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OPINION – Manpreet Sethi

Acceptance of No First Use (NFU) by USA: Hope Redux?

In an interesting development on 15 April 2021, two Democrat members, one from each house of the US Congress, re-introduced the NFU Act. The bill proposes that the United States would not use nuclear weapons as a means of warfare first. This is expected to help in reducing the risk of miscalculation or misunderstanding by an adversary during a crisis that could lead to nuclear use—strengthening deterrence and increasing strategic stability by a clear declaratory policy and preserving the US second-strike capability to retaliate against any nuclear attack on the US or its allies.

Hurdles Ahead: Domestic Politics, Allies, and Adversaries: The presentation of this Act refocuses attention on the possibility of adoption of ‘No First Use’ by the US.

Though it would be naïve to expect quick action, hope is kindled by a few aspects. The first, of course, is President Joe Biden’s expressed personal conviction in this policy. As Vice President, and later during his presidential campaign, Biden has supported reduction in the role of nuclear weapons. NFU could be a meaningful step in this direction. Also, from past experience, Biden understands the stumbling blocks to acceptance

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of NFU at home and amongst US allies. Therefore, he can be expected to address these concerns and rally enough support before making a public pitch for a change in US policy.

A second development that could work in favour of NFU is a heightened sense of nuclear risks, especially in case of an inadvertent escalation as major power relations remain fraught, offence-defence spiral unspools, and unregulated new technologies emerge. There is greater recognition of the fact that an incident

of nuclear use, if triggered by the uncomfortable US-Russia/US-China relations, would possibly occur on the soil of US allies. This should prompt allies to support measures that obviate chances

of deterrence breakdown. NFU could be beneficial in this respect by alleviating the adversary's sense of insecurity about an imminent nuclear strike that would deter its own first use. By mitigating the 'use or lose' pressure, NFU lessens crisis instability. The case for NFU would be further strengthened if the US could convince its allies of its continued commitment to extended deterrence through conventional means. It certainly has this capability and its use should carry greater credibility, as compared to nuclear use, since breaking the norm of non-use of nuclear weapons can never be expected to be easy.

NFU could be beneficial in this respect by alleviating the adversary's sense of insecurity about an imminent nuclear strike that would deter its own first use. By mitigating the 'use or lose' pressure, NFU lessens crisis instability. The case for NFU would be further strengthened if the US could convince its allies of its continued commitment to extended deterrence through conventional means.

Besides allies, adversaries too weaken the case for the acceptance of NFU by dismissing it as a meaningless declaratory statement. When the Soviet Union had proclaimed NFU between 1983-1992, the US had scoffed at it for its unverifiability and lack of credibility. China and India's NFUs are also similarly treated by their adversaries. However, despite NFU being a unilateral, unverifiable statement, the seriousness of commitment can be seen in a country's force structure and force posture. The choice of weapons and delivery systems, as well as the kind of alertness at which they are maintained, gives evidence of that assurance.

In real-life scenarios, a show of preparedness for nuclear attack has often been used for coercion. It is worth remembering that despite umpteen examples of such show, nuclear use has never happened since 1945. This is because of the myriad dilemmas posed by a first use strategy.

Futility of First Use: To further drive home the case for NFU, it is also imperative to showcase the futility of first use. Traditionally, nuclear first use has been considered a viable deterrence strategy for countries that are conventionally weaker than their adversary, and hence, face an existential threat. But we forget that China, despite being conventionally weaker than the US—and similarly with India against China—both have declared NFU strategies. The reason for this lies not in

conventional weakness or strength but in understanding the futility of nuclear first use when the first user confronts the prospect of assured nuclear retaliation. In such a case, using a nuclear weapon would only compound 'temporary' conventional defeat into long-lasting nuclear damage.

Another circumstance for inevitability of first use is when a country is staring at an impending nuclear strike. However, in real-life scenarios, a show of preparedness for nuclear attack has often been used for coercion. It is worth

remembering that despite umpteen examples of such show, nuclear use has never happened since 1945. This is because of the myriad dilemmas posed by a first use strategy. Amongst the questions a nuclear first user must answer is when to use the weapon in conflict—early or late, where to target, counterforce or countervalue or both—and how to obviate nuclear retaliation?

Credible first use demands a pretty demanding slew of capabilities—a large arsenal of accurate missiles with real-time navigational aids to ensure high precision; MIRVed missiles to carry out multiple hits; sophisticated ISR for meaningful targeting; elaborate and delegated command and control to enable

simultaneous attacks; and highly capable active and passive defences to handle nuclear retaliation. None of this comes easy or cheap. And yet, despite the costly investment, there can be no guarantee of no retaliation. What then can be the military utility of first use?

The Cuban Missile Crisis showed that despite US nuclear preponderance and existence of an elaborate targeting strategy to use nuclear

weapons first, President Kennedy could not be assured by his generals that there would be no Soviet nuclear retaliation. So, despite having a first use strategy and capability, such use was found to be militarily useless, even dangerous. By contrast, nuclear retaliation is far more justifiable, and hence, more credible.

Disarmament purists do not appreciate the NFU since it allows nations to retain nuclear weapons and only seeks their non-use. However, given the contemporary reality where nations place a high value on nuclear weapons and are unwilling to discard them, NFU can provide a useful way-station. It allows nations to maintain a notional sense of security from their nuclear weapons, but significantly reduces possibilities of use.

An acceptance of NFU in the US, after adequate consultations with US allies, followed by visible force posture changes that stand down alert levels and offer other adjustments to the arsenal could change the prevailing atmosphere of nuclear mistrust. It is also likely to evince a response from China and India, who anyway profess NFU. China might also be able to rope in its friend and partner, Russia. The UK and France may be persuaded by the US. Pakistan and North Korea would have reservations and may hesitate to join in immediately. However, as the norm of NFU becomes stronger over time, Pakistan may like to join the club to showcase its responsible behaviour. Progress in negotiations with North Korea could get it to join too. This may need some security assurances, which may become possible as a cycle of positives is generated by majority of states accepting NFU.

Finally, to make NFU appealing, nations need to understand the current gravity of nuclear risks, the futility of first use strategies and their inability to achieve any worthwhile political objective in the face of an adversary's assured second-strike capabilities. Accepting NFU could ease arsenal

burdens, reduce crisis instabilities and the concomitant risk of inadvertent escalation, invoke greater political positivity, and thereby, reduce the overall salience of nuclear weapons. All of this would be conducive for national and international security.

Source: <https://www.orfonline.org/expert-speak/acceptance-of-no-first-use-nfu-by-usa-hope-redux/>, 15 May 2021.

OPINION – Antoine Levesques

India, Pakistan Need to Prioritise Nuclear Stability

Open government assessments of the state of India-Pakistan deterrence are rare. A recent US intelligence overview considered a 'general war' between the two countries 'unlikely', although

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'heightened tensions' remain a 'concern for the world', raising the risk of 'conflict between the two nuclear-armed neighbours'.

While awaiting the first major statement on South Asia by US President Joe Biden's administration, the words of the previous administration's Secretary of Defence, spoken last July, are still relevant. I had asked specifically about the nuclear and crisis stability. The six-sentence answer repeated three times that the matter was under close US observation. On short-term prospects for escalation, the statement was categorical: 'I don't see any indications right now that's happening at all'.

Ten months on, there is indeed no imminent crisis. Since February, there are even signs and reports of decreased, rather than increased tensions. Yet today, a new analysis published by the IISS provides comprehensive evidence of the persistence of major unresolved sources of instability at the heart of the India-Pakistan nuclear deterrence relationship, 23 years after they overtly tested nuclear weapons. There exist grave deficiencies

and asymmetries in the nuclear doctrines of India and Pakistan, which are compounded by mutual disbelief, existing and emerging military capabilities, and the prolonged absence of related dialogue mechanisms.

There is no indisputable yardstick to judge a nuclear doctrine. Yet a universal perspective is possible: with nuclear weapons, necessity and proportionality, as cornerstones of the laws of war and civilised conduct outweigh claims of regional or cultural exceptionalism. Moreover, nuclear doctrines, while not immutable, are designed to last. They carry weight and deserve respect.

Strategic instability is to be expected, especially when there is a large size differential between two nuclear-armed countries, as is the case between India and Pakistan. Conversely, striving for strategic stability is good for avoiding war. But this has no single end-state and requires careful attention, one new weapon system at a time. Seeking an edge over the opponent is more dangerous when official statements show peace is fragile and rhetoric is high during moments of tension. In the specific case of nuclear doctrines of India and Pakistan, textual analysis finds these are not symmetrical. Most worryingly, neither side believes the other side's core tenets. Doctrines suggest a scenario in which both sides could use nuclear weapons disproportionately. Meanwhile, that India's no-first-use commitment is a bedrock of its policy is not in doubt.

Capabilities-wise, in conventional weaponry, neither side has a qualitative edge, even if India outdoes Pakistan by every measure of quantity. Based on numbers of nuclear warheads only, the growing arsenal sizes of both are broadly equal as far as can be determined. India and Pakistan

claim to already possess sufficient weapons to ensure a robust, largely stable mutual nuclear deterrence. Both have a fledgling capability to mobilise enough nuclear weapons to strike back after being struck. But neither can yet launch a first strike against the other's military with any assurance of success. Each is developing new missile types in addition to India's seven and Pakistan's nine nuclear-capable missile designations in service.

Apart from the high cost of the arms race in the post-pandemic era, nuclear expansion casts doubt on their stated policies of having minimally-sized nuclear arsenals.

Beyond, India and Pakistan seek relevant technologies and capabilities in the naval or space domains. Sober analysis can identify which threshold capabilities may or may not become actual military options. But the strategic whole is arguably greater than the sum of the parts: India and Pakistan may continue to dangerously undermine each other's defence under the nuclear threshold and this could further affect future crisis stability negatively.

Meanwhile, crisis triggers persist. In February 2019, tensions saw India and

Pakistan make unprecedented use of airpower in each other's territory. The uncomfortable truth is that, based on what is known, chance played an ameliorative role in this episode. Whichever the lessons learnt from past crises, India and Pakistan are in uncharted territory requiring enlightened judgement. The diagnosis is incomplete without considering the manifest fatigue in both capitals about CBMs. Over a dozen past agreements remain in place, an often unsung achievement. But CBMs have in-built limitations and a chequered history in South Asia. Not one has been adopted in the prolonged diplomatic lost decade

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since the 2008 Mumbai attacks. Yet enabled by top-level political will, CBMs can lay a foundation upon which trust can grow.

Overall, these many challenges to nuclear deterrence stability do not mean that the proverbial next crisis between India and Pakistan, one major terrorist attack away, will necessarily hit the nuclear threshold.

But they make it more likely that the situation may come close to it. India and Pakistan could stumble into using their nuclear weapons through miscalculation or misinterpretation.

The stakes keep rising. A nuclear exchange would have catastrophic consequences for the two countries, including appalling ones for human security. Economically, even compared to the cost of the Covid-19 pandemic (both countries' worst post-independence economic shock), the damage from nuclear use would likely be several times higher. For onlookers, the use of a nuclear weapon for anything else than the tallest order of national interest — to ensure survival of the state — would be entirely unacceptable because the effects would be multidimensional and uncontrollable, well beyond the breach of a norm in place since 1945. Among others, the hit to the global economy would be severe and systemic.

The UK, during the 2001-02 tensions, conservatively estimated at £20 billion the hit to its economy from a nuclear use in South Asia. In today's currency and context, this figure alone might translate into nearly two-thirds of what that country is spending, supporting individuals and families in the pandemic.

... Growing consensus on seeing Asia through the Indo-Pacific lens is also reshaping the matter. China's evolving profile as a nuclear-weapons state compounds India's security challenges. But control over the drivers of the India-Pakistan nuclear deterrence and stability equation remains

almost entirely in the hands of leaders in New Delhi and Islamabad. Yet implications for crisis management are unclear.

With such facts and many more, this situation and its policy implications become more widely accessible. For its part, the report concludes neither India nor Pakistan can afford to be complacent. Only they can choose to creatively overcome the challenges to nuclear deterrence stability. To this end, the study proposes 15 measures India and Pakistan's leaderships can choose from to prioritise nuclear stability, without conceding that each can deter the other; that nuclear weapons are instruments of last resort, and mutual vulnerability can be a factor of stability.

Source: <https://www.tribuneindia.com/news/comment/india-pakistan-need-to-prioritise-nuclear-stability-255427>, 20 May 2021.

OPINION – Arvind Kumar, Monish Tourangbam

India Needs to Revisit its Nuclear Doctrine

India had no option left but to go nuclear and conduct a number of nuclear tests including thermonuclear device on 11 and 13 May 1998—the so called Pokharan II. There is no denying the fact that it was a geopolitical necessity because of growing Sino-Pakistan nexus and the lack of genuine commitment shown by acknowledged nuclear weapons states towards achieving a nuclear weapons free world. India understands it very well that its national security interests would be best served in a nuclear weapons free world. But there is a lack of consistency between the rhetoric and action on part of the acknowledged nuclear weapons states (US, Russia, UK, France and China) in adhering to the commitments made in Article VI of the NPT.

Instead of getting the role of nuclear weapons de-emphasised, the salience of the nuclear

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weapons got increased especially when one does the assessment on the nuclear strategy of nuclear weapons states. On the one hand these nuclear weapons states, more particularly the United States and Russia, tell the world that they are moving on the path of reducing their nuclear warheads, but in reality these two countries have been showing signs of putting more reliance on nuclear weapons—hence, nuclear weapons are here to stay. Even though the Cold War got over and the world witnessed the demise of the Soviet Union, the nuclear weapons which were deployed during the Cold War years are still on hair-trigger alert.

In practical sense, India had become frustrated because its voice was not heard at the United Nations whenever India proposed the means to achieve nuclear disarmament. India's contributions in terms of ideas, resolutions and action plans to achieve a nuclear weapons free world at the United Nations was not given due attention by the United States and Russia in particular. They became the champion of vertical proliferation. China became a pioneer of horizontal proliferation by providing nuclear technology to Pakistan. India's credentials remain very high because it has neither promoted vertical nor horizontal proliferation. Despite being a non-signatory to the NPT, it has followed all the provisions of the treaty guidelines.

India never defied any international law and principles and found the nuclear tests a good bet for conveying message to its adversaries. India also understood the predicament of the regional security environment. The acquisition of nuclear weapons by India is purely for the purpose of deterrence. India is the only country across the

globe which had put its nuclear doctrine in draft form for public debate and discussion. The response from the West in general and the US in particular on India's draft nuclear doctrine was highly critical although very interesting.

China became a pioneer of horizontal proliferation by providing nuclear technology to Pakistan. India's credentials remain very high because it has neither promoted vertical nor horizontal proliferation. Despite being a non-signatory to the NPT, it has followed all the provisions of the treaty guidelines.

India stated in clear terms about its "no first use" intent where it articulated that it would not be the first one to use nuclear weapons against NWS and the non-use of nuclear weapons against NNWS. The perception built by the NWS about the status of India whether it is an NWS or

NNWS was dictated by the NPT definition that those countries which have tested their nuclear device after 1 January 1967 are only acknowledged de jure NWS. China, somehow, has taken this very seriously and still puts India as NNWS despite for all practical purposes it is an NWS. The US understood India's potential and openly recognised it as a responsible nuclear player because it has not proliferated. The notion of India as a responsible nuclear power led the US to accept India as a de facto nuclear weapons state. The US accepted India's Separation Plan

where India has segregated both its civil nuclear and military facilities. This unique recognition of India by the US has elevated India's position across the spectrum.

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capability". It has obviously left to speculation as to how much minimum would be minimum. It must be emphasised here that the minimum number of nuclear warheads required for India would be relative. India requires to deal with two of the nuclear weapons states in its immediate neighbourhood. The West and the US have been trying their best to find the numbers. No sensible country will ever divulge the details of numbers

required when they have limited capability. Both the US and Russia shrouded everything in secrecy about their numbers and when they achieved everything in plenty, they slowly and steadily started giving the information in public domain.

India will have to be guarded on this and at the same time it has conveyed the message to the rest of the world that it is not interested in any nuclear arms race. It will keep its inventory at the minimum level. India has committed itself to retaliate in much greater force in the event of an attack by an adversary. India's notion of massive retaliation is to inflict sufficient damage to its adversary so that the question of a third strike does not arise.

India has also articulated that it will have a "triad" capability, which means it will have sufficient land-based, air-based and sea-based assets. The emphasis given on the acquisition of nuclear powered submarine tipped with sea launched ballistic missile all these years has boosted India's nuclear deterrent capability. Since India has "no first use policy", hence it should have a robust second-strike capability. In case of any eventuality, both land-based and air-based assets remain highly vulnerable and hence it is perhaps the sea-based assets which could complement India's no first use policy. The integration of "Arihant" with "K-15 Sagarika" is a sign of reflecting its preparedness in the case of any attack by its adversary.

India's nuclear doctrine has also spoken about a robust "command and control" system, which perhaps remains the key and will always remain under civilian control. Even in the nuclear doctrine, India has argued the need to have complete elimination of nuclear weapons from the world. India has shown its commitment to nuclear disarmament.

India's nuclear doctrine since its formalisation in 2003 has not changed any of its stated position

except that it added that India will retaliate with the use of nuclear weapons if it is attacked by chemical or biological weapons. It remains largely rhetoric because it would be too difficult for India to find the origin of attack in case these chemical or biological weapons are used. Right now, India is, undoubtedly, a victim of biological warfare. The pandemic has been continuing with dire consequences for India. There is an urgent need to figure out the origin of the use of biological weapons and obviously take stern measure to deal with its adversary.

It would be in India's interest to review and revisit its nuclear doctrine and see how there can be changes in some of the stipulations made. From time to time, the discussion on changing its "no-

It would be in India's interest to review and revisit its nuclear doctrine and see how there can be changes in some of the stipulations made. From time to time, the discussion on changing its "no-first use" stance to "first use" of nuclear weapons have taken place, but it seems that "no-first use" in the context of India has given more dividends.

first use" stance to "first use" of nuclear weapons have taken place, but it seems that "no-first use" in the context of India has given more dividends. Nuclear weapons for India will strictly remain for deterrent purposes. India will not get influenced by the changes occurring among the NWS about their

intentions, motivation, fundamental goals and how they keep relying on the role of nuclear weapons in their strategy.

Source: <https://www.sundayguardianlive.com/opinion/india-needs-revisit-nuclear-doctrine-2>, 15 May 2021.

OPINION – Tarja Cronberg

For Survival, the NPT has to be Renegotiated

The NPT has long been an arena for tension and debate on deterrence, non-proliferation and nuclear disarmament. Throughout its 50-year history, disarmament has typically been side-lined while nuclear-weapon states have pressed for greater restrictions to prevent proliferation.

The NPT has been in a crisis for a long time, protected as the only treaty regulating non-

proliferation and the nuclear order. Today this is challenged by a competing treaty, the Treaty on the Prohibition of Nuclear Weapons (TPNW). Following its entry into force in January 2021, frustrations are now open, with nuclear-weapon possessors aggressively opposing it, some even advocating for ratification withdrawal. But there are also deeper, more hidden threats to the NPT's survival.

The three pillars, non-proliferation, disarmament and peaceful uses, often seen as holding up the NPT, are also on rocky ground. Christopher Ford, former US Assistant Secretary on International Security and Non-proliferation, recently declared that the "three pillars" were in no way intrinsic to the treaty or part of its original understanding.

In my book "Renegotiating the Nuclear Order", I argue, based on three factors –a shaky foundation, distorted balance, and proliferation models– that the NPT requires modernisation to adapt to today's challenges. As it cannot be reformed, as each of the five nuclear-weapon states having a veto right, it must be renegotiated.

A Withering Foundation: According to the "grand bargain" understanding, nuclear-weapon states committed to nuclear disarmament and non-nuclear-weapon states, in turn, to not acquire nuclear weapons. Abstinence was traded for disarmament. Some fifty years later, historical documents on the initial negotiations have now been released, resetting this understanding. According to Roland Popp, the description of the NPT as a "bargain" emerged only in the sales pitch after its agreement in 1968. US officials delivered several public speeches to get non-nuclear states to sign the treaty "by pretending ex post facto that the non-nuclear states had played a dominant part through the actual negotiation of this treaty".

One misleading truth, according to Ford, is non-nuclear states' understanding that the three pillars are equal. The nuclear weapon states, in turn, believe that non-proliferation is the ultimate goal of the treaty. The two other pillars are "no pillars at all" but, instead, are subordinate clauses to the non-proliferation pillar.

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on International Security and Non-proliferation, recently declared that the "three pillars" were in no way intrinsic to the treaty or part of its original understanding. According to Ford, in 1984, the US proposed that the 1985 Review Conference be subdivided into three committees: non-proliferation and safeguards, peaceful uses, and disarmament. At the Review Conference ten years later, these were first referred to as the "three pillars" of the NPT. Ford underlines that this phrasing did not represent a doctrinal conclusion about the security architecture of the NPT.

The three-pillar understanding "has helped lead subsequent generations to forget important truths they need to remember if the non-proliferation regime is to thrive or even to survive." One misleading truth, according to Ford, is non-nuclear states' understanding that the three pillars are equal. The nuclear weapon states, in turn, believe that non-proliferation is the ultimate goal of the treaty. The two other pillars are "no pillars at all" but, instead, are subordinate clauses to the non-proliferation pillar.

A Distorted Balance: In 1965 a UN resolution defined goals for the NPT to require, among other things, "an acceptable balance of mutual responsibilities and obligations for the nuclear and non-nuclear powers." This balance included a temporary right for five states to maintain nuclear weapons, balanced by the "inalienable" right of non-nuclear states to explore peaceful uses, with the exception of nuclear explosions.

In the 50 years since the NPT's entry into force, nuclear-weapon states have transformed their temporary right into a permanent one. In early negotiations, non-nuclear states accepted the so-

called "Gromyko umbrella", believing that if "nuclear super-powers retain[ed] a certain, although strictly reduced, nuclear deterrent force throughout the disarmament process. [...] their mutual security would be safeguarded, which in turn [would] make them more ready to embark on a course of disarmament."

In the same period, the "inalienable" rights of non-nuclear states grew more and more limited. Restrictions now prohibit both uranium enrichment and plutonium reprocessing, and autonomous control of fuel cycles are not accepted by all, serving as a constant conflict feature in non-proliferation negotiations. Control functions, while no doubt providing security benefits for the world, have gradually increased for abstaining states. At the same time, there is no obligatory control of nuclear states' military or civilian use of nuclear technology. Even the right to withdraw from the NPT is being debated and seen as a "loophole". In sum, while restrictions may be motivated by the reduction of nuclear risk, these have targeted non-nuclear-weapon states only. At the same time, nuclear-weapon states have transformed their temporary right to a permanent one while disregarding their commitment to disarm.

A Comprehensive Approach? Horizontal proliferation was the theme of the 60s: New states should not acquire nuclear weapons. The main threat today is related to vertical proliferation: proliferation by nuclear-weapon states. Such proliferation takes place under the euphemism of

Horizontal proliferation was the theme of the 60s: New states should not acquire nuclear weapons. The main threat today is related to vertical proliferation: proliferation by nuclear-weapon states. Such proliferation takes place under the euphemism of "modernisation", covering a number of activities ranging from the maintenance of existing arsenals to developing completely new nuclear weapon systems. There are no restrictions on vertical nuclear proliferation.

"modernisation", covering a number of activities ranging from the maintenance of existing arsenals to developing completely new nuclear weapon systems. There are no restrictions on vertical nuclear proliferation. Nuclear weapons states (and even the four states outside the NPT) are free to do what they like as their military facilities are outside any control activities but their own. Horizontal proliferation, by contrast, is managed by a number of restrictions, such as uranium enrichment and plutonium reprocessing.

While details of modernisation activities are not necessarily known, there are cost estimates that imply huge investments in the coming years. The best-known assessment comes from the US, where the 30-year cost of the programs under the nuclear modernisation umbrella – including new nuclear-capable bombers, land-based nuclear missiles, and nuclear submarines – has been estimated at \$1.2 to \$1.7 trillion. This exorbitant sum represents only the costs of the US programs. Significantly, as both China and Russia are expected to follow the US, we have in front of us a new arms race.

A non-proliferation treaty worth the name cannot ignore vertical proliferation, which currently is the arena for an arms race. Nor can it ignore in the coming years the risks of proliferation by non-state actors. A comprehensive non-proliferation treaty should include three pillars: horizontal proliferation, vertical proliferation, and proliferation by non-state actors.

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Conclusion: Non-proliferation is the *raison d'être* of the NPT. Demanding progress on disarmament has already moved outside the NPT-frame as the TPNW has entered into force. Furthermore, seeking abstinence at the same time as enabling deterrence creates inequality at the heart of the NPT. The challenge is to separate non-proliferation and disarmament and the respective treaties. A constructive separation, where a renegotiated NPT integrates current threats to non-proliferation, is an alternative approach to better managing the nuclear order.

Source: <https://www.europeanleadershipnetwork.org/commentary/for-survival-the-npt-has-to-be-renegotiated/>, 14 May 2021.

OPINION – John Garamendi

The Stakes couldn't be Higher as Biden Prepares his Nuclear Posture Review

This year, America's long debated nuclear weapons modernization has reached a critical juncture as the Biden administration develops its nuclear posture strategy. Right now, the global trip wire is incredibly taut. The world is witnessing a new nuclear arms race as Russia and China undertake comprehensive modernization efforts simultaneously with the United States. Alarming, these dynamics greatly increase the risk of miscalculation and conflict. While there is a critical need to maintain a safe, secure, and effective nuclear deterrent system, aspects of current modernization plans are extraneous and unnecessary to maintain a capable deterrent to protect the United States and its allies from a nuclear attack in the foreseeable future.

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As chairman of the Armed Services Subcommittee on Readiness, I have studied this issue at length and worked with key personnel responsible for executing U.S. nuclear modernization efforts. This work has shown me that the risk for nuclear conflict is the greatest it has been in over three decades. After visiting the Francis E. Warren Air Force Base in Wyoming last week, the launching site for America's nuclear bomb caring Minuteman III ICBM, I am more convinced than ever

that we must have a serious and thoughtful discussion on our nation's nuclear modernization plans.

Precipitous advances in nuclear weapons by the great powers have led each nation to view each other with concern, and advances in nuclear weapons are being complemented by rapid developments in conventional, cyber, and space capabilities by all sides. As the United States works to outdistance competing nations' modernization efforts, it has risked transforming its modernization strategy into one that is predicated on dominance instead of deterrence. This creates an incredibly dangerous geopolitical

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dynamic that provides fodder for a modern nuclear arms race. The actions by previous administrations have led us down this path, and today our current nuclear arsenal exceeds our deterrence requirement. This trend will only be exacerbated if we proceed with the planned modernizations programs.

In addition to undermining global strategic stability, the United States' current modernization strategy has caused the cost of our nuclear weapons programs to balloon. Estimates by the Government Accountability Office (GAO) state that America's current nuclear modernization

program will cost at least \$634 billion from 2021-2030, \$140 billion more than previous estimates. The GAO also noted that the current plan to modernize every part of the U.S. nuclear arsenal simultaneously is a recipe for schedule delays. We also have reason to believe it will lead to costly overruns.

Supporters of the current modernization approach tell us that the only choice is proceed full steam ahead with the current modernization plans or allow our arsenal to rust into obsolescence. This is a false choice. There are several straight-forward actions we could take this year to address these unnecessary and unmanageable programs. For instance, the Minuteman III ICBM

The Minuteman III ICBM program could be life-extended and its planned replacement, the Ground Based Strategic Deterrent (GBSD), could be paused. Air Force leadership has previously confirmed that an extension to the Minuteman III is possible before a new missile is needed. This single commonsense step would cost billions less than developing and deploying the GBSD through 2036.

program could be life-extended and its planned replacement, the Ground Based Strategic Deterrent (GBSD), could be paused. Air Force leadership has previously confirmed that an extension to the Minuteman III is possible before a new missile is needed. This single commonsense step would cost billions less than developing and deploying the GBSD through 2036. There are scores of adjustments like this that we can make to our modernization strategy that would save billions of dollars that could be better spent on priority defense needs, such as maintaining America's conventional military edge over its adversaries.

Arms Control negotiations are imperative, and the good news for America and the world is that President Biden wants to chart a new course. In March, the interim National Security Strategic Guidance called for a reduced role of nuclear weapons in our national security strategy, and to re-establish the U.S. as a leader in arms control. Additionally, President Biden extended the New START treaty for five years, which caps the amount of deployed nuclear warheads and gives us the ability to conduct intrusive inspections of Russia's strategic nuclear forces. As a co-chair of the newly

formed bicameral Nuclear Weapons and Arms Control Working Group, I, along with other members of Congress, sent a letter to President Biden commending this action, and encouraging more concrete steps to avoid a costly and dangerous arms race. These actions will all culminate when the Biden administration finalizes its Nuclear Posture Review, which will have lasting effects on U.S. nuclear policy.

The recent bullish and helter-skelter decisions pertaining to the United States' nuclear modernization strategy made by previous administrations and Congresses are not set in stone. There are several commonsense changes we can make today to our nuclear modernization efforts to build upon the

progress the Biden administration has made and free up much-needed funds while staving off a costly and deadly nuclear arms race. As the chairman of the Armed Services Subcommittee on Readiness, I intend to do everything in my power to chart a new course in our modernization efforts — one that brings us back to a policy of deterrence rather than one of dominance. This issue is far too important to get wrong, and all of us in elected office have a responsibility to address this issue earnestly and thoroughly before we cross a line from which we cannot return.

Source: <https://thehill.com/blogs/congress-blog/politics/555451-the-stakes-couldnt-be-higher-as-biden-prepares-his-nuclear>, 26 May 2021.

OPINION – Puja Daya

Managing Nuclear Knowledge with Semantic Technologies

We now live in an era where information is accessible through our fingertips and search engines are used as portable libraries. With the past decade having seen vast technological improvements in collecting, managing, understanding, presenting, sharing and using

knowledge gained from data and information all over the world, access to the latest updates have become just a web search away. Semantic technologies use a wide range of tools in a similar way the human brain does. It helps process data and information and links them together to create understanding and meaning — keeping track of analysis outcomes, in the form of a conceptual and cognitive map.

Semantic technology, especially when combined with artificial intelligence, machine learning, modern taxonomies and ontologies, represents a powerful tool for managing the vast amount of nuclear data, information and knowledge.

According to a new IAEA Report, semantic technology, which underpins web searches and the management of online information, can be used in the nuclear field to help experts and stakeholders maintain, preserve, link and share nuclear knowledge. “Making more use of semantic technology could address the challenge of co-ordinating and compiling information from various institutions by enhancing access to knowledge resources throughout the field on a larger scale,” said Maxim Gladyshev, an IAEA Nuclear Engineer who is responsible for the report.

Semantic technology, especially when combined with artificial intelligence, machine learning, modern taxonomies and ontologies, represents a powerful tool for managing the vast amount of nuclear data, information and knowledge. One of the many key benefits of using semantic technology is that it improves the organisation of data and information – by linking various sources so they can be shared and reused across sectors, organisations and scientific communities. Through this improved knowledge, information and data organisation, nuclear safety standards, recommendations, experiences, best practices and previous research can become more widely available.

In research, this could have major implications: If already existing data and information can be

connected to other sources using semantic technology, research and development in the field becomes easier and faster and could lead to more breakthroughs. The IAEA is now exploring various prototypes and initiatives with potential benefits to the nuclear industry.

Nuclear Knowledge Management: The nuclear sector is knowledge driven and depends on sharing

information and experiences in designing, constructing, operating and decommissioning nuclear facilities amongst all stakeholders. It is a major challenge to adapt a systematic approach to nuclear knowledge and make it accessible to all relevant parties and organisations on a local, as well as on an international scale. Currently, many nuclear organisations host their knowledge on portals which act as central repositories for thousands of documents with little or no metadata – of the type of data that describes and provides information on the primary resource. Without metadata, it is difficult to search and gain access to the information required. Even greater difficulty would be to establish links between diverse information resources.

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The use of different standards and specifications belonging to semantic technology could provide a solution to this challenge by establishing a shared language within the nuclear community, developing a knowledge organisation system, or further building upon existing ones such as the

IAEA INIS Thesaurus. It could also help in integrating different data sources together, automating indexing and much more. By capturing meaning from unstructured data and interlinking various available sources of information, semantic technology can improve the sustainability of managing nuclear’s complex and interdisciplinary systems.

“Using semantic technology in nuclear knowledge management can help build knowledge models and combine disparate information sources to support applications and services based on them,” said Gladyshev.

Metadata in India: The use of this technology by the Indira Gandhi Centre for Atomic Research in Kalpakkam, India is a valuable example for how semantic technology can benefit the nuclear sector. To effectively utilise and preserve its decades of nuclear research, the Centre built a knowledge management portal. The portal was developed with features which allow relevant groups to capture tacit knowledge and obtain, store, share and use information in publications, projects, activities and much more.

“Our knowledge management system implemented with application of computational intelligence technologies has enabled us to organise memory, convert knowledge into intellectual capital, improve productivity and communication as well as create efficiency and improved safety of nuclear power plant operations,” said R. Jehadeesan, Head of the Computer Division at the Centre.

As a proof-of-concept, the IAEA also developed a pilot repository platform for knowledge and learning objects. The project revealed that as more educational organisations publish information in the repository, the richer the metadata becomes, allowing for complex queries to be asked from the data and filtering it to meet the needs of the user.

Source: <https://www.iaea.org/newscenter/news/managing-nuclear-knowledge-with-semantic-technologies>, 18 May 2021.

NUCLEAR STRATEGY

RUSSIA

Russia Publishes Nuclear Arms Numbers, Accuses US of Misleading Data

Russia owns 517 units of operational intercontinental ballistic missiles, operational submarine-launched ballistic missiles and operational heavy bombers, according to a document released by the Russian Foreign Ministry this week. That number is slightly lower than the number of similar missiles the United States has — 651 — but Russian officials said their country has 1,456 warheads deployed on ICBMs and other missiles, while the United States has 1,357. And while the U.S. has 800 operational and non-operational ICBM, SLBM launchers and heavy bombers, Russia has about 767. Those numbers reflect the notifications given by both the United States and Russia in March in accordance with the New START arms control treaty renewed by both countries in February.

The Russian government published the numbers earlier this week, according to the Russian news agency TASS. In the report, the ministry said the reduced number of U.S. operational and non-operational ICBM, SLBM launchers and heavy bombers was achieved “not only due to the real U.S. arms reduction, but also due to the unilateral exclusion of 56 SLBM launchers Trident II and 41 B-52H heavy bombers from the arms declared under the Treaty.” The foreign ministry also said the U.S. has renamed four missile launch facilities used for training as “training facilities” as opposed to describing them as non-operational ICBM launchers — putting the actual numbers in excess of those required by the treaty. According to the Arms Control Association, the

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treaty requires both sides to limit the number of deployed strategic nuclear warheads to no more than 1,550 and fielded delivery platforms to 700.

As of March 2020, Russia had 485 deployed strategic delivery systems, 1,362 deployed strategic nuclear warheads and 754 deployed and non-deployed strategic launchers, according to

the association. At the same time, the association reported United States had 655 deployed strategic delivery systems, 1,373 deployed strategic warheads and 800 deployed and non-deployed strategic launchers.

Source: Christen McCurdy, <https://www.upi.com/Defense-News/2021/05/25/Russia-nuclear-numbers-New-START-treaty/9431621977898/>, 25 May 2021.

Russia Says it can Now Operate Nuclear Capable Bombers from Syrian Air Base

Russia said on Tuesday it had the ability for the first time to operate long-range strategic nuclear-

capable bombers from its air base in Syria, expanding its capabilities and allowing such planes to train in new regions. Russia operates the Hmeymim base on Syria's Mediterranean coast, from which it has launched air strikes in the past in support of Syrian President Bashar al-Assad. The Russian defence ministry said in a statement that three Tupolev Tu-22M3 long-range bombers had flown to Hmeymim. It said runways at the base had been made longer and one of them upgraded allowing Russia to operate aircrafts of all types from the base. The three newly arrived bombers would hold training exercises in new geographical areas over the Mediterranean Sea, the defence ministry said, before returning to their permanent airfields in Russia.

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Source: <https://www.reuters.com/world/middle-east/russia-says-it-can-now-operate-nuclear-capable-bombers-syrian-air-base-2021-05-25/>, 25 May 2021.

USA-SOUTH KOREA

Moon Jae-in-Joe Biden to Discuss North Korean Strategy on Friday Meet

South Korean President Moon Jae-in is set to make a last-ditch attempt to bring the US and North Korea together under his watch when he meets Joe Biden at the White House on Friday, trying to revive dormant nuclear talks in his final year in office. But Pyongyang, which has displayed disdain for both leaders, has shown no interest in their diplomacy. That raises the stakes for the Friday summit as Moon tries to find fresh enticements to lure his neighbor back to table and the Biden administration undertakes a new strategy to end a nuclear program it sees as a serious threat to America and the world.

A key part of Biden's foreign policy has been turning to allies for support in addressing the security risks

posed by the likes of China and North Korea, trying to mend relations strained by his predecessor Donald Trump and placing a greater emphasis on the Indo-Pacific region. The summit with Moon is emblematic of that, being Biden's second White House meeting with a foreign leader since coming to office, after an April summit with Japanese Prime Minister Yoshihide Suga. But persistent troubles in the Middle East have flared up and the violence between Israel and Hamas militants in the Gaza Strip could be a distraction for the summit where the focus is supposed to be on North Korea.

Moon left Wednesday for the five-day visit and was expected to seek US cooperation on Covid-19 vaccines, aiming to step up production at home. Biden has been looking for help from South Korea's advanced semiconductor industry for chips as

Washington seeks to secure supply chains in its trade battles with China. Biden and Moon will hold a joint press briefing. Moon is likely to visit an SK Innovation plant in Atlanta on Saturday, according to his office, while the chairman of the SK Group, Chey Tae-won, was part of the contingent accompanying Moon. Ford Motor Co. and SK Innovation Co. are poised to announce Thursday they've reached an agreement to jointly build electric-vehicle batteries in the US, according to people familiar with the deal who asked not to be identified.

In what might be a conciliatory gesture, the Biden administration appears willing to accede to a denuclearization agreement reached between Trump and North Korean leader Kim Jong Un at a historic 2018 summit in Singapore. Moon helped bring the two leaders together and has been looking for Biden's backing of the pact that Seoul sees as a launching point for future discussions.

The Singapore summit resulted in a bare-bones declaration that included a call for the two sides "to work toward complete denuclearization of the Korean Peninsula." But the US and North Korea never agreed on what they meant by "denuclearization" and the accord resulted in no tangible steps for Kim to wind down his arsenal, which only became larger and more lethal.

A senior US official told reporters that the Biden administration was looking to build on not only the Singapore agreement, but other agreements made by previous administrations. The official said the US believed nuclear negotiations would be challenging and Biden — in contrast to his predecessor — wasn't orienting his diplomatic effort around achieving a grand bargain.

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The official, who asked not to be identified as a condition of participation in the briefing, sought to play down the likelihood the meeting would result in a splashy new North Korea announcement. While the leaders would consult on the best path forward, the White House doesn't expect to publicly detail changes to its diplomatic strategy, the official said. Instead, the US looks eager to highlight other elements, including a push for better collaboration amid a global semiconductor shortage, the official said. Commerce Secretary Gina Raimondo is expected to hold a meeting with South Korean Minister of Trade, Industry and Energy Moon Sung-wook on supply chain issues.

Moon is slated to attend the Medal of Honor ceremony for Korean War veteran Ralph Puckett, Jr., becoming the first foreign head of state to participate in the awarding of the highest decoration for US service members. The Biden administration has indicated it may be ready to ease some sanctions in exchange for steps by Kim to freeze, cap and wind down his nuclear arsenal. That could help the North Korean leader fix an economy that has only shrunk since he took power about a decade ago. Moon has said he wants to use the final year of his single, five-year term to reach an "irreversible peace" on the Korean Peninsula, but his role as a bridge between the US and North Korea has waned.

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North Korea froze out Moon as talks with Trump faltered. This month it released a 151-page photo book of Kim's diplomatic achievements where Moon was conspicuously absent, despite three summits with Kim. "From Kim Jong Un's point of

view, while Moon may not be able to play a pivotal role in US-North Korea diplomacy, he may be able to steer the Biden administration in a direction that would be more palatable to Kim," said Rachel Minyoung Lee, a nonresident fellow with the 38 North Program at the Stimson Center. Kim has turned up pressure early on Biden, starting 2021 by saying he wanted to develop more advanced nuclear technologies. In March, he test-fired ballistic missiles for the first time in a year and more launches could be coming soon. ...

Source: <https://www.hindustantimes.com/world-news/moon-jae-in-joe-biden-to-discuss-north-korean-strategy-on-friday-meet-101621591151908.html>, 21 May 2021.

"Not only will it not fulfill the role as an alternative system, but the costs will increase sharply while the benefits from installing the system decline," one government source said. "The general public will likely not be convinced as taxpayers footing the bill."

the Aegis Ashore land-based missile defense system in June 2020. Government officials had estimated that the total cost of installing and maintaining two such systems to protect Japan would amount to about 450 billion yen (\$4.1 billion).

In December, the government approved transferring the Aegis Ashore equipment to two destroyers as an alternative

missile defense system. Defense Ministry officials have released information about the estimated costs of installing the equipment on the two destroyers, putting the figure between 480 billion yen and 500 billion yen. But the defense equipment also requires continual repair and maintenance. Ministry officials never revealed what those costs might be.

BALLISTIC MISSILE DEFENCE

JAPAN

Paper: Sea-Based Missile Defense Double Cost of Land-Based Plan

A sea-based alternative to the Aegis Ashore ballistic missile defense system could cost taxpayers at least double the estimate for the now-abandoned land-based system, an internal Defense Ministry document shows. The ballooning costs have not been revealed to lawmakers, let alone the general public. "Not only will it not fulfill the role as an alternative system, but the costs will increase sharply while the benefits from installing the system decline," one government source said. "The general public will likely not be convinced as taxpayers footing the bill."

The Defense Ministry document also said undisclosed additional expenses for repair and maintenance could push the eventual total cost in excess of 1 trillion yen. Ministry sources have said that the need for upkeep of the two destroyers would make them available for only about a third of a year, a far cry from the year-round ballistic missile defense coverage that government officials claimed for the Aegis Ashore system.

It turns out an internal document was compiled in November that estimate the costs for maintenance and repair over a 30-year period at between 379.2 billion yen and 384.2 billion yen. The figures were based on data provided by the

United States and major shipbuilding companies. That would bring the total cost of the sea-based alternative close to 900 billion yen, or about double what the Aegis Ashore system was initially estimated to cost. When asked about the reported twofold cost of the sea-based alternative at a May 21 news conference, Defense Minister Nobuo Kishi said, "It is difficult to offer detailed figures at the present time."

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Soaring costs were cited as the main reason behind the Defense Ministry's decision to abandon

of a year, a far cry from the year-round ballistic missile defense coverage that government officials claimed for the Aegis Ashore system.

It is hardly a surprise that the cost of the sea-based alternative has ballooned. Transferring the land-based missile defense equipment onto ships at sea would be an unprecedented project. And there are likely other unexplored areas that might further push up the total cost of the sea-based alternative.

"We are pleased to announce the end of the missile guidelines. This is a symbolic and practical measure to externally show the solidity of the ROK-US alliance along with the conclusion of the ROK-US defense cost agreement in the early days of the Biden administration's inauguration," South Korean President Moon Jae-in said.

Source: <http://www.asahi.com/ajw/articles/14354941>, 21 May 2021.

USA-SOUTH KOREA

US, South Korea Scrap Bilateral Missile Guidelines

The US has agreed to lift restrictions on South Korea's ability to develop missiles. South Korean President Moon Jae-in announced the development on Friday following his meeting with US President Joe Biden in Washington. US restrictions previously banned Seoul from developing or possessing missiles with a range exceeding 800 km (497 mi).

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In 1979, South Korea agreed to limit its ballistic missile range to 180 km (112 miles) in exchange for the transfer of missile technology from the US. The limitations were relaxed in 2001, allowing South Korea to develop ballistic missiles with a range of up to 300 km (186 mi) and a warhead weight of 500 kg (1,102 lbs). In 2017, the payload cap was eliminated while the range limit was extended to 800 km (497 mi). All restrictions have now been lifted after 42 years.

Silence from China: This move by the US is widely seen as part of a strategy to counter China in the region, from whom a response is expected. But the South Korean military said on Monday that China has not raised any complaints about the

recent agreement. "I don't think it's an issue that we should make a decision on after taking the effect on neighboring countries into consideration," Defense Ministry spokesperson Boo Seung-chan said. "The termination of the guidelines reflects how the Biden administration lays

importance on the South Korea-US alliance, as well as the trust in our country based on our national capacity, status and as a model nation for international non-proliferation," he added.

Source: Tong Ong, <https://www.thedefensepost.com/2021/05/24/us-south-korea-scrap-bilateral-missile-guidelines/>, 24 May 2021.

NUCLEAR ENERGY

GENERAL

Using Nuclear Technologies to Address Plastic Pollution

...The IAEA is at the forefront of deploying nuclear science and technology to address global challenges, including for plastic pollution. "Nuclear techniques can help in assessing and understanding the dimension of the problem ... but also in the recycling of plastic through radiation techniques, which allow us to produce materials that can be further used in the concept of a circular economy," Mr Grossi said.

Controlling Plastic Pollution: Nuclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics) is set out to assist countries in integrating nuclear and isotopic techniques to address plastic pollution. "The IAEA is poised to provide unique nuclear solutions to plastic pollution through development and promotion of radiation technologies to help replace petroleum-based

plastics with biodegradable ones to improve conventional recycling practice and to renew end-of-life plastic," said Najat Mokhtar, IAEA Deputy Director General and Head of the Department of Nuclear Sciences and Applications. The approach of NUTEC Plastics is twofold: 1) to provide science-based evidence to characterize and assess marine microplastic pollution and 2) to demonstrate the use of ionizing radiation in plastic recycling to transform plastic waste into reusable resources.

NUTEC Plastics will enhance the capability of laboratories to study the impacts of plastic pollution in coastal and marine ecosystems, utilizing nuclear methods to precisely track and quantify the movement and impacts of microplastics and co-contaminants.

Nuclear technology also offers a solution to lower the volumes of plastic waste. The welfare of the environment and human life highlight the need to reroute the lifecycle of plastic toward a circular economy, focusing on the 4Rs: reduce, reuse, recycle and renew. As a complement to traditional mechanical and chemical recycling methods, NUTEC Plastics will demonstrate how gamma and electron beam radiation technologies can modify certain types of plastic waste to be recycled or upcycled for reuse. "A main obstacle in conventional plastic recycling is that recycling lowers the quality of plastic and pellets generated," Mokhtar explained. "You can use radiation to break down plastic polymers having insufficient quality into smaller components and use these to generate new plastic products, thus extending the plastic waste lifecycle." ...

Source: Excerpted from article by Joanne Liou. <https://www.iaea.org/newscenter/news/nutec->

plastics-using-nuclear-technologies-to-address-plastic-pollution, 18 May 2021.

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INDIA

ISRO Plans for Nuclear Energy Use in Space

On 28 January, 2021, the UR Rao Satellite Centre (URSC) of ISRO invited proposals for the three phase development of a 100 Watt Radioisotope Thermoelectric Generator (RTG). As ISRO's lead centre for design, development, fabrication, and testing of all Indian-made satellites, the centre envisions using RTG for power generation and thermal management of ISRO's deep space missions. With plans of setting up a space station, and launching the first Indian human space flight mission, Gaganyaan; the first Indian solar observatory, Aditya L-1; the second Indian space telescope XPoSat; Mangalyaan-2 to Mars; Chandrayaan-3 as a reattempt to land on the Moon; and the Venus orbiter mission Shukrayaan; ISRO has embarked on a monumental journey of exploring remote and challenging environments. It has told the world that India does not want to be a nascent space player anymore.

of a 100 Watt Radioisotope Thermoelectric Generator (RTG). As ISRO's lead centre for design, development, fabrication, and testing of all Indian-made satellites, the centre envisions using RTG for power generation and thermal management of ISRO's deep space missions. With plans of setting up a space station, and launching the first Indian human space flight mission, Gaganyaan; the first Indian solar observatory, Aditya L-1; the second Indian space telescope XPoSat; Mangalyaan-2 to Mars; Chandrayaan-3 as a reattempt to land on the Moon; and the Venus orbiter mission Shukrayaan; ISRO has

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Against this backdrop, the decision to invest in nuclear thermal propulsion (NTP) appears inevitable. RTGs are not new but the use of nuclear energy for launching rockets had been long given up, though small nuclear-powered rovers like the US's Perseverance have been in use. RTGs were first used in space during the Cold War in 1961 for the US's Transit-4A Mission. Since then, the erstwhile Soviet Union had launched over two dozen nuclear-powered space objects. However, budget constraints, complicated designs, progress in alternative sources of energy, and the possibility of escalation of the Cold War led to the curtailment of nuclear propulsion projects.

Now, as the importance of the space frontier and the desire to make new scientific discoveries increase, nuclear power sources have come into the spotlight once more. RTGs provide power by using thermocouples to convert thermal energy generated by the natural decay of radioactive isotopes into electrical energy. They are highly reliable and maintenance-free as the absence of moving parts in thermocouples reduces the chances of failure and wear out. Nuclear-propelled rockets are more

Nuclear-propelled rockets are more fuel efficient and lighter than chemical rockets. Hence, they would travel further, are faster, and would shorten the trip time. At the India Energy Forum, the US Energy Secretary, Dan Brouillette, emphasised this when he claimed that the new fuel would allow a trip to and from Mars on 'one tank of gas'. "What would take years, would take only months (now).

fuel efficient and lighter than chemical rockets. Hence, they would travel further, are faster, and would shorten the trip time. At the India Energy Forum, the US Energy Secretary, Dan Brouillette, emphasised this when he claimed that the new fuel would allow a trip to and from Mars on 'one tank of gas'. "What would take years, would take only months (now)," he said. This would also prove beneficial for human space travel. The astronauts' exposure to harmful space radiations would be lessened, thereby, decreasing the mission's overall risk. The Chief Engineer of NASA's Space Technology Mission Directorate, Jeff Sheehy, notes "the longer you're out there, the more time there is for stuff to go wrong".

Nuclear or radioactive energy can be employed both as an alternative to and a complement of other sources of energy. This is seconded by former ISRO Chairman, AS Kiran Kumar, who calls RTG 'futuristic'.

RTGs are an unmatched alternative to solar power. Solar power is not an option for space objects meant to operate on the dark sides of planets

where sunlight is obscured. Its intensity is inversely proportional to the square of the distance between the celestial body and the sun, hence, space objects sent to far off missions

require an alternative source of energy. RTGs are independent of solar proximity and planetary alignment.

This characteristic would help in minimising constraints like the 'launch windows' that the scientists have to operate within. More crucially, the current research is focused on developing radioisotope

thermoelectric systems, which can provide thrust for interplanetary travel only, thereby, complementing the chemical rocket thrusters that launch the spacecraft beyond the low Earth orbit.

Even with the above-mentioned advantages over conventional sources of energy, nuclear space reactors stir controversy due to the inherent safety challenges. There is a risk of radioactive contamination, with a rocket explosion,

disintegration or re-entrance into the atmosphere. However, if the highest standards of safety—keeping in mind both humans and the environment—are adopted, such risks can be minimised. A Seattle-based company, Ultra Safe Nuclear Technologies (USNC-Tech), claims to have designed an NTP engine that could protect the crew from being exposed to radioactive

The United Nations Office for Outer Space Affairs (UNOOSA) adopted 'Principles Relevant to the Use of Nuclear Power Sources in Outer Space' which recognise that "for some missions in outer space, nuclear power sources are particularly suited or even essential owing to their compactness, long life, and other attributes". It allows the use of nuclear reactors and radioisotope generators to operate on interplanetary missions and in sufficiently high orbits.

particles during the flight.

After the re-entry of nuclear-powered KOSMOS 954 into the atmosphere in 1978, the United Nations Office for Outer Space Affairs (UNOOSA) adopted 'Principles Relevant to the Use of Nuclear

Power Sources in Outer Space' which recognise that "for some missions in outer space, nuclear power sources are particularly suited or even essential owing to their compactness, long life, and other attributes". It allows the use of nuclear reactors and radioisotope generators to operate on interplanetary missions and in sufficiently high orbits. ISRO, adhering to its commitment to the principle, has explicitly mentioned in the January document that "the unit should be able to [be] resilient to any pre-launch or post-launch explosion so as to not cause any nuclear contamination in the environment". While chemical-powered rockets opened the door, nuclear energy would take humanity deeper into the space.

Source: Nitansha Bansal, <https://www.orfonline.org/expert-speak/isro-plans-for-nuclear-energy-use-in-space/>, 17 May 2021.

India's Nuclear and Space Sectors Contributes for Fight Against Covid-19

Financing the setting up of the oxygen delivery infrastructure/oxygen beds and air conditioned mortuary in hospitals, supply of oxygen concentrators, designing ventilators, oxygen concentrators and supplying oxygen are some of the ways the two strategic sector players – NPCIL and ISRO- are contributing to the nation's fight against coronavirus.

The NPCIL-Nuclear Power Corporation of India Ltd is the only atomic power generator in India while the ISRO is the country's sole space agency. "We have seven nuclear power generation sites. The needs of each site were different and hence they worked along with the local state administration to identify the needs and address the gap," S.K. Sharma, Chairman and Managing Director NPCIL, told IANS.

According to Sharma, the company had financed the oxygen delivery infrastructure for patients in

hospitals, construction of air conditioned mortuary in a hospital in Rajasthan. Sharma also said, NPCIL had made available oxygen concentrators for hospitals and also shared its own health care facilities with local authorities. "We also converted one wing of our own hospitals as Covid Care Ward and our doctors also offered tele-consultation," Sharma said.

According to him, a sum of Rs.43 crore has been spent on Covid-19 relief by NPCIL. Out of about 11,000 employees about 1,400 of them got infected by Coronavirus. While about 1,200 have recovered, unfortunately 15 of them lost their lives battling the coronavirus and the balance are under treatment, Sharma said. Sharma said the families of employees who lost their lives due to coronavirus were paid a solatium of Rs.30 lakh. Dr Jitendra Singh said that the DAE also successfully developed reagents for RT-PCR testing, besides powered respirators, Reefer, Portable Plasma sterilization and plasma incineration technology for medical waste.

On its part, the Indian space agency ISRO has started supplying oxygen out of its ISRO Propulsion Complex (IPRC) in Mahendragiri in Tamil Nadu. The ISRO supplies to Tamil Nadu, Kerala, Andhra Pradesh and Chandigarh. "Our production capacity is very small," ISRO Chairman

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K. Sivan had told IANS. ISRO's Space Application Centre at Ahmedabad has converted two liquid nitrogen tanks with a capacity of about 1.65 lakh litres into liquid oxygen tanks for storage and supply in Ahmedabad and nearby hospitals. Further, face shields and PPE kits are also being supplied to hospitals in Ahmedabad. The space agency has also set up Covid Care Centres in Bengaluru, Shillong and Sriharikota. The space agency has also developed ventilators and oxygen concentrators.

Source: <https://www.therahnuma.com/indias-nuclear-and-space-sectors-contributes-for-fight-against-covid-19/>, May 2021.

PAKISTAN

Karachi Unit 2 Inaugurated by Pakistan PM

Karachi 2 joins the five nuclear power plants already operating under the management of the Pakistan Atomic Energy Commission. Speaking from Islamabad by videolink in a ceremony that also marked the 70th anniversary of the establishment of diplomatic relations between Pakistan and China, Khan said the plant's 1100 MW of clean energy would "almost double" Pakistan's nuclear power generation.

Karachi unit 3 - which like unit 2 is also an 1100 MW Hualong One unit supplied by China National Nuclear Corporation (CNNC) - is expected to generate electricity early next year, he said. The Karachi units are the first exports of the Hualong One, which is promoted on the international market as HPR1000. "It is worth mentioning here that clean, reliable and affordable power generation will also bring economic benefits to the country," Khan said.

Construction of Karachi 2 began in 2015 and the unit achieved first criticality in February and was connected to the grid in March after the completion of commissioning tests. The plant's operational period is 60 years, which can be extended for another 20 years.

According to the Associated Press of Pakistan, China Atomic Energy Authority Chairman Zhang Kejian said the launch of Karachi 2 showed the commitment of both countries to the peaceful use of nuclear energy for the socioeconomic benefit of their people. CNNC Chairman China Yu Jian Feng said technology transfer and nuclear cooperation between China and Pakistan would "achieve new heights".

Source: <https://world-nuclear-news.org/Articles/Karachi-unit-2-inaugurated-by-Pakistan-PM>, 21 May 2021.

USA

U.S. Senators Introduce Nuclear Power Credit to Help Curb Emissions

Three Democratic U.S. senators introduced a measure on Wednesday to boost existing nuclear plants to a wide energy tax reform bill, after the Biden administration pushed for such a change to help curb carbon emissions. Senator Ben Cardin introduced the amendment on the tax production credit with fellow Democrats, Senators

Sheldon Whitehouse and Bob Casey. "We're in danger of seeing the premature closing of the nuclear reactors in this country," Cardin said before introducing the amendment at a hearing considering the wider bill, the Clean Energy for America Act. Cardin did not ask for a vote on the measure, a move to allow time to refine it as legislation advances.

The bill, Democratic Senator Ron Wyden's package of long term incentives for clean energy and clean vehicles that removes some tax breaks for fossil fuels, passed the Senate Finance Committee later in the day on a party line vote. It could eventually be absorbed into

infrastructure legislation but will likely see changes. Republicans on the committee took issue with the reductions in fossil fuel tax incentives, saying they would harm jobs and consumers.

Nuclear reactors are virtually emissions-free, but have been struggling to compete with power generation fueled by natural gas, and wind and solar power. The United States has 93 reactors,

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The United States has 93 reactors, down from 104 in 2012, as rising security and safety costs put additional pressures on the business. While some environmental groups oppose nuclear power, the Biden administration has signaled support for the credit for nuclear power plants as it seeks to put the country on a path to decarbonize the carbon grid by 2035.

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Two Republican senators on the Senate Finance Committee also spoke favorably about the amendment, increasing the odds it could eventually pass. Height Securities analysts said they believe that support for at-risk nuclear is likely to be included in the infrastructure package or other bills if robust clean energy tax provisions are included, given support from the White House and Senator Joe Manchin, a moderate Democrat.

The tax credit could help utilities such as Exelon Corp keep reactors open. The company has said it will close four reactors in Illinois in September and November but is seeking incentives from the state to keep them open. Cardin's amendment provides a production tax credit of \$15

per megawatt hour for existing nuclear plant owners or operators in states such as New York, Illinois, and Pennsylvania with deregulated power markets. The credit would be reduced by 80% for any market revenues above \$25 per megawatt hour. The credit would begin to phase down when greenhouse gas emissions fall by 50% below 2020 levels and ends entirely after 2030.

Source: Timothy Gardner, <https://www.reuters.com/business/energy/us-senators-set-introduce-nuclear-power-credit-energy-tax-reform-bill-2021-05-26/>, 27 May 2021.

UK

UK Space Agency, Rolls Royce Tie Up to Test Nuclear Technology to Power Spacecraft

The UK space agency is aiming to send a spacecraft to Mars in roughly half the time it takes now to reach the Red Planet, using nuclear powered-engines to be built by Rolls Royce. It said its research with the engineering company will

explore the "game-changing potential" of nuclear power to send astronauts to Mars in just three to four months — twice the speed of chemical engines that power our rockets today — making deep space exploration possible in the decades to come. The research, if successful, could revolutionise space travel.

A government report quoted Dr Graham Turnock, chief executive of the UK Space Agency, as saying, "Space nuclear power and propulsion is a game-changing concept that could unlock future deep-space missions that take us to Mars and beyond." It would not only save time but also radically reduce the radiation exposure to astronauts who would be making future trips to Mars. The

radiation dose increases the longer an astronaut spends in deep space, away from the bubble of protection given by the Earth's magnetosphere.

Nuclear powered-engines have long been a field of interest for space scientists, as they strive to discover the world far, far away from us. In the 1950s, the United States

attempted to develop nuclear spacecraft technology but the programme was later discontinued. A small nuclear power generator for propulsion could come in handy as power in space becomes increasingly precious with distance from the Sun and fuel cells are often too inconsistent as a source of energy.

Dr Turnock added that this research will also help them understand whether this technology could help spacecraft travel further and faster than ever before. Dave Gordon, UK Senior Vice President, Rolls Royce Defence, said they are "excited" to be working on this project as they continue to develop the power to "protect our planet, secure our world and explore our universe". Rolls Royce has previously provided the nuclear propulsion technology for the Royal Navy's submarines.

Source: <https://gadgets.ndtv.com/science/news/uk-space-agency-rolls-royce-mars-nuclear-engines-2448746>, 25 May 2021.

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RUSSIA

Russian Proposal for Fleet of Floating Nuclear Power Plants

The Baimskaya copper-gold mining project in the remote Chukotka Autonomous District is expected to need 350 MWe of reliable power. Rosatom has offered to supply this using five floating nuclear power plants of 100 MWe each – four in service and one rotating backup, for RUR 169 billion (\$2.29 billion). These would use the new RITM-200M reactors of 50 MWe each, with pairs on much smaller barges than that used for the plant at Pevek. The alternative is a natural gas fired plant built by Novatek, producing at RUR 6.45/kWh (9 cents/kWh), but with limited lifetime. The cost of the whole mining project is RUR 570 billion.

Source: <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power.aspx>, 20 May 2021.

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FRANCE

Proposal for Six Large New French Reactors

Electricite de France has submitted to the French government a plan to construct six EPR2 reactors at several nuclear power plant sites across the country. The €46 billion proposal is intended to stimulate government thinking about the country's power mix from the mid 2030s. A preliminary safety report has been submitted to the Nuclear Safety Authority detailing how the simplified 1750 MWe EPR2 design differs from the EPR already under construction at Flamanville - vastly over both budget and schedule. Sites proposed are Penly, Gravelines and another in Rhone-Alpes region, with two units each. EDF is

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also supporting plans for small modular reactors, and "To give this product every chance in its target markets outside France, we propose that the next multi-year energy programme will include the construction of the first SMR in France."

Source: *LaTribune*, 06 May 2021.

URANIUM PRODUCTION

USA

US Uranium Purchases Slightly Up for 2020: EIA

In total, US plant owners and operators purchased a total of 48.9 million pounds U3O8 equivalent (18,809 tU) during the year at a weighted-average price of USD33.27 per pound U3O8. Canada supplied 22.4% of total deliveries, slightly more than Kazakhstan, which accounted for 22.1%

of total deliveries. Total purchases for the year were slightly up on the 48.3 million pounds purchased in 2019, but the weighted-average price was 7% lower year-on-year and the lowest price since 2007, EIA said in its 2020 Uranium Market Annual Report.

Almost a quarter (24%) of the uranium delivered was purchased under spot contracts at a weighted-average price of USD28.70 per pound. The remaining 76% was purchased under long-term contracts at a weighted-average price of USD34.74 per pound.

Maximum uranium deliveries for 2021 to 2030 under existing purchase contracts totalled 194 million pounds U3O8 at the end of 2020, while unfilled uranium market requirements for 2021 through 2030 totalled 188 million pounds U3O8. "These contracted deliveries and unfilled market requirements combined represent the maximum

anticipated market requirements of 382 million pounds U3O8 over the next 10 years for COOs [civilian owner/operators]," the EIA said.

Total US commercial inventories, including those owned by COOs, brokers, converters, enrichers, fabricators, producers, and traders, were 123.1 million pounds U3O8 at the end of 2020, down 6% from 130.7 million pounds year-on-year. Commercial uranium inventories owned at the end of 2020 by COOs totalled 107.2 million pounds U3O8, a 5% decrease on the previous year. Inventories owned by US suppliers (converters, enrichers, fabricators, producers, brokers and traders) stood at 16.0 million pounds U3O8, down 9% from 2019 year-end levels.

The EIA earlier this year said it was unable to publicly release US uranium production data for the fourth quarter of 2020 because it did not reach a threshold where a specific production figure could be published without violating confidentiality protections. The Administration's Domestic Uranium Production Report, released earlier this month, reported that one conventional uranium mill - White Mesa in Utah - and two in-situ leach projects - Lost Creek and Smith Ranch-Highland, both in Wyoming - were operating in the USA at the end of 2020.

Source: <https://world-nuclear-news.org/Articles/US-uranium-purchases-slightly-up-for-2020-EIA>, 25 May 2021.

NUCLEAR COOPERATION

CHINA-RUSSIA

Xi, Putin Witness Launch of Biggest China-Russia Nuclear Energy Project

Chinese President Xi Jinping and his Russian counterpart Vladimir Putin hailed the nuclear cooperation between the two neighbours as they virtually attended the ground breaking ceremony of the biggest nuclear energy project to build four nuclear power plants in China costing about USD

3 billion.

The ceremony, which was attended by the two leaders via a video link, was held to mark the first day of construction of power units No. 7 and 8 of the Tianwan Nuclear Power Plant, and No. 3 and 4 of the Xudapu Nuclear Power Plant. The Tianwan Nuclear Power Plant is located in the city of Lianyungang in eastern Jiangsu province. The Xudapu Nuclear Power plant is located in Xingcheng in northeastern Liaoning province. "This has been the biggest China-Russia nuclear energy cooperation project to date and represents the highest level of practical cooperation between the two sides," Chinese Foreign Ministry spokesman, Zhao Lijian told a media briefing on Tuesday.

Speaking on the occasion, Xi reiterated China's close attention to energy cooperation with Russia as it is a traditional cooperative area between the two countries. He hailed the beginning of construction of the nuclear power plants, and noted that the energy projects set an example for bilateral cooperation in other sectors. Stressing that the bilateral cooperation on nuclear energy is meaningful for the high-level development of the China-Russia comprehensive strategic partnership of coordination for a new era, Xi said he hopes the two sides will follow the sound momentum and conduct more effective cooperation in other sectors.

China and Russia signed a strategic package of agreements on nuclear energy in June 2018 to jointly construct four nuclear power units, the biggest of such between the two countries so far, with a total contract value of over 20 billion yuan (about USD 3 billion), state-run CGTN-TV reported. All four units will adopt the third-generation VVER-1200 reactors developed by Russia. Compared to its predecessor VVER-1000 reactor, the latest VVER-1200 reactor features advantages in many aspects, according to Russia's Rosatom State Nuclear Energy Corporation. Once

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completed, the four units are expected to effectively reduce carbon dioxide emissions. The two countries firmed up their close ties as they faced mounting adversity from the US and European Union on a host of issues including human rights violations.

Source: https://www.business-standard.com/article/international/xi-putin-witness-launch-of-biggest-china-russia-nuclear-energy-project-121051901177_1.html, 19 May 2021.

INDIA–RUSSIA

Russian Firm to Make Vital Coolant Pumps for Tamil Nadu's Kudankulam Nuclear Power Plant

Atomash, the Volgodonsk branch of AEM Technology which operates alongside Russian State Atomic Energy Corporation's (Rosatom) machine-building division, has started manufacturing the bends of the main circulation pump for units 5 and 6 of Kudankulam nuclear power plant (KKNPP), according to a release.

The main circulation pump is a first-class safety item. It circulates the coolant at a nuclear power plant through the pipes of the main circulation pipeline from the reactor to the steam generator and vice versa. The work was carried out in two stages at the thermal press site of Atomash. In total, Atomash will manufacture eight bends of the MCP for two units of the plant, the release added. Process Works were carried out in two stages at the thermal press site of Atomash. In total, Atomash will manufacture eight bends of MCP.

Source: <https://www.newindianexpress.com/states/tamil-nadu/2021/may/15/russian-firm-to-make-vital-coolant-pumps-for-tamil-nadus-kudankulam-nuclear-power-plant-2302728.html>, 15 May 2021.

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RUSSIA–SAUDI ARABIA

Moscow Offers Cooperation on NPP Projects in Third Countries to Riyadh

Russia offers cooperation in the nuclear power sphere in third countries to Saudi Arabia, including in designing nuclear power plants with small capacity reactors, Deputy Prime Minister Alexander Novak says at the intergovernmental commission's meeting. "The second promising area is the cooperation in small capacity reactors sphere. This is a new area. We offer joint work in this

regard for building up Russian-Saudi partnership for refinement of the 600 MW NPP project and its further promotion on the third countries' market," Novak says.

Russia has competencies in building small units for floating and land-based nuclear power plants and the country is ready to prepare appropriate offers for Saudi Arabia if there is interest, he notes.

The Russian state-run corporation Rosatom currently bids in a tender in Saudi Arabia for construction of a high-capacity NPP. "We are ready to continue taking part in all the tender procedures," Novak adds.

Source: <https://tass.com/economy/1293673>, 25 May 2021.

USA–SOUTH KOREA

Seoul, Washington to Cooperate on Overseas Nuclear Plant Projects

South Korea and the United States announced [that] they will broaden cooperation in the nuclear energy sector to penetrate deeper into overseas markets. "We commit to develop cooperation in overseas nuclear markets, including joint participation in nuclear power plant projects, while ensuring the highest standards of international

nuclear safety, security and nonproliferation are maintained," the two countries said in a joint statement.

The statement came in line with the summit between South Korean President Moon Jae-in and US President Joe Biden held at the White House on Friday. "As part of our earnest effort to a separate fact sheet released by the two countries also said. The ROK refers to South Korea's official name, the Republic of Korea. The fact sheet added that the two countries will adopt a common policy to "require recipient countries have an IAEA safeguard agreement Additional Protocol in place as a condition of supply of nuclear power plants. "The IAEA refers to the International Atomic Energy Agency.

The Ministry of Trade, Industry and Energy said the two countries will continue to hold follow-up talks to carry out the agreement reached during the summit. The ministry said that based on South Korea's successful export of homegrown commercial atomic power plants to the United Arab Emirates, the latest agreement will give an extra boost for South Korean firms setting eyes on the global energy market. In 2009, a South Korean consortium won a contract to build four nuclear reactors in Barakah, 270 kilometers west of Abu Dhabi. The first reactor kicked off its commercial operation in April.

South Korea has been making efforts to penetrate deeper into the overseas nuclear energy market in line with efforts to find new demand, as it has been slowly reducing its local dependence on nuclear plants. South Korea plans to reduce the number of nuclear plants at home to 17 by 2034 from the current 24 in line with its green energy drive.

Source: <http://www.koreaherald.com/view.php?ud=20210522000119>, 22 May 2021.

NUCLEAR PROLIFERATION

IRAN

'Only Countries Making Bombs' are Enriching Uranium at Iran's Level, IAEA Chief Says

The chief of the IAEA has expressed alarm over Iran's nuclear program, spelling out his concern in an interview with the Financial Times this week. IAEA Director General

Rafael Grossi told the newspaper in an interview published Wednesday that the situation was "very concerning." Earlier this week, Iran and the U.N. nuclear watchdog agreed to extend an expired monitoring agreement by a month. Grossi's warning comes amid high tensions between Iran and the world powers that signed the 2015 Iran nuclear deal as negotiations between those countries to revive the deal are underway.

"A country enriching at 60 percent is a very serious thing — only countries making bombs are reaching this level," Grossi

told the FT. "Sixty percent is almost weapons grade, commercial enrichment is 2, 3 [percent]." While he said it was Iran's "sovereign right" to develop its program, which Tehran insists is for civilian energy purposes only, he added: "This is a degree that requires a vigilant eye."

Iran has been increasing its uranium stockpiling and enrichment in gradual breaches of the 2015 accord, which placed curbs on its nuclear program in exchange for the lifting of economic sanctions on the country. The ramp up in activity began in May 2019, one year after then-President Donald Trump pulled the U.S. out of the multilateral deal and imposed sweeping sanctions on Iran that have crippled its economy. Iran is now enriching its

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uranium to 60% purity, dramatically higher than the 3.67% level permitted under the deal. The level of enrichment required to make a bomb is 90%. Tehran continues to argue that its development is for peaceful aims.

Source: *Natasha Turak*, <https://www.cnn.com/2021/05/26/iaea-chief-on-iran-nuclear-program-only-countries-making-bombs-are-enriching-at-this-level.html>, 26 May 2021.

Iran Agrees to Extend IAEA Nuclear Monitoring Deal for One Month

Iran has agreed to extend by one month an agreement allowing the IAEA to keep surveillance cameras at nuclear sites. IAEA chief Rafael Grossi told reporters that the deal would now end on 24 June. Iran reduced its co-operation with the watchdog in February in retaliation for sanctions reinstated by the US when it abandoned a nuclear deal in 2018. It said the extension was a gesture of "good faith" while talks on lifting the sanctions continued in Vienna.

However, it will expire soon after Iran's presidential election on 18 June, when hard-line opponents of the outgoing Hassan Rouhani are expected to do well and the Iranian negotiators in the Austrian capital are likely to change. Iran has gradually breached its commitments under the nuclear deal to put pressure on the US to lift its sanctions and on the five remaining parties - China, France, Germany, Russia and the UK - to deliver the promised benefits.

The world powers have been particularly concerned by Iran's violation of all limits on the production and stockpiling of enriched uranium, which can be used to make reactor fuel but also nuclear weapons. In February, Iran said it would also stop implementing the Additional Protocol

to their IAEA Safeguards Agreement, which allows inspectors to access any site they deem suspicious and to obtain images from surveillance cameras installed at nuclear sites.

However, the country then reached a "temporary technical understanding" with the IAEA that saw it agree to store the images for three months and then delete them if no wider deal was reached for the US to re-join the nuclear accord and lift its sanctions.

...While he welcomed the move, Mr Grossi also acknowledged that the situation was not ideal. "The temporary understanding is a sort of stop-gap measure. It is to avoid flying completely blind," he said. Earlier, Iran's foreign ministry said "very significant progress" had been made at the Vienna talks and that it could "easily lead to results if a political decision is made in Washington".

The comments came after US Secretary of State Antony Blinken told ABC News: "Iran, I think, knows what it needs to do to come back into compliance on the nuclear side, and what we haven't yet seen is whether Iran is ready and willing to make a decision to do what it has to do. That's the test and we don't yet have an answer."

Source: <https://www.bbc.com/news/world-middle-east-57229775>, 24 May 2021.

Iran, World Powers Resume Talks on US Return to Nuclear Deal

World powers were set to open a fifth round of talks on Tuesday with Iran aimed at bringing the United States back into the landmark 2015 nuclear deal meant to prevent the Islamic Republic from obtaining an atomic bomb. The talks in Vienna come the day after the UN's nuclear

In February, Iran said it would also stop implementing the Additional Protocol to their IAEA Safeguards Agreement, which allows inspectors to access any site they deem suspicious and to obtain images from surveillance cameras installed at nuclear sites.

The talks in Vienna come the day after the UN's nuclear watchdog, the International Atomic Energy Agency, was able to strike a last-minute agreement with Tehran on a one-month extension to a deal on surveillance cameras at Iran's nuclear sites.

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The issue wasn't directly related to the ongoing talks on the nuclear deal, known as the Joint Comprehensive Plan of Action, or JCPOA, but had Iran not agreed it could have seriously complicated the discussions. The US is not directly involved in the talks but an American delegation headed by President Joe Biden's special envoy for Iran, Rob Malley, has also been in the Austrian capital. Representatives from the other powers involved Germany, France, Britain, Russia and China have been shuttling between the U.S. and the Iranians to facilitate indirect talks.

As he headed back to Vienna for the resumption of talks, Malley tweeted that the latest round had been constructive and saw meaningful progress. But much work still needs to be done, he wrote. On our way to Vienna for a fifth round where we hope we can further advance toward a mutual return to compliance. Russia's delegate, Mikhail Ulyanov, who has consistently been the most optimistic about the possibility of an agreement, suggested a resolution was in sight. "I think it can be final," he tweeted about the fifth round. But in order to be on the safe side I would prefer to say: let's see.

In 2018, then-President Donald Trump pulled the US unilaterally out of the agreement saying that it was not broad enough and needed to be renegotiated. As part of a maximum pressure campaign, he reimposed sanctions and added additional ones on Iran in an effort to bring Tehran back to the table. Iran's economy was crippled by the move but it has

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Despite Iran's violations of the JCPOA, the other nations involved have stressed that the agreement was still important as it allowed IAEA inspectors to continue their surveillance of Iran's nuclear facilities. Continuity of that surveillance was threatened, however, until the last-minute agreement negotiated by the IAEA with Iran on Monday.

refused new talks, instead retaliating by slowly and steadily breaking the restrictions of the JCPOA in an effort to pressure the other parties involved, thus far unsuccessfully, to come up with incentives to offset the American sanctions.

Biden, who was vice president when the original deal was negotiated, has said he wants the US to rejoin but that Iran has to return to complete compliance. Iran has insisted that all American sanctions imposed under Trump be dropped, including measures that were taken in response to non-nuclear issues. Iran's violations include a significant increase in the purity and quantity of uranium it has been enriching, effectively reducing the so-called break out time to produce an atomic bomb, even though that is something Iran says it does not want to do, insisting that its nuclear program is for civilian purposes only.

Ali Akbar Salehi, the head of Iran's civilian program, said Tehran had stockpiled 5 tons of uranium enriched up to 5% purity, 90 kilograms enriched up to 20% and 2.5 kilograms up to 60% still below weapons-grade levels of 90% purity.

Though the West fears it could be used to help Tehran potentially obtain an atomic bomb, US intelligence agencies have said they assess that Iran is not currently undertaking the key nuclear weapons-development activities ... necessary to produce a nuclear device."

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Under a confidential agreement called an Additional Protocol with Iran, the IAEA collects and analyzes images from a series of surveillance cameras installed at Iranian nuclear sites. Those cameras helped it monitor Tehran's program to see if it is complying with the nuclear deal. Iran's hard-line parliament in December approved a bill that would suspend part of UN inspections of its nuclear facilities if European signatories didn't provide relief from oil and banking sanctions by February.

The IAEA then struck a three-month deal with Iran in February to have it hold the surveillance images, with Tehran threatening to delete them afterward if no deal had been reached. Speaking at a news conference Monday in Vienna as the deal was due to expire, IAEA Director-General Rafael Grossi told journalists Iran had agreed to a one-month extension though his agency still cannot access the images taken by the cameras for the time being.

Source: https://www.business-standard.com/article/international/iran-world-powers-resume-talks-on-us-return-to-nuclear-deal-121052501358_1.html, 25 May 2021.

China Backs Iran's 'Reasonable Demands' on Nuclear Deal

Beijing supports Tehran's "reasonable demands" regarding the Iran nuclear deal, China's president said on Monday. Xi Jinping extended the assurance during a phone call with his Iranian counterpart Hassan Rouhani, China's state-run Xinhua News Agency reported. "China supports Iran's reasonable demands concerning the Joint Comprehensive Plan of Action [JCPOA] on the Iranian nuclear issue, and stands ready to strengthen coordination with Iran and safeguard the common interests of both sides," Xi told Rouhani.

The high-level exchange between China and Iran comes after the two countries signed a 25-year

strategic cooperation agreement on March 27 as part of China's Belt and Road Initiative.

The \$400 billion deal was on the cards since President Xi's visit to Tehran in January 2016. The future of the 2015 nuclear pact has been uncertain since the US withdrew from it in 2018 and slapped more sanctions on Iran, deepening the rift between Tehran and Washington and its allies.

Iran and the other signatories of the agreement – France, the UK, Germany, Russia, China, and the EU – started talks last month in Vienna to salvage the deal. Amid the impasse, Tehran has moved ahead with its nuclear program, while reducing cooperation with the IAEA. The UN agency struck a three-month monitoring deal with Tehran in February, which ended on Saturday but may be extended for a month, despite opposition from the Iranian parliament.

Rafael Grossi, head of the IAEA, has been holding talks with Iranian officials

on extending the arrangement, with Iran's Foreign Ministry also having hinted at the possibility of a "conditional extension." The extension is likely in view of the ongoing Vienna talks and the upcoming presidential election in Iran on June 18, according to a report by Iran's Nour News Agency on Sunday that cited an unnamed official of the country's Supreme National Security Council.

Source: Riyaz ul Khaliq, <https://www.aa.com.tr/en/asia-pacific/china-backs-irans-reasonable-demands-on-nuclear-deal/2252685>, 24 May 2021.

Blinken Says US Consulting with Israel Over Iran Nuclear Talks

U.S. Secretary of State Antony Blinken promised on Tuesday continued close consultation with Israel about any potential U.S. return to a nuclear deal between Iran and world powers. After talks with Blinken in Jerusalem, Prime Minister Benjamin Netanyahu said he hoped Washington would not sign back on to the deal, and that "whatever happens, Israel will always retain the

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right to defend itself” against any Iranian nuclear threat. Indirect talks between Washington and Tehran, which denies its nuclear programme is aimed at producing weapons, have been under way in Vienna.

Blinken, on a Middle East mission to try to shore up last week’s ceasefire between Israel and Gaza’s Hamas rulers, said the United States would continue to strengthen its “long-standing partnership” with Israel. That, he told reporters, with Netanyahu at his side, “includes consulting closely with Israel as we did today on the ongoing negotiations in Vienna around a potential return to the Iran nuclear agreement”. To Israeli acclaim, U.S. President Joe Biden’s predecessor, Donald Trump, withdrew the United States from the 2015 nuclear deal, deeming it too advantageous for Tehran, and reimposed U.S. sanctions.

The Biden administration has since sought to assuage Israel which sees a nuclear-armed Iran as an existential threat. On Sunday, Blinken said the United States has not seen yet whether Iran will move to comply with its nuclear commitments in order to have sanctions removed even as the talks have shown progress. Israeli teams have held discussions in Washington with U.S. counterparts over the potential revival of the deal. “I hope that the United States will not go back to the old JCPOA because we believe that deal paves the way for Iran to have an arsenal of nuclear weapons with international legitimacy,” Netanyahu said.

Source: <https://www.reuters.com/world/middle-east/blinker-says-us-consulting-with-israel-over-iran-nuclear-talks-2021-05-25/>, 25 May 2021.

NUCLEAR DISARMAMENT

USA-CHINA

U.S. Says China is Resisting Nuclear Arms Talks

China is resisting bilateral talks with the United States on nuclear weapons, the U.S. disarmament ambassador told a U.N. conference on Tuesday, as Washington seeks to advance efforts to reduce nuclear arms stockpiles. “Despite the PRC’s dramatic build-up of its nuclear arsenal, unfortunately it continues to resist discussing nuclear risk reduction bilaterally with the United States,” said Robert Wood, referring to the People’s Republic of China. “To date Beijing has not been willing to engage meaningfully or establish expert discussions similar to those we have with Russia. We sincerely hope that will change,” he added.

The United States has not seen yet whether Iran will move to comply with its nuclear commitments in order to have sanctions removed even as the talks have shown progress. Israeli teams have held discussions in Washington with U.S. counterparts over the potential revival of the deal.

“Despite the PRC’s dramatic build-up of its nuclear arsenal, unfortunately it continues to resist discussing nuclear risk reduction bilaterally with the United States,” said Robert Wood, referring to the People’s Republic of China. “To date Beijing has not been willing to engage meaningfully or establish expert discussions similar to those we have with Russia. We sincerely hope that will change.”

In an apparent rebuttal, China’s envoy later told the same virtual U.N. meeting that Beijing was prepared for dialogue. “We stand ready to carry out positive dialogue and exchange with all parties to jointly explore effective measures to reduce nuclear risk and to contribute to global strategic security,” Ji Zhaoyu said. The exchange came at

a discussion on the Prevention of Nuclear War at the 65-member U.N. Conference on Disarmament based in Geneva. The body, which makes decisions by consensus, has not reached a major agreement in decades but is often the theatre for tense rhetorical exchanges between superpowers.

Earlier this year, Russia and the United States agreed to extend the New START arms control treaty for five years, preserving the last treaty limiting deployments of the world’s two largest

strategic nuclear arsenals. Russia's President Vladimir Putin and U.S. President Joe Biden are set to discuss arms control and security issues at a meeting and strategic nuclear stability will be on the agenda. Wood said on Tuesday he hoped that such bilateral discussions may lay the groundwork for nuclear disarmament and future arms control treaties.

Source: Emma Farge, <https://www.reuters.com/world/china/us-says-china-is-resisting-bilateral-nuclear-talks-2021-05-18/>, 18 May 2021.

NUCLEAR TERRORISM

GENERAL

KTH Scanner Could Help Airports Prevent Acts of Nuclear Terrorism

A scanning technology aimed at detecting small amounts of nuclear materials was unveiled by scientists at KTH, with the hope of preventing acts of nuclear terrorism. Bo Cederwall, a professor of physics at KTH Royal Institute of Technology, says the technology can be used in airports and seaports for routine inspection of passengers and goods. The research is published and featured in the journals *Science Advances* and *Science*, respectively.

A 3D representation of how two sources of radiation of different strengths would appear when imaged at the same time. A form of tomography, the system enables quick 3D imaging of the source of neutron and gamma ray emissions from weapons-grade plutonium and other special nuclear materials, Cederwall says. The so-called Neutron-Gamma Emission Tomography (NGET) system goes beyond the capabilities of existing radiation portal monitors, by measuring the time and energy correlations between particles emitted in nuclear fission, and using machine learning algorithms to visualize where they're coming from. The system looks for coincidences of neutron and gamma ray emissions—which when mapped together in real-time allow pinpointing their origin.

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"The technology has a very high sensitivity and can within a few seconds detect gram-amounts of plutonium depending on the application and the plutonium isotope composition," Cederwall says. "It takes a little longer to get a really good picture so you can see exactly where the plutonium is. However, this can be done completely automatically." But NGET isn't only for intercepting nuclear materials that could be used for nuclear weapons and radiation-dispersing "dirty bombs"—it can be used to detect environmental radiation too, such as leaks from nuclear facilities or even natural sources. Cederwall says the research group is looking into equipping drones with the NGET system for this purpose.

"In case of a radiological emergency, it is extremely important to be able to quickly map the radioactive contamination in the environment in

order to protect the population in the best possible way," he says. The research was funded by Swedish National Safety Authority (project Nos SSM2018-4393 and

SSM2018-4972).

Source: <https://sciencebusiness.net/network-updates/kth-scanner-could-help-airports-prevent-acts-nuclear-terrorism>, 25 May 2021.

NUCLEAR SAFETY

GENERAL

Improving Safety of Ageing Nuclear Power Plants in Lockdown

Had you spoken to Robert Krivanek a year ago about where he'd be this spring, he may have asked you to reach him in Asco, Spain. A senior IAEA nuclear safety officer, he planned to conduct a safety review of the Spanish village's two-gigawatt nuclear power plant, and help its operators meet the requirements to extend the operating lifetime of the plant's two reactors. But Spain isn't where you'll find him today.

Imposed travel restrictions due to the COVID-19 pandemic have made safety reviews that required in person interactions and on-site observation and visits extremely difficult, if not impossible — but they've not stopped him and his team from being productive.

From its headquarters in Austria, the IAEA's Long Term Operation (LTO) team has refocused its efforts from missions to enhancing and expanding a new set of guidelines for nuclear facility operators — adding guidance for long-term operating power reactors, early-phase nuclear power plant operation, and research reactors, amongst other topics. This provides useful guidance for nuclear power plant operators until missions can resume and will be an additional support tool provided by the IAEA.

Safety Aspects of Long Term Operation (SALTO) is an IAEA peer review service that offers countries with nuclear power plants a comprehensive review that directly addresses strategy and key elements for the safe long-term operation of nuclear power plants. To-date the service has conducted 45 missions for nuclear power plants and one mission for a research reactor in 17 countries around the world since its creation in 2005.

As the fleet of nuclear power plants age and their operation lifetimes are extended, there are important safety consideration to manage. These include managing physical ageing and technological obsolescence of safety equipment, implementing necessary safety upgrades, and ensuring the availability of qualified personnel.

Today, more than two thirds of all the power reactors operating worldwide have been in

operation for more than 30 years. Keeping the global fleet of nuclear power plants operating is important, as roughly 10 per cent of total electricity production and a third of low-carbon electricity generation is nuclear.

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International Energy Agency (IEA) has found that the long-term operation of nuclear power plants constitutes the least costly option for low-carbon generation.

Extending a Power Plant's Life: Keeping a plant producing electricity safely and reliably for decades starts with careful design, high quality materials and sound construction. In addition to that, safety depends on sound management, policies, procedures, processes and practices; the capability and reliability of operating personnel; adequate resources; and frequent upgrading and modifications to plant structures, systems and components. All these contribute to the prolonging of a plant's life.

SALTO's safety review service supports these processes by comparing a facility's long-term operation related activities and programmes against IAEA Safety Standards and proven good international practices and then providing recommendations to operators to improve preparedness for safe LTO and achieve consistency with IAEA Safety Standards. "We appreciate the IAEA support to our plant in ageing management and preparation for safe LTO," said

"COVID-19 has not put a pause on the demand for low-carbon, reliable nuclear energy. The continued safe and reliable operation of nuclear power plants is essential, so we're employing methods beyond on-site reviews to help keep plants running safely," said Krivanek. The

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Dan Bigu, a corporate director at the Cernavoda Nuclear Power Plant, who was site Director during a SALTO mission in February 2020. "The results of this mission will help us to improve our activities for safe LTO and to further align them with IAEA safety standards." Summaries of all SALTO missions are made available on the IAEA's website along with analyses of all mission results in 2005-2015 and 2015-2018.

The upcoming third edition of the SALTO Guidelines, to be published in June 2021, expands on previous iterations — offering new detailed guidance for reviewers, introducing facilities for self-assessment and the development of self-identified issues prior to the SALTO missions, and providing better information to facilities for preparations for the missions.

The Next Missions: With travel restrictions to ease gradually in the near future, safety review missions, such as SALTO, will resume with advanced preparation already taking place. A next milestone will be the 50th mission, which might happen later in 2021 or early 2022.

Before that, missions to several nuclear power plants are planned. At the request of Ukraine's government, the SALTO team is preparing to conduct a review mission in August 2021, for instance. Ukraine's 15 operational reactor units produced 53.9% of the country's total electricity in 2019 and the country's energy strategy through 2035 notes commitment to keep the share of nuclear energy at half of total electricity production. The country's state-owned nuclear energy enterprise, Energoatom, estimates its nuclear fleet has avoided 2.7 billion tonnes of CO₂- emissions over the course of its operational

lifetime — a greenhouse gas equivalent of over 587 million passenger vehicles being driven for one year.

Source: Michael Amdi Madsen, <https://www.iaea.org/newscenter/news/improving-safety-of-ageing-nuclear-power-plants-in-lockdown>, May 26 2021.

INDIA

Uranium in 83 Percent of Water Samples, Says BARC Study

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Uranium was detected in 83.6 percent of all the collected water samples during a nationwide survey by the BARC for mapping of uranium content in drinking water sources across India. About 55,554 surface and groundwater samples were collected for the survey.

"Out of 12 water quality parameters measured to understand the geochemical processes governing uranium content in water sources, eight were found to exceed the acceptable limits set by the BIS for drinking water" said the study published in Current Science.

Sulphate, chloride, nitrate, fluoride, total dissolved solids, alkalinity, and hardness exceeded their limits by 4.2 percent, 12.9 percent, 14 percent, 20.5 percent, 34.3 percent, 45 percent, and 51.6 percent, respectively. Uranium content in 98 percent of groundwater samples was within the national limit fixed by the AERB for radiological safety.

"Out of 12 water quality parameters measured to understand the geochemical processes governing uranium content in water sources, eight were found to exceed the acceptable limits set by the BIS for drinking water".

"Dissolved uranium content in groundwater samples showed an upward trend with total dissolved solids and depth of water sources. No surface water samples exceeded the prescribed regulatory limit." The study further found that about 36 percent, 30 percent, 26.5 percent, 6.2 percent and 5.2 percent of surface water samples

exceeded the BIS recommended acceptable limits for hardness, alkalinity, TDS, fluoride and nitrate. In contrast, 51.6 per cent, 45 per cent, 36.3 per cent, 20.5 per cent and 14 per cent of groundwater samples exceeded the BIS recommended acceptable limits for the same parameters. "About 2 per cent of groundwater samples exceeded the AERB prescribed limits for uranium with respect to radiological safety, while no surface water samples exceeded the limit," it added.

Source: <https://www.newindianexpress.com/thesundaystandard/2021/may/16/uranium-in-83-percent-of-water-samples-says-barc-study-2303036.html>, 16 May 2021.

NUCLEAR WASTE MANAGEMENT

USA

ARPA-E Program will Fund Projects Aiming for Tenfold Reduction in Spent Nuclear Fuel, Minimizing Need for Disposal Sites

The U.S. Department of Energy (DOE) announced up to \$40 million in funding for a new Advanced Research Projects Agency-Energy (ARPA-E) program that will limit the amount of waste produced from advanced nuclear reactors, protecting the land and air and increasing the deployment and use of nuclear power as a reliable source of clean energy. "More than half of our zero carbon energy is generated from nuclear power, and through this ground breaking research we can expand nuclear's potential," said Secretary of Energy Jennifer M. Granholm. "America is an innovation leader, and DOE is proud to invest in the next generation of nuclear energy technologies that will power the nation and protect our environment."

As advanced nuclear reactor technologies move from research and development phases to deployment, ARPA-E's new "Optimizing Nuclear Waste and Advanced Reactor Disposal Systems" (ONWARDS) program addresses challenges posed by the limited disposal options for spent nuclear fuel through the development of novel processes and applications at the start of a fuel cycle that prevents the formation of nuclear waste.

Nuclear power is one of the most reliable sources of energy in America, and the largest domestic source of clean energy—providing 52% of the nation's carbon-free electricity in 2020, and about a fifth of U.S. electricity overall. Nuclear power production, however, produces approximately 2,000 metric tons of used fuel each year that must be

disposed and safely stored.

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ONWARDS is ARPA-E's first focused program working to identify transformative Advanced Nuclear Reactor (AR), used nuclear fuel (UNF) waste, and UNF disposal pathways. ARPA-E's statutory authority was updated in the ARPA-E Reauthorization Act of 2019, charging the agency to "provide transformative solutions to improve the management, clean-up, and disposal of radioactive waste and spent nuclear fuel."

Proactively reducing the amount of waste from AR poses an innovative opportunity that will enable the future deployment of nuclear power. ONWARDS teams will seek to facilitate a 10X reduction in UNF and waste volume generation or repository footprint across three key areas:

Process: Improvements in fuel recycling that significantly minimize waste volumes, improve intrinsic proliferation resistance, increase resource use, and bolster AR commercialization.

Safeguards: Improvements in sensor and data fusion technologies that enable accurate and timely accounting of nuclear materials.

Waste Form: Development of high-performance waste forms for all AR classes with an emphasis on those forms that span multiple reactor classes

and disposal environments and are safe and stable over required timescales.

Source: <https://www.energy.gov/articles/doe-announces-40-million-reduce-fuel-waste-advanced-nuclear-reactors>, 19 May 2021.



Centre for Air Power Studies

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

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