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NUCLEAR INTELLIGENCE WEEKLY®

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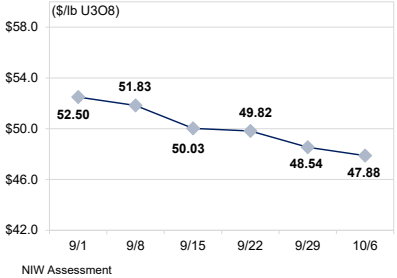
Market Points

US nuclear power and fuel industry members expressed concern this week that an amendment in the fiscal 2023 defense budget to ban Russian nuclear fuel imports could cause more problems than it solves.

The spot market this week saw little action from traders or investors, with Energy Intelligence's Uranium Price Panel delivering an average spot price of $47.88 per pound U3O8 on Oct. 6, down from $48.54/lb. on Sep. 29.

The escalation of Russian authority at the Zaporizhzhia nuclear power plant — amid calls from Ukrainian officials to sanction Rosatom — is adding pressure on US and European lawmakers to act and the prospect of a supply ban has put a freeze on buying activity.

UPP: $47.88/LB U3O8



NIW Assessment

WEEKLY ROUNDUP

UK to Site Prototype Fusion Facility at Brownfield Coal-Plant

- The UK government this week selected a location for the country's prototype fusion energy plant that it hopes will be built by 2040: the brownfield West Burton site in Nottinghamshire, currently home to a large EDF coal-fired power plant. The "Spherical Tokamak for Energy Production" is being developed by the government's UK Atomic Energy Authority, which plans to complete a "concept design" by 2024. "Over the decades we have established ourselves as pioneers in fusion science and I am delighted to announce an important step in that mission, replacing the West Burton coal-fired power station with a beacon of bountiful green energy," Business and Energy Secretary Jacob Rees-Mogg said in an Oct. 6 statement. "The plant will be the first of its kind, proving the commercial viability of fusion energy to the world." The UKAEA noted that "there remains a number of significant technical hurdles to overcome to realize fusion," and it, therefore, is targeting first operations of the prototype plant "in the early 2040s." The government is providing £220 million ($248 million) in funding over the next two years to develop the concept design.

- In 2021, global investments in non-hydro renewables totaled a record US$366 billion, adding roughly 250 gigawatts of net capacity, while operating nuclear capacity decreased by 0.4 gigawatts. That's one of several eye-popping comparisons noted in the World Nuclear Industry Status Report 2022 launched this week. The annual report found that wind and solar alone reached a 10.2% share of gross global power generation in 2021, for the first time surpassing the contribution of nuclear energy. "Globally the cost of renewables is now significantly below that of either nuclear power or gas, which also shows that economically it is clear for us that nuclear energy can't really serve as an answer to our energy demands," Jan Philipp Albrecht, president of the German Green Party organization Heinrich-Boll-Stiftung, said during the report's presentation on Oct. 5.

- Two powerful US senators have introduced a ban on Russian nuclear fuel imports in an amendment to the fiscal 2023 US Department of Defense budget being negotiated in the Senate. The amendment from Joe Manchin, a centrist Democratic senator from West Virginia, and long-time domestic nuclear fuel industry advocate John Barrasso, a Wyoming Republican, was introduced on Sep. 30 amid reports of Russian occupiers at Zaporizhzhia forcing workers to sign contracts with Russia's state-owned Rosatom for further employment. The bipartisan legislation would provide an avenue for US utilities to request an exemption to the ban if they can show "no viable source of alternative supply," but that waiver would expire by the end of 2025. The amendment to the National Defense Authorization Act for fiscal 2023 includes $3.5 billion in funding for the US Department of Energy's proposed domestic nuclear fuel procurement program, otherwise known as the American Assured Fuel Supply program, in an attempt to offset Russian supply. That could be in addition to a separate $1.5 billion the agency sought in a recent continuing resolution to fund the government through Dec. 16 that was ultimately stripped from the bill's language.

NUCLEAR FUEL MARKET

Manchin, Barrasso Introduce New Uranium Ban

A ban on Russian nuclear fuel imports to the US was introduced late last week as an amendment to the fiscal 2023 US Department of Defense budget, and while it includes waivers for utilities unable to source alternative supply, the US nuclear industry remains wary.

Various nuclear power and fuel industry members have expressed concern that an official move by the US to effectively block Rosatom's nuclear fuel supply could be met with a rebuke from Russia to sever that supply chain early. And Western nuclear fuel suppliers have consistently made the case that they would need until at least 2027 to ramp up capacity to offset Russian supply.

The recently-introduced amendment represents a compromise between powerful moderate Democrat Sen. Joe Manchin, of West Virginia, and Wyoming Republican Sen. John Barrasso. Barrasso first introduced an all-out ban on Russian nuclear fuel imports in March following Russia's invasion of Ukraine, with no waivers and the ban taking effect 45 days after enactment. Shortly after, Manchin introduced a more measured bipartisan approach, including support for a global nuclear liability regime and nuclear export financing, in addition to domestic nuclear fuel initiatives designed to "eventually eliminate reliance on Chinese and Russian nuclear fuels."

Since then the senators and their staff have been working closely with members of the Biden White House, the US Department of Energy (DOE) and nuclear industry leaders to outline a less punitive proposal for the US utilities that have existing long-term contracts with Russia's Rosatom. But these conversations have taken place and will likely continue to take place behind the scenes, particularly with the amendment being included in the nearly $850 billion fiscal 2023 National Defense Authorization Act (NDAA), which includes hundreds more amendments, many of which may never see the light of day.

Lawmakers are expected to resume negotiations to finalize the NDAA after the November mid-term elections. The amendment, introduced by Sens. Manchin, Barrasso and Jim Risch, an Idaho Republican, extends the nuclear import ban to Chinese supply, even though Chinese nuclear supplies have always been minimal, and are currently negligible.

The language would also amend the latest version of the Russian Suspension Agreement (RSA) to match the import ban. Following extensive negotiations over the RSA in 2020, one noteworthy provision was added. That provision designated as Russian the return UF6 feed that US utilities swap as part of their SWU contracts with Rosatom's Tenex. Had that provision not been included, and that feed not designated as Russian under the RSA quota limiting Russian imports, suppliers could have stocked up more UF6 feed in the US, and that might have alleviated the UF6 bottleneck that is helping constrain Western enrichment capacity.

The amendment also includes $3.5 billion to support DOE entering into two or more contracts to acquire "not less than 100 metric tons per year of LEU" by the end of 2026 and two or more contracts for "not less than 20 metric tons per year" of high-assay low-enriched uranium by the end of 2027. Those procurements are to take place 180 days after enactment. The amendment also stipulates that the agency procure "only uranium produced, converted, and enriched" in the US, or if not practical, from allied or partnered nations, associated entities, or a US nuclear energy company.

Many US buyers of Russian nuclear fuel have been reluctant to secure the long-term supply agreements that Western suppliers want before investing in the new capacity required to offset Russian supply. While US utilities have already self-sanctioned in that they are not signing any new contracts with Rosatom, there remains hope that in a year or two from now, the dust from the Ukraine conflict will have settled. For US utility fuel buyers trying to meet budgetary requirements, the choice is between signing expensive term contracts with Western suppliers now and the risky prospect that in time the geopolitical conflict is resolved and Rosatom somehow returns to the global stage as a trusted supplier of nuclear fuel at a lower price.

Meanwhile, illiquidity once again defined this week's spot uranium market, with Energy Intelligence's Uranium Price Panel delivering an average spot price of $47.88/lb. U3O8 on Oct. 6, down from $48.54/lb. on Sep. 29.

Jessica Sondgeroth, Washington

URANIUM PRICE PANEL

For the week ended October 6, 2022

Weekly Spot Market Prices

		Oct	Sep					Aug				Jul		
	Chg.	6	29	22	15	8	1	25	18	11	4	28	21	14
Price ($/lb U3O8)	-0.66	47.88	48.54	49.82	50.03	51.83	52.50	48.38	47.75	47.63	47.84	48.85	46.03	46.04
Total Assessments	*1.00*	*9.00*	*8.00*	*10.00*	*10.00*	*8.00*	*8.00*	*9.00*	*10.00*	*9.00*	*8.00*	*9.00*	*10.00*	*9.00*
% within 1 StDev	*-9.72*	*77.78*	*87.50*	*60.00*	*70.00*	*75.00*	*62.50*	*77.78*	*80.00*	*77.78*	*75.00*	*55.56*	*80.00*	*55.56*
Low ($/lb U3O8)	-0.75	47.50	48.25	49.00	49.00	51.25	52.00	48.00	47.50	47.25	47.50	48.50	45.75	45.50
High ($/lb U3O8)	-0.75	48.25	49.00	51.00	51.00	52.00	53.50	49.00	48.25	48.00	48.25	49.25	46.25	46.75
Variability*	-0.01	0.07	0.08	1.00	0.38	0.19	0.39	0.38	0.25	0.04	0.00	0.00	0.00	0.31

*This represents the value of the potential range of conceivable final averages that might result when random elimination is used to balance market positions within the panel.

UKRAINE

Russia Claims Zaporizhzhia

The situation for workers at the Zaporizhzhia nuclear plant grew more grim this week as the plant's manager was abducted and they were forced to decide between competing management and owners, following the Kremlin's announcement that the plant is now Russian. Workers at Europe's largest nuclear plant must now decide whether to sign employment contracts with — and follow the directives of — a new Russian firm the Kremlin asserts is the plant's owner, or whether to stay committed to Ukrainian operator Energoatom and face retribution from the Russian forces that control Zaporizhzhia.

"This is a particularly dangerous moment for the safety and security of" Zaporizhzhia, International Atomic Energy Agency (IAEA) Director General Rafael Grossi said in an Oct. 6 statement released after he met with Ukrainian President Volodymyr Zelensky in Kyiv. "Staff at the plant are being forced to make a hugely difficult decision for themselves and their loved ones. The enormous pressure they are facing must stop."

The latest developments risk exacerbating the situation by leading to confusion about who is in charge as well as ambiguity about the command-and-control chain at the plant, Grossi said.

The pressure began last week as Russia illegally annexed four provinces of Ukraine, including the Zaporizhzhia province, home to the six VVER-1000s at the nuclear power plant (NPP) that has been occupied by Russian troops since March. Late on Thursday, Sep. 29, the Ukrainian delegation at the IAEA General Conference alleged that Russia's Rosatom had told Zaporizhzhia employees they would need to apply for employment at Rosatom within the next two weeks.

The next day Ihor Murashov, the plant's director general who has overseen the plant throughout its occupation, was kidnapped and detained by Russian forces. "Such a detention of any member of the plant staff would be a source of grave concern in itself, but also for its psychological impact and pressure on the rest of the staff — which is detrimental to nuclear safety and security," Grossi said in an Oct. 1 statement.

After Russia's Duma ratified the annexation earlier this week the Kremlin made official its play for the nuclear plant: an Oct. 5 decree ensured the "acceptance into federal ownership" of the facility and established a new state-owned enterprise called "Zaporozhye NPP" — using the Russian rather than Ukrainian spelling of the plant — to operate it.

A Play for Ownership and Control

"In the near future, all current NPP employees will be employed as staff in the new operating organization with the same wages and social guarantees," Oleg Romanenko, the Russian-appointed head of the new Zaporozhye NPP operating company, said in an Oct. 5 statement released by Rosenergoatom, the Rosatom subsidiary that operates Russia's domestic nuclear fleet. Romanenko previously served as head of Rosenergoatom's Balakovo nuclear plant, which has four VVER-1000s.

The assertion of Russian operational control at Zaporizhzhia is a striking departure from the uneasy status quo of the past seven months. Only last week Mikhail Ulyanov, Russia's ambassador to the IAEA, boasted to Energy Intelligence that the Russian troops occupying Zaporizhzhia were not interfering at all operationally. "The plant is being operated by Ukrainians: Ukrainian personnel and Energoatom, which is located in Kyiv," said Ulyanov.

This past week, however, has seen a concerted Russian assault on Zaporizhzhia's operations, starting with the Sep. 29 ultimatum to plant workers and escalating with Murashev's kidnapping and detention over the weekend. Following diplomatic efforts Murashev was released, but once safely back with his family he stepped down from his role and Energoatom announced Oct. 5 that Petro Kotin, its president, would temporarily and remotely assume the role of Zaporizhzhia director-general.

Kotin can have only limited impact on Zaporizhzhia, however, given Russian assertion of operational control. In an Oct. 5 Telegram post Kotin exhorted plant workers not to conclude any agreements, statements or contracts with the Russian occupiers. "Do not do this under any circumstances!" said Kotin from Kyiv.

Energoatom has also established a telephone help line for its employees working under the Russian occupation.

Furious Reactions

Not surprisingly Russia's aggressive moves prompted furious pushback across the world, particularly following last week's annexation. UN Secretary General Antonio Guterres declared it has "no legal value" and "cannot be reconciled with the international legal framework."

The Kremlin's expropriation of Zaporizhzhia was dismissed as a "worthless decision" by Energoatom, while Ukrainian Energy Minister German Galushchenko sent letters to the IAEA, European Commissioner for Energy Kadri Simson and various G7 ministers calling on "all states" to implement sanctions against Rosatom and the Russian nuclear industry.

Rosatom is being drawn in ever further to the takeover of Zaporizhzhia, but the Kremlin's expropriation decree doesn't mention the state-owned nuclear powerhouse, and the Rosenergoatom announcement said only that the newly-launched Zaporozhye NPP company "is designed to ensure the safe operation of the nuclear power plant and oversee the work of the plant's existing personnel with the support of Rosenergoatom."

For the moment the likelihood of sanctions against Rosatom are remote. The operational and attempted legal seizures at Zaporizhzhia were condemned by both Washington and Brussels, but neither singled out Rosatom.

"Zaporizhzhia belongs to Ukraine, the power plant belongs to Ukraine, and the electricity and the energy that it produces rightly belongs to Ukraine," US State Department spokesperson Vedant Patel said Oct. 6. "President Putin has absolutely no authority to take over a power plant in another country and a piece of paper issued by him or his government certainly doesn't change that fact either."

In Vienna the EU mission to the Organization for Security and Cooperation-in Europe on Oct. 6 condemned "Russia's attempts to legitimise its illegal seizure of nuclear facilities in Ukrainian sovereign territory, including President Putin's recent decree" on Zaporizhzhia. The EU "fully supports" Grossi's work "assisting Ukraine to ensure nuclear safety and security, and to maintain the implementation of the safeguards," it continued. "However, the only way to assure the long-term safety and security of the facility is for Russia to withdraw its troops" from the Zaporizhzhia NPP "and return it to full and exclusive Ukrainian control."

For his part Grossi, who was headed to Moscow following his discussions in Kyiv, made clear that the IAEA "will be guided" by international law. But it's unclear how or whether he can contribute to de-escalating the situation, particularly the rival chains of command.

It's also unclear whether Grossi will obtain agreement from Russia to retain IAEA safeguards at Zaporizhzhia, as Ukraine has done. Ulyanov's office in Vienna declined to comment on whether Russia, which as a nuclear weapons state has no obligation to submit its domestic facilities to IAEA safeguards, will maintain the safeguards status quo at the embattled plant.

Phil Chaffee, London

NEWBUILD

MHI Unveils a New Reactor Design

The 1,200 megawatt "next-generation" pressurized water reactor (PWR) unveiled by Japan's Mitsubishi Heavy Industries (MHI) comes amid a major government push for more nuclear energy, but with an uncertain future. If ever developed the "SFZ-1200" would likely be used to replace aging PWRs in the Japanese fleet, or even reactors in decommissioning.

MHI has been working on the design since at least 2019 in collaboration with four Japanese utilities, including Kansai Electric Power Co., the largest user of MHI-designed, manufactured and constructed PWRs. The SFZ-1000 development work appears to be completely independent of MHI's joint-venture collaboration with France's Areva (the reactor division of which was subsumed by EDF) on the 1,100 MW Atmea1. That joint venture ended in 2020, having failed to secure any orders. Kansai "is in the driver's seat" on the project, according to a French industry source, who added that for MHI "there has always been" development work on a reactor suitable for Japan.

MHI's unveiling of the SFZ-1200 is the most overt push into newbuilds of any of Japan's traditional nuclear firms since the successive retreat over the past five years of Toshiba and Hitachi from the global newbuild market. Industry analysts said the design could be an option for replacing existing PWRs and serve as a bridge to sustain Japan's nuclear industry, but there are questions about how truly "innovative" the design is and whether the Japanese public will ever accept new nuclear projects. Former Atomic Energy Commission Deputy Chairman Tatsujiro Suzuki told Energy Intelligence that the SRZ-1200 "is not so much an 'innovative' design but an 'improved' light-water reactor." The rollout of design "is one way to keep nuclear vendors alive so that Japan can maintain a nuclear energy option in the future," he said, but "it is not clear at this moment whether utilities will make orders for such a plant in the future."

Besides Kansai, which has 11 MHI reactors in Fukui prefecture, the three other utilities involved in the MHI collaboration are Kyushu Electric, Hokkaido Electric and Shikoku Electric. If replacing reactors becomes an option, Kansai will have no shortage of candidate sites: It has four operating PWRs at Takahama, but at Ohi, two of four are in decommissioning, and at Mihama, only Mihama-3 is still operating with the first two reactors in decommissioning.

A recent Ministry of Economy, Trade & Industry report mooted possible newbuild deployments at previously planned expansions of existing nuclear plants using PWRs. These could include the proposed third and fourth units at Japan Atomic Power Co.'s (JAPC) Tsuruga nuclear power plant, one additional unit at Kansai's Mihama facility and a third unit at Kyushu Electric's Sendai facility, all of which were planned prior to the March 2011 disaster.

Kyushu, with six reactors in total, has retired the first two of four reactors at Genkai in Saga prefecture and two operating units at Sendai. Hokkaido has three idled MHI-designed units at Tomari while Shikoku has three PWRs at Ikata in Ehime prefecture, of which only Ikata-3 is operational. MHI is also the supplier of Tsuruga-2 to JAPC, which was not a listed participant in the design project.

A 'Bespoke' Option for Japanese Utilities

One French nuclear industry source told Energy Intelligence that the SFZ-1200 appears tailored to Japan's challenging operating environment, with tight space restraints and high seismic risk. For example, the SFZ-1200 turbine hall is "oriented perpendicular

to the axis of the nuclear island," said the source. The source added that Japanese reactor sites are "very, very small. That's why they choose to keep the turbine hall perpendicular to the nuclear island, so it can fit on a Japanese site."

MHI boasts that its SFZ-1200 offers diverse safety features, including a "core capture" mechanism and watertight construction, making it highly resistant to all types of natural disasters. It includes a high degree of cybersecurity as well as compatibility with variable energy sources that make it responsive to supply-demand trends. The reactor also has the capability of using mixed-oxide fuel, according to MHI, which has yet to release projected construction costs.

A Kansai spokesperson told Energy Intelligence that the design project began in 2019 as part of a program to examine new technology in line with the PWR alliance's effort to develop "next-generation light-water reactors with improved safety." In January, Japanese news media reported that MHI was developing an "innovative light reactor model" that would be safer and more compatible with variable energy resources, but MHI gave few details. As an MHI technology-user Kansai "presents our knowledge from our experience in operation and maintenance and our needs so that they can be reflected in the design developed by MHI," the spokesman explained. However, he added that the Osaka-based utility "has made no decision regarding specific construction sites or timing for additions or replacements."

Similarly, a Kyushu Electric spokesperson told Energy Intelligence that the utility has decided to maximize nuclear power generation on the premise of "ensuring safety," although the Fukuoka-based firm "has no specific plans at present to introduce the SRZ-1200" and will continue to explore various options and collect information on innovative light-water reactors, small modular reactors and fast reactors. "We believe that the innovative light-water reactor is one option," said the Kyushu spokesperson, who added that the MHI project "is very meaningful from the standpoint of "sharing mutually beneficial information" and "maintaining and improving nuclear power technology in the future."

Spokespersons for both Hokkaido Electric and Shikoku Electric told Energy Intelligence that their respective firms had no plans to build such reactors, but that safety designs and other technology and knowledge gained from participating in the review of the new MHI design could be applicable to future improvement in their existing facilities.

The MHI design joins a growing list of new designs, including small modular and advanced reactors, although a senior industry professional said that "the market for SMRs is likely to be small in Japan since new or distributed siting is difficult" as Japan has a densely populated coastline "and inland siting is not easy given high humidity and relatively small rivers."

Apart from an uphill battle for public acceptance of nuclear, other uncertainties for newbuild planners include cost, financing and regulation. "New regulatory standards will have to be formulated and it will not be easy to find sites for large reactor structures that must be installed semi-underground," cautioned Yoichi Nishiyama, an analyst with Kyoto-based Green Action.

Dennis Engbarth, Taipei City, Phil Chaffee, London

NUCLEAR FUEL

Russia's Hold on Medical Isotope Feed

Russia's hold over western reactor operators dependent on Rosatom fuel supply extends to the industry's little-noticed medical isotopes niche, and that may be a key reason governments are avoiding any sanctions on Rosatom.

Amid renewed calls by Ukrainian officials for sanctions on Rosatom, particularly after the Russian Federation annexed four eastern Ukraine regions and formalized control over the Zaporizhzhia nuclear power plant, lawmakers in the US and EU for the most part remain quiet. Meanwhile, US and EU officials are navigating research reactor schedules and shipments to ensure timely delivery of life-saving treatments and diagnostic materials while trying to rally buyers to fund investments in new capacity to diversify away from Russia.

Like the civilian nuclear fuel market, the western medical isotope industry expects it will take years to stand up new capacity. Long term, the industry is developing alternative methods for medical isotope production that involve technologies like particle accelerators. But for now Russia remains the sole supplier of some target materials needed to produce medical isotopes, including high-assay low-enriched uranium (Haleu), which is also required by a number of advanced reactor vendors.

"Any U.S. government sanctions on Rosatom, or its subsidiaries (and affiliates), will significantly disrupt the supply of many of our essential medical and industrial isotopes," warned Michael Guastella, executive director of the Council on Radionuclides and Radiopharmaceuticals, in Jun. 22 written testimony to the House Science Committee. In the same hearing, DOE Office of Science Director Asmeret Asefaw Berhe said that Russia's invasion of Ukraine had already disrupted transportation of medical isotopes.

Many medical isotopes have half-lives of only days, meaning for their application to be useful in treating or diagnosing patients, they have to be moved quickly. That's part of the beauty of this unique medical solution; the gamma rays decay shortly after use to minimize radiation exposure to the body. But Berhe said that of some 31 radioisotope supply chains which the US relies on for Russian supply, about 19 had experienced disruptions due to Russia's invasion of Ukraine.

Medical isotopes are produced in nuclear reactor cores, a process requiring HEU or Haleu. The "workhorse" medical isotope is molybdenum-99 which is used to create technetium-99m "used in 80% of all nuclear medicine diagnostic procedures," according to Remigiusz Baranczyk, who heads Euratom's Monitoring of Nuclear Market and Supply of Medical Radioisotopes. Europe accounts for about 60% of global production for that isotope, but there are only two suppliers of the uranium metal required for producing technetium: the US and Russia, and the US stock is limited.

"When you don't have a crisis situation, there are hundreds of other things to worry about," Baranczyk told Energy Intelligence. "Now with the Russian aggression in Ukraine, everybody's looking very seriously at it."

Enriched Feedstock

In the past, HEU enriched beyond 20% was the primary feedstock for medical isotope production but because HEU comes with higher security costs and poses a greater proliferation risk, the medical isotope industry has more recently shifted to Haleu. Haleu is enriched up to 19.75% and has slowly replaced HEU to produce medical isotopes in research reactors, and the US and Russia have been the chief suppliers of those source materials.

The US, however, produces Haleu by downblending HEU, and the government's existing HEU stockpiles have already been designated. Euratom has a 2021 memorandum of understanding to ensure US supply to the EU for five years. Beyond that, it's unlikely there is any excess US HEU available to meet further demand, and in an already tight market, the US has no capacity to produce Haleu by further enriching low-enriched uranium (LEU).

Both Euratom and the US Department of Energy (DOE) are working with commercial nuclear fuel suppliers to bring on new Haleu capacity but such efforts may not pay off until later in the decade. The DOE is currently in the process of soliciting responses from the industry to develop Haleu capacity for its Advanced Reactor Demonstration Program, which could see European consortium Urenco develop Haleu capacity at its plant in New Mexico.

The US requires up to 750 kgU, or less than 1 metric ton, of Haleu per year to produce medical isotopes. By contrast, the DOE's two advanced reactor vendors in the US require about 25-30 metric tons of Haleu for their first core load demonstrations. And the existing US reactor fleet uses about 2,000 metric tons of LEU per year.

Many of the same suppliers the civilian nuclear fleet relies on for fuel, like France's Orano and European consortium Urenco, have also been called on by Euratom to expand capacity for medical isotope production.

A Urenco spokesperson told Energy Intelligence the company is "working closely with industry partners on a complete fuel cycle solution, including deconversion" to convert Haleu to metal to enhance its "stable isotopes offering for medical, industrial and research applications" and "with progress being made at pace." In 2021, Urenco opened the "Leonardo da Vinci" cascade of centrifuges at its Urenco Stable Isotopes facility in the Netherlands, with "plans for further expansion," the company said.

France's Orano meanwhile has developed a new laser isotope separation technology and has indicated to Euratom it could take two to four years to complete it. And at its Tricastin site in southern France, Orano has recently completed the construction of a stable isotopes laboratory, expected to commence operations by the end of 2023.

While most medical isotope production occurs in research reactors in Russia, South Africa, Australia and across Europe, some Canadian power reactors have taken up the charge. After Canada's Chalk River research reactor closed in 2016, Bruce Power and OPG began producing medical isotopes in their civilian Candu power reactors. And while those Candu reactors are uniquely positioned to radiate medical isotopes, unlike many conventional reactors, the urgent need for supply diversification suggests that the civil fleet could have a larger role to play in medical isotope production in the future, potentially also as a secondary revenue source.

Jessica Sondgeroth, Washington

CORPORATE

Barakah Partners Seek New Opportunities

With their four showcase APR1400 reactors at Abu Dhabi's Barakah plant nearly complete, owner Emirates Nuclear Energy Corp. (Enec) and its South Korean supplier consortium are both casting around for next moves in the nuclear sector.

The reactor sales push by Korea Electric Power Co. (Kepco) and subsidiary Korea Hydro & Nuclear Power (KHNP) is getting a welcome boost from the relatively new government of South Korean President Yoon Suk-yeol, who wants to bolster his country's nuclear sector both domestically and abroad. Meanwhile, Enec's leaders are already mulling longer-term deployment in the United Arab Emirates (UAE) of nuclear-produced hydrogen and small modular reactors (SMRs), but in the nearer term state-owned Enec's next move is likely outside the UAE, and possibly as an investor alongside its South Korean partners.

The question now is the extent to which the Emirati and Korean nuclear industries join forces; a true political, commercial and financial partnership between the two sides could create a force able to defeat competitors in Russia, China and France.

New Korean Business

Team Korea's first major new foray into the nuclear export business came on Aug. 25, when KHNP won an order to supply the turbine islands for all four of the Rosatom-supplied VVER-1200s being built at Eldabaa, Egypt's first nuclear power plant. This 3 trillion won ($2 billion) contract was "a major achievement," South Korea's Trade, Industry and Energy Minister Lee Chang-yang said Sep. 29. Chairing his second Nuclear Energy Exports Strategy Committee meeting, Lee said the order represented the first nuclear export "win" since Team Korea won the Barakah contract in December 2009.

It also represented another win over French competition, considering that in 2009 Kepco and its partners beat out an EDF-led team. This time the France-based nuclear turbine business that GE is selling to EDF lost out. That GE division initially won the Eldabaa contract in October 2018, but then lost it for reasons that are not clear, whether commercial or political or some combination. Rosatom is ever less politically palatable in France right now, and it may be that GE pulled the plug on the contract to rescue the sale of its nuclear turbine division to EDF, or conceivably that Rosatom got cold feet.

That KHNP was willing to scoop up the Eldabaa supply indicates that Seoul is less wary of working across the geopolitical rift increasingly dividing the global nuclear business. Seoul's geopolitical acumen may soon be tested in Saudi Arabia, where Kepco's chances of locking in a supply deal for that Mideast kingdom's first nuclear power plant are likely dependent on navigating a trilateral deal with Riyadh and Washington that would see the latter drop or significantly modify export control restrictions and intellectual property claims for the APR1400.

Well placed to enable such a deal, of course, is Abu Dhabi, with its close relationships not only with Seoul, but also with Riyadh and Washington. And this comes just as Abu Dhabi is casting about for new nuclear opportunities on the back of growing success at Barakah. The third and fourth reactors at that plant in northern Abu Dhabi will start up over the next year, and in a speech in Vienna last week Enec executive Ahmed al-Mazrouei noted that the four Barakah reactors will free up 414 billion cubic feet of natural gas a year — or roughly $4 billion at today's prices.

Abu Dhabi's Next Steps

"We're now looking at the next strategy for us," Enec CEO Mohamed al-Hammadi told the World Nuclear Association's annual symposium in London last month, on Sep. 7. "Part of our market interest is to look and replicate the UAE success story in other nations and we are looking at business opportunities around the world, in Europe and other areas."

Only days before al-Hammadi's remarks, an industry source told the UK's *i* newspaper that Enec was "definitely interested" in investing in EDF's planned Sizewell C project, which would see twin EPRs built at the Sizewell site in the southeast county of Suffolk. Both Enec and EDF declined to comment on the story to Energy Intelligence. But sources agree that while Enec is almost certainly considering its options at Sizewell C and possibly other UK projects, its likely first external investment will be alongside Kepco or KHNP, which is angling to supply APR1400s to Poland and the Czech Republic.

Poland may be a particularly attractive proposition for Enec, as KHNP is now in a pole position to supply reactors to one of the sites Warsaw is looking at for its 6-9 gigawatt newbuild program. However, the initial preferred site adjacent to the Baltic seaside villages of Lubiatowo and Kopalino will likely go to AP1000s supplied by a US consortium of Bechtel and Westinghouse. Industry sources expect this to be announced later this month at the International Ministerial Conference on Nuclear Energy in Washington, although as Warsaw has made clear it may approve multiple vendors, a Korean bid could also prove successful at that conference.

Seoul has very publicly offered to take a 30% equity stake in any Korean-supplied newbuilds in Poland, and this is where its partnership with Enec might come in handy. In April 2018, an Enec subsidiary signed a "Charter for Joint Business Cooperation" with Kepco that "will enhance cooperation throughout the nuclear business cycle, from planning and construction to operation."

Such a partnership could unlock joint investment in Korean-supplied reactors in Poland or the Czech Republic, but it likely won't mark the end of Enec's ambitions. Even domestically Enec has some prospects, although for the moment the UAE doesn't anticipate enough power demand to justify building additional large reactors. However al-Hammadi said in London that Enec is "launching soon a leading plant for the SMR" and is "looking at technology providers — Framatome, TerraPower and others — for the technology."

Phil Chaffee, London

INTERVIEW

IAEA's Grossi on Talks With Kyiv and Moscow

International Atomic Energy Agency (IAEA) Director General Rafael Grossi was headed to Kyiv and Moscow this week to discuss the escalating situation at the Zaporizhzhia nuclear power plant, which has been occupied by Russian troops since March and which is in territory that Russia says it has now annexed. On the afternoon of Oct. 5, while en route to Kyiv, Grossi spoke remotely to Energy Intelligence's Stephanie Cooke as part of the Energy Intelligence Forum in London. Below is a transcript of that conversation, edited for length and clarity.

Q: It's good to hear you, Rafael. I know you're on your way to Kyiv, and I'll ask about that in a minute. First can you give us an overview of the situation at Zaporizhzhia?

A: Well, lots going on over there, as you may have been hearing from the news media and social media as well. We've had an eventful weekend, with the detention of the former director general of the plant, Ihor Murashev, whom I know very well. After some diplomacy he was released. We're very happy about this, and he's safely back with his family.

At the plant the operations continue in the way that has been the case for the last few weeks, in the sense that the six units are in cold shutdown, which means that they could be back to service if needed at some point. The situation with regards to external power continues to be extremely precarious. We do have at the moment external power, but it is fragile. There is one line feeding the plant at the moment, which allows it to operate.

The morale of the staff is of course difficult, but they continue very professionally. This is commendable and quite heroic, in the circumstances.

The situation is going to be experiencing a further layer of complication with the recent annexation — the attempts to annex — these territories. As you may have seen there was a decision at the Russian parliament, and I understand some administrative decisions are being taken now. This is going to have an impact, and I am going to be in consultations about this with the Ukrainian government in a couple hours, I hope, and then of course with the Russians.

Q: You are on your way to Kyiv. What do you hope to accomplish once you get there? I'm assuming you're going to be talking a lot about the safety and security zone you want to set up around the plant.

A: That is a priority and this is the reason for my trip. As you may remember, in New York 10 days ago I started the negotiations with both [Ukrainian and Russian] foreign ministers to establish a nuclear safety and security protection zone. I spoke about this with the UN Security Council as well, and we are working on the details. It is by no means guaranteed that I am going to be successful. But of course I am trying. I am trying very hard.

Q: With Russia's annexation of these four Ukrainian territories, including Zaporizhzhia, do you consider that six-unit plant — the largest nuclear plant in Europe, actually the largest power plant in Europe — to be effectively Russian now? Especially given that Rosatom has, or so we were told, said that by Oct. 14, anyone who wants to remain working there has to reapply to Rosatom?

A: This is a part of the conversations we are going to be having. We are clear on what international law says about annexations of territories. But I would not like to get into that. Because I am going to be discussing this in Kyiv and later on in Russia.

Q: Right. But if you are pushing for a security zone, are you tacitly sanctioning a Russian theft of this $40 billion to $60 billion plant?

A: I'm sorry, come again?

Q: I'm asking you an admittedly difficult and slightly controversial question. But what I'm asking is, if by pushing for a security zone around the plant now that it's effectively under Russian control, critics might say you're tacitly sanctioning the theft of that plant. That may not be fair, but I'm asking you to respond to such a statement.

A: I always expect your questions to be difficult, Stephanie, so I'm used to it. No worries.

From the very beginning people on one side of the debate or the other have been attributing to the IAEA intentions or unintended consequences of our actions. I have a clear mission, and I stick to my mission, and my mission is to ensure the safety and the security of this plant. And let people speculate about what this may mean.

Q: Director general, you're going to be heading to Moscow after Kyiv. There's been a lot of signaling very recently on both sides on the possible use of nuclear weapons. Will you be addressing that issue when you get to Moscow?

A: I will be Russia in the next few days, yes. I will be addressing every relevant topic.

Q: Do you have any sense of what the response might be at this stage?

A: Of course not. Let me go and have the talks. Let me go and work Stephanie. I will tell you more when I come back, OK?

Q: OK! On Iran, do you think the talks are basically dead at this stage?

A: The talks are in a difficult stage. Everybody knows that. I just met the president of the Atomic Energy Organization of Iran after a long pause of a few months. We had a professional discussion and exchange of views of what is needed. And so I am patiently trying to go back to a serious negotiation and to a serious clarification of the pending issues, which are of course central to the possibility of having an agreement at the JCPOA [Joint Comprehensive Plan of Action] table as well. So this is where we are at the moment.

Q: Do you have any, any sense — this has been going on, dragging on, now for two or three years — any sense of when you could both possibly wind it up?

A: Are you talking about the JCPOA or the safeguards verifications?

Q: I'm talking about the safeguards issue that had become an issue in the JCPOA.

A: Well, you know, this depends on my Iranian partners more

than ourselves. We know exactly what is needed there. This is not an overnight thing, because it has to do with different places, different locations, different types of information that may require us to engage interactively with them on the process. So it may take some time, but not a very long time.

We are quite hopeful that if there is serious intent, and a good disposition to work, this could be done in a matter of a couple of months or something like this. But it will depend. It all depends. I think that my answer is not clear but unfortunately it does not depend entirely on me.

Q: We should have time for one more question. My colleague interviewed Ambassador Mikhail Ulyanov [the Russian emissary to the IAEA] and he was blaming all the shelling at Zaporizhzhia on the Ukrainians. He said that there are agency observers there who could back him up on this, and he compared the agency to a dog: a dog who understands everything and keeps his silence. What are your thoughts about that comment?

A: Well we are a nuclear watchdog, so maybe the comparison is not that bad.

You know, this is a very delicate question. I am in the process of trying to establish a protection zone, which is not there at this point. So there is no political commitment to exercise restraint — other than what is already existing in international law, which says that you cannot attack nuclear power plants. But setting that small detail aside, there is no restraint: shelling continues. What our people are doing is to register everything there, and to be informed about it.

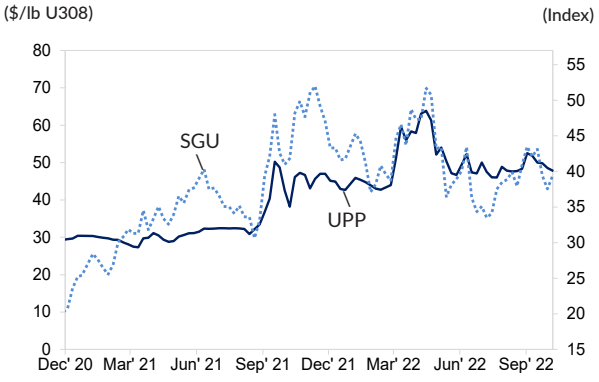
We are not putting ourselves in the position of a judge or a political arbiter, because this is not our function.

URANIUM MARKET UPDATE

All prices as of Thursday, October 6, 2022

UPP VS. SOLACTIVE GLOBAL URANIUM INDEX

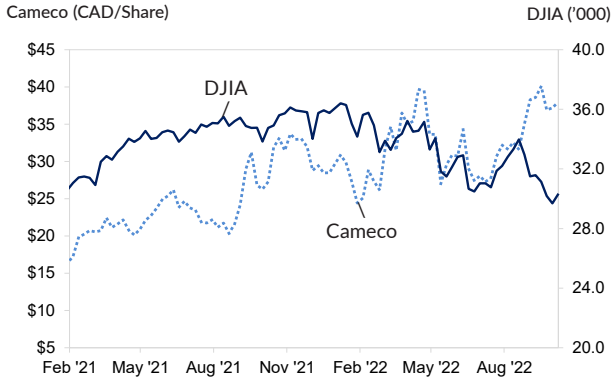
(previous 52 weeks)



The Solactive Global Uranium Total Return Index, created by Structured Solutions AG, tracks the price movements in shares of companies active in the uranium mining industry. Calculated as a total return index and published in US$, its composition is ordinarily adjusted twice a year.

CAMECO VS. DOW JONES INDUSTRIAL AVERAGE

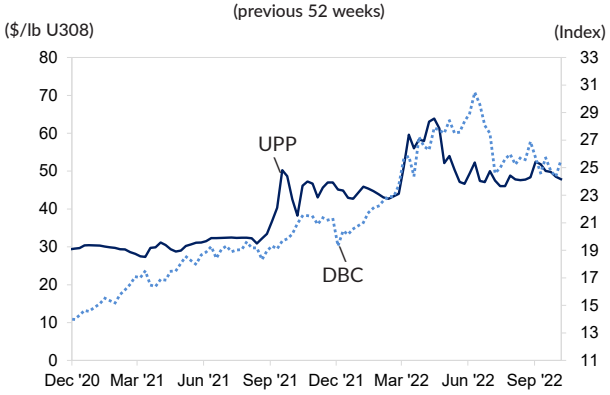
(previous 52 weeks)



Canadian uranium miner Cameco's stock is valued in Canadian dollars compared with the US dollar on the Dow Jones Industrial Average (DJIA). Roughly two-thirds of DJIA's 30 component companies are manufacturers of industrial and consumer goods. The others represent industries ranging from financial services to entertainment.

UPP VS. POWERSHARES DB COMMODITY INDEX

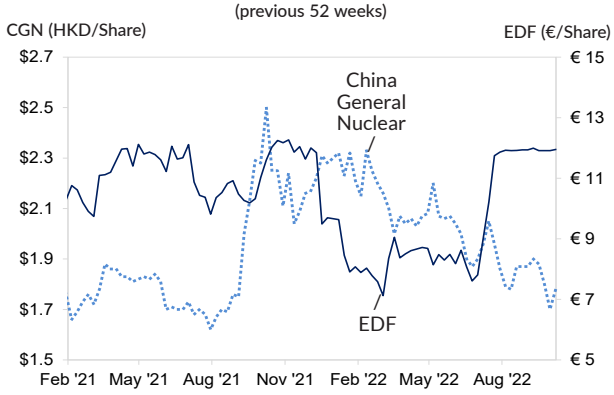
(previous 52 weeks)



The PowerShares DB Commodity Index Tracking Fund is designed to provide investors with a broadly diversified exposure to the returns on the commodities markets. It is based on the Deutsche Bank Liquid Commodity Index, which is composed of futures contracts on 14 of the most heavily traded and important physical commodities.

EDF VS. CHINA GENERAL NUCLEAR

(previous 52 weeks)



The stock valuation of France's Electricite de France (EDF), largely owned by the French state, is in euros compared to state-owned China General Nuclear (CGN) Power Co., valued in Chinese yuan renminbi. Both companies build nuclear power facilities, design and service reactors, operate nuclear reactors and supply nuclear components and technology.

MONTHLY SPOT MARKET PRICES

		2022									2021		
	Chg.	Sep '22	Aug '22	Jul '22	Jun '22	May '22	Apr '22	Mar '22	Feb '22	Jan '22	Dec '21	Nov '21	Oct '21
Uranium ($/lb U3O8)													
Low	+1.00	48.50	47.50	45.50	45.50	46.00	52.50	51.00	42.50	43.00	42.00	43.00	36.00
High	-1.00	52.50	53.50	50.50	52.50	54.00	64.00	60.00	44.50	46.50	47.00	47.50	48.00
Conversion ($/kgU)													
Low	-	36.00	36.00	32.00	30.00	30.00	28.00	26.00	16.00	16.00	16.00	15.00	16.00
High	-	39.00	39.00	37.00	33.00	33.00	30.00	28.00	17.00	17.00	17.00	18.00	19.00
Enrichment ($/SWU)													
Low	+2.00	92.00	90.00	89.50	84.00	84.00	82.00	100.00	59.00	57.00	56.00	56.00	55.50
High	+4.00	96.00	92.00	95.00	150.00	150.00	150.00	150.00	61.00	59.00	57.00	57.00	57.50

NIW monthly UF6, SWU and U3O8 prices rely on the general consensus of direct market participants and is informed by actual market transactions. This section was previously known as the Nukem Weekly Report and the Nukem Price Bulletin. The methodology for NIW's weekly UPP price is different – more information about the methodology behind that price is available on page two.