

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

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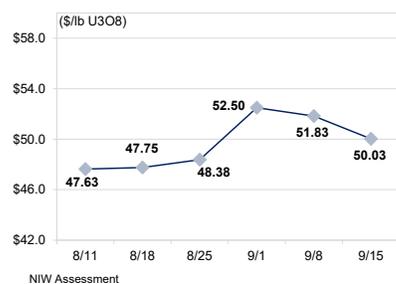
## Market Points

Centrus Energy reported this week it has secured \$320 million in new sales contracts over the past year, prompting market participants to speculate whether Centrus is flipping borrowed SWU from Japanese utilities.

Orano told Energy Intelligence it is preparing to launch an ISR pilot plant by year's end to "confirm the economic and environmental feasibility" of uranium mining in the Djengeldi area of Uzbekistan, which hopes to double yellowcake production by 2030.

Wider commodity market trends signaled a weaker uranium price to nuclear fuel investors, leading Energy Intelligence's Uranium Price Panel to deliver an average spot price of \$50.03/lb. U3O8 on Sep. 15, down by about 3% from Sep. 8

### UPP: \$50.03/LB U3O8



## WEEKLY ROUNDUP

### Green Light for Four More Chinese Newbuilds

- Chinese Premier Li Keqiang presided over this week's State Council approval of four nuclear newbuilds, bringing to 10 the number of reactors greenlit by Beijing this year. The Sep. 13 approvals were for China National Nuclear Corp's (CNNC's) Zhangzhou-3 and -4, twin Hualong-One reactors in Fujian, and for State Power Investment Corp's (SPIC's) Lianjiang-1 and -2, twin CAP1000 reactors in Guangdong. Preparatory work on the two 1,212 megawatt reactors at Zhangzhou is already underway, CNNC's Shanghai-listed subsidiary said in a statement. CNNC did not update the status of Zhangzhou-1 and -2, the twin Hualong-Ones respectively under construction since 2019 and 2020, or reveal plans for Zhangzhou-5 and -6. Meanwhile an SPIC official said first concrete is targeted for Lianjiang-1 in June 2023. Lianjiang's twin CAP1000s follow the four CAP1000s approved earlier this year at CNNC's Sanmen-3 and -4 and Haiyang-3 and -4 in Shandong. In that Apr. 20 decision the State Council also greenlit twin Hualong-Ones at China General Nuclear's Lufeng project, the first unit of which (Lufeng-5) began construction last week.
- Unit 6 of Ukraine's Russian-occupied Zaporizhzhia nuclear plant, the last of the plant's VVER-1000s to operate, was powered down early in the morning on Sep. 11 after operating for three days in "island mode" — producing enough electricity for the needs of the broader Zaporizhzhia facility. After a transmission line was restored connecting Zaporizhzhia to Ukraine's power grid, "a decision was made to shut down Unit 6 and transfer it to the safest state — cold shutdown," explained operator Energoatom. This was in line with recommendations from the International Atomic Energy Agency following a visit of officials to Zaporizhzhia. This week the Vienna-based agency's 35-member Board of Governors passed another resolution demanding the withdrawal of Russian troops from Zaporizhzhia, and as the case for a similar resolution in March some 26 members voted for the resolution and both China and Russia opposed it. India, Pakistan, Vietnam, Senegal and South Africa all abstained from both votes, while Egypt abstained this week after supporting the March resolution. Burundi's voting rights are suspended due to non-payment.
- Switzerland's National Cooperative for the Disposal of Radioactive Waste (Nagra) last weekend selected the Nordlich Lagern site on the German border to host the country's planned deep geological repository (DGR) that will store its high-level radioactive waste. Nordlich Lagern was one of two sites — the other being the nearby Jura Ost — under investigation by Nagra since 2015. Switzerland is one of the few nuclear countries to finalize such a DGR site selection, and it joins a small group including Finland, France and Sweden. In the Swiss case, the material to be buried in the DGR includes both spent fuel and vitrified waste from the foreign reprocessing of spent Swiss nuclear fuel. That reprocessing ended in 2006. For the Nordlich Lagern site, Nagra will now prepare an application for a DGR construction license that it hopes to submit to the Federal Council in 2024. "Should this decision be put to a national referendum, the Swiss voters will have the final say," said Nagra.

## NUCLEAR FUEL MARKET

# Centrus' New Sales Follow Increased Borrowing

US trader Centrus Energy announced on Sep. 14 that it has secured \$320 million in new sales contracts, including approximately \$270 million secured earlier this year. Market participants wondered whether the separative work units (SWU) trader plans to use the seemingly growing volume of material it has borrowed to help meet its latest commitments.

Energy Intelligence understands traders (like Centrus and Itochu) and suppliers (such as ConverDyn and Orano) have over the past few years been able to borrow Japanese inventories — mostly held as UF6 and enriched uranium product (EUP) — and flip the material into supply contracts with utilities. But this material must be repaid in-kind, raising questions about the extent to which these borrowers are prepared to source it. Because of the Russian invasion of Ukraine, that material would likely have to be sourced from already thinly-stretched western converters and enrichers.

One source told Energy Intelligence that they believe it was likely borrowed Japanese inventories that helped Centrus “offer non-Russian origin” and secure new sales, but caveated that it “may be a risky thing because I’m sure that the Japanese counterpart probably requires non-Russian origin material to repay the loan.”

In March and May 2022, Centrus borrowed SWU “recorded to inventory at a value of \$9.4 million and \$8.5 million, respectively,” according to Centrus’ third-quarter earnings report. “The inventory value was calculated based on the anticipated sourcing of inventory for repayment at the date of acquisition.” Depending on the timing of the repayment, this would indicate Centrus borrowed around 150,000 SWU in March and up to 100,000 SWU in May.

But it’s not the first time Centrus has borrowed material. “In 2018 through 2020 the Company borrowed SWU inventory valued at \$20.7 million from a customer” repayable only in SWU under a 2017 agreement, Centrus reported in its 2021 annual report.

Most of Centrus’ revenue comes from multi-year contracts with utilities, Centrus said this week. “The new sales commitments cover deliveries from 2022 to 2030, with the revenue and cost of sales to be booked in the quarter and year of delivery.”

Beyond its borrowed material, Centrus contracts to buy SWU from France’s Orano and Russia’s Tenex. Centrus’ long-standing contract to purchase SWU from Rosatom subsidiary Tenex contains a clause that enabled a price reset, based “a mix of market-related price points and other factors” that “was subject to an adjustment at the end of 2018 that reduced the unit costs of SWU under this contract in 2019” and for its duration, according to Centrus.

Centrus’ 2018 contract with Orano ensures SWU supply for 2020–28, with an option to extend for two more years, and includes “flexibility to adjust purchase volumes, subject to annual minimums and maximums” that vary by year, Centrus reports. Subject to floors and ceilings, pricing is determined by “a combination of market-related price points and other factors.”

As was the case with the 2018 adjustment in the Tenex contract, market participants speculate that the price mechanisms in the Orano contract have enabled Centrus to conduct occasional aggressively-priced, end-of-month sales of about 50,000 SWU over the past year or so. Some believe these sales have pressured the SWU price lower.

In the uranium sphere Orano this week provided an update on its joint venture with the Uzbek government, Nurlikum Mining, to develop uranium production in the Djengeldi area of Uzbekistan. Nurlikum’s 50 employees are conducting geological exploration work to confirm and increase the resources, and are preparing to launch an in situ recovery pilot plant “before the end of the year to confirm the economic and environmental feasibility” of mining the area, Orano spokesperson Gwenael Thomas told Energy Intelligence. Uzbek President Shavkat Mirziyoyev said in a Jul. 14 decree, according to the Tashkent Times, that the country plans to increase uranium production from 3,526 tons in 2021 to 7,100 tons by 2030.

The spot uranium market this week slipped on wider downward economic trends watched closely by uranium investors. Energy Intelligence’s Uranium Price Panel delivered an average spot price of \$50.03/lb. on Sep. 15, down from \$51.83/lb. on Sep. 8.

*Jessica Sondgeroth, Washington*

## URANIUM PRICE PANEL

For the week ended September 15, 2022

	Weekly Spot Market Prices													
	Chg.	Sep			Aug				Jul				June	
		15	8	1	25	18	11	4	28	21	14	7	30	23
Price (\$/lb U3O8)	-1.81	50.03	51.83	52.50	48.38	47.75	47.63	47.84	48.85	46.03	46.04	47.53	50.00	47.13
Total Assessments	2.00	10.00	8.00	8.00	9.00	10.00	9.00	8.00	9.00	10.00	9.00	10.00	10.00	10.00
% within 1 StDev	-5.00	70.00	75.00	62.50	77.78	80.00	77.78	75.00	55.56	80.00	55.56	70.00	60.00	90.00
Low (\$/lb U3O8)	-2.25	49.00	51.25	52.00	48.00	47.50	47.25	47.50	48.50	45.75	45.50	47.00	49.25	47.00
High (\$/lb U3O8)	-1.00	51.00	52.00	53.50	49.00	48.25	48.00	48.25	49.25	46.25	46.75	48.50	50.75	47.50
Variability*	0.19	0.38	0.19	0.39	0.38	0.25	0.04	0.00	0.00	0.00	0.31	0.50	0.16	0.06

\*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.

## INTERVIEW

## Kazatomprom's Batyrbayev on the Trans-Caspian Route

*The world's largest uranium producer has since 2018 worked to secure an alternative transportation route to the west from its primary route through Russia and the Port of St. Petersburg. But since Russia's invasion of Ukraine in February and the ongoing threat of sanctions on Rosatom and its subsidiaries, Kazatomprom has felt mounting pressure to secure a comparable pathway for Class 7 material across the Caspian and Black Seas. Last week on the sidelines of the World Nuclear Association's annual symposium in London Energy Intelligence's Jessica Sondgeroth sat down with Kazatomprom's Chief Commercial Officer Askar Batyrbayev to discuss the company's efforts to not only secure the new export route but to bring down costs as they compare to the well-established St. Petersburg route. (After fighting broke out earlier this week between Azerbaijan and Armenia, Batyrbayev answered one further question via email.) Batyrbayev also provided an update on China National Uranium Corp.'s (CNUC's) Alashankou Uranium Bonded Warehouse and the prospects for Kazatomprom's interest in taking part in a mooted trading hub there.*

**Q: The big thing is, of course, transport. Everybody wants to know everything about Kazatomprom's exploration of an alternative route to St. Petersburg due to the ongoing Russian invasion of Ukraine. Could you walk us through the route, where it goes from truck to ship, what kind of approvals are required, and costs, insurance, those kinds of things?**

A: It starts like our usual transportation: from the mines using trucks to the closest railway station, where it's trans-loaded to the rail cars to Aktau, the Kazakh seaport at Caspian Sea, where we use ferries that actually load the railway cars. Then the ferry goes from Aktau to Baku, the capital of Azerbaijan. Then it's offloaded from the ferry at Baku and then goes by railway to Poti, a Georgian seaport at the Black Sea. We have to clear customs in Baku and at the border between Georgia and Azerbaijan before it goes to the Poti seaport.

Currently, containers with uranium are in Poti waiting for the vessel, which we charter. There are no shipping lines like we have in St. Petersburg, so we charter the vessel. The vessel comes, picks up the goods and sails very close to Turkish territory to the Bosphorus Strait and on to the final destination, which is either Orano, Cameco or ConverDyn.

**Q: So this shipment is currently waiting for the charter vessel?**

A: Yes, waiting for the vessel while we will send another batch to make it bigger.

**Q: And what is the volume of each batch?**

A: We don't disclose, but one container holds about 13.5 tons and each batch could be up to 150 containers.

**Q: So with the next batch, will you double the number of containers?**

A: It's always different. It sometimes could be 120-110 containers. Part of it is already at Poti and we are going to send the second half. Once they are combined, the vessel will come at the end of September to pick up the full batch.

**Q: And given the brewing conflict between Azerbaijan and Armenia, is there some concern over how that might or might not affect this alternative route?**

A: We're closely monitoring the situation. Currently, the Trans-Caspian International Transport Route (TITR) is not affected, but the situation continues to evolve and potential future risks could limit the availability of the TITR. Although the specific risks are difficult to evaluate at this time, mitigation measures have been developed and are in place. Regardless, we'd like to again confirm that our primary route through the port of St. Petersburg is available and operating. Kazatomprom also has swap deals opportunities, discussions with China regarding the transit of material moving east, and even air shipment options in case both primary and TITR routes were at risk for a period of time. As always, the underlying message is that Kazatomprom is a reliable supplier committed to its contractual obligations and we will put in every effort required to ensure the timely delivery of material to our clients around the globe.

**Q: How does the TITR route compare cost-wise to St. Petersburg?**

A: It's hard to compare with St. Petersburg because St. Pete is a commercial route. Shipping lines have a fixed cost per container. With this route, we are chartering two vessels. One is a ferry at the Caspian Sea and the second is at Poti, and the bigger the batch, the cheaper container. It's always a different number of containers, so the cost varies a lot.

We are working hard with all the ports and all the people to see if we can have some kind of shipping line there, but at the moment the Black Sea is not that popular. We can imagine that there could be transport to France, but I mean, transport to Canada or the US is a little bit difficult.

We are considering, at the moment, involving Turkey in the process. If we can get approval from Turkey, we can use a railway from Georgia to Turkey. If we can use that railway, then we can get the shipment to one of the Mediterranean ports in Turkey, and it would be much, much easier to get a shipping line from there.

**Q: What is required to secure access to the Turkish ports?**

A: We'll have to see if the railway can accept the Class 7 cargo, if it is in good condition, and if they have everything to accommodate our needs, including the security requirements for transportation of Class 7. And how large of batches they can receive.

The next challenge is to verify that any of the seaports in Turkey can handle and store Class 7 cargoes. But as long as Turkey is going to

build nuclear power plants, sooner or later, they will come to that.

**Q: So you hope to expedite that process for them?**

A: We would like to discuss with them. It would put them at an advantage to develop all the documentation, put the legislation in place earlier than they need. That's a future transit for them and additional income that they could be earning.

For us, we would not need to go through the Bosphorus Strait. And access to the Mediterranean Sea is much better than access at the Black Sea. It would also make access to the US and Canada much easier, and everywhere, France, US, Canada. The Mediterranean Sea would also give us much better access to the Suez Canal if we deliver to India.

**Q: How would the rates compare to St. Petersburg if you could get Turkish approval?**

A: That would have a predictable cost for us. It's hard to compare the cost with the commercial route in St. Pete, but even in St. Pete, because of the increases in fuel costs, we cannot actually get a fixed rate for at least a year. The shipping lines cannot provide a fixed rate for more than three months because the cost of fuel is changing dramatically. It goes up, down, up, down. Very roughly speaking, mine to market cost through St. Petersburg was \$1.50 per pound before and now has gone up to \$2 per pound.

**Q: How does the cost of insurance compare between the routes?**

A: Before, we had a fixed rate on the insurance, but now if we deliver through Russia, every single delivery is separately considered, and the rate is given only for the exact shipment. So it also can vary a lot. It depends on the current situation with insurers. They are giving a separate insurance rate for every delivery. In terms of Black Sea it's more or less okay.

There's a lot of speculation that insurance companies will not cover the Black Sea route, but actually we received a letter from our insurance syndicate just after the [Ukraine] conflict broke out. From Poti, where the vessel picks up the shipment and brings it to the entrance of the Bosphorus Strait, very close to the Turkish territory, there are no issues and problems with transportation here and the insurance rate is predictable. We can contract the insurance and they don't change the rate, unlike for the Russian territory where they consider it every time as a different contract.

**Q: And you mentioned approvals required from the Trans-Caspian transit countries.**

A: Every transit country approves your transportation. We apply in every country to get this transit approval. We get similar approvals from Russia as well. It's a common thing, for example, whenever you deliver to Cameco, but your discharging port is in let's say Philadelphia, the shipping company gets transit approval to deliver to Canada through US territory. What makes it all a bit complicated

is that countries like Azerbaijan and Georgia have little experience in dealing with Class 7 cargo. That's why we started this work much earlier.

Everyone is already aware that we started to develop these routes after the World Cup in 2018, when St. Pete was temporarily unavailable to Class 7 material. So we went to Azerbaijan and Georgia and we showed them all the relevant documents: that this is natural uranium, it has nothing to do with enriched or weapons-grade uranium, what kind of radiation levels it has, and all the specifications to make them comfortable with transit through their countries and the safety and security protocols that are in place.

We are doing the seventh delivery since 2018, all in smaller quantities. But in April we discussed with the authorities in Azerbaijan and Georgia whether we can move bigger volumes. If we were to divert all shipments from Russia to this alternative route, it still wouldn't be that many containers. We ship about 1,200 containers maximum per year through that route. Altogether that is the size of one ship, so it is not creating a lot of issues for them to ship 1,200 containers total throughout the year.

**Q: I hadn't realized this was the seventh shipment.**

A: This is to keep institutional memory alive in these countries. We have been shipping in small batches and the route's current limit is 3,500 tons and we've probably never used anywhere near that on an annual basis. But the route is capable of millions of tons because it was developed as a part of an intergovernmental project called the Trans-Caspian International Transport Route or TITR, which we will start to refer to it as. The Class 7 cargo is just a fraction of the overall volume of cargo moving on the route, including oil, coal, grain, etcetera, between Europe and China. And because it is an alternative route from the one between Russia and Europe, it is getting more traffic now.

We will still be using St. Petersburg, as long as there are no restrictions and it's open. We would like to keep all options available to us.

**Q: On that subject, what is the contingency plan if sanctions are imposed on Russia, what does Kazatomprom do with its joint venture partnerships with Russian entities?**

A: With Rosatom we have five joint ventures. As far as how the sanctions work, the secondary sanctions would hit companies where the sanctioned company has 50 percent or more of the ownership share. So two of those JV companies would not be affected and three could be potentially affected. For these three companies, we would be discussing with JV partners in Rosatom how we can change the structure. Because it's not in our best interest, nor in their best interest to disadvantage both parties.

**Q: Are those talks active?**

A: We'll be as proactive as we can but we're not getting governments together until there's something material to discuss.

**Q: Thank you. And then on Alashankou, do you have a status update on the progress there? I'm curious whether there might be an interest available to Kazatomprom if a trading hub is developed.**

A. Our interest is obvious, it's on the border between China and Kazakhstan and if we just compare how much cargo is passing through that single railway station, the amount of uranium cargo is much bigger than anywhere in the world. The Chinese companies are starting to create infrastructure and additional storage areas for themselves. They have completed the first stage. You'll have to confirm with CNUC, but I believe they've already completed 3,500–4,000 tons of storage for their internal use and that I think they've already filled.

Next year they will increase it almost four times; the second stage is 13,000 tons storage to be constructed in 2023. Then we will see if they will use it as a trading hub and how it'll work. What will the taxes and customs look like? We are not yet sure. But once we can travel to China and meet our partners, that's something we would be looking into. Because of the huge turnover of the material, having a trading hub there makes a lot of sense. But again, we will have to see how it'll work within Chinese legislation. That's still not yet clear, but having a fourth location, beyond ConvergDyn, Orano and Cameco – of course it's not a conversion plant – if it could be used as a trading hub, that would be very interesting to see.

**Q: And regarding supply chain issues, like sulfuric acid supply that had impacted not just Kazakh production but uranium production generally, how are you mitigating those?**

A. I think all these issues started with the Covid-19 pandemic and whenever China closes any borders or provinces, the internal transport in China stops and it affects the rest of the world. In terms of sulfuric acid, there was a shortage at one time, but it wasn't very big and we have inventories of sulfuric acid and we have our own sulfuric acid plant that meets roughly half our needs, so that helped us to overcome that period. And the company is evaluating increasing capacity at that plant or building another.

*Jessica Sondgeroth, London*

## FRANCE

# EDF Losses Balloon as Restart Plan Doubted

With half its domestic reactor fleet still offline France's EDF is now projecting the outages will cost its bottom line some €29 billion (\$29 billion) this year, roughly quadrupling the €7.3 billion hit from the outages in the first half of 2022. Meanwhile French power system operator RTE this week discounted EDF's pledge to the government to restart over the coming months the 28 of its 56 reactors currently offline, as RTE placed the French power system

for the first time ever under "reinforced monitoring" over the high-demand winter.

In a Sep. 15 statement the state-owned nuclear operator said that it now anticipates 2022 French nuclear production coming in "at the bottom" of the range 280–300 Terrawatt hours it had projected in May. Between this and the electricity forward prices as of Sep. 13, EDF reassessed the impact of the outages on its annual Ebitda at –€29 billion. After 2022 EDF contends that things should get better: CEO Jean-Bernard Levy told the National Assembly this week that online nuclear capacity should reach 50 gigawatts by early January, out of its total 61.4 GW of total French nuclear capacity and up from 27 GW today. In 2023 EDF is maintaining its target of 300–330 TWh, and in 2024 it hopes to reach 315–345 TWh.

All of these figures must be taken with a grain of salt, however, according to RTE. "Feedback from past years still shows regular time lags compared to the initial announcements" on output from EDF, the grid operator said in its annual outlook for the 2022–23 winter, released Sep. 14. Beyond the outages linked to checks and repairs for stress corrosion anomalies, "nuclear availability will largely depend on the keeping of the schedule on the other outages concerning the 'classic' maintenance programs (outage for reloading, partial inspection or ten-year inspection for some of them)."

## EDF's Restart Effort

Levy's target of reaching 50 GW of online French nuclear capacity by early January is therefore in line with RTE's upper scenario. In its central scenario the grid operator instead envisions EDF reaching 45 GW of online nuclear capacity by the end of January. This would bring back online some 20 GW of nuclear capacity over the following months, which is what EDF achieved in the second half of 2020 following the response to plunging demand at the height of the Covid-19 crisis.

EDF's workforce is making "every effort to optimize the availability of the nuclear fleet, in complete safety, for the passage of winter," an EDF spokesperson said in an emailed statement responding to Energy Intelligence questions. "Fuel savings are being made on reactors to optimize their availability this winter," and the schedule of maintenance operations "has been modified for 15 scheduled reactor shutdowns, in order to keep them in production throughout the winter." As for the biggest cause of EDF's nuclear outages — the reactors down due to the stress corrosion found on crucial piping — "EDF and the industrial sector are fully mobilized to restart these reactors safely."

Both RTE and EDF noted that repair work is now underway on the reactors that have undergone "destructive testing", or the systematic cutting of piping to carry out laboratory examinations on the removed components. Repairs have been completed on the 915 megawatt Tricastin-3, are underway at the 905 MW Chinon B-3, and have begun at the 1,495 MW Civaux-1. "EDF confirms the availability of spare parts within the announced deadlines," said the

spokesperson. “Training and specific training of welding teams continues, in order to guarantee a high quality of repair completion.”

In recent months, therefore, “the uncertainty about the scope of checks and repairs has decreased,” said RTE. “There remains, however, considerable uncertainty about the ability of EDF and its subcontractors to carry out all the inspections and repair work within a very demanding schedule (the return of eight of the reactors concerned is notably planned between October and December), in order to significantly increase available nuclear capacity by the end of the year.”

## RTE’s System Planning

For its part, RTE is therefore preparing a number of tools to respond to supply shortfalls in order to avoid outages.

Using the “red Ecowatt alert”, based on generally-reliable forecasts three days ahead, RTE can warn of outages unless consumers adapt and reduce demand. RTE modelling shows that the grid operator may have to use this red alert between zero and five times this winter, but it shouldn’t result in any actual outages as consumers should be able to quickly reduce peak demand by 10 GW, out of 80–100 GW.

Other tools include “interruptible contracts” RTE has with a dozen power-intensive companies that can cut demand by 1 GW in just 5 seconds, and the ability to slightly reduce voltage in the distribution grid, which is almost unnoticeable by consumers.

Given these measures, RTE CEO Xavier Piechaczyk actually talked down broader panic over Europe’s energy situation this coming winter. “Market players anticipate much bigger problems than we anticipate,” Piechaczyk said as RTE presented its winter outlook. “Their outages expectations are three times more severe than in our most extreme scenario. Current market prices are irrational. There’s uncertainty about winter weather, gas and nuclear production, but we’ve suddenly switched from a situation where the market wasn’t anticipating any risk to one where it anticipates everything will happen at the same time.”

*Phil Chaffee, London, Philippe Roos, Strasbourg*

## INDIA

# Largest Power Utility Eyes Nuclear

India’s largest power utility may finally be actively moving into nuclear power after over a decade of moribund discussions with state-owned Nuclear Power Corp of India Ltd. (NPCIL) to work together on nuclear newbuilds. Both NPCIL and NTPC Ltd., a government-run utility highly dependent on coal-burning plants, are now in talks for partnering on twin 700 megawatt indigenous

pressurized heavy water reactor (IPHWR) newbuilds at Gorakhpur, in the northern state of Haryana. Solidifying this partnership may help NPCIL stitch similar deals with other state firms, which are lining up billions of dollars of investment for net-zero emissions goals. If successful the nuclear utility could attract considerable funds for its ambitious capacity expansion plans.

“As part of our company’s energy transition program, along with renewable energy sources, we have started working on storage technologies and discussion are underway for adding nuclear capacity as well,” NTPC’s Chairman Gurdeep Singh said in the company’s latest annual report. As power demand increases “we will have to add sizable capacity in the coal-based power stations unless the nuclear power stations can be commissioned much faster,” Singh told analysts on Aug. 1, and that scenario is something the power company is “looking at.”

About 87% of NTPC’s installed generation base of 55 gigawatts is coal-based. Including joint ventures, it has 69.5 GW capacity, making up roughly 17% of India’s total generation capacity, and NTPC accounts for 24% of India’s actual generation. By comparison NPCIL’s 21 reactors total 6.78 GW of capacity and account for just 2% of India’s generation base, and the nuclear firm has struggled to bring new capacity online.

New Delhi-based NTPC has now developed a net-zero roadmap to align with Prime Minister Narendra Modi’s goal of making the world’s third largest greenhouse gas emitter net carbon zero by 2070. “Nuclear is the cleanest source of base load power. So it makes sense for companies to invest in it to meet net-zero commitments,” Debasish Mishra, partner at Deloitte Touche Tohmatsu, said.

Of the 130 GW capacity NTPC hopes to have generating by 2032, 85 GW would be from coal, 30 GE from solar, 6 GW from natural gas, and only 2 GW would be from nuclear.

“This is a self-fulfilling exercise for both NTPC and NPCIL,” Former Power Secretary Anil Razdan said. “NPCIL needs funds and NTPC needs to move to cleaner power sources. Also, India’s large power grid needs strong baseload as it ramps up renewable generation base and nuclear fits well there.”

## Partnership Route

In January 2011, NTPC formed a joint venture with NPCIL named Anushakti Vidhyut, in which it had a 49% stake. NPCIL entered into similar JVs with Indian Oil Corp. in April 2011 with the state-run refiner having a 26% stake. Another JV was formed with miner National Aluminum Co. Ltd. (Nalco) in 2012.

These initial agreements made little progress as India’s 1962 Atomic Energy Act limited nuclear generation to NPCIL and state-owned Bharatiya Nabhikiya Viduyt Nigam, which is building a 500 MW prototype fast breeder reactor. In December 2015, the Parliament amended the law to allow state companies to partner with NPCIL. The pace of development however remained slow due to India’s Civil

Nuclear Liability Law, which made suppliers liable for damages in some nuclear accidents, and due to Covid-19. But more recently New Delhi has worked to address supplier concerns and between the effort to build 10 IPHWRs in a “fleet mode” and the net-zero commitment, the broader nuclear program is getting back on track.

Last month NTPC’s Singh told investors that the company is “seriously thinking” on participating in nuclear power generation “because the (Atomic Energy) Act is really enabling now rather than restricting.” As recently as last year NTPC reported in its annual report that “no activities are being taken up” by Anushakti Vidhyut, but this year it revealed that it had formed a working group with NPCIL to examine “modalities of execution” at Gorakhpur. Beyond that NTPC is exploring further investments in light water reactor, small modular reactors and advanced reactors.

## Investment Gap

According to the Central Electricity Authority’s just released National Electricity Plan draft report, India will add 7,000 MW of nuclear capacity over the next five years through March 2027. This requires investment of 1.29 trillion rupees (\$16 billion), and another 748.85 billion rupees (\$9 billion) will be needed to add 8,700 MW over the next five years through March 2032. Since NPCIL’s newbuild projects are funded in 70:30 debt equity ratio, it will need to raise at least \$7.5 billion in equity. Currently the nuclear firm’s equity support comes from internal accruals and government budgetary support.

NTPC, which is in robust expansion phase, had a capital expenditure of \$2.66 billion in the last fiscal year that ended Mar 31 while its net profit was \$2.15 billion. It had a group debt of \$25.4 billion as on Mar. 31. Considering its plans for just 2 GW of nuclear capacity by 2032, its investments may not be a huge support for NPCIL but could make a key difference at Gorakhpur.

NPCIL’s ventures with other state firms are moribund. In its latest annual report, Indian Oil noted that the nuclear venture is yet to start operations. “We do not have funds for our existing capital expenditure plans,” one board member of the refiner told Energy Intelligence, “so new investment ventures like nuclear are not under consideration.”

Indian Oil and other state refiners have been selling diesel and gasoline at state-set discounted rates to help government keep inflation under check and have posted heavy losses on fuel sales, which has hit cash flows. Though last month Indian Oil committed investment of 2 trillion rupees (\$25 billion) to become net-zero by 2046, it did not announce any details for nuclear projects.

But while cash-rich state firms such as miner Nalco and state-owned explorer Oil and Natural Gas Corp. have seen mooted nuclear ambitions come to nothing, power generation is not their core business as it is with NTPC. That may explain why the latter’s partnership with NPCIL “fits well”, said Former Power Secretary Razdan.

*Rakesh Sharma, New Delhi*

## INTERVIEW

# Cez Nuclear Leader on Fuel Diversification, Dukovany II

*Cez, the Czech Republic’s major state-owned power company and nuclear operator, has in recent years been at the center of the geopolitical fissures that have split the nuclear world. In June it signed a fuel fabrication deal with both Westinghouse and Framatome for both companies to start supplying its twin VVER-1000 reactors at Temelin, supplanting existing supplier Tvel, a subsidiary of Russia’s state-owned Rosatom. This came only weeks after Cez subsidiary Elektrarna Dukovany II launched a newbuild tender for up to 1.2 gigawatts of new nuclear capacity next to Cez’s existing Dukovany plant, currently home to four VVER-440 reactors. That Dukovany II tender was released to France’s EDF, South Korea’s Korea Hydro & Nuclear Power (KHNP) and US-based Westinghouse, but excluded — following controversial government decisions last year — both Rosatom and China General Nuclear. Finally in June Cez purchased Czech-based legacy nuclear firm Skoda JS from OMZ, a subsidiary of Russia’s Gazprombank. Last week on the sidelines of the World Nuclear Association’s annual symposium in London Energy Intelligence’s Phil Chaffee sat down with Cez Chief Nuclear Officer Bohdan Zronek to discuss these initiatives as well as the broader energy landscape, including Prague’s interest in small modular reactors (SMRs).*

**Q: In June, following Russia’s invasion of Ukraine, you signed a contract with both Westinghouse and Framatome for over ten years of fuel assembly supply to your twin Temelin VVER-1000s, starting in 2024. I know you’ve already qualified Westinghouse test assemblies, which will be sourced from its Vasteras plant in Sweden. Do you need to go through a similar qualification process for the Framatome assemblies coming from its Lingen plant in Germany and its Romans plant in France?**

A: We started with the tender a couple years ago, and it was not related to the Ukraine conflict at all. It was a coincidence that we finished the tender at the beginning of this year, and then during the spring season we signed the contracts. It was our intention to begin fuel diversification, and because our current contract expired, we were looking for new deliveries and a new contract.

The input there is clear, regarding technical and safety specifications. And then you have the bids and some final evaluations. A typical tender process. And speaking about qualification, each fuel delivery has to go through the fuel development and licensing process, so it’s part of the contract and part of the delivery. Each has to be licensed and get the regulatory body approval.

**Q: Do both fuels have to go through the LTA [lead test assembly] process, by which test assemblies are tested in the existing core?**

A: The LTA process helps. It’s something that in the Czech legal environment is not necessary. We did it for Westinghouse. In the case of the Framatome deliveries, it was not used because we really use the current technical specifications.

**Q: Right. My understanding is that while Westinghouse developed its own VVER-1000 fuel, Framatome will deliver an identical fuel to the existing fuel, and is therefore not a new technology.**

A: Anyway we have to confirm the qualification and licensing, because it's a new contractor. And this is also the case for the Westinghouse fuel.

**Q: And are Westinghouse and Framatome basically splitting the post-2024 supply to Temelin? Is it 50/50?**

A: The amount of deliveries from both sides is comparable.

**Q: What about Dukovany? My understanding is you have three years of stockpiles of Dukovany fuel, and that would get you through 2025. What is the plan then?**

A: We keep stockpiles for both sites - in Temelin also. This is the strategy we will be keeping. It's also a matter of security of fuel supply, in case of any unintentional disruption of deliveries. In the case of Dukovany, we have pretty large stockpiles. Even if so, we'd like to go the way of diversification of deliveries, as with Temelin. And now we are dealing with professional contractors, with the conditions and timing to come next year.

**Q: When does your contract with [Rosatom subsidiary] Tvel for Dukovany fuel expire? Or has it expired?**

A: It used to be an open-ended contract, through 2024 plus an option. A couple years ago there were no other suppliers of VVER-440 fuel. Now the world is changing, and the current situation made us look for a similar solution as in the case of Temelin. We can utilize the current contract, but it has to be limited. During the upcoming years we will be looking for a new contract. It goes together with the current situation: the Temelin [tender] was started before the conflict, the Dukovany will start in upcoming years. It's speeded up the process.

**Q: So the tender for Dukovany may be launched in the next year or so?**

A: In this situation we have to think about how to secure two VVER-440 deliveries, and how to support the commercial part of the delivery.

**Q: In a new tender would you exclude Tvel and Rosatom?**

A: You raise a question of what the world will look like. We cannot guess. At this moment it is impossible for us to sign a new contract [with Tvel], but nobody knows how things will be in one or two years.

**Q: Moving onto your newbuild plans, I'd like to start with your negotiations with the state. Brussels began its state aid review of the Dukovany II project on Jun. 30. To what extent must you wait for that for potential European Commission alterations to the**

**project's financial infrastructure before you conclude a deal with the state?**

A: Commercial financing is based on some kind of [state] assurance, because signing the contract will bring us the certainty that we will be able to complete the project and then operate under some clear and visible and understandable conditions. The idea is very similar to the contract for difference [scheme] in the UK.

We would like to use a power purchase agreement, and to get the difference if the price [of kilowatts sold from the plant] is higher, and to give back the difference if the price is lower — right to customers. And I personally believe that we will be giving back the money, especially if you look at the current market. It seems to be very probable, and it will allow us to complete a project. There are a number of items and inputs to be solved to confirm the level of state aid support in the final supplement. So it's being discussed at the moment with the Czech government and also at the European level.

**Q: So are you negotiating with the government that "strike price" in the power purchase agreement right now?**

A: We're in the middle of the process of these discussions and negotiations.

**Q: What about the issue of construction risk? My understanding is that the state will back a very cheap loan to Elektrarna Dukovany II, your subsidiary project company. But what happens if the costs escalate precipitously, as has happened to Flammanville-3 or Olkiluoto-3 or Hinkley Point C?**

A: It's a question of the risk distribution between our contractors and us, and the state part. Generally construction risks are the responsibility of the contract owner or the company - Cez or our subsidiary. We would like to derisk the nuclear project as much as possible. Even if so, we have to look at these potential delays, these potential hazards. We know what does it mean if there's higher inflation than anticipated at the moment, or if there is some delay. And frankly financing risks will have a much higher impact.

**Q: Will this new inclusion of nuclear in the EU taxonomy of sustainable activities make a difference to your costs of financing?**

A: This is a question for upcoming years. In the current perspective? Probably not much. It's a question of how it will impact the next potential newbuilds.

If you look at Czech energy, one new unit will not be enough at all. If we take into account the obsolescence of the current fleet, there will come the day — I believe it will be not soon, but it will come — when we will have to replace first the Dukovany units and then Temelin. We will have to replace the current coal-fired fleet, which is pretty close. And it will create a gap between demand and the availability to deliver.

We are focusing on renewables on one hand, and then we have to think about how to proceed with new nuclear. It might be a larger unit or units or it might be SMR deployment.

**Q: I understand that the tender that's already gone out for Dukovany II is for one unit, with the option of additional units.**

A: The tender is for one unit, with a non-binding option for up to three [additional] units.

**Q: Would that be at Dukovany, or Temelin, or elsewhere?**

A: There's potential at the Dukovany and Temelin sites. I can't imagine opening another large nuclear site in the Czech Republic.

If you look at Dukovany and its limits, after we shut down the current units we can accommodate in the long-term perspective 2,400 MW, and in the mid-term perspective 3,250 MW. It's why we would like to operate Dukovany-5 and operate it together with the current four units, and then after they come close to shutting down think about another unit to replace them.

In between there will probably be the space to go back to Temelin, because Temelin was originally envisioned to accommodate four units.

**Q: Before moving onto the Dukovany II tender, I'm curious about your vision for Skoda JS now that you've taken it over, and in particular whether you want it to play a big role in Dukovany II?**

A: Our other priority is to stabilize Skoda, and the services provided to our current fleet. They provide services to both sites. And there is huge potential for development and delivering components or parts anywhere, without limitations. At the moment one of the examples is Hinkley Point C, for which Skoda is producing reactor internals as a subcontractor to Framatome.

**Q: But will you mandate that the suppliers of Dukovany II use Skoda?**

A: It's a question for the upcoming months and years. At first we have to select a major partner and we have to always proceed in accordance with legislation. It's too premature a discussion at this moment.

**Q: Moving onto the Dukovany II tender, my understanding is that bids are due Nov. 30, and then final binding bids will be due at the end of next year. How long after that do you envision making the final selection?**

A: We would like to get to final selection at the end of next year, 2023, and then we have to submit the results to the government. And during 2024 we would like to go through specific contract negotiations.

**Q: One thing I've never understood about the Dukovany II process is that you've talked about wanting this not to be a first-of-a-kind project, but at the same time you've limited the size of the reactor to 1,200 MW, meaning that two of the finalists — KHNP and EDF — will by necessity be offering first-of-a-kind technologies, with the APR1000 or the EPR1200, respectively. How do you square that circle?**

A: These limitations are based on the EIA [environmental impact assessment] and the long-time limit of the locality, which is able to accommodate 2,400 MW, and in the short term up to 3,250 MW. In this regard we made the decision to limit up to 1,200 MW to fully utilize the locality and enable long term operation of current units.

All three candidates announced that they are ready to offer based on their current products, using current equipment, current design, even if in case of two of them it's a partially new kind of solution, but based on standard equipment and standard production. So there will be some differences, but they are free to go through EUR [European Utility Requirements] certification, they are free to prove and compare the design and all of the different features with the current deliveries.

So it's possible to do it. Maybe it may bring a little bit more work during this evaluation phase and licensing phase.

**Q: If you hope to sign an EPC contract by the end of 2024, when do you hope to conclude a deal with the government, including a power purchase agreement and the other various financial and support mechanisms?**

A: It should be soon. We're supposed to sign these contracts in parallel — they should go together: the contract itself and securing the conditions with the government. And then we proceed with the final phases of designing, licensing and then construction.

**Q: Moving beyond Dukovany II, my understanding is that you're talking about a pilot SMR plant by 2035, and then potentially building out a whole gigawatt of SMR capacity by 2040.**

A: Definitely we would like to reach first pilot installation in the Temelin site in the mid-30s. The style of commercial settlement or potential partnership could speed this up, because we would like to focus on only the most developed designs. And there are also other sites — the current coal sites — with appropriate infrastructure, from connection to the grid, cooling water, and integration in district heating.

**Q: It sounds like the primary attractions of SMRs in the Czech Republic are just electric capacity and district heating. Are you also thinking about hydrogen or other potential non-power applications?**

A: We believe that they will come, but the priority is electricity and heat production now, and then we can add something more.

**Q: Which SMR vendors or advanced reactor vendors are you already talking with?**

A: The most developed designs, and the ones which are closest to a license in the country of origin. We would like to have a shortlist by the end of this year, and then continue with two or three of them in detail. Then to bring some kind of commercial solution which makes sense.

*Phil Chaffee, London*

**PERSPECTIVE****August's NPT RevCon was a Failure Preordained**

*The Tenth Review Conference (RevCon) for the nuclear Non-Proliferation Treaty (NPT) concluded last month with no agreement on even a final statement, as Moscow objected to language criticizing its actions at Ukraine's Zaporizhzhia nuclear power plant. In the following opinion piece Nuclear Intelligence Weekly Editor Stephanie Cooke examines the extent to which the RevCon's failure was preordained.*

Attempts to shore up the aging NPT, worthy though they may be, are almost always destined to fail. That's largely due to a fundamental imbalance in the 1970 treaty, which obligates all but a handful of nations to subject their nuclear programs to international inspections while nuclear weapon-state signatories are let off the hook, with nothing but a vague promise to pursue "good faith" negotiations toward disarmament.

August's NPT RevCon was ostensibly aimed at strengthening the NPT's role in preventing the proliferation of nuclear fuels and technology for use in nuclear weapons. Predictably, it ended like so many previous review conferences, with most of the treaty's 191 signatories frustrated by the lack of progress on disarmament. But unlike previous RevCons that foundered on the issue of disarmament in the NPT's Article VI, this one failed for a different reason: the Russian Federation's refusal to entertain any language in a final document that mentioned its military invasion and takeover of the Zaporizhzhia nuclear plant in southeastern Ukraine.

Russia's invasion of Zaporizhzhia breached a central tenet of the NPT, which assumes a clear distinction between "non-peaceful" and "peaceful" uses of nuclear energy, and promotes the latter at the expense of the former. The importance of this military-civilian line, thin though it may sometimes be, cannot be overstated because it allows governments and industry to claim that international trade in nuclear fuels and technology can be conducted with minimal risk of their diversion for use in nuclear weapons.

Nowhere does the treaty deal with the possibility of a military attack on an operating nuclear power plant, or that an invading

power might use such a plant, and more specifically its spent fuel pool, for its potential as a 'dirty bomb' — effectively shielding soldiers and equipment from attack because of the threat of a massive radiation release. No one can be certain of Russia's motivations but some US intelligence officials and policymakers believe that this type of strategic thinking lies behind Russian President Vladimir Putin's reasons for targeting Zaporizhzhia, according to the *New York Times*.

This was not the first military attack on a nuclear facility. Israel attacked ostensibly civilian reactors in Iraq and Syria, respectively in 1981 and 2007, and was harshly criticized at the NPT RevCons that followed. Israel justified the attacks as defensive, and the reactors had never operated and had not been fueled so there was no obvious risk of a radiological release.

The same cannot be said of Russia's attack on Zaporizhzhia, which in normal times supplies about a fifth of Ukraine's electricity. When Russia — one of the NPT's three original signatories — ordered its military personnel and vehicles into the plant and allowed them to park in a turbine hall, it drove a hole through the NPT and the notion of a military-civilian divide that the treaty depends on for legitimacy and rulemaking. A cynic might ask: What is the value of agreeing to International Atomic Energy Agency (IAEA) safeguards — and IAEA inspections — as Ukraine has done alongside many other non-weapons states — when the IAEA has no power to protect an otherwise "peaceful" nuclear reactor from military aggression?

That's not to suggest that Russia's actions will destroy a safeguards system built over decades and aimed at reassuring the world that most countries' nuclear programs are peaceful. But Russia, besides being a founding signatory to the NPT and a permanent UN Security Council member, also possesses the world's second-largest nuclear arsenal. And its actions can only exacerbate general frustration among the NPT's non-weapon member states over the backward leaning state of affairs regarding Article VI's disarmament commitment. All nine weapon states are modernizing and expanding their nuclear arsenals.

This time it was Zaporizhzhia that ultimately scuttled the RevCon. Russia objected to five paragraphs out of some 140 in a draft final statement because of their reference to the plant, although diplomats had erased any specific mention of the Russian Federation by name in an effort to get the document through. Russia's delegate was "the only one to speak openly against the draft outcome document — thus preventing its adoption" and some 40 countries, including the EU, UK, US, Japan, Canada and Australia, issued a statement condemning "the unjustifiable and unprovoked war of aggression," according to the UN's own coverage of the event.

But the five NPT member states with weapons also refused to agree to any timelines, benchmarks or accountability measures on disarmament, and as per usual dismissed the new nuclear weapon ban treaty as unrealistic and unhelpful to the ultimate goal of disarmament. Israel, India and Pakistan are not NPT signatories.

North Korea is a signatory but announced in 2003 it would no longer be bound by the treaty.

This discouraging outcome prompted former IAEA Director General Mohamed El Baradei to tweet that the “ugly truth” is that “all nine nuclear weapon states have no intention to disarm; quite to the contrary the trajectory is towards more sophisticated ‘usable’ weapons and delivery systems! The emperor has no clothes ...”

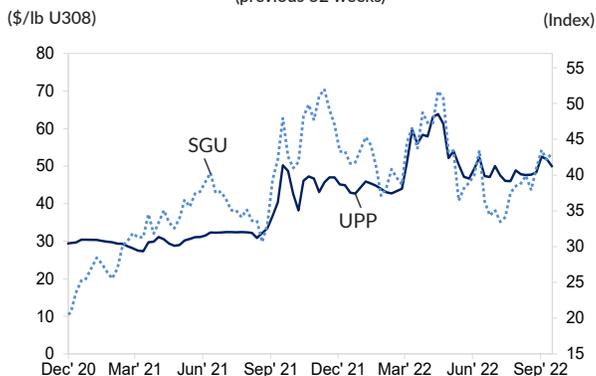
There are reasons to be cynical about the NPT, and its assumption of a military–civilian divide in the applications of nuclear energy. The line is routinely blurred, particularly by weapon states. But Russia obliterated the distinction, and with potentially devastating consequences, opening a new front on the perils of nuclear energy. Anyone who doubts that should look no further than Taiwan, where earlier this month Atomic Energy Officials conducted nuclear safety drills incorporating “lessons–learned” through observation of events at Zaporizhzhia.

*Stephanie Cooke, Washington*

# URANIUM MARKET UPDATE

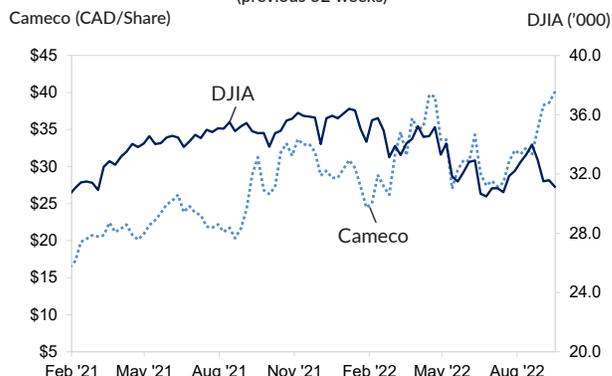
All prices as of Thursday, September 15, 2022

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



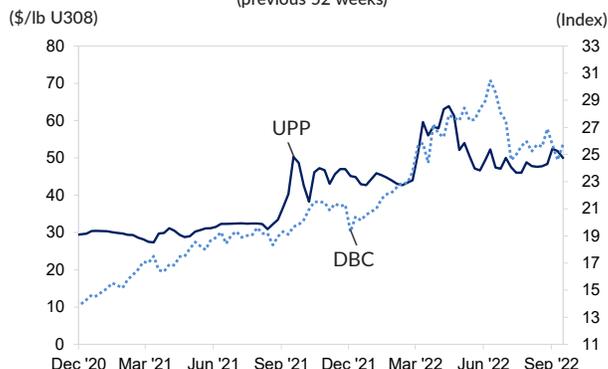
The Solactive Global Uranium Total Return Index, created by Structured Solutions AG, tracks the price movements in shares of companies active in the uranium mining industry. Calculated as a total return index and published in US\$, its composition is ordinarily adjusted twice a year.

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



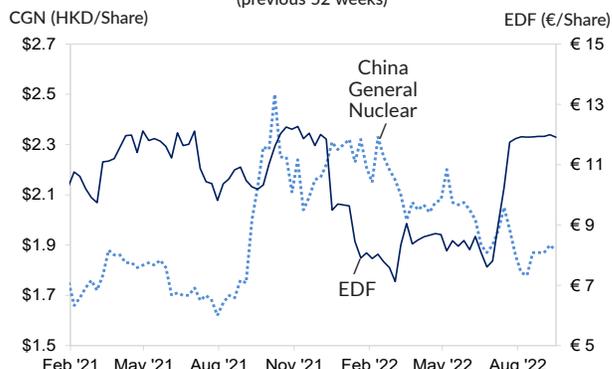
Canadian uranium miner Cameco's stock is valued in Canadian dollars compared with the US dollar on the Dow Jones Industrial Average (DJIA). Roughly two-thirds of DJIA's 30 component companies are manufacturers of industrial and consumer goods. The others represent industries ranging from financial services 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				
		Aug	Jul	Jun	May	Apr	Mar	Feb	Jan	Dec	Nov	Oct	Sep	
<b>Uranium (\$/lb U3O8)</b>														
Low	+2.00	47.50	45.50	45.50	46.00	52.50	51.00	42.50	43.00	42.00	43.00	36.00	36.00	
High	+3.00	53.50	50.50	52.50	54.00	64.00	60.00	44.50	46.50	47.00	47.50	48.00	51.00	
<b>Conversion (\$/kgU)</b>														
Low	+4.00	36.00	32.00	30.00	30.00	28.00	26.00	16.00	16.00	16.00	15.00	16.00	19.00	
High	+2.00	39.00	37.00	33.00	33.00	30.00	28.00	17.00	17.00	17.00	18.00	19.00	21.00	
<b>Enrichment (\$/SWU)</b>														
Low	+0.50	90.00	89.50	84.00	84.00	82.00	100.00	59.00	57.00	56.00	56.00	55.50	55.50	
High	-3.00	92.00	95.00	150.00	150.00	150.00	150.00	61.00	59.00	57.00	57.00	57.50	57.50	

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

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