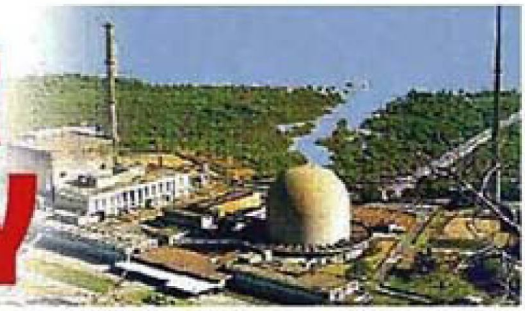
NUCLEAR SECURITY



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

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OPINION – Manpreet Sethi

Nuclear Energy in India's Energy Mix

Two contrasting developments in the nuclear energy domain caught public attention last year. In Europe, Germany shut down the last of its 17 nuclear reactors and bid goodbye to nuclear energy in April 2023. Meanwhile, in Asia, India's 23rd nuclear reactor, Kakrapar 3, began commercial operation in July 2023. Earlier this year, India announced an ambitious nuclear expansion, planning to add 18 new nuclear power reactors with a capacity of 13,800 MWe by 2031-32. The NPCIL has announced that with these additional units, the total share of nuclear power in India's energy mix will rise to 22,480 MWe by 2031-32 from the current capacity of 8,180 MWe.

Why is India steadfast on its nuclear power programme, though it is currently contributing only about 2 per cent to the electricity share, while Germany, which was once getting 22 per cent of its electricity from nuclear, decided to dispense with it? The answer to this question lies in the unique circumstances of each country which make it choose the sources of electricity generation in its national energy mix.

India announced an ambitious nuclear expansion, planning to add 18 new nuclear power reactors with a capacity of 13,800 MWe by 2031-32. The NPCIL has announced that with these additional units, the total share of nuclear power in India's energy mix will rise to 22,480 MWe by 2031-32 from the current capacity of 8,180 MWe.

Understanding Germany's Decision to Phase Out Nuclear Energy: Germany took the decision to phase out nuclear energy two months after the March 2011 nuclear accident in Fukushima, Japan, which severely shook public confidence in nuclear safety. Succumbing to the pressure from Green parties, the government announced that all of the 17 operational nuclear reactors in Germany, which were then producing about 22 per cent of the country's electricity, would be phased out by 2022. By 2020, 11 of the 17 plants had been shut down, and Germany was down to producing only 13 per cent of its electricity from nuclear energy. Thirty per cent was being generated from coal-fired plants and 47 per cent

from renewables. To its credit, the country had, in a decade, become a front-runner in the use of renewables for electricity generation. However, several German business and industry leaders argued in favour of nuclear energy for the sake of having a reliable baseload source of electricity. Many expressed concern that the loss of nuclear electricity could end up pushing the country towards greater use of coal, thereby increasing its environmental emissions.

One challenge, though, that Berlin had not accounted for while taking the decision to shut out nuclear energy was the disruption in its energy relations with Russia, a major supplier of natural gas to Germany. The Russia–Ukraine conflict cast an ominous shadow on Germany's energy scenario, and the country had to push back its planned date of shut down of the last reactor from 2022 to one year later so as to make time for securing electricity from other sources.

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The German decision of a nuclear phase-out in 2011 was only in part triggered by the anti-nuclear inclinations of the political firmament of the time. It was also facilitated by several national socio-economic realities. These included a stable population with high per capita energy consumption of above 7000 kWh; a surplus national electricity market that had been exporting electricity to the tune of about 15 bn kWh; a forecast of as low as 1.1 per cent per annum growth of electricity; the option of making up for the loss of electricity caused by the shutdown of nuclear plants by importing more coal from Poland, more gas from Russia, and even electricity from France and Czechoslovakia. Germany, therefore, had the luxury of removing the option of nuclear electricity from its energy basket. Not many others enjoy this situation. India certainly does not.

Understanding India's Need for Nuclear Energy: India faces a different reality. Some facts peculiar to India need to be understood to answer questions that are often raised about why India should continue to invest in a nuclear power programme when, even after 60 years of having been in the fray, it contributes only a small slice to national electricity generation. Should the focus not be on modern, renewable sources like hydro (including small hydel plants), solar and wind energy? After all, in just the past decade new installed capacities in solar and wind have taken the share of renewables from about 14 per cent to close to 40 per cent? Today, India ranks fourth globally in Renewable Energy Installed Capacity (including large hydro), fourth in wind power capacity and fourth in solar power capacity. Solar energy has emerged as the star performer in this period, with more than thirty times increase in installed capacity from 2.5 GW in 2014 to 75 GW in 2024. What, then, is the rationale for retaining nuclear power in India's energy mix?

This question cannot be answered without adequately understanding India's unique socio-economic realities and energy compulsions. India is a developing nation with a population close to a bn and a half that is mostly young and aspirational. The country's economy is dominated by the manufacturing and service sectors, which are energy-intensive. The first thing to note, therefore, is a continuous upward demand for electricity in the coming years. India's power generation capacity has increased phenomenally from the total installed power generation capacity of a mere 1362 MW at the time of Independence to 400,000 MW today. Today, India is the third largest producer of electricity in the world. These are all creditable developments, but India's per capita electricity consumption is still at a mere 1255 kWh in 2021-22. This compares dismally with Canada's 17179 kWh, 13338 kWh in the US, and about 5000 kWh even in China.

According to the '*Economic Survey'* tabled in Parliament in July 2019, India needs to quadruple electricity production to assure a reasonable quality of life to its citizens. To give one example, the World Energy Outlook 2023 predicts skyrocketing consumption of electricity in India based on a surge in air conditioner ownership. As temperatures soar to new highs, electricity demand for cooling registers a surge, with nearly 10 per cent of total electricity consumption attributed to space cooling. With household air conditioner ownership projected to increase nine-fold by 2050, this trend will further exacerbate energy demands and peak electricity requirements. Besides growing ownership of such personal appliances, the Indian economy in general is expected to grow at over six per cent, concurrently increasing the demand for electricity too.

According to the '*Economic Survey'* tabled in Parliament in July 2019, India needs to quadruple electricity production to assure a reasonable quality of life to its citizens. To give one example, the World Energy Outlook 2023 predicts skyrocketing consumption of electricity in India based on a surge in air conditioner ownership. As temperatures soar to new highs, electricity demand for cooling registers a surge, with nearly 10 per cent of total electricity consumption attributed to space cooling.

Unlike the situation a few decades ago when the government could have nonchalantly met this demand with the cheapest and easiest available fuels, mostly by quickly setting up coal-fired plants, an increased sensitivity to human and environmental health has changed the focus on kinds of fuel sources now found acceptable. Currently, India draws nearly 63 per cent of its total energy generation from thermal sources. Of this, nearly 55 per cent is met from coal and the rest from gas, with a miniscule amount from oil-fired plants. Such a configuration causes two types of worries. The first of course relates to the greenhouse gases emitted from such use of coal. India's per capita carbon emissions stand at 1-1.2 tons, compared to the US' 20 tons per capita. If a growing Indian economy continues to rely on coal, carbon emissions are bound to rise. This will have implications for national expenditure on domestic environmental and health measures and India's global climate commitments. The second cause for concern comes from the fact that India imports a significant part of its fossil fuels. For a large and rapidly developing country, bulk fuel imports raise economic and strategic vulnerabilities.

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Both these concerns explain the current inclination towards increased use of low-carbon sources. Amongst such sources that India has in its energy mix, the most important are renewables such as hydro, solar and wind. Of these, hydroelectricity from large hydel projects was the first to be exploited going back to the decade of the 1890s well before independence. Interestingly, in 1947, of the total installed capacity of 1362 MW, 508 MW came from small and medium hydropower projects. Soon after independence, the focus shifted to building large hydroelectric power stations. Work on the Bhakra Nangal dam and hydroelectricity project, for instance was initiated in 1948 itself. Over the decades, however, interest in such plants has plateaued and they have become less popular owing to the related large-scale displacement and rehabilitation issues. Micro or small hydel projects are more common today, but these are only expected to meet the needs of a local community or industry.

Evidently, the contemporary focus is on solar and wind energy, and installed capacities of both have grown exponentially in the last decade, as stated earlier. However, their limitations should also be understood. Firstly, solar and wind energy

generation is land-intensive. To give a comparison on this front, one can look at Asia's largest solar park, which was commissioned in 2018 in Rewa, Madhya Pradesh. It is spread over 1590 hectares and produces 750 MWe. In comparison, the Kakrapar Atomic Power Station (KAPS), which houses two operational 220 MWe units and two 700 MWe reactors, occupies only 959 hectares. Of this area, nearly 500 hectares are covered by the green belt and 200 hectares by a township, with the actual plant site being a minor fraction of the total. In fact, nuclear plants offer the best land utilization factor. As explained by the Nuclear Energy Institute, wind farms require up to 360 times as much land area, while solar PV facilities require up to 75 times as much land area, to produce the same amount of electricity as a nuclear energy facility.

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Another handicap of solar plants is a high dependence on imported materials such as photovoltaic cells and battery and storage equipment, as compared to the Indian PHWRs that have become completely indigenous. KAPS 3 and 4, for instance, which are the largest indigenously designed PHWRs and the first to have advanced safety features, "have been designed, constructed, commissioned, and operated by NPCIL, with the supply of equipment and execution of contracts by Indian industries and companies, reflecting the true spirit of *Atmanirbhar Bharat*," NPCIL has said. In contrast, India's domestic solar photovoltaic (PV) module manufacturing has yet to come to the level of meeting the pace of solar capacity growth. While hopes are tied to the Production Linked Incentives programme offered by the government, the nation, for now, remains a net importer of solar PV modules.

Despite these challenges, renewables still merit a place in India's energy basket. Given the country's demographic growth, the aspirations of a young population, lack of indigenous fuel resources, and mounting climate change, India needs a long-term vision and commitment to safe generation of electricity that must include all sources. However, it must be recognised that the exploitation of renewables alone cannot take India to meet its net zero commitments because both solar and wind energy would need backup options for the time they are unable to generate electricity for want of sun and wind. Therefore, the advantage of nuclear energy as a baseload source of electricity remains indisputable.

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Moving Ahead: It is not surprising, therefore, that India has indicated its plans to move ahead with nuclear energy expansion. At the recently concluded first Nuclear Energy Summit, Dr KK Mohanty, Chairman, Atomic Energy Commission and Secretary Department of Atomic Energy, said that "as a medium-term target, we aim to achieve tripling nuclear power generation capacity by 2030 from around 7.5 GW at present." In order to meet this objective, the government had approved the construction of ten indigenous new nuclear reactors. As these become operational, built in the fleet mode, there will be a steady increase in the country's nuclear power capacity.

Apart from this indigenous fleet, hopes are also pinned on reactors that are to be built with

international cooperation and are at various stages of negotiations. Of course, Kudankulam (KK) 1 and 2 built with Russian help are already operational, and KK 3 and 4, will be the next among the foreign ones to become operational. Negotiations with France and the US continue but these have not yet reached the stage of construction commencement. However, it needs to be noted that in every new civilian nuclear cooperation agreement that India has recently signed with nuclear supplier countries such as the USA, France and South Korea, the possibility of cooperation on SMRs has been mentioned. One of the future issues of *NuClealry Put* will explore the concept, advantages and disadvantages of SMRs.

For now, a question that is often raised is whether India needs foreign reactors at all, given that the Indian nuclear reactors have now graduated to 700 MW. The answer to this should be yes because imported nuclear power plants of a capacity higher than 700 MW would help India rapidly meet its electricity requirements. It must be remembered that India's electricity demand remains on the ascendant. The rehabilitation of India into international nuclear commerce with the conclusion of the Indo-US nuclear deal has opened possibilities of newer technology induction for accelerated capacity expansion, and this should not be allowed to go to waste.

Nuclear energy, certainly, will have to remain a part of the country's electricity mix owing to the vulnerabilities faced with other fuel sources. Fortunately for India, its nuclear programme is mature, and the industry is geared to perform its role, especially with the announcement on construction of a fleet of reactors. Another recent development of significance is the commencement of core loading of the prototype fast breeder reactor that has raised hopes that India's move into the second stage of its nuclear power programme may be on the anvil.

For the future, a three-pronged approach is recommended to move India's nuclear power programme up the ladder: firstly, the government must continue to offer its steadfast commitment and support to the nuclear sector including by providing predictability into the policy environment; secondly, the NPCIL must continue to provide safe operations and use of good management practices to ensure rapid induction of reactors to undercut the cynicism that is often expressed at the slow pace of growth of the nuclear sector vis a vis other sources of electricity generation. In fact, it would be a further shot in the arm if the joint ventures already formed by NPCIL with NTPC and Indian Oil Corporation, as well as the recent reports on possibility of investments by private firms, such as Reliance Industries, Tata Power, Adani Power, and Vedanta, could come to fruition; and thirdly, there is need for a continuous and proactive public outreach by the DAE to help the public better understand the need for nuclear power as part of the country's humongous electricity requirement, its environmental advantages and the focus on safety aspects. India needs every watt it can get from all safe, secure, and sustainable sources, and nuclear energy ticks all the three boxes.

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Source: https://capsindia.org/nuclear-energy-in-indias-energy-mix/, 31 March 2024.

OPINION – David Hess

SMRs: A Catalyst for Nuclear Change

There is no technology development more important to the future of the nuclear industry than widescale deployment of SMRs. Long promised,

these designs do not represent a fad, they are completely integral to the future of nuclear energy and complementary to larger designs. Stick around in the nuclear industry long enough and you are bound to become a cynic. Many join the industry as starry-eyed optimists and idealists, but over time – the looong timescale of nuclear policy and project developments – that spirit fades. Look at the big picture and ask yourself how much has really changed in the last 20 years? In many nuclear countries, and specifically Western ones, what you will see is a litany of premature plant closures and stalled new-build programmes.

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At conferences, the industry comforts itself with stories of advanced technology messiahs, but where are they? Most seem to have got lost in the journey from paper to steel and concrete, or at best stuck at one government-funded demonstration unit. As for the newer reactor designs that have actually been constructed, overwhelmingly they are evolutions of large light water reactor technologies. Overwhelmingly the construction performance and numbers built have been underwhelming.

Change is necessary, it is welcome, and of these potential changes none are more important to the future of nuclear than the development of SMRs. While the pathway to SMR deployment has been torturously long, the impacts stand to redefine the sector.

It is easy to become jaded and convinced that nothing will change in the nuclear industry, to become closed to the idea of it. But if enough folk get trapped in this fatalism then the industry will decay as surely as the radioactive isotopes it handles. Change is necessary, it is welcome, and of these potential changes none are more important to the future of nuclear than the development of SMRs. While the pathway to SMR deployment has been torturously long, the impacts stand to redefine the sector. Take a moment to reflect on what SMRs really represent. We used to talk of nuclear technology developments primarily in terms of Gen IV reactors – molten salt, sodium-cooled fast spectrum, etc. Today, it is customary to at least start these conversations with a description of reactor size and potential applications. This simple change normalises nuclear and makes it understandable to a larger public, no longer solely the domain of scientists, engineers and nerds.

There is an ongoing debate about whether SMRs will ever be able to compete with large reactor designs, whether economies of factory production, easier financing and standardisation will ever be able to compensate for lost economies of scale. While this debate is valid it is a mistake to think there is a single answer. The factors influencing nuclear economics and construction success are different country by country. They include things such as the established industrial base, labour costs, regulatory approach, market structure, and much more. What's true in the USA is unlikely to be true in Europe and certainly won't be true in South Korea or African countries. Of these, market factors will probably have the largest impact on whether SMRs or large reactors are more competitive and become the focus in the near term. This debate often misses something more fundamental. This is not an apples for apples comparison. SMRs promise to provide more than just grid-scale electricity. Their size and design allows them to be placed in new settings – next to industrial centres, in remote communities, on ships.

They can readily provide heat, hydrogen and motive force in addition to electricity. SMRs radically expand the market envelope of nuclear energy, and this is profoundly more important than the relative economics between large and small.

What is most likely to determine the success of any given SMR design/designer is whether it successfully identifies a market niche, meets the requirements of customers and forms partnerships with a competent supply base. The key universal benefit that SMRs offer is flexibility, not cost. Flexibility here defined in a broad sense and including application, siting, output (load following) and even flexibility of financing. People don't expect a sports car to be cheaper per person mile travelled than a bus. It's curious that this expectation exists for SMRs.

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Individual SMR designs that promise to do everything whilst also being radically cheaper deserve scepticism. There is a hint of snake oil in the SMR space. This is natural and to be expected in a competitive start-up sector. More generally though, where industry scepticism towards SMRs used to make sense 10 or so years ago, it simply does not now. It frankly makes more sense to be sceptical of large reactor projects in Western countries than SMRs, given announcement after announcement of disappointing construction performance. This remains true even in light of the cancellation of the NuScale and UAMP Carbon Free Power Project and the recent news that some other Western SMR starts-ups have recently had to scale back or change financial partners.

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In the commercial-led approach to SMR technology deployment the path was always going to be bumpy. Consolidation is to be expected sooner or later. The question is whether governments take a hand in down-selecting certain promising designs and vendors, or just leave the emerging sector to struggle on. And, for the avoidance of doubt – yes, we will need both large and small reactors in the coming decades. SMRs are inherently more complementary to large reactors than they are to be considered competition. Indeed, some visionaries have outlined a scenario where the deployment of SMRs allows companies (and countries) to regain the necessary nuclear competencies in a manner that doesn't bet the farm, and that will eventually allow them to build large reactors efficiently again.

SMRs have clearly now become the buzzword in nuclear innovation and the badge under which advanced reactor technologies are expected to be researched and developed. While it is a bit silly to hit all technologies with an arbitrary 300 MW size limit and insist on an automated manufacturing approach, it also tolerable if it secures funding and allows progress to be made. The other crucial innovation that SMRs unlock is in business models. Microreactors are especially noteworthy, with vendors proposing reactor leasing arrangements. The idea of sending an assembled and fuelled reactor to a site, plugging it in, using it for a while and then transporting it away – all whilst never operating/refuelling/ maintaining it themselves – is clearly a tantalising one. Big tech especially is paying close attention.

SMRs bring innovation to the nuclear industry and make it sexy again. But equally they demand innovation from other parts of the fuel cycle and the industry's supporting bodies. This may now be the primary challenge standing in the way of successful SMR deployment. Regulators especially have proven slow and reluctant to approve crucial

enabling features and certify novel designs. Even more disappointing has been the continued snail's pace on international harmonisation and design certification.

In terms of fuel supply the lack of HALEU and facilities ready to produce this is a well-known bottle neck. But we also need to see the same culture of innovation emerge in the back end – in waste management, reprocessing and disposal – if the real potential of SMRs and a more flexible and adaptive nuclear sector are to be unleashed. In case you missed it, SMRs are no longer future technology. They are part of the fabric of nuclear sector today. The SMR age officially began on 19 December 2019 when the twin reactors on the Akademik Lomonosov started providing electricity (and later heat) to Pevek. It was further cemented when the high temperature gas cooled reactors connected to the grid in Shidaowan. China and Russia have realised the SMR promise and are set to build more. As usual, other countries are struggling to catch up. Maybe it's that old idealism talking, but when those first Western SMR projects do spark up it should mark the end of the long nuclear stagnation in Europe and USA and unleash a new wave of nuclear energy development globally.

Source: https://www.neimagazine.com/opinion/opinionsmrs-a-catalyst-for-nuclear-change-11676427/, 11 April 2024.

OPINION – Steffan Puwal

Should Artificial Intelligence be Banned from Nuclear Weapons Systems?

Against a backdrop of conflict and global security concerns, 2023 may prove to have also been a pivotal year for automated nuclear weapons systems. A year that began with chatbots and Artificial Intelligence (AI) as the subjects of major news stories - some with particularly concerning headlines - ended with members of the United States Congress introducing legislation to ban AI systems from nuclear weapons and US President Biden signing an Executive Order on the subject. The issue was even raised in discussions between the United States and China at the Asia-Pacific Economic Cooperation forum, which met in San Francisco in November.

We seem to be on a fast track to developing a diplomatic and regulatory framework that restrains AI in nuclear weapons systems. This is concerning for at least two reasons:

1. There is a utility in AI that will strengthen nuclear deterrence without necessarily expanding the nuclear arsenal.

2. The rush to ban AI from nuclear defenses seems to be rooted in a misunderstanding of the current state of AI—a misunderstanding that appears to be more informed by popular fiction than by popular science.

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The policies of the United States – the NATO Ally with the largest nuclear arsenal - regarding the use of AI in nuclear defence systems will likely set the tone for the other nuclear capable NATO member states, France and the United Kingdom. This is why misunderstandings about AI, particularly in the US but across the entire Alliance more generally, must be addressed, and lawmakers should be urged to proceed more carefully with any proposed legislation. With potential geopolitical benefits to be realised, banning AI from nuclear defences is a bad idea.

Misunderstanding a New Science: When people think of AI in the context of nuclear weapons, they may imagine something like the Skynet system from the 1991 film *Terminator 2: Judgment Day*. In the film, Skynet becomes self-aware and launches a massive global nuclear strike. Perhaps they think of the 1983 film *WarGames* and its artificial intelligence system, known as WOPR, or even more niche cinema, like the 1970 film *Colossus: The Forbin Project*. These films, released in each of the last three decades of the Cold War, depict AI systems

capable of independent thought — what is sometimes referred to as Artificial General Intelligence (AGI). The danger they portray is that systems capable of independent thought would be capable of independent objectives and ulterior motives. To be sure, it would be concerning if such systems existed. But they do not; and, while a skeptical consensus is not universal, there is serious doubt among at least some researchers as to whether such systems will ever exist.

The kind of artificial intelligence that is available today is not AGI. It may pass the Turing test that is, it may be indistinguishable from a human as it answers questions posed by a user but it is not capable of independent thought, and is certainly not self-aware.

Works of popular fiction are not always accurate representations of a new science. At its best, fiction can provide a starting point for debate and strategic thought. H.G. Wells' *The Last War*, for example, was one of the first works of fiction about nuclear war; written while nuclear science was in its infancy, it is replete with misunderstandings about concepts like explosive yield and half-life. Nevertheless, Herman Kahn's later work of non-fiction, *On Thermonuclear War*, takes as its starting point scenarios that one immediately recognises from the plot of *The Last War*. Kahn demonstrated through his writing that serious academic thought could begin with a consideration of fictional scenarios, even those with scientific inaccuracies; but arguably his more important work, developed later, was based on empirical evidence—the now ubiquitously cited On Escalation. Scientific accuracy and empirical evidence must similarly be central to our discussions of AI.

hanks to the deployment of more accurate missile systems like Polaris, Titan II, and Pershing by the United States in the late 1970s, it was no longer necessary to target a city or military installation with many missiles, and so the US could still effectively deter the Soviet Union and meet its strategic objectives with fewer warheads. Pictured: Pershing II weapon system tested in February 1983.

The kind of artificial intelligence that is available today is not AGI. It may pass the Turing test that is, it may be indistinguishable from a human as it answers questions posed by a user but it is not capable of independent thought, and is certainly not self-aware. There are myriad roles for AI in our nuclear defences, including AI-based targeting systems. If we assume that AI-based targeting will make nuclear weapons more accurate — that is, more likely to hit what they should hit and not hit what they should not — then what are the geopolitical benefits of its development and deployment? It is useful to revisit historical examples to illustrate how increasing the accuracy of nuclear weapons strengthened US and NATO defences during the Cold War.

In his March 1983 Oval Office address, President Reagan presented his case for the development of a ballistic missile defence system. One of his key points was that the Soviet Union possessed more nuclear weapons than did the US. In the late 1970s, the Soviet Union did indeed overtake the US in the number of nuclear weapons it possessed, but this was largely a result of the deployment of more accurate missile systems like Polaris, Titan II, and Pershing. It was no longer necessary to target a city or military installation with many missiles, and so the US could still effectively deter the Soviet Union and meet its strategic objectives with fewer warheads. The cost savings achieved by having a smaller number of more accurate nuclear weapons allowed the US to free up valuable defense dollars to develop new systems like the stealth bomber and the cruise missile.

Thanks to the deployment of more accurate missile systems like Polaris, Titan II, and Pershing by the United States in the late 1970s, it was no longer necessary to target a city or military installation with many missiles, and so the US could still effectively deter the Soviet Union and

meet its strategic objectives with fewer warheads. Pictured: Pershing II weapon system tested in February 1983. The reduction in the overall number of US nuclear weapons in the concluding decades of the Cold War, at a time when defence spending was a substantially greater share of gross domestic product than it is today, is suggestive of the idea that more accurate weapons can mean fewer weapons.

One piece of evidence that suggests how the development of more accurate nuclear weapons potentially influenced US nuclear policy comes from the recently declassified Presidential Directive 59, signed by President Carter in 1980. Two salient points in this directive are a request for increased intelligence on targets and a push for what is referred to as a "look-shoot-look" capability — the ability to find a target, hit it, and then assess the strike. Implicit in this approach are the ideas that a nuclear strike should hit its intended target, the target should have strategic value, and that a form of nuclear carpet bombing that fails to hit an intended target is strategically pointless.

In parallel to these developments in nuclear weapons, conventional weapons also became increasingly more accurate. The Gulf War (1990-1991) was an important turning point for conventional weapons systems — accurate munitions that hit military targets and comparatively minimised civilian casualties were front and centre in the press briefings provided by US General Norman Schwarzkopf. The benefit of minimising civilian casualties has since led many NATO Allies to ban older and relatively indiscriminate weapons like cluster munitions. What form a more accurate, AI-based targeting system for nuclear weapons may take is difficult to estimate at this point, with much of the technology still in the development stage. One can imagine a hypothetical scenario in which a nuclear weapon targets a naval base, but an approach pattern recognition determines that the target submarines have already put to sea, and so the missile opts for a redirected underwater strike instead of an atmospheric detonation. This is but one of many possible scenarios to consider involving AI.

If past is prologue, and the use of more accurate AI-based targeting systems leads to a reduction in the overall number of nuclear weapons, where might such reductions be made? A strategic review will, of course, answer this question. One possibility may be land-based ICBMs. While it is not currently US policy, former officials, including US Secretary of Defense William Perry, have argued for precisely that. Potential benefits can extend beyond nation state threats. A reduction in the number of nuclear weapons will make it easier to secure the remaining stockpile and prevent the nightmare scenarios of nuclear terrorism, where poorly secured weapons fall into the wrong hands.

Potential benefits can extend beyond nation state threats. A reduction in the number of nuclear weapons will make it easier to secure the remaining stockpile and prevent the nightmare scenarios of nuclear terrorism, where poorly secured weapons fall into the wrong hands.

There is, of course, the potential for an arms race in AI-based targeting systems for nuclear weapons. But it is also important to note the role that continued research and development can play in nuclear diplomacy and a reduction of arms. Returning to the historical precedent, by the time the US deployed intermediate range Pershing missiles to Europe, they were seen as a bargaining chip in the strategic arms reduction talks that would follow. President Reagan's ballistic missile shield was similarly viewed by the Soviets as something that could be bargained over. At the 1986 Reykjavik Summit, President Reagan found Soviet leader Mikhail Gorbachev willing to negotiate away large numbers of nuclear weapons in exchange for an agreement by the US not to deploy a ballistic missile defence system. Instead, the summit was followed by negotiations for the Intermediate-Range Nuclear Forces Treaty, which led to the removal of the Pershing missiles.

There are currently serious issues related to nuclear diplomacy that must be addressed. Russia rejects nuclear inspections and continues

to develop next generation hypersonic ballistic missiles. Meanwhile, China has historically preferred to self-limit its nuclear arsenal, rarely opting for formal agreements with the US. The hope of nuclear diplomats today is for a multilateral arms reduction treaty between the US, Russia, and China. With Russia's brutal war in Ukraine and simmering tensions in the Indo-Pacific region, the challenges of developing such a treaty are immense. Should all parties eventually agree to talks, nuclear weapons systems with AI-based targeting can, if nothing else, provide the US and its NATO Allies with a bargaining chip in those negotiations. This function in future arms control negotiations is, in effect, "building up to build down" (a strategy well established in nuclear arms negotiations); but it creates an imperative to be the first to invest in the development of the most effective systems, not to restrain their development.

And if, ultimately, it is decided that AI systems should be withheld from nuclear defenses, any proposed legislative language must carefully define artificial intelligence — a difficult task for a rapidly developing science.

And if, ultimately, it is decided that AI systems should be withheld from nuclear defenses, any proposed legislative language must carefully define artificial intelligence — a difficult task for a rapidly developing science. A proposed bill in the US Congress, for example, suggested that systems that "select or engage targets for the purposes of launching a nuclear weapon" should be banned, and defined "'autonomous weapons system' as a weapons system that, once activated, can select and engage targets without further intervention by an operator." In this case, it should be pointed out that since the early 1970s, the US nuclear arsenal has used MIRVs; a system that launches and then redirects to a new trajectory for each of the multiple warheads it carries without the further intervention of a human operator. Expert legal testimony should consider whether such legislative language is so broad that it could unintentionally ban MIRVs, a proven technology that has been at the core of US nuclear defence for decades.

AI systems offer an opportunity to strengthen nuclear deterrence by providing a more accurate and capable defensive nuclear response. The purpose of making nuclear weapons more accurate and capable is not to promote their usage. Such capabilities, instead, provide a more credible deterrence to nuclear war and are consistent with classic nuclear doctrine. AI is simply a strategic tool, like nuclear weapons themselves.

Conclusion: With each new decade, fear of the bomb has been entwined with fear of the transistor, the microprocessor, and the silicon wafer, and this has been reflected in our popular culture. Those who developed the nuclear arsenal, its control systems, and deterrence theory were well aware of this and studiously considered the proper role automated systems should play. While it may seem like a more *sophisticated* problem today, any potential risk of combining automated systems with nuclear weapons is certainly not a *new* problem. Legitimate concerns over a rapidly developing technology are valid; but concerns over the capabilities of AI systems must be based on the actual science of these systems, not merely their depiction in popular fiction.

AI systems offer an opportunity to strengthen nuclear deterrence by providing a more accurate and capable defensive nuclear response. The purpose of making nuclear weapons more accurate and capable is not to promote their usage. Such capabilities, instead, provide a more credible deterrence to nuclear war and are consistent with classic nuclear doctrine. AI is simply a strategic tool, like nuclear weapons themselves.

Concern over AI should not preclude the use of AI in strengthening nuclear deterrence. Nor should AI be deployed in those systems simply for the sake of deployment. Employing AI should serve a strategic objective. Where to find the right balance

will be difficult because the science is still in its infancy. Expert testimony from the defence and AI communities should be heard — not just the management of AI companies, but engineers, academics, military officers, and legal counsel. In a time of major global security concerns and rapidly developing nuclear and AI technologies, legislators and political leaders should proceed carefully with any proposed legislation.

Source: https://www.nato.int/docu/review/articles/2024/04/12/should-artificial-intelligence-be-banned-from-nuclear-weapons-systems/index.html, 12 April 2024.

NUCLEAR STRATEGY

RUSSIA

Putin's Ultimatum to NATO Nation Over Nuke Trigger; 'Be Ready to Face Russian Action...'

The Vladimir Putin government has issued an ultimatum to NATO member Finland. Moscow said Finland would face Russian countermeasures if it posed a nuclear threat. In an open threat, Russia said that Helsinki should be ready for consequences. The threat was in response to statements by Finnish authorities that the country may allow the transit of NATO nuclear weapons. Watch this report for more.

Source: https://www.hindustantimes.com/videos/world-news/putins-ultimatum-to-nato-nation-over-nuke-trigger-be-ready-to-face-russian-action-101712935644477.html, 12 April 2024.

UK

Keir Starmer: Labour Commitment to Nuclear Weapons Unshakeable

Sir Keir Starmer has said his commitment to the UK's nuclear weapons is "unshakeable" and "absolute". Writing in the *Daily Mail*, he described the creation of the NHS and an independent British nuclear programme as "towering achievements" of the Labour government elected in 1945. The Labour leader has also said he wants to raise defence spending to 2.5% of GDP "as soon as resources allow". The government plans to spend 2.3% of GDP on defence this year. Chancellor Jeremy Hunt has also said he wants the figure to rise to 2.5% "as soon as economic conditions allow", but neither party has set out a timeline for this.

Earlier this year, two ministers – Tom Tugendhat and Anne-Marie Trevelyan - publicly urged the government to invest in defence at a "much greater pace". Defence Secretary Grant Shapps said Labour could not "be trusted with our nation's defences" because Sir Keir had "tried twice to put Jeremy Corbyn in charge of the nation's armed forces". "The same man who wanted to scrap our nuclear deterrent, dismantle Nato and questioned the integrity of British intelligence community," he added.

Neither Sir Keir's pledge on the UK's Trident nuclear weapons nor his aspiration to increase defence spending were "credible", Mr Shapps claimed, as 11 members of the Labour leader's team - including deputy leader Angela Rayner and shadow foreign secretary David Lammy - had voted against renewing Trident in 2016. He accused Sir Keir of "saying whatever he needs to, to get your vote".

Neither Sir Keir's pledge on the UK's Trident nuclear weapons nor his aspiration to increase defence spending were "credible", Mr Shapps claimed, as 11 members of the Labour leader's team - including deputy leader Angela Rayner and shadow foreign secretary David Lammy - had voted against renewing Trident in 2016. He accused Sir Keir of "saying whatever he needs to, to get your vote".

Since the United States dropped atomic bombs on Hiroshima and Nagasaki in 1945, Labour has often been divided on nuclear weapons - and the related issue of multilateral versus unilateral disarmament - not least during the leadership of Sir Keir's predecessor, Jeremy Corbyn. Clement Attlee, who was prime minister from 1945-1951, is widely revered in the party as the father of the NHS and much of the rest of the welfare state. But he was also the father of Britain's nuclear

bomb, ensuring the UK got its own "nuclear deterrent" and committing many millions of pounds to its development at a time when the country was technically bankrupt. His foreign secretary, Ernest Bevin, was a key figure in the establishment of the Nato alliance.

In his Mail article, Sir Keir emphasised these points, calling them a "proud part of my party's heritage". Visiting the BAE Systems shipyard in Barrow-in-Furness in Cumbria, where the UK's nuclear submarines are built, the Labour leader said his party was making a "generational commitment". This was "to the Dreadnought submarines, to the continuous at-sea deterrent, and to the upgrades that are needed over time. And of course there's AUKUS in there as well," he added. AUKUS is the security pact agreed by the UK. the US and Australia to counter China's ambitions in the Indo-Pacific region. Last October, BAE Systems secured a £3.95bn contract to build a new generation of nuclear-powered attack submarines as part of the pact.

In the face of rising global threats and growing Russian aggression, the UK's nuclear deterrent is the bedrock of Labour's plan to keep Britain safe. "It will ensure vital protection for the UK and our Nato allies in the years ahead, as well as supporting thousands of high-paying jobs across the UK." He also stressed his party had "changed" - a reference to Mr Corbyn, a long-time opponent of the UK's Trident missile system and vice-president of the Campaign for Nuclear Disarmament (CND).

The UK's four nuclear-armed Vanguard submarines that carry Trident missiles are housed in the west of Scotland. Earlier, when asked about defence spending in an interview with the newspaper, Sir Keir said he would conduct a strategic review "to be clear what the priorities are". But, he added: "In the face of rising global threats and growing Russian aggression, the UK's nuclear deterrent is the bedrock of Labour's plan to keep Britain safe. "It will ensure vital protection for the UK and our Nato allies in the years ahead, as well as supporting thousands of high-paying jobs across the UK." He also stressed his party had "changed" - a reference to Mr Corbyn, a long-time opponent of the UK's Trident missile system and vice-president of the Campaign for Nuclear Disarmament (CND). Nuclear weapons were "expensive but it's absolutely vital and needed", Sir Keir said. Annual running costs are estimated at 6% of the defence budget - about £3bn in 2023-24. The new Dreadnought boats being built at Barrow-in-Furness to replace the current submarines in the early 2030s carry an estimated cost of £31bn.

Source: Kate Whannel & Chas Geiger, https://www.bbc.com/news/uk-politics-68790435, 12 April 2024.

It would be expedient for Poland to seek the deployment of U.S. nuclear warheads in its territory as part of the NATO Nuclear Sharing program, Polish President Duda said in an interview with the Dziennik Gazeta Prawna newspaper. At the same time, the head of state doubted the possibility of starting a nuclear war because "it would mean the end of the world."

USA–POLAND

Poland Asks United States for Nuclear Weapons

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In 2022, *Duda* already announced Poland's desire to receive nuclear weapons from the United States and participate in the nuclear deterrence program. This happened after russian President Putin threatened to use nuclear weapons against

Ukraine amid the successes of the Armed Forces at the front. In the summer of last year, after it became known that russia had transferred nuclear weapons to Belarus, the Polish authorities again recalled their intention to participate in the Nuclear Sharing program and achieve the deployment of American nuclear weapons in their territory.

China is providing Moscow with cruise missile, drone and tank parts, fuelling the biggest Russian military expansion since Soviet times, the US has warned. US defence officials warned that China is propping up Russia's defence industrial base, funnelling weapons technology towards the war in Ukraine.

Nuclear sharing is an agreement between the United States and allied countries within NATO, which includes Poland, on the transfer, in case of military necessity, of nuclear weapons from storage bases in the United States. As part of the mission of the North Atlantic Alliance, the United States has already placed about 150 of its nuclear bombs near European states. As the Ukrainian News agency earlier reported, in the spring of 2023, it became known that Russia had transferred nuclear weapons to the territory of Belarus. The press secretary of the President of the Russian federation, Peskov, later explained Moscow's actions as a "concern for security."

Source: https://ukranews.com/en/news/998716-poland-asks-united-states-for-nuclear-weapons, 13 April 2024.

BALLISTIC MISSILE DEFENCE

CHINA–RUSSIA

China Supplying Russia with Cruise Missile, Drone and Tank Parts, Warns US

China is providing Moscow with cruise missile, drone and tank parts, fuelling the biggest Russian military expansion since Soviet times, the US has warned. US defence officials warned that China is propping up Russia's defence industrial base, funnelling weapons technology towards the war in Ukraine. Biden, the US president, raised concerns directly with Jinping on April 2, warning the premier that the United States was unhappy with China's huge support for the Russian military. A Biden administration official, speaking on the condition of anonymity, accused China of helping Moscow to meet its most ambitious defence expansion since the Soviet era and on a faster timeline than we believed possible early on in this conflict. China is accused of supplying Russia with machine tools to increase its ballistic missile production, which has allowed Putin's forces to outgun Ukraine on the battlefield.

Source: https://www.msn.com/en-us/news/world/china-supplying-russia-with-cruise-missile-drone-and-tank-parts-warns-us/ar-BB1lx29g 12 April 2024.

INDIA

India has successfully carried out a night launch of new generation nuclear capable ballistic missile 'Agni Prime' from the Abdul Kalam Island off the coast of Odisha, boosting the country's strategic deterrence capability.

India Successfully Carries out Night Launch of Nuclear Capable Agni Prime Missile

India has successfully carried out a night launch of new generation nuclear capable ballistic missile 'Agni Prime' from the Abdul Kalam Island off the coast of Odisha, boosting the country's strategic deterrence capability. The defence ministry said the test-flight was carried out on Wednesday evening and it met all the trial objectives, validating the reliable performance, as confirmed from the data captured by a number of range sensors deployed at different locations. The SFC, along with DRDO, carried out the flight test of the missile that has a strike range of 1,000 to 2,000 km. Defence Minister Singh congratulated the DRDO, SFC and the armed forces for the successful test flight and stated that the successful development and induction of the missile will be an excellent force multiplier for the military.

Source: https://www. msn.com/en-in/news/India/india-successfully-carries-out-night-launch-of-nuclear-capable-agni-prime-missile/ar-BB1I3V4N, 04 April 2024.

NORTH KOREA

North Korea Fires Medium-Range Ballistic Missile

North Korea fired a medium-range ballistic missile on Tuesday, with South Korea, the United States and Japan conducting a joint aerial exercise involving nuclear-capable B-52H bombers just hours later. Pyongyang's latest launch comes less than two weeks after Kim supervised a solid-fuel engine test for a new IRBM, with experts suggesting the Tuesday launch could be of the same weapon. Seoul's military said the missile, launched early Tuesday, flew around 600 kilometres (373 miles) before splashing down in waters between South Korea and Japan. The Joint Chiefs of Staff said the military was analysing the launch, with a defence official telling the Yonhap news agency that it had likely involved a hypersonic warhead "on top of the delivery system used in the engine test last month".

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North Korea has long sought to master more advanced hypersonic and solid fuel technologies, to make its missiles more capable to neutralise South Korean-US missile defence systems and threaten America's regional military bases. In January, Pyongyang said it had launched a solid-fuel IRBM tipped with a hypersonic warhead, then last month flagged the successful engine test of the "new-type intermediate-range hypersonic missile". Hypersonic missiles are faster and can manoeuvre mid-flight, making them harder to track and intercept, while solid-fuel missiles do not need to be fuelled before launch, making them harder to find and destroy, as well as quicker to use. Seoul's defence ministry said it conducted a joint aerial exercise with Washington and Tokyo on Tuesday involving a nuclear-capable B-52H bomber and F-15K fighter jets near the Korean peninsula.

Source: https://www.barrons.com/news/north-korea-fires-medium-range-ballistic-missile-seoul-ff265066, 01 April 2024.

RUSSIA

Russia Says it Conducts Successful ICBM Test Launch

Russia's Defence Ministry said on 12 April it had conducted a successful test launch of an intercontinental ballistic missile at the Kapustin Yar rocket launch complex in the southern Astrakhan region. The launch came late on 12 April – which Russia marks as Cosmonautics Day, commemorating the day in 1961 when Gagarin made the world's first-ever space flight. A launch on the same day one year ago was believed to be a test of a new version of Putin's Topol range – known for now as Topol-ME. The mystery missile in the new launch is not believed to be the Sarmat – or Satan-2 – which appears to be dogged by testing delays. This is destined to be the largest missile in Putin's nuclear arsenal, described as an 'unstoppable' apocalypse 208-ton intercontinental silo-launched 15,880mph weapon, the size of a 14-storey tower block. Before properly going into service it is expected to be tested over the South Pole.

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Source: https://www.usnews.com/news/world/articles/2024-04-12/russia-says-it-conducts-successful-intercontinental-ballistic-missile-test-launch, 12 April 2024.

USA

RTX's SM-6 Destroys Ballistic Missile Threat in Test at Sea

Raytheon's SM-6 missile, operating under the RTX banner, showcased its capabilities by intercepting a medium-range ballistic missile target in a test conducted at sea. The successful

test, designated as Flight Test Aegis Weapon System (FTM)-32, highlights the strength of the SM-6, further bolstering its reputation as a defence system. Raytheon's SM-6 missile, operating under the RTX banner, showcased its capabilities by intercepting a medium-range ballistic missile target in a test conducted at sea.

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The successful test, designated as Flight Test Aegis Weapon System (FTM)-32, highlights the strength of the SM-6, further bolstering its reputation as a defence system. The test, conducted off the coast of Hawaii and involving the USS Preble (DDG 88), marked another event in the development of the SM-6 system. Utilising the Baseline 9.C2 variant of the Aegis Combat System, the SM-6 Dual II (Block IA) configuration, equipped with newly qualified software, demonstrated its ability to neutralise incoming threats, even in the final seconds of flight.

Based on the developmental requirements and characteristics of different design options for mw-class space nuclear reactors, a technical scheme for a mw-class small lithium-cooled space reactor is designed. This scheme uses a lithium-cooled reactor coupled with a Brayton power conversion system that is lightweight and durable.

Source: https://www.msn.com/en-us/news/world/rtx-s-sm-6-destroys-ballistic-missile-threat-in-test-at-sea/ar-BB1I60pe, 09 April 2024.

EMERGING TECHNOLOGIES AND DETERRENCE

CHINA

China Gives Details of its Nuclear Space Engine Project

Design and R&D of a mw lithium-cooled space nuclear reactor was the subject of a recent detailed article in the scientific journal *SCIENTIA SINICA Technologica* (V. 54, Issue 3, pp. 365-376) co-sponsored by the Chinese Academy of Sciences and the National Natural Science Foundation of China. According to the abstract of the paper: "Space nuclear reactor power, with the advantages of high energy density, high output power, long duration, and minimal influence from the external environment, is the preferred route for energy supply for future high-power long-life space missions and deep space exploration missions.

Based on the developmental requirements and characteristics of different design options for mw-class space nuclear reactors, a technical scheme for a mw-class small lithium-cooled space reactor is designed. This scheme uses a lithium-cooled reactor coupled with a Brayton power conversion system that is lightweight and durable." Chinese team selected liquid metal as the most suitable cooling option. Inert gas was excluded due to the need to have a large active zone and heavy protection, and heat pipes. Various options for liquid metal coolants (sodium, potassium, etc.) were investigated before lithium was selected.

Source: https://www. neimagazine.com/news/newschina-gives-details-of-its-nuclear-space-engine-project-11677559, 12 April 2024.

NUCLEAR ENERGY

BANGLADESH

Electrical Work Paves Way for Reactor Assembly at Rooppur 1

Specialists of Russia's ESCM have completed the full range of electrical work on the reloading machine at unit 1 of the Rooppur NPP under construction in Bangladesh. This ensures that the

main equipment is ready for commissioning and paves the way for reactor assembly. More than 200 ESCM employees were involved in the work. Currently, the total number of ESCM specialists at the site exceeds 2,500. ESCM opened a branch in Bangladesh in 2018.

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The Rooppur plant is being built by Rosatom on the eastern bank of the Ganges River in Bangladesh's Pabna district, about 160 km northwest of Dhaka. It will comprise two VVER-1200 reactors. In November 2011, Russia and Bangladesh signed an inter-governmental agreement on cooperation in the construction of the NPP and in mid-December 2015, a general contract was signed. Construction began in 2021. Construction of the unit 1 began in November 2017 and unit 2 in July 2018. The plant's design life is 60 years with the possibility of extending its operating life for another 20 years. Fresh fuel for the units was delivered to the site in the latter part of 2023.

Source: https://www.neimagazine.com/news/newselectrical-work-paves-way-for-reactor-assembly-at-rooppur-1-11677530, 12 April 2024.

CHINA

China's Fangchenggang 4 Achieves First Criticality

Unit 4 at China's Fangchenggang NPP in the Guangxi Autonomous Region has achieved first criticality, according to China General Nuclear (CGN). The unit is the second of two demonstration Hualong One (HPR1000) reactors (units 3&4) at the site. The Fangchenggang plant will eventually house six reactors. Phase one (units 1&2) are CPR-1000 units which began commercial operation in 2016. Units 5 and 6 are expected to be Hualong One reactors.

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Hot functional testing of Fangchenggang 4 began in September 2023. The National Nuclear Safety Administration (NNSA) issued CGN a licence to operate in February 2024 and fuel loading was completed on 2 March. NNSA inspections followed and permission to launch the reactor granted on 1 April. CGN said the 1,180 MWe pressurised water reactor became critical on 3 April. Unit 3 began commercial operation in March 2023. The first concrete for the nuclear island of unit 3 was poured in 2015 and for unit 4 in 2016. The units were originally expected to be launched in 2019 and 2020 but this was delayed until 2022 for both units. The Fangchenggang plant is planned to house six reactors. The first phase comprises two CPR-1000 units which were put into commercial operation in 2016. Units 5 and 6 are expected to feature Hualong One reactors.

Source: https://www.neimagazine.com/news/newschinas-fangchenggang-4-achieves-first-criticality-11676138, 11 April 2024.

CZECH REPUBLIC

ÈEZ Highlights Benefits of Increasing Output of Existing Units

The modernisation of existing nuclear power units in the Czech Republic has added extra capacity equivalent to the output of a large coal-fired power plant, operator ÈEZ has said. The company said that the latest development was Dukovany's third unit achieving a thermal output of 1475 MWt - equivalent to 511 MWe - a 2.3% increase achieved without any increase in fuel

consumption or emissions. The units at the Dukovany nuclear power plant started up between 1985 and 1987 and are VVER-440 reactors, originally rated at 440 MWe. The installed capacity of each of them was increased after a nine-year modernisation programme to 500 MWe in 2009. The units at the Temelin nuclear power plant were also upgraded from 981 MWe to 1086 MWe.

The company said that the latest development was Dukovany's third unit achieving a thermal output of 1475 MWt - equivalent to 511 MWe - a 2.3% increase achieved without any increase in fuel consumption or emissions. The units at the Dukovany nuclear power plant started up between 1985 and 1987 and are VVER-440 reactors, originally rated at 440 MWe.

Preparation for the latest capacity increase started in full in 2020 as part of a programme which also included the switch from an 11-month to a 16-month fuel cycle. Preparations included modernisation of some technological and safety systems, with the temperature of the water at the outlet of the reactor increased from 298.4°C to 300.4°C. ÈEZ says it expects the annual production of Dukovany to increase in 2025 by about 300,000 MWh after all the units are modified. Four VVER-440 units are currently in operation at the Dukovany site. Two VVER-1000 units are in operation at Temelín, which came into operation in 2000 and 2002. The Czech Republic uses nuclear power for 34% of its electricity. Its current new nuclear plans include up to four new units, as well as a possible roll-out of small modular reactors.

The inclusion of nuclear energy in the global stockake at COP28, as a means for reductions in greenhouse gas emissions, was indeed a historic milestone. This development is a testament to the progress made collectively in ensuring the safety and security of nuclear energy and highlights the instrumental role of the IAEA.

Source: https://www.world-nuclear-news.org/Articles/CEZ-highlights-increased-capacity-of-existing-unit, 11 April 2024.

GENERAL

COP29 Hosts Aim to Include Nuclear in Deliberations

The "inclusion of facilitated and affordable nuclear technologies in the resource deliberations of the COP process is essential", Azerbaijan's Foreign Minister Bayramov has said. Bayramov, whose country is hosting the 29th UN Climate Change COP29 in November was speaking at the Nuclear Energy Summit, co-organised by the IAEA and Belgium, in Brussels last month. In his address to those attending. The inclusion of nuclear energy in the global stockake at COP28, as a means for reductions in greenhouse gas emissions, was indeed a historic milestone. This development is a testament to the progress made collectively in ensuring the safety and security of nuclear energy and highlights the instrumental role of the IAEA. The text of the COP28 global stocktake agreement said that the parties recognise that limiting global warming to 1.5°C with no or limited overshoot requires deep, rapid and sustained reductions in global greenhouse gas emissions of 43% by 2030 and 60% by 2035 relative to the 2019 level and reaching net-zero carbon dioxide emissions by 2050.

Source: https://www.world-nuclear-news.org/Articles/COP29-hosts, 05 April 2024.

GERMANY

Proxima Raises More Funding for its Fusion Programme

Munich-based start-up Proxima Fusion has raised €20m ($21.7m) in seed funding to accelerate its plans to build the first generation of fusion power plants based on quasi-isodynamic (QI) stellarators with high-temperature superconductors. Proxima Fusion is the first spin-out from the Max Planck Institute for Plasma Physics (IPP). The start-up was founded by former scientists and engineers from the Max Planck IPP, MIT, and Google-X. The group aims to deploy a new high-performance stellarator over the coming years. Its roadmap targets a first-of-a-kind fusion power plant within the 2030s. It completed its Pre-Seed fundraising of €7m in June 2023 to

support fusion power plant development based on the stellarator concept. The fundraising was co-led by Plural and UVC Partners, and joined by High-Tech Gründerfonds (HTGF) and the Wilbe Group.

Source: https://www. neimagazine. com/news/newsproxima-raises-more-funding-for-its-fusion-programme-11677586, 12 April 2024.

INDIA

India Eyes 100 GW Nuclear Power by 2047: AEC Chairman

India aims to produce 1 lakh MW of nuclear power by 2047, a massive increase from the current production of over 8,000 MW, Atomic Energy Commission Chairman Mohanty said. Mohanty was speaking at the release of a report, 'Synchronising Energy Transitions Towards Possible Net Zero for India: Affordable and Clean Energy for All', largely funded by the Office of the Principal Scientific Adviser to the government of India. Grover, Chairman Emeritus of the Homi Bhabha National Institute, said the report was necessary as studies for energy transition for India have come up with a very insignificant role for nuclear citing high input cost and lower public acceptance.

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Source: https://m. economictimes. com/industry/energy/power/india-eyes-100-gw-nuclear-power-by-2047-aec-chairman/articleshow/109012593.cms, 04 April 2024.

Indian Net-Zero will Need Nuclear, Report Finds

India can achieve clean, affordable electricity and become net-zero by 2070 - but will need substantial nuclear power and renewable energy to do this, according to a new in-depth report prepared for the Indian government. Synchronizing energy transitions towards possible Net-Zero for India: Affordable and clean energy for all was launched by Sood, principal scientific adviser to the Government of India, on 3 April. The 224-page report was prepared by the Indian Institute of Management Ahmedabad (IIMA) as part of a project sanctioned in November 2021 by the Office of the Principal Scientific Adviser (PSA) to the Government of India. The aims of the project were to carry out a comprehensive study looking at methods for minimising the cost of power at the consumer end and to work out an optimum mix for all sources of power to reach net-zero emissions.

The IIMA project team was led by Garg under the guidance of an expert group constituted by the Office of the PSA which included representatives from the coal, nuclear, solar, wind and biofuels generation sectors. The report was independently reviewed by Tata Consulting Engineers Limited. At the COP26 climate conference in Glasgow in November 2021, PM Modi pledged that India would achieve net-zero carbon emissions by 2070. To achieve this, the report notes, India's electricity sector will need to decarbonise "well before" then. The study explores how the country can achieve clean and affordable electricity under four different net-zero (NZ) pathways and maps out its future energy requirements under seven alternative scenarios ranging from low to high economic growth, aligned with India's ambition of achieving "developed country" status by 2047.

India can achieve clean, affordable electricity and become net-zero by 2070 - but will need substantial nuclear power and renewable energy to do this, according to a new in-depth report prepared for the Indian government. Synchronizing energy transitions towards possible Net-Zero for India: Affordable and clean energy for all.

Recommendations: Among its recommendations, the report calls for a "level playing field" for all low-carbon technologies with new, innovative finance and/or transition finance mechanisms to avoid preferential treatment for any technology, and life-cycle assessments for all alternative

energy systems. Trade bans and India's lack of indigenous uranium have hampered nuclear energy's momentum in the past until the more recent opening of the civil international uranium trade, the report notes. It recommends that uranium storage facilities are commissioned to allow for resilience.

Among its recommendations, the report calls for a "level playing field" for all low-carbon technologies with new, innovative finance and/or transition finance mechanisms to avoid preferential treatment for any technology, and life-cycle assessments for all alternative energy systems.

Source: https://www.world-nuclear-news.org/Articles/Indian-net-zero-will-need-nuclear,-report-finds, 05 April 2024.

IRAN

Iran Reviews Nuclear Achievements

The President of the Atomic Energy Organisation of Iran (AEOI) MEslami said Iran had unveiled 150 scientific and technological achievements in the nuclear industry in the previous Iranian calendar year, which ended on 19 March. He made the remarks at a ceremony to mark the national Nuclear Technology Day. Among the achievements, 15 were registered in the radiopharmaceuticals field, Eslami said, adding Iran ranked among the world's top three countries in this area. He noted that using alpha particles for cancer treatment a key achievement in the area, the use of which he said had only recently started in the world.

He also noted that irradiation systems will be installed in 12 centres across the country to prevent 130 t of agriculture products from rotting. Plans are underway to open 50 clinics in the country for the treatment of wounds by implementing plasma technology, he added. Eslami said that Iran will hold its first international nuclear conference within a month, adding experts from 30 countries had agreed to take part in the event. Eslami outlined measures undertaken by the AEOI to generate 20,000 mws of nuclear electricity in the coming years, including the construction of several new power plants in the southern region of the country and expansion of the Bushehr NPP.

Source: https://www.neimagazine.com/news/newsiran-reviews-nuclear-achievements-11677619, 12 April 2024.

JAPAN

Japanese Court Allows Continued Operation of Five Ageing Nuclear Plants

A Japanese court has decided to allow five ageing nuclear reactors to continue operating at NPPs run by Kansai Electric Power Co, dismissing local residents' safety concerns that led to demands for suspensions. The Fukui District Court denied injunctions to halt unit 3 at the Mihama NPP units 1-4 at the Takahama plant, both in Fukui Prefecture. The reactors began commercial operations between 1974 and 1985. Presiding Judge Yasushi Kato said the court did not find any reasons to believe the reactors would encounter problems and endanger residents. The reactors are operating in line with the stricter standards implemented after the Fukushima Daiichi nuclear accident in 2011, and factors unique to the locations of the reactors have been appropriately assessed, Kato said. The safety measures necessary for operating such ageing facilities have been taken, he added. Mihama 3, which started operation in 1976 in 2021 became first nuclear unit in Japan to operate beyond the government-mandated 40-year service period, introduced under the post-Fukushima regulatory standards. The service period for reactors was subsequently extended to 60 years or more in 2023 provided the necessary safety upgrades were completed.

A Japanese court has decided to allow five ageing nuclear reactors to continue operating at NPPs run by Kansai Electric Power Co, dismissing local residents' safety concerns that led to demands for suspensions. The Fukui District Court denied injunctions to halt unit 3 at the Mihama NPP units 1-4 at the Takahama plant, both in Fukui Prefecture.

Source: https://www.neimagazine.com/news/newsjapanese-court-allows-continued-operation-of-five-ageing-nuclear-plants-11649651, 02 April 2024.

SOUTH AFRICA

Support Grows for South Africa's HTMR-100 SMR

South Africa's Koya Capital has signed a partnership agreement with Stratek Global to assist in securing finance for construction of a high temperature modular reactor. The ZAR9bn ($480m) HTMR-100 is based on South Africa's Pebble Bed Modular Reactor (PBMR). South Africa began developing the PBMR in the 1990s, but it was put into care and maintenance in 2010. It was reincorporated, into Eskom, in 2012. The pebble bed reactor design was developed in Germany and was used there in the 1970s and 1980s. South Africa became involved in 1988 when Johan Slabber, then with the Atomic Energy Commission met with the German pebble bed reactor scientists. The proposal for a direct cycle pebble bed reactor designed for South African conditions was formulated. Slabber later joined the South African systems engineering company IST and introduced the concept to IST's Dieter Matzner and to Eskom's Nicholls. The three founded PBMR (Pty) Ltd in 1993.

The pebble bed reactor design was developed in Germany and was used there in the 1970s and 1980s. South Africa became involved in 1988 when Johan Slabber, then with the Atomic Energy Commission met with the German pebble bed reactor scientists. The proposal for a direct cycle pebble bed reactor designed for South African conditions was formulated.

In 1995, the South African government lent support to the study of the project, and in 2000 South Africa approved the detailed feasibility phase. Internal research was strong, with the PBMR project generating more than 100 patents during the period 1999-2004. The PBMR was a small-scale high-temperature reactor using graphite-coated spherical uranium oxycarbide tristructural isotropic (TRISO) fuel, with helium as the coolant, able to supply process heat as well as generating electricity.

Source: https://www.neimagazine.com/news/newssupport-grows-for-south-africas-htmr-100-smr-11676146, 11 April 2024.

USA

Licensing and Testing Progress for Innovative Thorium-Based Fuel

Days after announcing the start of accelerated irradiation testing and qualification of its patented ANEEL thorium and high-assay low-enriched uranium (HALEU) fuel at Idaho National Laboratory, Clean Core Thorium Energy announced it has completed the first phase of the Canadian nuclear regulator's pre-licensing review process. ANEEL has been developed for use in pressurised heavy water reactors and Candu reactors (its name is taken from Advanced Nuclear Energy for Enriched Life). The company says it can offer significantly improved performance with existing proven heavy water reactor systems by leveraging thorium's "inherently superior" nuclear, thermal and physical properties while retaining the same external dimensions and configuration design as in currently used natural uranium fuel bundles. It can be used to replace current fuel bundles, without any significant modifications to the reactor, to reduce life-cycle operating costs and waste volumes, increase safety and accident tolerance, and result in additional proliferation resistance, the company claims. ANEEL is the first thorium-based fuel for

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Candu reactors to successfully complete the first phase of the Canadian Nuclear Safety Commission (CNSC) pre-licensing process for new fuel designs, Clean Core said.

Source: https://www.world-nuclear-news.org/Articles/Licensing-and-testing-progress-for-innovative-thor, 10 April 2024.

DOE Releases Community Guide on Coal-to-Nuclear Conversion

The US DOEhas released an information guide for communities considering replacing their retired or retiring coal power plants with nuclear power plants. The guide is based on a technical study that found transitioning from a coal plant to nuclear would bring local benefits including employment opportunities, increased revenues and economic activity.

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Nearly 30% of the USA's coal plants are projected to retire by 2035, but pivoting away from carbon-emitting sources for electricity generation means economic uncertainty for the communities where those plants are situated, *Coal-to-nuclear transitions: An information guide* notes. But advanced small modular reactors are particularly well suited to replace coal plants, it says. The report is based on an in-depth technical study prepared for the DOE, and builds on a 2022 DOE report highlighting the opportunities and challenges as coal communities consider converting to nuclear. A nuclear power plant replacing a coal power plant would employ more people and create additional long-term jobs and increase total income in host communities, as well as increasing revenue for host communities, power plant operators, and local suppliers. In addition the study found that, with planning and support for training, most workers at an existing coal plant should be able to transition to work at a replacement nuclear plant.

Source: https://www.world-nuclear-news.org/Articles/DOE-releases-community-guide-on-coal-to-nuclear-co, 04 April 2024.

Diamondback Energy to Purchase Energy from Oklo SMRs

US Oklo has signed a non-binding letter of intent (LOI) with oil and gas producer Diamondback Energy to enter into a 20-year power purchase agreement (PPA). The proposed agreement focuses on engaging Oklo's Aurora powerhouses to supply electricity to Diamondback's operations in the Permian Basin. According to the terms of the LOI, Oklo intends to license, build, and operate powerhouses capable of generating 50 MW of electric power to Diamondback E&P, a wholly owned subsidiary of Di amondback near Midland, Texas. Oklo is developing the Aurora microreactor, which uses heat pipes to transport heat from the reactor core to a supercritical carbon dioxide power conversion system to generate electricity. It will use HALEU fuel. Oklo says the reactor builds on the Experimental Breeder Reactor-II (EBR-II) and space reactor legacy. EBR-II features a hexagonal fuel element with a sealed heat pipe and a passive air-cooling system. Oklo initially marketed a 1.5 MWe microreactor version of the Aurora, but has now expanded its capacity offerings from 15 MWe to 100 MWe.

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Source: https://www.neimagazine.com/news/newsdiamondback-energy-to-purchase-energy-from-oklo-smrs-11677739, 12 April 2024.

SMALL MODULAR REACTORS

CHINA

Digital Control System Installation Begins at Chinese SMR

Installation of the digital control system has begun at the ACP100 small modular reactor demonstration project at the Changjiang site on China's island province of Hainan, China National Nuclear Corporation (CNNC) has announced. The first cabinet of the digital control system - the 'nerve centre' of nuclear power plant operation - was moved into place at 9.58am on 10 April, and installation and debugging work has now started, CNNC said. The digital control system (DCS) system for the ACP100 - referred to as the Linglong One - adopts two domestically-developed platforms: the Dragon Scale platform (safety level) and Dragon Fin platform (non-safety level). The Dragon Scale platform can realise reactor safety control under various working conditions and ensure the safe operation of the nuclear power plant. Meanwhile, the Dragon Fin platform is responsible for operation and management and is an important guarantee for the efficient and economical operation of the nuclear power plant. Between them, the two platforms control hundreds of systems within the nuclear power plants, nearly 10,000 equipment operations and various operating conditions.

Installation of the digital control system has begun at the ACP100 small modular reactor demonstration project at the Changjiang site on China's island province of Hainan, China National Nuclear Corporation (CNNC) has announced.

Steady Energy - Finnish developer of the LDR-50 small modular reactor - has signed a collaboration agreement with TVO Nuclear Services related to the development of a nuclear heating plant, initially focusing on the planning of the nuclear facility's operation and safety.

Once completed, the Changjiang ACP100 reactor will be capable of producing 1 bn kilowatt-hours of electricity annually, enough to meet the needs of 526,000 households. The reactor is designed for electricity production, heating, steam production or seawater desalination. The project at Changjiang involves a joint venture of three main companies: CNNC subsidiary China National Nuclear Power as owner and operator; the Nuclear Power Institute of China as the reactor designer; and China Nuclear Power Engineering Group being responsible for plant construction.

Source: https://www.world-nuclear-news.org/Articles/Digital-control-system-installation-begins-at-Chin, 11 April 2024.

FINLAND

Steady Energy Taps TVO Nuclear Expertise

Steady Energy - Finnish developer of the LDR-50 small modular reactor - has signed a collaboration agreement with TVO Nuclear Services related to the development of a nuclear heating plant, initially focusing on the planning of the nuclear facility's operation and safety.

TVO Nuclear Services (TVONS) is a consulting company wholly owned by Finnish utility Teollisuuden Voima Oyj (TVO), owner of the Olkiluoto nuclear power plant. The agreement gives Steady Energy access to TVO's expertise in the planning and implementation of nuclear power plant projects as well as the operation, maintenance and service life management of the plants. Steady Energy - which last year was spun out from the VTT Technical Research Centre of Finland - aims to construct the first of several district heating plants based on its LDR-50 small modular reactor (SMR) technology in Finland by 2030. The LDR-50 district heating SMR - with a thermal output of 50 MW - has been under development at VTT since 2020. Designed to operate at around 150°C and below 10 bar (145 psi), Steady Energy says its "operating ..nuclear industry".

Source: https://www.world-nuclear-news.org/

Articles/Steady-Energy-taps-TVO-nuclear-expertise, 11April 2024.

POLAND

Economic Benefits of Polish AP1000 Deployment Highlighted

The construction of six Westinghouse AP1000 reactors would contribute more than PLN118.3 bn (USD30.2 bn) in GDP for Poland, while their subsequent operation would generate PLN38 bn in GDP annually, an independent study has found. Poland has set out a pathway to develop new nuclear power, with the aim of building six to nine GWe of nuclear capacity, using pressurised water reactor technology. According to latest Polish Nuclear Power Programme timeline, published in 2020, construction is due to begin in 2026, with commissioning of the first unit targeted for 2033.

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In November 2022, the then Polish government selected the Westinghouse AP1000 reactor technology for the country's first nuclear power plant, at the Lubiatowo-Kopalino site in the Choczewo municipality in Pomerania in northern Poland. An agreement setting a plan for the delivery of the three-unit plant was signed in May last year by Westinghouse, Bechtel and Polskie Elektrownie J[1]drowe (PEJ). The country's Ministry of Climate and Environment in July issued a decision-in-principle for PEJ to construct the plant. The aim is for Poland's first AP1000 reactor to enter commercial operation in 2033.

The new partnership brings together the US DOE and Japan's Ministry of Education, Culture, Sports, Science and Technology to work to accelerate the demonstration and commercialisation of fusion energy. The announcement was made during a visit PM Kishida to the USA.

Source: https://www.world-nuclear-news.org/Articles/Economic-benefits-of-Polish-AP1000-deployment-high, 10 April 2024.

NUCLEAR COOPERATION

JAPAN–USA

Japan and USA form Strategic Partnership for Fusion

The new partnership brings together the US DOE and Japan's Ministry of Education, Culture, Sports, Science and Technology to work to accelerate the demonstration and commercialisation of fusion energy. The announcement was made during a visit PM Kishida to the USA.

Announced by US Deputy Secretary of Energy David Turk (pictured above left), and Japan's Minister of Education, Sports, Science and Technology Masahito Moriyama (pictured above, right), the partnership intends to focus on advancing the US Bold Decadal Vision for Commercial Fusion Energy and Strategy for International Partnerships in a New Era of Fusion Development, as well as the Japan Fusion Energy Innovation Strategy. It will leverage a long history of Japan-US collaborative activities in the area of fusion covered by the Coordinating Committee on Fusion Energy (CCFE), which was established in 1979 and is currently implemented under a 2013 intergovernmental agreement. The two countries are also both participants in the ITER multinational fusion project.

The partnership is expected to further develop complementarity between US and Japanese resources and facilities in fusion, including those in universities, national laboratories and private companies in the respective countries. It will focus on six pillars:

· Address the scientific and technical challenges of delivering commercially viable fusion energy for various fusion systems

· Explore opportunities for shared access and/or development of facilities required for fusion research and development

· Promote the international harmonisation of regulatory frameworks and codes and standards, including leveraging of rule-making efforts by the US Nuclear Regulatory Commission as well as ongoing discussions under the auspices of the International Atomic Energy Agency and the Agile Nations Fusion Energy Working Group

· Identify and support the development of resilient global supply chains that facilitate commercial fusion deployment

· Support public engagement with communities to facilitate a social licence for deploying fusion energy and to support an equitable clean-energy transition

· Promote skills development to ensure the people and talent growth necessary for the robust, inclusive and diverse workforce required by the fusion sector in the next decade and beyond.

Source: https://www.world-nuclear-news.org/Articles/Japan-and-USA-form-strategic-partnership-for-fusio, 11 April 2024.

NUCLEAR SAFETY

GENERAL

IAEA's Grossi Warns Against Violating Principles Preventing Nuclear Accidents

IAEA DG Grossi has called for compliance with the key principles preventing nuclear accidents as he said they were violated by recent drone strikes on the Zaporizhzhia nuclear power station in Ukraine. Grossi's comments came at the start of an emergency extraordinary meeting of the 35 members of the IAEA board on 11 April, called by Russia and Ukraine. Both sides have denied responsibility for a series of drone attacks on the six-unit Zaporizhzhia station. He added that attacking the Zaporizhzhia plant, which has been occupied by Russia since soon after its invasion of Ukraine in February 2022, means endangering nuclear safety, with those who could be affected most directly being the people who work at the plant and IAEA experts, specifically the impartial international civil servants working on behalf of the agency's 178 member states.

Source: https://www.nucnet.org/news/iaea-s-grossi-warns-against-violating-principles-preventing-nuclear-accidents-4-4-2024, 11April 2024.

JAPAN

Further Japanese Research Reactor Free of HEU

All remaining HEU from the Japan Atomic Energy Agency's (JAEA's) Japan Materials Testing Reactor Critical Assembly has now been returned to the USA. Japan and the USA have been cooperating for many years to repatriate HEU from Japanese research reactors to the USA.

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The Japan Materials Testing Reactor Critical Assembly (JMTRC) was built in 1965 in advance of operation of the adjacent Japan Materials Testing Reactor (JMTR). It was used to perform various critical experiments to collect data on characteristics of the JMTR core and in-core irradiation facilities. The majority of the facility's HEU was repatriated to the USA between 2003 and 2009 following its decommissioning in 1996. In December 2023, the US Department of Energy National Nuclear Security Administration (NNSA), Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and JAEA transported the remaining HEU from the JMTRC to the USA. The Y-12 National Security Complex in Oak Ridge, Tennessee, provided US technical support for the project and received the HEU upon

its arrival in the USA. The HEU will be downblended to low-enriched uranium and/or dispositioned, permanently reducing the risk it could be used to produce an improvised nuclear device.

The removal of all the HEU from the JMTRC was welcomed by US President Biden and Japanese PM Kishida when they met in Washington, DC, on 10 April. During the meeting, they confirmed further advance cooperation in strengthening global nuclear non-proliferation and nuclear security. The removal of the JMTRC HEU fulfills a commitment made by NNSA Administrator Hruby and MEXT former Deputy Minister Takashi in November 2021 and was completed more than two years ahead of schedule through the financial support of the Defense Threat Reduction Agency.

Source: https://www.world-nuclear-news.org/Articles/Further-Japanese-research-reactor-free-of-HEU, 12 April 2024.

UKRAINE

IAEA Chief Warns that Risk of Zaporizhzhya Nuclear Accident is Rising

The already dangerous situation at the Russian-occupied Ukrainian nuclear power plant in Zaporizhzhya is getting worse, the UN's nuclear watchdog said. The drone attacks on the plant were "significantly increasing the risk of a nuclear accident," said Grossi, the head of IAEA.

At a special meeting of the IAEA board of governors, he urged military decision-makers and the international community to focus on de-escalating the hostilities around Europe's biggest nuclear plant. Representatives of Moscow and Kiev, who were in attendance at the meeting, once again blamed each other for the attacks. Grossi, however, avoided apportioning blame. The nuclear power plant was attacked by drones in three places, according to IAEA observers. The dome of a reactor and targets in the immediate vicinity of reactor buildings were hit. No serious structural damage was sustained, but one person was reported injured. The observers also reported shots fired by Russian forces stationed at the nuclear power plant. The IAEA team on site was informed by the plant's Russian management of another drone attack on a training centre at the nuclear power plant.

Source: https://www.msn.com/en-gb/news/world/iaea-chief-warns-that-risk-of-zaporizhzhya-nuclear-accident-is-rising/ar-BB1It46L, 12 April 2024.

International Atomic Energy Agency staff at the Zaporizhzhia nuclear power plant report that they have been told unit 4 is being transferred to cold shutdown - making it the sixth and last unit to do so.

Final Zaporizhzhia Unit being Switched to Cold Shutdown

International Atomic Energy Agency staff at the Zaporizhzhia nuclear power plant report that they have been told unit 4 is being transferred to cold shutdown - making it the sixth and last unit to do so. The IAEA DG Grossi has been urging the Russian operators of the occupied plant to put all its units into cold shutdown, as part of efforts to minimise risks to nuclear safety and security. The plant, which has been under Russian military control since early March 2022, stopped generating electricity in September 2022 but has kept one of its units in 'hot shutdown' to provide heating for the plant and the nearby town of Energodar, as well as for process steam for liquid waste treatment at the site.

Earlier this year four diesel steam generators were installed to handle the waste requirements, and the decision to move the unit into cold shutdown follows the official end of the winter heating season at Energodar. The advantage of cold shutdown is, the IAEA says, "there is an additional response margin of several days before the cooling of the nuclear fuel in the reactor might be challenged" and it also requires less cooling water. Grossi said that the IAEA experts stationed at the Zaporizhzhia plant visited the main control rooms of all six units, the off-site radiation monitoring laboratory and the radioactive waste storage facility but were not granted access to parts of unit 2's turbine hall or some parts of the waste facility.

Source: https://www.world-nuclear-news.org/Articles/Final-Zaporizhzhia-unit-being-switched-to-cold-shu, 12 April 2024.

URANIUM PRODUCTION

USA

Anfield Applies to Restart Shootaring Canyon Mill

Anfield Energy Inc has submitted its production reactivation plan for the Shootaring Canyon uranium mill to the State of Utah's Department of Environmental Quality. The Vancouver-based company said it is targeting the mill restart for 2026 - it has been on standby since 1982. The plan outlines an increase in mill throughput capacity to 1000 t of ore per day from 750 t per day and an increase in annual uranium production capacity to 3 mn pounds (1154 tU) from 1 mn pounds (385 tU).

Anfield Energy Inc has submitted its production reactivation plan for the Shootaring Canyon uranium mill to the State of Utah's Department of Environmental Quality. The Vancouver-based company said it is targeting the mill restart for 2026 - it has been on standby since 1982.

The Shootaring mill is one of only three licensed, permitted and constructed conventional uranium mills in the USA. Anfield acquired the Shootaring Canyon mill in 2015. The conventional acid-leach facility had been owned by Uranium One since 2007, but the Canadian-based and Russian-owned company's mining operations are focused on in-situ leach production methods. The mill - built in 1980 - commenced operations in 1982 and operated for about six months, before operations ceased due to the depressed price of uranium. During its period of operation, it produced and sold 27,825 pounds of U3O8. Surface stockpiles at the facility include an estimate of 370,000 pounds of U3O8 at an average grade of 0.147%. Anfield agreed in August 2014 to acquire the mill plus a portfolio of uranium assets from Uranium One in a deal worth USD5 mn.

Source: https://www.world-nuclear-news.org/Articles/Anfield-applies-to-restart-Shootaring-Canyon-mill, 10 April 2024.

NUCLEAR WASTE MANAGEMENT

LITHUANIA

Lithuania Develops Concept for Geological Disposal Facility

Lithuania's State Enterprise Ignalina NPP (INPP) has developed a general concept for the construction of a geological disposal facility (GDF) with assistance from Finnish waste management company Posiva Solutions Oy, a subsidiary of Posiva, under a one-year contract signed in January 2022. Posiva has developed Finland's GDF at Olkiluoto, which is expected to begin operations in the mid-2020s – the world's first such facility. In July 2023, an IAEA Integrated Review Service for Radioactive Waste & Spent Fuel Management, Decommissioning & Remediation (ARTEMIS) concluded that Lithuania's siting plans for a GDF was in line with international safety standards.

Lithuania's radioactive waste and used fuel comes from the past operation and current decommissioning of INPP as well as from waste generated from industry, medicine and research. Ignalina NPP is currently decommissioning two 1500MWe RBMK reactors that provided 70% of Lithuania's electricity before they were closed as a condition for Lithuania's accession to the European Union.

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Source: https://www.neimagazine.com/news/newslithuania-develops-concept-for-geological-disposal-facility-11669637, 09 April 2024.

UK

Waste Transfer Milestone at Scottish Plant

The retrieval has been completed of more than 2100 t of solid intermediate-level radioactive waste from five above-ground concrete bunkers at the Hunterston A Magnox nuclear power plant in Scotland. The project began 20 years ago. Hunterston A - a twin Magnox reactor site - is 30 miles south west of Glasgow and was Scotland's first civil nuclear generating station. The plant, opened in 1964, ceased operations in 1989 after generating a total of 73 TWh of electricity. Intermediate-level waste (ILW) was transported from the plant via underground tunnels and stored in one of five above-ground concrete bunkers that were constructed on site between the 1960s and 1980s. This waste consists of contaminated metallic components, debris removed from used fuel elements and 30,000 fuel element graphite sleeves.

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Nuclear Restoration Services (NRS) - which is responsible for safely decommissioning the first generation nuclear and research sites across the UK - said the Hunterston A site holds the largest inventory of solid ILW across all its sites. NRS noted that ILW becomes a site's highest radiological hazard once all the used fuel has been removed. Defueling of Hunterston A was completed in 1995. NRS said this waste is often located in hard-to-reach areas, making the task of retrieving it "a complicated business requiring, in some cases, many years of engineering work before it can begin in earnest". The Solid Active Waste Bunker Retrieval (SAWBR) project was established to retrieve the ILW from the bunkers at Hunterston A. The initial breakthrough of the first bunker was conducted manually in 2014 using core drills and wire saws to remove an 800mm-deep concrete slab. Then a remotely-operated vehicle broke through the remaining 400mm depth to create the first full opening.

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Source: https://www.world-nuclear-news.org/Articles/Waste-transfer-milestone-at-Scottish-plant, 12 April 2024.

USA

Hanford Site Launches Second Melter

Workers at the US Hanford Site's Waste Treatment & Immobilisation Plant (WTP) have launched the second of two 300-tonne melters that has now reached the operating temperature of 2,100 degrees Fahrenheit as part of US DOEOffice of Environmental Management (EM) Direct-Feed Low-Activity Waste programme. EM said this represents significant progress toward starting plant operations to immobilise in glass mns of gallons of radioactive and chemical waste from large underground tanks. WTP personnel began heating up the melter in March by turning on 18 temporary startup heaters. The melter temperature was then gradually raised, reaching the operating temperature of 2,100 degrees.

For more than 30 years, EM has remained focused on addressing the environmental legacy of nuclear weapons development and nuclear energy research during World War II and Cold War. Hanford is home to

177 underground waste storage tanks: 149 single-shell tanks (SST), and 28 double-shell tanks (DST), ranging from 55,000 to 1.265m gallons in capacity. Those tanks are organised into 18 different groups called farms. Currently, the site's underground tanks store approximately 56m gallons of radioactive and chemical waste. As part of an agreement regulating Hanford cleanup, crews must remove at least 99% of the waste in every tank on the Site, or at least as much waste as can be removed based on available technology. The final stage for the tank farm waste is treatment at the WTP.

Source: https://www. neimagazine.com/news/newshanford-site-launches-second-melter-11677618, 12 April 2024.

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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