

NUCLEAR INTELLIGENCE WEEKLY[®]

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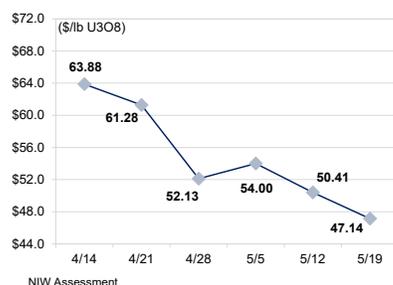
Market Points

Korea Hydro & Nuclear Power on May 11 collected offers on 200,000 kgU as UF6 for delivery in September, with an award this week at about \$30 per kgU, nearly double UF6 prices at the end of last year.

Brazil's state-owned Industrias Nucleares do Brasil meanwhile received no offers on its extended request for 260,000 kgU for August delivery. The lack of responses may force the company to ease up its procurement requirements.

The lack of robust uranium demand helped send prices lower again, with Energy Intelligence's Uranium Price Panel assessing U3O8 at \$47.14 per pound on May 19, from \$50.41/lb. on May 12.

UPP: \$47.14/LB U3O8



WEEKLY ROUNDUP

France's Nuclear Fleet Is Running at Less Than Half Capacity

- More than half of French nuclear reactors are currently off line. Explanations include postponed maintenance following the pandemic, extended outages for planned 10-year inspections across the fleet's oldest half, plus unexpected corrosion issues in newer reactors. In addition, an early heat wave is likely to force EDF to reduce output at several plants located on rivers too warm to ensure proper cooling. EDF's use of river water as coolant is regulated by law to protect plant and animal life. "All these events are leading to the situation we were fearing, where tensions could generate conflicts between nuclear safety and grid reliability," the Nuclear Safety Authority's boss Bernard Doroszczuk recently warned. By end April, less than 30 gigawatts out of France's 61 GW nuclear fleet were available, or some 10-15 GW below a "normal" month of May, according to transmission system operator RTE. France's nuclear generation could fall below 300 terawatt hours in 2022 according to EDF, down from 361 TWh in 2021 and almost 450 TWh in the early 2000s.
- Japan's Nuclear Regulation Authority (NRA) granted initial approval May 18 for plans to discharge over 1 million tons of treated but tritium-laced water into the Pacific from the disabled Fukushima nuclear plant. The NRA announced a 30-day public comment period ending Jun. 17, after which final approval is expected. Formally introduced by the national government and operator Tokyo Electric Power Co. (Tepco) in March 2021, the plan still requires local government consent amid continuing controversy. Greenpeace argues the plan fails to address critical concerns such as the potential for rising volumes of groundwater contaminated from contact with melted nuclear fuel, and long-term environmental risks of "organic bound tritium" on marine life and humans. The NRA's report on the 30-year plan follows Tepco in estimating dose effects only on an annual basis, contrary to an International Atomic Energy Agency recommendation to assess "the dose for the 30th year to take into account the maximum accumulation or buildup of long-lived radio-nuclides and the in-growth of radioactive progeny in the environment."
- The US Department of Energy (DOE) this week extended the deadline to Jul. 5 for US nuclear plant operators to submit applications for its five-year \$6 billion Civil Nuclear Credit program to aid uneconomic reactors. The original May 19 deadline produced no response from the two nuclear plants that qualify for the first tranche of funding for reactors set to retire by 2026: Entergy's Palisades reactor in Michigan, which remains on course to retire on May 31, and Pacific Gas & Electric's two-unit Diablo Canyon, scheduled to close in 2025. Since DOE launched the program on Apr. 19, California Gov. Gavin Newsom, who was instrumental in securing Diablo's 2025 closure, is now evaluating options to keep the plant open. But legal and technical hurdles make that difficult, and the fact the plant operates in a regulated market might disqualify it for federal aid. The 47-day extension came at the request of the Nuclear Energy Institute and Edison Electric Institute.

NUCLEAR FUEL MARKET

U3O8 Price Slips as Conversion Tightens

The nuclear fuel market is beginning to experience a bottleneck in the conversion sector with little capacity available to meet spot demand. That is slowly translating to increased demand for uranium, but not enough to encourage producers to increase output.

Limited conversion capacity is pushing up UF6 spot prices, which have nearly doubled since the beginning of the year. Korea Hydro and Nuclear Power (KHNP) on May 11 collected offers on 200,000 kgU as UF6 for delivery in September, with an award this week at about \$30/kgU. Though various suppliers and traders have some UF6 on hand, they may be holding out for higher prices. Energy Intelligence also understands that Rosatom's subsidiary Tenex did not offer into the KHNP solicitation, due to a lack of available conversion capacity.

And while Brazil's Industrias Nucleares do Brasil (INB) extended its request for 260,000 kgU for delivery by August to May 11, it did not receive any offers. The process to offer into an INB solicitation for material is infamously tedious, which has been a factor limiting offers to INB in the past. Still, the lack of a single offer is notable. INB also extended a follow-up request to May 27 for 160,000 kgU as UF6 for delivery by September. The company may have to shift its procurement strategy if it again receives no offers, as Energy Intelligence understands from one supplier that INB "absolutely" needs the material. "They have no inventory," he said.

As a state-owned nuclear fuel supplier, INB may be in a unique position, as most utilities have some inventory. But until Honeywell's Metropolis plant in the US restarts early next year, the spot market for conversion is likely to remain tight. One major factor likely contributing to this tightness is that enrichers Orano and Urenco are looking to procure any available UF6 to meet increased demand for non-Russian enriched uranium product.

Conversion capacity in the West is limited to Cameco's Port Hope facility in Canada near Toronto, and Orano's Philippe Coste (otherwise known as Comurhex II) in southern France. Cameco is operating near full annual capacity of 12,500 tons of uranium (tU) and expansion at Port Hope is geographically constrained, while Orano

is at least a year behind on its 15,000 tU ramp-up previously anticipated for this year.

Metropolis could increase output from its planned restart at 7,000 tU per annum to its licensed nominal capacity of 15,000 tU, but that would require more capital expenditure and Honeywell has yet to make any moves in that direction.

As long as conversion capacity remains constrained, uranium producers may not see the robust term demand they need to justify increasing production. That, combined with the fallout of a wider market downturn, saw uranium prices slip again this week.

The uranium price delivered by Energy Intelligence's Uranium Price Panel slid to \$47.14 per pound U3O8 on May 19, from \$50.41/lb. on May 12.

Cameco CFO Grant Isaac, in a Bank of America investor conference this week, described the current state of play as "the early innings of a contracting cycle," noting active interest among Cameco's customers. With Cameco "still in supply discipline mode, despite how robust everything is looking," the Canadian miner is waiting "for those terms and conditions that make sense for us." The procurement cycle has "yet to change" the company's production outlook.

Meanwhile, Kazatomprom's new ANU Energy fund — focused on capturing investors in Central Asia, Asia and the Middle East — completed its first round of funding oversubscribed, and took its first full delivery of Kazakh uranium on May 12 at Port Hope. ANU Energy received more than \$74 million from initial investors, \$24 million more than initially planned. According to the fund, additional investments came from "one of the SWF [sovereign wealth fund] Samruk-Kazyna JSC group's investment companies." The SWF had long been associated with former Kazakh President Nursultan Nazarbayev, but since the civil unrest in Kazakhstan early this year and under the transition of authority to President Kassym-Zhomart Tokayev, the fund is said to be undergoing reforms.

Jessica Sondgeroth, Washington

URANIUM PRICE PANEL

For the week ended May 19, 2022

	Weekly Spot Market Prices													
	Chg.	May			Apr					Mar			Feb	
		19	12	5	28	21	14	7	31	24	17	10	3	24
Price (\$/lb U3O8)	-3.27	47.14	50.41	54.00	52.13	61.28	63.88	63.07	57.94	58.34	56.00	59.63	51.07	44.00
Total Assessments	1.00	10.00	9.00	11.00	9.00	10.00	10.00	9.00	10.00	9.00	9.00	10.00	11.00	10.00
% within 1 StDev	2.22	80.00	77.78	72.73	55.56	60.00	90.00	77.78	80.00	66.67	66.67	80.00	72.73	70.00
Low (\$/lb U3O8)	-2.00	47.00	49.00	53.50	51.25	59.00	63.75	63.00	57.50	58.00	55.00	59.00	50.50	43.25
High (\$/lb U3O8)	-4.50	47.50	52.00	55.00	53.00	63.25	64.00	63.50	58.75	58.50	57.00	60.25	52.00	45.00
Variability*	-0.28	0.00	0.28	0.50	0.50	0.75	0.08	0.00	0.28	0.13	0.50	0.25	0.16	0.63

*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.

LEGAL

Lawsuit Alleges ‘Shoddy’ Science in Wipp Recertification

Earlier this month, the US Environmental Protection Agency (EPA) “recertified” the government’s Waste Isolation Pilot Project (Wipp), a step it must take every five years to ensure that the world’s only operating underground nuclear waste repository continues to accept radioactive waste from US nuclear defense sites. This year the recertification came with a twist.

In January a whistleblower who had worked on the recertification filed a lawsuit alleging that scientific information provided to the EPA in support of the approval was “shoddy, inaccurate and fraudulent” — and in a lengthy technical document in November, the EPA itself said that some of the information is based on “experimentally derived” parameters and “incomplete datasets.”

None of this puts Wipp at risk, at least for now, but it raises the stakes for the country’s only centralized nuclear waste storage facility. Wipp is mainly designed for transuranic wastes, including contaminated tools, rags, protective clothing, sludges, soil and other materials created by the US nuclear weapons program. Beyond that, however, and notwithstanding strong opposition, the 16 square mile site southeast of Carlsbad, New Mexico, could become the destination for diluted plutonium from the government’s surplus plutonium stockpiles; and to that might be added considerable amounts of waste stemming from a massive increase in plutonium pit production — at 80 new pits per year — planned for the next decade.

This additional waste would push Wipp’s legal storage capacity well past its limit of 175,564 cubic meters set by the 1992 Land Withdrawal Act that allowed Wipp to be built, and would likely extend the operational life of the repository. Although by law Wipp was to close in 2024, it now appears as if the facility will continue operating until at least 2050, and some Department of Energy (DOE) documents have suggested a closure date of 2080.

The 1992 act put the EPA in charge of developing radioactive waste disposal standards and certification compliance criteria, mandating the five-year compliance reviews, beginning with the initial certification in May 1998 that allowed Wipp to begin operating the following year. At issue now is the science that underpins those recertifications, which is supposed to demonstrate that the statistical probabilities of a radiological release to the environment over 10,000 years (following the repository’s closure) don’t exceed the EPA’s regulatory thresholds.

A lawsuit filed on Jan. 24 by whistleblower Charles Oakes in a New Mexico district court, since removed to a federal court, suggests that since at least 2001 — two years after EPA initially certified Wipp — the EPA has calculated the probabilities of radiological

release using faulty data and methodologies, and despite being aware of the problem the DOE and EPA did little to address it. Asked to comment on the lawsuit, Sandia spokesperson Mollie Rappe told Energy Intelligence, “Sandia National Laboratories cannot discuss ongoing lawsuits, including the lawsuit filed by Charles Oakes.”

Depending on the outcome of the lawsuit, however, the issue of scientific credibility may make Wipp’s future recertifications more difficult to justify, potentially even threatening the repository with closure.

Separately, the Wipp site sits above the hydrocarbon-rich Permian Basin and is ringed with hundreds of oil and gas wells. While the implications of this proximity aren’t raised in the whistleblower action, growing awareness of Wipp’s vulnerability to errant hydrocarbon drilling — and particularly horizontal gas fracturing — may further undermine the repository’s long-term stability. “Drilling activity is one of the biggest risks for a release of nuclear waste material at Wipp if oil and gas drilling accidentally penetrates the repository,” the EPA said in its November report.

‘Problematic’ Probabilities

The statistical probabilities which the EPA uses as part of the recertification process are developed by scientists in the Carlsbad section of Sandia National Laboratories (SNL). Oakes began working on the most recent EPA recertification project in June 2017 as a “limited-term employee” to provide expertise on “chemical reactions and thermodynamic models that Sandia uses to evaluate the probabilities and quantities of radiation releases to the environment” under “conceptual repository breach scenarios,” his lawsuit said. Oakes had particular expertise on the so-called “Pitzer model” long used by Wipp for such evaluations.

From the start of his employment, Oakes raised questions and leveled complaints about the probabilities developed by Sandia over almost two decades, and in 2018 Oakes “pointed out that certain Pitzer parameters” derived by a Sandia contractor prior to 2001 “did not reproduce independent data. These parameters had been used” in compliance recertification applications “since at least 2004 — or at least a decade and a half,” the lawsuit said.

Oakes’ immediate supervisor, Christi Leigh, “acknowledged” that Sandia “should publish revisions to key portions of its modeling work,” and said that “it would not stand up to scientific scrutiny outside of the Sandia bubble.” She was eventually removed from the project and transferred, according to the lawsuit.

In late 2018 “authorities within the EPA and the DOE were becoming concerned” with Sandia’s scientific representations, and DOE officials “specifically and directly” addressed their concerns with the Sandia-Carlsbad site manager, Paul Shoemaker, who is named in the lawsuit along with his subordinate Carol Adkins. Both have management roles within Honeywell International, which manages Sandia through a subsidiary.

When Shoemaker was questioned by DOE representatives in December 2018 as to what Sandia was doing to address the faulty work, “Shoemaker falsely informed” them “that the tainted data had been removed from their database” and Sandia “was actively working on other remedies.” That same month, the lawsuit alleges that another Sandia employee uncovered the “knowing use” of faulty Sandia computer codes over many years that “produced physically impossible results that were scientifically unsound.”

Oakes said he “was instructed to ignore the errant model parameters until after” the 2019 Wipp recertification application with the EPA was filed. This was the basis for the May 3 recertification. “Sandia did not report these model parameters as errant to the DOE or the EPA,” according to the lawsuit.

Oakes was “summarily terminated” on Jan. 31, 2019, after making it known “that he would not cooperate in submitting false and fraudulent data and incorrect science to the EPA and the DOE,” the lawsuit said. “When defendants terminated Dr. Oakes, they removed his work from materials provided to federal regulatory authorities ... despite that Dr. Oakes was an acknowledged authority and had been praised by direct supervisors for the quality of his work and for his efforts to correct faulty science.”

Stephanie Cooke, Washington

WASTE

Oil and Gas Drilling Threaten Wipp Nuclear Waste Repository

Extensive oil and gas drilling in southeastern New Mexico has scientists at the Environmental Protection Agency (EPA) worried — for good reason. With the boom in hydraulic fracturing, hundreds of wells have been drilled within just 5 miles of the world’s only operating underground nuclear waste repository known as the Waste Isolation Pilot Plant, or Wipp, and some of them lie along Wipp’s borders. Drilling — particularly when it’s followed by horizontal fracking — could lead to radioactive leakage from the underground installation, according to the EPA.

In order to assure the public that they won’t find radioactive elements, or actinides, in their drinking water, the Department of Energy (DOE) must deliver a “performance assessment” every five years estimating cumulative releases of radionuclides to the “accessible environment” over 10,000 years. If these are found to be within EPA thresholds, the agency recertifies Wipp, as it recently did on May 3. This latest recertification may have been a close call. Not only does it follow accusations by a whistleblower that the Department of Energy’s (DOE) performance assessment was based on “shoddy science,” a recent EPA report warns that Wipp is vulnerable to oil and gas drilling.

“Drilling activity is one of the biggest risks for a release of nuclear waste material at Wipp if oil and gas drilling accidentally penetrates the repository,” said the report, *The Geochemistry of the Waste Isolation Pilot Plant*, published in November.

The Wipp repository, near Carlsbad, New Mexico, lies some 660 meters underground in a salt deposit known as the Salado Formation. The rich hydrocarbon deposits within the Northern Delaware Basin (part of the Permian Basin) lie some 2,000 meters below the Salado. Above all of these formations are a series of geological strata containing groundwater. Salt formations have long been considered nearly ideal for radioactive waste because they are essentially impermeable. However, the Salado is “interbedded” with layers of more permeable mudstone and minerals, which basically provides an escape route for actinides in the event of their release from the “engineered barriers” within the manmade repository.

Wipp’s transuranic wastes are derived primarily from weapons-related activities within the DOE’s vast network of nuclear facilities, and include contaminated tools, rags, protective clothing, sludges, soil and other materials. Of the alpha-emitting wastes within Wipp which the EPA is most concerned with, “the longest-lived radionuclides throughout the repository’s life are Pu [plutonium], Am [americium], and Cm [curium], and these actinides, especially Pu, will dominate potential releases over 10,000 years,” according to the 73-page EPA report. As they decay the composition of the actinides will change.

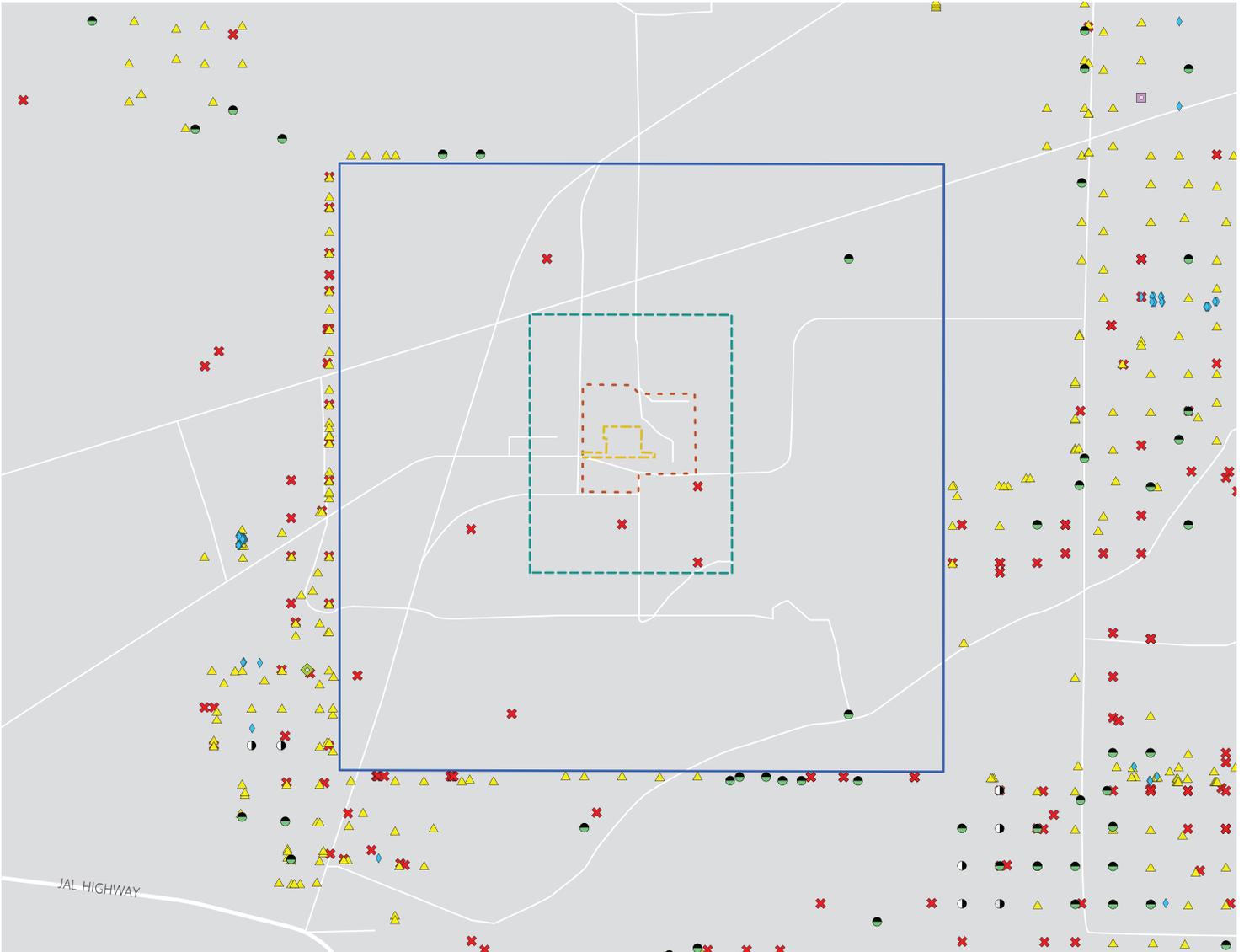
The Salado “is expected to encapsulate the waste” once the repository is closed, the report says, and while “actinides in the waste” could over time “be released from the repository through fractures” in the salt formation, “calculations show that the amount that potentially could reach the surface will be negligible.”

However, that assessment comes with a big caveat — namely it assumes the formation will remain “undisturbed.” In other words, the same can’t be said for an intrusion that occurs as a result of hydraulic fracturing, an activity that in some nearby Permian Basin locations has been tied to earthquakes. The EPA report doesn’t mention seismic activity or earthquakes. However, it states that “When an intrusion through drilling occurs, multiple routes for a potential release are possible,” including “long-term brine releases ... to the surface.”

“Because of the advent of drilling techniques, including horizontal drilling and hydraulic fracturing, these ‘unconventional’ formations have received renewed attention and have been drilled extensively in recent years,” said the EPA report.

Indeed. Within 5 miles of Wipp’s outer boundaries, comprising roughly 16 square miles, there are 772 active wells and another 336 in the works, including many virtually adjacent to the boundary lines, according to the nonprofit FracTracker Alliance, which provided Energy Intelligence with a map of their locations as well as

OIL AND GAS DRILLING NEAR WIPP*



WIPP Facility Boundaries: Property Protection Area Exclusive Use Area Off Limits Area Land Withdrawal Area

Oil and Gas Wells: ▲ Active ✕ Cancelled ◆ New ● Plugged (not released) ● Plugged (site released)

 Temporary Abandonment Temporary Abandonment (expired)

*Oil and gas drilling activity within five miles of Wipp's outer boundary; the map is significantly zoomed in from that range and there are also well pads that include multiple wells that might not be immediately apparent. Sources: FracTracker Alliance; New Mexico Energy Minerals and Natural Resources Department; Energy Intelligence

the locations of plugged and inactive wells.

The oil and gas analytics firm Envirus also provided data to Energy Intelligence on drilling activity so far this year. This includes six horizontal wells within a 5 mile radius of the site's center, which means they are right up on Wipp's boundary. "Extend out to 10 miles, you're at 26 wells, 15 miles is 43 wells, 25 miles 207 wells and 50 miles encompasses [the] majority of the Northern Delaware Basin [which] had 365 wells completed so far in 2022," said Mark Chapman, senior vice president with OFS Intelligence, which is part of Envirus.

Stephanie Cooke, Washington, Caroline Evans, Houston

FUEL CYCLE

DOE Pushes Onward With VTR, Sidelining Alternatives

The US Department of Energy (DOE) appears prepared to green-light plans for its Versatile Test Reactor (VTR) next month, even after Congress zeroed out funding for the program in fiscal year 2022. But even if it moves forward the VTR is still years away from being built, leaving advanced reactor developers to find other means for testing their fuels in the meantime.

The DOE on May 13 released an environmental impact statement (EIS) for the VTR, setting the stage for a final determination, likely in June, on whether to go forward with the project. The department's Office of Nuclear Energy (NE) claims that a VTR is "essential" to advanced fast reactor innovation. But critics say that without substantial congressional funding, which is unlikely, the project will inevitably fail, wasting whatever sums that are allocated in the meantime. Moreover they argue that the existing Advanced Test Reactor (ATR) at Idaho National Laboratory (INL) already has been used for fast reactor testing, and could be modified for further testing, without requiring the billions that would be needed for the VTR.

Without funding for this year, the DOE's NE canceled the initiation of new work and ramped down "in-process activities" to preserve and archive "the work completed to date," according to a March VTR status report acquired by SRS Watch. Funds approved for the project prior to that were used to complete the EIS. In its fiscal 2023 budget request, the DOE is seeking \$45 million for the VTR to support conceptual design optimization, "component risk reduction activities, including prototyping and testing, nuclear fuel feedstock sourcing and fabrication studies." But \$45 million is a drop in the bucket for a project that could cost upwards of \$6 billion.

Another hurdle for the VTR is its place in the lineup for fast reactor development, namely behind the 345 megawatt sodium-cooled fast reactor, Natrium, which is being developed by TerraPower and GE-Hitachi. Both firms are also committed to developing the VTR, although clearly not as strongly as they are to Natrium. Both DOE and TerraPower contend that the two designs, while similar, have very different missions, with Natrium designed for power production and the VTR for fuel, material and component testing.

When Congress zeroed out funding for the VTR in fiscal year 2022, it appropriated \$2.5 billion for the two lead reactors in the Advanced Reactor Demonstration Program (ARDP) — Natrium and X-energy's high-temperature gas-cooled reactor, the Xe-100. It also shifted oversight of the ARDP away from NE to the new Office of Clean Energy Demonstrations. Neither developer is relying on the VTR for fuel testing. TerraPower has been running tests at INL's ATR to develop its high-enriched, low-assay uranium (Haleu) fuel; and X-Energy announced in 2020 that its pebble-bed type Triso-X fuel is being tested at the Massachusetts Institute of Technology Nuclear Reactor Laboratory's research reactor.

DOE is now planning construction approval of the VTR in late 2027, using the sequencing with Natrium "to take advantage of synergies between the projects." Natrium and the VTR would require similar components, albeit different sizes, that could simplify the supply chain, which is one of the areas DOE wants to focus on if it gets more VTR funding for fiscal year 2023.

VTR Alternatives

DOE spokesperson Karla Olsen told Energy Intelligence that the department has examined "multiple alternatives for providing a fast spectrum neutron testing capability," including "modifying

the ATR at the Idaho National Laboratory or the High Flux Isotope Reactor at the Oak Ridge National Laboratory."

Among its alternatives, a June 2019 report by INL found that with a few modifications to fuel designs, its ATR — mainly used to test light water reactor fuel — would allow for "the development of a large test matrix of samples with rapid throughput" enabling "expedited testing of novel fuels and materials for fast neutron reactors." Since 2003 INL has "successfully tested various metallic, oxide and nitride fuels for fast reactor applications in the thermal neutron spectrum" but the complex process to do that has driven up costs. Seeking a less costly alternative, INL concluded that if the fuel diameter is reduced "power density can be increased while maintaining prototypical temperatures in the fuel and cladding."

But the DOE's preference is for a wide suite of fast reactor testing options offered by the VTR "that will support long-term innovation for both advanced and light-water reactor technologies in the development of fuels, materials and instruments and sensors," Olsen said.

Critics say this is a colossal waste of taxpayer money. The availability of alternative research facilities to test fast spectrum fuels rebuts DOE's demand case for the VTR, "other than for university projects," Ed Lyman, of the Union of Concerned Scientists, told Energy Intelligence. "Sure, it would be great for the students, but there are probably much better educational uses for the more than \$6 billion that the VTR would likely cost."

Funding Shortfall

With relatively paltry congressional funding so far on a project the DOE has approved within a range of \$2.6 billion to \$5.8 billion, VTR supporters are looking abroad — specifically to Japan, South Korea and France — for upfront capital. And last month, powerful moderate Democrat Sen. Joe Manchin of West Virginia proposed the International Nuclear Energy Act, which would lift a restriction on the Export-Import (Ex-Im) Bank Act to "guarantee, insure or extend credit, or participate in the extension of credit" for "any liquid metal fast breeder nuclear reactor." But even if that were to pass and the Ex-Im Bank were to support such financing, Congress would have to dramatically increase appropriations to incentivize potential international VTR project partners to match funds.

Amid numerous questions around proliferation and the transuranic waste the VTR poses, another is the processing of VTR fuel.

The "conceptual design for the first VTR driver fuel core is an alloy" comprising 70% uranium, 20% plutonium and 10% zirconium (by weight), meaning it will require between 0.4 and 0.54 metric tons of plutonium annually, or up to 34 metric tons over 60 years of operation. The agency says it would use "excess plutonium" stored at the Savannah River Site (SRS) in South Carolina and at Los Alamos National Laboratory in New Mexico, or surplus pit

plutonium. And if US sources are unavailable, DOE has identified potential sources of plutonium in Europe.

Whatever the source, the plutonium would still require some level of processing “to chemically remove impurities” before it is mixed with uranium and zirconium. That could require “the conversion of the material from metal to oxide and oxide to metal, and dissolution in acid solutions” either at INL’s existing facilities or at SRS, according to the EIS. SRS Watch remains vehemently opposed to using SRS for such processing, which it says “would pose a safety hazard and creates a huge amount of transuranic waste.”

Jessica Sondgeroth, Washington

JAPAN

JNFL Races to Complete Rokkasho by September

Japan Nuclear Fuel Ltd. (JNFL) is rushing to secure regulatory approval for extensive safety improvements in its Rokkasho Reprocessing Plant (RRP) and affiliated mixed-oxide (Mox) Fuel Fabrication Plant in hopes of completing construction of the RRP by September. The Mox plant is targeted for completion two years after that.

The JNFL’s push to complete the RRP is clearly aimed at avoiding a potentially embarrassing 27th postponement in the plant’s operation since construction began in 1993. But JNFL is also riding on a wave of political and industry expectations for the nuclear fuel complex in Aomori prefecture. Most notably, the Federation of Electric Power Companies (FEPC) continues to promote a tripling of the number of reactors using Mox by 2030. Beyond that, key political figures, such as the governor of nuclear-heavy Fukui prefecture, see the planned back-end activities as a partial solution to the problem of mounting spent fuel stockpiles — and a means of lowering Japan’s embarrassingly high plutonium stockpiles.

In addition to completing the RRP by September, JNFL also aims to resume operations at the complex’s uranium enrichment plant and complete improvements at its vitrified waste storage center by then. These plans were outlined by JNFL Executive President and CEO Naohiro Masuda at a May 10 meeting with a Ministry of Economy, Trade and Industry (Meti) nuclear power advisory subcommittee. In addition, JNFL currently expects to complete improvements for its Mox fuel fabrication plant by September 2024, Masuda told the committee.

The focus of current efforts are to meet new Nuclear Regulation Authority (NRA) safety requirements, including counter-measures against terrorism and specific severe accidents as well as

improved seismic measures. Masuda said, for example, that JNFL had increased its earthquake ground motion threshold from 450 gal to 700 gal.

Responses to “new” threats include added protection for cooling towers and ducts against tornadoes and moves to improve fire prevention, such as relocating chemical tanks, such as for hydrazine nitrate, from the surface to underground containment.

“We have established an action plan to ensure safe and stable operation, and are working on maintaining and improving the technical capabilities of operators and training on dealing with serious accidents,” Masuda affirmed.

Regulatory Uncertainties?

After a review meeting on the RRP Apr. 25, one NRA commissioner reportedly said “there are no technical issues left” for the examination of safety-related construction design changes for the Mox fuel fabrication plant. For its part, since the Apr. 25 review, JNFL has submitted several packages of supplemental documentation, the latest on May. 18. However, the fate of the NRA’s review of the RRP is evidently uncertain.

Whether the recent drive by pro-nuclear ruling conservative Liberal Democratic Party (LDP) parliamentarians and business groups for “expedited” NRA reviews will help or hurt JNFL is an open question.

NRA Chairman Toyoshi Fukuda has repeatedly signaled that he has no intention of compromising on safety to expedite reviews. Most recently during a May 18 press conference Fukuda didn’t specifically mention Rokkasho but stressed that while there is no answer to the issue of balancing examination, inspection and regulatory efficiency, “safety compromises are unacceptable and we must never neglect safety for the sake of haste.”

In his presentation to the Meti subcommittee meeting, Kansai Electric Power Co. Vice President Mikio Matsumura, who heads the FEPC’s nuclear power development policy committee, said that completion and stable operation of the Rokkasho facilities is an “extremely important project for the establishment of the nuclear fuel cycle.”

Matsumura promised that the FEPC and its member companies “will continue to utilize their knowledge and experience to support” JNFL’s enterprise. And he restated the FEPC’s objective of expanded Mox fuel use, with at least 12 reactors using Mox by 2030. At present, only four restarted reactors are able to use Mox, including Kansai’s Takahama-3 and -4, Shikoku Electric’s Ikata-3 and Kyushu’s Genkai-3, all pressurized water reactors.

During fiscal 2022-2024 Mox fuel owned by Japanese utilities but processed in France will be used in the two Takahama units, Matsumura said. But Ikata-3 and Genkai-3 do not plan to use such fuel “because they do not own plutonium in France.”

Matsumura said that after the Mox plant begins operation, it will fabricate fuel with the plutonium equivalent of 1.0 ton in fiscal 2025, 2.1 tons in 2026 and about 6.6 tons annually between 2027–2030. This increase means that more than four reactors will be required to consume Mox, hence the plan to get at least 12 reactors running on it by 2030.

Elusive Targets

Whether these plans pan out remains to be seen. Certainly, a reduction in Japan's rising plutonium stockpiles seems far off. The FEPC's own data hints at logjams. For example, in its pluthermal plan issued Feb. 26, 2021, Kansai Electric was committed to consuming 0.7 tons of plutonium in 2022 and 1.4 tons in 2023, but the latter figure is reduced to 0.7 tons in the updated version issued Feb. 18, 2022. As a result, the FEPC's estimate for the plutonium holdings of Japan's power companies will rise from 40.0 tons in fiscal 2024 to 41.4 tons in fiscal 2026.

In the meantime, with spent fuel stockpiles rising, Japanese utilities have committed to expand onsite spent fuel storage capacity "by about 4,000 tons around the mid-2020s, and further increase by about 2,000 tons around 2030, for a total of about 6,000 tons," Matsumura said.

For Gov. Tatsuji Sugimoto of Fukui prefecture, the RRP couldn't come quickly enough. He and previous Fukui governors have committed to finding solutions to removing spent fuel from the prefecture. So it's not surprising that Sugimoto told the May 10

meeting of the Meti nuclear power subcommittee that the national government "should take the lead in promoting nuclear fuel cycle and spent fuel measures." Since the RRP's completion "has been delayed repeatedly, its completion and steady operation will promote public confidence in the overall nuclear fuel cycle policy," Sugimoto said.

Other subcommittee members, including nuclear proponents and critics, urged the government to reconsider the pluthermal plan. For example, Kyoto University nuclear engineering professor Ken Nakajima cautioned in a written statement to the May 10 meeting that realization of the pillars of the nuclear fuel cycle "may take longer than initially expected" and warned that "at present there is no long-term plan [for the nuclear fuel cycle]" that considers the future number and types of reactors and the timing of their operation.

Citizens' Nuclear Information Center Secretary-General Hajime Matsukubo told the subcommittee, of which he is a member, that "there is a big gap between the theory of reducing nuclear waste with repeated reprocessing and fast reactors and the reality of how much money and resources will be required," he recounted to Energy Intelligence.

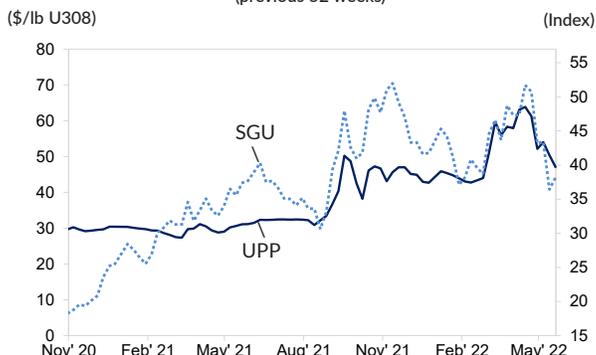
"The nuclear fuel cycle strategy should be thoroughly discussed from the perspectives of economic efficiency, plutonium balance, environmental protection and social acceptability together with other options, such as direct disposal," Matsukubo added.

Dennis Engbarth, Taipei City

URANIUM MARKET UPDATE

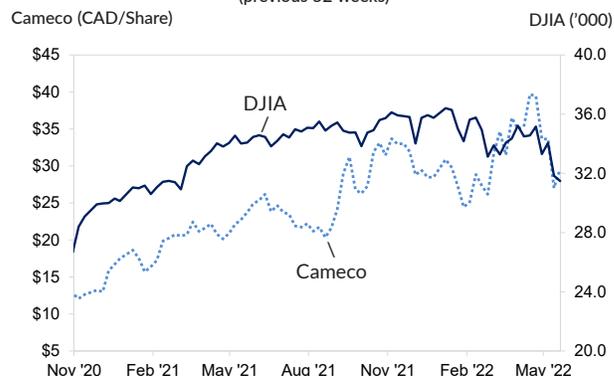
All prices as of Thursday, May 19, 2022

UPP VS. SOLACTIVE GLOBAL URANIUM INDEX
(previous 52 weeks)



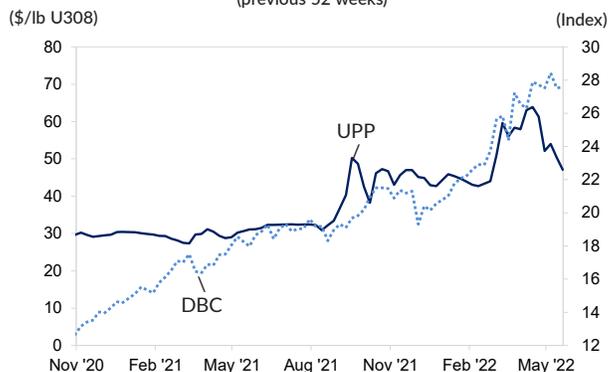
The Solactive Global Uranium Total Return Index, created by Structured Solutions AG, tracks the price movements in shares of companies active in the uranium mining industry. Calculated as a total return index and published in US\$, its composition is ordinarily adjusted twice a year.

CAMECO VS. DOW JONES INDUSTRIAL AVERAGE
(previous 52 weeks)



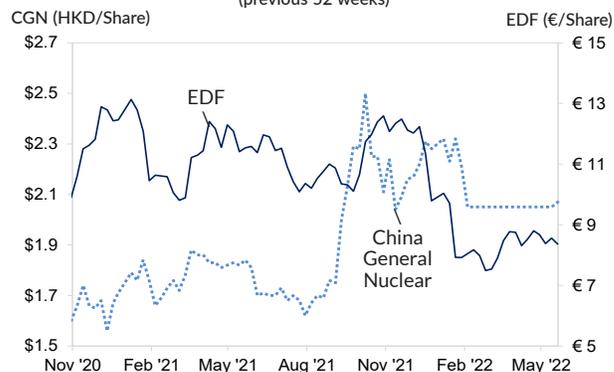
Canadian uranium miner Cameco's stock is valued in Canadian dollars compared with the US dollar on the Dow Jones Industrial Average (DJIA). Roughly two-thirds of DJIA's 30 component companies are manufacturers of industrial and consumer goods. The others represent industries ranging from financial services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

	Chg.	2022					2021						
		Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May
Uranium (\$/lb U308)													
Low	+1.50	52.50	51.00	42.50	43.00	42.00	43.00	36.00	36.00	32.20	32.20	31.00	29.15
High	+4.00	64.00	60.00	44.50	46.50	47.00	47.50	48.00	51.00	36.00	32.50	32.50	31.35
Conversion (\$/kgU)													
Low	+2.00	28.00	26.00	16.00	16.00	16.00	15.00	16.00	19.00	19.00	19.50	19.50	19.50
High	+2.00	30.00	28.00	17.00	17.00	17.00	18.00	19.00	21.00	21.00	21.50	21.50	21.50
Enrichment (\$/SWU)													
Low	-18.00	82.00	100.00	59.00	57.00	56.00	56.00	55.50	55.50	54.00	54.00	54.00	52.00
High	-	150.00	150.00	61.00	59.00	57.00	57.00	57.50	57.50	56.00	56.00	56.00	54.00

NIW monthly UF6, SWU and U308 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.

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