



OPINION – Manpreet Sethi

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China’s Nuclear Build-up: Implications for India

China’s nuclear build-up is much in news. The November 2022 annual report on Military and Security Developments related to the People’s Republic of China, released by the US Defence Department has raised its own estimates from last year on the likely increase in China’s nuclear warheads. Last year it had claimed that China may have 1000 nuclear weapons by 2030; the latest report has raised them to 1500 by 2035. Much of these guesstimates are being premised on the discoveries made through commercial satellite imagery showing new silos were being constructed at three sites in China and the increasing number of dual use capable missiles in Chinese inventory.

Traditionally, American official estimates of China’s nuclear numbers have been found to be inflated. Since Beijing maintains silence, neither confirming nor denying the discoveries or figures, there is no way of determining whether it wishes to, or will reach, the American figures. However, there is little doubt that there is an accelerated activity around China’s nuclear capabilities. What could be the possible reasons for this? How should India understand these developments? What kinds of responses

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do these merit? In order to answer these questions, this article examines the reasons why China has become active in its nuclear build-up, analyses some of the Chinese explanations and offers some suggestions for India’s responses.

Possible Reasons for Nuclear Build-up: The sudden increase in Chinese nuclear arsenal is a new development given that the nuclear numbers had remained roughly stagnant around 250-270 for some decades. But, during this period too, China was nonetheless busy enhancing the reliability, range,

accuracy, mobility, penetrability and overall survivability of its delivery systems. So, the capability build-up had been targeted at other technological advancements. Once China announced the deployment of MIRVed missiles capable of carrying 3-10 nuclear warheads, a concomitant increase in numbers was expected. However, news about construction of hundreds of silos seems to exceed this requirement. What is the purpose of this?

Many motives can be surmised. Even as all of them have to do with the Chinese perception of the US, two reasons stand out: one is related to its security concerns while the second to a belief that a bigger arsenal will fetch it better respect from Washington.

Security-related Reasons for Increase: Enhancing survivability can be counted amongst the most important objectives of this exercise. In what may be a shell game, the silos can be seen as part of a deception strategy to complicate the aggressor's targeting plans, forcing him to waste his warheads on silos that may or may not contain any missiles. The silos under construction are believed to be for housing more DF-41s. The signal to the US therefrom is that it cannot be confident of carrying out a disarming first strike against China. This need may have been felt after the US abandonment of the INF treaty, which allowed it to build and deploy missiles in intermediate ranges closer to China, including on SSBNs positioned in the Pacific. Given China's extreme sensitivity to a 'Taiwan contingency', especially in wake of the Russia-Ukraine conflict, China could have felt the need to enhance its deterrence by increasing the number of its own ICBMs. Another reason could be that

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silos enable a higher state of operational readiness by allowing the targeting coordinates to be pre-fed.

US BMD along with a focus on conventional global prompt strike (CGPS), including the development of conventional hypersonic missiles that can potentially destroy Chinese nuclear assets, have been perceived by China to erode its ability to cause unacceptable damage after taking a first strike. Therefore, silos, besides mobility of missiles, are being used to signal better survivability of the retaliatory capability.

Status-related Reasons for Increase: China's nuclear expansion is also likely a piece in its aspiration for great power status. In an apparent desire to 'beat' the US on every parameter, Beijing has felt the need to do so on nuclear stockpiles too. Xi Jinping himself has designated PLA Rocket Force (PLARF) as "the strategic support for the country's status as a major power". A Chinese scholar, Dr Tong Zhao, too has linked the silos to "bolster China's image as a much stronger nuclear power than before. Whether China will actually fill each silo with an ICBM is a different matter..." But, as he suggests, the "bigger arsenal would make the country's rivals respect China and exercise more self-restraint when dealing with Beijing."

Indeed, nuclear weapons appear to have become central to China's national security and international status. To recall, in his address to the 19th Party Congress, Xi Jinping identified three duties for the newly reorganised PLA Rocket Force (PLARF), which has also been elevated to the position of the fourth arm of the military alongside the army, navy and the air force. He exhorted it to act as the "core strength of China's strategic

deterrence, the strategic support for the country's status as a major power, and an important cornerstone safeguarding national security".

The US has instinctively dubbed this as potentially destabilising since it could make China's posture and strategy more "coercive" and able to "execute any plausible employment strategy". US military leaders have, therefore, demanded a reciprocal increase in US capabilities. Adm Charles Richard, Commander of US STRATCOM, in a speech to the space and missile symposium on Aug 23, 2021, drew attention to the unprecedented "three-party dynamics" that had emerged with Russia and China both having become near peers.

While US assessment has its own logic, including its tendency to see nuclear weapons as war-fighting instruments, it is not sure whether that is the Chinese aim. An analysis of writings by Chinese scholars on this subject yields mixed results. While some have linked it to increasing operational readiness with silo-based missiles, others have dismissed silos as an obsolete technology that is far less preferential to mobile missiles. Beyond scholars, media strategists like Hu Xijin, the editor in chief of Global Times, dispute the very claims of increase being made by US think tanks. He espies in this effort an objective to put pressure on China and to "wage a war of public opinion"; the push of such a narrative in state media is telling of the narrative the Communist Party is keen on advocating vis-à-vis its nuclear programs.

China's Developments from India's Perspective: The nuclear modernisation underway in China may be surprising in its pace and scale of development, but it is not new. There has been continued development and deployment of road and rail mobile, solid-fuel missiles, improvements in H-6N nuclear-capable aircraft and the SSBNs now equipped with longer range and more accurate JL-

3 SLBMs. Accuracy of medium range missiles, such as the DF 26, which is designated as a dual capable missile, has also been improving over years. This is a more worrisome dimension from India's perspective than the newly discovered ICBM silos.

Even as it can be argued that most Chinese nuclear developments are triggered by a US threat perception, India is nevertheless an affected party. A bigger and better arsenal would obviously bring China the benefit of more kinds of employment

In contrast, India considers these weapons of mass destruction as best suited for achieving deterrence through the threat of inflicting punishment. Therefore, its focus needs to be on building a capability that can promise delivery of nuclear ordnance to cause unacceptable damage to the adversary. Such an approach then liberates India from a sense of panic to add to the warhead stockpile. Rather, attention remains on building robust and survivable second-strike forces to signal certainty of retaliation.

strategies. It also may give it a better sense of escalation management. Nonetheless, the good news for India is that much of the confidence of managing nuclear escalation rests on assumptions (not empirical evidence) and can prove to be illusionary. In contrast, India considers these weapons of mass destruction as best suited for achieving deterrence through the threat of inflicting punishment.

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Such an approach then liberates India from a sense of panic to add to the warhead stockpile. Rather, attention remains on building robust and survivable second-strike forces to signal certainty of retaliation. For deterrence to work, even in face of a better equipped nuclear adversary, the ultimate requirement is the ability to signal inflicting punishment with even a few attacks on countervalue targets that would nullify the adversary's assumed gains.

It is evident that China's reasons for undertaking the expansion and upgradation of its nuclear forces ranges from its sense of insecurity vis-à-vis the US to its desire for 'beating' the existing great power. It is also flush with money and has invested lavishly in advancing its technological capabilities.

It can afford this build-up. During the Cold War, the US had planned to race the Soviet arsenal to force the country's economic downfall. The same may not apply to China. Rather, not only will China not easily go bankrupt, but the economic consequences of nuclear arms racing would be felt by Washington.

The best option for India is to stay away from such build-up spirals. It can neither afford this, nor is it necessary. In fact, India's security challenges arise more from the probability of having to fight conventional wars given the kinds of threats posed by both its nuclear armed adversaries. Pakistan, on the one hand, regularly mounts cross-border terrorist attacks on India. China meanwhile has increased its salami slicing transgressions across the unresolved line of actual control.

India's requirement in these circumstances is for a suitably equipped conventional military that can undertake surgical punitive strikes against Pakistan, while being able to hold off an aggressive China at the borders, besides being able to handle a possible two front war too. New Delhi must maintain a sharp focus on building the right kind of conventional military capability to match these threat perceptions.

Nuclear weapons are obviously not the answer for these kinds of threats. In fact, given their nature as instruments of mass destruction, the possibility of using them for credible military objectives is severely constrained. Hence, overspending on a capability of limited utility would be wasteful. Irrespective of Chinese increase in nuclear numbers, for India, the focus should be on steadily building and improving its second-strike capability. Credible and survivable retaliatory

action is the best, and relatively the least expensive option, to pursue.

Source: <https://orcasia.org/2022/12/chinas-nuclear-build-up-implications-for-india/>, 27 December 2022.

OPINION – Li Jiabao

Willful Nuclear Expansion Makes US Biggest Source of Nuclear Threat

According to foreign media reports, the US new-generation strategic bomber B-21 Raider recently made a high-profile appearance. B-21 Raider is a long-range stealth strategic bomber capable of carrying nuclear weapons and serves as the first achievement of the US\$ 1.2 trillion nuclear arms expansion plan. As one of the measures taken by the US to expand its nuclear arsenal and hype up the competition among major powers, this move is bound to bring great risks to global security and strategic stability.

America's Frequent Moves to "Expand Nuclear Arms": In recent months, the US government has released a series of documents including the National Security Strategy (NSS), and the 2022 Nuclear Posture Review (NPR), which makes clear the Biden administration's nuclear strategy. At the same time, the US has taken multiple measures and moves to keep upgrading its nuclear arsenal. It has accelerated the deployment of new tactical nuclear weapons B61-12 to several NATO bases in Europe and upgraded its nuclear arsenals in Europe. The US has also planned to establish a small-scale multilateral nuclear consultation mechanism with Japan, the ROK and Australia in the Indo-Pacific

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region to share nuclear intelligence and even considered copy the European model to deploy strategic bombers, dual-capable aircraft and related nuclear weapons to the frontline in the Indo-Pacific region.

In this regard, Guo Xiaobing, Director of the Center for Arms Control Studies, China Institutes of Contemporary International Relations, pointed out that from the multiple documents issued and moves taken by the Biden

administration, the US has currently planned to implement integrated deterrence, maintain a low threshold for the application of weapons, promote the upgrading of nuclear arsenals, emphasize the construction and development of nuclear weapons infrastructure, highlight its so-called "limited nuclear war" to develop and deploy low yield nuclear warheads while strengthening extended deterrence, and reinforce the "Indo-Pacific" nuclear sharing mechanism and the forward deployment of strategic forces.

Hyping Up Major Power Competition: The US Department of Defense recently released its 2022 Military and Security Developments Involving the China, also known as China Military Power Report, which has made wild guesses and comments on China's military modernization, claiming that "China currently has more than 400 nuclear warheads, which will increase to 1,000 in 2030, and 1,500 in 2035". "The data released in this report by the US are very unserious. It is not a calculation based on proven data or any inference method, but purely a deliberate fabrication to hype up the so-called 'China's nuclear threat'." Guo Xiaobing pointed out that, the move taken by the US is aimed at covering up its disgraceful actions in the area of nuclear arms control and non-proliferation, and trying to make black white and putting pressure on China to limit its normal military power development.

Li Haidong, a professor at the Institute of International Relations of China Foreign Affairs

University, also pointed out that the US has the most advanced nuclear arsenals in the world, yet it still continues to create excuses for expanding

its arsenals, by hysterically hyping up the external nuclear threats and forging an "imaginary enemy". This is not convincing even to the least extend. The nuclear issue concerns major power relations and global strategic balance and stability. The US moves are bound to push its foreign policy and nuclear strategy to the influence of

its domestic military industry interest groups, exacerbating its competitive situation with China and threatening global security and strategic stability.

Intensifying Risks of Nuclear Conflicts: Guo believed that the current US nuclear policy has blurred the boundary between nuclear weapons and conventional weapons, actually increasing the probability for US to use nuclear weapons in local conflicts, enhancing the risks of nuclear war, and adding great uncertainty to the global security situation. Many experts in arms control also expressed serious concerns. Daryl G. Kimball, Executive Director of the US Arms Control Association, commented that the broad and ambiguous policy as mentioned in the 2022 NPR has been a violation of the US' commitment to reducing the role of nuclear weapons in its NSS. Tara Drozdenko, Director for the Global Security Program at the Union of Concerned Scientists, pointed out that the 2022 NPR has strengthened the nuclear threat, with its function more like a "rubber stamp" of the US nuclear military industrial complex.

Li pointed out that one of the US's main thinking in the field of nuclear arms control lies in highlighting the absolute advantage of the US in the compilation of relevant mechanisms and agreements. Out of the reason, the US has been acting passively in the international arms control framework in recent years, having successively withdrawn from multiple international arms

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control treaties including the ABM Treaty, and the INF Treaty. What the US is pursuing is not the common security of the international community; instead, it has been seeking absolute security for itself. Guided by this thinking, the US has been vigorously expanding its nuclear arsenals and hyped up threats from major powers, with a view to compressing the strategic choices of its allies and partners without bringing them real security, while aggravating the risks of the global arms race and making the world more insecure.

Source: http://eng.chinamil.com.cn/view/2022-12/15/content_10206061.htm, 15 December 2022.

OPINION – Editorial, Al Jazeera

What Can the Patriot Missile Do for Ukraine?

Patriot missile systems have long been a hot ticket item for the US and allies in contested areas of the world as a coveted shield against incoming missiles. In Europe, the Middle East and the Pacific, they guard against potential attacks from Iran, Somalia and North Korea. So, it was a critical turning point when news broke that the US has agreed to send a Patriot missile battery to Ukraine — something Ukrainian President Zelensky has sought for months to augment his country's air defences. US officials have confirmed the agreement, and an official announcement is expected soon. But experts caution that the system's effectiveness is limited, and it may not be a game changer in the war. A look at what the system is and what it does:

Out of the reason, the US has been acting passively in the international arms control framework in recent years, having successively withdrawn from multiple international arms control treaties including the ABM Treaty, and the INF Treaty. What the US is pursuing is not the common security of the international community; instead, it has been seeking absolute security for itself.

The Army said it currently has 16 Patriot battalions. A 2018 IISS report found those battalions operate 50 batteries, which have more than 1,200 missile interceptors. The US batteries are regularly deployed around the world. In addition, Patriots also are operated or being purchased by the Netherlands, Germany, Japan, Israel, Saudi Arabia, Kuwait, Taiwan, Greece, Spain, South Korea, the United Arab Emirates, Qatar, Romania, Sweden, Poland and Bahrain.

What is the Patriot? The Patriot is a surface-to-air guided missile system that was first deployed in the 1980s and can target aircraft, cruise missiles and shorter-range ballistic missiles. Each Patriot battery consists of a truck-mounted launching system with eight launchers that can hold up to four missile interceptors each, a ground radar, a control station and a generator. The Army said it currently has 16 Patriot battalions. A 2018 IISS report found those

battalions operate 50 batteries, which have more than 1,200 missile interceptors. The US batteries are regularly deployed around the world. In addition, Patriots also are operated or being purchased by the Netherlands, Germany, Japan, Israel, Saudi Arabia, Kuwait, Taiwan, Greece, Spain, South Korea, the United Arab Emirates, Qatar, Romania, Sweden, Poland and Bahrain. The Patriot system "is one of the most widely operated and reliable and proven air missile defence systems out there," and the theatre ballistic missile defence capability could help defend Ukraine against Iranian-supplied ballistic missiles, said Tom Karako, director of the Missile Defense Project at the Center for Strategic and International Studies.

Patriot Cost: Over the years the Patriot system and missiles have been continually modified. The current interceptor missile

for the Patriot system costs approximately \$4m per round and the launchers cost about \$10m each, CSIS reported in its July missile defence report. At that price, it's not cost effective or optimal to use the Patriot to shoot down the far smaller and dramatically cheaper Iranian drones that Russia has been buying and using in Ukraine.

“Firing a million-dollar missile at a \$50,000 drone is a losing proposition,” said Mark Cancian, a retired Marine Corps reserves colonel and senior adviser at CSIS.

Deployment Concerns: A Patriot battery can need as many as 90 troops to operate and maintain it, and for months the US was reluctant to provide the complex system because sending forces into Ukraine to operate it is a non-starter for the Biden administration. But there were also concerns that deployment of the system would provoke Russia, or risk that a missile fired could end up hitting inside Russia, which could further escalate the conflict. According to officials, the urgent pleadings of Ukrainian leaders and the devastating destruction of the country’s civilian infrastructure, including loss of electricity and heat as winter drags on, ultimately overcame US reservations about supplying the Patriots.

A key hurdle will be training. US troops will have to train Ukrainian forces on how to use and maintain the system. Army soldiers assigned to Patriot battalions get extensive training to be able to effectively locate a target, lock on with radar and fire. The US has trained Ukrainian troops on other complex weapons systems, including the HIMARS. In many cases they have been able to shorten the training, getting Ukrainian troops out to the battlefield in weeks. Officials have declined to provide details on how long the Patriot training would take and where exactly it will be done.

Patriot Capabilities: Ukraine faces a range of Russian threats, and the Patriot is good against some and not that useful against others. One

Ukraine faces a range of Russian threats, and the Patriot is good against some and not that useful against others. One former senior military official with knowledge of the Patriot system said it will be effective against short-range ballistic missiles and it represents a strong message of US support, but one battery isn’t going to change the course of the war.

The success rate of the Patriot, however, has been repeatedly questioned. A 1992 Government Accountability Office report said it could not find evidence to support reports that the system had achieved a 70 percent success rate against Scud missiles in the Gulf War. In 2018, Saudi Arabia’s success in using Patriots against missiles fired by Houthi rebels in Yemen was questioned when videos surfaced of systems failing.

former senior military official with knowledge of the Patriot system said it will be effective against short-range ballistic missiles and it represents a strong message of US support, but one battery isn’t going to change the course of the war. The official, who spoke on condition of anonymity because the Ukraine deal has not yet been made public, noted that one Patriot battery has a long firing range, but can cover only a limited broad area. As an example, Patriots can effectively protect a small military base, but cannot fully protect a large city such as Kyiv. They could only provide coverage for a segment of a city.

Patriots are often deployed as a battalion, which includes four batteries. This will not be the case with Ukraine, which officials said would be receiving one battery. The Patriot has a more powerful radar that is better at discriminating targets than the Soviet-era S-300 system the Ukrainians have been using, but it has limitations, both Karako and Cancian said. Still, the Patriot’s ability to target some ballistic missiles and aircraft could potentially protect Kyiv if Russian President Putin carried through on his persistent threat to deploy a tactical nuclear device. But that would depend on how the weapon was delivered, Karako said. If it was a gravity bomb delivered by a warplane, the system could target the aircraft; if it was a cruise or short-to-medium-range ballistic missile, it could also possibly intercept the missile, Karako said.

Raytheon, which manufactures the Patriot, says it has been involved in 150 intercepts of ballistic missiles since 2015. The success rate of the

Patriot, however, has been repeatedly questioned. A 1992 Government Accountability Office report said it could not find evidence to support reports that the system had achieved a 70 percent success rate against Scud missiles in the Gulf War. In 2018, Saudi Arabia's success in using Patriots against missiles fired by Houthis rebels in Yemen was questioned when videos surfaced of systems failing. But beyond the Patriot's capabilities, its deployment is a big statement of support for Ukraine. "There's a lot of symbolism here," Cancian said.

Source: <https://www.aljazeera.com/news/2022/12/15/what-can-the-patriot-missile-do-for-ukraine>, 15 December 2022.

OPINION – Dylan Spaulding

What Does a Nuclear Fusion Breakthrough Mean for Energy Production and Nuclear Weapons?

On December 5, 2022, scientists at Lawrence Livermore National Laboratory in California focused the power of a stadium-sized laser at a target no larger than a thimble, vaporizing it within a few billionths of a second. Measurements soon showed that more energy came out of the target than went in – the first time that energy gain had ever been achieved in a laboratory fusion reaction. What does this experimental achievement mean for energy production? And what does this mean for nuclear weapons? Physicists have dreamt of harnessing fusion power since 1920 when Arthur Eddington first proposed that the sun's power may be coming from nuclear fusion— under the extreme pressures and temperatures within the sun, the natural repulsion between protons can be overcome, allowing hydrogen atoms to fuse into helium, releasing the energy that powers our star. In the years leading up to WWII, theoretical and experimental work by physicists and chemists indicated that tremendous amounts of energy could be unleashed, either by splitting heavy

nuclei apart (fission) or by combining light nuclei together (fusion). Fission's potential was demonstrated in the pre-dawn New Mexico desert when, on July 16, 1945, the Trinity device utilized the fission of plutonium to generate an explosion with a force equivalent to over 20,000 tons of TNT, shaking the world into the 'Atomic Age'.

The still greater energy potential of nuclear fusion was demonstrated seven years later when a fission bomb was used to initiate fusion reactions in the world's first demonstration of a thermonuclear device. The test, dubbed 'Ivy Mike', had a yield of 10.4 megatons – 450 times more powerful than the fission bomb detonated over Nagasaki. That astonishing increase in destructive power was made possible by the fact that fusion reactions, though harder to initiate, release far more energy than fission. Because of their greater power, thermonuclear weapons now dominate our nuclear arsenal. Ever since, fusion has represented a powerful dichotomy as nature's ultimate energy source and man's most destructive capability. The pursuit of controlled fusion energy and the drive to build more sophisticated nuclear weapons have been linked ever since.

The US conducted more than 1,000 explosive nuclear tests from 1945-1992 in order to develop and test its nuclear weapons designs. In 1996, the US signed CTBT, agreeing to cease explosive nuclear tests. 185 other nations have since joined the treaty however the US remains one of 10 yet to ratify it, despite abiding by its terms.

The Role of the National Ignition Facility in the Nuclear Stockpile: The US conducted more than 1,000 explosive nuclear tests from 1945-1992 in order to develop and test its nuclear weapons designs. In 1996, the US signed CTBT, agreeing to cease explosive nuclear tests. 185 other nations have

since joined the treaty however the US remains one of 10 yet to ratify it, despite abiding by its terms. To understand the performance, longevity, and to maintain the existing nuclear weapons, the US began a science-based "stockpile stewardship" program in which sophisticated laboratory experiments and advanced computer simulations are used to certify weapons viability and performance. The facility that carried out the ground-breaking Dec 5th experiment is key to this program. Known as the National Ignition Facility (NIF), it is the centerpiece of Lawrence Livermore National Laboratory and the successor of several prior laser facilities at the lab.

NIF has played an important role in the stockpile stewardship program by generating data on relevant materials that can be used to benchmark and improve computational models under temperature and density conditions that could previously only be reached with explosive nuclear tests. The size of three football fields, NIF can focus optical powers of up to ~500 trillion watts onto a mm-scale sample in a precise, highly tunable manner. It employs 192 laser beams that simultaneously fire a single pulse a few nanoseconds (billionths of a second) in duration. NIF's lasers have been trained on materials across the periodic table to find out how they transform into liquids and plasmas at high density. This supports more detailed understanding of nuclear weapons physics, for example, of 'boosted' fission weapons (which also rely on fusion of deuterium and tritium) and of the processes occurring in the secondary phases of thermonuclear weapons where fusion reactions occur to increase yield. NIF can also be used to generate x-rays and gamma-rays which are used to study radiation hardness of weapons components and assemblies.

A Bumpy Road to Fusion:

The ability to drive matter to unprecedented densities and temperatures also makes NIF a unique tool for fusion research. Fusion requires overcoming the natural tendency for protons in the nuclei to push away other nuclei (like magnets set in opposition).

NIF relies on a technique called 'Inertial Confinement Fusion,' or ICF, in which the laser light is converted to x-rays that ablatively drive off a thin diamond shell containing the fusion fuel. That process sends a powerful shock wave inward, heating and compressing the fuel to extraordinarily high pressures and temperatures (a hundred billion atmospheres and millions of degrees) – just enough, it turns out, to coax deuterium and tritium,

both isotopes of hydrogen, to fuse into helium as Eddington originally postulated. This process is often compared to squeezing a water balloon without allowing it to bulge out of one's fingers at any point.

A decade worth of frustratingly slow progress showed that even tiny imperfections or asymmetries during compression of the fuel can poison the outcome. This engineering challenge led many to reasonably doubt whether ICF was a viable approach to fusion at all. Throughout that time, progressive improvements were made in the laser infrastructure and in the production of targets with extremely tight tolerances. Models were tuned, the symmetry of compression was improved and, progressively, the hindrances that plagued previous attempts were better understood. In the Dec 5th experiment, 1.5 times as much energy was generated by fusion compared to the energy that reached the fuel. This was nearly double the previous record at NIF, achieved in August of 2021 but not repeated since.

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Competing technologies that rely on magnetic confinement using donut-shaped accelerators called 'tokomaks' may prove more feasible for commercialized fusion energy though they have yet to demonstrate a net gain of the type NIF produced. The largest such device, known as 'ITER' is a multi-national collaboration presently under construction in France while many smaller research tokomaks are operational worldwide.

Are We on the Way to Commercialized Fusion Energy?

Despite the recent, much-lauded result, NIF is not a nuclear fusion plant, nor will it ever be. The energy produced by the December 5th experiment only returned 1% of the total energy that came from the electrical grid to power the lasers. The lasers can be fired about once per day (and

even less when the facility is pressed to its limits) whereas for ICF to be a viable energy source would require repetition at about 10 times per second and with a gain in energy much higher than 1.5. Competing technologies that rely on magnetic confinement using donut-shaped accelerators called 'tokomaks' may prove more feasible for commercialized fusion energy though they have yet to demonstrate a net gain of the type NIF

produced. The largest such device, known as 'ITER' is a multi-national collaboration presently under construction in France while many smaller research tokomaks are operational worldwide. While NIF's result is an exciting science and engineering breakthrough built on decades of effort, it does not signal that commercial fusion for energy production is on the horizon. Many technical hurdles will need to be overcome first, and these will likely take decades; if a viable fusion power plant is like sending astronauts to the moon for the first time, this was, perhaps, Kitty Hawk. Thus, this result should not distract us from the fact that urgent action to develop clean energy sources and combat climate change is required in this decade.

A Tool for Science (and Politics): While most experiments are reserved for the purposes described above, NIF has also produced new results in fundamental science through a limited and competitive academic user program. Experiments have

been carried out to study the internal structure of exoplanets, instabilities in supernovae, and nucleosynthesis in the earliest history of the universe. Because NIF can reach conditions inaccessible on any other platform, it permits new science in unexplored conditions, not just in weapons research. At the same time, NIF is part of a new technological arms race. In the post-Cold War era, demonstration of technical competency in high-energy physics has become a surrogate method for nations to demonstrate the credibility of their nuclear deterrent. Other nuclear states, including the UK, France, Russia, and China either have or are developing large laser facilities, ostensibly for fusion research but also closely associated with nuclear modernization programs. While the recent experimental breakthrough on NIF is likely to inspire private-sector interest, the reality of fusion's dual-use nature means that ICF and defense research can never be fully disentangled. As with so many technological breakthroughs, the most powerful can also be the

Scientists at the Energy Department's Lawrence Livermore National Laboratory ("LLNL") in California recently announced the first-ever demonstration of fusion "ignition." This means that more energy was generated from fusion than was needed to operate the high-powered lasers that triggered the reaction.

most destructive. As we learn to control the power locked in the atomic nucleus, it is up to us to choose how we use it.

Source: <https://blog.ucsusa.org/dylan-spaulding/what-does-a-nuclear-fusion-breakthrough-mean-for-energy-production-and-nuclear-weapons/>, 21 December 2022.

OPINION – Frank Holmes

Nuclear Fusion Technology Could Be A \$40 Trillion Market

Scientists at the Energy Department's Lawrence Livermore National Laboratory ("LLNL") in California recently announced the first-ever demonstration of fusion "ignition." This means that more energy was generated from fusion than was needed to operate the high-powered lasers that triggered the reaction. More than 2 megajoules (MJ) of laser light were directed onto a tiny gold-plated capsule, resulting in the production of a little

over 3 MJ of energy, the equivalent of three sticks of dynamite.

This important milestone is the culmination of decades' worth of research and lots of trial and error, and it makes good on the hope that humanity will one day enjoy 100% clean and plentiful energy. Unlike conventional nuclear fission, which produces highly radioactive waste and carries the risk of nuclear proliferation, nuclear fusion has no emissions or risk of cataclysmic disaster. That should please activists who support renewable, non-carbon-emitting energy sources such as wind and solar and yet oppose nuclear power.

75th Anniversary of Another Great American Invention, the Transistor: I think it's only fitting that this breakthrough occurred not just in the U.S., the most innovative country on earth, but also on the 75th anniversary of the invention of the transistor. Like fusion energy, the transistor's importance can't be overstated. Invented in

December 1947 in New Jersey's storied Bell Labs—also the birthplace of the photovoltaic cell, fiber optic cable, communications satellite, UNIX operating system and C programming language—the transistor made the 20th century possible. Everything we use and enjoy today, from our iPhones to our Teslas, wouldn't exist without the seminal American invention.

In 2021, the electric vehicle maker unveiled its proprietary application-specific integrated circuit (ASIC) for artificial intelligence (AI) training. The ASIC chip, believe it or not, boasts an unbelievable 50 billion transistors.

Private Investment in Fusion Technology has been Increasing: Getting your electricity from a commercial fusion reactor is still years if not decades away, but that hasn't stopped money from

flowing into the sector. This year, private investment is estimated to top \$1 billion, following the record \$2.6 billion that went into fusion research in 2021, according to BloombergNEF.

At the moment, there aren't any publicly traded fusion companies. However, Bloomberg has a Global Nuclear Theme Peers index that tracks listed companies with exposure to the industry, estimated by Bloomberg to one day achieve a jaw-dropping \$40 trillion valuation. Some of the more recognizable names include Rolls-Royce, Toshiba, Hitachi and General Electric. For the five-year period, the index of 64 "nuclear" stocks has advanced approximately 100%, compared to the MSCI World Index, up 38% over the same period. The number of private firms involved in R&D continues to grow, raising the possibility that some will tap public markets in the coming years.

Among the largest is Commonwealth Fusion Systems, or CFS, which spun out of MIT's Plasma Science and Fusion Center in 2018. The company raised \$1.8 billion in December 2021, on top of

the \$250 million it had raised previously. Its investors include Bill Gates and Google (GOOG), along with oil companies, venture capital firms and sovereign wealth funds. CFS claims to have the fastest, lowest cost solution to commercial fusion energy and is in the process of building a prototype that is set to demonstrate net energy gain by 2025.

Another major player is TAE Technologies. Located in California, the company has raised a total of \$1.2 billion as of December 2022, from investors such as the late Paul Allen, Goldman Sachs (GS), Google and the family office of Charles Schwab (SCHW). TAE says it is developing a fusion reactor, scheduled to be unveiled in the early 2030s, that will generate electricity from a proton-boron reaction at an incredible temperature of 1 billion degrees.

Other contenders in the field include Washington State-based Helion Energy, Canada's General Fusion, and the United Kingdom's Tokamak Energy. In February 2022, Tokamak broke a longstanding record by generating 59 MJ of energy, the highest sustained energy pulse ever. As an investor, I would keep an eye on this space!

Source: Frank Holmes is a Canadian-American investor, venture capitalist and philanthropist. <https://seekingalpha.com/article/4566745-nuclear-fusion-technology-could-be-a-40-trillion-market>, 28 December 2022.

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NUCLEAR STRATEGY

INDIA

Days after China Clash, Agni V Successfully Tested, it can Target Beijing

India has successfully carried out night trials of the Agni V nuclear-capable ballistic missile which can hit targets beyond 5,400 km, sources in the

Defence Ministry said, amid heightened tensions with China over clashes along the de facto border in Arunachal Pradesh. The test was carried out to validate new technologies and equipment on the missile and has proved that the missile can now hit targets further away than before, they added.

The nuclear-capable ballistic missile was fired from Abdul Kalam Island, off the coast of Odisha. This is the ninth flight of the Agni V – a missile first tested in 2012 - and was a routine test, Defence Ministry sources said. While the test was carried out days after the clashes, it had been planned earlier.

Source: <https://www.ndtv.com/india-news/india-conducts-night-trials-of-nuclear-capable-agni-v-ballistic-missile-3610126>, 16 December 2022.

NORTH KOREA

North Korea Slams Japan's Military Buildup, Vows to Test Nuclear Missile

Japan announced its biggest military build-up since World War Two as tension with China and a hostile North Korea, and Russia's Ukraine invasion, stoke fears of war. North Korea condemned a Japanese military buildup outlined in a new security strategy, calling it dangerous and vowing counteractions, while also warning of another imminent test of an ICBM.

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and vowing counteractions, while also warning of another imminent test of an intercontinental ballistic missile. ...

Source: <https://www.ndtv.com/world-news/north-korea-slams-japans-military-buildup-vows-to-test-nuclear-missile-3622127>, 20 December 2022.

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RUSSIA

Russia Readies Hypersonic Missile for Launch in Fresh Nuclear Threat

Russia's MoD has reported that a regiment with an intercontinental hypersonic "Avangard" missile system has entered combat duty in the Orenburg region. In a

statement, it said that the missile system will increase the combat capabilities of the Strategic Missile Forces. Russian President Putin described the Avangard as "invincible" in 2018 and claims the weapon can hit any target on Earth in 30 minutes and at 27 times the speed of sound. The announcement follows Putin's meeting with his military commanders and a barrage of Russian missile strikes across a number of Ukrainian cities. Russia's Defence Ministry claims the 76

attacks, the majority of which were intercepted by Ukraine's air forces, prevented the delivery of foreign weapons to Ukraine. Meanwhile, emergency crews pulled the body of a toddler from the rubble in a pre-dawn search for survivors of a Russian missile attack

that tore through an apartment building in the central Kyiv was targeted by approximately 40 missiles, authorities said, but nearly all of them were intercepted by Ukraine's military.

Source: https://www.euronews.com/2022/12/17/russia-readies-hypersonic-missile-for-launch-in-fresh-nuclear-threat?utm_source=yahoo&utm_campaign=feeds_news&utm_medium=referral, 17 December 2022.

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Russia has Enough Missiles for 3-4 More Mass Strikes, Official Warns

“Kyiv is well aware that the Russian strategy is to wear down the will to resist through attacks on civilians and infrastructure and wants to signal that these will not achieve their goal.” About a month ago, Ukrainian Defense Minister Reznikov tweeted a list of high-precision Russian missile supplies on November 22, showing a reduced stockpile of Iskander, Kalibr, Kh-22/32 and Kh-35 missiles. More than a thousand missiles and rockets fired by Russian forces and collected by the Kharkiv prosecutor’s office to be included in future war crimes investigations are seen at a depot on December 18, 2022, in Kharkiv, Ukraine. In inset, Ukrainian National Security and Defense Council Secretary Oleksiy Danilov answers AFP journalists’ questions during an interview in his office in Kiev on December 24, 2021. Danilov said that Russia may have four attacks’ worth of missiles remaining to target critical Ukrainian infrastructure.

Source: <https://www.newsweek.com/russia-has-enough-missiles-3-4-more-mass-strikes-official-warns-1768222>, 19 December 2022.

SOUTH KOREA–USA

S. Korea, US to Develop ‘Realistic’ Training Scenarios against N. Korean Threats

South Korea and the US will develop “realistic” combat training scenarios that incorporate North Korea’s nuclear and missile threats in their combined exercises next year. At a meeting of the military’s top commanders led by defense minister Lee Jong-sup, the participants discussed conducting some 20 joint drills in 2023.

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The top brass also discussed advancing the alliance with the U.S., including a readjustment of the allies’ tailored deterrence strategy (TDS) and deploying U.S. strategic assets on the Korean Peninsula as part of the U.S.’ extended deterrence.

The exercises, such as the Sangyong marine training, will be carried out at the same level of intensity as the Foal Eagle field training that was suspended in 2019 amid signs of reconciliation with the North. The military will expand the size and scope of combined field drills in the first half of the year and develop “realistic” scenarios that take into account the North’s nuclear and missile threats to enhance theater-level training. The top brass also discussed advancing the alliance with the U.S., including a readjustment of the allies’ tailored deterrence strategy (TDS) and deploying U.S. strategic assets on the Korean Peninsula as part of the U.S.’ extended deterrence. The participants also reviewed the planned launch of a new Joint Chiefs of Staff (JCS) unit next month in charge of responding to the North’s threats involving its nuclear and WMD capabilities.

Source: http://world.kbs.co.kr/service/news_view.htm?lang=e&Seq_Code=174639, 21 December 2022.

USA

New Y-12 Facility to ‘Modernize’ US Nuclear

Weapons Stockpile

A new facility to help modernizes the US’ nuclear weapons stockpile is being built at Y-12, now that the former Biology Complex is completely gone. The demolition work on the complex wrapped up last year, and since that time, workers have been busy tearing up the old building’s foundations. The Department of Energy shared that this work is complete, freeing up 18 acres for the new facility. The Biology Complex was originally comprised of 11 buildings. It was built to process uranium in the 1940s, but it would go on to be used for research. According to the DOE, this research help people gain a greater understanding of genetics and the effects of radiation. The complex shut

down in 2002 and would be categorized as a "high-risk excess" facility due to its deteriorated structure.

Source: <https://www.wate.com/news/anderson-county-news/new-y-12-facility-to-modernize-united-states-nuclear-weapons-stockpile/>, 21 December 2022.

BALLESTIC MISSILE DEFENCE

INDIA

As China Lurks, India to Get New Missile; Can Strike Targets 500 Km Away: Report

Amid the ongoing conflict with China, the Indian armed forces are now going to acquire the 'Pralay' ballistic missile which can hit targets from 150 to 500 Kms. The proposal moved by the Indian defence forces is at an advanced stage and is scheduled to be taken up for clearance during a high-level meeting, defence sources told ANI. The proposal is also important as it comes at a time when the Indian forces are working on the creation of a rocket force which has been in discussion at the highest levels in the Defence Ministry. Recently, Navy chief Admiral R Hari Kumar stated that the late Gen Bipin Rawat was working on the creation of a rocket force to counter enemies on the border. The missile was successfully tested twice on two consecutive days last year in December and since then, the forces are working towards its acquisition and induction.

With a range of 150 to 500 km, 'Pralay' is powered with solid propellant rocket motor and other new technologies. The missile guidance

system includes state-of-the-art navigation and integrated avionics. "Pralay' is a quasi-ballistic surface-to-surface missile. The advanced missile has been developed in a way to able to defeat interceptor missiles. It has the ability to change its path after covering a certain range midair," sources said. Sources said that such missiles give a tremendous capability to own troops to completely destroy or take out enemy air defence sites or similar high-value targets. The Pralay missiles along with the BrahMos supersonic cruise

missiles would be the longest-range tactical weapon system in the defence forces as the long-range strategic weapons are controlled by the strategic forces command.

Source: <https://www.hindustantimes.com/india-news/indian-armed-forces-to-acquire-pralay-ballistic-missile-amid-ongoing-conflict-with-china-101671526970463.html>, 20 December 2022.

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NORTH KOREA

North Korea Fires 2 Ballistic Missiles Towards Eastern Waters

North Korea has fired two short-range ballistic missiles, according to South Korea's military, the latest in a recent flurry of weapons tests that took place days after a joint air drill by the South and the US. The Joint Chiefs of Staff said the missiles were launched at 07:32 GMT from the Sunan area of North Korea's

capital, Pyongyang, towards the sea off its east coast. "Our military maintains a full readiness posture while closely cooperating with the US while strengthening surveillance and vigilance," it said in a statement.

There was no immediate statement by North Korea

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on the launch, which came three days after the US flew nuclear-capable bombers and advanced stealth jets near the Korean Peninsula for joint training with South Korean fighter jets. North Korea typically views such military exercises as a rehearsal for an invasion. The US and South Korea have warned for months that North Korea is preparing to conduct its seventh nuclear test. Despite heavy international sanctions over its weapons programmes, North Korea in recent months has test-fired a barrage of ballistic missiles. These included the launch of its most advanced ICBM last month, the test of what it says was a new rocket engine, and claims it has developed new capabilities to take images from space.

Source: <https://www.aljazeera.com/news/2022/12/23/north-korea-fires-ballistic-missile-towards-eastern-waters-south>, 23 December 2022.

TURKEY

Turkey to Start Mass Production of Indigenous Air Defence Systems

Turkey has decided to start mass production of its indigenous air defence systems and its first national tactical ballistic missile Tayfun, the country's defence industry executive committee said. The committee made such decisions regarding 25 important defence industry projects during a meeting chaired by President Erdogan, reports Xinhua news agency. Erdogan earlier said Tayfun will have a range of 1,000 km. The indigenous air defence systems that will go into mass production include surface-to-air missile Siper, low-altitude air defense missiles Hisar and Sungur, anti-ship missile Atmaca, laser-guided missile TRLG-230, anti-tank missile Karaok, and air-to-air missiles Gokdogan and Bozdogan,

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according a statement by the committee.

Source: <https://daijiworld.com/news/newsDisplay?newsID=1031705>, 21 December 2022.

TURKEY-GREECE

Erdogan Warns Greece that Turkish Missiles can Reach Athens

Turkey has warned Greece that a missile could hit the Greek capital unless "you keep calm", further ramping up its rhetoric against Greece. Tefun, which is Turkish for "typhoon", is a short-range ballistic missile developed by Turkey. The missile, tested over the Black Sea in October and hit a target at about 560 kilometres, has more than twice the range of existing missiles in Turkey's arsenal. Despite being NATO allies, the neighbours have been at loggerheads for decades over several bilateral disputes, including maritime boundaries, overlapping claims on their continental shelves, and the long-running Cyprus dispute.

Source: <https://greekcitytimes.com/2022/12/12/turkeys-ballistic-missile-test-scares-athens-says-aa/>, 18 December 2022.

EMERGING TECHNOLOGIES AND DETERRENCE

CHINA

Chinese Nuclear Plant Starts Supplying Industrial Heating

China's first nuclear energy industrial heating project has officially been completed and put into operation at the Qinshan nuclear power plant in Zhejiang Province, China National Nuclear Corporation (CNNC) announced. The

project started on 15 July this year, with the construction of the main network completed on 15 November. It entered trial operation on 21 November. CNNC said the project can provide guaranteed 24-hour heat supply with annual industrial heat supply of about 288,000 gigajoules. This, it says, is equivalent to saving about 10,000 tonnes of standard coal and reducing carbon dioxide emissions by about 24,000 tonnes. "This is another major breakthrough made by CNNC Qinshan Nuclear Power and Haiyan County in the comprehensive utilisation of nuclear energy since the completion of the first phase of the Zhejiang Haiyan Nuclear Energy Heating Demonstration Project in 2021," CNNC said.

The first phase of the district heating demonstration project at Qinshan, with a total investment of about CNY940 million (USD135 million), was commissioned in December 2021. The project is divided into three phases. The initial phase now provides nuclear energy generated central heating to 460,000 square metres of accommodation in three residential areas and 5000 square metres of apartments for nearly 4000 residents of Haiyan County. The overall project goal is to have 704,000 gigajoules of heat, meeting the heating demand of 4 million square metres by 2025, covering the main urban area of Haiyan County and the entire area of Shupu Town.

The Zhejiang Haiyan Nuclear Energy Heating Demonstration Project utilises the remaining thermal power from the Qinshan plant in winter to provide heating to public facilities, residential communities and industrial parks in Haiyan County without affecting the original power generation and safety performance of the reactors. Qinshan is China's largest nuclear power plant, comprising seven reactors. Construction of Phase I of the plant - a 300 MWe PWR which was the first indigenously-designed Chinese nuclear power station to be built - began in 1985, with

the unit entering commercial operation in 1994. Qinshan Phase II is home to four operating CNP-600 PWRs, built with a high degree of localisation. Units 1 and 2, comprising the first stage of Phase II, began operating in 2002 and 2004, respectively. Units 3 and 4 entered commercial operation in October 2010 and April 2021. Phase III consists of two 750 MWe pressurised heavy water reactors supplied by Atomic Energy of Canada Ltd and commissioned in 2002 and 2003.

China's Haiyang nuclear power plant in Shandong province officially started providing district heat to the surrounding area in November 2020. A trial of the project - the country's

first commercial nuclear heating project - was carried out the previous winter, providing heat to 700,000 square metres of housing, including the plant's dormitory and some local residents. In 2021, the Haiyang Nuclear Energy Heating Project began providing heating to the entire Haiyang City. In May, CNNC started work on a project at the Tianwan plant in China's Jiangsu province to supply steam to a nearby petrochemical plant. Due for completion at the end of 2023, it will be China's first industrial-use nuclear energy steam supply project. The facility is expected to supply 4.8 million tonnes of steam annually.

Source: <https://world-nuclear-news.org/Articles/Chinese-nuclear-plant-starts-supplying-industrial>, 15 December 2022.

In May, CNNC started work on a project at the Tianwan plant in China's Jiangsu province to supply steam to a nearby petrochemical plant. Due for completion at the end of 2023, it will be China's first industrial-use nuclear energy steam supply project. The facility is expected to supply 4.8 million tonnes of steam annually.

NUCLEAR ENERGY

FRANCE

EDF Further Delays the Restart of Several Nuclear Plants

EDF has faced an unprecedented number of outages at reactors this year due to a delayed maintenance schedule and stress corrosion, reducing nuclear output to 30-year lows just as Russia's war in Ukraine hit Europe's energy supplies. French nuclear operator EDF has further

delayed the restart of several of its nuclear reactors affected by stress corrosion, in some cases until as late as June, as it struggles to get enough units online to meet winter power demand. EDF has faced an unprecedented number of outages at reactors this year due to a delayed maintenance schedule and stress corrosion, reducing nuclear output to 30-year lows just as Russia's war in Ukraine hit Europe's energy supplies. The restart of the 1.3 GW Penly 2 reactor was delayed four and a half months to June 11, according to a revised schedule published over the weekend. EDF said it had sent a letter about a new repair strategy for its 1.3 GW reactors to the Nuclear Safety Authority (ASN) and is aiming to deal with all those affected by the end of 2023.

Source: <https://energy.economictimes.indiatimes.com/news/power/edf-further-delays-the-restart-of-several-nuclear-plants/96342458>, 19 December 2022.

INDIA

India Gives Update on Nuclear Construction Projects

The Minister of State Jitendra Singh confirmed the government's plans for 21 new reactors - including those already under construction - and gave an update on the progress of the various projects in a written answer to the Lok Sabha. According to Singh's statement, the following projects are classed by the government as "under construction": Kakrapar 3&4: Kakrapar 3 was connected to the grid in 2021 and the project to build two 700 MWe PHWR is classed as 97.12% complete (as of October 2022). Expected completion 2023; Rawatbhata 7&8: 700 MWe PHWRs, 88.88% complete, expected completion 2026; Kudankulam 3&4: Russian-supplied 1000 MWe VVER pressurised water reactors, 63.67% complete, expected completion 2025; Kudankulam 5&6: 1000 MWe VVERs, 12.89% complete,

expected completion 2027; Kalpakkam: 500 MWe prototype fast breeder reactor, 97.64% complete, expected completion 2024. The government also classes Gorakhpur 1&2 - both 700 MWe PHWRs - as "under construction" with an expected completion date of 2029.

Foundation piles for the nuclear islands have been completed and work is under way on other buildings and structures at the Haryana site, according to Singh's statement. The following projects - all 700 MWe PHWRs - have been accorded administrative approval and financial sanction - Kaiga 5&6, Gorakhpur 3&4, Chutka 1&2, Mahi Banswara 1&2, Mahi Banswara 3&4. Pre-project site activities and bulk procurement of long-lead equipment are under way for those projects, all of which are expected to be completed "progressively by 2031". Excavation for Kaiga 5&6 has already begun. "Nuclear...energy," Singh said. Earlier this year

officials from India's Department of Atomic Energy said the country was preparing to begin building 700 MWe PHWRs in fleet mode from 2023, beginning with Kaiga 5&6.

Source: <https://world-nuclear-news.org/Articles/India-gives-update-on-nuclear-construction-project>, 16 December 2022.

JAPAN

Japan Wants to Restart More Nuclear Power Reactors

PM Kishida has set ambitious nuclear power goals to cut Japan's reliance on energy imports, but experts say it 'will be a challenge' to get existing reactors going again amid concerns around plants caught in the Ukraine war. Japan is facing its most severe energy crisis in decades and wants to speed up the revival of its nuclear energy industry to reduce its dependence on imported fossil fuels. But restarting more nuclear reactors remains controversial, more than a decade after the 2011

Kakrapar 3&4: Kakrapar 3 was connected to the grid in 2021 and the project to build two 700 MWe PHWR is classed as 97.12% complete (as of October 2022). Expected completion 2023; Rawatbhata 7&8: 700 MWe PHWRs, 88.88% complete, expected completion 2026; Kudankulam 3&4: Russian-supplied 1000 MWe VVER pressurised water reactors, 63.67% complete, expected completion 2025.

Fukushima disaster. All the country's reactors were shut down for safety checks after the Fukushima meltdown, and there are currently 33 considered operable. Before the Fukushima disaster, nearly a third of Japan's power generation came from nuclear energy, but in the financial year to March 2022, the figure stood at around seven per cent. The government is aiming for nuclear power to account for 20 to 22 per cent of electricity production by 2030, part of efforts to reach carbon neutrality by 2050.

Source: https://www.scmp.com/news/asia/east-asia/article/3204219/japan-wants-restart-more-nuclear-power-reactors-terror-threat-sparks-unease-public?module=perpetual_scroll_0&pgtype=article&campaign=3204219, 22 December 2022.

POLAND

Westinghouse and Poland's PEJ Sign Agreement on AP1000 'Next Steps'

Poland's Polskie Elektrownie Jądowe has signed a cooperation agreement with Westinghouse "defining the main principles and path forward for the first Polish nuclear reactors". In November, the Polish government selected Westinghouse for the country's first nuclear power plant, as it sets out on an ambitious plan to embrace nuclear energy in the country. The agreement sets out next steps, including site-layout, licensing and permitting support, engineering services contracts and procurement and construction planning services. Westinghouse faced competition to be selected for Poland's

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nuclear programme from Korea Hydro & Nuclear Power (KHNP) and France's EDF. ...

Source: <https://world-nuclear-news.org/Articles/Westinghouse-and-Polands-PEJ-sign-AP1000-reactor>, 16 December 2022.

RUSSIA

Inner Containment Dome Installed at Kursk II

The structure weighing 256 tonnes has a diameter of 36 metres and has been

installed in the design position on the reactor building of Kursk II's second unit. Oleg Shperle, vice president of JSC Atomstroyexport, project director for the construction, said the installation "opens up a new frontier of work in the reactor building and makes it possible to start preparations for the installation of the reactor vessel, steam generators and the main circulation pipeline in comfortable conditions. And the first in this series will be the operations to connect and start up the polar crane". Kursk II is a new

nuclear power plant in western Russia that will feature two VVER-TOI reactors, the latest version of Russia's large light-water designs. They have upgraded pressure vessels and a higher power rating of 3300 MWt that enables them to generate 1300 MWe gross. Construction of the first unit began in 2018, its polar crane was installed in October 2021 and the reactor vessel in June 2022.

Source: <https://world-nuclear-news.org/Articles/In-Pictures-Inner-containment-dome-installed-in-de>, 16 December 2022.

There is room to purchase as many as 35 small modular reactors, known as SMRs, Friedman said, citing Turkish aspirations for 20 GWss of electricity generation capacity from nuclear by 2050. US manufacturers of SMRs include NuScale Power Corp. and the Bill Gates-backed TerraPower LLC. SMRs typically generate a hundred MWss or slightly more — making them roughly a tenth the size of conventional reactors — and can be built in series, like components in a factory, rather than as the usual bespoke projects.

TURKEY

Turkey in Talks with US to Purchase American Nuclear Reactors

Turkey's government and private companies are in talks with the US for the purchase of small nuclear reactors as the country looks to wean itself off coal, "There is a serious interest in nuclear as a way to replace coal-fired power plants," Justin Friedman, senior advisor for commercial competitiveness in nuclear energy at the US State Department. There is room to purchase as many as 35 small modular reactors, known as SMRs, Friedman

said, citing Turkish aspirations for 20 GWss of electricity generation capacity from nuclear by 2050. US manufacturers of SMRs include NuScale Power Corp. and the Bill Gates-backed TerraPower LLC. SMRs typically generate a hundred MWss or slightly more — making them roughly a tenth the size of conventional reactors — and can be built in series, like components in a factory, rather than as the usual bespoke projects. The talks with the US come as Russian state company Rosatom nears completion of the Akkuyu. Turkey has 68 coal-fired power stations, which met about a third of its electricity needs last year, according to the energy ministry. The country aims to achieve net-zero carbon emissions by 2053.

Source: <https://www.turkishminute.com/2022/12/21/turkey-talk-with-us-purchase-american-nuclear-reactors-report/>, 21 December 2022.

UAE

UAE Combats Climate Change with Nuclear Power and Shares its Experience

One way the UAE is addressing climate change is by reducing the carbon footprint of its energy

system with nuclear power — a strategy that, through cooperation with the IAEA, it is helping to replicate in other countries. In 2007, after careful consideration, the UAE decided to develop a civilian nuclear energy programme. Just 8 years after construction began in 2012, a nuclear power reactor of South Korean design, the first in a series of four, was connected to the UAE grid.

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The new nuclear power plant situated in Barakah, almost 300 kms west of the country's capital, Abu Dhabi, is the first in the Arab world. Foulon works closely with the IAEA in coordinating activities where experts from other countries can

visit and learn from the UAE's experience. In this capacity, Khalifa University has been designated an IAEA Collaborating Centre for nuclear energy infrastructure and human resources since 2017. Decarbonizing energy in the UAE and beyond: Major drivers for the UAE to pursue nuclear power have been its reliability, 24-hour availability, and baseload low carbon power, Foulon said. Low carbon nuclear power is critical for the country as it pursues a 2050 'net zero' strategy that aims for 14 GW of clean energy

capacity by 2030.

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Source: <https://www.iaea.org/bulletin/uae-combats-climate-change-with-nuclear-power-and-shares-its-experience>, December 2022.

capacity by 2030.

Source: <https://www.iaea.org/bulletin/uae-combats-climate-change-with-nuclear-power-and-shares-its-experience>, December 2022.

UK

First Reactor Vessel for Hinkley Point C Completed

The manufacture of the reactor pressure vessel for the first of two EPR units at the Hinkley Point C nuclear power plant under construction in Somerset, UK, has been completed in France and the large component is ready for delivery to the

construction site. The reactor pressure vessel is the high strength steel cylinder that will house the reactor core and all associated components including the reactor vessel internals which support and stabilise the core within the reactor vessel, as well as providing the path for coolant flow and guiding movement of the control rods.

Construction of Hinkley Point C - composed of two EPR reactors of 1630 MWe each - began in December 2018. Unit 1 of the plant was originally scheduled to start up by the end of 2025. In January 2021, EDF said the start of electricity

generation from unit 1 had been rescheduled to June 2026. Delays arising from the COVID-19 pandemic would also increase the cost of the project by GBP500 million to between GBP22 and 23 billion. In May this year, following a review, EDF announced the start of electricity generation for HPC unit 1 is now expected in June 2027 and the project completion costs were now estimated in the range of GBP25 to 26 billion.

Source: <https://world-nuclear-news.org/Articles/First-reactor-vessel-for-Hinkley-Point-C-completed>, 16 December 2022.

In January 2021, EDF said the start of electricity generation from unit 1 had been rescheduled to June 2026. Delays arising from the COVID-19 pandemic would also increase the cost of the project by GBP500 million to between GBP22 and 23 billion.

An IAEA International Nuclear Security Advisory Service (INSServ) team said Sudan had strengthened its national nuclear security regime by implementing extensive nuclear security systems and measures in relation to materials out of regulatory control. The team encouraged Sudan to further enhance its relevant nuclear security detection and response system.

detection and response system. The first INSServ mission to Sudan was carried out at the request of the Sudanese government and hosted by the Sudanese Nuclear and Radiological Regulatory Authority (SNRRA) based in Khartoum. Sudan uses radioactive sources in an increasing number of applications in medicine, agriculture, industry, and research and education and hundreds of

radioactive sources are transported around the country and/or pass through Khartoum International Airport every year. Sudan is also considering the introduction of nuclear power in its energy mix.

Source: <https://www.neimagazine.com/news/newsiaea-finds-improved-nuclear-security-infrastructure-in-sudan-10433384>, 14 December 2022.

USA

Energy Dept Vacates 1950s Decision Revoking Security Clearance for Robert Oppenheimer

The Biden administration is vacating a decades-old decision to revoke the security clearance of World War II-era scientist J. Robert Oppenheimer, who is known today as the "father

of the atomic bomb." In a written statement first shared with *The Hill*, Energy Secretary Jennifer Granholm said the 1954 decision barring Oppenheimer's clearance went through a "flawed process" and noted that there was evidence of bias. Documents from his hearing that were declassified in 2014 raised doubts about the disloyalty accusations, suggesting, for example, that his opposition to the hydrogen bomb project was for technical and military reasons rather than pro-Soviet sentiments. The Atomic Energy Commission also granted Oppenheimer its Enrico Fermi Award in 1963 for his scientific work.

Source: <https://thehill.com/policy/energy-environment/3778263-energy-dept-vacates->

NUCLEAR SECURITY

SUDAN

IAEA Finds Improved Nuclear Security Infrastructure in Sudan

An IAEA International Nuclear Security Advisory Service (INSServ) team said Sudan had strengthened its national nuclear security regime by implementing extensive nuclear security systems and measures in relation to materials out of regulatory control. The team encouraged Sudan to further enhance its relevant nuclear security

1950s-decision-revoking-security-clearance-for-father-of-the-atomic-bomb-j-robert-oppenheimer/, 16 December 2022.

IAEA-says-Bangladesh-committed-to-nuclear-safety, 15 December 2022.

NUCLEAR SAFETY

BANGLADESH

IAEA Says Bangladesh Committed to Nuclear Safety

Bangladesh is committed to continuous improvement of nuclear and radiation safety; an IAEA team of experts has concluded. The Integrated Regulatory Review Service (IRRS) mission team identified areas for possible improvements. The IRRS team concluded a 13-day mission to Bangladesh on 8 December, the first IRRS mission to the country. It was conducted at the request of the government of Bangladesh and hosted by the Bangladesh Atomic Energy Regulatory Authority (BAERA) to assess Bangladesh's regulatory framework for safety against IAEA safety standards.

IRRS missions are designed to strengthen the effectiveness of the national nuclear and radiation safety regulatory infrastructure, based on IAEA safety standards and international good practices, while recognising the responsibility of each country to ensure nuclear and radiation safety. Rosatom in February 2011 signed an agreement for two reactors to be built at Rooppur for the Bangladesh Atomic Energy Commission. The initial contract for the project, worth USD12.65 billion, was signed in December 2015. The Rooppur plant, 160 kilometres from the capital Dhaka, will feature two Russian VVER-1200 reactors. Rooppur unit 1 is scheduled to begin operation in 2023, with unit 2 following in 2024.

Source: <https://world-nuclear-news.org/Articles/>

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Shield over nuclear waste storage site will protect against shrapnel, improvised explosive devices, says official. Russia has started installing a "protective dome" over the nuclear waste storage at the Zaporizhzhia nuclear power plant, an official said. Zaporizhzhia, Europe's largest and one of the world's 10 biggest nuclear power plants, has been under Russian control since March, soon after the start of the Ukraine war.

UKRAINE

Russia Starts Building 'Protective Dome' at Zaporizhzhia NPP

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of the Ukraine war. Fears of a nuclear catastrophe persist amid reports of shelling around the area. Vladimir Rogov, a pro-Russia official in Zaporizhzhia who heads the We Are Together movement, said work is underway to put up a "protective dome" over the plant's storage site for nuclear waste. In a separate statement, Russia's state-owned nuclear operator Rosenergoatom also announced the start of construction to set up a "safety cushion" to shield the nuclear waste storage site.

Source: <https://www.aa.com.tr/en/europe/russia-starts-building-protective-dome-at-zaporizhzhia-nuclear-plant/2766586>, 17 December 2022.

SMALL MODULAR REACTORS

FINLAND

Agreements for Micro Reactor Deployment in Finland and Further Afield

Ultra Safe Nuclear Corporation (USNC) has signed a MoU with Finland's Lappeenranta University of Technology to explore the deployment of a Micro-

Modular Reactor (MMR) in Lappeenranta. Meanwhile, USNC has signed an MoU with Canadian privately held investment firm Portland Holdings Investco Limited to promote the MMR in the Middle East, North Africa and the Caribbean regions. Lappeenranta University of Technology (LUT) plans to deploy an MMR as a research and test reactor at or near its campus in the city of Lappeenranta in southern Finland. The reactor will be operated as a training, research and demonstration facility. It will be connected to the district heating network of Lappeenrannan Energia, the local municipal utility, to provide carbon-free district heating to the university, city and surrounding area.

The MMR is at an advanced licensing stage at the Atomic Energy of Canada Limited's Chalk River Laboratories campus in Ontario. The project is a collaboration between USNC and Ontario Power Generation through the jointly owned Global First Power Limited Partnership. The project at LUT joins the growing list of global training, test, and research MMR projects at the University of Illinois Urbana-Champaign in the USA and at McMaster University in Canada.

Source: <https://world-nuclear-news.org/Articles/Agreements-for-microreactor-deployment-in-Finland>, 16 December 2022.

SWEDEN-FINLAND

Fortum and Kärnfull to Explore SMR Deployment in Sweden

Finnish utility Fortum and Swedish SMR project development company Kärnfull Next AB have signed a MoU to jointly explore opportunities in new nuclear for developing SMRs in Sweden. The companies said the collaboration will allow them

to jointly address Swedish SMR projects which could lead to concrete feasibility studies. They noted the schedule of the first operative SMR in Sweden is largely dependent on progress in permitting, licensing and legislation regarding the location and number of reactors in operation and any decisions about future investments will be made in due course. Earlier this month, Fortum and France's EDF signed a framework cooperation agreement to jointly explore collaboration opportunities

for SMR and large power plant deployment in Finland and Sweden.

Source: <https://world-nuclear-news.org/Articles/Fortum-and-Karnfull-to-explore-SMR-deployment-in-S>, 15 December 2022.

TURKEY

Türkiye in Talks with US for SMR: Report

Turkish government and private companies are in talks with the U.S. for purchases of SMRs, as the country looks to wean itself off coal, according to a report. "There is a serious interest in nuclear energy as a way to replace coal-fired power plants," Justin Friedman, senior advisor

for commercial competitiveness in nuclear energy at the U.S. State Department told Bloomberg. Friedman said that purchase of as many as 35 SMRs are possible as Türkiye wants to generate 20 GWss of electricity from nuclear energy by 2050. US SMR manufacturers include NuScale Power Corporation, and the Bill Gates-backed TerraPower LLC. Meanwhile, the country's first nuclear plant, Akkuyu Nuclear Power Plant (NPP), being built by the Russian state-owned company Rosatom as part of an intergovernmental agreement between Ankara and Moscow, is

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nearing completion in southern Türkiye. The government is also negotiating a second power plant with Rosatom that may be built in Sinop on the Black Sea coast.

Source: <https://www.dailysabah.com/business/energy/turkiye-in-talks-with-us-for-small-nuclear-reactors-report> USA, 21 December 2022.

UK

Two Contractors Appointed on SMR Programme

Two contractors have signed a deal that could lead to them building a series of small modular nuclear reactors in the UK. Balfour Beatty and South Korea's Hyundai Engineering and Construction Co signed a memorandum of understanding with energy firm Holtec Britain to work on the construction of a planned development programme using the technology. Construction of the SMRs could begin as early as 2028 if the plan gets regulatory approval. Last month, Holtec submitted an application to the UK government's Department for Business, Energy and Industrial Strategy for funding support towards a forthcoming application for regulatory approval from the Office for Nuclear Regulation.

Source: <https://www.constructionnews.co.uk/contractors/balfour-beatty/two-contractors-appointed-on-small-nuclear-reactor-programme-20-12-2022/>, 20 December 2022.

USA

HALEU Fuel Availability Delays Natrium Reactor Project

TerraPower has said it expects operation of the Natrium demonstration reactor to be delayed by at least two years because there will not be sufficient commercial capacity to manufacture

high-assay low-enriched uranium fuel in time to meet the proposed 2028 in-service date. The company's CEO Levesque said Russia's invasion of Ukraine in February caused "the only commercial source of HALEU fuel" to no longer be a viable part of the supply chain. The company has since then been working with the US DOE, Congressional allies, and project stakeholders to explore potential

alternative sources, and "while...demonstration plant." The company will fully update its schedule in 2023 when outcomes of such measures are known, he said. "But given the lack of fuel availability now, and that there has been no construction started on new fuel enrichment facilities, TerraPower is anticipating a minimum of a two-year delay to being able to bring the Natrium reactor into operation."

Source: <https://world-nuclear-news.org/Articles/HALEU-fuel-availability-delays-Natrium-reactor-pro>, 15 December 2022.

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SMR Market Set to Witness an Uptick of 21.5% CAGR through 2028

The latest report on 'Global Small Modular Reactor Market' highlights the elements enhancing the developmental scope of the market as well as inhibitors challenging its growth during the forecast period. The study presents information on market

segments in terms of product terrain, structure outlook, and distribution channel. It then highlights the verticals responsible for contributing to the remuneration of the marketplace by outlining their growth rate for the analysis period. It further assesses the geographical scope of the industry and sheds light on the performance of the regional markets throughout the review period. The global Small Modular Reactor market was around US\$ 3.5 million in 2021 and is expected to grow at a CAGR

of 21.5% over the forecast period of 2022-2028.

Source: <https://www.openpr.com/news/2854163/small-modular-reactor-market-set-to-witness-an-uptick-of-21-5, 19 December 2022>.

Dominion Energy Plans to Deploy SMRs Statewide by 2032

When Gov. Glenn Youngkin rolled out his energy plan in October, stating that Virginia must be “all in” on nuclear energy and that he wants to deploy a SMR somewhere in Southwest Virginia within 10 years, Dominion Energy, the state’s largest utility company, was already one step ahead of the game. While Dominion has not publicly disclosed any potential sites in Southwest Virginia, it considers the region as an “ideal location,” given the access to the area’s electric power transmission system and the ability to “transition the local fossil fuel workforce that has provided energy for decades” to support SMR deployment, Flowers said. Meanwhile, Appalachian Power Company is also considering advanced nuclear technology on its path to meet its goal of net zero carbon dioxide emissions by 2045. The company has formed an internal team that is studying SMR options, the utility told Cardinal News in a statement.

Source: <https://cardinalnews.org/2022/12/15/dominion-energy-plans-to-deploy-small-modular-nuclear-reactors-statewide-by-2032/, 15 December 2022>.

NUCLEAR COOPERATION

RUSSIA–BELARUS

Putin Commits Nuclear Plant, Better Economic Cooperation with Belarus

In his first visit to Minsk since 2019, President Putin expressed his commitment to developing nuclear plants and other scientific projects in sanction-riddled Belarus. Barred from global

business and alienated from several western societies and financial webs, Russia said that it would create a nuclear industry and train Belarusians for the industry. ... Despite sanctions, President Putin revealed his expectation for better outcomes in bilateral trade with Belarus. President Lukashenko said the sanctions against Russia and Belarus “have boomeranged,” reports state-affiliated media Belta. Putin, speaking to the reporters in Minsk, said Russia and Belarus had countered the sanctions effectively. It was the first meeting between Aleinik and Lavrov after Sergei

Aleinik assumed the position of Foreign Minister of Belarus. During the meeting, the two trading partners discussed Western sanctions, trade, and economic cooperation.

Source: <https://newindian.in/putin-commits-nuclear-plant-better-economic-cooperation-with-belarus/, 20 December 2022>.

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SRI LANKA–RUSSIA

Sri Lanka Discusses Nuclear Energy Cooperation with Russia

Sri Lankan Minister of Power and Energy Wijesekera said that the South Asian country is discussing nuclear energy cooperation with Russia. The minister said he met

with the Russian Ambassador to Sri Lanka Levan Dzhagaryan and discussed the requirements of Sri Lanka’s energy sector. “We discussed cooperation on fuel requirements, refinery operations, challenges in coal supply and the memorandum of understanding signed for nuclear energy cooperation with Rosatom,” he said. He said Russia can help address many of Sri Lanka’s energy problems. “Sri Lanka struggled with securing energy supplies earlier this year. We are actively looking for energy cooperation with other nations and Russia can play a big role” the minister said.

Source: <https://english.news.cn/20221215/e67a1ee40765460b9be7ce723008fbdc/c.html, 15 December 2022>.

USA-KENYA

The US and the Republic of Kenya Sign a MoU Concerning Strategic Civil Nuclear Cooperation

The US and Kenya signed a MoU Concerning Strategic Civil Nuclear Cooperation (NCMOU), which improves cooperation on energy security and strengthens our diplomatic and economic relationship. Under Secretary of State for Arms Control and International Security Bonnie D. Jenkins signed for the US, and Foreign Minister Alfred Mutua, Cabinet Secretary of Foreign and Diaspora Affairs, signed for Kenya. The US and Kenya have an enduring diplomatic relationship and long-standing cooperation in the fields of security, energy, and commerce. Our cooperation in nuclear energy, science, and technology also has the potential to make a significant contribution to clean energy goals, agricultural efforts, the availability of clean water, medical treatments, and more. NCMOUs are diplomatic mechanisms that strengthen and expand strategic ties between the US and a partner country by providing a framework for cooperation on civil nuclear issues and for engagement between experts from government, industry, national laboratories, and academic institutions.

Source: <https://www.state.gov/the-united-states-of-america-and-the-republic-of-kenya-sign-a-memorandum-of-understanding-concerning-strategic-civil-nuclear-cooperation/>, 15 December 2022.

The US and Kenya signed a MoU Concerning Strategic Civil Nuclear Cooperation (NCMOU), which improves cooperation on energy security and strengthens our diplomatic and economic relationship.

to establish a federal reserve of domestically produced material. The reserve is intended to be a backup source of supply for US nuclear power plants in the event of a significant market disruption. Peninsula recently made the decision to restart uranium production operations early next year at its Lance in-situ leach (ISL) project in Wyoming, where it previously produced uranium from 2015 until 2019. The company's announcement did not disclose the size of its contract award but said it expected to realise total gross proceeds of USD18.5 million. It expects to

complete the sale of the material - which is currently held in the company's inventory at the Metropolis Works Conversion Facility in Illinois - during the first quarter of 2023.

Source: <https://world-nuclear-news.org/Articles/First-contracts-awarded-for-US-strategic-uranium-r>, 16 December 2022.

US Backed High-Tech Nuclear Plant in Wyoming Delayed to 2030

TerraPower, a venture founded by billionaire Gates said last year its \$4 billion Natrium plant would be built in Kemmerer, a remote Wyoming town where a coal plant is set to shut in 2025. The 345-MW plant will likely be delayed for at least two years until 2030, the Casper Star Tribune said, citing a TerraPower spokesperson.

High-tech nuclear energy project in Wyoming, backed by the U.S. Department of Energy and Bill Gates, is delayed by at least two years and a U.S. senator said it showed that the US needs to reduce reliance on Russia for a special fuel for such reactors. TerraPower, a venture founded by billionaire Gates said last

year its \$4 billion Natrium plant would be built in Kemmerer, a remote Wyoming town where a coal plant is set to shut in 2025. The 345-MW plant will likely be delayed for at least two years until 2030, the Casper Star Tribune said, citing a TerraPower spokesperson.

U.S. companies are trying to develop a new generation of small nuclear plants to help cut carbon emissions but only one firm sells the fuel it needs, and it is Russian. The fuel, called high assay low enriched uranium, or HALEU, is enriched

URANIUM PRODUCTION

USA

First Contracts Awarded for US Strategic Uranium Reserve

Energy Fuels Inc and Peninsula Energy Limited subsidiary Strata Energy Inc have been awarded contracts to supply natural uranium concentrates

up to 20%, much above the up to 5% level today's reactors use. The U.S. government is looking to downblend some of its stockpile of weapons-grade uranium to help provide fuel, but Navin said it lacks the capacity to disassemble warheads faster. Only one company outside Russia, U.S.-based Centrus Energy Corp is licensed to produce the fuel but it is years away from making commercial amounts.

Source: <https://www.euronews.com/next/2022/12/15/usa-nuclearpower-terrapower-delay>, 15 December 2022.

Lightbridge, INL Team Up for Advanced Fuel Development

The advanced nuclear fuel company said it expects the first phase of work under two "innovative" agreements with Idaho National Laboratory (INL), in collaboration with the US DOE, will culminate in irradiation testing of fuel samples. The two "umbrella" agreements - a Strategic Partnership Project Agreement and a Cooperative Research and Development Agreement - are with Battelle Energy Alliance, LLC, DOE's operating contractor for INL, with an initial duration of seven years, the company said. Lightbridge's metal nuclear fuel technology, suitable for use in both small modular reactors and existing light-water reactors, has been developed with support from the DOE through its Gateway for Accelerated Innovation in Nuclear programme. The fuel operates at temperatures around 1000°C cooler than standard fuel, and offers enhanced reactor safety, economics and proliferation resistance.

The framework agreements lay a "strong foundation" for development efforts towards the

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exploration missions. TREAT is an air-cooled, thermal-spectrum test facility designed to evaluate the response of reactor fuels and structural materials to accident conditions. The facility was placed on standby in 1994, but was restarted for use in the development of new reactor fuels in 2017 and resumed operations in 2018.

Source: <https://world-nuclear-news.org/Articles/Lightbridge,-INL-team-up-for-advanced-fuel-develop>, 12 December 2022.

UEC Wins \$17.85 Million Award to Supply Uranium for US Uranium Reserve

Uranium Energy Corp announced that it has won a \$17.85 million award to supply 300,000 pounds of U.S. origin uranium

concentrates at \$59.50/lb. to the U.S. DOE - National Nuclear Security Administration ("NNSA"). The company said that the award is in response to the NNSA's Request for Proposals ("RFP") to establish its strategic national Uranium Reserve program. The Uranium Reserve was originally designed as a 10-year, \$1.5 billion, plan to help revitalize the domestic uranium and conversion industry. The award under the RFP is part of the initial \$75 million authorized by Congress in 2020 to advance the U.S. Government's goal of supporting America's nuclear fuel supply chain and capabilities, it added. UEC indicated it is the largest, diversified North American focused uranium company,

The Uranium Reserve was originally designed as a 10-year, \$1.5 billion, plan to help revitalize the domestic uranium and conversion industry. The award under the RFP is part of the initial \$75 million authorized by Congress in 2020 to advance the U.S. Government's goal of supporting America's nuclear fuel supply chain and capabilities.

advancing the next generation of low-cost, environmentally friendly in-situ recovery mining uranium projects in the US and high-grade conventional projects in Canada.

Source: <https://www.kitco.com/news/2022-12-20/UEC-wins-17-85-million-award-to-supply-uranium-for-U-S-uranium-reserve.html>, 20 December 2022.

UK

Westinghouse Targets New UK-Based Uranium Conversion Capabilities

UK government funding of GBP13 million (USD15.9 million) will be used to help “prepare the necessary design and enabling work to begin new conversion capabilities for the world’s utilities from 2028.” The money from the UK’s Department for Business, Energy and Industrial Strategy, along with Westinghouse’s own investment, aims to progress the facility which would provide both reprocessed and naturally occurring uranium conversion services to utilities around the world “as they seek to diversify supplies and transition from Russian-provided services.” It will be based at the Springfields site in Lancashire in northwest England, which already produces fuel for the UK advanced gas cooled reactor fleet. The funding will mean less reliance on imports, with Westinghouse saying it will be able “to offer utilities a high-quality western fuel alternative.” ...

Source: <https://world-nuclear-news.org/Articles/Westinghouse-targets-new-UK-based-uranium-conversi>, 15 December 2022.

NUCLEAR PROLIFERATION

IRAN

Iran Enriching ‘Worrying Quantities’ of Uranium, in Further Blow for Nuclear Deal

IAEA has reported that Iran intends to install new centrifuges at one of its fuel enrichment plants, and plans to produce more uranium enriched up to 60 per cent, at another. The agency, estimates

that the country now has a total enriched uranium stockpile of more than eighteen times the allowable amount under the JCPOA, the nuclear deal that was developed in the wake of Resolution 2231, including “worrying quantities of uranium” enriched to up to 60 per cent. The IAEA’s ability to effectively monitor Iran’s nuclear facilities and ensure that they are being used for exclusively peaceful purposes – a core element of the JCPOA. In addition, Ukraine, France, Germany, the UK and the US have alleged that some of the UAVs transferred by Iran to the Russia, were manufactured by an entity on a list of individuals and entities who, under Resolution 2231, fall under targeted sanctions. The political and peacebuilding chief declared that the UN is examining the available information and will

report back to the Council, as appropriate, in due course.

Source: <https://news.un.org/en/story/2022/12/1131872>, 19 December 2022.

IAEA Visits Iran in Effort to Break Logjam

The current visit was mostly played up by Iran, with the IAEA not only keeping mostly radio silence about it, but also not sending IAEA Chief Grossi. The IAEA began its trip to Iran by saying there would be no immediate public statement regarding any progress from the visit. Negotiations have been frozen since September, when the Islamic Republic suddenly hardened its position on resolving the IAEA probes, despite most of the world’s parties believing that a return to the 2015 Joint Comprehensive Plan of Action was all but signed. The current visit was played up by Iran, with the IAEA not only staying largely silent about it, but also not sending IAEA Director-General Grossi. In the meantime, nuclear experts have estimated that Tehran has enough enriched uranium for up to four nuclear bombs within a period of months – if the regime makes the decision to weaponize the uranium to the 90% level.

Source: <https://www.jpost.com/middle-east/iran-news/article-725207>, 18 December 2022.

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IAEA Official Leaves Iran, No Sign of Progress on Uranium Traces

A senior official of the IAEA left Tehran ...but there was no word of progress on a thorny issue. Aparo, IAEA Deputy Director General, led a delegation billed by Iran as addressing "outstanding issues," widely taken to refer to an impasse over uranium traces found by the agency in Iran in sites not declared as nuclear-related. The IAEA said it planned no public statement, and the Iranian news agency ISNA merely reported meetings – which included Mohammad Eslami, head of the Atomic Energy Organization of Iran – had addressed "future joint cooperation and programs, in addition to safeguarding issues." The IAEA has been seeking clarity over the uranium traces, found last year in sites linked to Iran's nuclear work before 2003.

The agency argues Tehran should provide satisfactory answers as part of its 'safeguards' obligations under the NPT. The 35-member IAEA board in June and November passed US-drafted motions condemning Iran over not satisfying the agency. Opposing the move, China and Russia said it would stymie talks to restore the JCPOA.

Source: <https://www.iranintl.com/en/202212196506>, 19 December 2022.

Iran and EU Signal Continued Work on Nuclear Deal in Jordan

Communication lines will be kept open despite worsening relations, but there has been no sign of serious progress toward an agreement. The top foreign policy representatives of Iran and the European Union have signalled that efforts to restore the country's 2015 nuclear deal will continue, after they held a meeting in Jordan.

Iran's Foreign Minister Hossein Amirabdollahian and the bloc's foreign policy chief Josep Borrell sat down on the sidelines of the second meeting of the Baghdad Conference for Cooperation and Partnership hosted by Jordan's King Abdullah. Iran's top negotiator in the nuclear talks, Ali Bagheri Kani, and the bloc's coordinator, Enrique Mora, were also present. Borrell wrote on Twitter following the meeting that it was a

"necessary" talk amid "deteriorating Iran-EU relations."

Source: <https://www.aljazeera.com/news/2022/12/20/iran-and-eu-signal-continued-work-on-nuclear-deal-in-jordan>, 20 December 2022.

Nuclear Deal with Iran "Dead" But Can't Be Announced: Biden

A video published on social media shows US President Biden saying the nuclear deal with Iran is "dead", but his administration is unwilling to announce it. This video, which was published on Twitter for the first time by Damon Maghsoudi, a software engineer living in the US, was recorded on the sidelines of the November

4th election campaign in California. In this video, an Iranian-American woman asks Biden to declare the West's nuclear agreement with Iran, known as the JCPOA, is "dead". In response, the US President clearly confirmed that the JCPOA is "dead", but he he said he cannot announce it for "a lot of reasons". Although Biden does not give a direct answer about the "reasons" why Washington refuses to officially announce this, but concerns about Iran's progress towards obtaining a nuclear weapon could be the main reason for leaving the door open with the Islamic Republic. However, analysts have been saying for weeks that the nuclear negotiations between Iran

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and the West have reached an impasse.

Source: <https://www.iranintl.com/en/202212201701>, 20 December 2022.

ISRAEL

US: Israeli Accused of Smuggling Military Components to Russia

The export of the technology involved in the case is heavily regulated and took place in violation of US sanctions. An Israeli citizen is among seven people charged by US prosecutors with smuggling sensitive electronics to Russia that could be used to make nuclear weapons. US prosecutors say the group worked with two Moscow-based companies controlled by Russian intelligence to acquire electronic components from the US for civilian use, but which can also be used to build nuclear and hypersonic weapons and in quantum computing. The newspaper said the supplies smuggled to the Brayman family home included semiconductors, which are critical to the production of the ballistic missiles Russia has deployed to deadly effect in Ukraine. The export of the technology involved in the case is heavily regulated and took place in violation of US sanctions, according to an indictment made public in Brooklyn.

Source: <https://www.i24news.tv/en/news/international/americas/1671295002-u-s-israeli-accused-of-smuggling-military-components-to-russia>, 17 December 2022.

NUCLEAR NON-PROLIFERATION

UAE

Executive Office of Anti-Money Laundering and Counter Terrorism Financing, Federal Authority for Nuclear Regulation Sign MoU

The Executive Office of Anti-Money Laundering and Counter Terrorism Financing (“EO AML/CTF”)

has signed a MoU with the Federal Authority for Nuclear Regulation (“FANR”) to facilitate the exchange of information through the FAWRI TICK system. The signing of the MoU will establish a framework for cooperation that will enhance the implementation and operation of the FAWRI TICK system, as well as set out the development of joint procedures. Under the terms of the agreement, the EO AML/CTF and FANR will share information and data through the FAWRI TICK system relating to proliferation financing covered by the Financial

Action Task Force (FATF); financing of terrorism money laundering; implementation of targeted financial sanctions; and combatting illegal organizations.

Source: <https://www.wam.ae/en/details/1395303113023>, 20 December 2022.

NUCLEAR DISARMAMENT

KAZAKHSTAN

Kazakhstan Marks 25th Anniversary of UNGA Resolution on Rehabilitation of Semei Region

In December 2022, Kazakhstan commemorates the 25th anniversary of the adoption of the UN General Assembly’s resolution on international cooperation

and coordination for the human and ecological rehabilitation and economic development of the Semei Region, adopted on Dec. 16, 1997, at the 52nd UNGA session. This resolution serves as a legal basis for mobilizing international support to rehabilitate the aftermath of negative destruction caused by tests conducted at the Semipalatinsk Nuclear Test Site, the largest former Soviet nuclear test site. The TPNW entered into force in 2021 and is the latest multilateral disarmament instrument adopted in the past 25 years. Supported by 122 United Nations Member States, it

An Israeli citizen is among seven people charged by US prosecutors with smuggling sensitive electronics to Russia that could be used to make nuclear weapons. US prosecutors say the group worked with two Moscow-based companies controlled by Russian intelligence to acquire electronic components from the US for civilian use, but which can also be used to build nuclear and hypersonic weapons and in quantum computing.

This resolution serves as a legal basis for mobilizing international support to rehabilitate the aftermath of negative destruction caused by tests conducted at the Semipalatinsk Nuclear Test Site, the largest former Soviet nuclear test site.

strengthens our collective hope for a world free of nuclear weapons.

Kazakhstan's support for the TPNW is based on the unwavering belief in the Treaty's profoundly positive role as a new step on the path towards the complete elimination of nuclear weapons. Kazakhstan, as a country that has directly suffered from the tragic consequences of nuclear testing, is honored to have been entrusted, jointly with Kiribati, the co-chairing of the working group on positive obligations on victim assistance, environmental remediation, international cooperation, and assistance under Article 6 and 7 of the TPNW. Kazakhstan has suffered terribly from past nuclear weapons testing, so we understand very clearly the dangers of escalating tensions between nuclear powers. For this reason, nuclear disarmament has become a key part of Kazakh foreign policy and we will be continuously struggling for a world free of nuclear arsenals.

Source: <https://astanatimes.com/2022/12/kazakhstan-marks-25th-anniversary-of-unga-resolution-on-rehabilitation-of-semei-region/>, 17 December 2022.

NORTH KOREA

IAEA Chief Says to Make All-out Effort to Stop North Korea's Nuclear Program

Grossi made the comments as he met South Korean President Yoon Suk-yeol during a visit to Seoul, South Korea's presidential office said. IAEA Chief Grossi said the international organisation will make an all-out effort to stop North Korea's nuclear program and preserve international non-proliferation. Grossi made the comments as he met South Korean President Yoon Suk-yeol during a visit to Seoul, South Korea's presidential office said.

Source: <https://www.hindustantimes.com/world-news/iaea-chief-says-to-make-all-out-effort-to-stop-north-korea-s-nuclear-program-101671100207283.html>, 15 December 2022.

NUCLEAR WASTE MANAGEMENT

USA

Underground Nuclear Waste Repository Begins Filling New Disposal Area

Workers at the nation's only underground nuclear waste repository have started using a newly mined disposal area at the underground facility in southern New Mexico. Officials at the Waste Isolation Pilot Plant made the announcement late last month, saying the first containers of waste to be entombed in the new area came from Oak Ridge National Laboratory in Tennessee — one of the many labs and government sites across the country that package up waste and ship it to WIPP.

Officials at the Waste Isolation Pilot Plant made the announcement late last month, saying the first containers of waste to be entombed in the new area came from Oak Ridge National Laboratory in Tennessee — one of the many labs and government sites across the country that package up waste and ship it to WIPP.

Known as Panel 8, the new area consists of seven separate rooms for placing special boxes and barrels packed with lab coats, rubber gloves, tools and debris contaminated with plutonium and other radioactive elements. Each room measures 33 feet wide, 16 feet high and runs the length of a football field minus the end zones. Carved out of an ancient salt formation about half a mile deep, the subterranean landfill located outside of Carlsbad received its first shipment in 1999. The idea is that the shifting salt will eventually entomb the radioactive waste left from decades of bomb-making and nuclear weapons research. In 2014, a fire and separate radiation release forced a nearly three-year closure of the repository and costly overhaul of the policies and procedures that govern WIPP and the nation's multibillion-dollar cleanup program for Cold War-era waste.

Source: https://www.coloradopolitics.com/news/underground-nuclear-waste-repository-begins-filling-new-disposal-area-out-west-roundup/article_04bf2cf2-75ef-11ed-915f-47e7ffa97af3.html, 18 December 2022.

The country's top nuclear energy innovator assured local industry and Connecticut government representatives that her office has reinvigorated its search for a storage solution for spent nuclear fuel, a daunting issue that threatens the state and country's near term energy goals.

US Nuclear Energy Chief Details Plans to Find Storage Sites for Spent CT Nuclear Waste

The country's top nuclear energy innovator assured local industry and Connecticut government representatives that her office has reinvigorated its search for a storage solution for spent nuclear fuel, a daunting issue that threatens the state and country's near term energy goals. Kathryn Huff, who leads the US Department of Energy's office of nuclear energy, told a group of industry stakeholders in Waterford that achieving aggressive state and federal green energy and carbon elimination goals is dependent on deployment of a new generation of smaller, safer and more efficient reactors. But she said new or even continuing nuclear generation is jeopardized by the government's inability to locate national repositories for highly radioactive spent fuel.

Source: <https://www.courant.com/news/connecticut/hc-news-katherine-huff-spent-nuclear-fuel-storage-connecticut-20221220-20221220-nirqxjosnebfdizcv3ifsl7ie-story.html>, 21 December 2022.

UK

Method Developed for Sellafield Floc Retrieval

A technique has been developed to suck up and move a sludgy radioactive substance, known as flocculant, currently stored in legacy effluent tanks at the Sellafield site in Cumbria, UK. The tanks the material is currently stored in are no longer fit for purpose, Sellafield Limited said, and a reliable method is needed to remove it and place it in modern containers. There is about 83 cubic metres of the material – classified as intermediate-level waste – in four legacy tanks. Access restrictions mean the only way to get at the waste is by sending people in air-fed suits into the tanks using hand-held suction equipment. Work to retrieve the floc is set to start in March 2024. It will see a giant vacuum system used to suck up the floc into a transfer vessel before being transported to its new home in Sellafield's Floc Storage Tanks facility. The work is scheduled for completion at the end of 2027.

Source: <https://www.world-nuclear-news.org/Articles/Method-developed-for-Sellafield-floc-retrieval>, 19 December 2022.



Centre for Air Power Studies

The Centre for Air Power Studies (CAPS) is an independent, non-profit think tank that undertakes and promotes policy-related research, study and discussion on defence and military issues, trends and developments in air power and space for civil and military purposes, as also related issues of national security. The Centre is headed by Air Marshal Anil Chopra, PVSM AVSM VM VSM (Retd).

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