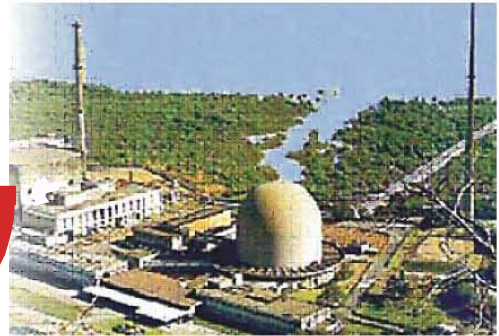


NUCLEAR SECURITY



A FORTNIGHTLY NEWSLETTER ON NUCLEAR ENERGY, NON-PROLIFERATION AND DEFENCE FROM CENTRE FOR AIR POWER STUDIES

OPINION – Manpreet Sethi, R.S. Shrikhande, Arun Sahgal

Vol 17, No. 19, 01 AUGUST 2023

Pakistan's New Nuclear Strategy is a Crisis in the Making

At the recent NATO summit in Vilnius, world leaders expressed concern over Russia's nuclear posture and the deployment of tactical nuclear weapons in Belarus, given the ongoing conflict between Russia and Western-backed Ukraine. Yet the international community also ought to pay attention to equally-as-important developments in the Indian subcontinent. A recent speech by Pakistan's Lt. General Khalid Kidwai has sent shockwaves across the region, potentially signaling that Islamabad may have just changed its own nuclear doctrine, and not for the better. If implemented, these changes could be highly destabilizing not just for the region, but also for the rest of the world. Washington ought to take notice and consider this development will affect its Indo-Pacific strategy.

The Nuclear "Horizontal" and "Vertical":

Lt. General Kidwai's speech, delivered on the 25th anniversary of Pakistan's nuclear tests, matters for two major reasons. The first reason is that it came from Lt. General Kidwai himself. As the former head of the SPD—which administers all policies and strategies regarding Pakistan's nuclear and

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CONTENTS

- ☛ OPINION
- ☛ NUCLEAR STRATEGY
- ☛ BALLISTIC MISSILE DEFENCE
- ☛ NUCLEAR ENERGY
- ☛ NUCLEAR COOPERATION
- ☛ URANIUM PRODUCTION
- ☛ NUCLEAR PROLIFERATION
- ☛ NUCLEAR NON-PROLIFERATION
- ☛ NUCLEAR DISARMAMENT
- ☛ NUCLEAR SAFETY
- ☛ NUCLEAR SECURITY
- ☛ NUCLEAR WASTE MANAGEMENT

missile programs—and an adviser to the country's NCA, Lt. General Kidwai is one of Pakistan's most senior and decorated generals. He has been described as the mastermind behind Pakistan's nuclear policy and deterrence doctrines, and "the architect" of the country's nuclear energy program. He is, in effect, the foremost author and authority on Pakistan's nuclear strategy.

The second reason is what Lt. General Kidwai actually said in his speech. In reiterating Pakistan's nuclear deterrence strategy, Kidwai described the country's ongoing

efforts to ensure “full spectrum deterrence” (FSD), supported by a nuclear triad of land, air, and sea-based capabilities. This, in short, is Pakistan’s policy of having sufficient capabilities to be able to respond to a wide range of threats—presumably originating from India.

Yet Kidwai went further, describing two dimensions of FSD: “horizontal,” which comprises of a robust tri-services inventory of a variety of nuclear weapons, and “vertical,” which encapsulates adequate range coverage of its vectors from “zero meters to 2,750 kilometers,” encapsulating “destructive yields suited for strategic, operational, and tactical levels.” Such an elaborate arsenal, he argued, provides Pakistan with a “strategic shield”, blunting the extant conventional asymmetry with India. In other words, Lt. General Kidwai is seemingly suggesting that Pakistan could or ought to develop short-range, potentially even front-line, nuclear weapons. These could include anything from nuclear artillery to even nuclear land mines.

“Zero Meters”: On one level, this proposed shift in nuclear doctrine, brazen as it may sound, is not out of the ordinary. Pakistan’s current doctrinal thinking and capability development are a result of the Indo-Pakistani War of 1971, which it lost. The conflict casts a long shadow over the psyche of the Pakistan’s military, resulting in a mindset that perceives nuclear weapons as the ultimate guarantor for the security of the country. Thus, the Pakistani military aims to undermine India’s military superiority through rapid nuclear weapons deployment and posturing of shallow thresholds. Yet an obvious and significant problem arises when

Pakistan doctrinally attempts to leverage nuclear weapons, especially its battlefield nuclear weapons, to support a policy of cross border terrorism.

Lt. General Kidwai first explained the value of TNWs when the country’s very short-range ballistic missile, Nasr, was first tested in April 2011. He said that it would “pour cold water over Cold Start”—a reference to India’s own punitive response doctrine. Though it has since been dismissed by Indian military leaders, New Delhi has nevertheless developed a carefully curated punitive retaliation strategy against Pakistani-sponsored terror attacks. This, in effect, has shown up the inefficacy of Pakistan’s nuclear weapons. After all, of what use are TNWs as a deterrent if India can conduct careful retaliation attacks, far below the nuclear threshold, against Pakistani-supported terrorist attacks?

In reiterating Pakistan’s nuclear deterrence strategy, Kidwai described the country’s ongoing efforts to ensure “full spectrum deterrence” (FSD), supported by a nuclear triad of land, air, and sea-based capabilities. This, in short, is Pakistan’s policy of having sufficient capabilities to be able to respond to a wide range of threats—presumably originating from India.

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Nonetheless, Pakistan’s attraction for TNWs, or tactical nuclear responses in general, continues as a preventive deterrence measure, despite the growing asymmetry in conventional military capabilities between the two countries. In fact, Kidwai has now coined a new term called “zero meters.” While he has not explained its meaning, it has been interpreted to mean nuclear artillery shells, atomic demolition munitions, or nuclear land mines.

Indeed, such TNWs—including naval cruise missiles carried on conventional submarines/ships, or shorter-range missiles—have generally existed since NATO deployed these weapons in Europe to deter the Soviet Union. Aping their strategy, Pakistan’s military command seems to

believe that it can adroitly sequence warfighting into three neat levels, and that its variety of warheads and ranges of delivery systems would counter each move by India. Yet as British historian and master strategist Lawrence David Freedman pointed out in the context of the NATO strategy, such matters would never unfold neatly, and TNWs could pose several substantial challenges. All this has been corroborated time and again via many wargames and exercises.

Courting Madness: India, for its part, has never accepted a step-by-step nuclear escalation ladder and instead pursues a doctrine of massive retaliation against any nuclear use, irrespective of how the first user describes the weapon or undertakes its use. It is astounding that Pakistani strategists believe that anything they do will be exempted from this doctrine. The folly of this new Pakistani strategy is also being called out by Pakistani analysts.

In a hard-hitting piece in Pakistan's weekly *Friday Times*, Ejaz Haider, a prominent Pakistani journalist and commentator on defense issues, recounts classic nuclear deterrence literature to question how Lt. General Kidwai's "illogic of instability to create the logic of strategic stability" could even work. Sitara Noor, a prominent Pakistani nuclear analyst, enquired in *Foreign Policy* magazine that if the "strategic objective" of zero-range weapons is to deter a "newly perceived gap" after the conduct of surgical strikes by India, then how could they be used to country's advantage? Irrespective of the logic driving such a strategy, she rightly finds

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It is worth considering the potential consequences of a deterrence breakdown and the resulting responses. "What" happens after a breakdown? Not only would such a move prove suicidal for the first user, but it also would wreak widespread havoc on the region and beyond. It is the unconstrained effects of nuclear weapons that set them apart from even the greatest of all conventional bombs, and loose talk about them has been as much a taboo as their use or threat of use.

it problematic for reasons of operational execution and regional stability.

It is heartening that Pakistani nuclear analysts are holding up a mirror to their misperceived nuclear doctrinal thinking anchored in the idea of "graduated warfighting." Given the many unknowns that arise once a nuclear weapon, whatever it may be called, is used, the neat schema of nuclear use at every level that Kidwai seems to suggest is unlikely to play out as intended. This is dangerous and wholly destabilizing thinking in the

extreme that could result in miscalculation and escalation. It is worth considering the potential consequences of a deterrence breakdown and the resulting responses. "What" happens after a breakdown? Not only would such a move prove suicidal for the first user, but it also would wreak widespread havoc on the region and beyond. It is the unconstrained effects of nuclear weapons that set them apart from even the greatest of all conventional bombs, and loose talk about them has been as much a taboo as their use or threat of use.

Pakistan's irresponsibility with its nuclear strategy could prove problematic well beyond its prime adversary. In fact, it is ironic that Kidwai invoked Youm-e-Takbir, the day of greatness, to glorify the willingness of the Pakistani populace to accept deprivation for the sake of its nuclear weapons program. Even as his country is going through a period of unprecedented political and economic turmoil, even by its own standard, Kidwai seems to be, like Marie Antoinette's apocryphal response, exhorting his countrymen to not despair for their

lack of naans, but rejoice at the existence of nukes.

Concerns to Remember: Pakistan's continued strategy of sub-conventional provocations and nuclear brinkmanship, to say nothing of its broader societal turmoil, are a shared concern for both India and the US. In fact, the heavy military hand in Pakistan's decisionmaking apparatus not only warps the democratic process but also tends to lean towards "first resort," as highlighted by Ejaz Haider. There are at least four major concerns regarding Pakistan that could have regional and even global implications, and should be viewed seriously.

First is the highly unstable political-economic environment within the country, including the possibility of social unrest spiraling out of control. Second is the deep fissures within the Pakistan Army, as seen in the emergence of rival cliques of senior officers, which has with ripple effects through junior ranks. The tendency of the Army to periodically "rescue" the country from incapable democratic government was supported by a united military leadership. That does not seem to be the case any longer, which only grows as a cause for concern as the number of warheads grow, with a wide range of newer type of smaller and even more dispersed "nukes" joining the arsenal.

Third, current public outrage, especially in the Pakistani "heartland," is unusual even for the seemingly Teflon-coated Pakistan Army. Consider the attack on May 9 on the Corps Commander's house in the highly-protected Lahore garrison—this seems much more like a targeted attack than spontaneous outrage leading to more than a symbolic breaching of the walls. Fourth, there is the role and influence of China in the proposed

There is the role and influence of China in the proposed "0 to 2,750 km" nuclear strategy and arsenal. It is entirely possible that low-yield nuclear weapons for Pakistan's naval platforms, especially the Chinese Yuan class submarines, are being produced. Technically, the challenge of warheads that fit into 533mm (21 inch) torpedo tubes is not insurmountable, and Beijing may have already helped resolve this.

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produced. Technically, the challenge of warheads that fit into 533mm (21 inch) torpedo tubes is not insurmountable, and Beijing may have already helped resolve this. The plans and intent for a naval leg of nuclear deterrence are not new. But potentially nuclear naval cruise missiles carried in conventional submarines/ships/patrol

aircraft could be highly destabilizing, since India does not see them as merely "tactical" or "operational."

With the kind of nuclear strategy Pakistan seems to be following, it is choosing to stand on the edge of the nuclear cliff. The "zero range" pronouncement may be perceived in the SPD as a major doctrinal shift, but it changes little for India. It remains important for New Delhi to assiduously continue to improve the efficacy and the survivability of its own triad. With a stated Indian strategy of retaliation to cause unacceptable

damage, the trigger could be called anything by the adversary. The response, unfortunately, would be far more than zero for that country, the environment, the region, and the world. Pakistan needs to reflect deeply on this misperceived notion of deterrence. As Haider wrote, such decisions "cannot be left to a few in a closed club."

Meanwhile, the words of U.S. president Joe Biden resonate: "I think (Pakistan) is maybe one of the most dangerous nations in the world...with nuclear weapons without any cohesion." Formulations like full-spectrum deterrence, buoyed by new

weaponry, may seem cohesive to Rawalpindi. But that is not the case in either New Delhi nor Washington. Policymakers from both ought to make this clear to Pakistan's military leadership.

Source: <https://nationalinterest.org/feature/pakistan%E2%80%99s-new-nuclear-strategy-crisis-making-206646?page=0%2C1>, 15 July 2023.

OPINION – Sitakanta Mishra

India's Policy Push for SMRs a Timely Step to Ensure Energy Security

On 16 May 2023, G20 Sherpa Ambassador Amitabh Kant, while addressing a session at the third ETWG meeting in Mumbai, called for "unfettered access" to cutting-edge nuclear technology from the USA, besides allowing the private sector, to build SMRs in India. Previously, India's Minister of State Jitendra Singh in an address to a workshop on SMRs held by the NITI Aayog in November 2022 revealed that India is taking steps for the development of SMRs to fulfil its commitment to clean energy transition.

These pronouncements indicate that India is steadfastly engaged with SMR R&D. Reportedly, in November 2022 the DAE has "held closed-door consultations with domestic and global industry players who showed significant interest" to become stakeholders in SMR development in the country. During the last ETWG meeting in Mumbai, both American and Russian industrial houses expressed their keen interest in sharing advanced SMR technology with India. In terms of options for foreign collaborations, India can look towards either Russian or US companies.

Russia has been a long-term partner for India in terms of nuclear energy cooperation and Rosatom, the Russian nuclear energy corporation, remains the only company with operational SMR capabilities as of now. Rosatom has multiple SMR

options as well: 1) the RITM200N, the world's first land-based water-cooled reactor, is under construction and planned to be commissioned in 2028; 2) the RITM200S, a pressurised water reactor of 105 MWe, is a floating SMR whose construction started in August 2022 and scheduled to complete by 2027; 3) the KLT-40S is a 35MWe floating reactor named Akademik Lomonosov is already connected to the grid in Pevek in Russia's far eastern region.

Dr Alexandre Volgin, Director of Project Rosatom, while speaking at the G20 international seminar in Mumbai on the role of SMRs in energy transition on 18 May 2023 expressed that "we are thrilled to share Rosatom's experience and knowledge on SMRs with India, who has been our trusted partner throughout the years. We firmly believe that our expertise and knowledge in the

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development, construction, and operation of small modular reactors will play a pivotal role in facilitating the global energy transition towards a sustainable future. We have several exciting upcoming projects in the future and look forward to collaborating and partnering with the Indian government and Indian industrial partners in pursuing these

opportunities". This suggests that Russia is eagerly anticipating collaborating with India and its partners to harness the full potential of SMRs in the upcoming projects in the country.

The known alternative is the American company Holtec International. Holtec uses light water technology in its SMRs to produce 160 MWe which is air-cooled, and convenient to locate even in a desert with low cost. If made in India, its construction cost is expected to reduce by 20 to 30% from its average cost of \$1 billion. Its subsidiary, Holtec Asia with its engineering office in Pune (Maharashtra) and manufacturing plant in Dahej (Gujarat) has been involved in the supply of high-density fuel racks for Kudankulam's away-from-reactor storage facility.

Although the Science and Technology Minister Singh has stated about India's decision to work on SMRs, no specific information is available in the public domain regarding the modalities and plans on the new venture. By joining the policy pronouncement dots during the last few years on SMR technology for India, one would assume that the NTPC in partnership with the NPCIL would venture into SMR projects in collaboration with foreign companies, and station them in de-commissioned thermal plants.

The DAE for the first-time plans to construct the country's first research reactor for the production of medical isotopes using a PPP model. "Exclusive rights to process and market the radioisotopes produced in the reactor" will be granted to private entities willing to invest in the construction of the reactor and its processing units.

So far, the private companies supply some components to Indian nuclear plants but cannot be partners in operating the reactors yet. The DAE for the first-time plans to construct the country's first research reactor for the production of medical isotopes using a PPP model. "Exclusive rights to process and market the radioisotopes produced in the reactor" will be granted to private entities willing to invest in the construction of the reactor and its processing units. For SMRs to base on the PPP model, additional legislative initiative to be undertaken to allow the private players to address the issue of technology sharing and availability of funding to fructify commercial viability.

The NITI Aayog's report while recommending overturning ban on foreign investment and allow for greater participation of private Indian companies in the domestic nuclear industry, highlights the urgency of "global regulatory harmonisation, developing manufacturing ecosystem and bringing in public as well as private capital would be the key for growth of the SMR industry." Recently, NTPC and NPCIL have signed an agreement for joint development of nuclear power plants in Madhya Pradesh and Rajasthan.

Partnership with foreign companies does not mean

that India is not capable of design, build, and operate SMRs indigenously; it has good experience of having built an 85 MWe reactor for its nuclear submarine. "While it has not utilised a modular factory process so far, the industry involved in manufacturing nuclear equipment is keen to build such reactors", says Manpreet Sethi, a Distinguished Fellow at the Centre for Air Power Studies, New Delhi. The need of the hour, and the DAE rightly on this path, is to ambitiously expedite reactor build-up of higher capacity; meanwhile India

should not lag behind in mastering cutting-edge technology of SMRs.

Source: <https://www.financialexpress.com/business/defence-indias-policy-push-for-smrs-a-timely-step-to-ensure-energy-security-3176259/>, 18 July 2023.

OPINION – Lyle Goldstein, Nathan Waechter

China Studies Nuclear Risk in the Context of the Ukraine War

Few issues are more salient to evaluate than how Beijing views the nuclear shadows surrounding the present bloody conflagration in Eastern Europe. There is some reasonable hope that Chinese pressure could cause the Kremlin to completely rule out nuclear escalation, and this indeed may have been a major theme of President Xi's visit to Moscow back in March 2023. Just as important is another looming question:

What lessons does Russia's nuclear signaling hold for a prospective Chinese war to force unification with Taiwan? Although China's nuclear arsenal is nowhere near as large and advanced as Russia's, a Taiwan scenario could involve war between two nuclear powers, so issues related to nuclear escalation are germane. Moreover, China is rapidly

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building up its nuclear capabilities at present. Therefore, these questions could become more and more acute in the context of China-U.S. strategic interaction.

The original article in this series cited a January 2023 PLA Daily assessment noting that Russia was relying heavily on its nuclear deterrent to balance against NATO's superiority in conventional arms. In this piece, we explore the issue in much greater detail through the lens of a spring 2023 Chinese-language article entitled "Will Russia Use Nuclear Weapons?" from the magazine "Ordnance Industry Science and Technology" (uQå]Ñy€b).

While such discussions are reasonably commonplace in Western discourse, such a direct discussion is extremely unusual in the Chinese defense media discourse and so merits closer scrutiny. This Chinese article says that "the situation is evolving [in the Ukraine War], such that it will not reach the level of requiring Russia to use nuclear weapons." But at the same time, the article observes, "There is little doubt that the longer the war goes on, the greater the risk of escalation." It notes recent decisions by the United States and its Western allies to take the major step of providing Ukraine with main battle tanks, as well as longer-range missiles, followed by serious discussions about providing combat aircraft.

At the outset, the piece repeats the ominous nuclear warning issued by the Kremlin on February 24, 2022, at the start of the war, and also Russian President Putin's order three days later that Russian nuclear forces be put on a "special state of readiness." The Chinese analysis says that despite these warnings, the U.S. and its allies have provided Kyiv with precision targeting information, aided in the killing of Russian military leaders, and helped to limit Russia's advantage in airpower. The analysis goes so far as to say that the U.S. is actually seeking

"regime change" in Russia, but notes that American officials have recognized repeatedly that "if Putin's regime is threatened, then Russia might resort to the use of nuclear weapons."

The article observes that these tensions seemed to become more acute during fall 2022, when the Ukrainian offensive surprised many with its impressive advances. The article highlights President Putin's statement from September 21, 2022, when he said that Russian territory would

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be defended by all necessary means. The Russian president's emphatic emphasis, "This is not a bluff," is duly noted. But taking a reasonably objective approach, this Chinese analysis also reports Defense Minister Shoigu's comment shortly thereafter, suggesting that

Russia was not preparing to employ nuclear weapons in Ukraine.

The article discusses how the issue has returned to the fore during 2023, as nuclear signaling continued. A RAND report from January 2023 is cited in this assessment as noting the real possibility of nuclear escalation. The article emphasizes warnings from the Kremlin from February 2023, including President Putin's statement that Russia has the means to respond to NATO's decision to send tanks to Ukraine. Also noted is the threat by former Russian President Medvedev, who asserted starkly, "We do not need a world without Russia." At the same time, the Chinese analysis also observes that Russia has also tested its new highly advanced ICBM Sarmat and even brandished its Il-80 nuclear command and control aircraft, termed the "doomsday plane," during the spring of 2023.

A somewhat disturbing theme in this Chinese analysis is the focus on the balance of tactical nuclear weapons. The article reviews available data in some detail and concludes, citing a 2019 estimate from the U.S. intelligence community, that Russia may possess 2,000 tactical nuclear weapons. Moreover, that number was projected

to be increasing, according to the Chinese rendering. By contrast, the US is said to have 230 such weapons, of which 100 are deployed in Europe.

The Chinese assessment points to a potentially unstable paradox: "Therefore, if we say that there is a relatively large gap between Russia and NATO in terms of conventional military power, then in terms of the number and types of non-strategic nuclear weapons, Russia may have a considerable advantage." Appearing to defend Russia's nuclear saber rattling, the piece asserts at one point,

Nuclear states have an extremely cautious attitude toward the use of nuclear weapons, and Russia is no exception." The Chinese assessment does examine the June 2020 Russian doctrinal statement regarding the Kremlin's conditions for resorting to nuclear use and explains that the final point might be relevant: if "the adversary's attack with conventional weapons threatens the survival of the Russian state.

"Nuclear states have an extremely cautious attitude toward the use of nuclear weapons, and Russia is no exception." The Chinese assessment does examine the June 2020 Russian doctrinal statement regarding the Kremlin's conditions for resorting to nuclear use and explains that the final point might be relevant: if "the adversary's attack with conventional weapons threatens the survival of the Russian state." The piece also notes that many Western experts have dismissed or at least downplayed Moscow's nuclear threats.

In addition, the Chinese article discusses various related concerns, including the threat of a "dirty bomb," the possibility of an attack on the Zaporizhzhia nuclear power plant, as well as even a potential use of chemical weapons. The end of the Chinese article aims to make an overall assessment of possibilities for Moscow's potential employment of nuclear weapons in the context of the Ukraine War. Its conclusions imply a disturbingly wide scope for Russian nuclear use, unfortunately. The first and most obvious of the conditions concerns a "battlefield reversal that implies defeat." A second condition cited in the Chinese discussion is a possible "diminishing of the effectiveness of deterrence," and in this context the much-discussed "escalate to de-

escalate" strategy is mentioned. Most disturbing perhaps is the mention of tactical nuclear weapons to "probe the bottom line of U.S. extended deterrence" and thus "break the NATO alliance."

One should not exaggerate the meaning of the above analysis for Chinese nuclear strategy. Indeed, China's nuclear forces are hardly mentioned in the article and there is no discussion of the Taiwan issue or any other potential conflict scenarios involving China. Still, the article is noteworthy since such issues have generally not been taken up publicly in Chinese military discourse – at least since the beginning of the Russian invasion of

Ukraine. In fact, there are a variety of other hints that Chinese strategists are thinking very hard about the meaning of the Ukraine War for the future of deterrence and concerning China's nuclear strategy, in particular. For example, a recent Chinese academic study, which incidentally does mention the Taiwan issue explicitly, endeavors to explain how the US "failed" to deter Russia in the Ukraine situation. Another academic article suggests that recent developments "are pushing China to rethink the relationship between its conventional and nuclear forces."

As a whole, it is a bit shocking to realize that nobody truly knows whether or not nuclear weapons might be used in a hypothetical Taiwan conflict involving China and the US. Indeed, a recent and extremely thorough report on a series of war games by the CSIS concludes with respect to the nuclear question: "No one knows what those escalation dynamics would be." Studying China's lessons regarding the nuclear shadows in the Ukraine conflict could help, but in circumstances of such startling uncertainty, extreme caution is warranted on both sides of this potentially catastrophic conflict.

Source: <https://thediplomat.com/2023/07/china-studies-nuclear-risk-in-the-context-of-the-ukraine-war/>, 21 July 2023.

OPINION – Paul Day

Canada's Nuclear Drive Picks Up Speed

Nuclear power accounts for around 15% of Canada's electricity generation with most capacity in Ontario where some 40% of the population resides. A total of 19 reactors provide around 13.6 GW across the country, though most are in the provinces of Ontario and New Brunswick, which are 60% and 36% powered by nuclear respectively. The federal government's commitment to nuclear power was brought into question in 2022 after the technology was excluded from the government's green bond framework, leaving nuclear investments at a disadvantage over other low carbon solutions such as wind and solar. However, rising energy insecurity following Russia's invasion of Ukraine and increasingly vocal support for urgent greenhouse-gas-emission reduction have helped bring the government back to nuclear power, especially in Ontario.

The Federal Budget 2023, announced in March, showed strong support for nuclear power. The budget offers a 15% refundable Investment Tax Credit (ITC) for clean electricity including nuclear and a 30% ITC for clean technology manufacturing (including nuclear energy equipment, and processing or recycling nuclear fuels). The budget also explicitly backs nuclear power through a range of other initiatives, such as an extension of reduced tax rates, financing from the Canada Infrastructure Bank, cash for the regulatory authority, and half a billion dollars in SMR project investment.

Large Reactors: At the start of July 2023, Ontario announced that it was beginning pre-development work to site a large-scale nuclear power build over

three decades. Community and environmental assessments would aim to win federal approval to determine the feasibility of new nuclear generation of up to 4.8 GW, state authorities said. The build, the first large scale nuclear project in the country since 1993, will be on the Bruce Nuclear Generating Station site in Bruce County, the world's largest operating nuclear power station with eight units generating 6.4 GW, or 30% of Ontario's electricity, across a 2,300-acre site. "The announcement is a recognition by the province of the role of nuclear, current and in the future, and the importance of

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starting some of those long development items to ensure that they're moving the ball forward and, based on lessons learned, going through the process, such as engaging with communities and indigenous peoples, early," says James Scongack, Executive Vice President, Operational Services & Chief Development Officer at Bruce Power.

The Bruce station is currently under a Major Component Replacement (MCR) project starting with Unit 6 in 2020, Unit 3 in 2023, and Unit 4 in 2025. The refurbishment will add approximately 30 to 35 years of operational life, along with other investments in the other units, to the plant. The decision to go ahead with

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new build planning comes after the Independent Electricity System Operator (IESO) found in its 'Pathways to Decarbonization' study that in less than 30 years, Ontario would need to more than double its electricity generation capacity to 88 GW in 2050 from 42 GW today. The report forecast an additional 17.8 GW of nuclear power could be required to meet that demand increase. While all of Canada's nuclear power stations run on CANDU (Canada Deuterium Uranium) reactor technology, Scongack would not commit to any

specific technology. "It's always exciting to speculate around different reactor types and designs, but it's premature to make that decision at this stage. We want to take this one step at a time. This is a step by step, deliberate, incremental process," Scongack says....

More SMRs: As Bruce Power begins pre-development work for the new large-scale nuclear build, Ontario Power Generation (OPG) announced in July 2023 it will work with the provincial government to plan and license three additional SMRs at the Darlington nuclear site. OPG had originally only planned to build one SMR at the site, which it announced in January after signing a contract with GE Hitachi Nuclear Energy (GEH), SNC-Lavalin, and Aecon, the first commercial contract for a grid-scale SMR in North America. Subject to Ontario Government and Canadian Nuclear Safety Commission (CNSC) regulatory approvals on construction, the additional SMRs could come online between 2034 and 2036, the government says. Construction for the first of the four grid-scale SMRs is scheduled to be complete by 2028. The four BWRX-300 SMRs are expected to have a combined capacity of some 1.2 GW.

Fighting Cancer: At the end of June 2023, the Canadian government announced CAN\$35 million (\$26.5 million) in funding for the creation of the Canadian Medical Isotope Ecosystem (CMIE), with projects at Bruce Power, TRIUMF Innovations, the Centre for Probe Development and Commercialization (CPDC), McMaster Nuclear Reactor, Canadian Nuclear Laboratories, and BWXT Medical. The global supply of medical isotopes used in the detection and treatment of cancer rests on an unreliable supply chain, often involving Russian research reactors, and are subject to radioactive

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decay, which makes them difficult to store. "For this reason, they have to be delivered just-in-time through a complex supply chain that requires sufficient capacity for ongoing production, plus a reserve in case of unplanned outages," according to the OECD-NEA study 'The Supply of Medical Isotopes'.

The CMIE funding will help launch three high-demand medical isotopes and related drug products to the market as well as advance two medical isotopes from

early stage to pre-clinical evaluation. The CMIE is also expected to raise more than CAN\$75 million in investment and create over 600 highly skilled jobs.

Source: <https://www.reuters.com/business/energy/canadas-nuclear-drive-picks-up-speed-2023-07-25/>, 25 July 2023.

OPINION – Peter Huessy

What Does Oppenheimer Teach About Nuclear Deterrence?

The new movie about J. Robert Oppenheimer, one of the top scientists running the Manhattan project often credited with building the first atomic bomb, has spawned much commentary and analysis about the US current nuclear deterrent, the nuclear balance with Russia and China, and whether nuclear abolition should be seriously pursued. One such essay ("The Long Shadow of Oppenheimer's Trinity Test") by Jack Detsch, the national security reporter at Foreign Policy and Anusha Rathi, also with Foreign Policy, published July 23, 2023, makes two central points. The first is that the massive use of nuclear weapons would devastate much of the world, trigger global winter and possibly killing five billion people. The second calls into

The global supply of medical isotopes used in the detection and treatment of cancer rests on an unreliable supply chain, often involving Russian research reactors, and are subject to radioactive decay, which makes them difficult to store.

question the credibility of the US deterrent to prevent nuclear war, and the need alternatively through a campaign of Global Zero to get Russia and China to join the US in "disarmament talks."

Ironically, the current disarmament campaign actually makes the use of nuclear weapons more likely as funding cuts and delays pushed by global zero advocates often undermine the very US deterrent that for seventy-five years has avoided the Armageddon the disarmament groups fear will someday occur. And while a major nuclear war could indeed destroy much

of civilization, the limited use of nuclear weapons under a strategy of "escalate to win" has been adopted by Russia and China, the leaders of which believe such a war can be waged and "won," despite their "dezinformatsiya" to the contrary. Detsch/Rathi contend the US spends far too much on nuclear deterrence, but then acknowledge that much of the nuclear industry that makes up the nuclear infrastructure, for example, is indeed "falling into despair," what former CSIS/PONI Director Clark Murdock once described as "rusting to obsolescence." Ironically, it has been the global zero advocates that for multiple decades refused to adequately fund a modernized nuclear deterrent, thus leading to the significant aging of US legacy nuclear systems and infrastructure that now costs so much to sustain.

Detsch and Rathi complain the Biden administration is unnecessarily pursuing an "arms

race" with a planned more than \$1 trillion nuclear modernization effort, which they blame on "Pentagon hawks" as if the Administration and Congress have no role in the current program of record now proceeding into its 14th year. But far from starting an arms race, all of the US strategic nuclear modernization effort is entirely consistent with the 2010 New START arms control treaty, as the US will build no more than the 700 allowed SNDVs or strategic nuclear delivery vehicles, and actually achieve a reduction in sub-launched nuclear armed missiles as we move from the Ohio class submarine carrying 20 missiles to the Columbia class submarine carrying 16 missiles.

There is thus no US led arms race or "buildup" as Detsch and Rathi claim. Even the authors concede the current US arsenal is "outdated" and thus is only being replaced, and thus not a "build-up." On the other hand, there is an arms race being pursued by Russia, where 20+ new strategic (long-range) nuclear weapons types have been pursued since the 2010 New START treaty was signed, some not within the treaty's framework, and by China which now has deployed more ICBM launchers than the United States while projecting by 2035 to increase its strategic arsenal by at least 400 percent, all of which is arms limits.

Detsch and Rathi also appear not to understand the entirety of the US nuclear deterrent is not designed to "destroy multiple Soviet Russian

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Detsch and Rathi also appear not to understand the entirety of the US nuclear deterrent is not designed to "destroy multiple Soviet Russian cities," but to hold at risk the military and security and leadership assets of our nuclear armed enemies, so as to prevent them from having the capability to achieve their hegemonic objectives. The US does not hold populations at risk nor target them and began not to do so beginning with the flexible response posture of the Kennedy administration.

cities,” but to hold at risk the military and security and leadership assets of our nuclear armed enemies, so as to prevent them from having the capability to achieve their hegemonic objectives. The US does not hold populations at risk nor target them and began not to do so beginning with the flexible response posture of the Kennedy administration. As noted earlier, the essay repeats the narrative that the cost of nuclear modernization is \$1 trillion or higher. In fact, in FY2024, the total research, development and acquisition costs of the nuclear submarine, land-based missile and bomber platforms, plus the nuclear command and control and warhead life extension, was \$18 billion in the combined DOD and NNSA budgets or 2% of the defense budget and 26th/100ths of the Federal budget. Even over a 30-year period, the cost would not approach \$1 trillion.

Overall, however, current nuclear expenditures are roughly one-third modernization and two-thirds sustainment. The legacy systems will be between 42, 50 and 60 years old when replaced and cannot be confidently sustained longer than now planned. Delaying modernization just escalates sustainment costs. And even a Democrat controlled House in 2022 understood this reality and slam dunked the idea of keeping the legacy Minuteman III and killing the new Sentinel ICBM program by a vote of 309-118. In short, there is no US led arms race; there is no \$1 trillion nuclear modernization budget; and there is no Congressional support for dismantling the US nuclear Triad or deterrent.

Detsch et al also believes the US nuclear arsenal vastly exceeds in numbers “any reasonable degree of [needed] security” but then fails to inform the reader that the US strategic long-range nuclear arsenal is some 90% smaller than at its height before the collapse of the Soviet Union

when the deployed (in the field) US long-range strategic nuclear arsenal exceeded some 12,000 allowable nuclear weapons. The actual deployed number of warheads now varies but according to most sources is around 1350, with the number on alert day-to-day probably slightly less than 1000.

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Through START I, the Moscow Treaty and New START, over 95% of the overall US nuclear arsenal is under arms agreement limits, while 55% of Russian weapons are not under arms limits, to say nothing of the entirety of the Chinese nuclear forces under no limits whatsoever. This trend toward lower US deployed strategic warheads is hardly descriptive of a country in “pursuit of nuclear

superiority” as the authors claim. And our modernized deployed strategic long-range systems when deployed will be no more than allowed by the New START counting rules and thus consistent with “arms control” and are certainly no bigger than the Russian forces.

However, the Russian upload capability is vastly greater than the US, Russia’s reserve stockpile is much bigger, and Russia’s theater or short-range nuclear forces are 10-20 times greater than the US as well. While the US did seek to deter the Soviet Union during the Cold War, by the end of the Soviet buildup in the era of détente and peaceful coexistence, the US was certainly not in any kind of superior nuclear position, nor is it today. While arms control has its place, it has not resolved the dangerous current Russian nuclear strategy nor its nuclear forces now approaching 7-8000 warheads.

As usual for disarmament advocates, the essay says those seeking global zero are gentle grassroots folks for peace, but that nuclear deterrent advocates are greedy companies coercing politicians to support nuclear spending in their Congressional districts. “Big bombs bring

big dollars” Detsch claims, although the bomb megatonnage of US nuclear forces has dropped some 90% since the end of the Cold War and it has been nearly 30 years since the US deployed a single new, modern nuclear platform. It may not be until 2030 when the first new nuclear-armed modernized platform is put into the field. Detsch et al., also claim the US nuclear arsenal was reduced only in the two decades after the peak in the 1960's.

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In fact, US strategic nuclear forces started declining with the START I treaty of 1991 and on the theater side with the 1987 INF Treaty. All US theater nuclear forces on US Navy ships were unilaterally withdrawn under the Bush 41 administration, as were theater land based deployed systems from the Pacific. But where the authors fall completely off the rails is their subsequent strange even bizarre declaration of the post-Cold War, post 1989 decision by the U.S to, according to the authors, “rethink the use of nuclear weapons” and come up with “modernization.”

Actually, after the initial nuclear deployments on US bombers, the US first modernized its nuclear force beginning under Presidents Eisenhower and President Kennedy, then subsequently modernized again primarily in the Reagan and Bush (41) administrations. Subsequently, in the post-Cold War period, the US stopped production of the Ohio class submarine, the Peacekeeper ICBM and the B2 bomber (1992, 1995 and 1997, respectively), primarily as a result of the START I and START II arms reduction agreements first put on the table by President Reagan in his November 1981 National Press Club speech, a result of the highly creative work of the administration's OSD

One discovered document revealed China had military designs on some 17 neighboring nations. With respect to attacking Taiwan, the CCP threatened to bomb Japan, a non-nuclear state, with nuclear weapons should Japan come to the assistance of Taiwan, and in the words of the CCP, “make you surrender unconditionally just as you did in WWII.

and NSC staff working to produce numerous NSDD's creating an entire peace through strength framework for joint nuclear modernization and arms control.

US is now putting together some three decades late. Since primarily 2006-10, the US has put together a modernization plan, which will be completed roughly in 2042, and which indeed as the authors acknowledge, has been supported by a “remarkably bipartisan” Congress, but which is coming into the force some 40 years after the fall of Communism and the USSR.

If anything, the post USSR collapse period was characterized at the time by USAF General Garret Harencak as a “holiday from history” where the US for decades decided not to modernize its nuclear forces or establish a viable, updated framework for deterrence, both of which the

For some reason, Detsch and Rathi think the balance between the US and China is not one of good vs evil, that the CCP is not communist and not godless, and there is no reason to have a mindset against China that reflects a “Cold War” mentality. But China murders its own people to harvest their organs, exports

fentanyl to the US that kills over 70,000 Americans annually, steals \$600 billion annually in US intellectual property, and unleashed a virus on the world that killed one million Americans. It imprisons millions in a 21st century gulag, while unleashing its brutal security forces routinely against its own people, and against Hong Kong, Tibet, Nepal, and other of its neighbors. One discovered document revealed China had military designs on some 17 neighboring nations. With respect to attacking Taiwan, the CCP threatened to bomb Japan, a non-nuclear state, with nuclear

weapons should Japan come to the assistance of Taiwan, and in the words of the CCP, “make you surrender unconditionally just as you did in WWII.”

Source: <https://warrormaven.com/global-security/what-does-oppenheimer-teach-about-nuclear-deterrence>, 25 July 2023.

OPINION – Markham Heid

Why Ultra-Green Germany Turned its Back on Nuclear Energy

Earlier this spring, the German government closed down the country’s three remaining nuclear power plants — the last vestiges of what was once a large domestic fleet. While not everyone in Germany supported the closures, many here — particularly supporters of the Greens (Die Grünen), one of the world’s strongest and most powerful environmentally focused political parties — viewed the event as the happy culmination of a decades-long battle to rid the country of nuclear energy.

“We are embarking on a new era of energy production,” said Steffi Lemke, a Greens member and Germany’s federal minister for the environment and nuclear safety.... Nuclear energy is a controversial topic in most places, but Germany is notable for its historic antipathy toward technology. “Anti-nuclear sentiment in Germany is widespread and longstanding, and it’s highly correlated with concern for climate change” says Pushker Kharecha, deputy director of the Climate Science, Awareness, and Solutions Program at Columbia University’s Earth Institute.

In the US, Gallop polls going back 20 years have found that Americans are generally split on the subject of nuclear energy, though support for

nuclear has swelled in recent years. For its part, the White House has invested heavily in sustaining the country’s nuclear infrastructure, and President Biden has also touted nuclear as an important component in the country’s quest for carbon neutrality. Many countries are following the same path based on similar climate calculations, and some experts support this position. “Nuclear is actually one of the cleanest and safest energy sources”.... For countries that want to mitigate climate change and reduce air pollution...nuclear energy should be embraced — at least until better options come along.

But environmental advocacy groups and left-leaning American voters have traditionally opposed nuclear power. And, despite the president’s efforts, recent Gallup data suggest this is still the case: Less than half of Democrats back nuclear, compared to 62 percent of Republicans. It’s not all that odd that

environmentally conscious Germans would support finishing off the country’s long-dying nuclear sector. What’s harder to square is that as Germany was finalizing its plans to shutter its remaining nuclear plants, it was also reactivating old coal-fired power facilities, mining more lignite (a.k.a. brown coal), and generally ramping up its use of fossil fuels to address energy shortages brought on by the conflict in Ukraine.

According to figures from Germany’s Federal Statistical Office, one-third of Germany’s electricity in 2022 was generated from coal. That represents an 8 percent increase compared to 2021. Meanwhile, the country’s use of nuclear-generated electricity fell by almost 50 percent during the same period.

No less a climate-change evangelist than Greta Thunberg has argued publicly that, for the planet’s sake, Germany should prioritize the use of its existing nuclear facilities over burning coal. Yet this is not the way the country has gone, and there has been relatively little public protest or political

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No less a climate-change evangelist than Greta Thunberg has argued publicly that, for the planet’s sake, Germany should prioritize the use of its existing nuclear facilities over burning coal. Yet this is not the way the country has gone, and there has been relatively little public protest or political handwringing over the increased use of coal-generated power to address its deficits.

handwriting over the increased use of coal-generated power to address its deficits. Why would a country that stands out for its environmentalist bona fides — where the reality of climate change and the push for renewable energy sources has been embraced by all major political parties — choose coal over nuclear in the midst of an energy crisis? A clearer understanding of Germany's energy choices may help other countries, including the US, better assess the risks and rewards of nuclear power.

Germany's Complicated History with Nuclear Energy:

Christoph Löffler was just 9 years old when a reactor melted down at the Soviet nuclear facility near Pripyat in what is now northern Ukraine. "I was only 9, but I remember Chernobyl," Löffler says. "There was a shortage of milk, and people here paid more — double the price — for milk produced before a certain date." Löffler, 46, is an otolaryngologist. He's also my neighbor. We live in Freiburg im Breisgau, a university city in southwest Germany that is one of the greenest regions of the country — both literally and politically. Freiburg is nestled on the western edge of the Black Forest. It is one of the most eco-conscious cities in Europe, and Greens politicians represent the mayorship and the largest bloc of the city's municipal council.

To an American visitor, Freiburg is reminiscent of Berkeley or Santa Cruz — one of those lush northern California college towns where a disproportionate number of people ride bikes, wear Birkenstocks year-round, and rank climate change as the most important consideration when casting their votes. In late 2021, 12,000 people here marched in the streets in support of climate action. People with banners in German march through the street. One person holds an umbrella that reads "solar energie." The local citizenry's anti-nuclear zeal is everywhere in evidence; flyers and graffiti around the city advocate for a future without nuclear power.

A popular bumper sticker here, one that dates back to the 1970s, depicts a smiling sun and the slogan "Atomkraft? Nein danke." ("Nuclear power? No,

thank you.") When I asked Löffler about nuclear energy, he talked measuredly about its pros and cons. "However, I am more against it than for it," he concluded. Like other Germans I spoke to for this piece, he brought up the threat of nuclear disaster as a strong argument against the use of the technology. Another friend, a teacher, asked me if pro-nuclear Americans had forgotten the Three Mile Island nuclear disaster in Pennsylvania. (I have even seen newspapers here refer to nuclear power plants generally as "drei Meiler," or "Three Milers.")

The Chernobyl meltdown captivated and horrified many Americans. But while the US shuddered, Germans suffered directly from the disaster's fallout. It wasn't just a question of tainted milk. Radioactive particles drifted across much of the German landscape. Sandboxes were nicknamed "death boxes."

Chantal Kopf, a Greens politician here in Freiburg and elected member of the Bundestag (basically, Germany's House of Representatives), likewise raised the specter of a nuclear disaster. "As Greens, we've always had in our tradition a more critical perspective on

whether humans are capable of controlling every circumstance, and we've already seen really catastrophic accidents." ... The Chernobyl meltdown captivated and horrified many Americans. But while the US shuddered, Germans suffered directly from the disaster's fallout. It wasn't just a question of tainted milk. Radioactive particles drifted across much of the German landscape. Sandboxes were nicknamed "death boxes." Contamination turned up in meat, vegetables, fruits, and foodstuffs produced all over the country, and frightened parents didn't know what to feed their children. Some experts estimated that hundreds of thousands of people on the continent would eventually develop Chernobyl-related cancers. That didn't come to pass, but recent government analyses of German wild mushrooms found that 95 percent of samples still contained radioactive contamination from Chernobyl, and the residue of that disaster has likewise soaked deep into the nation's views on nuclear power.

"Chernobyl was much bigger and closer to home for Germans than anything Americans have experienced," says Sarah Wiliarty, an associate professor of government at Wesleyan University in Connecticut. "It was very much a lived threat."

Wiliarty has published work on the history of Germany's nuclear industry. She says the country's anti-nuclear movement emerged alongside the environmental movement in the 1970s, and Chernobyl helped weld the two together. While overall support here for nuclear has ebbed and flowed over the years, the Greens Party has never wavered in its opposition to nuclear. And another, more recent disaster helped align the rest of the country behind the Greens' anti-nuclear agenda.

Similar fears have cropped up whenever the fighting has raged near one of Ukraine's nuclear facilities, including Zaporizhzhia, Europe's largest atomic power plant. The destruction on June 6 of the Kakhovka Dam, which is the ultimate source of the plant's cooling water, raised new fears of a possible nuclear disaster.

After Fukushima: At least by American standards, the nations of Europe are small and packed together. Calamities that befall one country often have repercussions for their neighbors. At the start of the conflict in Ukraine, many Germans feared that the fighting would soon find its way to their borders. Similar fears have cropped up whenever the fighting has raged near one of Ukraine's nuclear facilities, including Zaporizhzhia, Europe's largest atomic power plant. The destruction on June 6 of the Kakhovka Dam, which is the ultimate source of the plant's cooling water, raised new fears of a possible nuclear disaster. Some Germans I spoke with told me these sorts of threats are evidence that nuclear power is simply not worth the risk; even if you believe that operator or technological error has been removed from the equation — a debatable position — unforeseen events could still induce a nuclear accident. "There is always the potential for an attack — a terrorist or cyber or war attack like we're seeing in Ukraine," says Kopf, the Greens politician. "It may be a small chance something like that happens, but if it happens, the consequences are so dramatic."

However, it would be an exaggeration to say that all Germans are anti-nuclear. Especially since the conflict in Ukraine has weakened the country's energy stability and sent energy prices soaring, Germany's pro-nuclear camp has gained support. A 2022 poll found that a majority of respondents would be in favor of extending the life of the country's existing nuclear facilities, though a majority still oppose the construction of new plants.

More than a decade ago, just such a dramatic event caused Germany to abandon its nuclear industry. In March 2011, a massive earthquake and consequent tidal wave induced the meltdown of three nuclear reactors at Japan's Fukushima Daiichi Nuclear Power Plant. Just three days after that earthquake, Chancellor Merkel and Germany's two-party ruling coalition — which until that point had supported the continued use of nuclear energy — ordered the immediate closure of eight of the country's 17 nuclear power plants. A few months later, the German Parliament approved, by a large majority, the total phase-out of Germany's nuclear industry by the end of 2022. All of this helped accelerate the country's shift toward renewable energies (namely wind and solar), which now generate about half of Germany's electricity.

"Pre-Fukushima, the left [in Germany] had an anti-nuclear stance, but the right wing was more favorable to nuclear," Wiliarty says. "After Fukushima, Merkel essentially said that if Japan can't handle nuclear, we should not believe that we can handle nuclear, and most Germans agreed with her." Mentioning the legacy of WWII, Wiliarty adds that the possibility, however remote, of causing another tragedy on the European continent is enough to make nuclear energy a nonstarter for many Germans. (This may help explain why Germany continues to buy, situationally, nuclear-generated electricity from France even as it moves away from "homegrown" nuclear.)

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energy stability and sent energy prices soaring, Germany's pro-nuclear camp has gained support. A 2022 poll found that a majority of respondents would be in favor of extending the life of the country's existing nuclear facilities, though a majority still oppose the construction of new plants. In many places, not just Germany, this is a significant point of debate and division. Using the nuclear facilities you already have is one thing. Building new ones is quite another. ...

But some energy experts I talked with said that, by and large, Germany has only shuttered nuclear plants that were end-of-life or otherwise unfit for service. "Most of the plants – except where the plants were having serious technical problems – were shut down when they would have been shut down anyhow," says Miranda Schreurs, a professor of environment and climate

policy at the Technical University of Munich. On the broader question of whether the country's abandonment of nuclear energy has made sense, she says that it has certainly involved uncomfortable trade-offs. "The priority no doubt has been the move away from nuclear, not coal," she says. "But the German response isn't either-or, it's how do we get both out of the system as quickly as possible." Germany has committed to ending its use of coal by 2030. It has also become one of the world leaders in the development and use of renewables, something Schreurs says has only been possible because money and other resources that would have been sucked up by nuclear energy have instead been funneled into renewable technologies. However, some argue that the country's anti-nuclear priorities have come at a steep cost.

Does Nuclear Make Sense for Germany – Or for Any Country? There are some unimpeachable justifications for opposing nuclear energy. There's the risk of a catastrophic accident, first and

foremost, and also the problem of storing or disposing of nuclear waste. "From our point of view, it's not right to say nuclear is a sustainable technology," says Kopf, the Greens politician. "You need uranium, which is not extracted in an environmentally friendly way, and there is no real solution for nuclear waste." However, when making energy trade-offs, these risks must be balanced against the harms associated with the use of non-nuclear energy sources — such as air pollution and CO2 emissions produced by fossil fuels. According to estimates from Our World in

According to estimates from Our World in Data, nuclear is cleaner and safer than any power source apart from solar. The number of deaths caused by either accidents or air pollution as a result of nuclear power is estimated to be just 0.03 deaths per terawatt-hour of energy produced. That is far, far below the 18 deaths and 25 deaths per terawatt-hour associated with oil and coal sources, respectively.

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Yale University's Environmental Performance Index (EPI) ranks the world's countries in terms of their climate-change measurables, such as greenhouse gas emissions. Germany now slots in at 14th, one spot ahead of the United States. While a top-15 ranking is decent enough, nearly all of the other countries near the top of the index have improved their EPI score during the past decade. Germany's score, on the other hand, has fallen, and that's due mostly to the country's CO2, NO2, and other fossil fuel emissions. Germany has the third-most "carbon intensive" electric grid among European countries, and by some estimates, the amount of carbon dioxide it emits to generate electricity is multiples higher than many of its neighbors. These emissions harm the planet, but they're also poisonous for people. ...

His comments are grounded in some of his own peer-reviewed research. Similar analyses, including a more-recent paper from the National Bureau of Economic Research (NBER), a US-based nonprofit, have likewise found that Germany's withdrawal from nuclear resulted in thousands of

preventable deaths, mostly due to air pollution caused by the burning of coal. That NBER paper also concluded that the phase-out cost the country \$12 billion. Kharecha acknowledges that Germany has done “a very impressive job” of rapidly scaling up solar and wind sources of energy production. But he says the unreliability of renewables requires supplementation with other sources, and that’s where nuclear is needed. “Nuclear provides continuous ‘baseload’ power,” he says. “Renewables and nuclear really should be viewed as complementary choices, not binary ones.”

But other energy experts say renewables and nuclear make poor bedfellows.

“One of the issues with nuclear is its inflexibility — it either operates at 100 percent or zero, and you can’t just flip a switch and turn it on or off,” says Andrzej Ancygier, a lecturer at New York University’s Berlin satellite campus and a senior energy and climate policy analyst at Climate Analytics. For renewables to work at scale, he says, flexible complementary energy sources are needed, and nuclear isn’t that. Also, nuclear power plants have a finite lifespan. To extend that lifespan requires significant investments of both cash and time and may come with mounting risks. ...

Schreurs, the Technical University of Munich professor, makes a similar point. She says that very few Western nations, even pro-nuclear countries, have managed to build new nuclear plants in recent years. Those that have tried — for example, the UK’s still-in-progress Hinkley Point power plant — have run into major

delays and massive budget overruns. ... In 2022, more than half of France’s nuclear reactors were shut down unexpectedly for maintenance reasons, and the country had to rely on German

energy imports to meet its shortfalls. Schreurs highlights these problems as evidence that nuclear too can be unreliable.

What’s Next for Germany?: Germany’s move away from nuclear and toward renewables has forced it to rely on fossil fuels. Proponents of this strategy say this reliance is temporary — a short-lived trade-off that, in the long run, will allow Germany to power itself cheaply, safely, and sustainably. Some will no doubt scoff at

this argument. In the US, many still view solar, wind, and other renewables as unreliable energy sources that cannot anchor a country’s electricity industry. But even some American observers say the German view of renewables’ potential may be closer to reality. ...

Ancygier echoes these sentiments. He says German policymakers have at times vacillated in their support for renewables — something that has slowed progress. But while some political dissent persists, the current government has affirmed its commitment to renewables, and its stated policy aims are for these sources to make up 80 percent of the country’s electricity

production by 2030. The great debate over nuclear energy is sure to rage on, both here and in the United States. In the end, the lesson other countries may take from Germany is that abandoning nuclear in favor of safer and greener renewables is possible but that it comes with

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In the end, the lesson other countries may take from Germany is that abandoning nuclear in favor of safer and greener renewables is possible but that it comes with uncomfortable trade-offs. It also requires political will and broad public support. For much of the past 20 years, Germany has had both. Whether it can sustain them will likely determine how much success it has, and how quickly that success comes.

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Source: <https://www.vox.com/future-perfect/2023/7/19/23799448/germany-climate-change-nuclear-power-fukushima-carbon-emissions-coal-global-warming>, 19 July 2023.

OPINION – Tamarra Soma, Kevin Maars

We're Not Ready for a Nuclear Winter. Neither are Our Food Systems

Around the world, our food systems — the interconnected networks of food production, distribution, consumption and everything in between — have been faced with severe disruptions due to the COVID-19 pandemic, climate change and growing inflation. In many nations, these disruptions have led to a food crisis for food banks, as the number of people requiring access to charities has ballooned while food supplies are limited. Disparities in food access are growing; in our own country of Canada, one in four people faces some form of food insecurity and one in three children risks going without breakfast. After a spate of flooding and wildfires in Canada that left thousands of livestock dead in 2021, Guelph University professor Evan Fraser noted in an op-ed that our nation's food supply leaves us "nine meals from anarchy." Our government, he argued, needs to plan for food systems resiliency in a changing world.

Yet all these seemingly insurmountable challenges to our food systems still seem minuscule when compared to the growing tensions and the escalating language around the potential use of nuclear weapons due to the Russia-Ukraine war. With very little hope for de-escalation or peace talks, the potential use of nuclear weapons in what each side considers an existential threat will

have global repercussions. This threat is growing with the delivery of depleted uranium rounds to Ukraine from the UK, cluster munitions from the US, and threats surrounding the Zaporizhzhya nuclear power plant. And while only a few countries possess nuclear weapons, many "non-nuclear" countries host U.S nuclear bases in their territories and will therefore be impacted.

It is unclear whether Canada and its NATO allies are prepared to handle a global disruption from a nuclear war. The threat of global nuclear war may sound like hyperbole, but it is real. So is the possibility of a nuclear winter. It's acknowledged

in the Bulletin of the Atomic Scientists' Doomsday Clock report; the clock, which represents how close humanity is to destroying the world with technologies of its own making, was recently set to 90 seconds to midnight, with midnight being a full-scale nuclear war and global catastrophe. UN Secretary General

Antonio Guterres, too, has warned that we are entering "a time of nuclear danger not seen since the height of the Cold War."

The fear of a two-degree temperature rise due to climate change will be dwarfed by the prediction that a nuclear war, followed by the injection of 5 Tg – about 11 billion pounds – of soot into the upper troposphere would drop the global temperature to values below Ice Age conditions for decades. This is what we call "nuclear winter." In the event of a nuclear war between the United States and its NATO allies versus Russia, a study in Nature has estimated, the global average calories will drop by 90% with five billion people dying due to famine. Soil irradiation, global cooling and crop loss due to sunlight reduction will produce a world where growing many crops will be impossible, especially in the Northern hemisphere. While nuclear war, as the late U.S. President Reagan and Soviet President Gorbachev agreed, "cannot be won and must never be fought," several studies have highlighted the need

With very little hope for de-escalation or peace talks, the potential use of nuclear weapons in what each side considers an existential threat will have global repercussions. This threat is growing with the delivery of depleted uranium rounds to Ukraine from the UK, cluster munitions from the US, and threats surrounding the Zaporizhzhya nuclear power plant.

to nevertheless prepare in case the unthinkable happens.

Researchers have highlighted different nuclear scenarios: The number of survivors will vary greatly if nuclear war happens during summer or winter, or whether it is a regional conflict (between, say, India and Pakistan) versus global (most likely NATO countries versus Russia). The number and power of nuclear weapons will also determine how much soot is released in the stratosphere and how long the sun will be blocked. According to climatologist Alan Robock of the Rutgers University's Climate Institute, nuclear weapons are an instrument of suicide rather than one of defense. "If country A used enough weapons only against military targets to prevent country B from retaliating, in what is called a 'first strike,' the climatic consequences could be such that everyone in country A could die," he wrote.

Preparing for the Worst:

From a food systems resilience angle, it is important to note that there is no easy way to prepare for nuclear winter. The catastrophic nature of nuclear war is such that there is limited conclusive evidence on how people can survive. While the first step is to consider all options to ensure that nuclear weapons are abolished and to ensure that nuclear war would never see the light of day, there are practical steps that countries should take to protect their populations. We identify three important food considerations that should be explored immediately: preliminary actions to undertake pre-war, post-nuclear attack food production options, and public education and awareness. By preparing for a possible nuclear winter, governments still have the opportunity to prevent decades of destroyed soil, loss of sunlight and billions of deaths from famine.

First, ahead of any nuclear attack, we must ensure coordinated efforts to hold large reserves of food stockpiles as a buffer. Canada may, for example,

want to ensure that it has more than three months' worth of food for our own domestic use should global trade and agriculture be disrupted. This recommendation was highlighted in a recent study modelling how regional nuclear conflict would disrupt global food security. Unfortunately, current federal funding for such preparation is limited in Canada, and funding such as the \$30 million Emergency Food Security Fund dedicated to COVID-19 is focused on supporting food banks and charities, without long-term considerations for extended disruption and the need for government mobilization. Actions such as holding food reserves, managing stock and assessing food assets would be critical to identify gaps and strengths.

Second, there needs to be more research dedicated to post-nuclear food production options.

We know that large volcanic eruptions have caused some of the rapid cooling effect that has resulted in loss of crops, loss of daylight and disruptions in global agri-food production and ecosystems. So there's no harm in planning for the worst-case scenario for nuclear, as doing so can

also offer solutions for other less damaging scenarios. A study by researchers affiliated with the Alliance to Feed the Earth in Disasters, envisioning a balanced diet amidst so-called "Abrupt Sunlight Reduction Scenarios" (e.g. nuclear winters and large volcanic eruptions), found that seaweeds and macroalgae are nutritious and scalable in a short period of time. We also urgently need to identify what the authors termed as "resilient foods" for abrupt sunlight reduction scenarios: more cold tolerant crops and greenhouse crops, single cell protein, as well as organs and meats from ruminant animals such as deer.

Last but by no means least, it's important to make a serious investment in public education to spread awareness about the catastrophic nature of

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nuclear weapons and the impact of a nuclear winter. Our current population may no longer feel the same concerns as those who lived through the Cold War and has likely have forgotten the horrors of U.S. nuclear bombs on innocent civilians in Hiroshima and Nagasaki, which may have lulled us into a dangerous complacency.

In a poll by the University of Cambridge's Centre for the Study of Existential Risk, researchers found that public awareness of nuclear winter is too low. Their study revealed how groups exposed to infographics outlining the effects of a nuclear winter decreased their support for retaliation with nuclear weapons by 13% to 16%, as compared with groups who did not receive any information. These results make clear the influence that accessible information has on the court of public opinion, and the stakes for winning over the public could never be higher. The prospect of decades of destroyed soil, loss of sunlight and five billion people dying of famine is terrifying. However, with thoughtful and deliberate action, our governments still have the opportunity to prevent the unthinkable.

Source: <https://www.analystnews.org/posts/were-not-ready-for-a-nuclear-winter-neither-are-our-food-systems>, 25 July 2023.

NUCLEAR STRATEGY

NORTH KOREA

Report to Congress on North Korea's Nuclear Weapons and Missile Programs

North Korea continues to advance its nuclear weapons and missile programs despite UNSC sanctions and high-level diplomatic efforts.

Recent ballistic missile tests and military parades suggest that North Korea is continuing to build a nuclear warfighting capability designed to evade

regional ballistic missile defenses. Such an approach likely reinforces a deterrence and coercive diplomacy strategy—lending more credibility as it demonstrates capability—but it also raises questions about crisis stability and escalation control. U.S. policy as well as U.N. resolutions call on North

Korea to abandon its nuclear weapons and missile programs. Premier Kim Jong Un has repeatedly rejected “denuclearization” talks. According to the U.S. intelligence community’s 2023 annual threat assessment (ATA), North Korean leader Jong-un views nuclear weapons and ICBMs as “the

ultimate guarantor of his autocratic rule and has no intention of abandoning those programs, believing that over time he will gain international acceptance as a nuclear power.”

The Korea People’s Assembly adopted a new law in September 2022 that reportedly expands

the conditions under which North Korea would use nuclear weapons to include possible first use in situations that threaten the regime’s survival. In response to these developments, the United States and South Korea have conducted joint military drills and revived the bilateral Extended Deterrence Strategy and Consultation Group. The Biden Administration’s 2022 NPR said, “Any nuclear attack by North Korea against the United States or its Allies and partners is unacceptable and will result in the end of that regime.” Congress may choose to examine U.S. policy toward North Korea....

Source: <https://news.usni.org/2023/07/25/report-to-congress-on-north-koreas-nuclear-weapons-and-missile-programs-2>, 25 July 2023.

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North Korean Nuclear Attack would 'End' Kim Jong Un Regime, Seoul Warns

Seoul on July 21 warned North Korea that using its nuclear weapons would spell the swift "end" of Premier Jong Un's regime after Pyongyang said U.S. military deployments could justify a nuclear strike, further escalating tensions on the peninsula as the North ramps up weapons testing and South Korea bolsters its ties with Washington. Any nuclear attack against the alliance between Seoul and Washington would provoke "an immediate, overwhelming and decisive response," South Korea's defense ministry said in a statement...Both Seoul and Washington have "made clear" the dire consequences of a nuclear strike against them before, the statement said, adding that a response of that kind would spell the "end of the North Korean regime."

The warning comes a day after Pyongyang's defense minister said the arrival of the USS Kentucky—a U.S. nuclear-capable submarine—in Busan, South Korea, for a port visit this week could justify its use of nuclear weapons. North Korea's nuclear doctrine changed significantly in 2022 when Pyongyang adopted sweeping legal changes governing its use of nuclear weapons. Many of the changes—which enshrined the right to use preemptive nuclear strikes—were vague and would seemingly give Pyongyang the right to use nuclear force against conventional attacks or if its leaders feel threatened. Seoul criticized the policy in its statement on July 21, particularly the inclusion of "illegal preemptive strikes," and said Pyongyang has been undertaking repeated preemptive strike drills and making nuclear threats against itself and its U.S. allies.

The USS Kentucky arrived in the South Korean port of Busan on July 18, marking the first visit of a U.S. nuclear-capable sub since the 1980s. While such visits were relatively commonplace during the Cold War, they are now a rarity—the unknown

whereabouts of submarines is a key element of nuclear strategy—and the White House said it was intended to send a powerful signal to Pyongyang over its commitment to defending Seoul. The two allies also held the first Nuclear Consultative Group in Seoul on July 18, designed to improve their joint response to a nuclear attack from the North and discuss how to strengthen nuclear deterrence. The joint action was predictably rebuked as a provocation by Pyongyang, which has escalated tensions in recent months with its renewed focus on weapons testing, including suspected intercontinental ballistic missiles capable of hitting the U.S. mainland...

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Source: <https://www.forbes.com/sites/roberthart/2023/07/21/north-korean-nuclear-attack-would-end-kim-jong-un-regime-seoul-warns/?sh=462cbd4a1b6e>, 21 July 2023.

BALLISTIC MISSILE DEFENCE

IRAN

Iran Unveils New Ballistic Missile After US Deployment to Gulf

Iran's Defense Ministry said it had mass-produced the country's first long-range naval ballistic missile with a host of new combat features, designed to "completely destroy" enemy carriers, state media outlets reported on July 21. "We have employed artificial intelligence within the software of the naval missile's trajectory planning," Defense Minister Brig. Gen. Mohammad-Reza Ashtiani announced at a televised ceremony in Tehran. The ceremony marked the delivery of dozens of the projectiles to the IRGC and Iran's regular army.... The missile is dubbed Abu Mahdi after Abu Mahdi al-Muhandis, the deputy commander of Iraqi's Tehran-backed Popular Mobilization Units. ...

Iran's defense minister said the new missile could be launched from "entirely secret" locations deep inside Iranian territory to blow up enemy

warships, frigates and carriers. The delivery came in the wake of American reinforcements to the Persian Gulf in mid-July of F-35 warplanes and the USS Thomas Hudner destroyer vessel. The Pentagon has said the deployment is meant to tackle a recent wave of Iranian seizures of oil tankers and commercial ships in the strategic waters.

Abu Mahdi is the latest in an array of ballistic missiles Iran has developed and publicly unveiled in the past decade, inattentive to pressure from the West and its regional Arab rivals. The Islamic Republic also insists that unlike its nuclear activities, the controversial missile program remains “a non-negotiable red line.” The new missile, according to state media outlets, dramatically expands the coverage area of the Iranian navy. It can be launched from both stationed and moving pads and its navigation system is capable of updating the final impact point in flight. The projectile operates with an integrated navigation system and robust propulsion, making it capable of firing in quick succession, according to state media, which also claimed that Abu Mahdi can make warplanes stationed on aircraft carriers “useless.”

Iranian commanders boasted specifically about the projectile’s radar evasion, its ability to fly in low altitudes and stealth nature up until impact. Detailing that feature, IRGC-run Fars News said the undetectable missile will appear upon its targets like a “ghost.” The “unique” missile, as described by the Iranian defense minister, features a cruise range of 1,000 kilometers (620

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miles). Yet in an apparent message of defiance to Iran’s adversaries, the IRGC’s US-sanctioned naval commander, Rear. Adm. Alireza Tangsiri, promised at the Tehran ceremony that new versions with a doubled range of 2,000 kilometers (1,240 miles) are on the way.

Source: <https://www.al-monitor.com/originals/2023/07/iran-unveils-new-ballistic-missile-after-us-deployment-gulf#ixzz88YPOs800>, 25 July 2023.

SLOVAKIA

Patriot Air Defence Systems Go Operational in Slovakia Boosting NATO

The Patriot air defence system is now fully operational in central Slovakia, with Dutch and German military personnel joining forces to protect critical systems and facilities from airborne threats. The joint deployment, carried out under NATO’s leadership, is a robust defensive measure to deter potential risks and reinforce security in Eastern Europe. Slovakia received the Patriot missile defence systems in March 2023. Lieutenant Colonel Patrick Wekking expressed confidence as he announced

The Patriot system’s capabilities enable it to neutralize various threats, including helicopters, manned and unmanned aircraft, ballistic missiles, and cruise missiles. Although the deployment is defensive, it aims to provide an effective deterrent against potential missile threats from outside NATO territory, particularly from Russia. Various European countries have inducted the Patriot air defence systems following the invasion of Russian forces into Ukrainian territory.

the operational readiness of the Patriot air defence system in central Slovakia. ... The deployment comprises several launchers, a fire control centre, a radar system, and a command and logistics element. Nestled between forested hills, the positions of the air defence units, located just two kilometres apart near the town of Zvolen, provide strategic advantages for protecting the country against airborne threats....

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manned and unmanned aircraft, ballistic missiles, and cruise missiles. Although the deployment is defensive, it aims to provide an effective deterrent against potential missile threats from outside NATO territory, particularly from Russia. Various European countries have inducted the Patriot air defence systems following the invasion of Russian forces into Ukrainian territory. Some noticeable nations to have recently acquired or have entered Patriot systems into their inventory include Ukraine-bordering Poland, which recently had an approved sale of 48 Patriot Batteries from the US for \$15bn (60bn zlotys) in a strategic move.

In June 2023, the Ukrainian President called for more Patriot air defences alongside the anticipated F-16 fighter jets to bolster Ukraine's air defence. President Zelenskyy claimed that Patriot air defences are the backbone of the European "sky shield". Addressing concerns about escalating tensions, Lieutenant Colonel Wekking clarified that the deployment was not an act of aggression against Russia. ... The Russia-Ukraine conflict has increased demand for missile defence systems, as several NATO countries are now focusing on improving their missile defence capabilities in the wake of the growing missile capabilities of Russia. As the Patriot unit commences its operational duties, it serves as a symbol of assurance for the region, emphasising NATO's readiness to protect its member countries and maintain peace and stability in Eastern Europe.

Source: <https://www.army-technology.com/news/patriot-air-defence-systems-go-operational-in-slovakia-boosting-nato/>, 25 July 2023.

USA

Guam Fears Becoming 'Target' Over Planned \$1.5bn US Defence System

A planned missile defence system on the island of Guam could turn the US Pacific territory into a "target," local residents have said, as opposition to the plans grow. The Pentagon plans to invest \$1.5bn in a 360-degree, air and missile defence architecture on Guam. It aims to complete the system by 2027. In January 2023, the MDA, a procurement division of the Department of Defense, awarded a half-a-billion-dollar contract to Lockheed Martin to develop Guam's missile defence system. The components will be built on sites that will be selected among 20 potential locations.

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Plans for the defence system have been met with widespread resistance from the residents of Guam. The objections include concerns the territory will become embroiled in any potential conflict, as well as fears over environmental risks to the island and its indigenous culture. ... There are also worries that the scale of the proposed system would expand the military footprint in Guam and claim land belonging to the indigenous Chamorro community. The territory has a population of about 170,000 including roughly 21,000 US military personnel who are stationed at three bases. ... The Pentagon has described China's rising assertiveness as "the most consequential and systemic challenge" in the Indo-Pacific region. "Current forces are capable of defending Guam against today's North Korean ballistic missile threats ... However, the regional threat to Guam, including those from [China]

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continues to rapidly evolve,” Michelle Atkinson, MDA’s director for operations, said in a press briefing in March 2023.

Guam’s defence currently consists of a single THAAD battery – an anti-ballistic missile defence system designed to intercept and shoot down short-, medium- and intermediate-range missiles in their terminal phase. Rear Adm. Gregory Huffman, commander of the Joint Region Marianas, which oversees the US military bases on Guam, said the proposed defence system was aimed at defending the island “against rapidly evolving advanced missile threats from regional adversaries”. Many Guam residents shared their concerns over the plans at a public meeting facilitated by lawmakers in second week of July....

Source: <https://www.theguardian.com/world/2023/jul/26/guam-fears-becoming-target-over-planned-15bn-us-defence-system>, 26 July 2023.

NUCLEAR ENERGY

CHINA

Government-Industry Conference to Chart the Nuclear Energy Path to Net Zero

The French Ministry for Energy Transition and the OECD Nuclear Energy Agency (NEA) will hold an international conference convening Ministers and industry leaders from over two dozen countries to explore how to bring new nuclear energy capacity in line quickly to help governments to achieve their net zero targets. The conference Roadmaps to New Nuclear will be held on 28-29 September, 2023 in Paris. The announcement follows a meeting between the French Minister for Energy Transition Runacher

Rear Adm. Gregory Huffman, commander of the Joint Region Marianas, which oversees the US military bases on Guam, said the proposed defence system was aimed at defending the island “against rapidly evolving advanced missile threats from regional adversaries.

To achieve net zero by 2050, NEA projections show that total nuclear energy capacity will need to triple by 2050. Many countries are moving forward to expand their nuclear energy capacity and, therefore, nuclear new build has become a top priority in several NEA countries. Most face significant challenges in regard to evolving policy, industrial and regulatory contexts.

and NEA Director-General Magwood, IV in Paris, where the two leaders discussed the global nuclear energy outlook in a context where many countries are currently reviewing their energy priorities, and seeking pathways to net zero that maintain energy security and foster economic growth.

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become a top priority in several NEA countries. Most face significant challenges in regard to evolving policy, industrial and regulatory contexts. French Minister for Energy Transition Runacher said: “For the first time, more than 20 OECD NEA countries will convene in Paris, a few weeks before COP28, to send a strong message: nuclear power is essential to achieve carbon neutrality and fight against global warming, and many countries are ready to commit to it, like France, which is reviving its sector with vigour.”

NEA DG Magwood, IV, said: “Reducing global carbon emissions to achieve net zero by 2050 is one of the greatest challenges and opportunities of our time. NEA analysis shows that advanced

nuclear energy, alongside renewables and emerging technologies such as hydrogen, provides a realistic and practical path to meet this goal while maintaining energy security and fostering economic expansion. There is much work ahead and the NEA is pleased to work with the Government of France to advance the international collaboration needed to

realise this vision.” In the lead up to COP28, the outcomes of the Paris Roadmaps conference will set the stage for joint, focused action by

policymakers, utilities and the overall private sector....

Source: https://www.oecd-nea.org/jcms/pl_83775/government-industry-conference-to-chart-the-nuclear-energy-path-to-net-zero, 26 July 2023.

INDIA

ISRO, BARC Join Hands to Develop Nuclear Engines for Rockets

India's space agency, ISRO, is jointly developing a nuclear-powered engine along with BARC.... Chemical engines, such as those that power the thrusters in satellites, are fine up to a point, but if you want to send a spacecraft deep into space, such as into inter-planetary missions, they will not do—neither can they carry that much fuel nor can they be solar powered because sunlight will not reach a solar panel at such long distances. According to sources, ISRO-BARC are developing what are called Radio Thermoelectric Generators (RTGs). "The work has already begun and has been identified as a major task that has to be completed soon." ...

The nuclear engines are not to be thought of as nuclear fission reactors that generate electricity. The RTGs use radioactive materials, such as Plutonium-238 or Strontium-90, which release heat as they decay. Essentially, the engine contains two parts—the radioisotope heater unit (RHU) which generates heat, and the RTG, which converts the heat into electricity. This heat is transferred to a 'thermocouple'—a material that develops a voltage if there is a heat gradient across it. To put it in simple terms, think of it as a rod—if one end is hot and the other end is not, there will be a voltage across the rod ('Seeback Effect'). The voltage can be harnessed to charge batteries that can provide motive force to a satellite.

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ISRO is targeting a 5W RTG, it is learnt. "RTGs are independent of solar proximity and planetary alignment. This characteristic would help in minimising constraints like the 'launch windows' that the scientists have to operate within," says Nitansha Bansal, a cyber security specialist with the Columbia University, in an article for the ORF. RTGs, however, are not entirely new. US spacecrafts such as the Voyager, Cassini and Curiosity have been powered by RTGs.

Source: <https://www.thehindubusinessline.com/news/science/isro-barc-join-hands-to-develop-nuclear-engines-for-rockets/article67087008.ece>, 16 July 2023.

Yatra to Create Awareness on Nuclear Science

"Anu Awareness Yatra - 2023" with the theme of 'Atoms in the service of the nation' was launched at the IGCAR, Kalpakkam, on July 20. The programme is being organised by IGCAR in association with the National Council of Science Museums (NSCM), Vigyan Bharathi - Arivial Sangam, Tamil Nadu, and Indian Association for Radiation Protection in seven districts of Tamil Nadu and three districts of Kerala as part of the Azadi Ka Amrit Mahotsav celebrations.

B. Venkatraman, Director, IGCAR, said the yatra will initiate scientific curiosity amongst the students in rural areas and spread awareness on the necessity of nuclear energy and the spin-off technologies developed by the Department of Atomic Energy. K.A. Sadhana, Director, Visvesvaraya Industrial and Technological Museum (VITM) said a mobile van of NSCM "Science on Wheels" would accompany this yatra in all the places to create hands-on experience for the students visiting the exhibition. Ajit Kumar Mohanty, Chairman, AEC and Secretary, DAE, in his message, said nuclear

energy was an essential ingredient in the energy basket of the country and its efforts towards net zero carbon. An exhibition showcasing India's nuclear power programme and societal applications of nuclear energy was organised.

Source: <https://www.thehindu.com/news/national/tamil-nadu/yatra-to-create-awareness-on-nuclear-science/article67120430.ece>, 25 July 2023.

RUSSIA

Russian Designs for Underwater Nuclear Power Plant in Arctic

A project for a submersible underwater power module, featuring two nuclear power units with a total capacity of 20 MWe, that can dive to a depth of 400 metres and provide energy in Arctic regions is being worked on by the Malakhit Marine Engineering Bureau in St Petersburg, Russia. *Strana Rosatom*, the Russian nuclear corporation's magazine, reported that being able to reach such depths will "reduce the risk of collision with icebergs", adding that "the module will operate autonomously with periodic maintenance: once every three months it will be checked by up to six specialists".

The intention is "to provide energy to deposits in the Arctic shelf zones and remote northern garrisons - territories where traditional power plants cannot be located".

According to the project page on the Malakhit website, the advantages include the ability to have "controlled diving and ascent with the help of eight anchor lines" and "increased seismic resistance when hovering in the water column". It is not clear how far advanced the project is, but the ambition

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to create an underwater nuclear-powered complex is not a new one - in 2016 Interfax reported on a Russian project where studies and 3D modelling had been completed for a reactor "that meets the requirements of the IAEA". There was a similar project

launched by France's DCNS - building on its experience of making submarines for the French navy - in 2011 which proposed a small offshore nuclear power plant called Flexblue which would be a cylindrical unit 100 metres in length and 12 to 15 metres in diameter and would have featured pressurised water reactor technology similar to that of a nuclear submarine and produce "50 to 250 MWe". ...

Source: <https://www.world-nuclear-news.org/Articles/Russian-designs-for-underwater-nuclear-power-plant>, 20 July 2023.

NUCLEAR COOPERATION

HUNGARY-JAPAN

Hungary and Japan Sign Close Nuclear Cooperation Agreement

Hungary and Japan have sealed an agreement on nuclear industrial cooperation aimed at ensuring that nuclear energy remains a key part of both countries' energy policies, Péter Szijjártó, the minister of foreign affairs and trade, announced in Tokyo on July 22. The purpose of the deal is to ensure both countries continue to enjoy "cheap, safe and environmentally

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friendly" energy production.... Foreign Minister Szijjártó also called for "rational international discussions on nuclear energy based on common sense, free from "ideological, emotional attacks" against the nuclear industry. Meanwhile, the minister said Hungary supports NATO cooperation

with countries of the Pacific region as well as closer NATO-Japan ties....

Source: <https://dailynewshungary.com/hungary-and-japan-sign-close-nuclear-cooperation-agreement/>, 26 July 2023.

USA–BRAZIL

United States and Brazil Strengthen Bilateral Clean Energy Cooperation with a Renewed Commitment to Mobilize Private Sector and Community Engagement

U.S. Secretary of Energy Granholm and the Federative Republic of Brazil's Minister of Mines and Energy, Silveira, announced on July 21 their commitment on joint clean energy cooperation when they met on the margins of the 14th Clean Energy Ministerial and 8th Mission Innovation meetings in Goa, India. The leaders renewed their commitment to work together as global energy powerhouses with shared values and priorities through the U.S.-Brazil Energy Forum (USBEF)—the premier bilateral dialogue for technical, policy, trade, and investment cooperation focused on accelerating clean energy transitions.

Secretary Granholm and Minister Silveira emphasized that government-enabled, private sector-led approaches are essential to drive clean energy innovation, deployment, and investment. The two leaders agreed to work hand-in-hand with the private sector to implement new work in sustainable aviation fuels, clean hydrogen, and carbon and methane management through the Clean Energy Industry Dialogue (CEID). The ministers agreed to fully launch CEID public-private action committees to make progress across these three critical technologies by COP28. The CEID will also facilitate cooperation on grid modernization and storage as well as offshore wind power in its second phase. Secretary Granholm and Minister Silveira emphasized the

important leadership role that both nations play in accelerating clean energy transitions in the Western Hemisphere. They emphasized and agreed to integrate shared priorities of investing in local communities, protecting the environment, building a clean energy workforce, promoting energy access, and advancing diversity, equity, inclusion, and accessibility.

The ministers adopted the USBEF Action Plan 2023-2024, a roadmap that identifies four thematic areas for collaboration:

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1. Mobilizing Private Sector and Community Engagement: Convene the CEID this year, share approaches to incentivizing private sector investment, deepen community engagement and benefits especially for publicly funded energy projects;

2. Carbon and Methane Management: Exchange expertise in carbon capture, storage, and utilization, and methane mitigation;

3. Civil Nuclear Power: Continue and expand cooperation on civil nuclear power and launch new efforts on civil nuclear regulation and new nuclear power generation; and

4. Renewables and Grid Modernization: Increase the cooperation on renewable energy and energy efficiency, particularly in strategic sectors such as clean hydrogen, offshore wind, sustainable fuels, and grid modernization and storage.

The leaders agreed their senior officials and interagency policy experts would meet on quarterly basis to accelerate implementation, and announced Brazil would host the next USBEF ministerial in 2024 on the margins of the 15th Clean Energy Ministerial and 9th Mission Innovation meetings in Foz do Iguaçu, Brazil. Secretary Granholm welcomed Minister Silveira's participation in the Carbon Management Challenge – a global effort to scale up the deployment of carbon, capture, utilization, and storage and carbon dioxide-removal technologies

as a necessary complement to aggressive mitigation action.

Source: <https://www.energy.gov/articles/united-states-and-brazil-strengthen-bilateral-clean-energy-cooperation-renewed-commitment>, 21 July 2023.

USA–GHANA

USA and Ghana Reaffirm Nuclear Regulation Cooperation

The US NRC and Ghana's Nuclear Regulatory Authority (NRA) have reaffirmed their cooperation on nuclear safety and regulation, part of wider cooperation between the two countries as Ghana aims to create a nuclear power programme. NRC chairman Christopher Hanson and Nii Kwashie Allotey, DG of Ghana's NRA, discussed "their significant collaboration since the 2017 signing of an inaugural bilateral arrangement for cooperation and the exchange of technical information" as Ghana develops a regulatory programme and framework for its planned nuclear energy.

...During his visit to the country Hanson also met with the Ghana Atomic Energy Commission, the Ministry of Energy, and the Ministry of Environment, Science, Technology and Innovation. The NRC said a key message was the importance of regulatory independence for building public trust. ... Ghana has adopted the IAEA's Milestones Approach, a phased method to help countries that are considering or planning their first nuclear power plant.

In August 2022, President Akufo-Addo said the country had officially moved from the first of its three-phase programme - 'Considerations before a decision to launch a nuclear power programme is launched' - to Phase 2 - 'Preparatory work for the construction of a nuclear power plant after a policy decision has been taken'. The third and final stage of the policy is 'Activities to implement the

first nuclear power plant'. According to information from World Nuclear Association, Ghana's Minister of Environment, Science, Technology and Innovation in 2021 said five vendors - from the USA, Russia, Canada and South Korea - had responded to a request for interest in

helping the country build its first plant, with an expectation that a contract for a 1 GWe plant would be signed sometime in 2024-2025. Last year the USA, Japan and Ghana announced a strategic collaboration to support the deployment of small modular reactors in the West African nation.

Source: <https://www.world-nuclear-news.org/Articles/USA-and-Ghana-reaffirm-nuclear-regulation-cooperat>, 24 July 2023.

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URANIUM PRODUCTION

GENERAL

Global Uranium Mining Market 2023-2027

The latest report on the uranium mining market, titled "Global Uranium Mining Market 2023-2027," has been made available on ResearchAndMarkets.com. The market is expected to witness significant growth, with a projected increase of 3490.06 tons during the forecast period of 2022-2027, representing a Compound Annual Growth Rate (CAGR) of 1.39%.

Source: <https://finance.yahoo.com/news/global-uranium-mining-market-2023-110800006.html?...>, 26 July 2023.

NAMIBIA

Rosatom to Mine Uranium by 2029

... Rosatom has announced plans to start mining uranium in Namibia by 2029. The corporation — through its global mining company Uranium One — plans to complete the prospecting and

exploration phase of the project by 2026, dubbed the Wings project. Exploration started in 2010, with geological studies conducted between 2018 and 2021 confirming the presence of a large sandstone-type uranium deposit. With an initially-projected lifespan of 25 years, the project will proceed to its next stage of development following data collection, an environmental impact study and costs. At a total investment of \$500 million, planned output at the project is measured at 3,000 metric tons of uranium per year. Rosatom will utilize the In Situ Leaching (ISL) method – the primary method of uranium mining worldwide but a first in Africa – with the aim of ensuring effective and sustainable production.

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According to Wings Project Manager Kirill Egorov-Kirillov, “If exploration and prospecting results are positive and the use of ISL is justified, more than \$300 million may be invested in a uranium mill.” Following the start of production, the Wings project is expected to increase Namibia’s Gross Domestic Product by between 1% and 2%. Egorov-Kirillov added that “over \$50 million has been invested in the Namibian economy since the launch of the Project Wings...This will make a sizable contribution to the national budget and create 500 jobs for the locals. Even now, while exploration activities are still underway, our contractors hire local professionals. Last year, over 150 local residents worked for the project,”....

Source: <https://energycapitalpower.com/namibia-rosatom-to-mine-uranium-by-2029/>, 25 July 2023.

NUCLEAR PROLIFERATION

IRAN

Iran will Slow Uranium Program if Int’l Deal Revived: Nuclear Chief

Iranian VP and nuclear chief Mohammad Eslami said on July 21 that Tehran can slow its uranium

enrichment program depending on U.S. proposals to rebuild a stalled international deal, with the nation also keen to restart its nuclear safety cooperation with Japan. Under the 2015 pact struck with six major powers — Britain, China, France, Germany, Russia, and the US — Iran agreed to curb its nuclear activities in exchange for the lifting of sanctions. But former U.S. President Trump criticized the deal struck by his predecessor as flawed and pulled Washington out of it in 2018.

Iran countered the move by expanding the capacity and purity of its uranium enrichment beyond the limits set in the deal.

VP Eslami, who heads the Atomic Energy Organization of Iran, told...that the country is committed to the 2015

nuclear deal with world powers but does not want to implement it unilaterally. If the United States

and the other signatories abide by their commitments, Tehran will downgrade the nuclear enrichment purity, he said, without elaborating further.

VP Eslami also said there

are opportunities for mutual nuclear cooperation with Japan, stressing Tokyo can benefit from Iran’s mature and reliable nuclear industry.

Iran plans to construct six new power plants to produce nuclear electricity and if Japan has the willingness in this field, “we will definitely provide an opportunity for their presence in Iran’s nuclear industry”.... Japan formerly trained Iranian scientists in a program aimed at developing nuclear safety, but the program was stopped after the United States imposed sanctions on Iran for its nuclear development program. After the IAEA adopted a resolution against Iran’s expanded nuclear activity last November 2022, Tehran announced the increase of uranium enrichment purity to 60 percent.... Iran’s relationship with the U.N. nuclear watchdog is based on the so-called safeguards agreement and the NPT and Iran’s

nuclear activity is intensely monitored by the agency, VP Eslami said. Iran will not implement the nuclear deal unilaterally and will not accept “illogical and extremist” demands, he said.

Regarding past disputes with the IAEA over “alleged locations” where Iran conducts suspected secret activities related to nuclear development, VP Eslami said, “There is no undeclared or suspicious (nuclear) location in Iran. We will try to resolve all ambiguities of the IAEA.” The IAEA confirmed Iran has no illegal or undeclared nuclear activities at two such sites but needs to examine further. Eslami said Iran has informed the agency that it is ready to cooperate and review the findings together. The IAEA repeatedly asked Iran to improve its transparency during probes while Iran has consistently denied any ambition to develop nuclear weapons, insisting its activities are peaceful....

Source: <https://english.kyodonews.net/news/2023/07/ecbf14d1f5c7-iran-will-slow-uranium-program-if-intl-deal-revived-nuclear-chief.html>, 26 July 2023.

Blinken Says US is Not in Talks to Rejoin Iran Nuclear Deal, Blasts Trump’s Decision to Pull Out

U.S. Secretary of State Blinken on July 20 called former President Trump’s decision to pull out of the Iran nuclear deal a “terrible mistake,” while at the same time saying Biden administration officials are not currently in talks to revive it. “We are working across a whole series of lines of effort to push back on them, to make sure we have a strong deterrent, to make sure we have the appropriate pressure, and then to see if we get back to an opportunity where we can work on a nuclear deal.” ... “It was a terrible mistake to pull out of that agreement because we had Iran’s nuclear program in a box,” he added. “It’s now ... gotten out of that box.”

On the campaign trail in 2020, President Biden said he would rejoin the deal if Iran abides by the terms. When pressed on why that has not happened yet given now-President Biden’s pledge, Secretary Blinken pushed back, saying “that’s exactly what we sought to do...We worked, engaged intensely – and not just us, our European partners, the U.K., Germany, France, and actually China and Russia as well – to see if we could get back into mutual compliance with the JCPOA, with the nuclear deal.”...

The secretary added the Biden administration believes “diplomacy” is the best way to “resolve the problem.” Republicans have written to the Biden administration expressing concern over its efforts to revive the deal and warning officials not to finalize any agreement without first submitting it to Congress.

“An agreement was on the table,” Secretary Blinken added. “Iran either couldn’t or wouldn’t say yes.” He argued the U.S. offered Iran “modest modifications” to what was essentially the existing deal from 2015, saying the U.S. was not going to “take any deal...It has to meet our security

objectives, it has to meet our interests”...adding U.S. officials are making it clear to their counterparts in Iran that they need to take steps to de-escalate tensions in the relationship between the two countries. The secretary added the Biden administration believes “diplomacy” is the best way to “resolve the problem.” Republicans have written to the Biden administration expressing concern over its efforts to revive the deal and warning officials not to finalize any agreement without first submitting it to Congress. “It is imperative that the American people, through Congress, have the opportunity to review any agreement, especially if it would hand tens of billions of dollars to the world’s largest state sponsor of terrorism, and lift sanctions on terrorists with blood on their hands,” then-House Minority Leader McCarthy, R-Calif., and Rep. Michael McCaul, R-Texas, wrote in a letter to Blinken in March of 2022. ...

Source: Maddie Gannon, <https://www.ny1.com/nyc/all-boroughs/news/2023/07/24/blinken-says-u-s—is-not-in-talks-to-rejoin-iran-nuclear-deal->, 24 July 2023.

NUCLEAR NON-PROLIFERATION

SRI LANKA

Sri Lanka Ratifies Comprehensive Nuclear-Test-Ban Treaty

Sri Lanka's Permanent Representative to the UN, Mohan Peiris, deposited the instrument of ratification by Sri Lanka of the CTBT at a ceremony held at the Treaty Section of the United Nations. The ratification comes after approval by the Cabinet of Ministers and completion of the domestic ratification process by Sri Lanka. The Geological Survey and Mines Bureau is the focal point in Sri Lanka for data transmission with the International Data Centre of the CTBT Organization. ...Sri Lanka also operates an auxiliary seismic station AS100 in Pallekelle as part of this network. The ultimate objective is to ban nuclear weapon test explosions and any other nuclear explosions in any environment (air, land, sea) in an effectively verifiable manner.

Sri Lanka supported the draft treaty by participating in the negotiations of the CTBT in the conference on Disarmament in Geneva and signed the Treaty on 24 October 1996. Ratification further reaffirms Sri Lanka's contribution to global non-proliferation and nuclear disarmament objectives. As the 178th ratifying party to the CTBT, Sri Lanka's ratification contributes to confirming the status of the CTBT as a norm-setting instrument against the use of nuclear weapons. Ratification also allows Sri Lanka's line agencies to engage in the decision-making discussions and consultations. It also presents further opportunities to access technical benefits and expertise in many areas related to potential civil and scientific applications; including in earthquake and Tsunami warnings, volcanic eruption and monitoring movement of hazardous volcanic ash which can impede aviation, use of IMS data for climate change studies, aircraft crash investigations and others. ...

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Source: <https://www.newsfirst.lk/2023/07/27/sri-lanka-ratifies-comprehensive-nuclear-test-ban-treaty/>, 27 July 2023.

NUCLEAR DISARMAMENT

GENERAL

Revamped Disarmament Yearbook Highlights Progress, Challenges in Turbulent 2022

The United Nations Disarmament Yearbook, a comprehensive reference guide on global disarmament, non-proliferation and arms-control efforts, is now available in a new, graphically enhanced preview edition. Developed to share key findings from the Yearbook in a concise and accessible format, the updated publication provides a succinct exploration of disarmament-related developments and trends from 2022, highlighting achievements and challenges amid the ongoing war in Ukraine and other threats to international peace and security. ...

... "In 2022, we witnessed both setbacks and rays of hope in the field of disarmament." ...On the one hand, we saw record levels of military spending and division within important arms-control frameworks, including the NPT. On the other hand, we also saw the first-ever Meeting of States Parties to the Treaty on the Prohibition of Nuclear Weapons, as well as the adoption of the new Political Declaration on Strengthening the Protection of Civilians from the Humanitarian Consequences Arising from the Use of Explosive Weapons in Populated Areas."

The disarmament resolutions, decisions and voting patterns of the General Assembly — previously featured in "Part I" of the Disarmament Yearbook — are now available through the revamped Disarmament Resolutions and Decisions Database. Likewise, the latest details on current disarmament treaties and agreements can be found in the redesigned Disarmament Treaties Database. Prepared annually at the request of the

General Assembly since 1977, the United Nations Disarmament Yearbook provides a comprehensive overview of multilateral disarmament activities undertaken by Member States, United Nations entities and civil-society organizations. It covers developments in nuclear disarmament, non-proliferation and arms control; chemical and biological weapons; conventional weapons; regional disarmament; confidence-building measures; disarmament education; disarmament machinery; and other relevant topics.

Source: <https://press.un.org/en/2023/dc3860.doc.htm>, 24 July 2023.

NUCLEAR SAFETY

JAPAN

Japan Considers Financial Aid for Utilities to Upgrade Existing Nuclear Power Plants

Japan is considering a financial scheme to help utilities boost safety measures at existing nuclear power plants to promote the restart of reactors that have been idled since the 2011 Fukushima disaster. Power utilities, facing higher energy costs and expenses related to implementing safety measures and stricter emissions goals are reluctant to invest in nuclear facilities as there has been a lack of predictability on their returns on investment. Japan is already set to introduce a new auction programme in January 2024 as a measure to encourage the construction of new decarbonised power plants such as renewable and nuclear energy. But the industry ministry proposed

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on July 23 to alter the scheme so that existing nuclear power plants can take part in the auction to receive financial support for necessary upgrades.

The revised scheme is aimed at encouraging utilities to invest in existing nuclear power stations to comply with stricter safety standard imposed after the 2011 disaster, an official at the Ministry of Economy, Trade and Industry (METI)

said. "The proposal is to help Japan make maximum use of existing nuclear energy," the official said, adding it will improve predictability on the utilities' returns on investment. The proposal was made at an expert committee's meeting on July 23 to discuss the country's nuclear energy policy.

Japan made a major nuclear power policy shift in 2022 to tackle an energy crisis more than a decade after the 2011 Fukushima disaster prompted it to idle most of its reactors. The government has restarted only about a third of its 33 operable

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reactors. Japanese companies had 54 reactors operating before the Fukushima disaster. The programme, called "long-term decarbonised power supply auction," guarantees income for 20 years for electricity generation companies building new decarbonised power stations, using

funds collected from electricity retailers. Another panel of energy experts will discuss METI's proposal in coming months, with no deadline being set, the METI official said, adding that no decision will likely be made in time for the first auction. The programme also covers the construction of thermal power plants that reduce CO2 emissions to zero with new technologies by 2050....

Source: <https://www.reuters.com/sustainability/sustainable-finance-reporting/japan-considers-financial-aid-utilities-upgrade-existing-nuclear-power-plants-2023-07-26/>, 26 July 2023.

SOUTH AFRICA

Safety of Koeberg Nuclear Plant 'Questionable'

The Western Cape government has reassured residents around the Koeberg nuclear power station that the plant does not pose a safety threat. It will reach the end of its lifespan in July 2024, but Eskom wants to extend that by 20 years. The plant is seen as key to solving South Africa's energy crisis, but residents and civil society organisations have been calling for its closure, citing safety concerns.

The premier's energy advisor Alwie Lester said there's no nuclear threat posed by the ongoing refurbishments at Koeberg. "I think the safety component of the station is not questionable. I think right now, the biggest risk is that we don't get the energy back into the system, as soon as possible, and that then has a ripple effect in terms of load shedding. "I don't think there's a risk that there will be any fallout, or that there's risk to the immediate community – not at all," he explained.

Source: <https://ewn.co.za/2023/07/27/safety-of-koeberg-nuclear-plant-unquestionable-says-energy-advisor>, 27 July 2023.

NUCLEAR SECURITY

PAKISTAN

Pakistan's Overall Ranking Improves in Nuclear Security Index 2023

In the latest Nuclear Security Index 2023, Pakistan has achieved an upgrade in its status, indicating consistent progress in securing nuclear materials and facilities. The report, compiled by the US-based NTI, measures countries' nuclear security capabilities and efforts based on a set of indicators. It evaluates factors such as the security of weapons, materials, and facilities,

adherence to international norms and treaties, the nuclear security regulatory framework, and the adoption of best practices to prevent unauthorized access to nuclear weapons or materials.

Pakistan ranked 19 on the list of 22 states in the 'Secure Materials' category, gaining three points since the last assessment. The country saw significant progress, ranking above Iran, and North Korea. In the overall

score for the security of materials, Australia secured the top spot followed by Switzerland and Canada. In the category of protection of nuclear facilities, such as nuclear power reactors and research reactors, Pakistan ranked 32 out of 47 countries with four additional points this year. In terms of the security of its nuclear facilities, Pakistan tied with Russia and Israel and ranked above Chile, Iran, Mexico, South Africa, Egypt and several other countries on a list of 47 nations. ...

Source: <https://gulfnnews.com/world/asia/pakistan/pakistans-overall-ranking-improves-in-nuclear-security-index-2023-1.97131708>, 23 July 2023.

UKRAINE

UN Inspectors Find Mines at Russian-Occupied Nuclear Plant in Ukraine

UN atomic watchdog inspectors have found landmines at the site of Ukraine's Zaporizhzhia nuclear power plant, occupied by Russian forces since the early days of the war after their full-scale invasion in 2022. The IAEA said the mines were planted in a buffer zone between the internal and external perimeter barriers, at what is the biggest nuclear facility in Europe. "Having such explosives on the site is inconsistent with the IAEA safety standards and nuclear security guidance and creates additional psychological pressure on plant staff," Rafael Grossi, the IAEA's director-general, said on July 21 night. But he added the "detonation of these mines should not affect the site's nuclear safety and security systems".

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Since 2022 Ukraine has accused Russia of militarising the plant by basing troops there and storing weaponry at the site. It is located in Energodar, a city in the southern regions of Ukraine, which Russia's forces occupy along with the country's far east. Director Grossi said the IAEA had been aware of the previous placement of mines "outside the site perimeter and also at particular places inside". He added the nuclear body's permanent inspectors on the site "have been told that it is a military decision, and in an area controlled by military".

The IAEA said its experts had carried out inspections and regular "walk-downs" across the nuclear plant "without seeing any heavy military equipment". But they said they were "continuing to request access to the roofs of the [plant's] reactors and their turbine halls, including units three and four which are of particular interest". Western officials, military analysts and scientists have long warned about the possibility of a nuclear accident at Zaporizhzhia. Safety concerns increased since June 2023 after the nearby Kakhovka dam along the Dnipro river was blown up, flooding swaths of land and threatening to deprive the nuclear plant of water needed to cool nuclear fuel on site, even though electricity generation was halted last year.

"The IAEA experts are continuing to closely monitor the situation regarding the availability of water for cooling the ZNPP's six reactors and other essential nuclear safety and security functions...Available water supply remains relatively stable...the site continues to have sufficient water for some months".... Linger concerns about the nuclear power plant come a week into a Russian air strike campaign that has targeted Ukraine's Black Sea ports in an attempt to choke Ukrainian grain exports....

Source: <https://www.ft.com/content/23ff34e9-18e0-4f3a-98a2-efeaf7bee9d4>, 25 July 2023.

NUCLEAR WASTE MANAGEMENT

USA

World's Largest Radioactive Waste Melter Heats to 2,100 Degrees in E. WA

The world's largest radioactive waste melter has heated up to 2,100 degrees Fahrenheit, its planned operating temperature, on a second try. The first melter to be used to glassify waste at the vitrification plant at the Hanford nuclear reservation site in Eastern Washington is expected to be kept at that temperature for several days. Then ground glass

will be added as the next step of testing the melter. ... The melter is expected to remain on continuously now for its planned lifespan of five years.

Construction on the vitrification plant started 21 years ago and the plant is expected to start treating some of the least radioactive waste held in underground tanks at Hanford by late 2024 or 2025, turning it into a stable glass form for disposal. Hanford's underground tanks hold 56 million gallons of radioactive and hazardous chemical waste from the production of

nearly two-thirds of the plutonium for the nation's nuclear weapons program during World War II and the Cold War.

Bechtel National, the contractor building and commissioning the vitrification plant for the Department of Energy, attempted to heat up the vitrification plant's first 300-ton melter on Oct. 8, 2022. But heating was halted just after midnight the morning of Oct. 10 with temperatures only close to 300 degrees after a problem was discovered with the power supply to the melter's

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startup heaters. Temperatures were rising in the power supply cabinets, and pictures taken after the heat up was halted showed blackened inductors in one of the three cabinets. Troubleshooting to thoroughly understand the cause of the problem, a detailed check of all melter heater equipment and then some redesign was done. Some new equipment was purchased, tested and installed. The second attempt at heating up the melter began June 25, 2023 with 2,100 degrees reached Thursday afternoon (July 20).

... After adding frit, or ground glass, to the melter, a second set of heaters, replacing the temporary startup heaters, will be turned on. Those joule heaters will pass an electrical current through the pool of melted glass. Then bubblers will be installed that blow air into the bottom of the melter glass pool to mix the glass and prevent hot spots from forming. The melter is about 20 feet by 30 feet and 15 feet high. It is nearly five times larger than the 65-ton melter operating at DOE's Savannah River Site's Defense Waste Processing Facility in South Carolina. The heatup test will help prepare for the next step of commissioning — testing the melter using a nonradioactive material to simulate waste.

Commissioning of the first melter for the vit plant's low activity waste is planned to be completed before the second of two melters is heated up at the vitrification plant's Low Activity Waste Facility. Additional melters will be used at the High-Level Waste Facility, where construction is not yet completed. A federal court judge has given DOE a deadline to start vitrification of high-level radioactive waste by 2033.

Source: https://www.wenatcheeworld.com/news/major-step-worlds-largest-radioactive-waste-melter-heats-to-2-100-degrees-in-e-wa/article_95903550-2b34-11ee-b221-5b5deddf01bd.html, 24 July 2023.

"The Octopus" Molecules – A New Potential Solution to Nuclear Waste

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Now, a team of University of Houston researchers has come up with an innovative solution for nuclear waste management: molecular crystals based on cyclotetrazol benzil hydrazones. These crystals, which are based on a groundbreaking discovery made by the team in 2015, are capable of capturing iodine — one of the most common radioactive fission products — in aqueous and organic solutions, and on the interface between the two.

As global awareness regarding the environmental and geopolitical impacts of fossil fuel consumption intensifies, nuclear energy has re-emerged as a topic of significant attention. Its capacity to produce large-scale electricity without the associated greenhouse gas emissions presents a promising prospect for a clean, sustainable energy source. This could pave the way for society's transition from fossil fuels to a future of net-zero emissions. Nonetheless, the production of nuclear power does lead to the creation of radioactive waste. Ensuring the safe handling and disposal of this nuclear waste is a key issue that needs resolution for the public to fully trust and embrace this potential game-changing energy solution.

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management: molecular crystals based on cyclotetrazol benzil hydrazones. These crystals, which are based on a groundbreaking discovery made by the team in 2015, are capable of capturing iodine — one of the most common radioactive fission products — in aqueous and organic solutions, and on the interface between the two. "This last point is particularly salient because iodine capture on interfaces could prevent the iodine from reaching and damaging the specialized paint coatings used in nuclear reactors and waste containment vessels," said

Ognjen Miljanic, professor of chemistry and corresponding author of the paper detailing the breakthrough in Cell Reports Physical Science.

These crystals exhibit an astonishing iodine uptake capacity, rivaling that of porous metal-

organic frameworks (MOFs) and covalent organic frameworks (COFs), which were previously deemed the pinnacle of iodine capture materials. Alexandra Robles, the first author of the study and a former doctoral student who based her dissertation on this research, was working with the crystals in Miljanic's lab when she made the discovery. Her interest in finding a solution for nuclear waste led Robles to investigate using crystals to capture iodine. ...

Not only does this process preserve the integrity of reactor coatings and enhance containment, but the captured iodine could also then be moved from one area to another. ... Of course, all of these great potentials still need to be tested in practical applications, which has Miljanic thinking of the next steps.

Molecules, Crystals, and Octopi, Oh My!: Miljanic's team creates these tiny organic

molecules containing only carbon, hydrogen, and oxygen atoms using commercially available chemicals. Each crystal is a ring-shaped structure with eight linear pieces emanating from it, which has led the research team to nickname it "The

Octopus." "They are quite easy to make and can be produced at a large scale from relatively inexpensive materials without any special protective atmosphere," said Miljanic.

These hungry little crystals are very versatile and can capture more than iodine. Miljanic and his team have

used some of them to capture carbon dioxide, which would be another great step toward a cleaner, more sustainable world. ... He is excited by the multitude of potential offered by the crystals and looking forward to exploring practical applications. His next goal is to find a partner who will help the scientists explore different commercial aspects. Until then, the researchers are planning to further explore the kinetics and behaviors of the crystal structures to make them even better.

Source: https://scitechdaily.com/the-octopus-molecules-a-new-potential-solution-to-nuclear-waste/#google_vignette, 27 July 2023.

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Centre for Air Power Studies

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Centre for Air Power Studies

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