

NUCLEAR INTELLIGENCE WEEKLY[®]

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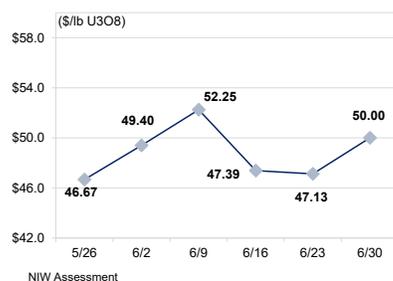
Market Points

Canadian sanctions on Russian exports threaten to disrupt a Class 7 vessel, likely containing Russian nuclear fuel, set to move from St. Petersburg to Philadelphia next week.

The threat of disruption put upward pressure on the spot price delivered by Energy Intelligence's Uranium Price Panel, at \$50 per pound U3O8 on Jun. 30, up from \$47.13/lb. on Jun. 23.

The US Department of Energy's National Nuclear Security Administration is preparing to procure US-origin uranium and conversion services for the \$75 million domestic uranium reserve.

UPP: \$50.00/LB U3O8



WEEKLY ROUNDUP

Concrete Pour at Sanmen-3

- China National Nuclear Corp. (CNNC) started pouring concrete for the base of the reactor building at Sanmen-3 in Zhejiang province, the state-owned operator announced Jun. 28. This marks the first AP1000 construction start since the concrete pour for Vogtle-4 in the US, in November 2013. The milestone follows State Council approval in April for four more AP1000s — two each at Sanmen and at Haiyang, in Shandong province — and two Hualong-One reactors at Lufeng, in Guangdong province. The new AP1000s, rebranded “CAP1000” reactors, will join the twin units already operational at Sanmen and Haiyang. The Sanmen units have “generated more than 60 billion kilowatt hours” since the start of commercial operation in 2018, said CNNC. Sanmen-3 is the third reactor in China on which construction was started this year. Work on two Rosatom-supplied VVER-1200s began earlier this year: Tianwan-8 on Feb. 25 and Xudabu-4 on May 19.
- Indirect nuclear talks between Iran and the US ended without progress on Wednesday and there was no clear indication of when they might resume. The latest round followed a recent weekend trip to Tehran by the EU's foreign policy chief Josep Borrell and resumed more than three months after they were suspended. “We are concerned that we might not make it over the finishing line,” Borrell said Thursday in remarks delivered to the United Nations. “The time to overcome the last outstanding issues, conclude the deal, and fully restore the JCPOA is now.” The EU acts as mediator in the talks, which were held for the first time in Qatar, a Mideast Gulf ally of both Iran and the US. Iran's ambassador to the UN Majid Takht Ravanchi said that “agreement is not out of reach” if the US “shows its serious intention to implement its obligations.” US sources say a deal is not in sight, at least for now.
- California's legislature this week passed a hugely controversial bill that some see as a first step toward reversing the state law requiring Diablo Canyon's shutdown in 2025. The bill sets up a strategic reserve that would allow the state to help utilities prolong the lives of aging fossil fuel plants and Diablo Canyon and thus enable “on-call emergency supply” while the state struggles to meet demand during its energy transition. This coincides with the US Department of Energy's (DOE) Jun. 30 decision, signaled last week, to extend the deadline by 60 days for applications to its \$6 billion Civil Nuclear Credit Program geared toward keeping uneconomic reactors open. Diablo Canyon operator Pacific Gas & Electric (PG&E) is now likely to apply by the new Sep. 6 deadline. In a Jun. 27 letter to the DOE one PG&E official explained that by extending operations past 2025 the utility “will incur significant transition costs which are not recoverable.” But experts on the Diablo Canyon Independent Safety Committee, whose members are appointed by the governor and other top state officials, warned at a meeting last week that far more work is required to keep the plants operating beyond their license expiration dates, and some of it may not prove doable.

NUCLEAR FUEL MARKET

Canadian Sanctions Interrupt Russian Shipment

Canadian sanctions on Russian exports imposed last month are threatening to disrupt a nuclear fuel shipment scheduled to move out of St. Petersburg next week. A Canadian-flagged ship is set to depart the port, with or without the Class 7 cargo that was destined for the port of Philadelphia, in what could be a challenging precedent for the nuclear fuel industry.

Responding to Russia's aggression in Ukraine, Canada on Jun. 7 imposed a new set of sanctions on the country. They prohibit any Canadian person or entity from providing any service to any Russian entity or person, including water transportation and chemical manufacturing and chemical products.

While the sanctions do not specifically name nuclear fuel or any of its components, the broad language seems to encompass the nuclear fuel trade. This is in contrast to the situation in the US where nuclear fuel has so far been clearly exempted from Russia sanctions.

The vessel was due to ship nuclear fuel, likely in the form of enriched uranium product (EUP) and potentially other forms of nuclear fuel, from St. Petersburg to the Port of Philadelphia. Because the vessel is carrying other non-Class 7 goods, it is expected to move next week, potentially without any Russian nuclear fuel on board. The issue has caused a great deal of consternation and confusion among buyers, transporters, producers and intermediaries reliant on Russia's nuclear fuel trade, but it could also have implications for uranium shipments from Kazakhstan and Uzbekistan.

The news put upward pressure on the spot price delivered by Energy Intelligence's Uranium Price Panel, at \$50 per pound U3O8 on Jun. 30, up from \$47.13/lb. on Jun. 23.

Market sources say the Canadian government might be amenable to granting a sanctions exemption to the Canadian shipping company, CIS Navigation, but that could not be confirmed with Canada's Global Affairs office as of press time. Sources, however, have indicated that the required paperwork to seek an exemption may be gummed up internally at CIS Navigation.

CIS Navigation, based in Montreal, is a sister company to ARRC, or Atlantic Ro-Ro Carriers, also based in Montreal, each of which is a member of the CISN Shipping Group, whose ownership is less clear. The vessel is understood to be an ARRC vessel operated by CIS Navigation, which is typically contracted to export nuclear fuel from Russia, Kazakhstan and Uzbekistan. But the Canadian ownership of the two companies and the recent Canadian sanctions are presenting an additional challenge to an industry already facing a dearth of maritime transporters willing to take on the liability of shipping Class 7 fissile material.

Beyond that, Canada's new sanctions could be interpreted to affect any Canadian transport or logistics company beyond CIS and ARRC — such as TMI International for example — that use the Port of St. Petersburg and the services of its stevedores or longshoreman to ship Russian and non-Russian material through the region. That includes U3O8 from Uzbekistan and Kazakhstan, the latter of which is already working on an alternative route through the Caspian and Black Seas.

The parties affected by the delayed shipment are also looking for alternate routes and non-Canadian shippers to move the material, but there are problems around liability. In the past, even the smallest logistical problems associated with Class 7 material have created the biggest headaches for ports and shipping lines simply because of the required safety and safeguards measures. The geopolitical complexities are making the situation even worse.

Meanwhile, in the US, the Department of Energy's National Nuclear Security Administration (NNSA) is preparing to procure material for the domestic uranium reserve mandated by Congress in December 2020 with an allocation of \$75 million. Energy Intelligence understands the NNSA is looking to procure about 1 million lbs. of already mined, domestically produced U3O8, which would at today's price cost about \$50 million. The remaining \$25 million could go to conversion services marketed by ConverDyn from the Metropolis plant set to restart next year. At a price of about \$32.50/kgU today, that would amount to about 770,000 kgU.

Jessica Sondgeroth, Washington

URANIUM PRICE PANEL

For the week ended June 30, 2022

	Chg.	Weekly Spot Market Prices												
		June			May				Apr					
		30	23	16	9	3	26	19	12	5	28	21	14	7
Price (\$/lb U3O8)	2.87	50.00	47.13	47.39	52.25	49.40	46.67	47.14	50.41	54.00	52.13	61.28	63.88	63.07
Total Assessments	0.00	10.00	10.00	11.00	10.00	10.00	12.00	10.00	9.00	11.00	9.00	10.00	10.00	9.00
% within 1 StDev	-30.00	60.00	90.00	72.73	70.00	40.00	75.00	80.00	77.78	72.73	55.56	60.00	90.00	77.78
Low (\$/lb U3O8)	2.25	49.25	47.00	46.60	51.70	49.00	46.00	47.00	49.00	53.50	51.25	59.00	63.75	63.00
High (\$/lb U3O8)	3.25	50.75	47.50	48.50	52.50	50.15	47.50	47.50	52.00	55.00	53.00	63.25	64.00	63.50
Variability*	0.10	0.16	0.06	0.09	0.40	0.32	0.05	0.00	0.28	0.50	0.50	0.75	0.08	0.00

*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.

OUTLOOK

IEA Says Nuclear Is Set for a 'Comeback'

Nuclear power is “set to make a comeback,” International Energy Agency (IEA) Executive Director Fatih Birol said this week, as his agency released a long-awaited report on nuclear power’s role in the global energy transition. If the transition proceeds with a precipitous decline in nuclear power generation, from 10% of global output to 3% by 2050, the energy transition will be more challenging, more risky and \$500 billion more expensive, the report argues. But the IEA also warned that any true nuclear buildout needs industry to lower reactor construction costs by 40%, and governments to develop frameworks that “facilitate investment” in nuclear.

The new report repeats the IEA call — first made in its influential May 2021 report on achieving worldwide net-zero emissions by 2050 — for doubling nuclear power, which the Paris-based agency argues will provide a complementary role to renewables via its dispatchability and its provision of “system services.” It also builds on a May 2019 report, the first by the IEA to focus entirely on nuclear power, which argued that nuclear life-extensions are “generally cost-competitive” with other power generation sources, including new wind and solar capacity.

This week’s report, titled *Nuclear Power and Secure Energy Transitions* and released Jun. 30, expands its focus to argue that nuclear energy “can help make the energy sector’s journey away from unabated fossil fuels faster and more secure,” and notes that the global policy “landscape” is “opening up opportunities for a nuclear comeback.”

Birol praised recent policy shifts in Belgium and South Korea that reversed official nuclear phaseout goals just as he had last week implicitly criticized Germany’s decision not to extend its last three reactors beyond 2022. But he also refocused his pro-nuclear arguments on both energy security, cost and geopolitical grounds, noting in the last instance that China and Russia are taking the lead in nuclear power, and China is set to operate more nuclear plants than any other country by 2030.

A Growing Appetite

“We were already seeing before the current war context that there was a growing appetite for nuclear power,” said Birol, but thanks to “high energy prices,” a “growing attention to energy security” and the “national security of many governments,” the IEA is “seeing that several countries around the world are reviewing their position vis-à-vis nuclear power.” Birol pushed stridently for such a review, explaining that IEA staff examined what would happen if instead of more nuclear power, there were “less nuclear in the future.” Their conclusion was that “it would be technically more challenging, more expensive and riskier. Therefore we thought we should bring this to the attention of the decisionmakers.”

The IEA’s official role is advising OECD member states on energy policies, and given recent policy signals it’s safe to say that many OECD decisionmakers are already receptive to these arguments.

“Those countries that opt to use it reaffirm the role of nuclear energy in their energy mix,” read this week’s communiqué from the G7, comprising the world’s leading democracies, issued on Jun. 28 two days before the IEA report. “Those countries recognize its potential to provide affordable low-carbon energy and contribute to the security of energy supply as a source of baseload energy and grid flexibility. They state their assessment that the development and deployment of advanced nuclear technologies including small modular reactors within the next decade will likely contribute to more countries around the world adopting nuclear power as part of their energy mix.”

Another policy signal could come on Wednesday, Jul. 6, when the European Parliament votes on a European Commission “taxonomy” proposal that would classify some natural gas and nuclear power projects as “sustainable,” and thus eligible for “green” funding.

Necessary or Extraneous?

Not surprisingly, advocates of 100% renewables pushed back on the report, with Stanford University’s Amory Lovins saying “it is no more transparent, soundly structured, or plausible than the IEA’s two similarly lopsided previous versions.” He argued in a perspective that locally optimized clean-energy portfolios “obviate classical dispatchability and ‘baseload’ capacity.” Separately, researchers at Stanford, led by Mark Jacobson, published a study last month arguing that grid stability analyses indicates that some 145 countries, grouped into 24 regions, can by 2050–52 “exactly match demand” with 100% supply from water, wind and solar power.

The IEA report, which was externally reviewed by multiple industries within the nuclear sector and by pro- and antinuclear governments, came to a dramatically different conclusion.

“Nuclear and other dispatchable power sources complement renewables by providing critical services to the electricity systems,” Keisuke Sadamori, the IEA’s director of energy markets, said in a Jun. 30 presentation. “The predominance of wind and solar in the power mix, and the end of unabated fossil fuel generation, must be complemented by a diverse mix of dispatchable generation to provide stability, short-term flexibility and adequate capacity during the peak demand periods.”

Indeed, Sadamori and the IEA believe that this role is so important that governments must restructure energy markets to reward it. “The wholesale markets should price system services to reflect their value,” said Sadamori. “The need for system services such as flexibility, adequacy and stability increases sharply as the share of variable renewables increase. Electricity markets should be designed to fully value these services, not just the electricity production.”

This leads to the new report's most notable rhetorical gambit: a low-case nuclear variant of the agency's 2050 net-zero scenario that "considers the impact of failing to accelerate nuclear construction and extend lifetimes." In this case, nuclear's share of total global generation would decline from 10% in 2020 to 3% in 2050, and solar and wind would "need to fill the gap, pushing the frontiers of integrating high shares of variable renewables. More energy storage and fossil fuel plants fitted with carbon capture, utilization and storage would be needed." As a result, this scenario would require "\$500 billion more investment" and raise annual consumer electricity bills by an average of \$20 billion to 2050.

Phil Chaffee, London

FUEL CYCLE

X-energy Plans First Haleu Fabrication Facility

X-energy expects to break ground this year on a commercial fuel fabrication facility in Oak Ridge, Tennessee, for its higher-enriched uranium Triso (tristructural isotropic) fuel that would be used in its under-development Xe-100 advanced reactor. The US Department of Energy (DOE), meanwhile, is still working to secure a supply of high-assay low-enriched uranium (Haleu) to supply the fabrication plant once it begins planned operation in 2025.

X-energy subsidiary Triso-X signed an agreement this week to acquire from the state's Industrial Development Board 110 acres at an industrial park in west Oak Ridge to host the plant. The move is expected to draw on the existing workforce and communities that have long supported Oak Ridge National Laboratory (ORNL) and X-energy's work at the lab, including a pilot Triso fuel fabrication program. The DOE is heavily subsidizing the effort in order to meet its aggressive advanced reactor demonstration targets by 2027, but success rests largely with securing enough Haleu to supply the fuel fabrication facility. With groundbreaking imminent, X-energy is not yet certain when or from where it will secure the fuel for the facility's operation.

Energy Intelligence understands that DOE's Office of Nuclear Energy (NE) is working closely with the agency's quasi-independent National Nuclear Security Administration (NNSA) to procure at least 6 metric tons of high enriched uranium (HEU) for downblending into about 25-30 metric tons of Haleu. It would be dedicated to DOE's two Advanced Reactor Demonstration Program (ARDP) projects: TerraPower's 345 megawatt sodium-cooled fast reactor, Natrium, and X-energy's high-temperature gas-cooled reactor, the Xe-100. This represents something of a breakthrough given NNSA's previous

reluctance to part with any of its HEU because all of it is already spoken for, whether for the nuclear Navy fleet or other DOE research and development projects. As part of the Bipartisan Infrastructure Law (passed in November) that allocated \$2.5 billion to ARDP, the program's oversight is shifting from NE to a new Office of Clean Energy Demonstrations, although NE is still handling fuel procurement.

Longer term, the DOE is working with lawmakers to secure more funding for the commercialization of Haleu supply beyond the two demonstration projects that are expected to be up and running by 2027. While the effort appears to enjoy bipartisan support, the funding levels Congress might ultimately approve are less certain.

Triso Fuel Fab

The ARDP has awarded about \$300 million to X-energy for commissioning the Triso-X Fuel Fabrication Facility (TF3) at the newly acquired Oak Ridge site. The TF3 will be designed to initially produce 8 metric tons of Haleu fuel per year, which X-energy says is enough to support about 12 Xe-100 SMRs with a capacity of 80 MWe each. The company says it could expand annual capacity to 16 metric tons by the early 2030s.

X-energy submitted a license application for TF3 to the US Nuclear Regulatory Commission (NRC) on Apr. 6, at a cost of nearly \$20 million. The company expects NRC's review process to take 24-36 months; if approved, the license would be the nation's first under 10 CFR 70 Category II, which defines the fuel as being of moderate strategic significance in terms of its potential for use in nuclear weapons. Fuel fabrication plants that supply the existing fleet with low-enriched uranium fuel fall into Category III.

In 2020 X-energy initially planned to work with Global Nuclear Fuels (GNF) to develop commercial-scale Triso production equipment within GNF's Wilmington, North Carolina, fuel plant. But with plenty of DOE support, X-energy went its own way to complete the TF3 design alongside a fuel fabrication license application. That follows the 2018 commissioning of a Triso fuel fabrication pilot facility at the nearby ONRL — with about \$80 million in DOE funding — that produced Triso fuel using a small amount of Haleu supplied by ORNL "to refine our proprietary Triso-X fuel form," X-energy spokesperson Robert McEntyre told Energy Intelligence.

By comparison, the DOE is spending about \$3.5 billion through 2027 for the Xe-100 reactor demonstration and licensing. X-energy plans to site the Xe-100 reactor on the other side of the country at Energy Northwest's Columbia nuclear plant in Washington state. McEntyre said that once demonstrated X-energy estimates the total cost of a four-unit Xe-100 plant at \$2 billion.

While the company's plan for TF3 is focused on Triso fuel, it is also evaluating options to supply other types of fabricated fuel for other types of advanced reactors.

Safety Case

X-energy may have started TF3’s licensing process but it is still in the pre-application stage for licensing its Xe-100 reactor, and that will require a strong safety case. By design, the Xe-100 is cooled by pressurized gas and operates at temperatures up to 800°C, compared with around 300°C for existing light water reactors. First developed in the 1960s, Triso fuel is designed to withstand high operating temperatures.

Triso fuel generally consists of tiny kernels of uranium oxide surrounded by layers of carbon-based materials. X-energy’s TF3 requires HALEU enriched to less than 20% U-235 in the form of uranium oxide (UO₂) powder. As UO₂, the HALEU is converted into “a uranyl nitrate solution, into gel spheres, and then into fuel kernels,” according to the TF3 license application. The fuel kernels are subsequently processed “through coating, overcoating, fuel form pressing, and carbonization.” The end result is spherical “pebbles” each about the size of a billiard ball embedded with 18,000 Triso particles.

In a loss-of-coolant accident, Triso fuel “can retain radioactive fission products up to about 1,600°C” but any temperature increase beyond that would likely result in a significant acceleration of fission products from the fuel, according to a March 2021 report on advanced reactors by Ed Lyman of the Union of Concerned Scientists. “So, while Triso has some safety benefits, the fuel is far from meltdown-proof, as some claim.” Lyman points to a recent Triso irradiation test in the Advanced Test Reactor in Idaho that, according to a June 2021 report, had to be terminated prematurely when the fuel began to release fission gas products at a rate nearing off-site radiation dose limits.

Jessica Sondgeroth, Washington

UZBEKISTAN

Site Selected for First Nuclear Plant

Uzbekistan has chosen the site and conducted all the necessary engineering studies for its inaugural nuclear power plant, but has so far failed to sign the crucial commercial contract to move forward with Russia’s Rosatom. That’s according to the country’s top nuclear official, who explained that both sides are still analyzing the project’s economic viability.

“We have already chosen the site, conducted the whole complex of research in line with requirements from the International Atomic Energy Agency (IAEA),” Jurabek Mirzamahmudov, general director of UzAtom, the state nuclear corporation, told Energy Intelligence on May 24. “We conducted all the engineering studies and we are going to hold public hearings both

in Uzbekistan and neighboring countries as there are some doubts that we need to dispel.” The location — in the Farish district of the Jizzakh region and near Lake Tuzkan in the southern part of Lake Aydarkul (see map) — had been “pre-selected” as a potential site in May 2019, and is now set to host twin Rosatom-supplied VVER-1200s.

Mirzamahmudov affirmed that talks with Rosatom on the engineering, procurement and construction (EPC) contract continue, but said that there is no deadline for it to be signed. He admitted that the Covid-19 pandemic has slowed negotiations, but argued that it gave the two sides more time to consider details of the deal, including the price, economics and technologies involved.

The Uzbek official gave no indication that Tashkent is reconsidering such a long-term commercial relationship with Moscow given the geopolitical shifts that followed Russia’s invasion of Ukraine in February. Rosatom has continued to push ahead on newbuilds in Bangladesh, China, India and Turkey, and the April re-election of Hungarian Prime Minister Viktor Orban appeared to ensure that plans for the supply of twin VVER-1200s to Hungary’s Paks II project would proceed. Indeed, the only solid newbuild setback for Rosatom was Finland’s cancellation of plans for a single VVER-1200 at Hanhikivi-1.

Mirzamahmudov made clear that recent Ukraine-related sanctions against Russia had no impact on the negotiating process, pointing out that the planned nuclear power plant is not a political project, but an economic one. “The decision will be made based on our agreements with Rosatom and the economic expediency for the republic of Uzbekistan,” he added. The landlocked country of over 35 million people continues to experience blackouts and is prioritizing low-carbon energy projects such as solar, wind and natural gas. The twin VVER-1200s at Lake Tuzkan are meant to boost baseload capacity.

SITING UZBEKISTAN’S FIRST NUCLEAR POWER PLANT



Lake Tuzkan is the southeastern portion of Lake Aydarkul.
Sources: UzAtom and Energy Intelligence

Political and Technical Concerns

When the 2018 intergovernmental agreement between Russia and Uzbekistan was first announced, locking in Rosatom as the supplier of Uzbekistan's first nuclear power plant, Tashkent's planners were determined to see construction start in 2020. But since then obstacles appear to have emerged relating to commercial, technical and public acceptance issues. From the UzAtom perspective the latter appears to be solved: Mirzamahmudov pointed to recent polls demonstrating support for nuclear power of over 75% of the Uzbek population.

The commercial issues are likely the central area of discussion in the current negotiations. Mirzamahmudov declined to comment on the final price, but earlier he said that the price will determine the intergovernmental loan from Russia, which usually covers 80%–90% of construction outlays. Sources say that the sides have recently intensified negotiations, specifically on price aspects.

Mirzamahmudov also added that one of the reasons for the delay in talks was because Tashkent is studying the viability of using "dry" cooling towers rather than the near-universal wet cooling system. The UzAtom official said that at a recent meeting with other reactor vendors, all confirmed the feasibility of using dry cooling, which would allow the two-unit plant to consume 35 times less water, albeit with a minor loss in capacity.

While the use of dry cooling towers is common in conventional thermal power plants, the only nuclear plants to have used it appear to be Rosatom's four domestic 12 megawatt Bilibino reactors above the Arctic Circle. Tashkent's interest in adapting that technology for a much larger plant in Central Asia may speak to concerns over current water availability at Lake Tuzkan, or to what climate change might do to that availability.

"The need for power plant cooling water can come into conflict with agricultural, residential, industrial and environmental requirements," the IAEA noted in a 2012 report on efficient water usage in water-cooled reactors. "To reduce water consumption in thermoelectric plants a design approach is to replace the evaporative wet cooling towers in closed-loop systems with dry cooling towers cooled only by air. However, dry cooling systems are more costly than comparable wet systems and their use can reduce plant efficiency and limit plant output during the hottest hours of the year."

Other parameters for the Russian-supplied plant, meanwhile, look poised to remain the same. Mirzamahmudov said that construction itself will take 69 months once the EPC contract is signed. Mirzamahmudov said that Tashkent is also studying small modular reactors and fast-neutron reactors but clarified that the focus for now remains on the inaugural plant.

Staff Reports, Tashkent

INTERVIEW

ASN's Gupta on Regulating in a New Era

As director general of France's Nuclear Safety Authority (ASN) and chair of the Western European Nuclear Regulators Association (Wenra), Olivier Gupta has a unique perspective on the major challenges facing nuclear regulators. In a Jun. 20 speech to the European Nuclear Safety Regulators Group (Ensreg), Gupta argued that while the "post-Fukushima decade" has seen stakeholders focusing on learning safety lessons from the March 2011 disaster at Japan's Fukushima Daiichi nuclear plant, "we are now entering a new decade" in which the main driver will be renewing "electricity-generating means all over the world." Energy Intelligence's Phil Chaffee sat down with Gupta after this speech, given in Brussels, to discuss Gupta's broader vision.

Q: I'd like to start with your speech to Ensreg this morning, in which you discussed regulators moving beyond the post-Fukushima decade. What are the new challenges ahead?

A: What I'm saying is that over the 10 years after 2011, all stakeholders have been focusing on improving safety, drawing the lessons from the accident of Fukushima. All the resources and attention have been captured by this.

And we are getting out from this and moving to a quite new situation: due to a greater awareness of climate change; the need all over Europe to renew the electricity production means, and we have also a short-term issue linked with the war in Ukraine and possible shortages in electricity supply.

All this leads to a renewed interest, at least in some countries, in nuclear power. And we — both industry and the regulators — have to make sure that this renewed interest also serves safety, that focus doesn't switch from safety to something else.

There are projects to develop new plants and new technologies, this will stimulate research, and this can be and should be beneficial for safety.

Q: I'd like to ask a bit of what you call a "short-term" post-Ukraine power crisis. I hope it's short-term! I'm in the UK, and my power bills have gone up quite a lot. To what extent should nuclear regulators be thinking about the resilience of the broader power system — and security of supply — as they regulate?

A: As regulators, our mission is the protection of people and the environment, and we should not take part in energy policy.

However, as independent bodies, we are able to speak quite explicitly about long-term issues. And we should do so each time there are decisions that have to be made now in order not to find ourselves in dead ends in terms of safety some years later. That, I think, is part of our role as nuclear regulators.

Q: In terms of these decision crunch points, or dead ends, there is always this risk — particularly as you look at LTO (long-term operations) going longer and longer, to 50, 60 or even 80 years in the US — of realizing that there are new generic design defaults or generic aging defaults that you weren't cognizant of before. Just as an example, there is this issue of the corrosion in France. But thinking more broadly than that particular issue, how do you think about preparing for the potential of these generic issues — and particularly for the possibility that they could suddenly turn off half a fleet of reactors?

A: We need to warn well in advance about these kind of situations. When we think that within 10 or 15 years there is a possibility of conflict between safety issues and electricity supply issues, we should say quite early so that the right decisions are made. You are talking about LTO: at some point the nuclear power plants will be renewed, and we have to warn industry and government of any key LTO risks so that they will not make bets on how long the plants will be able to operate. They can be replaced by nuclear power plants, by conventional plants, or by a reduction in electricity demand — there can be several ways of managing energy policy — but we have to say at the right time that the decision must be made. That's what ASN does in France, but I think that the situation is similar in other European countries also.

Q: In terms of both LTO and new nuclear capacity, regulatory harmonization — and industry harmonization — have been major goals for well over a decade now. If we're going into this post-post-Fukushima era, where do you see harmonization going?

A: I see two aspects on which we must further work, recognizing that quite a lot of work has been done over the past 20 years.

I often say that we have been able to build a Europe of nuclear safety. This has been done mainly through Wenra — this association of independent nuclear regulators — through the safety reference levels that we have been publishing year after year and keeping up to date, and which form a really sound basis for harmonizing our national regulations. If you look at the situation in Europe now, it's much more harmonized already than was the case 20 years ago.

On long-term operation, progress has been made after the post-Fukushima stress tests in which all European power plants have undergone a review, and with modifications in the same kind of areas: power supplies, robustness to very large natural hazards, and so on.

So there has been some degree already of harmonization related to long-term operation of existing plans, but we can go further. Inside Wenra we have started a study of specific and relevant reference levels for long-term operation of existing plants, and making a more precise benchmark of which kind of measures have been added in our countries, to see where we are and how we can make harmonization progress.

Obviously the other aspect of harmonization is new designs. It's a long way off, but it's another important field.

Q: Is there any risk in efforts to harmonize regulations of new designs of over-saturation? It seems like there are so many different multilateral efforts — there's Wenra, there's Ensreg, there's the IAEA (International Atomic Energy Agency), there's MDEP (the Multilateral Design Evaluation Program), I'm sure I've forgotten a couple — are they all too much? A regulator like the ASN has a fair amount of bandwidth, but when you talk about smaller regulators, is there too much going on? Or is this all complementary?

A: We try to keep them complementary. For instance, inside Wenra we did not intervene in licensing, which was done in the framework of the MDEP. Now there is this new initiative from the IAEA.

We say several things. First of all, we see some asking 'Is regulation an obstacle to new designs, especially to SMRs [small modular reactors]?' My answer would be, it can be in some countries where the regulation is very detailed, very prescriptive. In most European countries, the regulation is more objectives-oriented, and that's the way the safety reference levels of Wenra are written: objectives-oriented, and not so much means-oriented. On the whole, the regulation should not be an obstacle, and we will check that inside Wenra, to be sure.

Another aspect on which we should be cautious is to embark with as many regulatory bodies as possible from the beginning of the evaluation of a design. This does not mean that all regulatory bodies need to duplicate all the analysis. We can trust each other for one part or another of the analysis. But it cannot be such that a regulatory body comes at the end and buys blindly what has been done by their counterparts. This won't work, because it's contradictory to the national responsibility that we bear as regulators.

We have to find a way. I know there are proprietary issues that make these things difficult, and there are industrial practices, and codes and standards, that are not the same from country to country. So industry has their part of the job in this harmonization process, but we as a regulator have to do our part.

Q: Do you envision further ad hoc initiatives similar to this recently announced agreement between you and [Finnish regulator] Stuk and Czech nuclear regulator SUBJ to cooperate in the review of EDF's Nuward SMR?

A: It can be a way. I don't mean it's exclusive from other things. There is also this initiative from the IAEA; for the moment it's difficult to know exactly how it will be implemented.

I think that putting around the table the various players — the industry, the regulators — is beneficial. That's also what is being done at the European level. The commission has launched an initiative around SMRs to stimulate discussion within the industry, and with regulators.

That's useful. But at some point, once technical files will be ready — and some designs are quite far away from this — regulators have to open them, as far as practicable, at the same time.

Q: Beyond SMRs, there's also growing excitement about advanced reactors — that includes designs with much more complex cooling systems and some with much more advanced fuel cycles. Given that France has one of the longest experiences with a closed fuel cycle, including reprocessing, is there also any initiative to discuss with other regulators how to oversee a much more complex fuel cycle?

A: That could be of interest, but this is not yet the case.

When you say complex, it's more a question of mature. If you take light-water SMRs, or even if it's a bit behind, high-temperature SMRs, these are designs on which there is some kind of experience. For light-water reactors this is particularly the case. There is also some experience around high-temperature reactors.

This is much less the case for molten salt reactors for instance. You say ASN in France has a large experience, but we don't have any with these kind of technologies.

Q: You made the point in your address to Ensreg this morning that there were no Chinese or Russians in the room, even as China and Russia have some of the most ambitious nuclear programs on the planet. Given the geopolitical split we've seen over the last couple years, and particularly this year, do you hope to engender any regulatory cooperation that crosses these divides?

A: What I would not like is to have two safety visions in the world.

Until now we had been able to discuss with all nuclear countries, although Covid-19 made meetings difficult. I don't have any solution right now. I was just warning about the issue. Putting it on the table so at least we are aware. Also we have quite a Western perspective here, because we have at this conference quite a lot of Western countries.

But we have to be careful. We need to understand the safety perspectives of Russia and China and nobody knows how long it will be for normal discussions to begin again.

Q: Finally I'd like to ask about Ukraine. You spoke this morning about Wenra's efforts, where the focus was getting information for the respective national governments and national publics and interpreting what was going on.

A: Getting information, and developing a common understanding of what's happening there, and what could be the conse-

quences of any further aggravation of any situation at such-or-such plant. That was the case when electricity was fully lost on the Chernobyl site, or when two lines of four were lost at Zaporozhye. Because these situations are situations in which safety was quite explicitly weakened, and so the question was 'What if the situation becomes worse, because they lose additional lines?'

It wasn't just disseminating information. It was being able to tell the same things to our governments and citizens about 'What if?' That's what we did by issuing written positions that we had discussed in Wenra, and through which we developed a joint understanding of the current situation, the potential further development, and the consequences — even radiological consequences — if an accident was to happen.

This was very useful. I served as a spokesman for ASN for these briefings, and it was useful to be able to say 'What I am telling you about what could happen is an opinion shared by all my European counterparts.' It gives you authority, it gives credibility to what you say.

Q: Nuclear Transparency Watch and the European Environmental Bureau sent a letter on May 19 to both Ensreg and to the European Commission arguing for the need for a new round of EU stress tests, similarly to the post-Fukushima nuclear stress tests, focusing on nuclear security in light of what's happened in Ukraine. Is there a need for that type of stress tests?

A: I was not aware of that. We did not discuss it in Wenra.

I'm sure some discussions will happen regarding the situation in Ukraine. But I'm not sure we need further guidance and regulations. This is a very specific situation. We should not place ourselves in a situation where we give an impression that war can happen just like anything else. War is something exceptional, and it should stay so.

Q: That's an interesting point. I would say, the Geneva Conventions a hundred years ago made rules for how you can treat prisoners of war, because war does happen. And is there not an argument that there should be some sort of codified rules even if there's a risk they won't be followed?

A: This is not for Wenra to answer. This is very political. We are technical people, we are regulators.

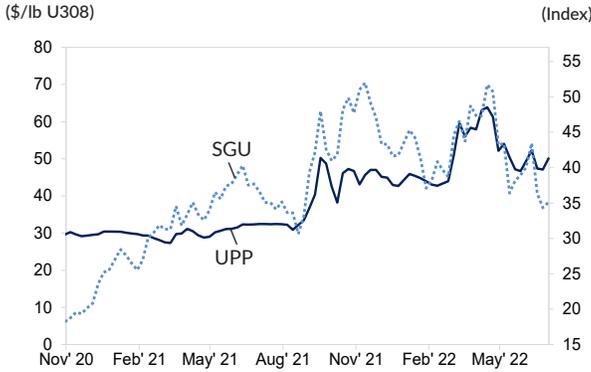
In any case, we have to stay very humble. Because it's a very peculiar situation, outside of many things.

Phil Chaffee, London

URANIUM MARKET UPDATE

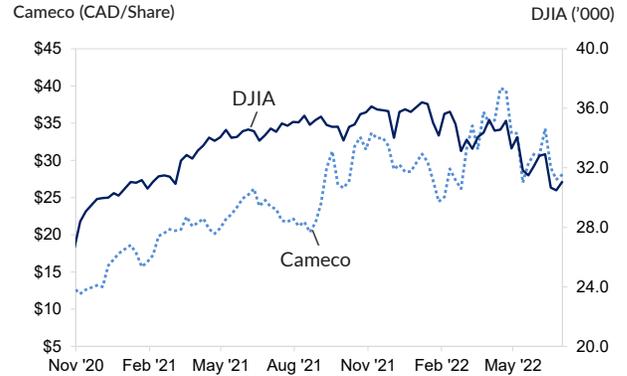
All prices as of Thursday, June 30, 2022

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



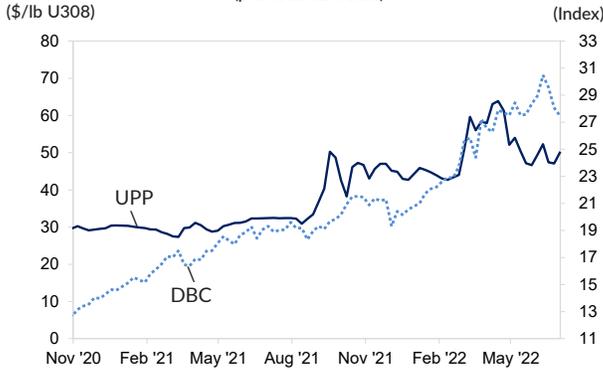
The Solactive Global Uranium Total Return Index, created by Structured Solutions AG, tracks the price movements in shares of companies active in the uranium mining industry. Calculated as a total return index and published in US\$, its composition is ordinarily adjusted twice a year.

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



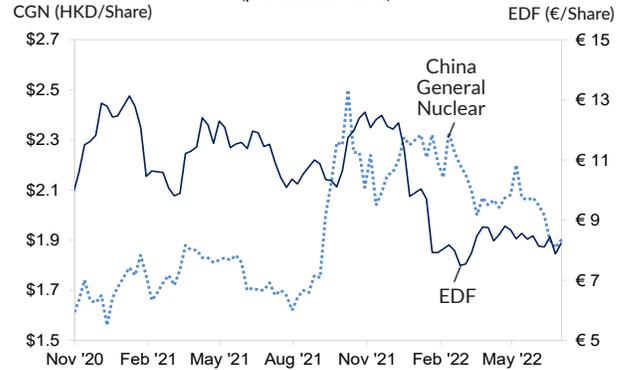
Canadian uranium miner Cameco's stock is valued in Canadian dollars compared with the US dollar on the Dow Jones Industrial Average (DJIA). Roughly two-thirds of DJIA's 30 component companies are manufacturers of industrial and consumer goods. The others represent industries ranging from financial services 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						
		Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep	Aug	Jul	
Uranium (\$/lb U308)														
Low	+1.00	45.50	46.00	52.50	51.00	42.50	43.00	42.00	43.00	36.00	36.00	32.20	32.20	
High	-1.50	52.50	54.00	64.00	60.00	44.50	46.50	47.00	47.50	48.00	51.00	36.00	32.50	
Conversion (\$/kgU)														
Low	-	30.00	30.00	28.00	26.00	16.00	16.00	16.00	15.00	16.00	19.00	19.00	19.50	
High	-	33.00	33.00	30.00	28.00	17.00	17.00	17.00	18.00	19.00	21.00	21.00	21.50	
Enrichment (\$/SWU)														
Low	-	84.00	84.00	82.00	100.00	59.00	57.00	56.00	56.00	55.50	55.50	54.00	54.00	
High	-	150.00	150.00	150.00	150.00	61.00	59.00	57.00	57.00	57.50	57.50	56.00	56.00	

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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