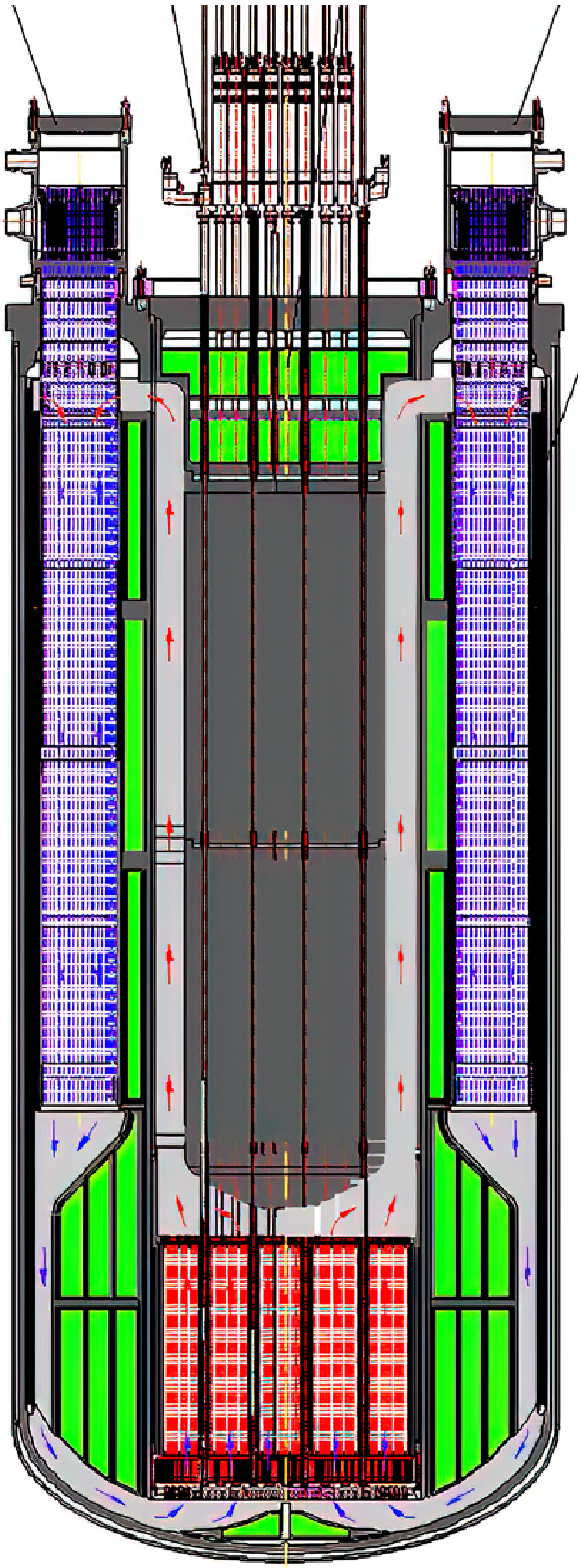
The idea was innovative, but the properties of lead-bismuth eutectic had not been studied thoroughly. Dozens of test facilities were built but research, design and construction of the nuclear submarine ran almost simultaneously due to urgency of the task. The lack of knowledge played its part: engineers had to study the reactor properties in the process of operation, fixing problems and adjusting production and operation manuals 'on the go.' As a result of those efforts, six nuclear submarines with lead-bismuth reactors had remained on duty with the Navy until 1996. Their total service life amounted to almost 80 reactor-years in different modes of operation, with advantages of the technology confirmed and initial design solutions validated.

Going onshore: SVBR-100

In the second half of the 1990s, a blueprint design was developed for a nuclear power plant consisting of two 1,600 MW units with 16 lead-bismuth fast neutron 100 MW reactors each. The work was later suspended and resumed in 2006 as engineers proceeded with the design of a pilot reactor. Soon Rosatom and Irkutsk-based utility IrkutskEnergo established a company, AKME Engineering, to carry out the project (currently under development).

The expected power capacity of the lead-bismuth fast reactor (abbreviated as SVBR in Russian) is 100 to 130 MW. The reactor can run on either uranium or uranium-plutonium, both oxide and nitride, fuel. SVBR-100 can also be loaded with fuel





assemblies containing up to several percentage points of minor actinides. The reactor is planned to be mounted in a sealed box, and all of its systems placed in a containment building with 1.5-meter walls.

Rosatom also develops two more lead-bismuth cooled reactors, SVET-M and SVGT-1, on its own.

SVET-M reactor

In Russian, SVET-M stands for a 'natural circulation lead-bismuth modular reactor.' This is an integral fast neutron reactor: its primary coolant systems are placed inside a single containment with no primary circuit pipes and fittings — they are simply not needed. Natural circulation of coolant is its primary distinction. That means that the reactor has no circulation pumps and coolant is driven by the difference in pressure in a hot reactor core and a relatively 'cold' steam generator. Since the temperature of lead-bismuth differs greatly in the hot and 'cold' sections of the circuit, this creates a higher pressure (as compared to other coolants) and allows for reducing the reactor height and saving on structural materials.

SVET-M is being developed in a number of designs ranging from 1 to 50 MW of electric power, the most elaborated of them being a 10 MW design. The temperature of steam exiting the reheater reaches 445 . High temperature increases efficiency of the reactor unit. Similar to SVBR-100, SVET-M can run on either uranium or uranium-plutonium, both oxide and nitride, fuel. SVET-M is developed at OKB Gidropress (part of Rosatom's engineering division AtomEnergoMash). Schematic design of the reactor was completed in 2022.

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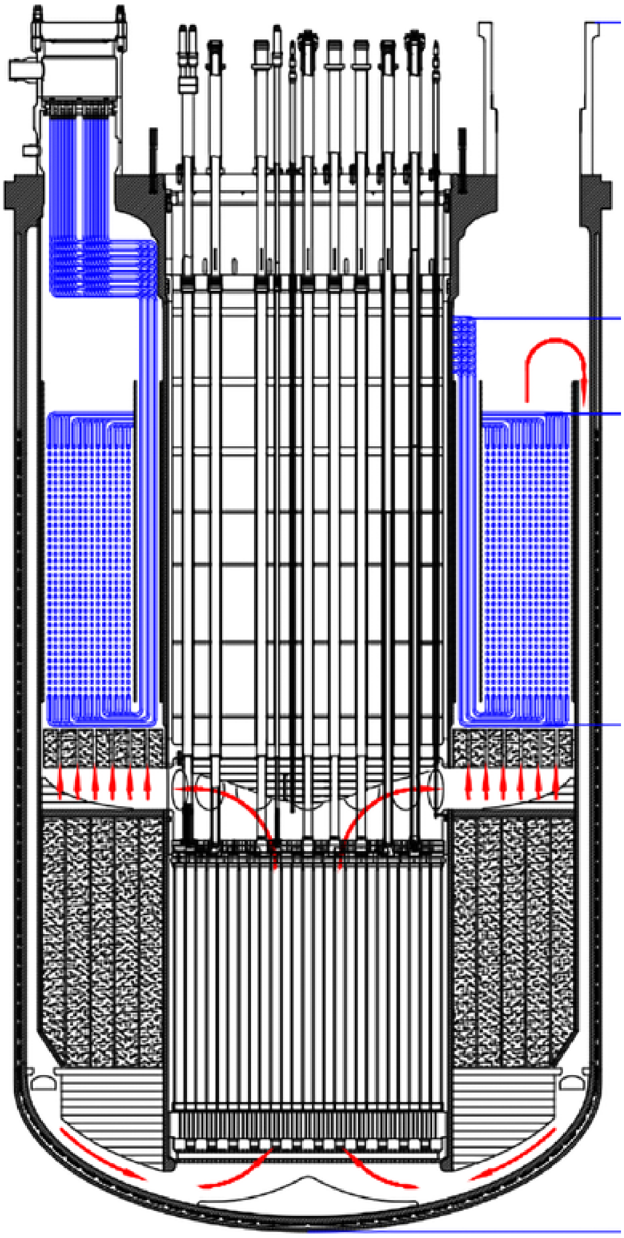
SVGT-1 reactor

SVGT-1 stands for a 'gas turbine lead-bismuth 1MWe reactor.' Developed at the Leipunsky Institute of Physics and Power Engineering (part of Rosatom's research division), it belongs to microreactors on the IAEA scale. It is a combination of a lead-bismuth reactor and a gas turbine plant, Anton Verbitsky, Head of the Fast Reactor Safety Assessment and Software Laboratory at Leipunsky Institute, explained in an interview for the Atominfo.ru web portal. Featuring a natural circulation design, SVGT-1 does not have pumps either. Currently, the reactor is at the preliminary stage of development. A plan has been prepared to proceed with engineering studies needed to develop a detailed design. If the plan is approved, engineers will begin working on the detailed design in three years. According to preliminary estimates, the entire design cycle will last seven to ten years.



All developers believe that lead-bismuth reactors have good prospects on the back of growing interest in small nuclear power plants and inherent safety of coolant circulation.

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Goal: Self-sufficiency

We wanted to begin our regular talk about the nuclear market trends, the first in 2023, with a review of the Red Book, a biennial publication produced by the OECD Nuclear Energy Agency jointly with the International Atomic Energy Agency (IAEA) and covering the global uranium market and resources. Although ready to come out, the publication was delayed. So, let us talk then about American and European attempts at making their nuclear fuel markets self-reliant.

Almost a year of waiting

For the anti-Russian sanctions imposed by the government of Canada, the Canadian uranium mining company Cameco could not receive its share of uranium produced at the Inkai mine in Kazakhstan almost until the end of the previous year (Cameco holds a 40% stake in Inkai LLP, a joint venture with Kazatomprom). The company reported supply disruptions in its press release about Q1 2023 performance. Before the sanctions were imposed, yellow cake shipments to Canada used to be dispatched from Saint Petersburg.

It was as late as September when the first batch of yellow cake was shipped to Canada, but this time via the Trans-Caspian International Transport Route, also known as the Middle Corridor, through Azerbaijan and Georgia. On December 20, Kazatomprom made an announcement, **"The cargo comprising both uranium owned by Kazatomprom and uranium owned by JV Inkai LLP finally arrived at a Canadian port."**

Cameco's press releases for the second and third quarters of 2022 warned that delays could affect equity earnings and dividend, as well as the share and timing of proceeds from Inkai.

In other words, actions of the Canadian government backfired on the company, which is also Canadian. While reporting Q3 2022 results, Kazatomprom pointed out, **"There are currently no restrictions associated with the product shipments to our customers worldwide."**

Finnish uranium from tailings

Finland's Terrafame announced plans to begin recovering uranium from tailings

of its nickel and zinc production at the Sotkamo mine. **"As the recovery begins, Terrafame will become a Finnish uranium producer, and thus will also play a role in building Europe's energy self-sufficiency,"** the company explains its move. Uranium recovery is assumed to begin no later than the summer of 2024 and reach full capacity of around 200 tons of uranium per year by 2026. To compare, Finland needs 421 tons of uranium annually after Olkiluoto 3 was put in operation, while all european nuclear stations together consume about 49,000 tons of uranium per year, according to WNA.

This is Terrafame's second attempt at setting up uranium production. The first attempt was made back in 2011. In February 2011, the Sotkamo mine operator, Talvivaara Mining Company Plc, signed an agreement with Cameco to finance a uranium recovery plant with an annual capacity of 350 tons of uranium. Cameco planned its investments would pay off with uranium. The second agreement provided for the terms of shipments until the end of 2027.

According to the 2012 annual report, the Canadian company invested CAD 40 million in the project, which actually did not go smoothly. There were at least four leaks from the tailings pond (gypsum sediment pond) at Sotkamo in 2012–2013. The wastes contaminated nearby lakes, with the concentration of uranium in lower and medium water layers exceeding drinking water limits six times. The environmental impact sent shockwaves through the public and resulted in Talvivaara's bankruptcy. Its founder and CEO Pekka Perä was fined half a million euros, and the project was closed. Cameco announced in its 2013 annual report that it had written off CAD 70 million of its investments in Talvivaara.

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Terrafame became the successor of Talvivaara. In October 2017, the company filed for a uranium production license with the Finnish watchdog STUK and obtained it in February 2020. Re-launching uranium recovery operations requires EUR 20 million. After the plant reaches full capacity, the company plans to earn around EUR 25 million per annum.

What makes the recovery project really challenging is that uranium, which is present there in extremely low concentrations, needs to be separated from zinc and nickel inevitably remaining in the tailings. According to the Geological Survey of Finland, uranium content in Sotkamo's black shales is 0.001% to 0.004%. To compare, Inkai ores contain 0.04% of uranium, which is at least ten times higher.

Therefore, Terrafame's business project is of local significance only. The recovery of uranium will account for **"a few percent of Terrafame's estimated net sales in the coming years,"** the company says. It is quite likely that the new operations will change the structure of uranium supplies for the Finnish nuclear stations but they will hardly increase the uranium self-sufficiency of the European market. The company can call itself 'Europe's largest uranium producer' for the only reason that there are no other uranium mining operations in the region.

Backing American uranium

The US uranium mining industry has been in tatters for the last few years. **"US uranium mines produced 21,000 pounds of triuranium octoxide (U_3O_8), or uranium concentrate in 2021. Production data was withheld in 2020 but 2021 production was down 88% from 2019 production levels,"** says the 2021 Domestic Uranium Production Report published by the US Energy Information Administration (EIA). For nine months of 2022, the United States produced 19,233 pounds of U_3O_8. It should be noted, though, that EIA accounted for only the first two quarters in its interim estimates (see the screenshot below), so the resulting amount is lower.

TOTAL PRODUCTION OF URANIUM CONCENTRATE IN THE UNITED STATES, pounds U_3O_8

Quarter /year	2019	2020	2021	2022
1st quarter	58,481	8,098	W	9,946
2nd quarter	44,569	W	W	6,042
3rd quarter	32,211	W	5,297	3,245
4th quarter	38,614	W	9,978	—
Calendar year total	**173,875**	**W**	**20,633**	**15,988**

Source: *U.S. Energy Information Administration, Domestic Uranium Production Report - Quarterly*

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In the US, three mines were producing uranium in the first nine months of 2022. These are Nichols Ranch ISR Project (101 pounds), Ross CPP (367 pounds), and Smith Ranch-Highland Operation (2,777 pounds). It is evident that only the last of the three mines operates on a commercial scale.

In late June 2022, the National Nuclear Security Administration, a US Department of Energy agency, issued a solicitation to purchase up to one million pounds of U_3O_8 for the strategic reserve. The US Congress allocated USD 75 million for this purpose back in 2020.

Individual awards will range from 100,000 to 500,000 pounds of U_3O_8. It can be supplied by a vendor that has produced uranium at a domestic recovery facility at any time since January 1, 2009. Interestingly, the uranium to be procured must be from inventory already in storage at the Honeywell Metropolis Works uranium conversion facility in Illinois.

Based on the proposals received, five companies were selected, including Energy Fuels Inc., Strata Energy Inc. (a subsidiary of Peninsula Energy Limited), enCore Energy, Ur Energy, and Uranium Energy Corp. The purchase price ranged from little less than USD 60 to little more than USD 70 per pound. In 2021, the weighted average price was USD 33.91 per pound of U_3O_8, according to the 2021 Uranium Marketing Annual Report. In 2022, both the spot and long-term prices hovered around USD 50 per pound.

One million pounds of U_3O_8 is equivalent to about 385 tons of uranium. For reference, the US-based nuclear stations need 17,587 tons of uranium per year, as estimated by WNA. In 2021, according to the 2021 Uranium

Marketing Annual Report, **"owners and operators of U.S. civilian nuclear power reactors purchased a total of 46.7 million pounds U_3O_8e (equivalent) of deliveries from US suppliers and foreign suppliers during 2021."** Since 46.7 million pounds make nearly 17,963 tons of uranium, one million pounds that NNSA intends to procure can hardly be called a reserve because it covers a little more than 2% of the US annual demand. Truly strategic reserves are made by consumers themselves. **"Total US commercial inventories were 141.7 million pounds U_3O_8e at the end of 2021, up 8% from 131 million pounds at the end of 2020,"** says the 2021 Uranium Marketing Annual Report.

The government-funded procurement will give uranium companies a chance to earn some money, although it is not quite correct to call them 'uranium.' For example, Energy Fuel Inc. last sold uranium in 2019 for USD 66,000, while its primary source of income in 2019–2021 was 'alternate feed materials processing and other.' Its sales amounted to USD 3.18 million in 2021 and only USD 1.66 million in the COVID-affected 2020. The company survived by selling assets in 2021 to pay its debt. Its general and administrative expenses alone came in at about USD 14–15 million per annum in 2019–2021. The company hopes to cash in USD 18.5 million by selling uranium to the strategic reserve.

It is not difficult to compare the data and figure out the true position of the company. No more difficult is to understand that dependence on exports will persist. **"The vast majority of uranium delivered in 2021 was of foreign-origin with Kazakhstan the top source at 35% of total deliveries. Canadian-origin material accounted for the second-most material at 14.8% of total and Australia third with 14.4% of total deliveries,"** says the 2021 Uranium Marketing Annual Report. In 2021, Russia was the fourth in that list with a 13.5% share. Russian prices are the best for consumers as they are almost twice as low as those of the US producers and 1.5 times lower than the market average.

Looking for a new British fuel

The British government made it clear that it would establish a Nuclear Fuel Fund **"to encourage investment in new and robust fuel production capabilities in the UK, to reduce reliance on civil nuclear and related goods from Russia."**

The mere reading of the press release and the Nuclear Fuel Fund Application Guidance shows there is nothing behind the declaration to 'reduce reliance' on Russian goods. Moreover, the Application Guidance directly says the opposite, that the nuclear reactors in the UK have everything they need to operate properly: **"Nearly all the UK's historic and existing nuclear reactors have been fueled using a UK-led supply chain for uranium enrichment and fuel fabrication.**

This has led to a domestic capability spanning nuclear fuel research and development (R&D) through to modern, well- invested commercial-scale enrichment and fabrication facilities, all of which are underpinned by a highly skilled workforce."

The thing is the UK wants to build new reactors (24 GW of new capacity by 2050) and needs fuel for them. This is said clearly in the introduction to the Application Guidance: **"However, whilst the domestic fleet has to date consisted of mostly a single reactor technology — Magnox and Advanced Gas-cooled Reactors (AGRs) are both gas-cooled reactors — the future UK fleet is expected to be made up of a variety of reactor technologies spanning other types of Gigawatt (GWe) reactors, Small Modular Reactors (SMR) and Advanced Modular Reactors (AMR), many of which require new and advanced fuel types. It is therefore likely that in future the UK supply chain will need to meet demand for a range of different fuel types."** Russia is not mentioned in the Application Guidance at all.

The Nuclear Fuel Fund will invest up to GBP 75 million, but GBP 13 million out of this amount has been invested to expand uranium conversion capacity at the Springfields nuclear fuel manufacturing site. GBP 50 million will be spent on new projects. The remaining GBP 12 million has not been earmarked yet.

The conclusion is rather straightforward: a fundamental property of the global natural uranium market is that uranium is produced and consumed in different regions. The geopolitical shift that shaped the world in 2022 caused concerns about the integrity of supply chains. In reality, only one such chain was broken and affected the fuel market. The Western media landscape propped by state declarations and corporate press releases is awash with ideas of self-sufficiency in nuclear fuel, but it is impossible in the USA or Europe either now or in the next five years at least.

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