

Uranium Production Pressures

A new spotlight has shone on nuclear power over the past couple of years as both a reliable source of baseload and carbon-free power that is increasingly being valued in the global transition to clean energy. On the demand side, the current energy crisis has mitigated the potential for further nuclear reactor closures in Europe and the U.S., essentially de-risking uranium demand from these two regions. In Europe, Germany has at least temporarily delayed the closure of two of its three remaining nuclear reactors, and Belgium plans to extend the lives of its two newest reactors, Tihange 3 and Doel 4, by 10 years to 2035. Meanwhile, EDF Energy is considering lifespan extensions for Hartlepool and Heysham 1 in the UK beyond their current closure dates in 2024. In the U.S., the forecast for uranium demand is more positive than in years past as PG&E works with the state of California to extend the lifespan of Diablo Canyon 1 & 2 by five years through 2030. And Holtec International’s Palisades plant in Michigan has a chance of being saved by DOE’s Civil Nuclear Credit program that aims to keep marginal units in deregulated environments online to help accelerate the U.S. energy transition. The stabilization of Western uranium demand means nuclear power growth in Asia, notably China, and the Middle East will represent positive incremental demand growth as opposed to a mere shifting of demand from West to East.

At the same time, utility inventories in the U.S. and Europe continue to decline at a remarkable rate. U.S. utility inventories have fallen 15% from their peak of 128 million pounds U₃O₈ in 2016, currently representing about 2.4 years of annual reactor requirements. Similarly, European Union (EU) utility inventories have declined for eight years in a row, dropping 30% since 2014. However, this should be caveated by the fact that the current EU figure no longer includes UK utility inventories because of Brexit.

In addition, the huge volume of secondary buying from financial players over the past two years has resulted in the net removal of ~58 million pounds U₃O₈ of inventory from the market, at least temporarily, and has been a key factor in the near doubling of the spot price from a low of \$27.30 in March 2021 to its current level of around \$50 today. Russia’s invasion of Ukraine in February has added to upward pressure on uranium prices, with the potential for secondary supplies to tighten further if direct sanctions are placed on Russia and open market utilities are forced to diversify away from Russian uranium imports.

Ux Price Indicators Click for Market Page				
Weekly Ux U ₃ O ₈ Prices (10/17/22)				
Ux U ₃ O ₈ Price [®]	\$50.45 (+\$1.95)	CMC [Cameco]	\$50.25	
Ux U ₃ O ₈ 3-Yr Price	\$56.00 (Unch.)	CVD [ConverDyn]	\$50.50	
Ux U ₃ O ₈ 5-Yr Price	\$59.50 (Unch.)	ORO [Orano]	\$50.75	
Month-End Ux Prices (9/26/22)				
U ₃ O ₈	Ux U ₃ O ₈ Price [®]	\$48.50	NA Spot	\$38.00
	CMC	\$48.50	NA Term	\$26.50
	CVD	\$48.50	EU Spot	\$38.00
	ORO	\$48.50	EU Term	\$27.00
	Spot MAP*	\$49.81	NA Price	\$164.75
	3-Yr Forward	\$54.50	NA Value*	\$164.72
SWU	5-Yr Forward	\$58.25	EU Value*	\$164.72
	Long-Term	\$49.00	NA Spot*	\$2,257
	Spot	\$92.00	NA Term*	\$2,420
	Long-Term	\$135.00	* Calculated values	

Top Stories

- Spot uranium activity surged last week, pushing the spot U₃O₈ price above the \$50 level (see page 14).
- Cameco is joining Brookfield Renewables to purchase Westinghouse Electric Company for a reported price of nearly \$8 billion (see page 3).
- The new AP1000 at Vogtle 3 has begun loading fuel as it moves to start operations in early 2023 (see page 3).
- Efforts are underway in Finland and Sweden to evaluate potential new reactor builds (see pages 5 & 7).

Given a more favorable global demand scenario compared to just two years ago, greater attention will be focused on the ability of primary production to respond to higher future demand. As both spot and LT prices hover around the \$50 level today, we have already witnessed some production restart announcements and plans for increased production, but this will likely not be enough to meet demand beyond the middle part of this decade without more mines in the mix.

At the end of 2021, primary production totaled only ~124 million pounds U₃O₈, well below UxC’s estimated base case market demand of nearly 220 million pounds U₃O₈ in 2021, which includes secondary demand and utility inventory build. In response to the potential for future production deficits, the market witnessed its first major production restart announcement in February when Cameco elected to restart its Tier 1 McArthur River mine in the fourth quarter of this year, ramping up production to 15 million pounds U₃O₈ per year by 2024. However, Cameco also said it would reduce Cigar Lake production from 18.0 million pounds U₃O₈ per year to

13.5 million pounds U_3O_8 per year by 2024. Accordingly, the net production gain from these two projects will be ~10.5 million pounds U_3O_8 per year by 2024.

Last year, Kazatomprom approved commercial ramp-up for its new Budenovskoye 6/7 ISR project to 2,500 tU (~6.5 million pounds U_3O_8) no earlier than 2024, but the first three years of production (2024-2026) are expected to be committed to Russia under an offtake agreement. It is still unknown whether post-2026 production from the new ISR project will be made available to the open market. The more impactful news from Kazakhstan was Kazatomprom's decision in August to increase Kazakh uranium production to between 25,000 tU (~65.0 million pounds U_3O_8) and 25,500 tU (~66.3 million pounds U_3O_8) in 2024, which is about 9-10 million pounds U_3O_8 higher than projected Kazakh production of 55.9 million pounds U_3O_8 this year.

In April, Paladin Energy raised A\$200 million to fund the restart of mining operations at its idled Langer Heinrich mine in Namibia, supported by a six-year contract award at the time with a U.S. utility. The company made a formal restart decision in July that anticipates start-up in 2024, with peak production of about 6.0 million pounds U_3O_8 per annum for seven years over a 17-year mine life. Similarly, Boss Energy made a final investment decision in early June to restart its Honeymoon ISR project in South Australia in late 2023/early 2024, ramping up to a steady-state rate of 2.45 million pounds U_3O_8 per year within three years.

Meanwhile, Global Atomic continues to make development progress at its brownfield Dasa mine in Niger, with a plan to commission the processing plant in the fourth quarter of 2024 with a view to commence production in early 2025. The company expects recovery to be higher in the initial years of operation at between 3.5-6.0 million pounds U_3O_8 per year for Years 2 through 8 based on an overall higher average feed grade, with the processing of lower grade material in Years 9 through 14 resulting in the recovery of 1.6-2.8 million pounds U_3O_8 per year. To date, the company has secured a supply agreement with a North American utility for 2.1 million pounds U_3O_8 over a six-year period and recently signed an LOI with a Western utility for the supply of up to 2.4 million pounds U_3O_8 starting in 2025.

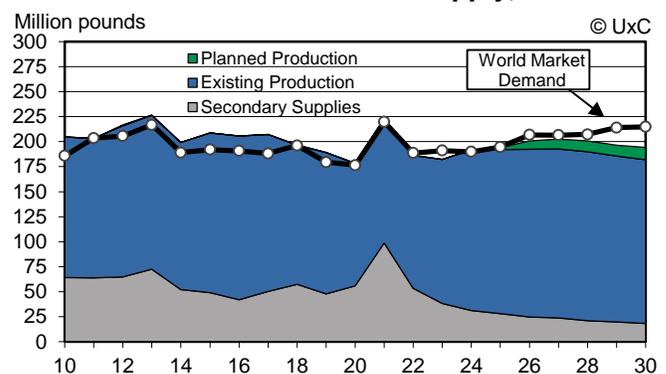
The potential for production restarts in the U.S. is also advancing with three producers – enCore Energy, Energy Fuels, and Ur-Energy – having reached supply agreements with utilities over the last several months. enCore Energy expects to restart the past-producing Rosita ISR mine next year with a capacity of 800,000 pounds U_3O_8 per year. Neither Energy Fuels nor Ur-Energy have announced formal production decisions, but UxC expects both producers to target new production in 2023/2024 based on recently concluded supply agreements. Energy Fuels is expected to look toward conventional production from its Pinyon Plain mine in Arizona and La Sal Complex in Utah, while Ur-Energy will seek to restart its Lost Creek ISR mine in Wyoming with a capacity of 1.2 million

pounds U_3O_8 .

Based on the above-mentioned primary production developments, UxC anticipates supply and demand to be in relative balance through 2025, but this of course assumes production increases remain on schedule, which, as history tends to remind us, is not always the case. Over the period from 2003 to 2016, primary production increased by 79% from 92 million pounds U_3O_8 to 164 million pounds U_3O_8 , but most of that increase, or 77%, came from the expansion of Kazakh production alone. Canadian and African production accounted for just 13% and 5% of the expansion, respectively, over the period. While Kazatomprom is not operating its ISR projects at 100% capacity, the company is also in a situation where it must replace existing projects with new projects as reserves are depleted in the coming years. The market also must be cognizant of the impact that high inflation and supply chain constraints can play in dictating the pace that primary production is brought online. High inflation can contribute to cost overruns and start-up delays, especially if additional financing is required and/or rates of return on investment begin to appear less favorable. Another factor is regulatory impacts, as new uranium projects in the development process also often experience unplanned delays due to licensing issues.

Beyond 2025, supply deficits under UxC's mid case production scenario in our [Q3 Uranium Market Outlook](#) are projected to widen relative to base case demand and become quite prolific even before 2030. This will necessitate a combination of unutilized production capacity, the restart of higher cost mines, and new uranium projects to fill the widening supply gap. The reality is that current prices around the \$50 mark are clearly not high enough to incentivize the next wave of projects in the development pipeline. While investment demand for uranium has been subdued lately as financial markets have retreated on the prospect for a global recession, we must be reminded that nuclear power is needed now more than ever in the transition to clean energy. Going forward, improving supply-demand fundamentals for uranium and utility diversification away from Russia are likely to maintain or increase investor demand in the space with the understanding that incremental primary production necessary to meet growing demand in the second half of this decade will command prices much higher than today.

Market Demand vs. Mid-Case Supply, 2010-2030



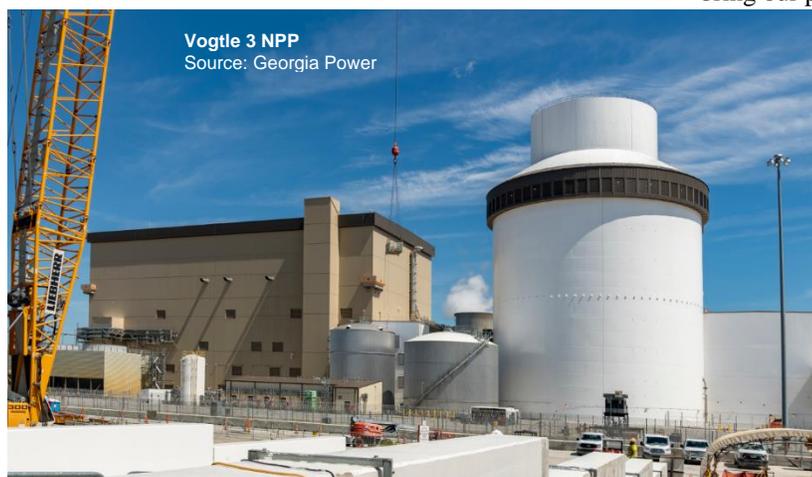
News Briefs

Nuclear Power

Georgia Power begins loading fuel into Vogtle 3

On October 14, Southern Company subsidiary Georgia Power announced it commenced fuel loading at the Westinghouse AP1000 PWR at Unit 3 of the Vogtle nuclear power plant Augusta, Georgia. The company noted the fuel loading milestone is a “historic and pivotal” achievement in its quest to commence commercial operation of the first new nuclear units to be built in the U.S. in more than three decades. The start of Vogtle 3 fuel load comes after Southern Nuclear received a 103(g) finding from the Nuclear Regulatory Commission (NRC) in August (*UxW36-32*), which signified the new unit has been constructed and will operate in line with the company’s combined Construction and Operating License as well as NRC regulations. During fuel load, technicians and operators from Westinghouse and Southern Nuclear are set to transfer 157 fuel assemblies one-by-one from the Unit 3 spent fuel pool to the reactor core in the coming days. “The Vogtle 3 & 4 nuclear units represent a critical, long-term investment in our state’s energy future, and the milestone of loading fuel for Unit 3 demonstrates the steady and evident progress at the nuclear expansion site,” said Chris Womack, Chairman, President, and CEO of Georgia Power. “We’re making history here in Georgia and the U.S. as we approach bringing online the first new nuclear unit to be built in the country in over 30 years. These units are important to building the future of energy and will serve as clean, emission-free sources of energy for Georgians for the next 60 to 80 years.”

Georgia Power, on behalf of the project’s minority stakeholders, plans to commence startup testing upon completion of the fuel loading milestone. Startup testing aims to demonstrate the integrated operation of the primary coolant system and steam supply system at design temperature and pressure with fuel inside the reactor. In the coming weeks, Vogtle 3’s operators will bring the plant from cold shutdown to initial criticality, synchronize the 1,250 MWe (gross) PWR to the



Vogtle 3 NPP
Source: Georgia Power

Industry Calendar

- October 16-18, 2022
International Uranium Fuel Seminar
NEI
<https://www.nei.org/Conferences/>
Caesars Palace, Las Vegas, NV, USA
- November 1-3, 2022
Asia Nuclear Business Platform
Industry Platform
<http://www.nuclearbusiness-platform.com/asia/>
Ritz-Carlton Jakarta, Indonesia
- February 27-28, 2023
7th Asian Nuclear Power Briefing 2023
Strategic Communications
<https://stratcomsevents.biz/7ANE2023/>
Tokyo, Japan
- April 18-20, 2023
World Nuclear Fuel Cycle 2023
NEI/WNA
<https://www.wnfc-event.com/>
The Hague, Netherlands
- May 15-17, 2023
Nuclear Energy Assembly
NEI
<https://www.nei.org/conferences/nuclear-energy-assembly>
Grand Hyatt, Washington, DC, USA
- June 11-14, 2023
UxC Nuclear Fuel Training Seminar – Vienna
UxC
https://www.uxc.com/p/products/uxc_seminar.aspx
Hilton Vienna Plaza, Vienna, Austria, USA
Details are available at:
<https://www.uxc.com/c/data-industry/Calendar.aspx>

electric grid, and systematically raise the unit’s power to 100% under power ascension testing. The company maintains its current schedule calling for Vogtle 3 to enter commercial operation in the first quarter of 2023.

Reactor vendor Westinghouse Electric Co. (WEC) commended Georgia Power and all related project partners for achieving the important fuel loading milestone. WEC added that Vogtle 3’s advanced nuclear fuel assemblies were manufactured at its Columbia Fuel Fabrication Facility in South Carolina. “This is an exciting and important milestone to bring our proven AP1000 reactor to the very last stage before

starting to generate clean, affordable and reliable power in America,” said Patrick Fragman, WEC President and Chief Executive Officer.

Cameco and Brookfield Renewable partner to acquire Westinghouse Electric Co.

On October 11, Cameco Corp. and Brookfield Renewable Partners announced the formation of a strategic partnership to acquire Westinghouse Electric Co. (WEC) in a deal valued at roughly \$7.9 billion. Upon conclusion of the deal, which is scheduled for closing in the second half of 2023, Brookfield Renewable will own a 51% in-

terest in WEC with Cameco owning the remaining 49% interest. Cameco noted that WEC's existing debt structure will remain in place, leaving an estimated \$4.5 billion equity cost to the consortium, subject to closing adjustments. This equity cost will be shared proportionately between Brookfield and its institutional partners (approximately \$2.3 billion) and Cameco (approximately \$2.2 billion).

Brookfield Renewable is pursuing the Westinghouse opportunity through the Brookfield Global Transition Fund I (BGTF I), which is the largest fund in the world focused on the energy transition. The company expects to invest approximately \$750 million to acquire an approximate 17% interest in WEC, which will be funded through normal course funding initiatives, including asset level upfinancings and asset recycling. Cameco noted it currently has available liquidity and committed financing facilities to support the transaction to acquire a 49% share in WEC. However, Cameco will pursue a permanent financing mix of capital sources (cash, debt, and equity), which is intended to preserve the company's balance sheet and ratings strength while maintaining liquidity prior to closing.

The transaction follows the turnaround of Westinghouse by Brookfield Business Partners (BBU) – the industrials and services business of Brookfield Asset Management – which acquired the business in 2018. Under BBU's ownership, Westinghouse has refocused on core nuclear services, reduced its operating cost base, and pursued several complementary M&A transactions to strengthen its in-house expertise. The consortium partners noted they see several major external trends that are expected to benefit the acquisition of Westinghouse, including:

- **Critical transition technology:** Nuclear power is the one of the only zero-emission, baseload sources of electricity currently available at scale. Driven by electrification, decarbonization and energy security benefits, an estimated 400 GW of additional nuclear capacity will be needed by 2050.
- **Accelerating growth plans:** Nuclear power is experiencing a resurgence around the world with more than 20 countries across the Americas, Europe, the Middle East and Asia pursuing new projects or plant extensions. More than 50 GW of plant extensions have been announced to date and more than 60 GW of new-build reactors are expected between 2020-2040.
- **Energy security:** Energy supply chains are coming under stress as a result of geopolitical uncertainty. In the short-term, the transaction provides the opportunity to win new business supporting dozens of nuclear facilities across Eastern European countries traditionally served by Russia. In the medium term, demand for stable supply of nuclear fuel and technology is expected to grow substantially, commensurate with the growth in nuclear power generation as countries look to increase energy security.
- **Technology advancements:** There are multi-decade

growth opportunities in the rollout of next-generation advanced nuclear technology and long-term nuclear energy storage solutions. Modular baseload generation, such as Westinghouse's eVinci micro-reactor technology, can play a growing role in an increasingly decentralized and decarbonized energy system.

Together, Cameco and Brookfield Renewable said they will bring "a compelling combination of strategic and operational expertise to Westinghouse." The transaction was unanimously approved by the independent directors of Brookfield Renewable based, in part, on the recommendation of a committee of independent directors who assessed the fairness of the transaction from a financial perspective. The independent committee received an opinion as to the financial fairness of the consideration from Greenhill & Co. Canada, Ltd., as independent financial advisor, as well as advice from independent legal counsel. Goldman Sachs & Co. LLP and CIBC Capital Markets are acting as financial advisors to Cameco on the transaction.

Cameco President and CEO Tim Gitzel commented, "The opportunity to partner with Brookfield Renewable, a leader in the clean-energy space, to acquire Westinghouse is expected to create a platform for growth across the nuclear value chain. Coupled with our more than 30-year proven track record of providing secure and reliable fuel supplies to a global customer base, this transaction fits perfectly within Cameco's strategy and is expected to increase our ability to meet the growing needs of existing and new customers at a time when origin and security of supply is of significant concern. At the same time, we expect the recurring demand for Westinghouse's operating plant services and nuclear fuel will generate a strong revenue stream and add stable cash flow to complement Cameco's existing uranium and fuel services business."

Brookfield Renewable CEO Connor Teskey stated, "Partnering with Cameco brings deep nuclear sector expertise, alongside our knowledge of energy markets and global customer base, to form a formidable champion for nuclear power. We see significant potential to grow the business and deliver on broader growth in the nuclear power sector through our strategic partnership with Cameco."

In other related news, Cameco reported October 17 it closed on a bought deal offering of 34,057,250 common shares of the company, including the exercise in full of the underwriters' option to purchase additional common shares, at a price of \$21.95 per share, for gross proceeds of approximately \$747.6 million. The company said it intends to use the aggregate proceeds from the Offering, after payment of fees and expenses, to partially fund its share of the acquisition of Westinghouse Electric. CIBC Capital Markets and Goldman Sachs & Co. LLC acted as joint bookrunners for the Offering.

CGN Power and CNNP issue Q3 2022 performance results

On October 11, China General Nuclear's (CGN) operating

subsidiary, CGN Power, released operational results for the third quarter of 2022. At the end of September 2022, CGN Power operated 26 reactors with 29.3 GWe in total capacity. CGN Power produced a total of 152 TWh of nuclear electricity during the first nine months of 2022, which marks a decrease of 3.97% compared to the same period in 2021. In this context, CGN Power reported that operations and maintenance work at some plants took longer during the first nine months of 2022 compared with the same period of 2021, possibly due to impacts from the COVID-19 pandemic. During Q4 2022, the company expects Lingao 3, Ningde 2, Daya Bay 1, and Taishan 2 to go offline for maintenance and refueling outages. As of September 30, CGN Power had seven reactors under construction. The latest unit to start construction is Lufeng 5, which saw safety-related first concrete poured in early September (*UxW36-37*). Of the units under construction, Fangchenggang 3 is in the commissioning stage and is expected to start operating in the second half of 2022. Fangchenggang 4 and Taipingling 1 & 2 are in the equipment installation stage and should start operating in the first half of 2024 and 2025/2026, respectively.

Separately, also on October 11, China National Nuclear Corp.'s (CNNC) operating subsidiary CNNP released its operational results for the first nine months of 2022. At the end of September 2022, CNNP said it had 25 nuclear reactors in operation with a total capacity of 23.7 GWe. The company produced a total of 135.9 TWh of nuclear electricity during the first nine months of 2022, which is an increase of 5.27% compared to the same period in 2021. CNNP also has eight reactors under construction with a total capacity of 8.8 GWe.

China currently has 53 nuclear reactors in operation with roughly 51.6 GWe in net capacity and 23 units under construction with roughly 23.1 GWe (net).

Fortum kicks off new nuclear feasibility study in Finland and Sweden

On October 17, Finnish utility Fortum announced it has commenced a two-year feasibility study to explore the prerequisites to build new nuclear power capacity in Finland and/or Sweden. The company said the study will examine commercial, technological, and societal conditions both the construction of SMRs and conventional LWRs. "The goals of energy independence, security of supply and carbon neutrality are challenges facing our entire society. We want to find out under which conditions we could meet them with nuclear power generation, which is known to be reliable and CO₂-free," says Simon-Erik Ollus, Executive Vice President, Generation Division at Fortum.

The company stated that due to the current uncertainty in the energy market, "ventures in the nuclear industry will most likely involve partnership constellations." Thus, Fortum is exploring partnerships between nuclear generating and district heating companies, industrial off-takers of power and heat. The feasibility study will also explore the potential for service

business offerings for new projects in Europe and hydrogen for industrial applications.

"The challenges related to new nuclear are well-known. Achieving competitive construction times and costs are must-win battles for our industry. In this feasibility study, we aim to explore novel partnerships, new business models and technologies, such as small modular reactors (SMRs), which are promising in terms of taking nuclear power forward to future generations," says Laurent Leveugle, who is leading the nuclear feasibility study.

Fortum noted that given its decision to fully divest Uniper to the German State, the company is now in the process of updating its standalone strategy with the focus on sustainable power generation, security of supply and affordable energy. The company concluded, "Fortum's CO₂-free generation assets are now needed more than ever."

Labor union strikes continue to curb already constrained French nuclear generation

On October 13, the FNME-CGT labor unions in France called for "industrial action" to be taken by the group's members across the entire French energy sector. The demand prompted strikes at five EDF reactors as well as walkouts at several French oil refineries and gas storage sites across the country. An FNME spokesperson said that strikes as of October 14 were underway at the Bugey, Cruas, Tricastin, Cattenom, and Gravelines nuclear power plants, as workers demand better wages to compensate higher inflation. "We respect the strike and it is a right given to the workers," an EDF spokesperson told *Reuters*.

It was later reported on October 14 that the FNME-CGT union strikes widened to include the Dampierre and Paluel nuclear sites as well. FNME-CGT representative Virginie Neumayer commented, "The demands are a little different depending on the site, but converge towards (wage) requests." She added that negotiations with the unions and EDF are expected to take place on October 19. France's Minister for Energy Transition Agnes Pannier-Runacher said she hopes the rolling strikes across the nation's energy sector can be quelled soon, as France is dealing with a rash of reactor outages for maintenance work as well as surging energy prices across the EU. "We have just learned that the CGT Energie signed the branch agreement on the salary increase... I think this is good news to ease the situation," she said. Union-affiliated labor in France are legally bound to ensure the continuity of the public electricity service, requiring them to raise production or resume operations to return reactors to the grid in case of a supply-demand imbalance. Thus, FNME-CGT Secretary General Sébastien Menesplier commented, "The actions only weigh on the company's accounts: one day of delay on a unit outage is usually worth 1 million euros. At the current price of electricity, it is 5 to 10 times more."

Steam generators installed at Rooppur 2 in Bangladesh

On October 13, Russia's Rosatom reported that site contractors hoisted and placed the first steam generators for the VVER-1200 PWR under construction at Unit 2 of the Rooppur nuclear power plant in Bangladesh. The 14-meter-long, 325-ton steam generator was lifted into the reactor building's transport portal using a Liebherr LR 11350 crane, whereupon the component was placed on a mounting trolley and delivered into the central hall of the reactor compartment. Rooppur 2's first steam generator was installed into its designed position using the VVER-1200's polar crane. "The installation of steam generators is one of the key events in the construction of a nuclear power unit. This operation was preceded by a lot of work to ensure the construction readiness of the reactor building. All four [steam generator] units of the unit are planned to be installed by the end of October," said Alexei Deriy, Vice President of JSC ASE, Director of the Rooppur NPP construction project.

Units 1 and 2 at Rooppur are both VVER-1200 reactors. Unit 1 is targeted to commence operation in late-2023 or early-2024, with Unit 2 to follow in late-2024.

NEK commences overhaul of Krško NPP in Slovenia

Slovenia's nuclear power utility Nuklearna Elektrarna Krško (NEK) recently embarked on an overhaul of the company's single-unit PWR at the Krško nuclear power plant located near the country's southeastern border with Croatia. The overhaul, expected to last for approximately one month, foresees a range of tasks completed, including the replacement of the plant's high-pressure steam turbine, which aims to increase the reactor's power output by 10-12 MWe. A range of technological updates are also underway, including the replacement of the 60-ton rotor, which has operated for 40 years. The company noted that the ongoing overhaul is aimed at preparing the Krško nuclear power plant for a planned periodic safety review in 2023, which aims to extend the unit's lifetime by a decade to 2033. NEK's long-term plans envision the company working to obtain an additional 10-year extension thereafter to ensure the plant can operate until 2043.

Krško 1 currently provides approximately 36% of the country's total power supply. The plant is equally co-owned by Slovenia and Croatia, and extended operations of the facility is vital to both countries' energy security. To that end, both countries have been in negotiations aimed at funding construction of a new unit, Krško 2's, following the issuance of the unit's preliminary energy permit from Slovenia's Infrastructure Ministry in July 2021 (*UxW35-29*).

Laurentis Energy Partners working with Synthos Green Energy for SMRs in Poland

On October 14, Laurentis Energy Partners, a subsidiary of

Ontario Power Generation (OPG), and Polish energy company, Synthos Green Energy, announced the signing of a Master Services Agreement (MSA) to support the development and deployment of SMRs in Poland. The signing took place at the Ministry of Climate and Environment in Poland, following a meeting between the Province of Ontario's Energy Minister Todd Smith and the Polish Undersecretary of State Adam Guibourgé-Czetwertyński. The agreement enables international collaboration between Laurentis and Synthos Green Energy, beginning with early project planning. Synthos Green Energy, together with its Polish partner PKN ORLEN S.A., the largest multi-energy company in Central Europe, has established the joint venture (JV) company ORLEN Synthos Green Energy or OSGE, which aims to deploy a fleet of GE-Hitachi BWRX-300 SMRs in Poland, targeting the first unit to be in operation by the end of this decade. Laurentis' parent company OPG is currently working to deploy the first BWRX-300 SMR at the site of the existing Darlington nuclear power plant in southern Ontario by the end of this decade.

"The fact that the BWRX-300 technology has been chosen by experienced utilities from Canada – the country with decades of experience in nuclear business – confirms that we have made the right decisions and that we are on the right track," said Rafał Kasprów, CEO of Synthos Green Energy. "Working with Canadian entities, such as Laurentis Energy Partners, will allow us to learn from the first planned BWRX-300 deployments in the world, to accelerate project development in Poland."

NRA conducts geologic fault inspections at Shika 2 in Japan

On October 15, Japan's Nuclear Regulation Authority (NRA) announced it carried out a two-day field survey of Hokoriku Electric Power Co.'s (EPC) Unit 2 at the Shika nuclear power plant in Ishikawa Prefecture to investigate whether the facility is located above an active geologic fault. Presence of an active fault under the facility would prevent Hokoriku EPC's plans to restart the 1,358 MWe ABWR. The utility



contends that the fault is inactive, and thus the NRA should permit the unit's restart.

NRA has been evaluating the presence of geologic faults at the Shika site since Hokoriku EPC applied for restart permission in 2014 (*UxW28-33*). NRA geology expert Akira Ishiwatari said that following the latest investigation, the Authority confirmed the state of the stratum at the S-4 fault line that runs directly under the reactor building. "We have a lot of data. I don't expect (a decision) to take that long," Ishiwatari said. If the regulator determines the fault underlying the plant is indeed active, Hokoriku EPC would not be allowed to restart Shika 2. However, even if NRA concludes that the fault on the premises is inactive, the utility must still conduct a thorough evaluation of the earthquake and tsunami resistance, which would necessarily prolong the years-long process to restart Shika 2.

OPG and CEZ collaborate to advance clean nuclear energy

On October 11, Canadian utility Ontario Power Generation (OPG) and Czech Republic-based CEZ announced the signing of a Memorandum of Understanding (MOU) that seeks to collaborate to advance deployment of nuclear technology, including SMRs, to safely produce clean, reliable electricity in their jurisdictions. The two companies also committed to achieving net zero by 2040. Under the MOU, OPG and CEZ will share information related to the deployment of new nuclear projects, with an overarching aim to reduce financial, technical, and schedule risk to both parties on their respective future projects. OPG is deploying an SMR at its Darlington site, the only location in Canada licensed for new nuclear construction with an approved Environmental Assessment. And, in Europe, CEZ has taken steps toward expanding its nuclear program with a new LWR planned for the Dukovany nuclear power plant, and lands sanctioned to potentially construct SMR-based new nuclear at the Temelin nuclear power plant.

OPG President and CEO Ken Hartwick commented, "Working together with entities like ČEZ, we can leverage our combined experience to develop and build the new technology needed to power the future and meet decarbonization goals." CEZ Board Member and Chief of the New Energy Division Tomáš Pleskac noted, "We are preparing for the construction of a new nuclear unit in Dukovany and the upcoming allocation of space at Temelín, where the first SMR could be built in the first half of the next decade. The collaboration with OPG is therefore, for us, a logical step forward."

Policy & Regulation

Kyushu EPC submits 20-year life extension application for Sendai 1 & 2 in Japan

On October 12, Kyushu Electric Power Co. (EPC) announced it submitted to Japan's Nuclear Regulation Authority (NRA) an application seeking to extend the operational

lifespan by 20 years each for Units 1 & 2 at the Sendai nuclear power plant in Kagoshima Prefecture, Japan. The country's nuclear plants can be operated for 40 years under current regulations, but utilities can apply for a one-time, 20-year operating extension. The company noted that special inspections conducted in October 2021 and February 2022 "confirmed the integrity of the reactor vessel and reactor containment vessel," which validates there are no issues preventing the site's two PWRs from operating for an additional 20-year term. "We will respond sincerely and carefully to the examination of the government in the future, and will strive to actively disclose information so that everyone in the region can feel safe and trust us," read the company's press release outlining plans to achieve 60 total years of operation at Sendai 1 & 2.

Currently, under the plant's initial 40-year operating license, Sendai 1 is allowed to operate until July 3, 2024 and Unit 2 can operate until November 27, 2025. Should the NRA grant Kyushu EPC's license extension request, Sendai 1 would be extended until 2044 and Sendai 2 until 2045. Based on the NRA's regulatory review period of other operating extensions filed by JAPC and Kansai EPC, it should take about one year to obtain a final ruling on Kyushu EPC's latest application.

New Swedish government coalition pushes for new builds, examines restart of Ringhals 1 & 2

Sweden's incoming government, led by a center-right coalition, has signaled it plans to push state-owned utility Vattenfall to build new nuclear capacity and investigate the potential to restart Units 1 & 2 of the Ringhals nuclear power plant. The new government's coalition agreement, known as the Tidö Agreement, outlines many policy ambitions, including a revision of the previous government's goal to reach 100% renewable energy in lieu of "100% fossil-free" energy. To that end, the Agreement establishes new mechanisms to underpin nuclear new build in Sweden, including government credit guarantees of up to SEK400 billion (~\$35.7 billion). "The boundaries in today's system of green credit guarantees need to be reviewed so that the credit guarantees can also be used for new construction of nuclear power," reads the Agreement.

The document also notes that the new center right government plans to implement new regulations needed to allow for the deployment of new SMRs in Sweden. The Tidö Agreement notes that the government must implement new rules in the nation's Environmental Code to streamline regulations and prioritize new nuclear development. "Vattenfall should immediately start planning new nuclear power at Ringhals and other suitable locations," notes the Agreement. Vattenfall previously reported (*UxW36-28*) it commenced a pilot study to understand the conditions building at least two SMRs at a site adjacent to the existing Ringhals nuclear power plant. The company noted that the pilot study focuses on the conditions for building SMRs in the country's southern bidding

zones, as Vattenfall projects “a need for more electricity generation in southern Sweden.” The study is expected to be completed by the end of 2023 or early 2024.

Finally, the document calls for the country to conduct a thorough investigation of the feasibility of restarting Ringhals 1 & 2, which were shuttered in 2020 and 2019, respectively. The new government coalition agreement calls for an in-depth understanding of costs and schedules involved in “unconditionally and quickly” restarting the stie’s two 910 MWe BWRs. The government notes that it must first amend existing rules on restarting closed reactors. Then the government and related entities can begin efforts to review the technical and economic feasibility of restarting Ringhals 1 & 2.

U.S. DOE issues new round of GAIN awards

On October 10, the U.S. Department of Energy (DOE) office of Nuclear Energy (NE) announced that three nuclear companies have been awarded Gateway for Accelerated Innovation in Nuclear (GAIN) Vouchers to help accelerate innovation and application of advanced nuclear technologies in the U.S. NE Vouchers provide advanced nuclear technology innovators with access to the extensive nuclear research capabilities and expertise available across the DOE national laboratory complex. The latest round marks the fourth and final award made for FY 2022. The businesses selected to receive a GAIN nuclear energy voucher for Round 4 FY 2022 are:

- Curio Solutions – This award seeks to evaluate the criticality safety limits of the conceptual equipment designs for Curio’s NuCycle, used nuclear fuel recycling process. The company will work with the Nuclear Criticality Safety Group at Oak Ridge National Laboratory (ORNL) to perform evaluations of the equipment containing fissile material in the expected chemical forms to help determine necessary steps that must be taken to ensure a commercial scale reprocessing facility can be brought to market.
- Elementl Power LLC – Elementl Power is an advanced nuclear development company that identifies, acquires, and prepares locations throughout the U.S. to accommodate the deployment of advanced reactors. Under the company’s GAIN Voucher, it will work with ORNL subject matter experts and the Oak Ridge Siting Analysis for power Generation Expansion (OR-SAGE) tool to assist in the identification of potential advanced nuclear development locations across specific regions in the U.S.
- TVA – The Tennessee Valley Authority (TVA) has begun planning an Advanced Nuclear Program and is beginning to study future deployment of advanced reactors (ARs). This project will screen the TVA service area to help determine suitable sites for future AR deployment. Under the latest award, TVA will work with ORNL subject matter experts and the OR-SAGE tool to assist in defining suitable candidate sites for AR development.

The U.S. DOE-NE established the GAIN program to provide the nuclear community with the technical, regulatory, and financial support necessary to move innovative nuclear energy technologies toward commercialization while ensuring the continued safe, reliable, and economic operation of the existing nuclear fleet. Through GAIN, DOE is making its state-of-the-art and continuously improving RD&D infrastructure available to stakeholders to achieve faster and cost-effective development of innovative nuclear energy technologies toward commercial readiness.

ZNPP offsite power reestablished again as IAEA’s Grossi meets with Russia’s Putin

The International Atomic Energy Agency (IAEA) announced October 12 that offsite power was again lost at the embattled Zaporizhzhya nuclear power plant (ZNPP) in southern Ukraine. A team of IAEA experts stationed at the plant said the facility’s connection to its last remaining operating 750 kV power line was re-established around 1:40pm local time, which allowed the plant to switch off its backup diesel generators that had been providing the reactors with electricity after the off-site power was cut earlier that day. IAEA Director General Rafael Mariano Grossi welcomed the restoration of external power but stressed that the power situation at the ZNPP, Europe’s largest nuclear power plant, remained “very fragile.”

In other related news, IAEA’s Grossi met with Russia’s President Vladimir Putin in St. Petersburg, Russia, to advance the Agency’s efforts to prevent a nuclear accident at the ZNPP site. “The situation in the region around the Zaporizhzhya Nuclear Power Plant and elsewhere has become increasingly dangerous, precarious and challenging, with frequent military attacks that can also threaten nuclear safety and security,” Director General Grossi said in a statement following their meeting. Press reports following their discussion noted that Russia’s Putin remains “open to dialogue” about ZNPP, adding he is “ready to discuss all issues of mutual interest or cause for concern, for example, regarding the situation around the Zaporizhzhya power plant.”

It was later reported that Russia’s nuclear power plants operator, Rosenergoatom, said the company plans to switch ZNPP to utilize Russian nuclear fuel after it exhausts current reserves at the plant. “The fuel that is in operation will be used up ... ours will be used in the future,” said Renat Karchaa, an adviser to the Director General of Rosenergoatom as quoted by TASS. The decision to switch fuel suppliers from ZNPP’s current Westinghouse to utilize Russian fuel follows reports issued earlier in October that Russia’s Rosatom and Rosenergoatom “received the right” to take management of ZNPP following a widely condemned referendum held last week that Russian officials claim saw a majority of residents vote to join Russia. The company said the new operating subsidiary, known as Operating Organization of Zaporizhzhya (EO ZNPP), will be led by Balakovo NPP Chief Engineer Oleg Romanenko, and remains dedicated to

maintaining the safe operation of the plant as an asset of Rosatom.

Turkey's Erdogan discusses Akkuyu 1 startup schedule; possible deal for Sinop site

On October 13, it was reported that Russian President Vladimir Putin and Turkey's President Recep Tayyip Erdogan met in Astana, Kazakhstan at the Sixth Summit of the Conference on Interaction and Confidence Building Measures in Asia. The two heads of state discussed the latest progress at the Russian built four-unit Akkuyu nuclear power plant in Mersin Province, Turkey. Therein, Turkey's President Erdogan said that Unit 1 of the Akkuyu nuclear power plant remains on track to commence initial operation in the first half (H1) of 2023. Russia's President Putin added that Rosatom plans to deliver "first fuel" to Akkuyu 1 in May 2023, with startup activities commencing thereafter.

Erdogan's latest startup schedule calling for Akkuyu 1 to enter operation in H1 2023 is noteworthy, as reports surfaced in July (*UxW36-31*) that Akkuyu's construction slowed considerably after Russia fired the plant's Turkish subcontractor, IC İtaş. Rosatom replaced the Turkish firm with Russian contractor TSM Enerji, which was not well received by Turkey's government, who sought to maintain maximum participation of Turkish contractors at the site. However, in September (*UxW36-38*), the Turkish and Russian sides reportedly reached an agreement to rehire IC İtaş to expedite construction activities at the Akkuyu nuclear power plant.

Erdogan added that, beyond Akkuyu, it is possible that Russia's Rosatom could be asked to build another nuclear power plant at the Sinop site located along the Black Sea. At one time, Sinop was to host four ATMEA-1 PWRs, built by the ATMEA joint venture between Mitsubishi Heavy Industries (MHI) and EDF/Framatome. While the venture carried out significant early site studies and feasibility assessments for Sinop's development, the ATMEA-1 project was later abandoned in 2020 (*UxW34-03*) as a feasibility study for the project failed to meet Turkey's time, scope, and schedule needs to complete construction on the facility. However, it appears that Turkey could tap Russia to build another large nuclear power plant at the Sinop site. "The opening of Akkuyu's first turbine in the first half of next year will make a different sound in the world. If a step can be taken regarding [nuclear power plant] Sinop, this will, of course, have a much different multiplier effect," he stated.

German reactor reserve plan in doubt due to political disagreements

It was widely reported on October 13 that Germany's government failed to pass a draft law outlining previously announced plans to retire the Emsland nuclear power plant at the end of 2022, while also placing Unit 2 of the Isar and Unit 2 of the Neckarwestheim nuclear power plants on reserve into 2023 to mitigate the threat of electricity supply disruptions in winter of next year. Germany's Economy Minister Robert

Habeck announced last month (*UxW36-36*) that a stress test carried out on the country's electricity grid in the wake of Russia's military invasion of Ukraine showed that Germany had sufficient electricity supply capacity, but the government wanted to maintain the option of bringing Isar 2 and Neckarwestheim 2 back online in early 2023 if necessary. The findings of the stress test required the government to formulate and pass new legislation that facilitated the two reactors' extension into 2023. However, the bill failed to pass on October 13 due to disagreements within the nation's cabinet, as objections raised within the Finance Ministry led to a missed deadline to pass legislation. An unnamed spokesperson from Germany's Economy Ministry said, "This means that the tight schedule for the procedure cannot be kept," adding that the Ministry has informed the operators of the lapse. The Economy Ministry later noted that it still "continues to work on solutions," without providing further details.

The pro-nuclear Free Democrats party, which controls the Finance Ministry, demanded the reactor not just be placed in a reserve state, but rather receive decisive operating lifespan extensions. "The Finance Ministry is of the opinion that the proposed continued operation of only two power plants alone is not sufficient," said a Ministry source.

UK NDA and Cwmni Eginio ink MOU for SMRs at Trawsfynydd site in Wales

On October 11, the UK Nuclear Decommissioning Authority (NDA) announced the signing of a Memorandum of Understanding (MOU) with SMR project vehicle Cwmni Eginio to support development of a new SMR at the legacy Magnox site at the Trawsfynydd nuclear power plant in North Wales, UK. NDA said the MOU allows for the effective sharing of information and expertise around the characteristics of its land at Trawsfynydd, with the aim of aligning the existing site's decommissioning plans and site activities with the new SMR construction project, and to support Cwmni Eginio with stakeholder engagement and developing socio-economic plans. The latest MOU follows an announcement earlier this year from the UK Department for Business, Energy and Industrial Strategy (BEIS) that the NDA would work alongside stakeholders, including Cwmni Eginio, to enable engagement on



Trawsfynydd NPP Site
Source: Daily Post

potential future nuclear developments in the UK.

Cwmni Egino CEO Alan Raymant commented, “Our relationship with the NDA is critical to the successful delivery of our vision for the development of new nuclear at Trawsfynydd. We’re very pleased that the MoU is now formally in place. We look forward to working with the NDA as we continue to develop our proposals which will bring significant benefits to local communities, as well as help achieve energy security and net zero targets.”

Cwmni Egino, the development company established by Welsh Government in 2021 to drive future development at the Trawsfynydd site, has set an objective for construction on SMRs at the site to begin in 2027. The company is currently developing a business proposition for the development in Trawsfynydd, and UK SMR vendor Rolls-Royce views the Trawsfynydd site along with the Wylfa site, which is also located in Wales, as among its top locations building its UK SMR design. The UK SMR is currently working its way through the UK nuclear regulatory process with a view to deploy its 470 MWe PWR-type SMR at a site in the country toward the end of the decade.

Russia inks nuclear cooperation agreement with Morocco

It was reported in *Sputnik* on October 12 that the governments of Russia and Morocco signed an intergovernmental agreement on cooperation in the field of peaceful use of atomic energy. The draft agreement includes, among other items, the possibility of constructing a nuclear power plant in Morocco. According to reports, state nuclear concern Rosatom was directed to negotiate with its Moroccan partners, together with the Russian Foreign Ministry to pursue the peaceful use of nuclear energy, including “the design and construction of power reactors, as well as research reactors, desalination plants and elementary particle accelerators,” according to the draft agreement.

Morocco’s Energy Transition and Sustainable Development Ministry announced in June (*UxW36-23*) the compilation of a report to the country’s Parliament that considers the construction of nuclear reactors to increase domestic non-fossil energy supply. The Ministry has been working on a project to study various pathways to ensure energy security while decarbonizing the electricity production sector. Energy Transition and Sustainable Development Minister Leila Benali said, “The report comprises recommendations for switching to nuclear energy,” adding that the recommendations cover both the “framework and infrastructure” as well as legislation for nuclear energy projects. “Morocco has invested in solar and wind energy, and it is now eyeing nuclear energy to ensure its electricity needs in the future...we now need a national decision to start producing electricity from nuclear energy,” said Benali, noting that the report should be presented to the country’s Parliament in the near future.

Russia will also reportedly help Morocco in the exploration

and development of uranium deposits and the study of the country’s mineral resource base, the training of personnel at nuclear power plants, as well as the training and retraining of staff at the National Center for Nuclear Energy, Science and Technology (CNESTEN), which is the country’s nuclear regulator.

Ghana’s NRA tasked with including nuclear energy in country’s energy mix

It was reported on October 14 that Ghana’s Ministry of Environment, Science, Technology and Innovation (MESTI) has tasked the new board of the Nuclear Regulatory Authority (NRA) to include nuclear power in the nation’s future energy mix. MESTI Minister Dr. Kwaku Afriyie said the committee is obligated to initiate “pragmatic policies and actions” to prepare the NRA to effectively deliver on its mandate in the nation’s nuclear power program. “The (NRA) board is a requirement in international circles, because if it does not exist we would not have the IAEA permission to proceed and that would be against international law, so this board is very important,” said Dr Afriyie. “I urge you to be passionate about this duty, bring your years of experience, expertise and excellence which all of you are noted for, to bear on the task ahead. Above all, take your mandate as a “sacred calling” for which posterity would applaud your memory,” he said as quoted by *Business Ghana*.

Ghana has been actively advancing plans to add nuclear power to its overall energy mix, with plans in place to construct its first nuclear power plant by 2030. In late 2021 (*UxW35-40*), it was reported that five international companies responded to Ghana’s Request for Interest (RFI) issued to gauge international interest in building the country’s first nuclear power plant. In that RFI, Ghana received responses from reactor vendors in the U.S., Russia, Canada, and South Korea. Specific vendors were not revealed, but NPG said the country is on path to sign a contract for a 1.0 GWe nuclear power plant sometime in 2024/2025. In early 2022 (*UxW36-07*), the government entity established to build the nation’s first nuclear power plant, Nuclear Power Ghana (NPG) announced that it plans to complete site selection for the country’s first nuclear power plant this year. NPG Executive Director Stephen Yamoah told the press that the agency has whittled the potential host sites for a new LWR plant down to four locations. Yamoah said NPG aims to produce a Site Approval Report before the end of 2022 that will be submitted to the NRA for review. Moreover, it was reported in September that Ghana’s President Nana Addo Dankwa Akufo-Addo approved the inclusion of nuclear power into the country’s power generation mix last month, indicating the nation’s commitment to join the ranks of nuclear power nations.

Uganda’s government seeks investors to build its first NPP

On October 12, Uganda’s government reported it is now working to identify potential partners to develop the nation’s

first nuclear power plant. Ugandan Energy Ministry Permanent Secretary Irene Batebe told *Bloomberg* that the government is currently working with China, Russia, and the U.S. to find investors to construct a 2.0 GWe nuclear power plant in the future. Batebe noted that due to the ~\$9 billion price tag, the country could elect to develop its first nuclear plant in two phases. Uganda is heavily reliant on hydropower for most of its electricity supply, and aims to diversify its generation mix while keeping carbon emissions low. Generation from other sources will help bridge expected spike in energy demand by 2040, according to the government. Only 57% of the country has access to electricity, with 19% connecting to the national grid and the remainder using local resources.

Uganda's government announced earlier this year (*UxW36-20*) that it acquired a tract of land upon which to build its first reactors. A source within Uganda's Ministry of Energy and Mineral Development told the press in May that the country has long been evaluating sites, and recently whittled the list down to eight target locations. "We mapped the entire country to determine which site could accommodate a nuclear power plant and targeted eight sites in the Buyende, Nakason-gola, Kiruhura, Kasanda, and Lamwo regions," said the source. In 2017, Uganda announced its intention to develop a nuclear power plant with two 1,000 MWe reactors coming online as early as 2031. Ugandan President Yoweri Museveni believes the nation needs to pursue nuclear energy as its current use of hydroelectric power is not sufficient to support future objectives.

Uranium & Fuel Cycle

X-energy's TRISO-X breaks ground on TF3 in Tennessee

On October 13, U.S. advanced reactor (AR) developer X-energy announced that its TRISO-X LLC subsidiary officially broke ground and commenced full construction activities on the U.S.' first commercial-scale AR fuel fabrication facility in Oak Ridge, Tennessee. The facility, known as the TRISO-X Fuel Fabrication Facility (TF3), aims to become the genesis of future commercial-scale advanced nuclear energy innovation and deployment, creating more than 400 jobs and attracting an investment of approximately \$300 million. X-energy estimates the TF3 is to be commissioned and operational by 2025. In 2016, X-energy opened a pilot-scale nuclear fuel facility in Oak Ridge to further develop its TRISO-X fuel and support its Xe-100 reactor design. X-energy continues to evolve the proud nuclear tradition in Oak Ridge with the construction of its new TF3.

TF3 is being commissioned through funding, in part, from the U.S. Department of Energy's (DOE) Advanced Reactor Demonstration Program (ARDP). The commercial facility's cross-cutting design will enable manufacturing of fuel for any number of advanced or small nuclear reactors based on TRISO structural isotropic (TRISO) fuel. X-energy's TRISO-X fuel is manufactured to seal the uranium particles in a protective



coating that makes the facility "meltdown impossible" while retaining any wastes generated within the fuel cladding. The company reported in April (*UxW36-15*) that TF3 will initially produce 8 metric tons per year (MTU/year) of fuel that can support about twelve Xe-100 reactors. The TRISO-X venture added that it aims to expand the facility's capacity to 16 MTU/year by the early 2030s.

Denison Mines recovers uranium bearing solution from Phoenix ISR FFT

On October 17, Denison Mines Corp. announced that it successfully recovered uranium bearing solution from the Phoenix in-situ recovery (ISR) Feasibility Field Test (FFT) underway at the company's 95% owned Wheeler River uranium project in the Athabasca Basin of northern Saskatchewan, Canada. Denison President and CEO David Cates, commented, "The successful recovery of uranium bearing solution from Denison's high-grade Phoenix deposit is a historic moment for uranium mining in Canada. This accomplishment reflects the culmination of several years of technical de-risking and provides tangible validation of the company's selection of the ISR mining method for Phoenix in our 2018 Wheeler River Pre-Feasibility Study."

The leaching phase of the FFT began in September 2022 (*UxW36-39*) and preliminary results received to date have demonstrated the successful acidification of the Test Pattern and recovery of uranium through the ISR mining method. Several samples of recovered solution were collected during the leaching phase and remain subject to full lab assay and analysis, which will generate additional detailed information about the performance of the FFT.

Based on the successful results of the FFT, lixiviant injection has ceased, and operators at the Phoenix FFT site are preparing to transition from the leaching phase of the FFT to the neutralization phase, which is expected to be completed before the end of the year. The final phase of the FFT, which involves management of the recovered solution, is expected to begin in the spring of 2023.

UEC acquires Rio Tinto's Roughrider uranium project in Saskatchewan, Canada

Uranium Energy Corp. (UEC) announced October 17 that it completed its previously announced acquisition of the Roughrider uranium development project located in the Athabasca

Basin in Saskatchewan, Canada, from a subsidiary of Rio Tinto plc. Under the terms of the transaction, Rio Tinto has now received \$80 million in cash and 17,805,815 UEC common shares, valued at \$70 million based on the 5-day volume-weighted average price (VWAP) of \$3.93 per share as of October 7, 2022. The cash component of the transaction was fully funded using UEC's existing balance sheet, and post-closing UEC has no debt and \$93 million of cash and liquid assets. In December 2011, Rio Tinto purchased the Roughrider project from Hathor Exploration Ltd. for C\$654 million.

The Roughrider project has a non-current, historic resource of 58 million pounds U_3O_8 at an average grade of 4.73% U_3O_8 . For the Roughrider West Zone, the historic technical report from September 13, 2011 showed an indicated resource of 17.21 million pounds U_3O_8 at an average grade of 1.98% U_3O_8 and an inferred resource of 10.6 million pounds U_3O_8 at 11.03% U_3O_8 . For the Roughrider East Zone, the historic report showed an inferred resource of 30.13 million pounds U_3O_8 at 11.58% U_3O_8 . The 2011 historic report did not include the Far East Zone, which UEC said may represent additional resource upside.

UEC President and CEO Amir Adnani commented, "Our next steps for Roughrider will be to first complete an S-K 1300 technical report summary based on over 650 diamond drillholes already completed for a total of approximately 225,000 meters of drilling on the project. UEC is currently engaging with consultants to develop a technical report update in the next few months. Second, UEC intends to progress permitting and a production study of Roughrider and optimize its integration with UEC's existing Canadian platform. ..."

Cameco provides preliminary Q3 2022 operating update

On October 11, Cameco Corp. provided preliminary operating results for the third quarter (Q3) ended September 30, 2022, noting that deliveries in the uranium segment are expected to be between 5 million and 5.5 million pounds U_3O_8 . In the fuel services segment, Cameco expects deliveries to be between 2.1 and 2.4 million kgU for the same period.

Production from the uranium segment in Q3 is expected to be 2 million pounds U_3O_8 from Cigar Lake. Cameco said restart activities at McArthur River and Key Lake continue to progress with first production coming from the mill expected later in the fourth quarter of 2022. The company said it has continued to experience delays in shipping uranium from its Inkai joint venture in Kazakhstan via the Trans-Caspian route. Cameco noted that, depending on when it receives its share of Inkai's 2022 production, its 2022 share of earnings from this equity-accounted investee and the timing of the receipt of its share of dividends from the joint venture may be impacted. Meanwhile, production from Cameco's fuel services segment is expected to be 1.5 million kgU for Q3.

Cameco reported it continues to see strong contracting in-

terest by third parties for the supply of uranium and fuel services. Year-to-date, Cameco has added 50 million pounds U_3O_8 to its long-term contract portfolio in the uranium segment and more than 7 million kgU as UF_6 conversion to its long-term contract portfolio in the fuel services segment.

Environment consultant cuts ties with Headspring Investments in Namibia

According to an October 13 article in *The Namibian*, mineralogical consultants Environmental Compliance Consultancy (ECC) has cut ties with Uranium One subsidiary Headspring Investments to conduct an environmental and social impact assessment for the proposed Omaheke pilot ISR project in eastern central Namibia. "Irreconcilable differences arose between ECC and Headspring Investments [Uranium One], resulting in ECC to formally withdraw their professional environmental consulting services from the project and the proponent," said ECC in a statement. The consulting company alleged it was difficult to obtain information from the Russian company.

Namibian Chamber of Environment (NCE) CEO Chris Brown said last month that the exploration method proposed by Headspring Investments would inevitably result in leakage into the aquifer and contaminate groundwater. "The entire Kalahari basin is dependent on groundwater – towns, villages, farms, tourism establishments, irrigation, domestic stock and wildlife. The aquifer system is shared with Botswana and South Africa. Impacts would go far beyond the basin and threaten tourism generally, and export markets for beef and other products," he stated. Brown added that Headspring Investments used a Kazakh company to conduct a groundwater study, but they were expecting a local firm to complete the work. "Needless to say, the work was hopeless. It was sent to an independent and reputable company in Cape Town, which had worked in Namibia and enjoyed the confidence of the government and the private sector. Their report, which the Russians have kept out of the public domain, found the Kazakhstan report to fall seriously short in many ways, not least that they provided virtually no data to support the results of their modelling," added Brown.

Uranium One has reportedly sent six Namibian journalists to Kazakhstan to observe similar ISR mining activities. Uranium One spokesperson Riaan van Rooyen told *The Namibian* last month that it cannot comment on "generalizations, wrong assumptions and slanderous, false accusations. The article has been forwarded to our legal counsel and the case is now sub judice." Meanwhile, Namibia's Minister of Mines and Energy Tom Alweendo said the Ministry would continue to monitor the company's activities to ensure it complies with all conditions of its exploration license.

Kingsland Minerals reports drill results from Cleo uranium project in Northern Territory

Kingsland Minerals Ltd. announced October 11 results from its maiden reverse core (RC) drill program at the Cleo

uranium project in Australia's Northern Territory. The most encouraging assay results for the first 16 RC holes drilled in a 30 hole program include 42 meters at 0.0679% U₃O₈, including 8 meters at 0.1655% U₃O₈ (CLRC029); 54 meters at 0.0447% U₃O₈, including 4 meters at 0.1706% U₃O₈; and 16 meters at 0.0747% U₃O₈ (CLRC033).

A program of ~3,800 meters of RC drilling began in early September and 900 meters of diamond core drilling commenced in early October. The RC drilling is expected to be complete by mid-October and the diamond core drilling about four to six weeks after that pending weather delays.

Skyharbour reports additional drill results at Moore Lake project in northern Saskatchewan

Skyharbour Resources Ltd. reported October 13 assay results from its 2022 spring diamond drilling program at its 100% owned Moore uranium project, located on the southeastern side of the Athabasca Basin in northern Saskatchewan, Canada. Drilling totaled 2,467 meters in seven diamond drill holes. Four exploratory holes (ML22-01 to -04) were drilled at the Grid Nineteen target conductors, two exploratory holes (ML22-05 and -06) were drilled in the Viper target area, and one hole (ML22-07) was drilled at the Maverick Zone. ML22-07 was drilled within the western part of the Maverick East Zone and intersected 5.0 meters averaging 0.13% starting at 275.9 meters.

According to Skyharbour, future drill programs will test targets identified by modeling down plunge of the Maverick East Zone, targets along the Grid Nineteen conductors where anomalous geochemistry and geology have been identified, and regional targets at the project where the geochemistry/pathfinders and geology are strongly indicative of potentially uraniumiferous mineralizing systems.

Labrador Uranium to acquire Anna Lake and Moran B assets in Central Mineral Belt

Labrador Uranium Inc. (LUR) stated October 13 that it signed a definitive purchase agreement with Beaconsfield Ventures Ltd. to acquire 100% interest in the Anna Lake project and Moran Lake B-Zone prospect located in the Central Mineral Belt in central Labrador, Canada. Pursuant to the agreement, LUR has agreed to acquire the assets in exchange for the issuance of 5.0 million common shares of LUR at a price to be determined on the closing date of the acquisition, currently anticipated on November 1, 2022. As part of the acquisition, LUR will also assume Beaconsfield's obligations to pay and existing 2% net smelter royalty with respect to the assets to a third party.

The Anna Lake projects contains a historical inferred mineral resource of 4.91 million pounds U₃O₈ at 0.044% U₃O₈. Reconnaissance fieldwork conducted by LUR to the northeast of the Anna Lake property during the 2022 field season revealed a similar boulder train to that described by Bayswater at the Anna Lake deposit.

Strathmore Plus Uranium upsizes private placement to C\$1.4 million

Strathmore Plus Uranium announced October 12 that due to significant investor demand, it has increased the size of its previously announced private placement on October 7 from C\$600,000 to up to C\$1.4 million at C\$0.33 per unit. Each unit consists of one common share of the company and one whole common share purchase warrant. Each warrant entitles the holder to purchase one common share of the company at a price of C\$0.40 per share for a period of 24 months following the date of issuance.

ALX Resources increases private placement to C\$1.0 million

ALX Resources Corp. reported October 12 that due to investor demand, the company's non-brokered private placement announced on October 11 of flow-through (FT) units has been increased for gross proceeds of up to C\$1.0 million. Up to 20.0 million FT units are being offered at a price of C\$0.05 per FT unit consisting of one FT common share and one half of one non-FT common share purchase warrant. One whole common share purchase warrant from the FT units will entitle the holder to purchase one non-FT common share of the company at a price of C\$0.075 for a period of 36 months following the closing date of the offering.

Proceeds from the sale of FT units will be used for exploration programs on the company's Quebec, Saskatchewan, Ontario, and Nova Scotia mineral properties. ALX's uranium holdings in northern Saskatchewan include 100% interest in the Gibbons Creek project, the Sabre project, and the Javelin and McKenzie Lake projects. Additionally, ALX has a 40% interest in the Black Lake project and a 20% interest in the Hook-Carter project.

U3O8 Corp. changes name to Green Shift Commodities

U3O8 Corp. reported October 17 that it will be changing its name to "Green Shift Commodities Ltd." to better reflect the progression of the company and its vision for the future. In addition, its trading symbol will change from "UWE" to "GCOM". It is anticipated that the company's common shares will trade on the TSX Venture Exchange under the new symbol "GCOM" as of the open of markets on October 19, 2022.

Trumbull Fisher, CEO of U3O8 Corp., stated, "While uranium and the Berlin project continue to be an important part of our strategy, our new name symbolizes the direction in which we are headed; a company that is focused on the exploration and development of commodities needed to help decarbonize and meet net-zero goals."

The Market

Uranium Spot & Forward Market

The second week of October continued to be active for spot U₃O₈ with 16 transactions confirmed as awarded through last Friday. The U.S. equity markets saw mixed trading while remaining on a downward trend. But, SPUT's stock traded up later in the week, and despite the spot price also increasing, SPUT was able to briefly post at a premium to its net asset value. Thus, the trust was able to raise an additional \$12.7 million and reported its first spot purchase since September 9th. The SPUT purchase added to a slight increase in market demand interest that also included some motivated buying. With specific buying interest during the week for Orano delivery, pricing shifted to reflect a slight premium for this location later in the week. This differential peaked on Thursday and declined slightly by Friday afternoon, although the differential has continued through today (Monday). Last week's buyers included traders, financials, and producers with utilities mostly absent. However, a non-U.S. utility is now evaluating offers received this past Friday based on its request for about 860,000 pounds U₃O_{8e} (330,000 kgU as UF₆) with delivery between February and August 2023. With this past week's activity, October spot volume now stands at 30 transactions involving about 3.0 million pounds U₃O₈ equivalent.

As the third week of October begins, many are enjoying the opportunity to hold face-to-face meetings at NEI's IUFS in Las Vegas. Activity today has been quiet with limited transaction interest; however, bids have continued to move up, especially for Orano delivery. In Las Vegas, discussions abound as market participants seek to determine where market levels reside and gauge how they could move next. Part of those discussions indicate that the price increases that emerged last week continue to hold today. With many involved in meetings, spot activity was slower today, yet, the small price increases for other delivery locations noted later in the day on Friday have continued into today.

Based on transactional volume breakdowns by location for recent activity, as well as current bids and offers at all locations, the Ux U₃O₈ Price increases to \$50.45 per pound, up \$0.30 for the day and up \$1.95 for the week. With shifting

Market Highlights

- Spot uranium activity was at higher levels for the second week in a row to start October with a total of 16 spot transactions booked during the week.
- Given sustained spot demand interest, and a motivated buyer in the market, spot prices continued to firm upward last week with some pricing differentials emerging later in the week due to location-specific demand interest.
- Term activity has remained quiet as a few utilities continue to evaluate offers, but no new formal demand or contract awards for any component were reported.

demand, pricing differentials reported last week continue. Based on the most competitive market information, price for delivery within three months at Cameco increases to \$50.25, ConverDyn increases to \$50.50, and Orano is at \$50.75 per pound. The Ux 3-Year & 5-Year U₃O₈ Forward Prices are unchanged at \$56.00 and \$59.50 per pound, respectively.

Uranium Term Market

Although the uranium market was quiet over the past week with no reported new demand or contract awards and only one utility is active with a formal request, multiple utilities have been quietly active while several are expected to enter the market this quarter. A non-U.S. utility is evaluating offers based on its request for EUP and/or components for 2022-2025 for variable quantities of just over 955,000 pounds U₃O₈ per year. A few utilities are expected to enter the term market in the near term, including a non-U.S. utility expected to submit requests for components and/or EUP with delivery that could include 2023-2032. Another non-U.S. utility is expected to come out for U₃O₈ starting in 2024, and a third utility is expected to match up U₃O₈ with recent term conversion and enrichment services procurement activity. Other off-market activity involving utilities seeking both mid- and longer-term coverage also continues.

Conversion & UF₆ Market

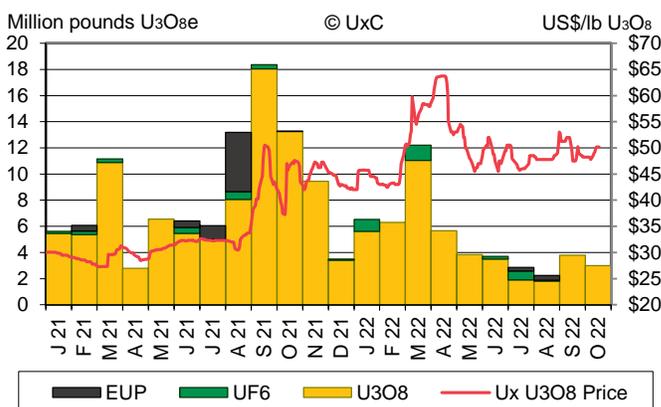
Market activity for spot conversion or UF₆ continues to be limited and sporadic. Recent formal activity consists of a single non-U.S. utility that is now evaluating spot offers received this past Friday based on its formal request for up to 330,000 kgU as UF₆ with delivery in February and August 2023. No

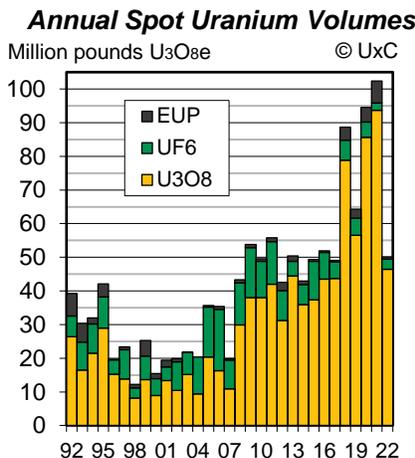
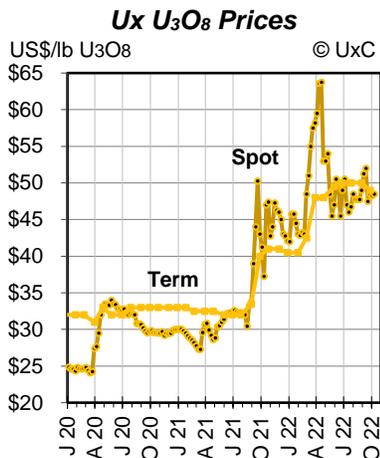
UxC Market Statistics

Monthly (Oct)	Spot		Term (Utility only)	
	Volume	# Deals	Volume	# Deals
U ₃ O _{8e} (million lbs)	3.0	30	W	W
Conv. (thousand kgU)	W	1	W	W
SWU (thousand SWU)	0	0	0	0
2022 Y-T-D	Spot		Term (Utility only)	
	Volume	# Deals	Volume	# Deals
U ₃ O _{8e} (million lbs)	48.4	348	>85.0	>40
Conv. (thousand kgU)	>2,350	25	>33,000	>25
SWU (thousand SWU)	1,172	14	22,700	18

Key: N/A – Not available. W – Withheld due to client confidentiality.

Ux U₃O₈ Price vs. Spot Volume by Form





Ux Price Indicators (€ Equiv [†])		
Weekly (10/17/22) 1 US\$ = 1.01612€		
Ux U ₃ O ₈ Price	\$50.45	€51.26
Ux U ₃ O ₈ CMC Price	\$50.25	€51.06
Ux U ₃ O ₈ CVD Price	\$50.50	€51.31
Ux U ₃ O ₈ ORO Price	\$50.75	€51.57
Ux 3-Yr Forward	\$56.00	€56.90
Ux 5-Yr Forward	\$59.50	€60.46
Mth-End (9/26/22) 1 US\$ = 1.04129€		
U ₃ O ₈ Ux U ₃ O ₈ Price	\$48.50	€50.50
CMC	\$48.50	€50.50
CVD	\$48.50	€50.50
ORO	\$48.50	€50.50
Spot MAP [†]	\$49.81	€51.87
3-Yr Forward	\$54.50	€56.75
5-Yr Forward	\$58.25	€60.66
Long-Term	\$49.00	€51.02
NA Spot	\$38.00	€39.57
NA Term	\$26.50	€27.59
EU Spot	\$38.00	€39.57
EU Term	\$27.00	€28.11
U ₃ O ₈ Conversion Ux U ₃ O ₈ Price	\$164.75	€171.55
NA Value*	\$164.72	€171.52
EU Value*	\$164.72	€171.52
SWU Ux U ₃ O ₈ Price	\$92.00	€95.80
Long-Term	\$135.00	€140.57
EUP Ux U ₃ O ₈ Price	\$2,257	€2,350
NA Spot**	\$2,420	€2,520
NA Term**	\$2,420	€2,520

other new demand is reported for the week. For the few sellers looking to place material there have been few options. However, last week, a small amount of UF₆ was reported sold in a spot transaction. Pricing in this deal shows that UF₆ pricing continues to closely track component values, and that the conversion spot price remains firm with upward pressure.

The term conversion market stayed quiet last week with no reported new demand or contract awards. A non-U.S. utility is evaluating offers based on its RFP for EUP and/or components for 2022-2025 for variable quantities up to just over 360,000 kgU as UF₆ per year. Another non-U.S. utility is expected to submit requests for conversion and/or EUP with delivery in 2023-2032. Other utilities continue with off-market discussions, while additional formal term conversion demand is anticipated in the near future.

EUP remains limited with only a few market participants noted as being interested in picking up additional material. While spot volume levels have been low, some material remains available for near-term delivery with a seller currently seeking to place material.

For term, no new enrichment demand or contract awards were reported over the past week. A non-U.S. utility is evaluating offers based on its request for EUP and/or components for 2022-2025 for variable quantities of up to just over 400,000 SWU per year. Another non-U.S. utility is expected to issue a formal request for SWU and/or EUP for delivery in 2023-2036. Multiple other utilities are planning future RFPs or remain in direct discussions with primary suppliers.

Enrichment & EUP Market

Activity in the spot enrichment market continues to be limited with no new demand or transactions reported over the past week. Interest for near-term delivery of either SWU or

Ux Price Indicator Definitions

Ux Spot Prices indicate, subject to the terms listed, the most competitive offers available for the respective product or service of which UxC, LLC is aware, taking into consideration information on bid and transaction prices as well as the timing of bids, offers, and transactions (with a cut-off time of 2:30pm Eastern Time). The **Ux U₃O₈ Price[®]** (Spot) includes conditions for delivery timeframe (≤ 3 months), quantity (≥ 100,000 pounds U₃O₈), and origin considerations. †The **Ux U₃O₈ Monthly Average Price** (Spot MAP) represents the average of all Monday Ux U₃O₈ Prices for the month. The **Ux U₃O₈ 3-Year and 5-Year Forward Prices** reflect UxC's estimate of prices for U₃O₈ delivery 36 and 60 months forward taking into account market activity and other indicators, using the same quantity and origin specifications as the Spot indicator. The **Ux LT U₃O₈ Price** (Long-Term) includes conditions for escalation (from current quarter), delivery timeframe (≥ 36 months), and quantity flexibility (up to ±10%) considerations. The **Ux Conversion Prices** consider offers for delivery up to 12 months forward (Spot) and base-escalated long-term offers (Term) for multi-annual deliveries of conversion services with delivery in North America (NA) or Europe (EU). The **Ux NA UF₆ Price** includes conditions for delivery timeframe (6 months), quantity (≥ 50,000 kgU as UF₆), and delivery considerations. *The **Ux NA and EU UF₆ Values** represent the sum of the component U₃O₈ (multiplied by 2.61285) and conversion spot prices as discussed above, and therefore do not necessarily represent the most competitive UF₆ spot offers available. The **Ux SWU Price** (Spot) considers spot offers for deliveries of SWU up to 12 months forward. The **Ux LT SWU Price** (Long-Term) reflects base-escalated long-term offers for multi-annual deliveries of SWU. **The **Ux Spot and Term EUP Values** are provided for comparison purposes only and represent calculated prices per kgU of enriched uranium product based on a product assay of 4.50% and a tails assay of 0.30%, using spot and term Ux NA and appropriate spot and term price indicators. The Ux U₃O₈ Price is published daily (excluding certain U.S. holidays), the Ux Forward Prices are published every Monday, and all other Ux Price indicators are only published the last Monday of each month. All Ux Month-End Prices are as of the last Monday of each month. Ux Prices represent neither an offer to sell nor a bid to buy the products or services listed. ‡The Euro price equivalents are based on exchange rates sourced from XE.com at the time of publication and are for comparison purposes only. (Units – U₃O₈: US\$ per pound, Conversion/UF₆: US\$ per kgU as UF₆, SWU: US\$ per SWU, EUP: US\$ per kgU)

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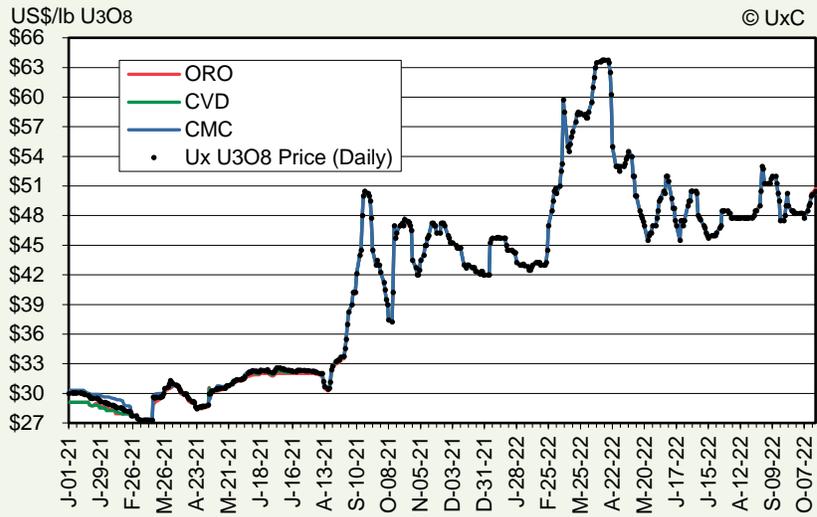
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UxC U₃O₈ Location Pricing

The spot UxC U₃O₈ CMC, CVD, and ORO Prices reflect UxC's determination of prices for U₃O₈ delivery at the specified delivery location taking into consideration bids, offers, and market activity, using the same delivery time period, quantity, and origin considerations as the UxC U₃O₈ Price® indicator, and are published daily (excluding certain U.S. holidays). The CMC [Cameco], CVD [ConverDyn], and ORO [Orano] naming convention represent individual book transfer delivery locations. Please note that the use of company names as part of the delivery location naming convention represents neither an endorsement by the respective companies nor by UxC.

Under cooperation with our participating brokers, Evolution Markets and Numerco Limited (the "Brokers"), UxC collects on a daily basis the best spot bids and offers reported for prompt delivery. *From this Broker data, UxC calculates the UxC Broker Average (BA) Bid and the UxC Broker Average (BA) Offer prices and presents them in the table below for comparison purposes only.



Daily UxC U₃O₈ Spot Prices (Change from previous day)

Date	UxC U ₃ O ₈ Price	CMC [Cameco]	CVD [ConverDyn]	ORO [Orano]	UxC BA Bid*	UxC BA Offer*
17-Oct-22	\$50.45 (+0.30)	\$50.25 (+0.15)	\$50.50 (+0.40)	\$50.75 (+0.50)	\$50.25 (+0.25)	\$50.75 (+0.25)
14-Oct-22	\$50.15 (+0.15)	\$50.10 (+0.20)	\$50.10 (+0.20)	\$50.25 (Unch.)	\$50.00 (+0.12)	\$50.50 (+0.12)
13-Oct-22	\$50.00 (+0.75)	\$49.90 (+0.65)	\$49.90 (+0.65)	\$50.25 (+1.00)	\$49.88 (+1.13)	\$50.38 (+0.63)
12-Oct-22	\$49.25 (+0.25)	\$49.25 (+0.25)	\$49.25 (+0.25)	\$49.25 (+0.25)	\$48.75 (+0.25)	\$49.75 (+0.25)
11-Oct-22	\$49.00 (+0.50)	\$49.00 (+0.50)	\$49.00 (+0.50)	\$49.00 (+0.50)	\$48.50 (+0.25)	\$49.50 (+0.50)
10-Oct-22	\$48.50 (+0.75)	\$48.50 (+0.75)	\$48.50 (+0.75)	\$48.50 (+0.75)	\$48.25 (+0.50)	\$49.00 (+0.75)
07-Oct-22	\$47.75 (-0.45)	\$47.75 (-0.45)	\$47.75 (-0.45)	\$47.75 (-0.45)	\$47.75 (-0.13)	\$48.25 (-0.25)
06-Oct-22	\$48.20 (-0.05)	\$48.20 (-0.05)	\$48.20 (-0.05)	\$48.20 (-0.05)	\$47.88 (-0.12)	\$48.50 (-0.12)
05-Oct-22	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.00 (-0.12)	\$48.62 (-0.26)
04-Oct-22	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.12 (+0.12)	\$48.88 (-0.12)
03-Oct-22	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.25 (Unch.)	\$48.00 (+0.12)	\$49.00 (+0.12)

CME Uranium U₃O₈ (UX) Futures

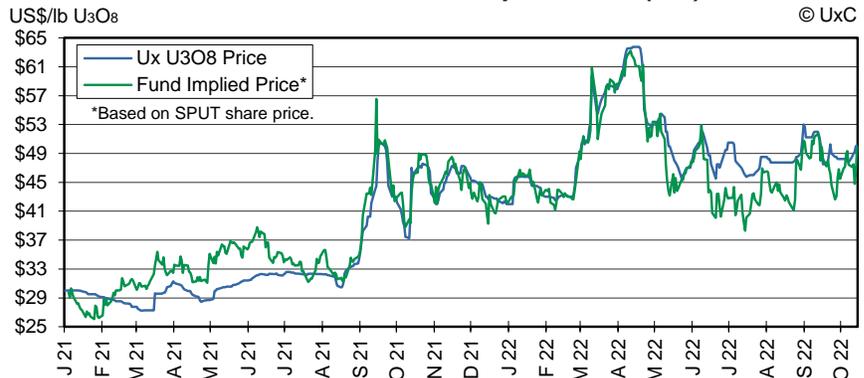
Activity as of October 7, 2022

Settlement	Price	Volume	Open
Dec 2019	\$25.00	1,745	-
Jan 2020	\$24.35	3	-
Feb 2020	\$24.70	1,603	-
Mar 2020	\$27.40	663	-
Apr 2020	\$32.75	5	-
May 2020	\$34.00	56	-
Jun 2020	\$32.60	1,209	-
Jul 2020	\$32.20	12	-
Aug 2020	\$30.65	9	-
Dec 2020	\$30.00	3	-
Aug 2021	\$33.75	200	-
Sep 2021	\$43.00	163	-
Feb 2022	-	80	-
Mar 2022	-	80	-
Apr 2022	-	80	-
Feb 2023	\$50.60	696	600
Mar 2023	\$50.85	200	200
From May 2007 Totals:		126,277	800

UxC U₃O₈ Prices vs. CME Forward UX Prices vs. NL Forward Curve



UxC U₃O₈ Price vs. Fund Implied Price (FIP)



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