



**OPINION – Air Marshal Rajesh Kumar**

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**How India Operationalised its Nuclear Deterrent after Pokhran Tests**

On May 18, 1974, India conducted a Peaceful Nuclear Explosion at Pokhran. Almost a quarter century later, it conducted five nuclear tests of advanced weapon designs, once again at the Pokhran range, catapulting the country into the nuclear club with the ability to weaponise and maintain a nuclear arsenal.

The process of weaponisation and operationalisation was not smooth. Because of the need to maintain secrecy and also because of the long gap between the first and the second tests, the military was kept out of the loop for a long time. Even before the 1998 tests, General K. Sundarji (retd), former Army chief, had written that the “really big secret is that India has no coherent nuclear weapon policy and worse still, she does not have an institutionalised system for analysing and throwing up policy options in this regard”.

Despite the obvious disadvantage in keeping the programme outside the military, India had to move fast to operationalise its nuclear deterrent as pressure was building up from various quarters. Post the tests, India faced sanctions and there was pressure to roll back the nuclear programme and sign the CTBT. The UN Security Council adopted Resolution 1172

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condemning the tests. India stood firm and released its Draft Nuclear Doctrine (DND) in August 1999, showcasing itself as a responsible nuclear power.

The expanding Chinese arsenal combined with the development and deployment of Beijing’s ballistic missile defence may force India to adjust the number of its warheads to retain an assured second strike capability. The objective of putting the nuclear doctrine in the public domain was four fold. It signalled India’s resolve to retain its nuclear weapons programme despite international condemnation of its tests.

Second, it projected India as a 'responsible' nuclear state that had voluntarily placed its nuclear cards on the table. Third, as a political declaration of intent directed at potential adversaries, it established India's overall deterrence posture. Finally, it demonstrated to the public that the government is committed to safeguarding national security and is able to provide guidance to officials who would be expected to act in the event of a crisis. The draft doctrine was followed by a press note on the operationalisation of the nuclear doctrine issued on January 4, 2003, the same day India's Strategic Forces Command (SFC) was created.

India's nuclear doctrine rests on three major pillars—credible minimum deterrent, no first use and massive retaliation in case of attack by nuclear weapons. In order to have a credible nuclear deterrent, a force structure that can ensure a second strike capability needed to be developed. The task was not easy, but was taken up in earnest. The current force structure has evolved from the guidance in the draft doctrine which states that "India's nuclear forces will be effective, enduring, diverse, flexible and responsive to the requirements in accordance with the concept of minimum credible deterrence. These forces will be based on a triad of aircraft, mobile land-based missiles and sea-based assets in keeping with the objectives outlined above. Survivability of the forces will be enhanced by a combination of multiple redundant systems, mobility, dispersion and deception."

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control structure was created along with the physical handing over of necessary assets. The first arm to operationalise was the air arm followed quickly by the land-based missile forces that began with the Prithvi II missiles followed by the Agni series. The sea-based deterrent was created with Dhanush missiles on surface platforms that were supplemented with the underwater arm led by INS Arihant.

While operationalising its nuclear delivery vehicles and warheads, India has had to contend with an aggressive Pakistani nuclear doctrine. Pakistan claims that its nuclear weapons are solely aimed at India and has vigorously expanded its warhead count vis-à-vis India and has developed tactical nuclear weapons. It claims to have "full spectrum deterrence" and has ruled out 'no-first-use' policy.

There is also the expansion of China's nuclear arsenal, as Beijing is locked in a nuclear arms race with the US. These factors are putting pressure on India's desire to have an arsenal it describes as a minimum credible deterrent. While India has so far resisted the temptation to match Pakistan warhead for

warhead, the expanding Chinese arsenal combined with the development and deployment of China's ballistic missile defence may force India to adjust the number of its warheads to retain an assured second strike capability.

The new technical developments in the last couple of years that have led to the canisterised Agni P and Agni V missiles are a step in the right direction. These missiles are more amenable to enhanced mobility and faster response times and are

inherently more survivable. The launching of INS Arihant also strengthens the sea-based deterrent. India needs to quickly operationalise a longer-range SLBM with MIRV as well as develop an ALBM to further bolster its nuclear arsenal.

**Nuclear deterrence is not a myth. It kept the world safe during the Cold War. Deterrence is a psychological concept. You have to convince a nuclear-armed adversary that it will not achieve its objectives by attacking you, and that if it goes to war its own annihilation is assured.**

Following the Pokhran tests, India has operationalised a credible deterrent that the nation should be justifiably proud of. As newer threats and technologies abound among our adversaries, the ability to keep our nuclear deterrent relevant is well within the reach of our homegrown solutions.

*Source: <https://www.theweek.in/theweek/specials/2024/05/31/how-india-operationalised-its-nuclear-deterrent-after-pokhran-tests.html#:~:text=The%20first%20arm%20to%20operationalise,arm%20led%20by%20INS%20Arihant,09%20June%202024>*

#### **OPINION – Dmitri Trenin**

#### **Here's How Russia can Prevent WW3**

Nuclear deterrence is not a myth. It kept the world safe during the Cold War. Deterrence is a psychological concept. You have to convince a nuclear-armed adversary that it will not achieve its objectives by attacking you, and that if it goes to war its own annihilation is assured. The mutual nuclear deterrence between the USSR and the US during their confrontation was reinforced by the reality of mutually assured destruction in the event of a massive exchange of nuclear strikes. Incidentally, the abbreviation for Mutually Assured Destruction is MAD. And that's very apt.

There are several reasons for 'mythologising' nuclear deterrence. Since the end of the Cold War,

**The American belief in its own exceptionalism and European 'strategic parasitism', devoid of any sense of self-preservation, is a dangerous combination. It's in such an environment that the idea of inflicting a strategic defeat on the nuclear power the is Russia – in a proxy conventional war in Ukraine –has been born. Russia's atomic capabilities are being ignored.**

there has been a widespread belief that every conceivable reason for nuclear war has disappeared. A new era of globalisation, with its emphasis on economic cooperation, has dawned. For the first time in history, the hegemony of a single

power, the US, has been established globally. Nuclear weapons remain in the arsenals of the great powers - though fewer than at the height of the confrontation - but the fear of their use has faded. More dangerously, a new generation of politicians has come to the fore, unburdened either by the memory of decades of confrontation or by a sense of responsibility. The American belief in its own exceptionalism and European 'strategic parasitism', devoid of any sense of self-preservation, is a dangerous combination. It's in such an environment that the idea of inflicting a strategic defeat on the nuclear power the is Russia – in a proxy conventional war in Ukraine –has been born. Russia's atomic capabilities are being ignored. The parallels that Moscow tried to draw with the Cuban missile crisis of 1962, when Washington considered the possibility of a nuclear war with the USSR in response to the deployment of Soviet missiles in the neighbourhood of the US, were rejected by the Americans as far-fetched.

In response, Moscow was forced to activate the deterrence factor. Under an agreement with Minsk, Russian nuclear weapons have been deployed in Belarus. Russian non-strategic nuclear forces have recently begun exercises. Nevertheless, Western countries continue to pursue escalation in the Ukrainian

conflict, which, if left unchecked, could lead to a frontal military conflict between NATO and Russia and a nuclear war. This scenario can be prevented by further strengthening deterrence - more precisely, by 'nuclear sobering up' our adversaries.

They must realise that it is impossible to win a conventional war involving the vital interests of a power armed with the bomb, and that any attempt to do so will lead to their own destruction. This is classic nuclear deterrence.

The word 'deterrence' itself has a defensive connotation, but theoretically, the strategy can also be used in an 'offensive' sense. This can happen when one party succeeds in dealing the first disarming blow to the enemy, and with its remaining forces threatens the weakened opponent with total destruction if they strike back. More appropriate here is the Anglo-American version of deterrence, which literally means 'to intimidate'. The French, by the way, use the term 'dissuasion' in their concept.

**The Impact of Non-Nuclear Weapons on Nuclear Deterrence Policy:** Non-nuclear weapons certainly influence nuclear deterrence policy. This is a fact. The US has built up a huge arsenal of non-nuclear methods to achieve its goals. Not only has it not dismantled its military alliances, it has expanded them and created new networks. In the current environment, Washington is demanding more and more real commitments from those allies - in the name of preserving the US-led global system. Fifty states take part in meetings to organise military aid to Kiev under the 'Ramstein' format. The result is the idea that it is possible to defeat a nuclear power, but on condition that it does not require resorting to nuclear weapons.

The only thing left to do is to convince a nuclear power not to use nuclear weapons under any circumstances and to allow itself to be defeated - in the name of saving the whole of humanity, and so on. This is an extremely dangerous illusion that can and must be dispelled by an active nuclear deterrence strategy, including the lowering of the threshold for the use of nuclear weapons, which is currently too high. The key

condition for use should not be a 'threat to the existence of the state' but a 'threat to the vital interests of the country'!

**A New Phase in Relations between Nuclear Powers has Begun:** We can say that a new phase

in relations between the world's nuclear powers has begun. Many of us are still psychologically somewhere in the 1970s and 1980s. That is a kind of comfort zone. Back then, relations between the USSR and the US were based on the two superpowers' strategic and political parity. In the military-strategic sphere, Washington was forced to deal with Moscow on an equal footing. After 1991, this parity disappeared. For the US, since the 1990s, Russia has been a declining power; throwing its weight around, always reminding itself of its former greatness, snapping back, even dangerous at times – but on a downward spiral. The difficult opening phase of the Ukraine conflict gave the Americans hope that the fields of that country would be the grave of the Russian superpower. They have since sobered up a bit, but

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equal status between Moscow and Washington is out of the question for them. This is the main difference between the current state of relations and the 'golden' period of the Cold War - the 1960s and early 1980s. And Russia has yet to prove the

Americans wrong.

As they say, it is always difficult to predict anything, especially the future. But today we have to assume that a long period of confrontation with the West, led by the US, lies ahead of us for about a generation. The future of our country, its position and role in the world, and to a large extent the state of the global system as a whole, will depend on the outcome of this confrontation, the main front of which is not in Ukraine, but within Russia: in the economy, in the social sphere, in science and technology, in culture and art. Internally, because the enemy realises the impossibility of

defeating Moscow on the battlefield, but remembers that the Russian state has collapsed more than once as a result of internal turmoil. This may, as in 1917, be the result of an unsuccessful war. Hence the bet on a protracted conflict in which they know they have more resources.

***Nuclear Polycentricity Reflects the World's Growing Multipolarity:***

During the Cold War there were five nuclear powers, but then the only real poles were the US and the USSR, plus China with its then small nuclear arsenal. Now Beijing is moving towards (at least) parity with America and Russia, while India, Pakistan, North Korea and Israel remain independent players (unlike NATO members Britain and France). The classic Cold War notion of strategic stability – i.e. the absence of incentives for the parties to launch a pre-emptive nuclear strike – is not only inadequate but sometimes inapplicable when characterising relations between the great powers today.

***Look at Ukraine:***

Washington is increasing arms supplies to Kiev, encouraging and providing for its provocative attacks on Russia's strategic infrastructure (early warning stations, strategic airfields), while at the same time proposing Moscow resumes dialogue on strategic stability! In the emerging world order, strategic stability will have to mean the absence of reasons for military conflict (even indirect) between the nuclear powers. This, in turn, will be possible if the powers respect each other's interests and are ready to solve problems on the basis of equality and the inpossibility of security. Ensuring strategic stability between all nine powers will require enormous efforts and the formation of a fundamentally new world order model, but it (strategic stability in the broad, i.e.

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**Negotiations on nuclear disarmament are possible and they can even produce results: a treaty banning nuclear weapons was adopted in 2017. But there is one thing to bear in mind. There is not a single nuclear power among the signatories. Moreover, the US, UK, France and Russia have already declared that they will never sign the treaty because it does not correspond with their national interests.**

real sense of the word) is quite realistic between pairs of states (Russia-China, the US-India, etc.). For Russia, only three of the other eight nuclear powers – the US, Britain and France – remain problematic.

***Arms Control is Dead and will not be Revived!*** As far as arms control in the classical form of the Soviet/Russian-American agreements or multilateral

agreements in Europe (CFE Treaty) is concerned, it is dead and will not be revived. The Americans started to roll back the system two decades ago. First they withdrew from the ABM Treaty, then from the INF Treaty and the Open Skies Treaty. They refused to implement the adapted Treaty on Armed Forces and Armaments in Europe. In the area of strategic nuclear weapons, one treaty remains, START-3, but it expires in 2026, and Moscow has stopped inspections under this treaty in the midst of the conflict in Ukraine. In the future, we will need not only new treaties, but also a new basis for negotiations and agreements. It will be necessary to co-develop new concepts, set new goals and objectives, and

agree on the forms and methods of their implementation. Greater Eurasia' - conventionally known as the SCO - could become a platform for creating a new model of international security on the scale of a huge continent (or at least most of it). The SCO includes four nuclear powers: Russia, China, India and Pakistan. Another SCO member, Iran, has an advanced nuclear programme. SCO members Russia and China have close security ties with North Korea. There is a huge space for work, new ideas and original solutions.

***No Continuation of Nuclear Arms Reduction Talks between Russia and the US in Sight:*** Negotiations on nuclear disarmament are possible and they can

even produce results: a treaty banning nuclear weapons was adopted in 2017. But there is one thing to bear in mind. There is not a single nuclear power among the signatories. Moreover, the US, UK, France and Russia have already declared that they will never sign the treaty because it does not correspond with their national interests. As for the issue of nuclear arms reduction, the long-standing confrontation between Moscow and Washington rules out any continuation of this practice. China, for its part, intends to build up its nuclear arsenal rather than reduce it, probably with a view to achieving parity with the US and Russia in the long term. The Americans, who have officially identified Russia and China as the main threats to their security, are considering how to balance the combined nuclear potential of Moscow and Beijing. So there is no hope here.

The main problem, however, is not the quantity of nuclear weapons or even their presence per se, but the quality of relations between states. The world order is experiencing an acute systemic crisis. In the past, such crises inevitably led to wars. Now nuclear deterrence is working, albeit with some issues. To prevent a world war, it is necessary to strengthen deterrence by activating the nuclear factor in foreign policy, restoring fear and building a ladder of escalation. However, we don't want to go all the way to the abyss and then fall into it, but instead prevent a catastrophic development of events. Nuclear weapons have already saved the world once – by threatening to destroy it. That mission continues.

Source: <https://russiancouncil.ru/en/analytics-and-comments/comments/here-s-how-russia-can-prevent-ww3/>, 11 June 2024.

**OPINION – P.K. Balachandran**

### **Sri Lanka is Now Well on the Way to Harnessing Nuclear Energy**

The Sri Lanka Atomic Energy Board (SLAEB) Chairman Prof. Remy Denzil Rosa has said that Sri Lanka has identified nuclear energy as a clean

and green energy source to fulfil future electricity demand. In March 2024, the Sri Lankan Cabinet committed the country to a nuclear power programme. The IAEA says that Sri Lanka is pursuing nuclear power to increase its low carbon power production, tackle climate change and increase energy security.

**Safety Main Criterion:** A team from the IAEA did a review of potential sites for a NPP from the safety perspective, from May 30 to June 5. The Site and External Events Design Review Service (SEED) mission of the IAEA reviewed Sri Lanka's adherence to IAEA guidelines on site selection, including exclusion and screening criteria. The SEED mission was carried out at the request of the Government and hosted by the SLAEB under the

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purview of the Ministry of Power and Energy. The team comprised three experts from Canada, Pakistan and Turkiye, and an IAEA staff member. The survey also involved scientists from the Geological Survey and Mines Bureau (GSMB), Central Environmental Authority (CEA) and the Department of Geology of the University of Peradeniya. According to the IAEA, Sri Lanka has identified six "candidate sites" from three regions, including Pulmoddai in the Eastern Province which is known for its mineral sands. In the next phase, which is ongoing, IAEA will evaluate, compare and rank the "candidate" sites. The final SEED mission report will be delivered to the Government within three months.

**Need for Nuclear Power:** In 2022, President Wickremesinghe exhorted Sri Lankans to "seriously think about nuclear power" to overcome power shortages. SLAEB Chairman Prof. Rosa had said that Russia, US, Denmark and China had offered help to set up a SMR that would cost about USD 2 billion. India too had offered such help. In 2015, PM Modi and the then Sri Lankan President Maithripala Sirisena jointly resolved to "facilitate cooperation in the transfer and exchange of knowledge and expertise, sharing of resources, capacity building and training of personnel in peaceful uses of nuclear energy." The

two leaders also resolved to facilitate enhanced cooperation in the areas of radioactive waste management, disaster mitigation, and environmental protection. It was reported that, in the long-term, India might be able to sell small-scale nuclear reactors to Sri Lanka which plans to produce 6,000 MW nuclear power by 2031. The SMR, which produces around 100 Mw is believed to be “inherently safe” and with “minimal risk,” SLAEB Chairman, Prof. Rosa, was quoted as saying. He expected the Sri Lankan plant to be offshore barge-based. He also said that Russia had agreed to take back the nuclear waste, which, he added, was the reason for considering the proposal.

**Advantages:** Justifying the decision to go nuclear, Prof. Rosa said that solar and wind are good but are “intermittent, unstable, and seasonal.” If Sri Lanka is to give up coal by 2030, as planned, it has to go nuclear, he reasoned. Other justifications cited were a lower running cost, the necessity to refuel only every two or three years, and the ability to supply electricity to consumers at a lower price. According to a report from the U.S. Office of Nuclear Energy, NPPs require less maintenance and are designed to operate for longer stretches before refuelling (typically every 1.5 or 2 years).

**Safety Concerns:** The safety of nuclear power generation and its economic advantages were discussed in detail in a 2018 paper by Mahesh N. Jayakody and Jeysingam Jeyasugiththan of Colombo University and Prasad Mahakumara of the Government of Sri Lanka. Their study noted that while the installation cost of nuclear plants would be high, nuclear plants are marked by low maintenance costs and a minimum adverse environmental impact. On safety, which is a major

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**According to Physics World, nuclear power is ‘hundreds of times’ safer than coal, gas and oil. On the danger from nuclear waste, the website [www.world-nuclear.org](http://www.world-nuclear.org) says: “The amount of waste generated by nuclear power is very small relative to other thermal electricity generation technologies; nuclear waste is neither particularly hazardous nor hard to manage relative to other toxic industrial waste.**

concern in Sri Lanka, the authors maintained that the evolution of NPP technologies had made reactors very safe and protected from human error. And in the long run, nuclear energy would work out to be cheaper, the authors said, and recommended the Russian VVER-1000 and the

American AP-1000 models based on PWR. According to Physics World, nuclear power is ‘hundreds of times’ safer than coal, gas and oil. On the danger from nuclear waste, the website [www.world-nuclear.org](http://www.world-nuclear.org) says: “The amount of waste generated by nuclear power is very small relative to other thermal electricity generation technologies; nuclear waste is neither particularly hazardous nor hard to manage relative to other toxic industrial waste.” A US Office of Nuclear Energy (USONE) report of 2021 said nuclear plants have the highest ‘capacity factor’ (maximum capacity) compared to any other energy source.

**Russia’s Pre-eminence:** Russia dominates the world market in nuclear material. Kristyna Foltynova of Radio Free Europe says that European nations are unable to stop the import of Russian nuclear material even amid the war in Ukraine. “The same goes for uranium enrichment, the next step in the nuclear cycle. According to 2018 data, Russia once again was responsible for the largest share about 46%,” the Radio Free Europe researcher said.

Russia is considered the world leader in the export of nuclear plants. According to Foltynova, between 2012 and 2021, the Russian nuclear company, Rosatom, initiated the construction of 19 nuclear reactors. Fifteen of these were abroad. The Russian TVEL Fuel Company is presently the only authorised supplier of fuel needed for VVER-440s, Foltynova points out. Russia is also able to supply High-Assay Low-Enriched Uranium (HALEU), which

is a type of fuel that will be needed for more advanced reactors that are now under development by many companies in the US. According to Bloomberg, Russia's nuclear fuel and technology sales abroad rose more than 20% in 2022, quoting data compiled by the UK's Royal United Services Institute.

**Russian Package Deal:**

One of the reasons many countries want to cooperate with Russia (even defying US sanctions) is that it offers a 'package solution'. "Russia will not only build a nuclear plant and supply fuel, but it also trains local specialists, helps with safety questions, runs scholarship programmes and disposes of radioactive waste," Foltynova points out. Sri Lanka has been offered such assistance according to SLAEB Chairman Prof. Rosa. Russia also offers attractive loans, which are backed by government subsidies and cover at least 80 per cent of construction costs. "Russia has already lent USD 10 billion to Hungary, USD 11 billion to Bangladesh and USD 25 billion to Egypt to build NPPs," Foltynova says. Russia has also signed MOUs with at least 30 countries, mostly in Africa.

Source: <https://www.dailymirror.lk/opinion/Sri-Lanka-is-now-well-on-the-way-to-harnessing-nuclear-energy/172-284556>, 11 June 2024.

**OPINION – Patrick Tucker**

**Missile Threats are Proliferating. Here's How the Pentagon is Trying to Keep Up**

As missile threats proliferate, the Missile Defense Agency is looking to new sensors, new digital tools—and new tweaks to older interceptors. For example, a recent booster-rocket adjustment promises to increase the effectiveness of the Ground-Based Interceptor, or GBI, MDA director Lt. Gen. Heath Collins said at a CSIS event. The GBI is a defense against intercontinental ballistic

**The GBI is a defense against intercontinental ballistic missiles, but a very limited one, with just 40 interceptors in Alaska and four in California. Its concept of operations has been described as "shooting a bullet with a bullet," and in tests, they've worked a bit better than a coin toss.**

**The Pentagon is years into a plan to field constellations of low-Earth satellites to better track new hypersonics as they maneuver. From the MDA side, Collins said, the arrival of new space and launch companies is also creating a new business in hypersonic vehicles that can be used as target practice.**

missiles, but a very limited one, with just 40 interceptors in Alaska and four in California. Its concept of operations has been described as "shooting a bullet with a bullet," and in tests, they've worked a bit better than a coin toss. A Pentagon effort to improve their accuracy with an elaborate multi-warhead programs called the Redesigned Kill Vehicle was canceled in 2019 as too challenging and costly. But in December, MDA personnel at Vandenberg Air Force Base in California found a relatively simple way to

improve GBI performance, Collins said. "We demonstrated two capabilities, and one was the three-stage/two-stage selectable launch, which was a new capability that was brought to bear. GBI was designed with three stages and every GBI today uses all three stages. The kill vehicle cannot separate until all the stages are burned and so you've got to wait for three stages to burn before you can separate to then close an intercept."

But a careful analysis determined that if they simply delayed the time between the second and third stage launch, "we actually picked up minutes of additional intercept space, decision space, to get maybe some previously uninterceptable scenarios," he said. Collins said that bringing modern digital and information tools into the agency will help find further performance improvements. A key question is whether such quick, cheap workarounds can rise to meet new missile challenges, such as Russian leader Putin's threat on Thursday to supply long-range strike weapons to proxy forces to attack Western targets. Russia has touted its new highly-maneuverable hypersonic missiles as "invincible," though they have proven vulnerable to Patriot interceptors in Ukraine, and may be so to SM-6 missiles as well.

The Pentagon is years into a plan to field constellations of low-Earth satellites to better track new hypersonics as they maneuver. From the MDA



side, Collins said, the arrival of new space and launch companies is also creating a new business in hypersonic vehicles that can be used as target practice. "Some of the near-term work is actually looking at hypersonic targets, because as we get an interceptor, we need to target," he said. If MDA can work with small, innovative teams and small businesses to "get them to the point where they're delivering capability that meets what we need in that intersection, that is going to be very powerful for us because...we can test more, and that is going to only help us in the long run," he said. Collins didn't directly address one newer airborne threat to U.S. forces: fast, advanced drones that sometimes blur the line between a robot and a missile. But he did point out that the Iranian attack on Israel in April, which employed hundreds of missiles alongside strike drones was "larger than we've seen, ever. And it just forecasts more to come."

Defense against large drone swarms is more likely to fall to the forces on the ground, possibly outfitted with capabilities provided by MDA. Earlier this week, the head of U.S. Army Futures Command said that the problem of drone swarms in the future might not look as difficult as it does on today's Ukraine battlefield. The US will have a much bigger and more coordinated force to confront the problem, Gen. James Rainy said at a CSIS event on Monday. "I'm a little more optimistic because what you're not seeing is anybody execute joint combined arms maneuver, right? So if somebody was flying [unmanned aerial systems] at us, we would fight the UAS. But we would also be fighting wherever they came from, plus their maneuver force, plus bringing the joint force to bear, so I'm a little more optimistic. It's hard to drop the quadcopter grenade

into the turret of an M1 tank when it's coming at you 70 kilometers an hour, with a couple hundred of its friends, and you're on fire. You know, it's just hard."

Source: <https://www.defenseone.com/technology/2024/06/missile-threats-are-proliferating-heres-how-pentagon-trying-keep/397193/>, 06 June 2024.

**OPINION – Martin Comben**

**Global Healthcare and Nuclear Power**

**With demand rapidly increasing, multiple initiatives are underway worldwide to boost the production of cobalt-60 for use in medical equipment sterilisation applications. While the global supply is currently focused on CANDU and RBMK reactors designs, PWRs hold a great deal of promise.**

With demand rapidly increasing, multiple initiatives are underway worldwide to boost the production of cobalt-60 for use in medical equipment sterilisation applications. While the global supply is currently focused on CANDU and RBMK reactors

designs, PWRs hold a great deal of promise. The radioisotope cobalt-60 that is manufactured in some nuclear reactors is used to sterilise approximately 40% of single use medical devices

**Cobalt-60 is produced in a small number of reactors located in Argentina, Canada, China, India and Russia. The largest producers are Bruce Power and Ontario Power Generation (OPG) that operate CANDU type reactors in Canada. CANDU reactors are well suited for cobalt-60 production with the technology and processes established in the early 1970s with a history dating back to the 1950s.**

globally. These devices include items such as syringes, catheters, IV sets, surgical gloves, and gauze that used in a wide range of health care applications. A patient in surgery or receiving wound care or simply having a blood sample taken, is highly likely to be treated using products that have been sterilised using cobalt-60 in a process

called irradiation. Other important uses of cobalt-60 include the non-invasive treatment of cancers and brain tumours, polymer processing, food treatment and environmental applications.

**Cobalt-60 Production and Supply:** Cobalt-60 is produced in a small number of reactors located in Argentina, Canada, China, India and Russia. The largest producers are Bruce Power and Ontario

Power Generation (OPG) that operate CANDU type reactors in Canada. CANDU reactors are well suited for cobalt-60 production with the technology and processes established in the early 1970s with a history dating back to the 1950s. CANDU reactors operate with stainless steel adjusters that shape the neutron flux for reactor operations. For cobalt-60 production, these stainless steel adjusters are replaced with adjusters containing bundles of metallic cobalt-59 slugs encapsulated into zirconium alloy capsules. The cobalt-59 adjusters are designed to replicate the neutron absorption characteristics of the stainless adjusters that they replace, so reactor operation is not impacted. While in the reactor core, the cobalt-59 atom absorbs one neutron to become cobalt-60 and over time the ratio of cobalt-60 to cobalt-59 increases. To achieve the required level of cobalt-60, the adjusters are activated over a period of 18-36 months. After this activation period, the adjusters are removed from the reactor during a routine maintenance outage. They are then transferred to a large pool at the reactor site where the adjusters are disassembled and the individual cobalt bundles are removed. These cobalt bundles are then shipped off site for processing and production of the finished product that is used for irradiation sterilisation.

**Only a very few specialist companies have the necessary infrastructure to meet these requirements and supply to the global irradiation sterilisation industry. All of the cobalt-60 from the Bruce Power and OPG reactors, currently making up around 50% of global supply, is manufactured into sources by Nordion (Canada) Inc., the world's largest supplier to the irradiation industry worldwide.**

**Approximately 80% of this cobalt-60 usage is for the sterilisation of medical devices. In the US alone, it is estimated that some 16 billion devices are sterilised annually using cobalt-60. The demand for sterilisation and, therefore, cobalt-60 is growing at rates not previously seen due to an increasing and ageing population, greater access to health care and the development of new devices that require sterilisation.**

The design of the finished product, sealed radiation sources, must comply with international standards and be licenced by national regulators, and their manufacture must be to the highest quality standards. Only a very few specialist companies have the necessary infrastructure to meet these requirements and supply to the global

irradiation sterilisation industry. All of the cobalt-60 from the Bruce Power and OPG reactors, currently making up around 50% of global supply, is manufactured into sources by Nordion (Canada) Inc., the world's largest supplier to the irradiation industry worldwide. The supply of cobalt-60 from Russia, which represents about 25% of global supply, is also mostly through Nordion although some volume is supplied direct to the irradiation industry by JSC Isotope, an enterprise of Rosatom. Despite the challenges to continued supply from Russia in light of the current geopolitical situation, governments around the world appreciate the importance of cobalt-60 to global healthcare and have worked hard to ensure supply from Russia remains uninterrupted. Most cobalt-60 produced in China and India and some from Argentina is used to supply regional markets. This is partly due to a desire to support local operators but also a result of licensing restrictions and transportation constraints.

**Cobalt-60 Supply and Demand Status:** Irradiation technology is applied globally by a network of approximately three hundred irradiators using cobalt-60. Approximately 80% of this cobalt-60 usage is for the sterilisation of medical devices. In the US alone, it is estimated that some 16 billion devices are sterilised annually using

cobalt-60. The demand for sterilisation and, therefore, cobalt-60 is growing at rates not previously seen due to an increasing and ageing population, greater access to health care and the development of new devices that require sterilisation. Some sectors are experiencing double digit annual growth rates and in recent

years, vaccine supply pressure concentrated the need for sterilisation and, in some cases, created a backlog.

Although cobalt-60 supply continues to increase, in recent years this growth has been out-paced by growth in demand. This is of concern to the healthcare sector that relies on irradiation sterilisation to enable it to meet growing patient treatment needs. Whilst alternatives to cobalt-60 technology are available for sterilisation, these alternatives do not have the capacity to meet existing demand or the infrastructure to enable

rapid growth to meet future demand. At a time of increasing sterilisation demand, there have been a few disruptions to cobalt-60 production. This includes the temporary shutdown for refurbishment of some existing cobalt-60 production reactors in Canada and Argentina, and periods of reduced supply from Russia. Reactor refurbishment is critical to extending the life of reactors by 25-30 years and but also creates opportunities to increase cobalt-60 production for the long term.

**Reactor Refurbishment and Conversion for Cobalt-60 Production:** In the case of the ongoing Bruce Power Life Extension Program and Major Component Replacement Project, the opportunity has been taken to add more cobalt-59 adjusters to increase cobalt-60 production above the existing levels. This investment will secure the operation of these reactors and cobalt-60 production until 2064. At the OPG Darlington refurbishment, the opportunity will also be taken to convert these four reactors

to enable cobalt-60 production. This will add valuable cobalt-60 supply and builds on OPG's experience of cobalt-60 production at Pickering. The Pickering reactors have been scheduled to cease commercial operation at the end of 2024,

however, the Ontario Government recently confirmed its support of OPG's plan to refurbish the Pickering B reactors that are also cobalt-60 producing units. This refurbishment is subject to approval by the Canadian Nuclear Safety Commission (CNSC) that is already considering a request from OPG to extend the operating licence of the Pickering B reactors until 2026. If approved, the reactors will

continue operation until shut down to begin the refurbishment programme. Refurbishment would enable continued operation of these reactors for a further 30 years.

The CANDU reactor at Embalse, Argentina, has also been refurbished recently to enable continued operation and cobalt-60 production for a further 30 years. Additionally, Russian cobalt-60 production has been expanded. While two of the cobalt-60 producing units at the Leningrad NPP have been shut down, five reactors at Kursk and Smolensk have been added.

There is also a reported intention to increase cobalt-60 production at Indian PHWR reactors; and Nuclearelectrica Romania has announced a study of cobalt-60 production at its CANDU reactors at Cernavoda NPP. Currently, almost all of the world's cobalt-60 is produced in CANDU PHWRs and RBMK Light Water Graphite-moderated Reactors (LWGRs) of

**Although cobalt-60 supply continues to increase, in recent years this growth has been out-paced by growth in demand. This is of concern to the healthcare sector that relies on irradiation sterilisation to enable it to meet growing patient treatment needs. Whilst alternatives to cobalt-60 technology are available for sterilisation, these alternatives do not have the capacity to meet existing demand or the infrastructure to enable rapid growth to meet future demand.**

**Currently, almost all of the world's cobalt-60 is produced in CANDU PHWRs and RBMK Light Water Graphite-moderated Reactors (LWGRs) of which there is a limited number. The greatest opportunity to significantly increase the availability of cobalt-60 is therefore to develop production in new reactor types. There are approximately 440 commercial reactors in operation of which more than 300 are PWRs. This has made PWRs the reactor platform of focus for future cobalt-60 production.**

which there is a limited number. The greatest opportunity to significantly increase the availability of cobalt-60 is therefore to develop production in new reactor types. There are approximately 440 commercial reactors in operation of which more than 300 are PWRs. This has made PWRs the reactor platform of focus for future cobalt-60 production.

In February 2020, Nordion announced that it was partnering with Westinghouse to develop large-scale production of cobalt-60 in PWRs. Both Nordion and Westinghouse have since updated the irradiation market with the timeline of this important initiative and confirmation that progress has been made with technology development, licencing, manufacture of components and the recruitment of three utility companies that operate five reactors. Production of cobalt-60 in PWR's would be highly scalable with the capacity to at least double existing worldwide production volumes from PWRs in the US alone. Other initiatives include the announcement in December 2021 that Framatome and Exelon Generation will cooperate to understand and develop solutions to produce cobalt-60 in PWRs operated by Exelon Generation (now Constellation).

**Securing the Critical Supply of Cobalt-60:** The healthcare industry has relied on cobalt-60 since the 1960s when the demand for medical device sterilisation started to grow. The production of cobalt-60 in nuclear reactors remains critical to health care and will continue to be critical for the long term future. Although significant steps are underway to increase production, growing demand for healthcare means that new cobalt-60 supply will always be important. The road to engaging in cobalt-60 production is complex. There are a number of design and engineering considerations, safety assessments, the need to understand the impact on reactor efficiency and operations, and many other regulatory and operational considerations. However, there is also a wealth of experience and willing partners who

understand the importance of increasing cobalt-60 production. In addition to the provision of clean energy, the production of cobalt-60 in support of health care remains a highly positive contribution by the nuclear industry to societal wellbeing.

Source: <https://www.neimagazine.com/analysis/global-healthcare-and-nuclear-power/?cf-view&cf-closed>, 06 June 2024.

## NUCLEAR STRATEGY

### USA

#### US to Announce Bold New Nuclear Strategy

The Biden administration is set to announce a new, bolder nuclear weapons strategy, Semafor reported. The U.S. must adopt a more competitive approach to non-proliferation and arms control and make certain adjustments to our posture and capabilities a senior official told Semafor. The

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outlet reported National Security Council member Vaddi will set out the new plans at an arms control conference on Friday, amid mid concerns that Russia might use nuclear weapons in its war with Ukraine. Arms control "is a means and not an end," Earth, senior policy director at the Center for Arms Control and Non-

Proliferation's said at the Future of Arms Control conference in 2023. In June, Air Force Global Strike Command (AFGSC) announced that the U.S. had carried out a planned test of an unarmed Minuteman III ICBM - a nuclear-capable missile with a range of more than 6,000 miles.

Source: <https://www.newsweek.com/us-announce-bold-new-nuclear-strategy-1909423>, 07 June 2024.

#### China urges US to 'Reflect' on Nuclear Arms Policy

China has suggested the US should "reflect" on its behaviour and reduce its nuclear arsenal after a senior official said Washington may need more warheads. Vaddi, senior director for arms control disarmament and non-proliferation at the National Security Council, recently warned that Russia, China and North Korea were expanding their

nuclear arsenals at a “breakneck pace” and showed “little or no interest in arms control”. ... The US has 3,708 nuclear warheads, and Russia has about 4,489, according to the Stockholm International Peace Research Institute. An existing agreement that the US has with Russia - set to expire in February 2026 - limits each country to 1,550 deployed strategic intercontinental warheads. The Chinese embassy in Washington said the country kept its nuclear capabilities at the “minimum level required by national security” and that it did not participate in any form of arms race.

Source: <https://www.msn.com/en-xl/news/other/china-urges-us-to-reflect-on-nuclear-arms-policy/ar-BB1nUbqO>, 09 June 2024.

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Kwajalein Atoll, Republic of the Marshall Islands. Reentry vehicles are the top part of the ICBM that carry the nuclear warhead. They are designed to detach from the missile, arc in space and then reenter Earth’s atmosphere to hit their intended target. The Minuteman III ICBM system first became operational in the 1970s and was expected to be in service for a decade. But now, about 50 years later, the weapons are still in use and will be until the 2030s, according to a November statement by Rep. Rogers, R-Ala., who chairs the House Armed Service Committee. The military had intentionally destroyed an unarmed ICBM

earlier in the month during a test due to an anomaly, the Air Force said at the time. Indeed, the Air Force intends to field its next ICBM, dubbed Sentinel, though the program is behind schedule and its cost has grown beyond what was anticipated. After a delay, the missile’s first test flight is expected to take place in February 2026, according to the Air Force’s budget documents.

Source: <https://www.defensenews.com/training-sim/2024/06/06/us-test-fires-two-unarmed-minuteman-iii-ballistic-missiles/>, 06 June 2024.

## BALLISTIC MISSILE DEFENCE

### USA

US Test-Fires Two Unarmed Minuteman III Ballistic Missiles

The U.S. military test-fired two unarmed Minuteman III intercontinental ballistic missiles this week, with the Air Force noting they were not driven by “current world events.” The tests, which involved the Air Force and Space Force, took place June 4 and June 6 from Vandenberg Space Force Base, California, Air Force Global Strike Command noted in its news releases. That command is tasked with handling two legs of the US’ nuclear triad, which is made up of land-, submarine- and bomber-launched nuclear weapons. A spokesperson for the command told Defense News both tests were “successful.”

The reentry vehicle of each missile traveled approximately 4,200 miles to the Ronald Reagan Ballistic Missile Defense Test Site on the

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## EMERGING TECHNOLOGIES AND DETERRENCE

### UK

**Contract for Expansion of Rolls-Royce Submarine Site**

International infrastructure group Balfour Beatty has been selected by Rolls-Royce as its non-fissile construction partner to help expand its Raynesway site in Derby, UK, to meet the growth in demand from the Royal Navy, and as a result of last year’s AUKUS announcement. In September 2021, the

leaders of Australia, the UK and the USA announced a new enhanced trilateral security partnership - the AUKUS partnership - under which Australia will acquire at least eight nuclear-powered submarines. The submarines are to be built in Adelaide, South Australia. In March last year, as part of the AUKUS trilateral agreement, it was announced that Rolls-Royce Submarines Ltd of the UK will provide reactors for the Australian submarines. Three months later, Rolls-Royce announced plans to almost double the size of its Raynesway site. In March this year, it was confirmed that Australia had committed GBP2.4 billion (USD3 billion) over ten years to the UK SSN-AUKUS programme, representing a proportionate contribution to both the expansion of Rolls-Royce Submarines infrastructure, as well as a fair contribution to costs associated with submarine design.

The increase in demand will see Balfour Beatty - which is currently involved in the construction of the Hinkley Point C NPP in Somerset, England - build new manufacturing and office facilities as well as the adjoining site infrastructure. The increase in work from the UK Ministry of Defence (MOD) will create 1170 skilled roles at Rolls-Royce, across a range of disciplines including manufacturing and engineering.

Source: <https://www.world-nuclear-news.org/Articles/Contract-for-expansion-of-Rolls-Royce-submarine-si>, 28 May 2024.

**NUCLEAR ENERGY**

**CANADA**

**OPG Investigates Fusion as Future Option for Ontario**

Ontario Power Generation has signed a memorandum of understanding with Stellarex Inc to explore the development and deployment of fusion energy in Ontario which will see them work

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**Ontario Power Generation has signed a memorandum of understanding with Stellarex Inc to explore the development and deployment of fusion energy in Ontario which will see them work together to identify potential future siting and deployment of a stellarator fusion energy device in the province.**

together to identify potential future siting and deployment of a stellarator fusion energy device in the province. Under the MoU, the two partners will also explore establishing a centre of excellence for fusion energy in Ontario.

Fusion energy technology development company Stellarex is a spinout of Princeton University in the USA, dedicated to the near-term realisation of commercial fusion energy production using stellarators. The stellarator approach to fusion energy uses extremely strong electromagnets to generate twisting magnetic fields to confine plasma and create the right conditions for fusion reactions. Stellarators offer increased plasma stability compared with tokamaks, which use a torus-shaped magnetic chamber to confine the plasma, require less injected power to sustain the plasma, and allow for the burning plasma to be more easily controlled and monitored.

However, stellarators are more complex than tokamaks to design and

build. Stellarex has already established supply-chain and fusion ecosystem relationships in Ontario and in the Canadian nuclear sector, and has MoUs with Canadian Nuclear Laboratories, Hatch, and Kinectrics, as well as several academic institutions in the province. OPG is preparing to construct the first of up to four GE Hitachi Nuclear Energy BWRX-300 SMRs at its Darlington site. It has already completed early-phase site preparation works, with plans to complete construction of the first unit by end of 2028 for commercial operation by the end of 2029.

Source: <https://www.world-nuclear-news.org/Articles/OPG-investigates-fusion-as-future-option-for-Ontar>, 10 June 2024.

**FRANCE**

**EDF Completes GE Steam Power Acquisition**

GE Vernova has completed the sale of a portion of its nuclear conventional islands technology and

services, including its Arabelle steam turbines, to EDF. Arabelle Solutions is now a wholly owned subsidiary of EDF. The transaction includes the manufacturing of conventional island equipment for new NPPs as well as related maintenance and upgrade activities for existing nuclear plants outside of the Americas. EDF's acquisition of the business - at that time, known as GE Steam Power - was first announced in early 2022 and the final agreement signed that November. EDF Group said the transaction will allow it to acquire key technologies and skills for the nuclear industry and European energy security.

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Employing around 3,300 people, Arabelle Solutions will supply equipment for new NPPs and will also maintain and upgrade equipment in existing NPPs. Its steam turbines will be used in particular in the EPR, EPR2 and SMR reactor series, the company said. French President Macron chose GE Steam Power's Belfort manufacturing site in eastern France to announce plans for a new reactor building programme in early 2022.

**South Korea could construct up to three large new nuclear power reactors as well as a SMR by 2038, according to a draft long-term energy plan released by the country's Ministry of Trade, Industry and Energy (MOTIE). According to the draft of the 11th Basic Electricity Supply and Demand Plan, South Korea's demand for electricity will increase to 129.3 GW by 2038 - an increase of more than 30% from 2023, with growth mainly being driven by demand from the semiconductor and data centre industries.**

Source: <https://www.world-nuclear-news.org/Articles/EDF-completes-GE-Steam-Power-acquisition>, 31 May 2024.

## **KAZAKHSTAN**

### **Kazakhstan Plans to Allocate \$10-12bn for Possible NPP Construction**

Kazakhstan plans to spend \$10-12bn on construction of its first NPP if the project is approved at a national referendum. The figure is contained in the draft law "On the use of alternative energy sources", published on the portal "Open regulatory legal acts". The document will be in public discussion until 27 July. In September 2023,

Kazak President Tokayev, in a wide-ranging state-of-the-nation proposed holding a referendum on the issue of NPP construction....

In August 2023, the Energy Ministry had provided an update on previously conducted studies related to the choice of reactor technologies and siting for Kazakhstan's first NPP. The Ministry also recommended choosing a technology "proven by the experience of construction and successful operation of a similar plant". The shortlist included the following potential suppliers of nuclear technologies:

- China National Nuclear Corporation's HPR-1000 (Hualong One) reactor;
- Korea Hydro & Nuclear Power's APR1400 reactor;
- Rosatom's VVER-1200 and VVER-1000 reactors; and
- EDF's EPR-1200 reactor.

Source: <https://www.neimagazine.com/news/kazakhstan-plans-to-allocate-10-12bn-for-possible-npp-construction/>

?cf-view, 11 June 2024.

## **SOUTH KOREA**

### **New Nuclear Included in Draft Korean Energy Plan**

South Korea could construct up to three large new nuclear power reactors as well as a SMR by 2038, according to a draft long-term energy plan released by the country's Ministry of Trade, Industry and Energy (MOTIE). According to the draft of the 11th Basic Electricity Supply and Demand Plan, South Korea's demand for electricity will increase to 129.3 GW by 2038 - an increase of more than 30% from 2023, with growth mainly being driven by demand from the semiconductor and data centre industries.

Under the draft plan, the portion of carbon-free energy sources in the country's energy mix will increase from about 40% in 2023 to 70% by 2038. It says the proportion of electricity generated by nuclear power in 2030 will be 31.8%, increasing to 35.6% in 2038. The country's 26 reactors currently provide about one-third of its electricity. Meanwhile, the proportion from renewable sources will increase from 7.9% in 2023 to reach 21.6% in 2031 and 32.9% by 2038.

Hydrogen and ammonia will account for some 5.5% of total power generation by 2038. Meanwhile, the proportion generated from coal-fired plants - which currently account for around one-third of Korea's electricity generation - will drop to 17.4% in 2030 and 10.3% in 2038.

Source: <https://www.world-nuclear-news.org/Articles/New-nuclear-included-in-draft-Korean-energy-plan>, 31 May 2024.

## **USA**

### **US Companies Join Up to Lower Nuclear Investment Costs**

Duke Energy, Amazon, Google, Microsoft and Nucor have signed agreements on proposed tariffs that would lower the costs of investing in clean energy technologies like new nuclear as they explore new and innovative approaches to support carbon-free energy generation and help utilities serve the future energy needs of large businesses in North Carolina and South Carolina.

MoU signed earlier this month were announced during the White House *Summit on Domestic Nuclear Deployment*, which took place on 29 May. In those agreements, the companies proposed developing new rate structures, Accelerating Clean Energy (ACE) tariffs, designed specifically to lower the long-term costs of investing in clean energy technologies like new nuclear and long-duration storage through early commitments. ACE

tariffs would enable large customers like Amazon, Google, Microsoft and Nucor to directly support carbon-free energy generation investments through innovative financing structures and contributions that address project risk to lower costs of emerging technologies, Duke Energy said.

These agreements allow for tailored customer solutions to meet large-scale energy needs, as well as enabling "innovative multi-industry risk-sharing" for new carbon-free energy generation, Duke said. Duke Energy's generating fleet includes 11 nuclear reactors at six power stations across the Carolinas with a total generating capacity of 10,773 MWe. The company last year filed an Integrated Resource Plan which recommended extending the lives of existing NPPs as well as building two new SMRs by 2035 as the most prudent way forward for North and South Carolina.

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**The US Administration announced the formation of a new working group to look at ways to reduce nuclear construction project risks, a programme to deploy advanced reactors to power multiple military sites in the USA and the release of a new primer on the enhanced safety of advanced nuclear reactors.**

Source: <https://www.world-nuclear-news.org/Articles/US-companies-to-work-on-lowering-nuclear-investmen>, 30 May 2024.

### **White House Holds Summit on US Nuclear Energy Deployment**

The US Administration announced the formation of a new working group to look at ways to reduce nuclear construction project risks, a programme to deploy advanced reactors to power multiple military sites in the USA and the release of a new primer on the enhanced safety of advanced nuclear reactors. According to a White House statement, the *Summit on Domestic Nuclear Deployment* on 29 May was held to highlight "the collective progress being made from across the public and private sectors". It drew attention to actions taken by the current Administration to reduce reliance on Russian uranium for civil



nuclear fuel, and build the nuclear fuel supply chain, the multi-country declaration at COP28 to triple nuclear energy capacity globally by 2050 as well as work on developing new reactor designs and extending the service lives of existing nuclear reactors and growing the momentum behind new deployments.

The Nuclear Power Project Management and Delivery working group announced by the Administration will draw on leading experts from across the nuclear and megaproject construction industry to help identify opportunities to proactively mitigate sources of cost and schedule overrun risk, the White House said. Working group members will come from federal government entities, including the White House Office of Domestic Climate Policy, the White House Office of Clean Energy Innovation & Implementation, the White House Office of Science and Technology Policy, and the DOE. It will engage stakeholders including project developers, engineering, procurement and construction firms, utilities, investors, labour organisations, academics, and NGOs.

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Source: <https://www.world-nuclear-news.org/Articles/White-House-holds-summit-on-US-nuclear-energy-depl>, 30 May 2024.

### **Granholm Calls for Tripling of US Nuclear Fleet**

It is time for the USA to cash in on the experience of nuclear new-build at Vogtle, US Secretary of Energy Granholm said at an event held to mark the completion of the two units in Georgia. Restarting recently retired nuclear plants could also play a part in meeting the need for new capacity. The two AP1000 units built as units 3 and 4 at the Vogtle site near Waynesboro, Georgia, entered commercial operation in July 2023 and April 2024, respectively. Granholm acknowledged the commitment, vision, cooperation and

collaboration that went into the project to construct the first US nuclear units in a generation to be built “from scratch”. About 30 US NPP sites have already been licensed or permitted for the construction of more reactors, she said, which would be a cost-effective way of expanding nuclear generation.

With the rise in energy demand driven by technologies such as artificial intelligence requiring power-hungry data centres, the US Administration is asking big technology companies to invest in clean energy generation, suggesting that such companies could work together to make use of SMRs. Placing orders simultaneously could reduce costs. Georgia Power announced the start of commercial operations at Vogtle 4 in April, joining Vogtle 3 which entered commercial operation in July 2023. Operated by Southern Nuclear on behalf of co-owners Georgia Power, Oglethorpe Power, MEAG Power and Dalton Utilities, the plant is now the largest generator of clean energy in the USA. Georgia Power is a subsidiary of Southern Company.

Source: <https://www.world-nuclear-news.org/Articles/Granholm-calls-for-tripling-of-US-nuclear-fleet>, 07 June 2024.

## **NUCLEAR SECURITY**

### **USA**

#### **U.S. Delegation Lays Out the Present and Future of Nuclear Security at ICONS**

During the 2024 International Conference on Nuclear Security (ICONS), representatives from the U.S. Department of Energy and its National Nuclear Security Administration promoted U.S. nuclear security priorities, celebrated achievements and those of our partners, and

discussed how to tackle the security challenges of today and tomorrow. ICONS, sponsored by the IAEA, is held every four years in Vienna. About 2,000 people representing more than 130 countries gathered at the conference, which is a key event for the global nuclear security community. ICONS focused on multiple topics including policy, law, and regulations; emerging technology; physical protection, emergency preparedness, and response; and capacity-building. DOE Deputy Secretary Turk led the U.S. delegation. He was joined by many DOE and NNSA nuclear security professionals, as well as representatives from the Departments of State and Homeland Security, Nuclear Regulatory Commission, National Security Council, Federal Bureau of Investigation, and various labs, plants, and sites from throughout the DOE/NNSA enterprise.

Reflecting the growing interest in nuclear power to combat climate change, NNSA hosted an event about security and the IAEA’s Atoms4NetZero initiative. Speakers outlined U.S. resources available to support the responsible global expansion of nuclear power with an emphasis on prioritizing safety, security, and nuclear safeguards. Representatives from Ghana and the Philippines had the opportunity to share their perspectives as countries on the cusp of nuclear development. At this event, Acting Principal Deputy Administrator Hinderstein announced that 28 countries had signed on to a joint statement on the role of nuclear security in the sustainable expansion of nuclear power.

Source: <https://www.energy.gov/nnsa/articles/us->

*delegation-lays-out-present-and-future-nuclear-security-icons-0, 31 May 2024.*

**NUCLEAR SAFETY**

**UKRAINE**

**Grossi Suggests Zaporizhzhia will not be Restarted During Conflict**

IAEA DG Grossi says there “was an understanding” that Zaporizhzhia NPP units “would not be restarted as long as nuclear safety and security remained in jeopardy due to the conflict”. The 6-unit Zaporizhzhia plant has been under the control of Russian military forces since early March 2022, and all its units are in cold shutdown. It is situated on the frontline of the war and, as well as parts of the site suffering some direct

damage, it has had to rely on emergency diesel generators for short periods on a number of occasions when it lost access to off-site power.

Power is required for some essential safety functions. Grossi’s latest update on the situation in Ukraine came after a meeting on Thursday with Ukraine’s Energy Minister Halushchenko, Energoatom boss Kotin and the head of the State Nuclear Regulatory Inspectorate of Ukraine, Korikov, where they discussed issues including the situation at Zaporizhzhia and also the impact of attacks on the energy infrastructure in Ukraine.

Grossi said that a year after the destruction of the Kakhovka dam, which had helped supply cooling water for the plant, the IAEA teams at Zaporizhzhia had visited the cooling

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pond and “observed ..destroyed”. The plant now gets the cooling water it needs for the units, while they are shut down, from 11 newly built groundwater wells. The operators of the plant told the IAEA team that all four on-site radiation monitoring stations are operational, but three of the 14 off-site stations remain damaged as a result of military activity in 2022, and that manual radiation monitoring measurements are also carried out.

Source: <https://www.world-nuclear-news.org/Articles/Grossi-suggests-Zaporizhzhia-will-not-be-restarted>, 07 June 2024.

### **EBRD Chernobyl Funding Plan Ratified by Ukraine’s Parliament**

Members of Ukraine’s parliament have backed a law approving the framework agreement between Ukraine and the European Bank for Reconstruction and Development for funding aimed at projects to boost safety measures at the Chernobyl NPP site and exclusion zone. The ratification of the framework agreement allows for the creation of a mechanism for managing the activities of the International Chernobyl Cooperation Account (ICCA), which include the work on making safe and dismantling the unstable structures of the original shelter built at pace after the 1986 accident.

Speaking in the Verkhovna Rada (the Ukrainian parliament) Ukraine’s Minister of Environmental Protection and Natural Resources, Strilets, said that following the start of the war, Ukraine had asked for the structure of the fund to be changed and already 18 countries had contributed EUR14 ml (USD15.2 ml), with an expectation that the

**Members of Ukraine’s parliament have backed a law approving the framework agreement between Ukraine and the European Bank for Reconstruction and Development for funding aimed at projects to boost safety measures at the Chernobyl NPP site and exclusion zone.**

amount would double once the law was ratified. The original shelter over the destroyed unit 4 at Chernobyl was constructed in a matter of just months, and the international Shelter Implementation Plan in the 1990s had three phases - firstly to stabilise it and secondly to build a larger secure construction to enclose it - the New Safe Confinement (NSC) which was completed in 2017 to pave the way for the dismantling and decommissioning stage.

Source: <https://www.world-nuclear-news.org/Articles/EBRD-Chernobyl-funding-plan-ratified-by-Ukraine-s>, 06 June 2024.

## **NUCLEAR COOPERATION**

### **CHINA–UAE–FRANCE**

#### **CNNC Extends Cooperation with ENEC, EDF**

China National Nuclear Corporation (CNNC) has signed a memorandum of understanding with Emirates Nuclear Energy Corporation (ENEC) on strategic cooperation in the peaceful use of nuclear energy. CNNC has also signed a comprehensive cooperation agreement with France’s EDF on nuclear energy. Under the MoU – signed by ENEC Managing Director and CEO Hammadi and CNNC Chairman Jianfeng in

Beijing on 30 May – the two companies will explore opportunities to collaborate and ensure best practice in the development and operation of NPPs. It followed the signing of a bilateral cooperation agreement on the peaceful use of nuclear energy witnessed and signed by Chinese President Jinping and UAE President Nahyan earlier that day.

**ENEC said the MoU provides a framework for collaboration in short and long-term fuel cycle procurement, developing best practices in operation and maintenance of civil nuclear energy facilities, nuclear environmental protection and other areas of mutual interest - including the development of new nuclear energy plants, research and development and exploring future areas of cooperation for benchmarking and knowledge sharing.**

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The latest agreement builds on previous cooperation initiatives between ENEC and CNNC, including an MoU signed in December last year at COP28, which outlined collaboration on new nuclear energy plants in third countries and the deployment of advanced reactor technologies. Also, at COP28, ENEC and CNNC signed an MoU to explore cooperation opportunities for the development of high-temperature gas-cooled reactors (HTGRs) to set out the pathway for HTGR technology development and the potential to deploy the technology in other countries.

**Emirates Nuclear Energy Corporation (ENEC) of the UAE and Korea Electric Power Cooperation (KEPCO) have signed a memorandum of understanding to bolster research and investment opportunities in nuclear energy in third countries. The MoU was signed on May 29 in Seoul by ENEC Managing Director and CEO Hammadi and KEPCO President and CEO Kim.**

Source: <https://www.world-nuclear-news.org/Articles/CNNC-extends-cooperation-with-ENEC,-EDF,04June2024>.

**GUINEA–RUSSIA**

**Guinea to Explore Possible Deployment of Floating NPPs**

Rosatom’s Engineering Division has signed a memorandum of intent with partners from the Republic of Guinea providing for interaction on a project for floating power units in Guinea. The

document was signed during the St Petersburg International Economic Forum, in the presence of Rosatom Deputy General Director for Engineering & Industrial Solutions, Nikipelov and the head of the Rosatom’s Engineering Division, Kotov.

Under the framework of the agreements reached, the parties will consider the possibilities of implementing the project of floating power units in Guinea and work out the terms and conditions for the implementation of the project. The RITM-200 advanced reactor plant of the type has proven itself in operation on Russia’s nuclear-powered icebreakers of project 22220. The reactor is now being adapted to power Russian projects for floating NPPs (RITM-200S) and ground-based small power plants (RITM-200N) to provide power to industrial projects in the Arctic and far east regions.

Source: <https://www.neimagazine.com/news/guinea-to-explore-possible-deployment-of-floating-npps/>, 11 June 2024.

**UAE–SOUTH KOREA**

**KEPCO, ENEC to Jointly Promote Overseas Nuclear Projects**

Emirates Nuclear Energy Corporation (ENEC) of the UAE and Korea Electric Power Cooperation (KEPCO) have signed a memorandum of understanding to bolster research and investment opportunities in nuclear energy in third countries. The MoU was signed on May 29 in Seoul by ENEC Managing Director and CEO Hammadi and KEPCO President and CEO Kim. The signing was witnessed by South Korean President Yeol and UAE President Nahyan.

Under a USD20 billion deal announced in December 2009, four Korean-designed APR1400

reactors have been built at the Barakah site in the UAE by a consortium led by KEPCO. First concrete for Barakah 1 was poured in July 2012, while that for units 2-4 was poured in April 2013, September 2014 and July 2015, respectively. Unit 1 began commercial operation in April 2021, unit 2 in March 2022 and unit 3 in February 2023. Unit 4 was connected to the grid in March this year and is scheduled to enter commercial operation later in 2024. ENEC said the Barakah plant is the flagship project of the UAE Peaceful Nuclear Energy Programme, with the company “now focused on exploring opportunities in the UAE and overseas in large-scale plants, SMRs and advanced reactors, related clean technologies such as hydrogen generation and R&D to maximise the full value of the expertise developed in nuclear mega project programme delivery, capacity building and technology deployment”.

Source: <https://www.world-nuclear-news.org/Articles/KEPCO,-ENEC-to-jointly-promote-overseas-nuclear-pr>, 30 May 2024.

### UKRAINE-FRANCE

#### Ukraine-France, EDF-Energatom Nuclear Cooperation Agreements

Ukraine’s Energatom and France’s EDF sign a cooperation agreement, while the two countries have renewed their cooperation on the peaceful use of nuclear energy, which was originally signed in 1998. Agreement between the two state-owned nuclear power giants covers the study of EDF’s GW-scale EPR and Nuward small modular reactor technologies as well as “exchange ..reactors”. The exchange of experience will also include the supply of nuclear fuel for VVER reactors for

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countries wanting to diversify their supply away from Russia. On the same day, the governments of the two countries exchanged letters putting into place a 20-year renewal of their 1998 agreement on the peaceful use of nuclear energy. The renewal creates the legal framework for cooperation in the field of maintenance of nuclear facilities and renews the agreement, which expired four years ago.

Ukraine has 15 nuclear units, which could generate about half of its electricity, including the six at the Zaporizhzhia NPP which has been under Russian military control since early March 2022. The country has plans for nine new Westinghouse AP1000 units in the future, as well as exploring potential deployment of small modular reactors.

France also has plans for a new era of nuclear energy construction. It already derives about 70% of its electricity from nuclear energy and has plans for as many as 14 new reactors.

Source: <https://www.world-nuclear-news.org/Articles/Ukraine-France,-EDF-Energatom-nuclear-cooperation>, 10 June 2024.

### URANIUM PRODUCTION

#### USA

#### US Uranium Purchases Show Year-on-Year Increase: EIA

US utilities purchased 27% more uranium in 2023 than 2022, according to the US Energy Information Administration’s latest annual report. Most of this came from foreign suppliers - US-origin material accounted for 5% of total deliveries, the same percentage as 2022. Owners and operators of US

civilian nuclear power reactors purchased uranium deliveries equivalent to a total of 51.6 million pounds U3O8 (19,838 tU), at a weighted-average price of USD43.80 per pound U3O8, the Energy Information Administration (EIA) said in its Uranium Marketing Annual Report, published on 6 June. This was 12% higher than the 2022 weighted-average price of USD39.08 per pound U3O8 and was the highest price since 2015.

Canada accounted for 27% of total deliveries, followed by Australia and Kazakhstan with 22% each. Russian-origin material accounted for 12% of total deliveries and Uzbekistan-origin material accounted for 10% of total deliveries. Deliveries also came from China and several countries in Africa. 15% of the uranium delivered was purchased under spot contracts at a weighted-average price of USD51.64 per pound, with the remaining 85% purchased under long-term contracts at a weighted-average price of USD42.42 per pound.

Based on reactor owner and operators' reports of deliveries under existing contracts from 2024-2033, together with unfilled uranium market requirements, the EIA anticipates market requirements of a maximum of 433 ml pounds U3O8 over the next 10 years.

*Source: <https://www.world-nuclear-news.org/Articles/US-uranium-purchases-show-year-on-year-increase-EI>, 11 June 2024.*

### **GLE Agrees to Acquire Land for Paducah Facility**

Global Laser Enrichment (GLE) has entered into a set of agreements that provides it with an option to purchase a plot of land for the planned Paducah Laser Enrichment Facility in Kentucky. GLE is the exclusive global licensee of the SILEX laser-based

uranium enrichment technology which was originally developed by Australian company Silex Systems Limited. It is 49%-owned by Canadian company Cameco, which is the commercial lead for the GLE project and holds an option to attain a majority interest of 75%.

GLE is working towards demonstration of the SILEX technology at its Test Loop pilot facility in Wilmington, North Carolina. It is also progressing activities to commercial-scale deployment at the Paducah Laser Enrichment Facility (PLEF). The plot of land that GLE is to acquire is strategically located adjacent to the US Department of Energy's former first-generation Paducah Gaseous Diffusion Plant (PGDP), which was shut down in 2013 after decades of operations. As a result of these operations, significant quantities of legacy depleted tails inventories were generated and remain in storage at the PGDP site.

*Source: <https://www.world-nuclear-news.org/Articles/GLE-agrees-to-acquire-land-for-Paducah-facility>, 05 June 2024.*

### **Framatome, TerraPower Announce Plans for HALEU Metallisation Plant**

Framatome and TerraPower have agreed to design and develop a high-assay low enriched uranium (HALEU) metallisation pilot plant at Framatome's nuclear fuel manufacturing facility in Richland, Washington. Metallisation is a crucial part of the deconversion process to turn enriched uranium hexafluoride - UF6 - into a form that can be used to fabricate HALEU fuel for advanced reactors. The pilot line is currently under construction and will demonstrate Framatome's capability to convert uranium dioxide into HALEU metal.

Framatome said the pilot line will initiate "a long-term collaboration to supply metal feedstock" and

**US utilities purchased 27% more uranium in 2023 than 2022, according to the US Energy Information Administration's latest annual report. Most of this came from foreign suppliers- US-origin material accounted for 5% of total deliveries, the same percentage as 2022. Owners and operators of US civilian nuclear power reactors purchased uranium deliveries equivalent to a total of 51.6 million pounds U3O8 (19,838 tU), at a weighted-average price of USD43.80 per pound U3O8, the Energy Information Administration (EIA) said.**

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help Terrapower to develop a domestic supply chain for HALEU in the USA. TerraPower's Natrium advanced nuclear power technology features a 345 MWe sodium-cooled fast reactor with a molten salt-based energy storage system. A Natrium demonstration plant is to be constructed near a retiring coal facility at Kemmerer in Wyoming. A strong domestic fuel supply chain is crucial for the wide-scale deployment of advanced nuclear energy solutions,

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which are needed to meet clean energy targets and provide reliable, baseload energy, TerraPower President and CEO Levesque said. A HALEU fuel cycle will need new enrichment facilities, transportation solutions, and conversion and deconversion facilities, but without a clear demand signal private fuel cycle companies cannot commit the required capital to build out the necessary infrastructure. This led to what has been described as a 'chicken and egg' problem threatening to delay the deployment of advanced reactors and small modular reactors.

Source: <https://www.world-nuclear-news.org/Articles/Framatome,-TerraPower-announce-plans-for-HALEU-met>, 31 May 2024.

## NUCLEAR WASTE MANAGEMENT

### GERMANY

#### RWE Permitted to Dismantle Gundremmingen Plant

German utility RWE announced it has received the third and final licence from the Bavarian State Ministry for the Environment and Consumer Protection to decommission and dismantle the former Gundremmingen NPP. The 1284 MWe Gundremmingen B BWR in southern Germany was disconnected from the grid on 31 December 2017 after 33 years of operation. Gundremmingen C - a 1288 MWe BWR - permanently shut down on 31 December 2021.

The licence for dismantling unit B according to the Atomic Energy Act was granted by the Bavarian State Ministry of the Environment and Consumer Protection in March 2019; the licence for dismantling unit C in May 2021. In December 2021, RWE awarded a contract to Westinghouse to dismantle the two reactors at the Gundremmingen plant. Under the contract, Westinghouse will dismantle and pack the reactor pressure vessels, including the associated internals, the fuel element storage racks and adjacent concrete shielding structures in units B and C of the Gundremmingen plant. The work is expected to be completed in 2030.

Source: <https://www.world-nuclear-news.org/Articles/RWE-permitted-to-dismantle-Gundremmingen-plant>, 31

May 2024.

### ITALY

#### Italian Interim Storage Facility Takes Shape

Construction has started at the Garigliano NPP in Italy of a facility for the interim storage of wastes generated through the decommissioning of the plant, which shut down more than 40 years ago. Societa Gestione Impianti Nucleari SpA (Sogin) - established in 1999 to take responsibility for decommissioning Italy's former nuclear power sites and locating a national waste store - has now completed the laying of the foundation slab for the new DT2 storage facility. Once completed, the DT2 facility - measuring 70 mts in length, 18 mts in width and 13 mts in height - will house about 1800 cc mts of low and medium-level radioactive waste.

This waste will exclusively come from the dismantling activities of the power plant and, in particular, from the dismantling work of the systems and components inside the reactor

vessel, which began in December last year. The waste will subsequently be transferred to the national repository, once available. This storage facility will include an operational handling area, a service building functional to the operation of the depot and a storage area equipped, among other things, with an

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overhead crane for the remote handling of radioactive waste containers, in which there will also be corridors for their inspection. Civil works are scheduled to be completed in June 2025, with commissioning expected in the first half of 2026.

Source: <https://www.world-nuclear-news.org/Articles/Italian-interim-storage-facility-takes-shape>, 10 June 2024.

## RUSSIA

### Rosatom Announces Novel Used Fuel Processing Technology

Russian state nuclear corporation Rosatom announced it has developed an innovative crystallisation refining technology for the purification and separation of nuclear materials from used nuclear fuel. Rosatom said that scientists from its Fuel Division and the *Proryv*, or Breakthrough, project area have developed the new technology, which will be implemented at the facility for reprocessing irradiated uranium-plutonium (SNUP) fuel as part of the pilot energy complex (ODEK) being built at the Siberian Chemical Combine's site in Seversk, Tomsk Region. Rosatom's *Proryv* project aims to enable a closed nuclear fuel cycle, ultimately eliminating production of radioactive waste from nuclear power generation.

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The ODEK complex comprises a fuel production/refabrication module for production of dense uranium plutonium (nitride) fuel for fast reactors;

a NPP with a BREST-OD-300 lead-cooled fast-neutron reactor; and a used fuel retreatment module. The crystallisation technology is expected to become the final technological stage in the process of purification of nuclear materials isolated from irradiated SNUP fuel - uranium, plutonium and

neptunium, the company said. Technologies for reprocessing irradiated fuel are of particular importance for closing the nuclear fuel cycle at ODEK, the company noted. Materials separated from used fuel, after reprocessing, will be sent for fabrication of fresh fuel.

Source: <https://www.world-nuclear-news.org/Articles/Rosatom-announces-novel-used-fuel-processing-techn>, 04 June 2024.

## USA

### DOE-Designed Railcar Cleared for Use

The Atlas railcar - developed by the US Department of Energy to transport used nuclear fuel and high-level radioactive waste - has been certified by the Association of American Railroads (AAR) to operate on all major freight railroads in the USA. The 12-axle railcar comes fully equipped with high-tech sensors and monitoring systems. It was designed to safely and securely transport shipments of commercial used nuclear fuel weighing up to 480,000 pounds (218 tonnes). DOE said the railcar project took ten years to complete and cost about USD33 million. It noted the certification was the highest safety standard set by the AAR for transporting high-level radioactive material.

The entire railcar system includes the Atlas railcar, two buffer railcars and a rail escort vehicle that was developed in partnership with the Naval



Nuclear Propulsion Program. Final testing of the railcars was marked by the completion of a 1680-mile round-trip journey from Pueblo, Colorado, to Scoville, Idaho. They are the first DOE railcars to meet the rigorous testing requirements of AAR's S-2043 standard for transporting high-level radioactive material. Atlas is one of two railcars DOE is developing to provide flexibility in transporting used nuclear fuel and high-level radioactive waste to future federal interim storage facilities and disposal sites. DOE intends to eventually transport more than 140,000 tonnes of commercial used nuclear fuel that it is estimated will have been generated in the USA by 2060.

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The location of the consolidated interim storage facility would be selected through DOE's consent-based siting process that puts communities at the forefront and would ultimately reduce the number of locations where commercial used nuclear fuel is stored in the USA. Construction and operation of the storage facility will require amendments to the Nuclear Waste Policy Act to move those phases of the project forward.

*Source: <https://www.world-nuclear-news.org/Articles/DOE-designed-railcar-cleared-for-use,05June2024>.*



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