

# NUCLEAR INTELLIGENCE WEEKLY<sup>®</sup>

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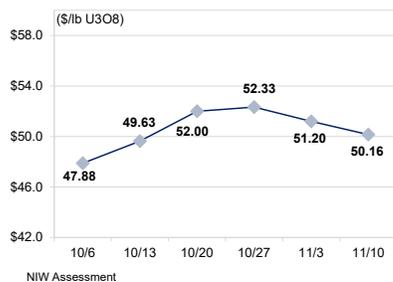
## Market Points

China National Nuclear Corp. re-upped some \$572 million in contracts with fuel suppliers in Canada, Kazakhstan, Russia, France and the US.

In the US, NextEra's Florida Power & Light came out for 2 million pounds U3O8 to be delivered from 2023-28.

The price still fell, with Energy Intelligence's Uranium Price Panel assessing the price at \$50.16 per pound U3O8 for Thursday, Nov. 10, down by more than \$1/lb. from last week.

### UPP: 50.16/LB U3O8



## WEEKLY ROUNDUP

### Centrus Haleu Demo Gets Extension

- Centrus Energy's failure to achieve operational readiness for production of high-assay low-enriched uranium (Haleu) at its Portsmouth enrichment plant in Ohio has prompted the US Department of Energy (DOE) to award the company an additional \$150 million. The cost-shared award announced Nov. 10 will allow Centrus subsidiary American Centrifuge to "complete the final steps of centrifuge assembly and clear an operational readiness review" of its 16-machine AC-100M to produce 20 kilograms of Haleu by the end of 2023, said DOE. The latest award follows a \$115 million three-year, cost-share deal for the same purpose that expires this year, and is expected to facilitate the eventual production of 900 kg of Haleu annually. But with only \$30 million allocated for 2023, future funds are "subject to appropriations, with additional options to produce more material under the contract in future years," DOE said. The award is separate from the DOE's recent mandate under the Inflation Reduction Act to allocate \$700 million toward Haleu availability and supply chain readiness, which Energy Intelligence understands will first require DOE to conduct a time-consuming environmental impact statement.
- Nuclear energy was touted this week for its potential to make "pink hydrogen," alongside green hydrogen made from renewables, at the COP27 climate summit in Egypt. US Department of Energy (DOE) official Kathryn Huff told a side event that pink hydrogen qualifies for the new hydrogen tax incentives in the US Inflation Reduction Act. While nuclear is carbon-free, "it's not part of 'clean hydrogen' in most [regulatory] taxonomies," said Huff, who suggested governments focus on a simpler question — "Is the hydrogen clean or not?" — based on grams of carbon. In a separate Nov. 9 post, the DOE highlighted various US pink hydrogen projects, including low-temperature electrolysis systems slated to debut at the Nine Mile Point, Davis Besse and Palo Verde nuclear plants respectively by next month, next year, and by 2024. The Prairie Island nuclear plant is expected to debut a high-temperature electrolyzer by early 2024.
- Small modular reactor (SMR) developer Rolls-Royce has narrowed in on four brownfield sites owned by the UK government's Nuclear Decommissioning Authority (NDA) at which it would like to deploy its SMRs. Two of those sites are directly controlled by the NDA: the land adjacent to the Sellafield nuclear site, and the Trawsfynydd site in Wales, where the Cwmni Eginio organization set up by the Welsh government to advance SMRs might be a key partner. Two other sites, at Wylfa in north Wales and Oldbury in England, are leased by the NDA to Hitachi. Rolls-Royce SMR believes all four sites meet the geotechnical, grid and size criteria for SMR deployment by the early 2030s. Rolls-Royce's SMR ambitions remain dependent on convincing the government to fund a first-of-a-kind SMR, but while it waits on this it is laying the groundwork: in July it shortlisted seven locations for a factory to manufacture heavy vessels for its SMR, adroitly spreading them across key political constituencies in Wales, northern England and the Midlands.

## NUCLEAR FUEL MARKET

# CNNC Re-Ups; Price Falls

US nuclear fuel buyers emerged on the market this week, while suppliers inked large multi-year agreements with Chinese fuel buyers. But that had little effect on a falling spot price, in part because most expected that given expansion of the Chinese fleet, buyers there would at some point re-up their supply contracts.

Canada's Cameco announced on Nov. 7 it inked a 10-year supply agreement with China Nuclear International Corp., a subsidiary of the China National Nuclear Corp. (CNNC). The announcement coincides with the first milled and packaged pounds of uranium ore from Cameco and France's Orano joint venture at the McArthur River mine and Cigar Lake mill in northern Saskatchewan, since operations were suspended in January 2018.

But that's not all. At the fifth China International Import Expo, the CNNC subsidiary also signed procurement contracts with Kazakh miner Kazatomprom and Russia's Rosatom, in addition to contracts further up the front-end supply chain with Canada's SNC-Lavalin subsidiary Candu Energy, France's Framatome, and US-based Westinghouse Electric. In total, those contracts amount to \$572 million, "further deepening international cooperation in the entire nuclear industry chain and sharing the achievements of nuclear development with the world," CNNC said in a Nov. 8 statement.

China signed "loads of 10-year contracts in 2010-11, so presumably, this a renewal of those contracts," one market source told Energy Intelligence. "It does show that China is being serious about recontracting."

Cameco's third-quarter earnings report revealed an order book of 50 million lbs. of U3O8 "added so far in 2022," of which the new order from the CNNC subsidiary "comprise(s) part," Cameco said in a Nov. 7 statement. Cameco is in the process of finalizing contracts for another 27 million lbs. U3O8, according to the statement.

Even with these improved fundamentals, including two US utilities shopping for uranium this week, the spot market price slipped. Energy Intelligence's Uranium Price Panel delivered an average price assessment of \$50.16/lb. U3O8 for Thursday, Nov.

10, down from \$51.20/lb. for Nov. 3. However, higher bids on Friday, Nov. 11, were starting to push the price higher.

Two US utilities came out with requests for quotations late this week. NextEra's Florida Power & Light came out for 2 million lbs. U3O8 to be delivered at multiple locations from 2023-28, with bids due Monday, Nov. 14, and validity until Friday, Nov. 18. Southern Co. also came out with a spot market request for 250,000 lbs. U3O8 for delivery in 2023 at Cameco's Port Hope facility in Canada.

In Africa, Vancouver-based GoviEx Uranium announced that it has filed a feasibility study for the Madaouela project showing life-of-mine output of 50.8 million lbs. U3O8, averaging 2.67 million lbs. per year for 19 years, with total operating costs at \$36/lb., although GoviEx is looking for offtakes near \$65/lb. U3O8.

GoviEx touts the facility's mining-friendly jurisdiction, thanks to French Orano's neighboring Somair mine. With \$343 million in capital costs, GoviEx says it has secured all major permits required for development, including a processing plant and renewable power supply, and plans to start producing in 2025, subject to project financing.

GoviEx and its debt advisors are engaging potential lenders and utilities "to develop a financial structure suitable to finance the development," GoviEx Executive Chairman Govind Friedland said in a Nov. 7 statement.

Also in the same mining region of Niger, Canadian junior Global Atomic announced on Nov. 7 it has commenced underground development at its Dasa uranium project. The announcement follows a financing deal made public in June, along with a letter of intent in October from a North American utility for 2.4 million lbs. U3O8 from 2025-30 from Dasa, and a production decision in November last year to proceed with the project. Global Atomic plans to begin the first phase of the mine plan in early 2023, with all-in sustaining costs near \$22/lb. for 3.8 million lbs. annually over 12 years.

Jessica Sondgeroth, Washington

## URANIUM PRICE PANEL

For the week ended November 10, 2022

	Weekly Spot Market Prices													
	Chg.	Nov		Oct				Sep				Aug		
		10	3	27	20	13	6	29	22	15	8	1	25	18
Price (\$/lb U3O8)	-1.04	50.16	51.20	52.33	52.00	49.63	47.88	48.54	49.82	50.03	51.83	52.50	48.38	47.75
Total Assessments	3.00	11.00	8.00	9.00	10.00	12.00	9.00	8.00	10.00	10.00	8.00	8.00	9.00	10.00
% within 1 StDev	10.23	72.73	62.50	66.67	70.00	83.33	77.78	87.50	60.00	70.00	75.00	62.50	77.78	80.00
Low (\$/lb U3O8)	-0.10	49.90	50.00	51.90	51.50	49.00	47.50	48.25	49.00	49.00	51.25	52.00	48.00	47.50
High (\$/lb U3O8)	-1.20	51.00	52.20	53.00	52.50	50.50	48.25	49.00	51.00	51.00	52.00	53.50	49.00	48.25
Variability*	-0.15	0.46	0.62	0.11	0.25	0.75	0.07	0.08	1.00	0.38	0.19	0.39	0.38	0.25

\*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.

## FRANCE

## Paving the Way for a €52 Billion EPR2 Fleet

The French government went full-bore over the past week to speed the domestic deployment of at least six EPR2 reactors, tapping into the French military for leadership and drafting a law that diminishes the possibilities for local and environmental objections. Significantly, a new interministerial office is being established to oversee the effort while a national debate is conducted ahead of a likely Parliamentary debate next year when a multi-year energy plan that includes the newbuilds will be submitted.

On Monday, Nov. 7, the government issued a decree establishing the new interministerial office, which will oversee implementation of the program, including costs, quality and deadlines, manage public participation procedures and help define a financing and commercial framework. It will be headed by Joel Barre, who previously led the agency tasked with procurement for the French military, and will boast 15 senior civil servants. This is the precise size of the General Secretariat for Ecological Planning launched in July, which like the newbuild office reports to the prime minister, but oversees the much broader French climate change effort, from renewable energy and efficiency efforts to food, forestry, agriculture, transport and the built environment.

The government's proposed legislation to accelerate new nuclear deployment, which has yet to be submitted to Parliament, similarly parallels a draft law to speed deployment of renewable energy across France. Both bills focus on reducing administrative and consultative burdens on developers. In the case of the nuclear proposal, it would reduce burdens related to urban planning and biodiversity. For instance, nuclear newbuilds would be deemed in the public interest, allowing planners to avoid proving the absence of harm to protected species.

The nuclear legislation will allow "some formal decisions to come earlier in the technical process," possibly paving the way for President Emmanuel Macron to make a formal decision on proceeding with the project before his presidential term ends in 2027, Institut Negawatt nuclear expert Yves Marignac told Energy Intelligence. "It's really about getting through some irreversible steps" that "create a lock-in situation to avoid as much as possible any change of course in the next [presidential] mandate."

### A €52 Billion Program - To Start

The Macron government hopes to build a fleet of three twin-EPR2 plants, for a total of nearly 10 gigawatts, on or "in the immediate vicinity" of three existing EDF nuclear plants: Penly, on the northern coast in Normandy; Gravelines, further to the east and still on the coast; and either Bugey or Tricastin, both inland plants located alongside a river. According to Macron, who signed off on the EPR2 fleet plans in a momentous early

February speech in Belfort, this fleet of six units could be followed by an additional eight EPR2s.

In its presentation to the National Commission on Public Debates (CNDP), which is overseeing the nuclear debates, EDF laid out commissioning targets for the six EPRs: the first would be brought online in 2035-37, with the last "in the middle of the 2040s." EDF put the total cost at €51.7 billion (\$52.0 billion), including €3.8 billion for development. As in the UK where it hopes to build more EPRs beyond the twin reactors under construction at Hinkley Point C, EDF envisages cost savings for later EPR2s from its much-vaunted "fleet effect." It estimates the price tag for the twin Penly units at €16.9 billion, reduced at Gravelines to €15.8 billion, and the final pair at either Bugey or Tricastin at €15.3 billion. These targets are ambitious, given the current total cost estimate of €12.4 billion to €12.7 billion for EDF's single EPR currently under construction at Flamanville-3 in Normandy.

Even if EDF is able to keep to these cost projections — something for which there may be no precedent — the EPR2 initiative would indisputably be a major initiative for France. That's why the CNDP made the case that it must oversee a national debate on the topic. The debate launched Oct. 27 will end Feb. 27 and address different topics at in-person sessions around the country. On Nov. 8 the topic was "Do we need a new nuclear reactor program in France?" while the session planned for Nov. 22 will consider possible nuclear alternatives to the EPR2. Subsequent sessions will focus on the lessons of Flamanville-3, the impact on the local environment and economy near Penly, and climate and geopolitical risks.

### The Uncertainties of Finance

It's not till two sessions in January, on the 19th and 26th, that the CNDP will delve into the economics of the newbuild program, from cost to financing to profitability. And on the financing front it's not clear whether planners have progressed much since January 2021, when a government official said "we are desperately looking for investors to invest in the nuclear construction."

This week Valerie Faudon, head of the French Society for Nuclear Energy, explained that French planners are looking at the possibility of long-term offtake contracts with heavy industry, which "is under pressure at current" electricity prices. Faudon was speaking at an International Atomic Energy Agency side event at COP27 in Sharm el-Sheikh, Egypt.

Such industrial firms "are really eager to have long term contracts with nuclear, to be able to have long-term visibility on their own decarbonization investments," said Faudon, who pointed to one steel plant in northern France that requires 1 GW of electricity to operate, and could therefore be matched to over half the output of an EPR2. This appears to be a reference to the ArcelorMittal steel plant in Dunkirk, on the northern French coast some 200 kilometers to the east of Penly.

*Phil Chaffee, London*

## FINANCE

## Washington Mulls \$3 Billion for Cernavoda

Washington may provide up to \$3 billion in debt financing to Romania to complete two long-unfinished Candu reactors at Cernavoda. That would help lock in scope for a US-based engineering, procurement and construction (EPC) firm in the project, as outlined in the October 2020 US-Romania intergovernmental agreement, which envisioned commissioning Cernavoda-3 and -4 by 2031.

But commercial commitments — and even basic public details — are scarce at best, and it's not clear that the newbuild effort has transitioned from much publicized government-to-government dealmaking to even initial commercial negotiations. For now the US-based EPC firm that might benefit from the US-Romania agreement remains unclear, as does the question of how Bucharest plans to finance and carry out two large nuclear projects alongside the €7 billion completion of Cernavoda-3 and -4. These include the €1.85 billion refurbishment of Cernavoda-1, by 2029, and a new six-module, 462 megawatt plant from US-based small modular reactor (SMR) vendor NuScale as soon as 2028.

Cernavoda-3 and -4 was in the limelight this week as the US Export-Import Bank (US Exim) issued two letters of intent on the sidelines of the COP27 in Sharm el-Sheikh, Egypt: the first envisions a \$50 million loan for the project's second phase of pre-project engineering services beginning in the second quarter 2023, and the second up to \$3 billion for US-supplied engineering and project management services as part of the third phase during which the twin 700 megawatt Candu reactors would be completed. There are no commitments in these letters. Instead, project planners may be hoping the US Exim announcement will spur other export credit agencies to ink similar deals, particularly those in Canada — home of Candu-supplier SNC-Lavalin, which is guaranteed to have considerable work on the Cernavoda nuclear islands.

The fact that this funding is mooted without any obviously committed commercial counterparties beyond Romanian nuclear operator S.N. Nuclearelectrica S.A. (SNN) highlights the extent to which this process is being driven by governments more than industry. After Bucharest nixed plans in January 2020 for China General Nuclear (CGN) to complete Cernavoda-3 and -4 it was almost guaranteeing support from Washington: first from a Trump administration eager to secure US nuclear exports to eastern Europe, and then from a Biden administration on board with this goal as part of a broader effort to fight climate change. At last year's COP26 this saw the Biden administration shepherd a deal for NuScale to supply its 462 MW plant to SNN. This week's move to begin implementation of the Cernavoda-3 and -4 deal first envisaged under the 2020 intergovernmental agreement (IGA) made clear the Biden administration also still wants to get these newbuilds off the ground.

"Years ago I was saying 'No, we don't need nuclear, we can't do that'," US Special Presidential Envoy for Climate John Kerry said at a COP27 side event announcing the US Exim letters of intent. Kerry explained that now he is "convinced" that nuclear power "is one of the ways that we can achieve net zero. I think the science, and the people who do the math, will tell you 'We don't get the Net Zero by 2050 without nuclear power being part of that mix'."

### A Phased Approach

SNN envisions three stages to the relaunched project to complete Cernavoda-3 and -4: Stage 1, the preparatory stage currently underway and set to conclude in late 2023; Stage 2, the preparatory stage estimated to last up to 30 months and ending with a final investment decision (FID); and Stage 3, the construction and commissioning phase. Planners hope to start commercial operation of Unit 3 in 2030, and Unit 4 in 2031.

When the US-Romania IGA was announced, the only mention of a US EPC firm was in a speech by Adrian Zuckerman, the Trump administration's ambassador to Bucharest. Zuckerman mentioned Aecom, which soon after sold its power construction business to a private equity company that rebranded it United E&C. But United E&C has gone quiet about the project, and subsequent SNN announcements have highlighted other nuclear firms.

In November 2021, for instance, SNN signed a contract with SNC-Lavalin to provide "engineering services for the elaboration and updating of some documentations" necessary to restart construction of the twin Candu reactors, including updating the licensing basis documents, safety design guides, and safety-related design changes. The announcement of this contract also included a reference to Sargent & Lundy ("We're thrilled to continue our business relationship" with SNC-Lavalin's Candu Energy and with Romania, said CEO Thomas White), though with no explanation of what role the US-based design firm might play. Then only weeks ago SNN organized a nuclear suppliers event with trade group Romatom alongside SNC-Lavalin, Sargent & Lundy, NuScale and Fluor, NuScale's 57% owner. United E&C does not appear to have been involved.

All of which begs the question: which companies might benefit from a \$3 billion loan for "US-supplied engineering and project management services"? Fluor almost certainly would be the EPC contractor of choice for any NuScale SMRs built in Romania, but does it also expect to play such a role at Cernavoda-3 and -4? Is United E&C still lurking in the background? Or perhaps mention of only "engineering and project management services" in the Exim announcement rather than full EPC scope means that the latter is no longer on the table, or at the very least a long way from being there. But it would be hard to square such reduced scope with that \$3 billion figure.

Answers are likely years away. An FID isn't expected before mid-2026, and it may not be much before then that a full commercial package — if one is ever agreed — is revealed. But much can

change, particularly during the Stage 2 preparatory work when the project's feasibility will be reassessed "based upon updated technical and economic indicators," according to SNN.

*Phil Chaffee, London*

## NEWBUILD

# NuScale Faces Drop in Subscriptions, Rising Costs

NuScale's downsized small modular reactor (SMR) project is facing higher costs, while offtake commitments stand at only 25% of the project's planned output. With one prospective subscriber abandoning the NuScale SMR in favor of a less developed advanced reactor project, existing subscribers are looking toward the next off-ramp, either to exit their deals or negotiate more favorable terms.

NuScale's primary developer, the Utah Associated Municipal Power Systems (Uamps), is confident it can get full subscription by early 2024 when it hopes to submit a combined operating license with Xcel Energy for building the plant at the Idaho National Laboratory. But the project has only 116 megawatts subscribed out of 462 MW, Uamps confirmed to Energy Intelligence.

As things stand, NuScale and its investors — Fluor remains its majority owner but there is also significant Japanese investment — would have to take on a lot more risk to see the project through. Offtakers are estimating increases of 40–70% in the levelized cost of electricity (LCOE), to as much as \$100 per megawatt hour versus a target price of \$58/MWh. This rise is being blamed on inflation, with higher material and borrowing costs, but experts have long predicted that NuScale, or indeed any new nuclear technology developer, would be hard-pressed to achieve such a target price this decade.

NuScale hopes to have a first-of-a-kind module up and running in 2029, with the remaining five modules generating power the following year. But as costs are refined Uamps is struggling to keep its member utilities aboard. NuScale is now offering a six-unit model consisting of 77 MW, a downsize from previous iterations including a 12-module plant and one which resulted in a slight increase in projected costs, from \$55/MWh to \$58/MWh.

The change initially garnered more interest, with as much as 515 MW from potential offtakers. However, most of that interest never materialized and one major offtaker — Grant County Public Utility District (PUD) in Washington state — which agreed to offtake 150 MW in the summer of 2021, pulled out in August. This was a blow to NuScale which was touting the fact that the US Nuclear Regulatory Commission (NRC) announced on Jul. 29 it was in the process of finalizing a design certification for the original 50 MW module.

"As of August 2022, we have ended our potential development plans with NuScale and UAMPS and are now in the early stages of exploring development of an X-energy XE-100 reactor," a Grant PUD spokesperson told Energy Intelligence. "Plenty of analysis remains, so we're not yet ready to discuss even an approximate timeline." Grant County PUD in April 2021 signed a memorandum of understanding with X-energy to develop the Xe-100, which is one of two projects in the US Department of Energy's Advanced Reactor Demonstration Program alongside TerraPower's Sodium project.

Uamps spokesperson LaVarr Webb told Energy Intelligence that Uamps "is working with a number of interested outside utilities." Uamps and NuScale are in the process of finalizing the project's Class 3 cost estimate (typically used to support full project funding requests), expected "in the next few weeks" and including "an economic competitiveness test" and the approval of a new budget and finance plan. That cost estimate will precede the federal licensing process, at which point costs are expected to increase again.

The economic competitive test (ECT) provides an off-ramp for Uamps and its members, and if the LCOE comes in above the target price Uamps and/or its individual members can withdraw from the project with no obligation to pay development and licensing costs, which are all part of the project's initial phase. "If the ECT comes in as projected at nearly twice the threshold of \$58, it will be interesting to see if UAMPS exercises their option to pull out of the project altogether or to renegotiate their terms of participation," Scott Williams of Heal Utah told Energy Intelligence.

If Uamps decides to proceed, perhaps with more favorable terms, Uamps members that have signed power purchasing contracts could still take the off-ramp, but they would only be required to pay their share of development costs if the ECT comes in below \$58/MWh. After that, all parties have one more final off-ramp prior to construction, at which point accrued development costs would be folded into bonds issued to finance construction. The project partners had anticipated the final off-ramp would take place in 2024, but the standard design approval (SDA) for the 77 MW module will likely involve numerous changes, which could delay the date.

In Washington City, Utah, Power Manager Rick Hansen predicted at an Oct. 4 power board meeting that the LCOE could be \$80–\$90/MWh (in 2020 dollars), which he believes could be competitive in 7–8 years. Even so, he added that whatever the figure "it will probably fail the economic competitive test" and "that'll mainly give us a decision point, and we'll see what comes out of those negotiations."

The problem for Washington City and other municipalities is that they're short on future resources so pulling out of the NuScale project means they have to find electricity supply elsewhere. Hansen mentioned a potential PPA from an unidentified project in which existing offtakers are backing off. The unnamed project

would provide 50 MW to the municipality, but given the nature of demand Washington City would probably be competing with 150 MW of interest from other municipalities, “so it’ll dilute what we can get,” he said.

In a similar power board meeting in Hurricane City, Utah, on Oct. 5, power manager Scott Hughes said he anticipates the NuScale LCOE will come in at \$90–100/MWh (in 2020 dollars) even with the 30% tax credit rate in the recently passed Inflation Reduction Act (IRA) extended to advanced reactors entering service after 2024.

## Rising Costs

“Inflation and interest rate increases are obviously impacting the project,” Webb said. Citing producer price indices, Webb points to a 54% increase in fabricated steel plate and a 70% increase in fabricated structural steel over the past two years, among other industrial commodity price spikes.

“It is important to recognize that the Class 3 estimate is more refined and current than that of any other SMR vendor,” Webb said. “No other SMR supplier has the supply chain information or construction details needed to create such an estimate. All other energy projects are facing similar increases.”

But given the size of the design uprate and unresolved safety concerns about the SMR’s steam generator, the project has significant hurdles to clear. NuScale is advancing undemonstrated design principles with respect to the steam generator and in May 2020 the NRC said it could not “sufficiently validate” the design with respect to the 50 MW module. NuScale plans to address the steam generator issue in its upcoming SDA application for the 77 MW uprate, expected to be submitted by year-end, and in a subsequent combined operating license application.

*Jessica Sondgeroth, Washington*

## SAFETY

# NRC’s OIG Queries Risk-Informed Oversight

The US Nuclear Regulatory Commission’s (NRC) internal watchdog has cast light on internal disagreements “among NRC staff and external stakeholders” over an apparent “increase in risk tolerance by the NRC” and whether it is appropriate. The report by the agency’s Office of Inspector General (OIG) speaks to the ongoing debate over the agency’s growing reliance on licensees’ risk computation models to support staff findings and approvals, and amid rulemaking for advanced reactors that would use the same models.

For more than two decades, and under pressure from the industry and Congress, the NRC has steadily shifted from a traditional reg-

ulatory approach reliant on engineering standards to a risk-informed, performance-based approach that relies heavily on licensee risk model computations, “balancing deterministic engineering judgment with quantitative analysis based on operating experience,” the Oct. 28 OIG report explains. This approach is further facilitated by the January 2019 passage of the Nuclear Energy Innovation and Modernization Act (NEIMA) requiring the NRC to establish a risk-informed, technology-inclusive regulatory framework to license advanced reactors.

But critics have long been wary of the agency’s heavy reliance on risk-informed computations, otherwise known as probabilistic risk assessments (PRAs), and in particular licensees’ own PRAs to support changes to their operating licenses. Victor Gilinsky, a former NRC commissioner, told Energy Intelligence that “the agency defines risk as probability times consequences” to get “average risk,” which “makes sense in situations where the consequences are limited and there is lots of data, like deciding where to put a traffic signal.” But it doesn’t make sense for decisions involving the likelihood of rare events “like major nuclear accidents,” Gilinsky said, and “there is no rule that risk is probability times consequences ... It is used because any consequence number can be overcome for licensing ... with a small enough probability number.”

To support reactor license amendments or NRC “event findings” and inspections, licensees have “increasingly” used PRAs to compute accident scenarios, including likelihood and consequences. But they can vary vastly from the NRC’s own standardized plant analysis risk (SPAR) model, which is maintained and updated by the Idaho National Laboratory.

Nuclear safety expert Dave Lochbaum has for years scrutinized the gap between the results of licensee PRAs and the SPAR model. In the case of even the “closest agreement,” involving safe shutdown at Oconee, “the licensee’s risk was half that determined by the NRC,” Lochbaum said in a 2015 letter to the NRC that he provided to Energy Intelligence. “The widest gap involved the flood protection issues at Watts Bar where the licensee’s risk was three orders of magnitude lower than that estimated by the NRC.”

Similarly, the OIG report notes that the NRC and its licensees “have methodological differences in their respective approaches” to PRAs, and “agency staff members sometimes disagree internally on the use of risk analysis in regulatory actions such as license amendments and inspection findings.” A “years-long decline in reactor inspection findings of very low safety significance (i.e., ‘green’ findings) has raised questions among NRC staff and external stakeholders about the root causes of this trend and whether it reflects an appropriate increase in risk tolerance by the NRC.”

## Risk-Informed Resistance

Nuclear watchdogs have long cautioned that the agency’s approach to risk fails to recognize or incorporate design errors or sufficient safety margins to account for unknowns in reactor

design, construction and operation, and pushed for more stringent PRAs. “I think the relentless external and internal pressure to make the NRC more ‘risk-informed’ is in some cases resulting in the inappropriate use of PRA information outside of the bounds where it can be applied with confidence,” Union of Concerned Scientists Nuclear Power Safety Director Ed Lyman told Energy Intelligence. For example, the NRC gives licensees “quantitative credit” for using equipment or mitigation strategies to cope with hazardous external events “without any meaningful validation of such scenarios,” he said.

In response to Lochbaum’s 2015 analysis, the NRC pointed to differences in “engineering assumptions” and “human reliability analysis” recognizing “that licensees may have unique perspectives on the event or condition under agency review.” For the NRC to credit a licensee for manual, human mitigation strategies, the licensee has to show it has “pre-existing procedures and training on exercising those procedures,” according to Lochbaum, but outside of NRC oversight, he suspects that the industry “relies more on miracles to save the day.”

Even among some NRC staff there is skepticism that more emphasis on a risk-informed approach is the right way to go. At an Aug. 16 meeting of the NRC’s Advisory Committee on Reactor Safeguards (ACRS), Region III Senior Reactor Analyst Laura Kozak noted “a fair amount of kind of a negative attitude” among NRC staff “that all we’re doing with risk is making things less significant or implying we don’t need requirements.”

While Kozak caveated that in her experience, “nothing could be farther from the truth,” she also underscored a deficiency in the NRC’s oversight of licensees’ PRA capabilities. Even though inspectors work closely with licensees to understand and redefine PRA parameters for specific inspection-related events or license amendment requests, she said “we have no specific inspection procedure that says, ‘Go look at licensee PRA capabilities.’”

Typically, she said, when a licensee comes to the agency with a license amendment, its PRA method has been peer-reviewed by other reactor operators, and reviewed by the NRC before being deemed “acceptable for use at the time of licensing. But, for the rest of the time, the plant is going to be using this PRA to make risk-informed decisions.” She said the agency is now considering what licensee PRA “configuration controls” should look like, how to ensure “continued technical adequacy of PRAs” and the scope NRC’s oversight should take.

## Advanced Reactor Rulemaking

The agency is still working through how it intends to regulate PRAs for new reactor designs but in March staff issued a trial use regulatory guidance that supports the use of PRAs by new applicants for advanced non-LWR nuclear power plants. The agency seems to be leaning toward requiring PRAs for all new reactor designs, but is also weighing a tiered approach advocated by industry called “alternative evaluation for risk insights.” This

would distinguish “between plants with relatively straightforward designs and plants with relatively complicated designs that warrant the development of a PRA in order to understand their risk,” according to an Oct. 12 NRC advanced reactor stakeholder presentation.

The NRC has used its SPAR model to conduct risk analyses for the Vogtle-3 and -4 newbuild project in Georgia. And the agency plans to use the same SPAR model in 2023 for NuScale’s 12-module 50-megawatt small modular reactor design which the staff is in the process of certifying. The SPAR model will also support the development of the oversight program for new reactors considered by the NRC to have lower risk profiles than existing plants.

*Jessica Sondgeroth, Washington*

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## JAPAN

# NRA’s ‘60-year’ Rule Change— Mixed Blessing?

Japan’s Nuclear Regulation Authority (NRA) has drafted a framework for regulating nuclear power plant operations beyond the current 60-year ceiling. The lifting of this ceiling by the government has been long sought by Japan’s nuclear industry although some operators appear skeptical of bottom-line benefits given the likelihood of substantially increased costs to meet stricter regulations covering degradation and other aging-related safety issues.

The proposed new safety regime, which would feature special inspections every decade after 30 years of operation, was unveiled in the wake of a push by the conservative Liberal Democratic Party (LDP) government to revive Japan’s nuclear power sector by expediting restarts of idled reactors and easing the current legal restrictions that mandate a basic 40-year period of operation with one possible 20-year extension. In October, Trade & Industry Minister Yasutoshi Nishimura told reporters that the existing lifetime limits were “under study” and that concrete proposals would be ready by the end of the year.

On Nov. 2, after the agency’s regular weekly meeting, NRA Chairman Shinsuke Yamanaka told reporters that the agency’s five commissioners had reached a “common understanding” on the outlines of a new inspection system for “aging reactors” and would formulate a concrete framework “without loopholes” by the end of the year.

This came less than a month after a dialogue between Ministry of Economy, Trade & Industry (Meti) officials and NRA commissioners Oct. 5 about the proposed new policy direction. The Nov. 2 meeting featured a presentation from the NRA’s secretariat on the proposed rules.

Under the current system, which was set after the Fukushima Daiichi triple meltdown in March 2011, utilities applying for 20-year operating life extensions for reactors reaching the 40-year legal cap must undergo special inspections. So far only four reactors have received such extensions.

The proposed new system would allow extensions past 60 years assuming plants clear special inspections every ten years from the time a reactor reaches 30 years of operation. Operators would also be required to formulate and receive NRA approval for “long-term facility management plans” aimed at controlling degradation and maintaining critical safety systems; these would be subject to NRA review for implementation. If the reactor fails a special inspection or the maintenance plan is deemed substandard, the NRA would be empowered to order a suspension of operation pending NRA approval and implementation of mandatory improvement plans.

The NRA secretariat listed 17 reactors which have passed the 30-year mark and 16 that were still short of this threshold, leaving out 24 units already earmarked for or in the process of decommissioning. Of those past 30 years, 10 have been restarted but as of Nov. 7 only three were in operation. The four reactors licensed to operate to 60 years include Kansai Electric’s Takahama-1 (47 years old), Takahama-2 (46) and Mihama-3 (45), as well as Japan Atomic Power Company’s Tokai-2 BWR (43).

Yamanaka said the NRA would begin by formulating a “broad framework” by the end of the year, but added that the NRA needed to have a thorough discussion on the detailed criteria for evaluating the safety of aging reactors and what items to evaluate at what times in light of the effects of natural disasters in Japan and other “complicated questions.” He added that, “We need to consider what items we need to examine and what criteria we should set in the evaluation of aging nuclear reactors.”

Yamanaka also affirmed that inspection standards for the 30<sup>th</sup> year in operation and each of the 10 years following “will not be relaxed” compared to the special examination carried out on reactors applying for a 20-year extension after 40 years in operation. “It is the responsibility of the operator to prove that the standards are met,” he said, vowing that the regulatory agency “will not have any hesitation in rejecting any application that does not meet the standards.” Yamanaka also stressed that safety inspections would be based on contemporary safety standards, including “new knowledge” introduced during the intervals.

On Nov. 8 officials from a nuclear policy subcommittee of Meti’s Agency for Natural Resources and Energy (Anre) floated three options for determining ultimate reactor operating lifetimes. The proposals included maintaining the current 40-year limit with

only one possible 20-year extension; maintaining the base operating period with additional extensions decided on a “usage policy perspective” and no ceiling; setting an as yet unspecified ceiling on operations with possible extensions (referred in the report as “20+alpha”)—but excluding from the calculation of a reactor’s age operational suspensions due to NRA safety checks or court-mandated shutdowns. A participant in the meeting told Energy Intelligence that most of the subcommittee members supported the latter two proposals, with Meti indicating preference for the third.

## How Realistic Are Further Extensions?

Reactions to the NRA’s draft aging reactor review guidelines, even from utilities, were mixed. Former Atomic Energy Council deputy chairman Tatsujiro Suzuki told Energy Intelligence that “this is a correct and technically sound decision by the NRA.” However, an electric power company official told the conservative *Sankei Shimbun* that “even though the path to operation for over 60 years is being opened, we would have to take safety measures at enormous expense every time we had a review. Is this realistic?”

A senior industry professional told Energy Intelligence that “I do not at all think reviews once every 10 years can be considered a ‘serious burden.’”

In a Nov. 5 editorial, *Asahi Shimbun* observed that the 40-year cap had been established in light of the “bitter lessons” of the Fukushima Daiichi triple meltdown in March 2011 and “must not be changed without national debate after only 10 years.” The editorial noted that in his Oct. 5 news conference Yamanaka said that the question of reactor life extensions is a policy decision outside the NRA’s mandate, which “means that the NRA’s mandate is to ensure proper regulation of nuclear power based on government policy.” This “in effect means regulation in line with promotion” and raises doubts about the NRA’s independence.

A petition presented to the NRA and Meti, backed by 22 citizen organizations and drafted by the Friends of Earth Japan, cited “technical and physical limitations to reviewing the aging of nuclear power plants” and pushed to maintain the 40-year rule.

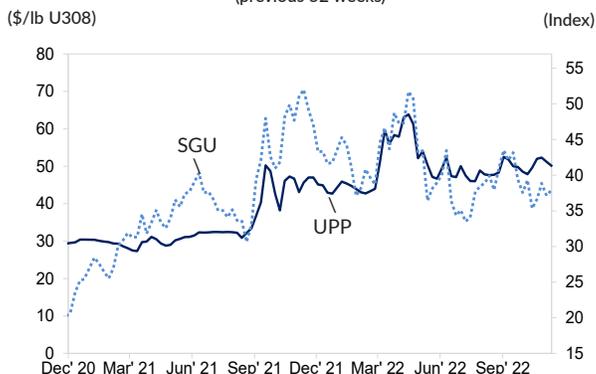
Perhaps in response to such concerns, Yamanaka signaled during his Nov. 9 news conference that the agency’s flexibility was not without limits and that the Anre proposal to exclude periods of suspended operation from the lifetime calculations was impractical. “It is difficult to think of anything other than a calendar based regulation and basically we have no intention of changing it.”

*Dennis Engbarth, Taipei City*

# URANIUM MARKET UPDATE

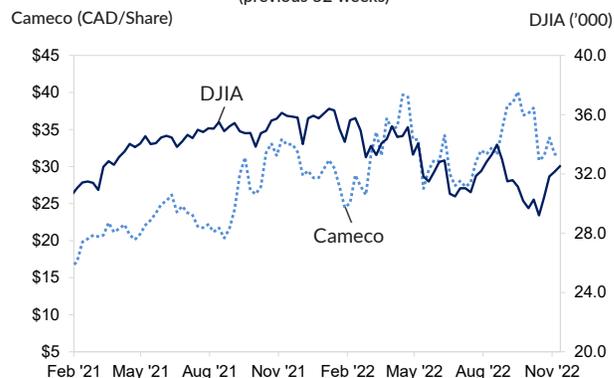
All prices as of Thursday, November 10, 2022

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



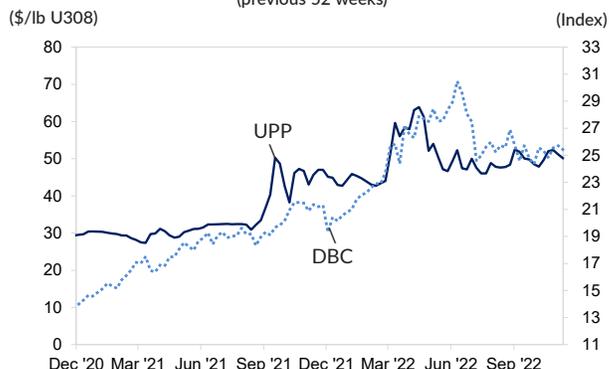
The Solactive Global Uranium Total Return Index, created by Structured Solutions AG, tracks the price movements in shares of companies active in the uranium mining industry. Calculated as a total return index and published in US\$, its composition is ordinarily adjusted twice a year.

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



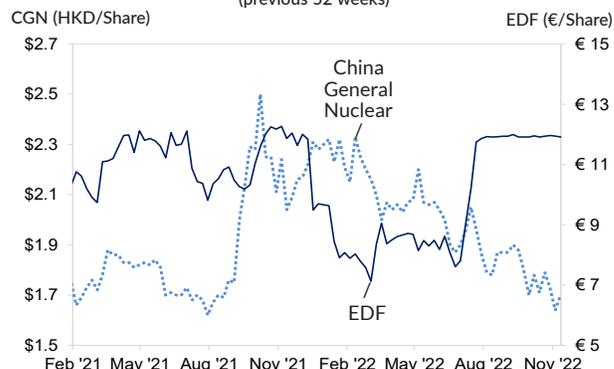
Canadian uranium miner Cameco's stock is valued in Canadian dollars compared with the US dollar on the Dow Jones Industrial Average (DJIA). Roughly two-thirds of DJIA's 30 component companies are manufacturers of industrial and consumer goods. The others represent industries ranging from financial services 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	
		Oct '22	Sep '22	Aug '22	Jul '22	Jun '22	May '22	Apr '22	Mar '22	Feb '22	Jan '22	Dec '21	Nov '21
<b>Uranium (\$/lb U3O8)</b>													
Low	-1.00	47.50	48.50	47.50	45.50	45.50	46.00	52.50	51.00	42.50	43.00	42.00	43.00
High	+0.25	52.75	52.50	53.50	50.50	52.50	54.00	64.00	60.00	44.50	46.50	47.00	47.50
<b>Conversion (\$/kgU)</b>													
Low	+2.00	38.00	36.00	36.00	32.00	30.00	30.00	28.00	26.00	16.00	16.00	16.00	15.00
High	+3.00	42.00	39.00	39.00	37.00	33.00	33.00	30.00	28.00	17.00	17.00	17.00	18.00
<b>Enrichment (\$/SWU)</b>													
Low	+1.00	93.00	92.00	90.00	89.50	84.00	84.00	82.00	100.00	59.00	57.00	56.00	56.00
High	-	96.00	96.00	92.00	95.00	150.00	150.00	150.00	150.00	61.00	59.00	57.00	57.00

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.

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