



OPINION – Manpreet Sethi

Vol 18, No. 14, 15 MAY 2024

Assessing the Promise of Small Modular Reactors from an Indian Perspective

There is a palpable sense of enthusiasm around the idea of SMRs. These are being seen as a solution to some of the persistent challenges of long construction times and high economic costs associated with traditional nuclear reactors. A race is underway within the nuclear industry, backed considerably by governments, to work on new designs and manufacturing processes that are expected to prove their commercial viability and make them operational within a decade. How realistic is this estimate? What kind of advantages will SMRs offer? What challenges are they likely to face? This issue of the column undertakes an assessment of SMRs, especially in the context of India’s energy mix.

What are SMRs? As the name suggests, SMRs would have two main attributes— small and modular. In terms of size, they are to be fission reactors with a capacity of about 300 MWe or less. In terms of modularity, they are envisaged to be amenable to being centrally manufactured at a factory and then transportable to the desired site for assembly/installation. Much like a machine, and quite unlike the traditional nuclear reactors that

In terms of size, they are to be fission reactors with a capacity of about 300 MWe or less. In terms of modularity, they are envisaged to be amenable to being centrally manufactured at a factory and then transportable to the desired site for assembly/installation. Much like a machine, and quite unlike the traditional nuclear reactors that are built on site, SMRs are expected to arrive at a site, be plugged in and start producing electricity.

CONTENTS

- ☛ OPINION
- ☛ NUCLEAR STRATEGY
- ☛ BALLISTIC MISSILE DEFENCE
- ☛ EMERGING TECHNOLOGIES AND DETERRENCE
- ☛ NUCLEAR ENERGY
- ☛ SMALL MODULAR REACTORS
- ☛ NUCLEAR COOPERATION
- ☛ NUCLEAR PROLIFERATION
- ☛ URANIUM PRODUCTION
- ☛ NUCLEAR SAFETY
- ☛ NUCLEAR WASTE MANAGEMENT

are built on site, SMRs are expected to arrive at a site, be plugged in and start producing electricity. They would also offer the possibility of the addition of multiple similar reactors when desired. Also, these could be placed on land, on ships for off-shore deployment (which are known as floating nuclear power plants), or even in an underground or submerged environment.

Over 70 SMR designs are being developed in different countries around the world today. At different stages on the drawing board, these

designs range from slightly modified versions of existing reactors to those involving completely new technologies. Staying abreast of the high level of activity around the new ideas, the International Atomic Energy Agency (IAEA) has set up the SMR Regulators' Forum to help countries share information on issues of

common concern. It published a Technology Roadmap for Small Modular Reactor Deployment in 2021 that identifies, evaluates and promotes collaboration and knowledge sharing amongst technology developers, industry, users and regulatory bodies.

Expected Advantages of SMRs

Speed of Installation and Cost Savings: One of the main advantages of SMRs is seen in their ability to be manufactured as pre-fabricated and pre-tested modules that can be easily assembled/installed on site after being transported conveniently. Modularity in manufacturing and assembly is expected to reduce construction time.

The idea, in fact, is to compress a large technological project into a relatively easy installation of a pre-fabricated product of standardised quality. A study in this regard has

suggested that SMRs can reduce construction time by 3.5 years in comparison to the average 6.5 years required as of now. Reduced gestation periods are then expected to reduce capital costs too, thus increase the economic competitiveness of the reactors.

Enhanced Safety and Security Features: Given the new technologies being incorporated by SMRs, these are expected to include enhanced safety and security features. On the safety front, the reactors

Modularity in manufacturing and assembly is expected to reduce construction time. The idea, in fact, is to compress a large technological project into a relatively easy installation of a pre-fabricated product of standardised quality. A study in this regard has suggested that SMRs can reduce construction time by 3.5 years in comparison to the average 6.5 years required as of now.

are being designed to incorporate modern passive safety systems that minimise the need for human intervention in case of emergencies. On nuclear security, they would incorporate the concept of "security by design" to address concerns of sabotage, theft, attacks and proliferation. Since many of these designs are expected

to operate for prolonged periods without the need for refuelling, there would be related benefits of reduced risks of transportation of nuclear materials too.

Flexibility of Installation and Siting: SMRs would provide flexibility in siting options, especially their placement in remote, isolated areas that are currently dependent on diesel generators. Given their compactness, they are envisaged to need less land, as well as concomitant emergency zone requirements. Addition or removal of new modules, as considered necessary, would add to the flexibility advantage.

Baseload Power in Support of Renewables: Nuclear power has a major advantage of being a baseload source of electricity. With the current trend favouring a rapid deployment of renewable energy, SMRs could complement these sources

On the safety front, the reactors are being designed to incorporate modern passive safety systems that minimise the need for human intervention in case of emergencies. On nuclear security, they would incorporate the concept of "security by design" to address concerns of sabotage, theft, attacks and proliferation.

to address their disadvantage of intermittency. So, SMRs could supplement solar, wind, small hydroelectric and tidal generation to ensure a continuous supply of electricity and thus help stabilise the grid. This combination would help overcome the challenge of storage that the use of renewables still poses. It would also allow renewable energy to enjoy a low-carbon backup source instead of relying on thermal plants for handling the problem of intermittency.

Better Waste Management: Spent fuel management has been perceived as a major challenge of nuclear plants. SMRs are trying to address this by experimenting with new ideas for dealing with nuclear waste. These include fast reactor designs that would ensure higher fuel burnup and hence a lesser amount of nuclear waste generation or the travelling wave reactor design that could consume the fuel that it breeds, thereby minimising the need to remove spent fuel. Likewise, other SMR technologies have been trying to develop a thorium fuel cycle, which too could reduce nuclear waste.

Better Resource Efficiency: SMRs are also likely to offer better resource efficiency, given their comparatively smaller physical footprint. Requirement of land would be less as compared to a traditional nuclear power plant. The latter needs an emergency planning zone extending up to 16 kms around the plant. In comparison, SMRs would require just about two kms. They are also expected to be time efficient in deployment as well as require lesser maintenance.

Challenges that Persist with SMRs: While SMRs seem promising in addressing the long-standing challenges of traditional nuclear reactors, it needs to be understood that all these promises are currently expectations. The true economic viability of SMRs will be available for appraisal only when some designs have matured, become standardised and gone into factory production. This currently appears on the distant horizon.

The problem, however, remains that for factories to sink in substantive capital investment to create the infrastructure for such manufacturing, they would need assurance of a sufficient number of orders. Only then will economic efficiencies emerge. Such orders, as of now, appear distant. It will take time before one particular design from the plethora currently being experimented with is sufficiently field-proven and accepted by a large number of companies, operators and regulatory bodies.

Supply Chain Maturity & Price Advantage– Long Way Off: Modularity is being touted as the biggest advantage of SMRs. It is expected that SMRs will reap the benefits of serial factory manufacturing, which would enable optimum standardisation of components. Pre assembled modules will simplify on site installation. The problem, however, remains that for factories to sink in substantive capital investment to create the infrastructure for such manufacturing, they would need assurance of a sufficient number of orders.

Only then will economic efficiencies emerge. Such orders, as of now, appear distant. It will take time before one particular design from the plethora currently being experimented with is sufficiently field-proven and accepted by a large number of companies, operators and regulatory bodies. Therefore, the supply chain maturity of SMRs will take time, even a few decades, to emerge.

Tussle between Industry and Regulators: Given the novelty of the concept, the nuclear industry investing in SMRs is facing challenges ranging from licensing to liability. The current regulatory regimes are designed for traditional nuclear plants. As the industry seeks changes, they are being met with overly cautious regulators who are not only careful

The current regulatory regimes are designed for traditional nuclear plants. As the industry seeks changes, they are being met with overly cautious regulators who are not only careful about the novel designs being experimented with but also wary of the reality that many players in the SMR space are new to the nuclear industry.

about the novel designs being experimented with but also wary of the reality that many players in the SMR space are new to the nuclear industry. Both sides, therefore, are yet to find a level of comfort with each other.

Another challenge in this space would emerge when reactors that have achieved design approval

in one country are exported for installation in another country as a pre-fabricated product. As per Current patterns, design approval secured by the regulatory agency of one country does not automatically become acceptable in another, and since different regulators place emphasis on different issues, any demand for design changes would defeat the advantage of modularity and stability of supply chains with pre-fab SMRs. Demands for changes would also drive up the cost of reactors, thereby negating one of the purported advantages of SMRs.

Liability Issues: Liability in case of an accident at a nuclear plant is also a matter of great concern and contention. The maximum concerns in this regard have been raised in the context of Floating Nuclear Power Plants (FNPPs). The first of these pertains to the very definition of such reactors under the existing conventions. For instance, the Convention on Nuclear Safety (CNS) defines a “nuclear installation” as “any land-based civil nuclear power plant under its jurisdiction”. Experts differ on whether a floating nuclear power plant at shore or off-shore could be considered a nuclear installation under the international third-party nuclear liability conventions. Questions have also been raised on what happens when the FNPP navigates through different maritime zones and high seas. The CNS only refers to the carriage of nuclear substances, i.e. nuclear fuel and radioactive products and waste, not a nuclear reactor. A discussion on the liability regime applicable during the carriage and operation of a nuclear reactor, therefore, becomes imperative. This is especially necessary to facilitate the insurance coverage of such

Experts differ on whether a floating nuclear power plant at shore or off-shore could be considered a nuclear installation under the international third-party nuclear liability conventions. Questions have also been raised on what happens when the FNPP navigates through different maritime zones and high seas. The CNS only refers to the carriage of nuclear substances, i.e. nuclear fuel and radioactive products and waste, not a nuclear reactor.

Carrying out the design of new reactor systems and refinement in the already performed design is an ongoing process, which is always under focus to improve the designer’s capability. SMRs also need some technology development to fill-up gap areas. The process of technology development also needs to be completed before

installations and protect potential victims in case a nuclear incident occurs during the journey.

India: The Way Ahead with SMRs: Of the 23 nuclear reactors operational in India today, the majority of those indigenously built have a capacity rating of 220 MWe. India also has the experience of having built an 85 MWe reactor for its nuclear submarine. This shows that India has the capability to design, build and operate small reactors. While it has not utilised a modular factory process so far, the industry involved in manufacturing nuclear equipment can be expected to make this possible in case the nuclear establishment is keen to build such reactors.

Cognisant of the potential of SMRs, India’s Department of Energy has design teams working on the technology. Speaking of SMR prospects for the country, K N Vyas, former Secretary, DAE and Chairman of the Atomic Energy Commission, had stated in 2019, “Carrying out the design of new reactor systems and refinement in the already performed design is an ongoing process, which is always under focus to improve the designer’s capability. SMRs also need some technology development to fill-up gap areas. The process of technology development also needs to be completed before tasks related to SMRs can be taken up in a more serious manner.”

While DAE is keeping abreast of SMR developments, its current priority is technological advances in the current stream of reactors. Having graduated from 220 MWe to 540 MWe to 700 MWe, India has striven to reach higher capacity reactors in order to ensure a rapid expansion of

nuclear electricity generation. In fact, one of the primary motivations for the conclusion of the Indo-US agreement for peaceful nuclear cooperation was to enable the import of larger-capacity reactors. While these imports have remained embroiled in price negotiations and liability issues, India's indigenous efforts have yielded 700 MWe reactors.

Can SMRs be attractive for a country like India, where the demand for electricity is expected to continue growing? Indeed, in such a situation, the rationale for large reactors is loud and clear. However, SMRs too could be useful in a few scenarios. One of these could be to replace old coal plants that need to be decommissioned. In this regard, Srikumar Banerjee, another former Chairman, Atomic Energy Commission, had rightly stated, "Some of the retiring thermal power plants can be replaced with small modular reactors." This would also help combat air pollution problems plaguing the country and meet its Paris Agreement goals. In fact, given the high induction of renewable power in a thrust to move towards green technologies, SMRs could supplement this by being a dependable base load and clean source of power. They might also come in useful for providing electricity in remote areas or islands.

However, it still remains unclear whether SMRs will become the force of transformation they promise to be. The buzz around them is certainly strong and fuelled by the urgent need to find low-carbon electricity generation sources. Not surprisingly, this space is being seen as a huge investment opportunity by the nuclear industry.

India, too, should find ways, especially through the private industry route, to keep its options open. The DAE/NPCIL may offer to do some hand-holding

Having graduated from 220 MWe to 540 MWe to 700 MWe, India has striven to reach higher capacity reactors in order to ensure a rapid expansion of nuclear electricity generation. In fact, one of the primary motivations for the conclusion of the Indo-US agreement for peaceful nuclear cooperation was to enable the import of larger-capacity reactors. While these imports have remained embroiled in price negotiations and liability issues, India's indigenous efforts have yielded 700 MWe reactors.

for private players to help them build such reactors once a design has been created and proven through a prototype. Thereafter, private players can be incentivised by the government through, as has also been suggested, production linked incentive schemes for manufacturing such reactors. Some of the more recent nuclear cooperation agreements signed with countries such as France,

USA, South Korea and Russia mention possibilities of collaboration on SMRs too.

The DAE/NPCIL may offer to do some hand-holding for private players to help them build such reactors once a design has been created and proven through a prototype. Thereafter, private players can be incentivised by the government through, as has also been suggested, production linked incentive schemes for manufacturing such reactors.

However, it needs to be emphasised that given the country's electricity requirements, it need not feature at the top of the DAE's priority list. Developed countries that are engaged with SMRs are doing so at a stage where their electricity demand and population growth are

mostly stable and, in some cases, even stagnant. The new technology development, then, is actually a way for the nuclear industry to keep itself gainfully occupied and with a view to popularise new nuclear build for countries where reactor construction has stagnated or where there is potential to export them to nuclear newcomers. For DAE/NPCIL to divert any large part of its nuclear resources towards such a technology would be a diversion from its focus, which should be on the quick construction of planned nuclear reactors in order to enhance the country's electricity supply with an environmentally friendly source. Long-term policy support is needed to bring the planned reactors of larger sizes to fruition and to do so within specified time schedules.

Source: <https://capsindia.org/assessing-the-promise-of-small-modular-reactors-from-an-indian-perspective-2/>, 30 April 2024.

OPINION – Erik Baker

Our World is Already Ravaged by Nuclear War

3 If you take a look right now, the ‘nuclear’ word is being mentioned all the time,” Donald Trump observed last year. The former (and perhaps future) US president blamed his weak-willed successor, rather dubiously, for the proliferation of what he described as one of two “N-words” better left unsaid by political leaders. But he was on to something nevertheless. After decades of relative dormancy, nuclear concern has emerged again. Trump himself was perhaps the original cause, as the most conspicuously unstable quarterback ever to handle the American nuclear “football”. But in the past eight years, the reasons for anxiety have multiplied: escalating tensions between the US and China; North Korea’s first successful thermonuclear test; an increasingly militarist posture in India; and devastating demonstrations of the atrocities that military decision-makers in Russia and Israel are willing to perpetrate.

Culture has kept pace. Novelists in the years after the 2016 US election imagined Trump pressing the button – Hanna Jameson in *The Last*, Mark Doten in *Trump Sky Alpha*, and more abstractly, Rumaan Alam in *Leave the World Behind*, now a major motion picture made by the Obamas’ production company. HBO’s *Chernobyl* miniseries reminded us of the danger of the vast Soviet nuclear infrastructure that is largely in Vladimir Putin’s hands. And then there was *Oppenheimer*. Analysts have tended to attribute the staggering commercial success of Christopher Nolan’s three-

hour biographical epic to the hunger of an audience starved of serious mainstream cinematic fare by Marvel hegemony, which is surely part of the story. But I suspect that its triumph also has to do with worries about nuclear weapons. The *New York Times*, astutely, has responded to Oppie-mania by launching a new essay series on the risk of nuclear catastrophe entitled “At the Brink.”

So far, however, almost a decade of renewed nuclear scrutiny has little to show for itself. Regardless of where one thinks we stand vis-à-

vis the brink, it is difficult to argue that we have moved further away of late. The headline for national security columnist W.J. Hennigan’s inaugural essay for the *Times* series asserts that nuclear war is “not imagined enough”. Maybe that was true in 2016. But it was not true during the Cold War, when, despite its other accomplishments, a nuclear disarmament movement far more robust than anything we’ve seen since failed to obtain its chief objective. And I don’t think it’s true any more today – especially

After decades of relative dormancy, nuclear concern has emerged again. Trump himself was perhaps the original cause, as the most conspicuously unstable quarterback ever to handle the American nuclear “football”. But in the past eight years, the reasons for anxiety have multiplied: escalating tensions between the US and China; North Korea’s first successful thermonuclear test; an increasingly militarist posture in India; and devastating demonstrations of the atrocities that military decision-makers in Russia and Israel are willing to perpetrate.

not after the publication of Annie Jacobsen’s new book *Nuclear War: A Scenario*, one of the most exhaustive imaginings of the start of nuclear war ever written. Jacobsen, whose books on the secrets of the American military-industrial complex have made her a Pulitzer Prize finalist and an occasional writer for the Amazon thriller series Tom Clancy’s *Jack Ryan*, clearly intends this latest salvo as a contribution to the disarmament struggle.

After the advent of nuclear war, she writes in the book’s closing pages, we will learn too late that “nuclear weapons ... were the enemy of us all”, instead of “North Korea, Russia, America, China, Iran, or anyone else vilified as a nation or a group”. But *Nuclear War* illustrates what goes wrong when we try to separate the threat posed by nuclear

weapons as a technology from the political structures of militarism and imperialism in which they exist. By envisioning the badness of a hypothetical nuclear war in excruciating detail, Jacobsen loses sight of the all-too-actual carnage that nuclear states, not least the US, have already unleashed.

‘One Nihilistic Madman’:

Despite Jacobsen’s concluding protestations that nuclear weapons themselves are the enemy, the apocalyptic scenario that Nuclear War elaborates has a clear villain: North Korea. The road to Armageddon begins with an intercontinental ballistic missile launched from a field near Pyongyang, destined for Washington. Jacobsen spills an enormous amount of ink justifying the plausibility of each link in the minute-by-minute chain of events she lays out in the rest of the book – culminating in the demise of most of humanity – but she never bothers to rationalise this fateful first step. North Korea “recklessly and foolishly ...started nuclear World War III”, Jacobsen reminds us later, “and why, we simply don’t know”. The closest we get to an explanation is a stray suggestion that Kim Jong-un, like the Joker in *The Dark Knight*, just wants to watch the world burn. “All it takes is one nihilistic madman with a nuclear arsenal to start a nuclear war no one can win,” Jacobsen writes.

In fact, it takes much less than that, at least according to the US federal government. Since the first mushroom cloud ascended over Trinity, it has been official American policy, never altered, that in theory there are circumstances in which a so-called first use of nuclear weapons by the US would be acceptable. Jacobsen never even considers the

possibility that the button might be pushed first in Washington, rather than Pyongyang or Moscow, despite the Biden administration’s recent reaffirmation that the US reserves the right to initiate the use of nuclear weapons in “extreme circumstances to defend the vital interests of the United States or its allies and partners”.

Even a partial list of situations in which American leaders have seriously contemplated a nuclear first strike is more frightening, in my view, than anything in the scenario Jacobsen has concocted. Harry Truman considered using atomic

weapons in Korea; Dwight Eisenhower directed the Joint Chiefs of Staff to prepare for nuclear use in response to hypothetical acts of aggression by both the People’s Republic of China and, more implicitly, Iraq; Richard Nixon proposed nuclear bombing in Vietnam; Jimmy Carter seriously considered using tactical nuclear weapons in case of a Soviet invasion of Iran in 1980. The number of cases in which the US has communicated a threat of first use to an adversary, whether or not officials were

actually prepared to go through with it, is far greater. As the Pentagon Papers whistleblower and former Rand Corporation nuclear war planner Daniel Ellsberg wrote in 2017 near the end of his life, “US presidents have used our nuclear weapons dozens of times in ‘crises’... in the precise way that a gun is

used when it is pointed at someone in a confrontation, whether or not the trigger is pulled.”

President’s Role on Doomsday: The reality is that properly assessing the risk of US nuclear first use is extremely challenging for a civilian, even one as intrepid as Jacobsen – for reasons that she obscures in her narrative. Channelling Tom Clancy

After the advent of nuclear war we will learn too late that “nuclear weapons ... were the enemy of us all”, instead of “North Korea, Russia, America, China, Iran, or anyone else vilified as a nation or a group”. But Nuclear War illustrates what goes wrong when we try to separate the threat posed by nuclear weapons as a technology from the political structures of militarism and imperialism in which they exist.

Dwight Eisenhower directed the Joint Chiefs of Staff to prepare for nuclear use in response to hypothetical acts of aggression by both the People’s Republic of China and, more implicitly, Iraq; Richard Nixon proposed nuclear bombing in Vietnam; Jimmy Carter seriously considered using tactical nuclear weapons in case of a Soviet invasion of Iran in 1980.

here as well as she does for Amazon, Jacobsen spins a suspenseful yarn about US military surveillance systems detecting the imminent North Korean strike and relaying the intelligence up the chain of command to the president, who agonises over the proper response as the missile speeds inexorably towards the Pentagon. She sketches the scenario with novelistic detail and the techno-thriller genre's characteristic affection

for jargon and acronyms: "When the CAT Element arrives, the SAC is on his phone calling for a status update on KNEECAP, Secret Service code for a Domsday Plane when carrying POTUS, which is the acronym for president of the United States."

All this attention to military hierarchy, proper channels, and presidential decision-making skirts the fact that crucial aspects of US nuclear launch protocols remain shrouded in secrecy. Jacobsen avers, dutifully, that "the US president ... has sole authority to launch

America's nuclear weapons". Every administration since Harry Truman consolidated presidential authority over nuclear weapons after World War II has said as much. And it is true that if the president were to order a nuclear attack – even if he had been drinking, as Richard Nixon was once, allegedly, when he contemplated a strike during the Vietnam War, or if he were Trump – it is not obvious anyone could stop the missiles from flying. That is alarming enough, but we also know with certainty that the Cold War White House was dissembling in implying that no one besides the president had the ability to launch nuclear weapons, beginning with Eisenhower's

Every administration since Harry Truman consolidated presidential authority over nuclear weapons after World War II has said as much. And it is true that if the president were to order a nuclear attack – even if he had been drinking, as Richard Nixon was once, allegedly, when he contemplated a strike during the Vietnam War, or if he were Trump – it is not obvious anyone could stop the missiles from flying.

There are probably only a handful of human beings who really have full knowledge of the structure of US nuclear decision-making, a club that does not include me and which I am confident does not include Jacobsen. Given her earlier work examining secrecy and deception in the American military, it is frankly bizarre how much credence Jacobsen gives to official descriptions of protocol in Nuclear War.

decision in 1957 to "pre-delegate" authority to launch nuclear weapons in certain circumstances if the designated commanders were not able to contact him.

During a Rand survey of American nuclear infrastructure in the Pacific in 1959, Elsberg discovered that at least one of these designees, Admiral Harry D Felt, had further pre-delegated this authority in case his sub-commanders couldn't reach him. Nuclear

security expert Bruce Blair reports that his sources inform him the pre-delegation policy persisted in one form or another until Bill Clinton rolled it back in about 1993, five years before Eisenhower's original instructions were declassified. Other

sources suggest that some aspects of the practice may have survived Clinton's roll-back, and Blair acknowledges that what Trump has done about pre-delegation is anyone's guess.

There are probably only a handful of human beings who really have full knowledge of the structure of US nuclear decision-making, a club that does not include me and which I am confident does not

include Jacobsen. Given her earlier work examining secrecy and deception in the American military, it is frankly bizarre how much credence Jacobsen gives to official descriptions of protocol in Nuclear War. The consequence is a preposterous scene where, as Washington is engulfed in flame and the president and other elected leaders go missing, top security officials debate who, if anyone, should be sworn in as acting president, so that further nuclear counterstrikes can be authorised.

In reality, if Washington were ever hit with a hydrogen bomb, it seems likely that military commanders elsewhere would swiftly decide that

they were empowered to make decisions about nuclear use themselves. If that were not possible, in fact, there would be a rather gaping flaw in American “deterrence” policy. The truly terrifying possibility is that someone might come to this conclusion even if a nuclear war was not already under way. That possibility is, to be sure, vanishingly remote, and less likely today than at the height of the Cold War. But the uncertainty itself is, for once in these debates, no hypothetical. It is metonymic of the broader insulation of US nuclear policy – and military decision-making writ large – from democratic scrutiny and popular accountability. There is much we know that we don’t know, and even more we don’t know that we don’t know (to paraphrase Donald Rumsfeld). But Jacobsen’s pretensions to omniscience occlude these gaps.

The Real Enemies: The subtitle of Nuclear War is accurate; the book contains exactly one scenario, and Jacobsen does not deviate from it, maintaining relentless focus on the question of whether US military bureaucrats can do anything to avert the worst-case scenario. Spoiler alert: everyone dies. That’s not exactly a surprise. “Up to now, no one outside of official circles has known exactly what would happen if a rogue state launched a nuclear missile at the Pentagon,” the jacket copy brags.

It’s true that I didn’t know exactly how such a scenario would unfold before reading Nuclear War, but I did know it wouldn’t be good. I suppose that’s the point. The only winning move is not to play, as the sci-fi film WarGames taught us many years ago. But the format of the book, as a non-fiction thriller, cuts against this lesson, relying as suspense must on the possibility that things could turn out otherwise. “Every fraction of a second matters,” Jacobsen writes early in the book. “Every byte of information counts.” But the rest of her story amounts to one long falsification of these initial assertions. Once the first warhead is aloft, nothing matters and

nothing counts, except the cockroaches.

In January, the government media office in Gaza estimated that Israeli forces had dropped 45,000 bombs weighing 65,000 tonnes on the enclave since October 7. The combined yield of the atomic bombs dropped on Hiroshima and Nagasaki, for comparison, was about 35,000 tonnes of dynamite. The fact that Israel has not yet deployed any of its nuclear weapons – despite public encouragement from one since-suspended Netanyahu cabinet member in November – is not much consolation to the tens of thousands of Gazan civilians killed by conventional munitions, or to the millions presently at risk of starvation due to Israel’s systematic demolition of civilian infrastructure and restrictions on humanitarian aid. It would come as news to victims in Gaza that nuclear weapons, rather than any particular nation, are their real enemies.

One might say the same of the thousands of civilian casualties of Russia’s war against Ukraine, despite Putin’s failure thus far to make good on any of his nuclear blustering, or the millions of innocent people around the world who have perished as a result of the manifold military operations the US has prosecuted in the name of combating communism and terrorism. Yet as Ellsberg argued, it would not exactly be accurate to describe these conflicts as “non-nuclear”, because the mushroom-shaped spectre of nuclear annihilation has stalked every military conflict since the fallout settled on Japan in 1945.

In January, the government media office in Gaza estimated that Israeli forces had dropped 45,000 bombs weighing 65,000 tonnes on the enclave since October 7. The combined yield of the atomic bombs dropped on Hiroshima and Nagasaki, for comparison, was about 35,000 tonnes of dynamite.

The American empire, like the countervailing imperial might that Putin and Xi Jinping would like someday to amass, is not some neutral scaffolding on which the nuclear apparatus happens to rest, such that enlightened policymakers may choose to remove it if they were so inclined. American imperialism is thoroughly nuclear: what the historian Garry Wills has called “bomb power”. And nuclear power – the warp and

weft of these weapons' influence on world events and the fate of human beings – is, to precisely the same extent, thoroughly imperial.

Jacobsen understands this, I think. Nuclear War takes the reader on a tour of the United States' truly globe-spanning nuclear infrastructure. We visit bunkers and bases on multiple continents; we peer inside nuclear submarines and airborne nuclear command centres; we meet some of the thousands upon thousands of individuals who toil day and night to maintain American nuclear readiness. But despite her professions of horror at the hypothetical body counts to which US nuclear planners have accommodated themselves, Jacobsen renders their activity on the precipice of doomsday with something that often feels like love. "The duty of the STRATCOM commander comes with a responsibility unlike any other in the world," she writes at one point. At another: "The function of NATO is to further democratic values and peacefully resolve disputes." Nuclear War is saturated with awe at the momentousness of the decisions being made and a gee-whiz amazement at the technical achievement of the whole system. One senses Jacobsen's frustration that, in her scenario, all this ingenuity and heroism is basically pointless, an impotent shield against the inevitable.

Dwelling on Nuclear Fantasies: But the vast American military network that Jacobsen traverses is not merely twiddling its collective thumbs in anticipation of an inexplicable ICBM launch by a rogue state. It is ceaselessly projecting power. Despite making a suite of authentically apocalyptic outcomes marginally more likely, nuclear weapons really do promote the stability of the global order – or at least the stability of global hierarchy. They have forced the rest of humanity to worry that any serious threat to the American empire might lead to the end of the world, and it is not very surprising that for nearly 80 years everyone else has blinked first. The

tragedy of nuclear weapons is that they work. Near the end of the eighth episode of David Lynch and

Mark Frost's 2017 series *Twin Peaks: The Return*, a monstrous creature, somewhere between a frog and an insect, emerges from an egg in the year 1956 on the site of the Trinity nuclear test, depicted earlier in the hour. It crawls across the desert into a small New Mexico town, and while a young

girl sleeps it enters her bedroom through an open window and insinuates itself into her throat. Here, Lynch and Frost make visceral the way that nuclear violence has taken up residence in the most intimate cavities of everyday life. It will continue to fester in the belly of the American imperium even if there is never another nuclear explosion on this planet. And if we persist in dwelling on our fantasies of what would happen if the bomb were to go off, we will never be able to confront the consequences of the fact that it already has. The day after is today.

Source: <https://www.afr.com/policy/foreign-affairs/our-world-is-already-ravaged-by-nuclear-war-20240426-p5fmsy>, 01 May 2024.

OPINION – Anna Mulrine Grobe, Sarah Matusek

In Deterrence We Trust? Cold War Nuclear Questions Make a Comeback

The Cold War never fully thawed in this single-stoplight town, nestled in a county of fewer than 4,000 people that seems built for a populace twice its size. Empty storefronts tell that story of six decades ago, when the nuclear missiles moved in. The weapons lie scattered beneath the high plains here – some a few miles from a school. Up to 400 of these intercontinental ballistic missiles, or ICBMs, remain on alert in rural parts of the American West, ready to launch at the president's call. Some outsiders may see Kimball as a sacrifice. Rich Flores calls his community "patriotic." "The people here, in my opinion,

believe that we have ‘peace through strength,’” says Mr. Flores, a county commissioner, echoing a line popularized by President Ronald Reagan. As he chats over coffee, an American flag pin glints from his chest.

“Who wants to attack a country that’s strong?” This is the logic of deterrence in a nutshell. Though the staggering cost of an upcoming missile upgrade in this region has ignited discussion about the necessity of America’s vast nuclear arsenal, the fact that the nation hasn’t used these weapons since World War II seems to deepen, for many, trust in their necessity. But as global conflicts involving nuclear powers escalate, this trust is being tested. In Kimball and beyond, questions about America’s nuclear strategy – and how people feel about it – are taking on more urgency as concern about the likelihood of a nuclear attack is on the rise. Senior U.S. military officials describe the world’s nuclear landscape as “breathtaking” in its potential for escalation.

The United States, they warn, is now on the verge of having not one but two nuclear “peer” adversaries, as the Department of Defense calls them. China’s rapid buildup of its nuclear forces means it could have at least as many ICBMs as either the U.S. or Russia by the decade’s end, analysts say. Russian President Vladimir Putin is expanding his nuclear arsenal and rattling these sabers toward the West in his war against Ukraine. As a result, the U.S. now faces threats that it “did not anticipate and for which it is not prepared,” a bipartisan commission appointed by Congress

concluded last autumn. While risk of a “major nuclear conflict remains low,” the nation needs to “urgently” prepare to take on adversaries who

want to impose undemocratic values on the free world, according to the report.

Part of that preparation will occur around Kimball, which is set to see nearby missile fields upgraded over the next decade with a new weapon system called Sentinel. Advocates for nonproliferation say America has more than enough nuclear weapons to deter opponents. Their imperative, rather, is reopening communication lines – laying the groundwork for lapsing or nonexistent arms control agreements – to restore a sense of safety and trust in what can seem like a precarious time. And some see promising developments along these lines. “One of the most important things that we can do is to head off unconstrained nuclear competition between the U.S., Russia, and China,” says Daryl Kimball, executive director of the Arms Control Association. “Taboos against nuclear weapons still exist,” he adds, “and each generation needs to ensure they’re not broken.”

Who wants to attack a country that’s strong?” This is the logic of deterrence in a nutshell. Though the staggering cost of an upcoming missile upgrade in this region has ignited discussion about the necessity of America’s vast nuclear arsenal, the fact that the nation hasn’t used these weapons since World War II seems to deepen, for many, trust in their necessity. But as global conflicts involving nuclear powers escalate, this trust is being tested.

Americans grapple with mixed views about the country’s nuclear weapons. A Chicago Council-Carnegie Corporation survey last year showed that 47% of U.S. adults believe the nuclear arsenal makes the U.S. safer. (Older adults are more likely than younger adults to say this.) Moreover, China and Russia aren’t the only countries that worry Americans, who rank the development of nuclear programs in Iran and North Korea as two of the top three “critical threats” to the U.S., according to Gallup.

American Trust in Nuclear Weapons: In the nearly 80 years since the U.S. dropped the only two nuclear weapons ever used in war, movements to abolish or champion nukes have ebbed and flowed. Currently, Americans grapple with mixed views about the country’s nuclear weapons. A Chicago Council-Carnegie Corporation survey last year showed that 47% of U.S. adults believe the nuclear arsenal makes the U.S. safer. (Older adults

are more likely than younger adults to say this.) Moreover, China and Russia aren't the only countries that worry Americans, who rank the development of nuclear programs in Iran and North Korea as two of the top three "critical threats" to the U.S., according to Gallup. As U.S. leaders face a public that's conflicted about trusting in deterrence, better communicating the country's nuclear capabilities, some say, could help.

Nuclear Nonchalance or Confidence? Retired Gen. John Hyten, who had been serving as vice chairman of the Joint Chiefs of Staff since 2019, recalls receiving a July 2021 phone call "so important that I went running to" the chairman and the secretary of defense after hanging up. It was top-secret news of "the most significant launch that had happened during my lifetime": a Chinese hypersonic missile designed to elude U.S. detection systems and potentially be used as a first-strike weapon in a nuclear war. It threatened the land-based leg of the U.S. nuclear triad, which is composed of ICBMs, like those kept around Kimball, as well as stealth bombers and nuclear-armed submarines.

General Hyten spent the last three months of his tenure working to get news of China's hypersonic missile declassified, he said in a February discussion at the University of Virginia's Miller Center. In November 2021, he got the Pentagon green light to air his concerns on CBS News. The sense after the broadcast was that it was going to "create a ruckus in this country like nobody's seen before," he recalled. "And like three days later, it had disappeared from the news." He grapples with nuclear nonchalance in America, but admires the general trust that citizens seem to have in the government's ability to keep them safe. "You know, I actually want to be the citizen of a country where people ... don't worry about this stuff. They go to bed at night, and they sleep like babies," he said. "But somebody's got to think about it."

The global nuclear stockpile has declined significantly since the Cold War, from roughly 70,300 warheads in 1986 to some 12,100 in 2024, the Federation of American Scientists estimates. But most of these reductions happened in the 1990s. Since then, the pace has slowed. Transparency is also on the decline.

Feeling Like a Target: As a high school social studies teacher in Kimball, Jeri Ferguson is one of those people who thinks about the question of trust in nuclear arms. She recalls safety-in-numbers logic that could evoke either confidence or unease during the Cold War. "I was in my car, driving in college, and with the radio on: 'Russia has enough nuclear weapons to kill us four times over. But we have enough to kill them 10 times over,'" she recalls. "I remember thinking, 'Once is probably enough for me!'"

On a recent afternoon, Ms. Ferguson began a unit on that history with a class of seven juniors. "What do you think the Cold War was about?" she asks the group. "Global warming?" No, the class groans, and volleys back more jokes. It was about "power," says a boy. "During the winter!"

The teacher turns the focus closer to home – the Sentinel upgrade that could swell the local population with workers. The class seems vaguely aware of the missile silos scattered across the county. "If there's a nuclear war, guess where the first bombs are coming?"

Restoring Transparency – and Talking to Each Other: The renewed conversation about nuclear arms in America points to a tension between the fear these devastating weapons inspire and the belief that the country wouldn't be safe without them. These are concerns that hint at the importance of bolstering transparency and communication to build trust not just in the weapons but among humans, too. The global nuclear stockpile has declined significantly since the Cold War, from roughly 70,300 warheads in 1986 to some 12,100 in 2024, the Federation of American Scientists estimates. But most of these reductions happened in the 1990s. Since then, the pace has slowed. Transparency is also on the decline. While the U.S. used to make its stockpile size public, this stopped under the Trump presidency. The Biden administration restored these disclosures at first, but then suspended them again.

While it's difficult to know precise reasons the government is now refusing declassification requests, it may be that the transparency is politically difficult to justify given Russian and Chinese opacity, says Matt Korda, senior research fellow in the Nuclear Information Project at the federation. The State Department, in a written response to the Monitor, said that declassification "does not occur on a planned calendar" and that the "value of transparency and its contributions to stability is increased when OTHER states take parallel steps." That said, a State Department official added on background that the U.S. "continues to view transparency among nuclear weapon states as extremely valuable for purposes of building confidence, avoiding misperception, and encouraging dialogue that can help mitigate the risk of costly arms competitions." Transparency, in other words, can be diplomatically productive.

Exposing Chinese officials to complex internal U.S. policy debates could help catalyze China's internal discussions, says Tong Zhao, senior fellow with the Nuclear Policy Program at Carnegie Endowment for International Peace.

There are movements on this front. At a summit last November, U.S. and Chinese diplomats discussed whether states are at risk of ceding too much nuclear oversight to artificial intelligence systems. Though no agreements came of it, China's willingness to discuss high-level principles of conduct could potentially be a productive wedge issue into other discussions, Dr. Zhao adds. Russia for now appears to be stiff-arming the idea of nonproliferation talks with Washington, citing U.S. support for Ukraine, even as the sole

Russia for now appears to be stiff-arming the idea of nonproliferation talks with Washington, citing U.S. support for Ukraine, even as the sole remaining arms control agreement between the U.S. and Russia – the New START Treaty – will expire in February 2026. The prospects for treaty renewal look remote for now, but surprising breakthroughs have emerged before.

The possibility of a Trump presidency, for example, is prompting European allies, who benefit from America's nuclear umbrella, to question whether it will hold – or whether they should pursue their own nuclear programs. It doesn't help that Ukraine, which voluntarily gave up its nuclear weapons after the dissolution of the Soviet Union, is now bearing the brunt of as yet unsated Russian aggression.

remaining arms control agreement between the U.S. and Russia – the New START Treaty – will expire in February 2026. The prospects for treaty renewal look remote for now, but surprising breakthroughs have emerged before. Even after President Reagan called the USSR an "evil empire," for example, the two nations in 1985 agreed that "a nuclear war cannot be won and must never be fought," notes Dan Smith, director of the Stockholm International Peace Research Institute.

Though straightforward, this sentence was considered a landmark declaration, and Russia, China, the U.S., France, and the United Kingdom reaffirmed it in 2022. Beyond being a hopeful signal, these sorts of statements "actually inform the thinking" of governments, Mr. Smith adds.

"Keep Engagement Alive": At the same time, these governments are wrestling with the prospect of increasing U.S. isolationism, which many analysts point to as one of the most troubling deterrence trends. The possibility of a Trump presidency, for example, is prompting European allies, who benefit from America's nuclear umbrella, to question whether it will hold – or whether they should pursue their own nuclear programs. It doesn't help that Ukraine, which voluntarily gave up its nuclear weapons after the dissolution of the Soviet Union, is now bearing the

brunt of as yet unsated Russian aggression. Countering isolationist inclinations will mean renewed civic education, cultural dialogue of the sort that emerged in wake of the recent "Oppenheimer" film, and more, says William Hartung, senior research fellow at the Quincy Institute for Responsible Statecraft.

In places like Kimball, there's less opportunity for disengagement. Student Jessica Terrill says she's

used to seeing missile silos, like one near her aunt's house. "That's definitely kind of scary sometimes," says the high school senior. "It's like, oh man. If those go off, we're going to know."

Source: <https://www.csmonitor.com/USA/Military/2024/0502/nuclear-weapons-deterrence-china-russia>, 02 May 2024.

This is the first time Russia has declared publicly that it will conduct drills involving tactical nuclear weapons, although its military regularly holds nuclear exercises. Tactical nuclear weapons are designed for battlefield use, and represent the kind of escalation Western officials have feared that the Kremlin might opt for in Ukraine.

demands special attention and special measures," Peskov said. Maj. Charlie Dietz, a Pentagon spokesperson, told Semafor that "Russia's attempt to use military exercises involving nuclear weapons as a pressure tactic is irresponsible." He added that the US Department of

Defense had not seen a reason to adjust its nuclear posture or indications that Russia is preparing to use a nuclear weapon.

Source: <https://www.semafor.com/article/05/06/2024/russia-orders-nuclear-weapons-drills-to-deter-the-west>, 06 May 2024.

NUCLEAR STRATEGY

RUSSIA

Russia Orders Nuclear Weapons Drills to Deter the West

Russian President Vladimir Putin ordered military exercises focused on the "preparation and deployment" of tactical nuclear weapons, the Russian military announced Monday. This is the first time Russia has declared publicly that it will conduct drills involving tactical nuclear weapons, although its military regularly holds nuclear exercises. Tactical nuclear weapons are designed for battlefield use, and represent the kind of escalation Western officials have feared that the Kremlin might opt for in Ukraine.

The defense ministry said the exercise will involve forces of the Southern Military District, which includes Russia-occupied Ukraine and parts of Russia that border on Ukraine, adding that it was in response to "provocative statements and threats" by the West. Kremlin spokesperson Dmitry Peskov elaborated that the drills are a response to French President Emmanuel Macron recently doubling down on the possibility of sending troops to Ukraine, and similar statements from Western officials. "This is a totally new level of escalating tensions. It is unprecedented, it

It represents a part of the modern arsenal that China offers for both its military use and for export. The BP-12B is capable of carrying a conventional or special payload over several hundred kilometers. The missile uses an advanced guidance system that may include combinations of inertial guidance, satellite (GPS or Beidou, the Chinese GPS system), and telemetry methods to enhance strike accuracy.

CHINA

Chinese Missiles Provider CPM IEC Release SY-400 Anti-Ship ICBM Launcher

Chinese missiles provider CPM IEC displayed materials during the DSA 2024 exhibition in Malaysia, one of the most interesting systems is the SY-400 loaded with the BP-12B short-range ballistic missile developed by China. This missile is specifically designed to hit strategic targets with high precision over short to medium distances. It represents a part of the modern arsenal that China offers for both its military use and for export. The BP-12B is capable of carrying a conventional or special payload over several hundred kilometers. The missile uses an advanced guidance system that may include combinations of inertial guidance, satellite (GPS or Beidou, the Chinese GPS system), and telemetry methods to enhance strike accuracy.

The missile is designed for rapid deployment and precise striking, making it ideal for missions requiring an immediate response against pre-identified or high-value targets. Its ability to be

BALLISTIC MISSILE DEFENCE

launched from mobile platforms, such as trucks, gives it significant operational flexibility, allowing armed forces to quickly reposition their strike capability as the battlefield evolves.

The BP-12B is suited for missions requiring effective penetration of enemy air defenses, thanks to its speed and optimized trajectory. This makes it particularly useful for countries looking to deter enemy intervention or carry out preemptive strikes against strategic sites. In contrast, the SY-400 is a short-range ballistic missile launch system developed and produced in China. It is designed primarily for export, although it is also in service with the Chinese military. This system is capable of launching ballistic missiles and rockets, enabling it to fulfill multiple roles on the battlefield, including artillery support and precision strikes against fixed or semi-mobile targets. In joint use, the SY-400 and the BP-12B are used against naval targets at short and medium range. The maximum range of the BP-12B is considered to be 400 km.

Source: <https://www.armyrecognition.com/news/army-news/army-news-2024/dsa-2024-chinese-missiles-provider-cpmiec-reveals-sy-400-anti-ship-icbm-launcher>, 08 May 2024.

JAPAN

Japan Stumps Up US\$1 Billion for Arms-Race Insurance with US-led Hypersonic Missile-Interceptor Project

Japan is expected to contribute US\$1 billion to a US\$3 billion missile-intercepting system under joint development with the United States, as it seeks to counter the reported deployment of highly advanced weapons – including hypersonic missiles

– by regional rivals. The move is insurance against an accelerating “arms race” in the region, according to one analyst, as lessons are learned from recent conflicts – particularly the neutralisation of Iran’s drone and missile attack against Israel last month. Tokyo’s concerns centre on countries with which it has territorial disputes such as Russia, which has reportedly received missiles from North Korea for its war against Ukraine, and China as it steps up aggressive actions in disputed waters. Japanese Prime Minister Fumio Kishida and US President Joe Biden finalised the details of the agreement in August last year while Kishida was in Washington.

The US will fork over an estimated US\$2 billion for the Glide Phase Interceptor project, according to 2025 budget estimates released by the US Department of Defence in March. Washington and Tokyo aim to achieve full operational capability for the system by the end of 2032. The objective is for missiles launched from US Navy warships to intercept hypersonic projectiles during their vulnerable glide phase. In an opinion piece last week for the Sankei newspaper, US Ambassador to Japan Rahm Emanuel said it was “imperative” that Japan and the US “absorb the lessons” of Iran’s April 13 attack, which saw some 300 missiles and drones launched against Israel – the vast majority of which were intercepted by its Iron Dome system and other air defences.

In the article, published on Thursday, he called for a “credible collective deterrence” to fend off a “belligerent China intimidating its neighbours and an unpredictable North Korea test-firing ballistic missiles into waters around Japan.” “To

In contrast, the SY-400 is a short-range ballistic missile launch system developed and produced in China. It is designed primarily for export, although it is also in service with the Chinese military. This system is capable of launching ballistic missiles and rockets, enabling it to fulfill multiple roles on the battlefield, including artillery support and precision strikes against fixed or semi-mobile targets.

Tokyo’s concerns centre on countries with which it has territorial disputes such as Russia, which has reportedly received missiles from North Korea for its war against Ukraine, and China as it steps up aggressive actions in disputed waters. Japanese Prime Minister Fumio Kishida and US President Joe Biden finalised the details of the agreement in August last year while Kishida was in Washington.

realise an integrated air-and-missile defence architecture in the Indo-Pacific ... we need to urgently accelerate the development of next-generation technology to deal with the missile and dronethreats of tomorrow.” The Glide Phase Interceptor system was critical to the goal of integrated defence, Rahm said, adding that stronger regional partnerships and more frequent training for possible future conflicts were also required. Yakov Zinberg, an international-

relations professor at Kokushikan University in Tokyo, said lessons were being learned from the conflicts currently being waged around the globe.

“Russia’s propaganda machine has been loudly claiming that they have ‘perfected’ a hypersonic missile and that they are using it in Ukraine, so it is extremely important for the US and Japan to find a way to detect and counter that new ability,” he told This Week in Asia. “They also see having a countermeasure as an effective way of countering [Russian President Vladimir] Putin’s rhetoric. Japan is also concerned about Chinese and North Korean efforts to develop hypersonic weapons, with Beijing and Pyongyang both claiming to have one that are combat-ready “I do not believe there is direct proof that those weapons are operational, but we do know both China and North Korea are working on them and that the North has provided Russia with missiles that have been used in Ukraine,” Zinberg said. Russia was likely assisting North Korea with the development of advanced weapons in return for its support in Ukraine, he added.

“But there is no question in my mind that we are now seeing an arms race in the Asia-Pacific region, and that it is more dangerous than the Cold War. The Cold War was between two superpowers who were aware of the dangers, but that is not the case today.” US

Japan is also concerned about Chinese and North Korean efforts to develop hypersonic weapons, with Beijing and Pyongyang both claiming to have one that are combat-ready “I do not believe there is direct proof that those weapons are operational, but we do know both China and North Korea are working on them and that the North has provided Russia with missiles that have been used in Ukraine,” Zinberg said. Russia was likely assisting North Korea with the development of advanced weapons in return for its support in Ukraine, he added.

The platform will be handed over to Kyiv alongside an undisclosed number of 155 mm artillery shells, one SAM P/T battery, and other military capabilities, according to news outlet La Repubblica. Italy’s aid is a direct response to Kyiv’s request for allies to donate more equipment to counter Russia’s attacks on the country’s energy infrastructure.

concerns about the technological advancements made by its rivals in recent years have fuelled a heightened sense of urgency surrounding the Glide Phase Interceptor project. Earlier this year, the US Congress approved doubling the project’s funding to expedite its development and deployment. Similar to existing anti-missile systems, the US-Japan project will require the implementation of an advanced detection and tracking system, with the

development of a long-range radar among the top priorities. Plans for the interceptor project are taking shape as other defence initiatives are also being developed and rolled out, such as the joint US-Israeli Iron Beam system: a laser-based directed-energy weapon designed to counter a wide spectrum of aerial threats, ranging from drones to ballistic missiles.

Source: <https://www.scmp.com/week-asia/politics/article/3261742/japan-stumps-us1-billion-arms-race-insurance-us-led-hypersonic-missile-interceptor-project>, 08 May 2024.

ITALY

Italy to Send Additional SAM P/T Air Defense System to Ukraine

The Italian government is preparing to send a second SAM P/T air defense system as part of its ongoing military aid to Ukraine. The platform will be handed over to Kyiv alongside an undisclosed number of 155 mm artillery shells, one SAM P/T battery, and other military capabilities, according to news outlet La Repubblica. Italy’s aid is

a direct response to Kyiv’s request for allies to donate more equipment to counter Russia’s attacks on the country’s energy infrastructure. The package will be presented at the upcoming G7 summit in Puglia, Italy, which will begin on June

13. The SAM P/T's radar system can simultaneously track up to 100 targets at a range of up to 74 miles (120 kilometers) and an altitude of 12 miles (20 kilometers).

Italy-Ukraine Relations:

Italy delivered its first SAM P/T to Ukraine in 2023 three months after the package was announced. A team of 20 Ukrainian servicemen were trained to operate the system by

French and Italian air defense personnel in Rome following the announcement. Part of Italy's ongoing support for Ukraine includes the handover of Storm Shadow air-launched cruise missiles used to strike standoff-range targets, as well as economic sanctions imposed on Russia by both the EU and NATO.

Source: <https://www.thedefensepost.com/2024/05/08/italy-samp-t-air-defense-ukraine/>, 08 May 2024.

EMERGING TECHNOLOGIES AND DETERRENCE

USA-JAPAN

Tokyo, Washington to Spend \$3B on Missile to Intercept Hypersonic Weapons

The United States and Japan have estimated the total cost of jointly developing a new type of missile capable of intercepting hypersonic weapons will exceed \$3 billion, a Defense Department official said, Report informs referring to Kyodo. Of the total, Japan will allocate \$1 billion to the Glide Phase Interceptor project, according to the official from the US Missile Defense Agency.

The two countries are aiming to complete the missile's development by the 2030s.

The joint development was agreed on by President Joe Biden and Japanese Prime Minister Fumio Kishida in August last year ahead of a trilateral summit with their South Korean counterpart at Camp David near Washington. The project comes

The two countries are aiming to complete the missile's development by the 2030s. The joint development was agreed on by President Joe Biden and Japanese Prime Minister Fumio Kishida in August last year ahead of a trilateral summit with their South Korean counterpart at Camp David near Washington. The project comes at a time when China, North Korea and Russia have been aggressively pursuing hypersonic capabilities.

at a time when China, North Korea and Russia have been aggressively pursuing hypersonic capabilities.

Hypersonic missiles and glide vehicles fly at speeds of over Mach 5, equivalent to five times the speed of sound. They are also maneuverable and can change course during flight, making them more difficult to shoot down or track by radar. It is the second time

that Japan and the United States have decided to develop an interceptor missile together following the Standard Missile-3 Block 2A.

Source: <https://www.azerbaycan24.com/en/tokyo-washington-to-spend-3b-on-missile-to-intercept-hypersonic-weapons/>, 03 May 2024.

NUCLEAR ENERGY

BANGLADESH

Bangladesh Reiterates Commitment to Peaceful Use of Nuclear Power

Bangladeshi Foreign Minister Hasan Mahmud has reiterated the country's commitment to non-proliferation and peaceful use of nuclear science, particularly in energy, food safety, medicine, and health sectors. He also restated Bangladesh's enduring commitment to nuclear disarmament and the safety and security of nuclear materials.

The foreign minister, who is on an official visit to Austria, made the remarks during a meeting with IAEA Director General Rafael Mariano Grossi in Vienna on Monday, a Foreign Ministry press release said here Tuesday.

Hasan ensured the director general that

Bangladesh will maintain the highest level of transparency, safety, and security of its nuclear power plants. Referring to the country's energy vision, the foreign minister said Bangladesh has contemplated a fair share of nuclear energy in its

Hasan ensured the director general that Bangladesh will maintain the highest level of transparency, safety, and security of its nuclear power plants. Referring to the country's energy vision, the foreign minister said Bangladesh has contemplated a fair share of nuclear energy in its future energy mix since it is a green and clean source of energy.

future energy mix since it is a green and clean source of energy.

Source: <https://english.news.cn/asiapacific/20240501/44990a933b8240cfb980ba0e944f0ee2/c.html>, 30 April 2024.

CANADA

Alberta, Saskatchewan to Cooperate on Nuclear Energy

The MoU will support collaboration and information sharing on key areas of nuclear power generation, including nuclear supply chains and workforce development, the security of supply of fuels, and the development and regulation of nuclear reactor technologies, including SMRs. The provinces will also work to advance industrial decarbonisation and enhance grid capabilities.

In 2019, the provinces of Saskatchewan, Ontario and New Brunswick signed an MoU to advance SMRs in Canada, with Alberta formally joining the MoU in 2021. The Interprovincial Strategic Plan for the Development of Small Modular Reactors, developed by the four provinces, was released in March 2022. The new, bilateral MoU between Saskatchewan and Alberta has additional areas of interest such as industrial decarbonisation and grid reliability. ...

Saskatchewan is home to the largest and highest-grade uranium mines in the world, but does not currently have any nuclear power reactors. The province announced in November that it is providing CAD80 million (USD59 million) for the Saskatchewan Research Council to pursue the demonstration of a microreactor in Saskatchewan, with plans for a Westinghouse-designed eVinci microreactor to be operational in the province from 2029. Last year, Alberta announced a CAD7 million investment in a multi-year study of the deployment of SMRs for

Saskatchewan is home to the largest and highest-grade uranium mines in the world, but does not currently have any nuclear power reactors. The province announced in November that it is providing CAD80 million (USD59 million) for the Saskatchewan Research Council to pursue the demonstration of a microreactor in Saskatchewan, with plans for a Westinghouse-designed eVinci microreactor to be operational in the province from 2029.

the province's oil sands operations.

At that time, Alberta Minister of Energy and Minerals Brian Jean said SMRs "are a critical component of the clean power generation supply mix and hold promise for the oil sands". In January, an agreement was signed between North American power producer Capital Power Corporation and Ontario Power Generation that will see the two

companies work together to examine the feasibility of developing grid-scale SMRs in Alberta, including possible ownership and operating structures. The feasibility assessment will be completed within two years.

Source: <https://www.world-nuclear-news.org/Articles/Alberta,-Saskatchewan-to-cooperate-on-nuclear-energy#:~:text=The%20governments%20of%20the%20Canadian,sustainable%20electricity%20grids%20by%202050.,03%20May%202024.>

GENERAL

Nuclear's Role in Reaching Climate Targets Recognised by G7

"Those countries that opt to use nuclear energy or support its use recognise its potential as a clean/zero-emissions energy source that can reduce dependence on fossil fuels to address the climate crises and improve global energy security," the document states. "These countries recognise

The ministers noted the declaration issued by 25 countries during the COP28 climate conference in Dubai in December last year, setting a goal to triple global nuclear generating capacity by 2050. The communique said the ministers "recognise that, for countries that opt to use it, nuclear energy will play a role in reducing dependence on fossil fuels, supporting the transition to net-zero and ensuring energy security, while other countries choose other energy sources to achieve these goals".

nuclear energy as a source of baseload power, providing grid stability and flexibility, and optimising use of grid capacity, while countries that do not use nuclear energy or do not support its use prefer other options to achieve the same goals, taking into account their assessment of associated risks and costs of nuclear energy." The ministers noted the declaration issued by 25

countries during the COP28 climate conference in Dubai in December last year, setting a goal to triple global nuclear generating capacity by 2050. The communique said the ministers “recognise that, for countries that opt to use it, nuclear energy will play a role in reducing dependence on fossil fuels, supporting the transition to net-zero and ensuring energy security, while other countries choose other energy sources to achieve these goals”.

The ministers also said that new reactor designs - including advanced and small modular reactors - “could bring in the future additional benefits such as improved safety and sustainability, reduced cost of production, reduced project risk, waste management improvement, better social acceptance, opportunities for industry by providing at the same time energy, high temperature heat, hydrogen”. They committed to support multilateral efforts to strengthen the resilience of nuclear supply chains and to continue the cooperation for building a robust nuclear supply chain in the framework of G7 and of the Nuclear Energy Working Group established in Sapporo. The ministers noted that G7 leaders remain committed to reducing reliance on civil nuclear-related goods from Russia and the ongoing efforts by countries that operate Russian-designed reactors to make progress in securing alternative nuclear fuel contracts and to reduce dependencies related to spare parts, components and services.

They also said they would promote research and development initiatives on innovative nuclear power technologies “for those countries that opt to use nuclear energy or support its use”. The communique added that the G7 will “promote the responsible deployment of nuclear energy technologies including for advanced and small modular reactors, including microreactors, and

work collectively to share national best practices, including for responsible waste management, enable greater access to project financing tools, support sectorial collaboration, designing licensing procedures and strengthening coordination on development of commercial projects among interested G7 members and third

The communique added that the G7 will “promote the responsible deployment of nuclear energy technologies including for advanced and small modular reactors, including microreactors, and work collectively to share national best practices, including for responsible waste management, enable greater access to project financing tools, support sectorial collaboration, designing licensing procedures and strengthening coordination on development of commercial projects among interested G7 members and third markets”.

markets”. The ministers said: “We underscore the importance for all countries and their respective people of upholding the highest standards of safety, security, and safeguards and non-proliferation, particularly as more countries adopt nuclear power as part of their energy mix.”

Speaking at a joint press conference following the ministerial meeting, which he presided over, Italy’s Minister of the

Environment and Energy Security, Gilberto Pichetto Fratin said: “When it comes to nuclear energy ... our seven countries indicated in the communique that we will proceed together in order to promote further research and ensure that the conditions are in place to promote the use of nuclear energy, which is a clean form of energy.” He added, without naming Germany: “This is something that is not binding. Obviously, we are aware that in the G7 there is a country that currently does not want to pursue the development of nuclear energy.” The ministers’ statement came following a call by the nuclear industry for G7 governments to embrace nuclear deployment as a strategic priority, by maximising use of existing nuclear power plants and setting clear plans for further deployment that would fulfil the targets they set at COP28, to triple global nuclear capacity.

The statement was signed by the heads of Associazione Italiana Nucleare, Canadian Nuclear Association, Groupement des Industriels Français de l’Energie Nucléaire (Gifen), Japan Atomic Industrial Forum, Nuclear Energy Institute, Nuclear

Industry Association, Nucleareurope and World Nuclear Association. The G7 is an informal forum that brings together Italy, Canada, France, Germany, Japan, the UK, and the USA. The European Union also participates in the group and is represented at the summits by the President of the European Council and the President of the European Commission.

Source: <https://www.world-nuclear-news.org/Articles/Nuclear-s-role-in-reaching-climate-targets-recogni>, 30 April 2024.

SM ALL MODULAR REACTORS

CANADA

Canada / Provinces Sign Additional Agreement in Bid to Deploy Small Modular Reactors

The governments of Saskatchewan and Alberta in Canada have signed an additional memorandum of understanding to advance the development and deployment of nuclear power plants as they look for ways to secure a supply of reliable and sustainable electricity generation by 2050. The two provinces said the MOU will support collaboration and information sharing on key areas of nuclear power generation, including nuclear supply chains and workforce development, the security of fuel supply and the development and regulation of nuclear reactor technologies – including small modular reactors.

The provinces will also work to advance industrial decarbonisation and improve grid capabilities, a statement said. In 2019, Saskatchewan, Ontario and New Brunswick signed an MOU to advance SMRs in Canada, with Alberta formally joining the MOU in 2021. A plan for the development of SMRs, developed by the four MOU provinces, was released in March 2022. The new, bilateral MOU between Saskatchewan and Alberta has additional areas of interest such as industrial decarbonisation and grid reliability. Canada is

The new, bilateral MOU between Saskatchewan and Alberta has additional areas of interest such as industrial decarbonisation and grid reliability. Canada is bullish about the prospects for nuclear energy, including SMRs. It has a fleet of 19 large-scale commercial nuclear power plants that provide about 14% of its electricity generation. Major projects have begun to extend the lifetime of reactors at the Bruce, Darlington and Pickering stations.

bullish about the prospects for nuclear energy, including SMRs. It has a fleet of 19 large-scale commercial nuclear power plants that provide about 14% of its electricity generation. Major projects have begun to extend the lifetime of reactors at the Bruce, Darlington and Pickering stations.

In August 2023, Canada approved up to CAD74m (€50m, \$54m) in federal funding for SMR development in Saskatchewan with potential deployment of a first plant in the mid-2030s and more units to follow. Ontario Power Generation is planning to build up to four new General Electric Hitachi BWRX 300 plants at the existing Darlington nuclear site in Ontario. Early site work for that project has begun and the first unit could go online by 2028. Utility SaskPower has already chosen the BWRX-300 SMR for potential deployment in Saskatchewan, subject to a decision to build expected in 2029.

Source: <https://www.nucnet.org/news/provinces-sign-additional-agreement-in-bid-to-deploy-small-modular-reactors-5-5-2024>, 03 May 2024.

Partnership Advanced for ARC-100 Commercialisation

Korea Hydro & Nuclear Power (KHNP), ARC Clean Technology and New Brunswick Power (NB Power) have signed a trilateral agreement that aims to establish a global fleet of SMRs. The companies signed a MOU last November to explore collaboration opportunities for the commercialisation of ARC's ARC-100 SMR in Canada, South Korea, the US and other countries in which KHNP operates. The new agreement, signed at the Reuters SMR and Advanced Reactor 2024 Conference in Atlanta, Georgia, ensures firm commitments to advance discussions on potential investment in the deployment of ARC units, beginning with the commercial demonstration unit in the Canadian province of New Brunswick. ARC and NB Power have been working together on the

development of ARC-100 since 2018. The two companies submitted an environmental impact assessment registration document as well as an application for a site preparation licence for an SMR at the Point Lepreau nuclear power plant site in New Brunswick. The unit is scheduled for commissioning in 2029. KHNP CEO Joohoo Whang said: "While we focus our capabilities on technological development for Korea's Innovative SMR (i-SMR) to have the highest level of competitiveness in the world, we are pushing for timely entry into the 4th generation SMR market.

Global cooperation is necessary for accelerating the development and construction of 4th generation SMRs, and the strengths of the leading companies in Canada as well as KHNP will lead to synergy in cooperation." Lori Clark, NB Power president and chief nuclear officer, said: "Small modular reactors are an important part of NB Power's strategic plan to meet government mandates to phase out coal by 2030 and achieve net-zero supply by 2035. The agreement with KHNP and ARC will assist us in deploying the clean energy we need to meet our climate goals and maintain energy security for New Brunswickers. In addition, we are excited about what this could mean for potential future commercialisation opportunities." Last October, the Canadian Government granted ARC Clean Technology C\$7m (\$5.12m) to help build the SMR at Point Lepreau.

Source: <https://www.power-technology.com/news/three-companies-have-entered-partnership-for-the-commercialisation-of-a-arc-100-reactor/?cf-view>, 03 May 2024.

NUCLEAR COOPERATION

CHILE-IAEA

Tackling Microplastics in Antarctica Using Nuclear Tech - Chile and IAEA Sign MoU

The agreement came during a visit to the country by IAEA Director General Rafael Mariano Grossi and was signed by Chile's Foreign Minister Alberto

van Klaveren - in a post on X Grossi said they would "study microplastic pollution in Antarctica, aiming to trace origins and impacts to develop strategies against it". Grossi also signed an agreement with Chilean Nuclear Energy Commission on nuclear technology and lithium "aimed at harnessing nuclear technology to enhance lithium mining".

The new agreement, signed at the Reuters SMR and Advanced Reactor 2024 Conference in Atlanta, Georgia, ensures firm commitments to advance discussions on potential investment in the deployment of ARC units, beginning with the commercial demonstration unit in the Canadian province of New Brunswick. ARC and NB Power have been working together on the development of ARC-100 since 2018.

NUTEC Plastics: The IAEA's scheme was established in 2020 and uses a series of monitoring laboratories to use nuclear technology to sample and analyse microplastics - which are

bits of plastic less than 5 millimetres in diameter - in the environment. There are more than 60 countries participating in monitoring of microplastics in the sea, and the goal is to equip more than 50 laboratories with the technology to form a global monitoring network. The aim is to then be able to take action to bring in measures designed to reduce the sources of the pollution - at least 30 countries are involved in developing innovative recycling technology, including using irradiation to treat plastics and make them fit for reuse, or for a wider range of reuses.

This process uses gamma and electron beam radiation technologies to modify certain types of plastic waste, breaking down plastic polymers judged not to be of sufficient quality into smaller components and then allowing them to be used to generate new plastic products. The IAEA cites studies suggesting that only around 10% of plastic produced between 1950 and 2015 has been recycled, with the majority (about 60%) going to landfill, meaning action is imperative given estimates that there will be one tonne of plastic for every three tonnes of fish within a few years.

This process uses gamma and electron beam radiation technologies to modify certain types of plastic waste, breaking down plastic polymers judged not to be of sufficient quality into smaller

components and then allowing them to be used to generate new plastic products. The IAEA cites studies suggesting that only around 10% of plastic produced between 1950 and 2015 has been recycled, with the majority (about 60%) going to landfill, meaning action is imperative given estimates that there will be one tonne of plastic for every three tonnes of fish within a few years.

Antarctica: Grossi visited an IAEA mission in Antarctica in January with Argentina's president to see the start of work there assessing the impact and scale of plastic pollution.

The two-person IAEA research team spent a month assessing "the impact of microplastics by investigating its occurrence and distribution in seawater, lakes, sediments, sand, discharge water and animals of the Antarctic ecosystem near the Argentine Carlini scientific research station". The IAEA

said at the launch of its mission, "there is still almost no information available on where and how much microplastics arrive in the Antarctic and how much is taken up by Antarctic organisms. There is also very little data existing on the types of microplastics reaching this pristine area through ocean currents, atmospheric deposition and the presence of humans in the Antarctic". It also said the "presence of microplastics can contribute to accelerating the ice-loss in Antarctica by reducing ice reflectivity, altering surface roughness, promoting microbial activity, acting as thermal insulators, and contributing to mechanical weakening of the ice structure".

Other Agreements: The IAEA director general and the Chilean Nuclear Energy Commission's Luis Huerta signed an agreement aimed at using nuclear technology to enhance the mining of lithium, which has applications in a range of energy sectors, including fusion and "paves the way for wider regional support from the IAEA". There were also discussions with Chile's health minister about expanding cancer care via the

IAEA's Rays of Hope: Cancer Care for All initiative. Grossi said: "Nuclear science boosts Chile's development in areas like health, food, security and environment. I look forward to furthering our collaboration."

Chile and Nuclear: Chile does not have nuclear power, although there have been discussions about a nuclear energy programme being developed. The Chilean Nuclear Energy Commission has operated the RECH-1 research reactor since 1974. This reactor is located at La

Reina Nuclear Centre in Santiago. It is a 5M W pool-type reactor using low-enriched uranium fuel assemblies, light water as moderator and coolant, and beryllium as reflector. The main use of the RECH-1 reactor is the production of radioisotopes, mainly for medicine. In addition, irradiation of samples is carried out for chemical

The Chilean Nuclear Energy Commission has operated the RECH-1 research reactor since 1974. This reactor is located at La Reina Nuclear Centre in Santiago. It is a 5M W pool-type reactor using low-enriched uranium fuel assemblies, light water as moderator and coolant, and beryllium as reflector. The main use of the RECH-1 reactor is the production of radioisotopes, mainly for medicine.

analysis and geological material, for purposes of determining age and preparing radioactive tracers.

Source: <https://www.world-nuclear-news.org/Articles/Tackling-microplastics-in-Antarctica-using-nuclear>, 03 May 2024.

USA–RUSSIA

US Senate Passes Act Banning Russian Uranium Imports

As well as banning the import of Russian-produced unirradiated LEU the bill also prohibits the import of unirradiated LEU "that has been swapped for the banned uranium or otherwise obtained in a manner designed to circumvent the ban's restrictions", according to summary information from the US Senate. However, the DOE may waive the ban if it determines that "no alternative viable source of low-enriched uranium is available to sustain the continued operation of a nuclear reactor or a US nuclear energy company" or that importation of uranium is in the national

interest. The amount of uranium that could be imported under such a waiver is limited, and any waivers must terminate by 1 January 2028.

The prohibition on imports of LEU would come into effect 90 days after the

date of the enactment of the bill, and would terminate in 2040.

Bipartisan senators including Joe Manchin and John Barrasso, respectively chairman and ranking member of the US Senate Committee on Energy and Natural Resources, issued a statement in which they applauded the bill's passage, which they said would strengthen US energy security as well as

boosting its nuclear sector. "Our bipartisan legislation will help defund Russia's war machine, revive American uranium production, and

jumpstart investments in America's nuclear fuel supply chain," Barrasso said, while Manchin added that it "simultaneously unlocks USD2.72 billion to ramp up domestic uranium fuel production". Ukrainian nuclear operator Energoatom has ended any use of Russian nuclear fuel since the start of the war in 2022, and has said it ultimately aims to create a

complete nuclear fuel cycle in the country. Minister of Energy Herman Halushchenko described the US Senate's "historic decision" as a "decisive step towards sanctions against Russia".

US uranium producer Energy Fuels Inc responded to the announcement saying on X: "We stand ready to help supply the nuclear market with responsibly produced US uranium." Amir Adnani, president and CEO of US uranium producer

Uranium Energy Corp (UEC), said the bill will strengthen US energy and national security, and end an "untenable reliance" on Russian uranium imports. "This new law, in conjunction with the recently passed Nuclear Fuel Security Act, creates

a firm foundation for long-term growth of the US uranium industry to supply the fuel that powers American households, data centres, and industrial base with clean baseload power," he said. UEC is working towards restarting uranium production at its operation in Wyoming in August, followed by the resumption its operations in Texas in 2025. Maria Korsnick, president and

CEO of the Nuclear Energy Institute, said: "A ban on Russian uranium imports is needed to release the USD2.72 billion included in recent

appropriations to revitalise a competitive domestic enrichment and conversion capability. It will take many years to build US capacity to serve the existing fleet and the deployment of next generation nuclear. The implementation of a meaningful programme to support capacity building is critical."

"NEI and our members have been working to create a

path to a reliable, secure domestic supply of fuel for more than two years, following Russia's invasion of Ukraine. We will continue to work with the Department of Energy on the design of an effective programme to spur expansion of US capabilities as well as a predictable and efficient waiver process."

Source: <https://www.world-nuclear-news.org/Articles/US-Senate-passes-act-banning-Russian-uranium-impor,01May2024>.

The prohibition on imports of LEU would come into effect 90 days after the date of the enactment of the bill, and would terminate in 2040. Bipartisan senators including Joe Manchin and John Barrasso, respectively chairman and ranking member of the US Senate Committee on Energy and Natural Resources, issued a statement in which they applauded the bill's passage, which they said would strengthen US energy security as well as boosting its nuclear sector.

A ban on Russian uranium imports is needed to release the USD2.72 billion included in recent appropriations to revitalise a competitive domestic enrichment and conversion capability. It will take many years to build US capacity to serve the existing fleet and the deployment of next generation nuclear. The implementation of a meaningful programme to support capacity building is critical.

NUCLEAR PROLIFERATION

IRAN

UN Watchdog Seeks to Repair Tattered Nuclear Deal with Iran

UN nuclear watchdog chief Rafael Grossi will hold talks with senior officials in Iran on Monday and Tuesday, hoping to bolster his agency's oversight of Iran's nuclear activities. Since then-president Donald Trump's decision in 2018 to pull the US out of a landmark deal between Iran and major powers that restricted Iran's nuclear activities in exchange for sanctions relief, that accord has unravelled. Iran retaliated to the reimposition of sanctions lifted under the deal by breaching and going far beyond the nuclear restrictions. It is now enriching uranium to up to 60% purity, close to the 90% of weapons grade, and has enough uranium enriched to that level, if enriched further, for two atomic bombs. Western powers say there is no credible civil justification for that. Iran says its aims are purely peaceful. Below are some of the difficulties the IAEA faces in Iran.

Snap Inspections: Under the 2015 deal between Iran and major powers, Iran agreed to implement the additional protocol, an agreement between the agency and member states that lets the agency carry out snap inspections at locations of interest, including undeclared ones, not just the declared facilities it inspects regularly. As part of measures it announced in February 2021, Iran stopped implementing the additional protocol, ending

snap inspections.

Monitoring Scope: As a party to the NPT, Iran is subject to atomic energy agency inspections of its core nuclear facilities, such as its uranium-enrichment plants at Natanz and Fordow. The 2015 deal, however, expanded the scope of agency monitoring to more activities and facilities. Those included production and inventory of parts for centrifuges, the machines that enrich uranium, as well as yellowcake, a form of uranium that needs further processing before it can be fed into centrifuges for enrichment. Iran scrapped those extra measures in

February 2021. The IAEA has now lost "continuity of knowledge" on items, including the number of centrifuges Iran has, heightening the fear that Iran could set up a secret enrichment site. Without snap inspections, that would be much harder to detect.

Cameras: To cushion the blow of the measures announced in February 2021, the atomic energy agency struck a deal with Tehran under which surveillance cameras and other equipment carrying out extra monitoring

introduced by the 2015 deal would stay in place, but the data collected would remain in Iran's hands, under seal. The agency still has not had access to any of that footage. In June 2022, Iran had the agency remove those cameras. In March 2023, Iran and the agency agreed on a "joint statement" that was short on detail but that the agency understood to be a sweeping pledge of cooperation by Iran, including reinstalling those

Since then-president Donald Trump's decision in 2018 to pull the US out of a landmark deal between Iran and major powers that restricted Iran's nuclear activities in exchange for sanctions relief, that accord has unravelled. Iran retaliated to the reimposition of sanctions lifted under the deal by breaching and going far beyond the nuclear restrictions. It is now enriching uranium to up to 60% purity, close to the 90% of weapons grade, and has enough uranium enriched to that level, if enriched further, for two atomic bombs.

In March 2023, Iran and the agency agreed on a "joint statement" that was short on detail but that the agency understood to be a sweeping pledge of cooperation by Iran, including reinstalling those cameras. In the months after the statement, a fraction of the cameras the agency wanted to install were installed, but the agency says there was "no further progress" after June 2023 on cooperation as outlined in the joint statement.

cameras. In the months after the statement, a fraction of the cameras the agency wanted to install were installed, but the agency says there was “no further progress” after June 2023 on cooperation as outlined in the joint statement.

Inspectors: In September 2023, Iran barred many of the agency’s top enrichment experts assigned to the country, which diplomats said left only one such expert on the highly sensitive technology. The agency condemned the move, saying that though it was technically allowed, it was unprecedented and a “very serious blow” to its ability to do its job properly in Iran.

Uranium Traces: The International Atomic Energy Agency has been demanding for years that Iran explain the origin of uranium traces found at largely old but undeclared sites in Iran. The agency’s 35-nation board of governors passed a resolution in June 2022 urging Iran to co-operate with the agency on the issue “without delay” and then another in November 2022 ordering Iran to co-operate urgently with the agency’s investigation. Iran has said such resolutions are “anti-Iranian” and politically motivated. Recent agency reports have said Iran has still not provided technically credible explanations for the uranium traces.

Modified Code 3.1: According to the IAEA so-called modified Code 3.1, part of the agreement spelling out Iran’s obligations under the non-proliferation treaty “provides for the submission to the agency of design information for new nuclear facilities as soon as the decision to construct, or to authorise construction of, a new facility has been taken, whichever is the earlier”. Since February 2021 Iran has said it is no longer implementing the code, but the agency says it is a legal obligation that Iran cannot suspend. This again

raises the question of whether Iran is planning or has started to build nuclear facilities in secret. It has publicly announced plans for new nuclear power plants and broken ground on them without informing the agency.

Source: <https://www.businesslive.co.za/bd/world/europe/2024-05-06-un-watchdog-seeks-to-repair-tattered-nuclear-deal-with-iran/>, 06 May 2024.

Since February 2021 Iran has said it is no longer implementing the code, but the agency says it is a legal obligation that Iran cannot suspend. This again raises the question of whether Iran is planning or has started to build nuclear facilities in secret. It has publicly announced plans for new nuclear power plants and broken ground on them without informing the agency.

In April, Rafael Grossi, the Director-General of the IAEA, announced that Iran has significantly moved towards the threshold of being able to produce a nuclear bomb in days rather than weeks.

Borrell Urges Nuclear Non-Proliferation, Regional De-Escalation in Call with Iran FM

European Union Foreign Policy Chief Josep Borrell urged the need to keep working on nuclear non-proliferation in a phone call with Iran’s Foreign Minister Hossein Amir-Abdollahian.

Iran’s ongoing nuclear program continues to pose one of the world’s biggest threats to peace. In April, Rafael Grossi, the Director-General of the IAEA, announced that Iran has significantly moved towards the threshold of being able to produce a nuclear bomb in days rather than weeks.

According to his account on X, Borrell also stressed “the importance of restraint and de-escalation

in the region,” which has witnessed intense tensions in recent weeks following tit-for-tat military attacks between Israel and Iran. “I explained EU’s sanctions on Iran’s UAVs and missiles,” Borrell wrote on X in reference to the recent bans against Tehran following the regime’s April 13 missile and drone offensive on Israeli territory. Further in his conversation with Iran’s top diplomat, Borrell discussed the case of EU citizens who have been detained in Iran, including a Swedish EU representative, one of multiple diplomatic hostages held in Iran.

The call came a week after the European Parliament slammed the Iranian regime’s notorious “hostage diplomacy,” demanding that

the bloc “launch a strategy to counter it with a dedicated task force to better assist detainees’ families and effectively prevent further hostage-taking,” according to the parliament’s website. Last month, Iran’s head of the Atomic Energy Organization said plans continue to expand the number of nuclear power plants in the country, aiming to reach a production capacity of 20,000 megawatts of nuclear electricity. However, while Iran continues to exceed levels of 60 percent purity for uranium enrichment in the face of global sanctions, the IAEA has admitted no country with plans for the peaceful uses would need to exceed the set levels.

Source: <https://www.iranintl.com/en/202405028287>, 02 May 2024.

URANIUM PRODUCTION

CANADA

Former Canadian Uranium Mine Site Returned to Province

The project, which is some 75 km south of Lake Athabasca and 15 km east of the border with the Province of Alberta, operated from 1979 to 2002, producing more than 62 million pounds U3O8 (23,848 tU) from two underground mines and four open pit mines. The operation also included a tailings management facility, a mill and other support facilities. The Cluff Lake Project is located on Treaty 8 territory, the Homeland of the Métis, and is within the traditional territories of the Dene, Cree, and Métis people. Cluff Lake was fully decommissioned in 2013. In May last year, the Canadian Nuclear Safety Commission (CNSC) revoked the uranium

Iran’s head of the Atomic Energy Organization said plans continue to expand the number of nuclear power plants in the country, aiming to reach a production capacity of 20,000 megawatts of nuclear electricity. However, while Iran continues to exceed levels of 60 percent purity for uranium enrichment in the face of global sanctions, the IAEA has admitted no country with plans for the peaceful uses would need to exceed the set levels.

mine licence held by Orano Canada for Cluff Lake Project, clearing the way for Orano to transfer the site to the Province of Saskatchewan. The CNSC has previously released properties at legacy uranium mining sites to provincial control, but Cluff Lake was the first decommissioned “modern” uranium mine to reach this milestone.

With the recent acceptance of a long-term monitoring and maintenance plan, and the provision of adequate funds by Orano to the Province of Saskatchewan to carry out the efforts (in perpetuity), the Cluff Lake property will now be

transferred into the provincial Institutional Control Program (ICP). The programme was set up by Saskatchewan in 2007 as part of its institutional control framework for the long-term management of decommissioned and reclaimed mine and mill sites on provincial Crown lands. The ICP allows for coordination between the provincial Ministry of Environment and the Ministry of Energy and

Resources, and provides clear direction for mining companies on what is necessary for a property to be transferred. The programme also ensures that any long-term monitoring, maintenance or response to overseen events is funded by the company. The area now has unrestricted public access, with no restrictions on

traditional land use. Orano noted that numerous studies have concluded that the area is safe today and into the future for hunting, fishing, drinking water and the gathering of berries. ...

Source: <https://world-nuclear-news.org/Articles/Former-Canadian-uranium-mine-site-returned-to-prov>, 03 May 2024.

NUCLEAR SAFETY

CHINA–RUSSIA

US Official Urges China, Russia to Declare Only Humans, Not AI, Control Nuclear Weapons

A senior U.S. official on Thursday urged China and Russia to match declarations by the United States and others that only humans, and never artificial intelligence, would make decisions on deploying nuclear weapons. State Department arms control official Paul Dean told an online briefing that Washington had made a “clear and strong commitment” that humans had total control over nuclear weapons, adding that France and Britain had done the same.

“We would welcome a similar statement by China and the Russian Federation,” said Dean, principal deputy assistant secretary in the Bureau of Arms Control, Deterrence and Stability. “We think it is an extremely important norm of responsible behaviour and we think it is something that would be very welcome in a P5 context,” he said, referring to the five permanent members of the United Nations Security Council. Dean’s remarks come as the administration of U.S. President Joe Biden tries to deepen separate discussions with China over both nuclear weapons policy and the growth of artificial intelligence.

The Chinese defence ministry did not immediately respond to a request for comment. The spread of artificial intelligence technology surfaced during sweeping talks between U.S. Secretary of State Antony Blinken and China’s Foreign Minister Wang Yi in Beijing on April 26. The two sides agreed to

hold their first bilateral talks on artificial intelligence in the coming weeks, Blinken said, adding that they would share views on how best to manage risks and safety surrounding the technology. As part of normalising military communications, U.S. and Chinese officials resumed nuclear weapons discussions in January, but formal arms control negotiations are not expected any time soon. China, which is expanding its nuclear weapons capabilities, urged

in February that the largest nuclear powers should first negotiate a no-first-use treaty between each other.

Source: <https://www.reuters.com/world/us-official-urges-china-russia-declare-only-humans-not-ai-control-nuclear-2024-05-02/>, 02 May 2024.

A senior U.S. official on Thursday urged China and Russia to match declarations by the United States and others that only humans, and never artificial intelligence, would make decisions on deploying nuclear weapons. State Department arms control official Paul Dean told an online briefing that Washington had made a “clear and strong commitment” that humans had total control over nuclear weapons, adding that France and Britain had done the same.

ROMANIA

Five-Year Project to Enhance Nuclear Safety

and Security in Romania Completed with Norway and IAEA Support

Romania’s regulatory infrastructure for nuclear safety and security has been strengthened by a five-year project that was completed last week.

Funded by the Norway Grants and supported by the IAEA, the Enhancement of Nuclear Safety, Security and Emergency Preparedness in Romania (NORROM) project stands as a testament to international cooperation to improve nuclear safety and security. The closing

conference of the project took place on 25 April in Bucharest and highlighted the collaborative effort to enhance nuclear safety and security in Romania and worldwide.

Through its five-year lifespan, the project completed 138 activities, 83 of which were organized and supported by the IAEA. These

Funded by the Norway Grants and supported by the IAEA, the Enhancement of Nuclear Safety, Security and Emergency Preparedness in Romania (NORROM) project stands as a testament to international cooperation to improve nuclear safety and security.

activities were designed to review and develop regulations, guidelines, computer security inspection guides, procedures, and training materials. Additionally, through the NORROM project, the Romanian National Commission for Nuclear Activities Control (CNCAN) was able to establish a new emergency information and training centre. “The project demonstrated clear evidence of Romania’s commitment to follow the international standards for safety and security guidance,” said Kirsj Alm-Lytz, head of the IAEA

Regulatory Activities Section. “Romania’s dedication to continuous improvement and upholding the high standards of nuclear safety and security is also confirmed by their willingness to host IAEA peer review and advisory services, notably the Integrated Regulatory Review Service (IRRS), the OSART, the Safe Aspects of Long Term Operation (SALTO), the Emergency Preparedness Review Service (EPREV) and the International Physical Protection Advisory Service (IPPAS),” she added.

This project was a partnership between the Norwegian Radiation and Nuclear Safety Authority (DSA) and CNCAN, and supported by the IAEA with a purpose of further enhancing nuclear safety and security, including emergency preparedness and response. This enables the country to be prepared and ready to prevent accidents or detect and respond to malicious acts involving nuclear and other radioactive material and associated facilities and threats of nuclear terrorism.

This project was a partnership between the Norwegian Radiation and Nuclear Safety Authority (DSA) and CNCAN, and supported by the IAEA with a purpose of further enhancing nuclear safety and security, including emergency preparedness and response. This enables the country to be prepared and ready to prevent accidents or detect and respond to malicious acts involving nuclear and other radioactive material and associated facilities and threats of nuclear terrorism.

Senator Edward Markey said in a letter to fellow Democrat Biden that Saudi Arabia, “a nation with a terrible human rights record”, cannot be trusted to use its nuclear program purely for peaceful purposes and will seek to develop nuclear weapons. Markey and other Democrats are critics of the country and its de facto ruler, Crown Prince Mohammed bin Salman, over human rights, his intervention in Yemen’s civil war and the murder of Washington Post columnist Jamal Khashoggi that U.S. spy agencies assessed was ordered by the prince.

“The cooperation with the IAEA has been crucial for the successful implementation of the project in Romania. A strong multilateral cooperation on

nuclear safety and security is more important than ever. I hope that we can continue our good cooperation,” reflected Ingar Amundsen, Head of the International Nuclear Safety and Security Section at DSA. Through the NORROM project, the IAEA connected CNCAN with international experts for technical exchange, guidance and collaboration for training, exercises and the development of

regulatory documents. “The results achieved during this project add another brick to the foundation of Romania’s regulatory infrastructure for nuclear safety, security and emergency preparedness and response,” said Cantemir Ciurea-Ercau, President of CNCAN.

Source: <https://www.iaea.org/newscenter/news/five-year-project-to-enhance-nuclear-safety-and-security-in-romania-completed-with-norway-and-iaea-support>, 02 May 2024.

USA–SAUDI ARABIA

US Senator Urges Biden to Include Safeguards in Any Nuclear Power Deal with Saudi Arabia

A Democratic U.S. senator on Wednesday urged President Joe Biden to include strict nonproliferation safeguards in any nuclear power deal with Saudi

Arabia that might come as part of a potential normalization of relations agreement brokered by Washington between the kingdom and Israel. The Biden administration has been talking with Saudi

Arabia and Israel on a potential peace agreement since before the Oct. 7 deadly attacks by Hamas on Israel and talks have continued during the Israeli war on the militant group in Gaza.

An agreement to help develop nuclear power in Saudi Arabia could benefit the U.S. nuclear industry which would supply technology. Senator Edward Markey, a longtime

advocate for nonproliferation safeguards, said in a letter to fellow Democrat Biden that Saudi Arabia, “a nation with a terrible human rights record”, cannot be trusted to use its nuclear program purely for peaceful purposes and will seek to develop nuclear weapons. Markey and other Democrats are critics of the country and its de facto ruler, Crown Prince Mohammed bin Salman, over human rights, his intervention in Yemen’s civil war and the murder of Washington Post columnist Jamal Khashoggi that U.S. spy agencies assessed was ordered by the prince.

The prince has said for years the kingdom will develop nuclear weapons if regional rival Iran does. “I urge your Administration to ensure that the path towards Middle East peace holds Saudi Arabia accountable for its appalling human rights practices and constrains its ability to become a nuclear power,” Markey said in a letter to Biden and other officials.

The Saudi embassy in Washington did not immediately respond to a request for comment. The letter, first reported by Reuters, urges the administration to adopt so-called “gold standard” nonproliferation safeguards, based on the 123 agreement in U.S. nuclear energy law that prohibit uranium enrichment and nuclear reprocessing, two pathways to nuclear weapons. The UAE agreed to these safeguards when it built a nuclear plant in 2021. Markey also urged the administration to insist that Saudi Arabia also be held to the “additional protocol” standards of the

U.N.’s nuclear watchdog, the International Atomic Energy Agency, which requires monitoring and inspections.

Time is growing short for the Biden administration to shepherd a U.S.-Saudi civil nuclear agreement and defense pact through the congressional approval process as lawmakers focus on campaigning ahead of the Nov. 5 elections.

relations with Israel. Perhaps most critically, Saudi Arabia has called for an immediate truce leading to a permanent and sustainable ceasefire in Israel’s war against Hamas and the establishment of an independent Palestinian state, both of which Israeli Prime Minister Benjamin Netanyahu has rejected. Time is growing short for the Biden administration to shepherd a U.S.-Saudi civil nuclear agreement and defense pact through the congressional approval process as lawmakers focus on campaigning ahead of the Nov. 5 elections.

The White House’s national security council did not immediately respond to a request for comment. Some experts question whether the timing and political circumstances will allow a U.S.-Saudi deal that leads to Riyadh normalizing

FEM A is seeking the public’s comments on the proposed plan change to replace sirens with wireless emergency alerts via cellular phones as the primary alert and notification system. This drill will test the government’s ability to alert and notify the public with the new system in the event of an emergency at the Susquehanna Steam Electric Station,

Source: <https://whtc.com/2024/05/01/us-senator-urges-biden-to-include-safeguards-in-any-nuclear-power-deal-with-saudi-arabia/>, 01 May 2024.

USA

Changes Proposed to Pennsylvania’s Nuclear Emergency Alert System

The Department of Homeland Security, along with the Federal Emergency Management Agency (FEMA), will host a meeting to hear public input regarding proposed changes to Pennsylvania’s alert and notification system for nuclear power plant emergencies.

According to FEMA, they plan on making significant changes to the Commonwealth of Pennsylvania’s alert and notification system for nuclear power plant emergencies within the Susquehanna Steam Electric Station emergency planning zone. “FEMA is seeking the public’s comments on the proposed plan change to replace sirens with wireless emergency alerts via cellular phones as the

primary alert and notification system. This drill will test the government's ability to alert and notify the public with the new system in the event of an emergency at the Susquehanna Steam Electric Station," MaryAnn Tierney, Regional Administrator for FEMA Region 3 said. "We will assess the plan changes that replace the sirens with wireless emergency alerts received through cellular phones within the emergency planning zone of the Susquehanna Steam Electric Station."

FEMA will be conducting an exercise to evaluate the new system on Thursday, May 9. The agency will then use the results of this exercise to make its decision on approving the significant plan change. FEMA will be seeking public comment from members of the public on Friday, May 10 at 10:00 a.m. to present their preliminary findings from the exercise. The meeting will be held at the Talen Energy East Mountain Business Center on 1190 East Mountain Boulevard, in Wilkes-Barre. For the public meeting, FEMA requests that questions or comments be submitted for review and response.

FEMA says it created the new Radiological Emergency Preparedness (REP) Program for the following reasons:

- To ensure the health and safety of citizens living around commercial nuclear power plants would be adequately protected in the event of a nuclear power plant accident.
- To inform and educate the public about radiological emergency preparedness.

REP Program responsibilities only cover "offsite" activities, which is state and local government emergency planning and preparedness activities that take place beyond the nuclear power plant. On-site activities still continue to be the responsibility for the NRC.

Source: <https://www.mytwintiers.com/news-cat/pennsylvania-news/changes-proposed-to-pennsylvanias-nuclear-emergency-alert-system/>, 01 May 2024.

NUCLEAR WASTE MANAGEMENT**BELARUS****Belarus' Energy Ministry Comments on Progress to Select Site for Radioactive Waste Storage Facility**

Belarusian Deputy Energy Minister Denis Moroz told a youth forum of OAO Belenergoremnaladka about the progress made in the selection of a site for a radioactive waste storage facility, BelTA learned from the press service of the Energy Ministry. According to the deputy minister, the government has set up a state commission to select a site for a radioactive waste storage facility. It should make a decision and submit materials for public discussions before the end of the year. "The relevant research has been carried out across all regions of the country," Denis Moroz said. He emphasized that the work took economic, social and environmental aspects into account. "Among 118 districts, four sites have been selected for further in-depth studies. The work continues. The final selection of the site, its design and construction require a very careful approach," Denis Moroz said.

The forum took place in the format of a dialogue platform in Minsk on 3 May. The role of young people in the development of the power engineering industry was discussed during the forum as well as opportunities for advanced training and career enhancement for young specialists, new areas of work and the spheres of activity where initiatives of young people enjoy the strongest demand. The forum also touched upon matters of importance for energy industry professionals such as making sure the power grid operates steadily, the operation of the Belarusian nuclear power plant, the main ways of power consumption, prospects of development of electric transport in the country, the modernization of power distribution grids, the management of radioactive waste, and the introduction of innovative technologies.

Source: <https://eng.belta.by/economics/view/belarus-energy-ministry-comments-on-progress-to-select-site-for-radioactive-waste-storage-facility-158035-2024/>, 04 May 2024.

CANADA

Municipality of South Bruce Signs Hosting Agreement with the Nuclear Waste Management Organization

The Municipality of South Bruce Council endorsed the Hosting Agreement between the Municipality and the Nuclear Waste Management Organization (NWMO) at its meeting May 1, 2024. Mayor Mark Goetz and CAO Leanne Martin signed the agreement on behalf of the Municipality following the vote on Wednesday evening. This Hosting Agreement maps out what happens if South Bruce decides it is a willing host, and it is selected for the NWMO Project to manage Canada’s nuclear waste. It also sets out how South Bruce would exit the process if it is not a willing host, or if it is willing to host but not selected by the NWMO. “Throughout the process, Council has focused on ensuring the Project would meet our community’s shared principles,” said Mayor Goetz. “This agreement represents our best efforts to do that. It will help people better understand what the Project could mean for South Bruce and help them make an informed decision in the referendum.”

“The Municipality of South Bruce and NWMO have co-created an agreement that is community-focused, building on South Bruce’s strong foundations and envisioning future possibilities,” said Lise Morton, Vice-President of Site Selection at the NWMO. “In preparation for the referendum, we encourage everyone to read the agreement and consider the benefits and impacts—including foundational investments and the creation of good jobs now and in the future.” The signed Hosting Agreement between the Municipality and the NWMO is an important milestone before the community decides if it is

This Hosting Agreement maps out what happens if South Bruce decides it is a willing host, and it is selected for the NWMO Project to manage Canada’s nuclear waste. It also sets out how South Bruce would exit the process if it is not a willing host, or if it is willing to host but not selected by the NWMO.

The signed Hosting Agreement between the Municipality and the NWMO is an important milestone before the community decides if it is willing. It provides voters with a clear map of how the community’s 36 Guiding Principles, which reflect its priorities, will be addressed. These cover health and environmental protection, community benefits and an ongoing voice in the Project.

willing. It provides voters with a clear map of how the community’s 36 Guiding Principles, which reflect its priorities, will be addressed. These cover health and environmental protection, community benefits and an ongoing voice in the Project. The Municipality of South Bruce also understands and respects that Saugeen First Nation and the Chippewas of Nawash Unceded First Nation have their own discussions with the NWMO regarding the Project and will express their willingness decision in their own way.

Source: <https://saugeentimes.com/municipality-of-south-bruce-signs-hosting-agreement-with-the-nuclear-waste-management-organization/>, 03 May 2024.

JAPAN

Government Asks Genkai Mayor to Accept Site Survey to Host Nuclear Waste

Industry minister Ken Saito has asked the mayor of the town of Genkai in Saga Prefecture to accept a so-called literature survey, as part of the process for selecting a final disposal site for high-level radioactive waste from nuclear plants Saito sought understanding from Genkai Mayor Shintaro Wakiyama at a meeting in Tokyo on Tuesday, saying that “the literature survey is not directly connected to the selection.”

Last month, the Genkai town assembly approved a petition submitted by local business groups asking for the literature survey request to be accepted. “I’m torn between the town assembly’s decision and my thinking,” Wakiyama told reporters after the meeting with Saito. The mayor said that he will make a decision by the end of this month. A literature survey is the first of three stages in the

selection process for disposal sites, and involves the condition of geological strata being examined on paper, based on maps and other data. So far, a literature survey has been accepted only by the town of Suttsu and the village of Kamoenai, both in Hokkaido. For a literature survey to be conducted, a local government must apply for or accept a central government request.

Source: <https://www.japantimes.co.jp/news/2024/05/08/japan/government-asks-town-to->

The mayor said that he will make a decision by the end of this month. A literature survey is the first of three stages in the selection process for disposal sites, and involves the condition of geological strata being examined on paper, based on maps and other data. So far, a literature survey has been accepted only by the town of Suttsu and the village of Kamoenai, both in Hokkaido.

accept-nuclear-waste-site-survey/, 08 May 2024.

Editorial Team: Dr Sitakanta Mishra, Javed Alam, Dr. Ngangom Dhruba Tara Singh, Rishika Singh, Ritika Mourya.

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.



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 Vice Marshal Anil Golani (Retd).

Centre for Air Power Studies

P-284

Arjan Path, Subroto Park,

New Delhi - 110010

Tel.: +91 - 11 - 25699131/32

Fax: +91 - 11 - 25682533

Email: capsnetdroff@gmail.com

Website: www.capsindia.org

Edited by: Director General, CAPS

Editorial Team : Dr. Sitakanta Mishra, Dr. Ngangom Dhruba Tara Singh, Rishika Singh, Ritika Mourya, Javed Alam,

Composed by: CAPS

Disclaimer: Information and data included in this newsletter is for educational non-commercial purposes only and has been carefully adapted, excerpted or edited from sources deemed reliable and accurate at the time of preparation. The Centre does not accept any liability for error therein. All copyrighted material belongs to respective owners and is provided only for purposes of wider dissemination.