



EURATOM Supply Agency

Nuclear Fuel Market Observatory Sector

● Quarterly Uranium Market Report 4th Quarter 2019

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International and EU developments

International Atomic Energy Agency (IAEA) held in October International Conference on Climate Change and the Role of Nuclear Power. The conference underlined the importance of the nuclear energy - forming baseload low-carbon electricity- to achieve climate change and sustainable development. Common forum is however needed for discussion between nuclear and renewable energy proponents on how to work together towards a common target of climate change, and to ensure integration of both within one system.

The important role of nuclear energy in Europe - generating 50% of low-carbon electricity there- on the way to decarbonisation was stressed at the New Nuclear Watch Institute forum organised beginning of November. The event “Nuclear energy as part of Europe’s energy mix” discussed the prospects of nuclear power in the long term up to 2050, noting the major role that long-term operations play, and, new-builds. Seamless continuation of nuclear energy in the fight against climate change however necessitates the assessment of alleged rising costs and, the schedules.

Ahead of UN Climate Change Conference COP25 in December, the European Parliament endorsed a position confirming that it “believes that nuclear energy can play a role in meeting climate objectives because it does not emit greenhouse gases, and can also ensure a significant share of electricity production in Europe; considers nevertheless that, because of the waste it produces, this energy requires a medium- and long-term strategy that takes into account technological advances (laser, fusion, etc.) aimed at improving the sustainability of the entire sector.”

In December the European Council recognised the nuclear power to play a role in the European Green deal, acknowledging “the need to ensure energy security and to respect the right of the Member States to decide on their energy mix and to choose the most appropriate technologies. Some Member States have indicated that they use nuclear energy as part of their national energy mix.”

Furthermore, in December the European Parliament and the Council agreed on the so-called “taxonomy regulation” - criteria to determine whether an economic activity is environmentally sustainable. According to the European Parliament “the text does not preclude or blacklist any specific technologies or sectors from green activities, apart from solid fossil fuels, such as coal or lignite. Gas, and nuclear energy production are not explicitly excluded from the regulation, however. These activities can potentially be labelled as an enabling or transitional activity in full respect of the “do not significant harm” principle.”

IAEA’s Low enriched uranium (LEU) bank in Kazakhstan started operation in October 2019 when it received the first shipment of LEU from Orano Cycle (France). In December it subsequently received another shipment of LEU from Kazatoprom (Kazakhstan) which filled up the capacity of the bank, totalling 90mt of LEU. The bank provides assurance to nuclear reactor operators in case of exceptional disruption of supplies of LEU. According to IAEA, its establishment and operation are funded by voluntary contributions from IAEA Member States and other donors totalling US \$150 million - sufficient to cover estimated costs for 20 years of operation.

Developments in the Member States

BELGIUM:

Support for nuclear energy in Belgium rises, according to the survey performed for the Belgian Nuclear Forum in 2019. 46% of the respondents would like to keep nuclear energy a part of the electricity mix even after 2025, the foreseen Belgian nuclear phase-out. This is a significant change compared to the results of the same survey conducted in 2017, when only 30% of respondents were in favour.

In November Belgian Tractebel and Spanish Empresarios Agrupados signed the first contract worth €7.6 million for the design of buildings and utilities for Myrhha research facility at the Belgian Centre for Nuclear Research SCK-CEN. Myrhha - Multi-purpose hYbrid Research Reactor for High-tech Applications is the world’s first prototype of a subcritical lead-bismuth cooled reactor driven by a particle accelerator.

BULGARIA:

Kozloduy NPP unit 6 operational license extended for another 10 years. The unit followed the unit 5 (both VVER-1000), the license of which was extended for a 10-year period in 2017. The units are now authorised to run until 2029 and 2027 respectively.

CZECHIA:

Czechia needs more reactors in longer term, according to the Minister of Industry and Trade of the Czech Republic, Karel Havlicek. Based on the data in the Mid-term Adequacy Forecast report published in October by the transmission system operator CEPS, due to the phase out of certain power sources (coal) the Czech Republic risks to become dependent on electricity imports by 2030. Therefore the discussion about new nuclear sources, additional to the already known plans for Dukovany NPP extension are to be envisaged in next five years.

ESTONIA:

Estonia explores small modular reactor (SMR) possibility. GE Hitachi Nuclear Energy and Fermi Energia of Estonia signed a Memorandum of Understanding to cooperate on potential deployment of SMR in Estonia. The SMR considered will be BWRX-300 reactor of Hitachi.

FINLAND:

Finnish Fortum Oyj is acquiring a majority share of German Uniper SE. Fortum signed an agreement to buy a 20.5% stake in Uniper for €2.3 billion, giving it majority ownership. Uniper spun off from E.ON SE in 2016, it runs conventional and nuclear power plants in Germany, Sweden, and UK. The transaction is subject to regulatory approvals in Russia and US, expected in the first quarter of 2020.

Manufacturing of main components of Hanhikivi-1 NPP started in October when GE Steam Power begun manufacturing the turbine generator for the unit. Forging of the generator rotor is being done at Japan Steel Works Ltd facilities in Japan. Hanhikivi-1 is a VVER-1200 reactor of Russian design, to be built on the Hanhikivi Peninsula.

FRANCE:

Fuel loading at Flamanville-3 is delayed until the end of 2022, due to the weld repairs, delaying operation until early 2023. The repairs required by French regulator ASN last summer will add €1.5billion to the cost of the construction, coming to the current total of €12.4 billion.

Électricité de France (EDF) estimates €46 billion for six new EPRs to be built in France over next fifteen years. It was reported in November by French newspaper Le Monde, stating that the cost estimate was presented to EDF's board at the end of July. Each reactor could cost €7.5 billion to €7.8 billion. The amounts include €400 million per reactor for dismantling.

EDF and Framatome are developing an optimized EPR to be competitive with natural gas. According to different press sources EDF and Framatome want to improve the EPR design and construction methods to achieve \$77 per MWh over the reactor's 60-year lifespan (2016 prices) reaching the price level of gas, with the additional advantages of energy independence and low-carbon power production.

Framatome announced in December that it signed a cooperation agreement with French Atomic Energy Commission (CEA) and Japanese organizations Japan Atomic Energy Agency (JAEA), Mitsubishi Heavy Industries (MHI), and Mitsubishi FBR Systems Inc. (MFBR) on the development of fast neutron reactors. This agreement follows the successful cooperation of the parties on the Advanced Sodium Technological Reactor for Industrial Demonstration (ASTRID) program.

In December EDF unveiled a plan called "excell" that "will drive the nuclear industry to achieve the highest standards of craftsmanship, quality and excellence". The plan focuses on three major objectives: 1) enhancement of manufacturing quality; 2) boosting skills; and 3) tighter governance of nuclear projects. The plan reserves €100 million for 2020-2021.

POLAND:

In November, "Poland's energy policy until 2040 - strategy for the development of the fuel and energy sector" (PEP2040) was updated. The draft document taking into account feedback from social consultation assumes,

amongst others 50%-60% share of coal in electricity generation in 2030 (down from 80% today); 21%-23% renewable energy in final gross energy consumption in 2033 and implementation of nuclear energy in 2033.

The Polish government seeks to secure funds (\$60 billion) to finance the construction of its six reactors and is looking for an investor to buy 49% in the company that will operate them. Financing is expected to be agreed next year for the first reactor, which is expected to be completed in 2033.

ROMANIA:

Memorandum of Understanding Concerning Strategic Civil Nuclear Cooperation (NCMOU) was signed in September between the U.S. and Romania. The memorandum aims to develop Romania's civil nuclear program and supports the energy security goals of both countries.

SLOVAKIA:

Mochovce 3 NPP Pre-Operational Safety Review Team (Pre-OSART) mission was completed in December. According to IAEA "the team of experts observed a commitment to safety by the operator and identified a few good performances to be globally shared with the nuclear industry, including implementation of a novel safety system to cool the reactor even when shutdown; an online tool to support event classification and prognosis, in case of emergencies; and an effective way of communicating with external organizations and interested parties to improve the awareness of nuclear power." Following the Pre-OSART mission completion Slovenské elektrárne proceeded to the repeated Unit 3 heating, results of which were to be available in January 2020.

SPAIN:

In December it was reported that the Administrative Litigation Court of Salamanca in Spain issued a suspension order for the judicial procedure of the Urbanism License (UL) for Salamanca uranium mine of Berkeley Energia Ltd. As a consequence Berkeley's plans for the Salamanca project are hampered. Berkeley filed an appeal at the Retortillo municipality City Council.

SWEDEN:

In order to maintain and secure technical expertise for its nuclear power plants, Swedish Uniper, Fortum and Vattenfall along with Finnish TVO decided to launch a joint trainee program. Scheduled to start in 2020, the aim of the 15-month programme is to attract 15 university engineers or technicians to undergo a training in Swedish and Finnish NPPs.

Swedish uranium mine Ranstad was released from regulatory oversight. The mine was used for uranium mining in 1965-1969, and was closed due to profitability reasons. It was decommissioned and remediated by the Ranstad Industriecentrum AB.

Swedish support for nuclear energy grows. According to recent polls by Novus published in October, 43% of respondents are open to new builds and 35% would like to continue exploiting the existing fleet until the end of its lifetime. Together it brings 78% support to nuclear energy, up from 71% in 2017. The percentage of opponents fell down to 11%, in contrast of usual 20% in previous years.

UNITED KINGDOM:

In October, UK government introduced Environment Bill. Calling it "a historic step change in the way we protect and enhance our precious natural environment" the Bill sets the vision and principles to be anchored in law to improve air and water quality, fight plastic pollution, restore habitats for plants and wildlife. A new independent Office for Environmental Protection will be established to cover all climate change legislation and "hold the government to account on its commitment to reach net zero emissions by 2050."

EU agreed to Brexit deadline of 31 January 2020. In October EU leaders reached an agreement to give the UK time until 31 January 2020 to exit the EU.

Plutonium oxide samples from Sellafield were sent to Melox for research. In Orano's Melox the samples will be examined whether the plutonium could be used in the production of MOX fuel in order to recycle the plutonium stockpiled at Sellafield.

... and worldwide

AUSTRALIA:

Australians` growing public support for nuclear energy has come apparent in October from the survey conducted by Roy Morgan company. The support for nuclear is at 51% (up from 16% in 2011) if nuclear was to be developed to reduce CO2 emissions, and at 45% (up from 11% in 2011) if only to supply Australians the electricity (without CO2 emissions reduction mentioned).

Another survey conducted in October by JWS Research company shows 40% of Australians supporting lifting the ban and 39% supporting the use of nuclear power in Australia. An interesting fact from the survey is, that 54% of respondents were unaware of a nuclear ban in Australia.

INDIA:

Kazakhstan will again supply India with uranium in 2020-2024. Already in agreement that ended in 2019 and securing 10 000t U₃O₈, India was to renew agreement with Kazakhstan for the import of Kazakh uranium in the period 2020 to 2024.

JAPAN:

In November the Nuclear Regulatory Authority approved the application of Tohoku Electric Power Co. to restart Unit 2 of the Onagawa NPP. The reactor was damaged during the earthquake and tsunami in March 2011 and is to still undergo a series of safety “anti-disaster” improvements. The reactor is not expected to start operation before April 2020.

RUSSIA:

Rosatom signed further agreements with African countries to develop nuclear science and technologies. Russia's state-owned nuclear power company Rosatom is already in negotiations with several African countries concerning nuclear power projects, and additional agreements were signed in October in Russia-Africa Summit. Rosatom proposes to develop complete nuclear industry, including research reactors, scientific centres and assistance in nuclear medicine.

Floating NPP Akademik Lomonosov started electricity generation in December, according to Rosatom. The NPP located in Pevek, Chukotka, was connected to the grid after approval of the regulatory authority Rostekhnadzor.

Technical documentation e-shop was officially launched by Rosenergoatom on its website in December. It will “enable any nuclear power operator in the world find the necessary regulatory and technical documentation on running a Russian-designed nuclear power plant in a single database and order these documents online”.

SOUTH-AFRICA:

In October, the South African 2019 Integrated Resource Plan (IRP), was published. IRP outlines amongst others the plans for nuclear development in the country to, and beyond 2030. It is foreseen to extend the lifetime of the NPP Koeberg to 2044 and the plans are to extend the nuclear programme with the small modular reactors.

SWITZERLAND:

On 20 December 2019 Swiss utility BKW permanently shut down the Mühleberg nuclear power plant after 47 years of operation. The company informed it would start dismantling and decommissioning works on January 6, 2020, lasting approx. 15 years to finish in 2034.

UKRAINE:

In December, Ukraine's Energoatom informed that Unit 5 at the Zaporozhye NPP was fully loaded with Westinghouse fuel. Other units will gradually follow over the coming years. Using different fuel supply sources Ukraine wants to ensure better energy security, reducing dependence on Russia.

USA:

Westinghouse Electric Co. announced in September that it came to an agreement with Rolls-Royce to buy its North America Civil Nuclear Systems and Services business.

The U.S. withdrawal from the Paris Agreement officially started in November when the U.S. submitted formal notification to the United Nations. The withdrawal will take effect one year from the delivery of the notification.

Centrus Energy Corp. signed a three year contract to demonstrate high-assay, low-enriched uranium (HALEU) production, in November. The company has signed a three-year contract with the U.S. Department of Energy to deploy a cascade of centrifuges to demonstrate production of HALEU fuel for advanced reactors. According to Centrus, “work under the contract will include licensing, constructing, assembling and operating AC100M centrifuge machines and related infrastructure in a cascade formation to produce HALEU at the American Centrifuge Plant in Piketon, Ohio, for the demonstration program.”

NuScale Power is designing two microreactors. Steve Mirsky from NuScale mentioned it at the American Nuclear Society winter meeting in November. Two microreactor designs are being developed: 10 to 50 MW micro NuScale power module and a smaller 1 to 10 MW heat pipe reactor. Microreactors were demanded by the US Department of Defence and Department of Energy.

NuScale`s SMR design advanced to phase 5 and 6 of the design certification application review in December when the U.S. Nuclear Regulatory Commission completed the phase four. Final safety evaluation report is expected in September 2020.

Uranium production

COMINAK uranium mine in Niger will shut down in March 2021. Orano and other COMINAK`s shareholders came to the decision due to the mine`s reserve depletion, high operating costs and the sharp drop in uranium prices.

Ukraine plans to increase uranium production in 2020. Ukraine earmarked in its draft budget for 2020 approx. \$5.8 million to support its domestic uranium production. The aim is to reduce Ukraine`s energy dependency on foreign uranium suppliers.

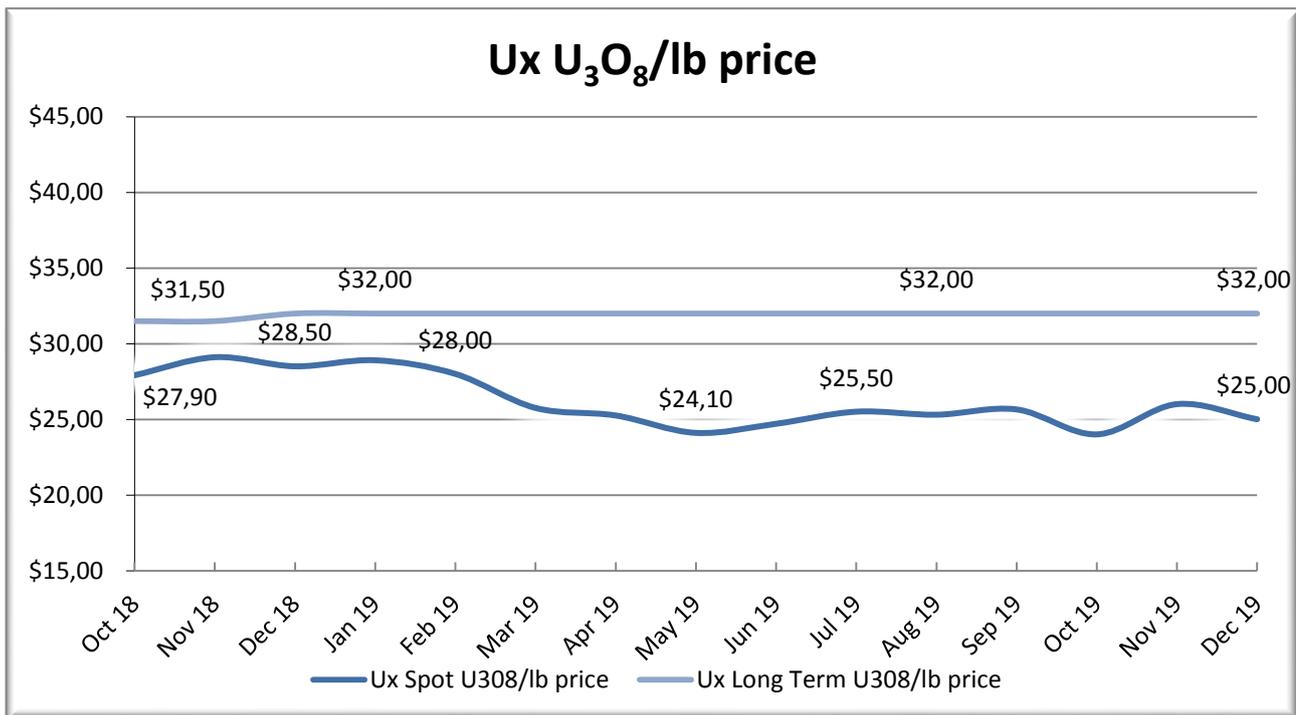
A new mine will be exploited in Kanampalli, India. A mine planned in Andhra Pradesh district in the vicinity of other uranium mines will be the biggest in India. Uranium Corporation of India Ltd expects to reach full scale production in seven years.

Orano established a uranium joint venture company with Uzbekistan. Created in December, the joint venture called Nurlikum Mining LLC (51% Orano, 49% Uzbekistan`s State Committee on Geological and Mineral Resources) starts uranium exploration and mining in 2020.

Uranium prices¹

In the fourth quarter of 2019, the UX monthly spot uranium price decreased by more than 2% comparing quarter to quarter and, at the end of December, it accounted for USD 25.00/lb U₃O₈. It was down by more than 12% compared to the fourth quarter of 2018.

The UX long term uranium price for the fourth quarter of 2019 accounted for USD 32.00/lb U₃O₈ at the end of December which means no change when compared quarter to quarter and in an annual comparison.

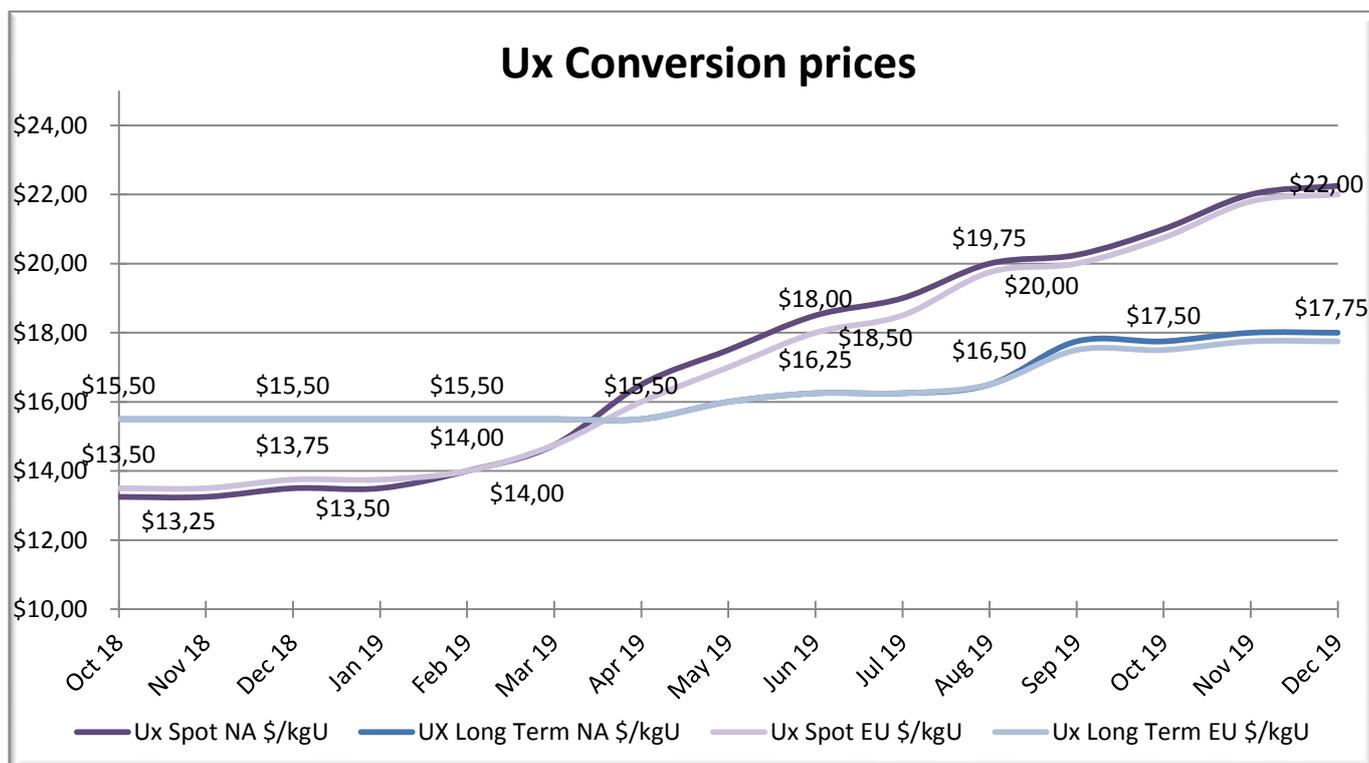


¹ The market price information in the following chapters: Uranium prices, Conversion and Enrichment is provided with permission of the Ux Consulting Company, LLC (UxC) www.uxc.com. UxC does not bear any legal liability for the use of these data

Conversion

In the fourth quarter of 2019, UX spot conversion prices in the European Union and in North America increased by 10% compared to the previous quarter and amounted to USD 22.00/kg in the EU and USD 22.25/kg in North America at the end of December. In an annual comparison, they increased by 60% and 65%, respectively.

UX long term conversion prices amounted to USD 17.75/kg in the EU and USD 18.00/kg in North America, which was 1% up, when compared to the previous quarter. They increased by 15% and 16% respectively in an annual comparison.

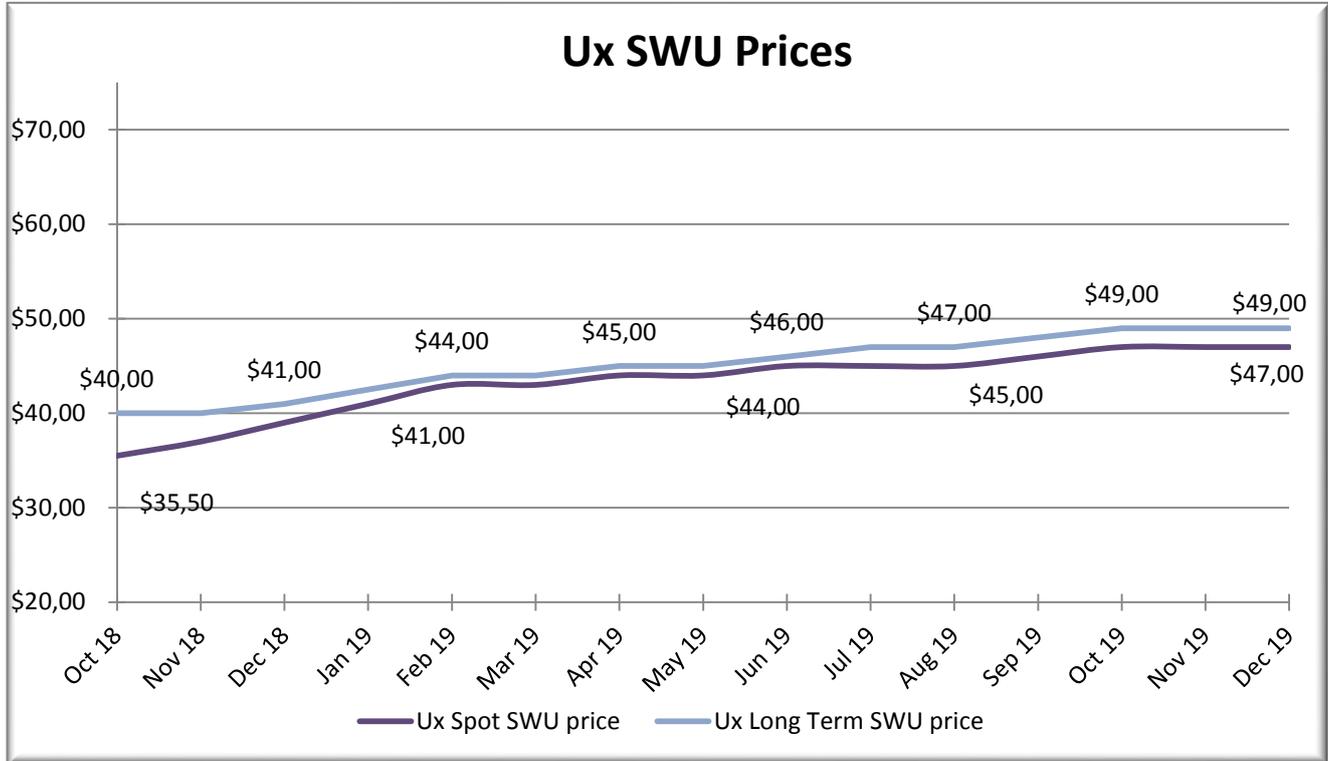


Electrochemical Plant JSC buys depleted uranium defluorination facility from Orano. The €40 million contract was signed in December, under which Orano will deliver its second facility to the company (first one was commissioned in 2009). The start of operation is expected in 2022.

Enrichment

At the end of December 2019, the UX spot SWU price amounted to USD 47.00 per SWU and it increased by more than 4% compared to the previous quarter. It was up 20% in an annual comparison.

The UX long term SWU price amounted to USD 49.00 and it was up by more 2% compared to the previous quarter and increased by 20% compared to the fourth quarter of 2018.



According to media, URENCO sent a train carrying 600 tonnes of depleted UF6 from its Gronau facility for re-enrichment in Russia. Subsequently the material should be sent back to URENCO. Approximately 30 000 tonnes of depleted UF6 have been shipped to Russia from Gronau since the mid-1990s.

Electrochemical Plant JSC informed in October that works were completed on its new generation 9+ gas centrifuges. It is a part of the modernization of the facility which also received a 30-year life extension, now licensed to operate until 2048.

Fuel fabrication

ESA concluded contract of nuclear fuel supply between Kozloduy NPP and TVEL, in December. The contract guarantees fuel reloads until 2025. At the same time the Bulgarian Ministry of Energy and the Utility committed to step-up fuel diversification efforts.

Nuclear medicine

SHINE Medical Technologies LLC closed a \$50 million financing with Oaktree Capital Management LP, “to support execution of construction and commercialization plans”, the company announced in October. “The financing supports the ongoing construction of SHINE’s medical isotope production facility and its commercialization of diagnostic and therapeutic isotopes, including molybdenum-99 (Mo-99) and lutetium-177 (Lu-177).”

The company informed “the establishment of the division enhances the company’s ability to focus on filling critical future needs in the rapidly growing therapeutic isotope market, while continuing to leverage its radioisotope production expertise.”

The company reported also “the U.S. Nuclear Regulatory Commission (NRC) has accepted SHINE’s Operating License Application to operate its medical isotope production facility in Janesville, Wisconsin”.

Dual supply of medical isotope iodine-125 collaboration was announced by McMaster University’s Nuclear Reactor in Canada and NRG from Netherlands. According to the McMaster University “with one of the three major suppliers ceasing its production of I-125, and the subsequent shutdown of another research reactor, we recognised that, together, we could address the shortage crisis and ensure a steady supply of this life-saving treatment”.

OECD/NEA published medical radioisotopes supply report in November. The report “The Supply of Medical Radioisotopes: An Economic Diagnosis and Possible Solutions” describes the situation in the medical radioisotope supply chain and analyses challenges in the provision of technetium-99m and nuclear medicine.

Isotek Systems, TerraPower and the US Department of Energy signed a public-private partnership agreement to use material recovered from a legacy uranium-233 (U-233) inventory at Oak Ridge. Isotek is responsible for the removal of the U-233 and extraction of thorium-229. TerraPower will then use it for the production of Ac-225. This arrangement will give TerraPower the capacity to produce 100 times more cancer treatment doses per year of Ac-225 than the 4 000 doses currently available, the partners said.

Concluded natural uranium contracts in the EU²

Quarter	ESA quarterly spot uranium price EUR/kgU	ESA quarterly spot uranium price USD/lb U ₃ O ₈	ESA All Users quarterly spot uranium price EUR/kgU*	ESA All Users quarterly spot uranium price USD/lb U ₃ O ₈ *	Number of spot natural uranium contracts concluded by EU utilities**	Number of spot natural uranium contracts concluded by all parties**	Total number of contracts processed by ESA***
2018 Q4	62.39	27.39	55.35	24.30	8	18	75
2019 Q1	-	-	65.33	28.54	8	10	87
2019 Q2	-	-	-	-	2	3	55
2019 Q3	-	-	60.73	25.98	3	8	86
2019 Q4	-	-	-	-	4	7	84

* prices converted with use of ECB reference exchange rate (www.ecb.europa.eu)

** including purchases, sales, exchanges and loans

*** including contracts, amendments and notifications on the front-end activities

List of common abbreviations:

ESA	Euratom Supply Agency
IAEA	International Atomic Energy Agency
OECD	The Organisation for Economic Co-operation and Development
(US) DoE	United States Department of Energy
(US) EIA	United States Energy Information Administration
WNA	World Nuclear Association
NA	North America
USEC	United States Enrichment Corporation
NPP	Nuclear Power Plant
PWR	Pressurized Water Reactor
ABWR	Advanced Boiling Water Reactor
EPR	European Pressurised Water Reactor
VVER	Water-Water Power Reactor
SWU	Separative Work Unit
tU	tonne U (= 1 000 kg uranium)

² The statistics and data analysis provided by ESA are for information purposes only, and ESA does not bear any legal liability for using them. ESA ensures confidentiality and physical protection of the commercial data.