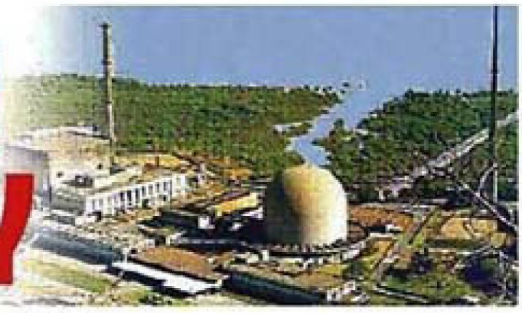
NUCLEAR SECURITY



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

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OPINION – James Clad

Thirty Years On, Arms Control has Slipped Off the Agenda

These days, it is hard to find much that's stable in contemporary 'strategic stability,' the polite phrase describing the balance of nuclear terror. Thirty years after the end of the Cold War, global efforts must resume to prevent the proliferation of weapons that can never be 'uninvented. Just a one-time 'tactical' use of a nuclear weapon would completely transform the world. Yet new technologies and deteriorating relations with China and Russia are now raising the risks. Technical upgrading of nuclear weapons continues to ensure the weapons' reliability; while this cannot be avoided, hugely de-stabilizing changes to the weapons' delivery systems can and must be slowed.

Recent reports describe Chinese orbital vehicles circling the globe, while Russia has just tested an anti-satellite weapon putting dangerous space trash into low earth orbit. The U.S. now strives to regain the hypersonic advantage. Thirty years ago, in 1991, a newly-independent Kazakhstan shuttered a 18,500 sq. km Soviet test site at Semipalatinsk which, since 1949, had conducted 1,100 nuclear tests – the equivalent of 2,400 Hiroshima-sized bombs. Since then, and with U.S. help, Kazakhstan has remained focused on non-proliferation. Former President Nursultan Nazarbayev had defied Moscow's wishes in 1991; five years later his country completely relinquished what had been the world's 4th largest nuclear arsenal. Accession to the NPT has kept it on this path ever since, managing its two contiguous nuclear-armed neighbours, China and Russia, while staying on good terms with the U.S. Consistent with this thrust, Kazakhstan recently launched the Global

Just a one-time 'tactical' use of a nuclear weapon would completely transform the world. Yet new technologies and deteriorating relations with China and Russia are now raising the risks. Technical upgrading of nuclear weapons continues to ensure the weapons' reliability; while this cannot be avoided, hugely de-stabilizing changes to the weapons' delivery systems can and must be slowed.

Alliance of Leaders for Nuclear-Free World, to rekindle the non-proliferation dialogue. A low-enriched uranium bank has been set up in Kazakhstan under the aegis of the IAEA. This 'LEU bank' has stockpiled 90 metric tons of low enriched uranium hexafluoride, a fuel for the most common light water reactor in use today.

Unlike the Trump era, the Biden administration wants strategic dialogue with China and Russia, especially as today's competitive great power environment poses an inherent risk of conflict. The new delivery systems pose the most immediate risks; hypersonic vehicles can now glide to targets undetected by a free-fall trajectory. This opens the spectre of a first-strike capability, the stuff of nuclear nightmares.

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Prioritizing arms control should not be a hard sell, but today's security agenda includes many threats — global pandemics, global warming, global migratory pressures, cyber security sabotage, and, not least, a rise in authoritarian leadership. Severally or collectively, none of these challenges equates to nuclear catastrophe. Avoiding nuclear war still comes first. The Kazakhs focus on 'old-fashioned arms control', curbing production and dispersal of nuclear weapons materiel, and slowing the build-up of nuclear arsenals now underway in North Korea, South Asia, and China.

Three decades have passed since Kazakhstan's bold move. Memories fade. The Trump administration's flippant attitude to arms control elicited matching disdain from Russia and indifference from China. Yet new trends in weapons miniaturization and in weapons delivery systems, worry the national security establishments of nuclear powers. When the cold war ended, bipartisan congressional leadership helped fund denuclearization programs in Kazakhstan and other former Soviet republics. This year, Kazakhstan's National Nuclear Centre signalled continuing support for strong "foreign partnerships" (meaning primarily the U.S.). In August, President Joe Biden sent a letter to Kazakhstan President Kassym-Jomart Tokayev, applauding the 30th anniversary of Kazakh independence and the closing of Semipalatinsk. Working with the U.S. Defense Threat Reduction Agency, the Kazakhs interact with China and Russia in ways we cannot. Kazakhstan's outreach includes interaction with European nuclear agencies, with Japan, and with the IAEA.

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Naturally, monitoring civil liberties and governance will also figure in any US relationship with Kazakhstan, or the other countries now adjusting to the Taliban victory in Afghanistan. Weakening a key non-proliferation partner makes little sense, especially with declining 'strategic stability'. There's lots of room to discuss secondary issues with Kazakhstan but preventing nuclear war still tops the list.

Source: https://insidesources. com/thirty-years-on-arms-control-has-slipped-off-the-agenda/, 02 December 2021.

OPINION – Nuclear Engineering International

Time to Show Nuclear can Deliver

In May the International Energy Agency (IEA) launched its 'Net Zero by 2050' report. Nearly 30 years from now it foresees a future where electricity accounts for almost 50 per cent of total energy consumption. In that future electricity plays a key role in transport, buildings and industry, and it is also essential to produce low emissions fuels such as hydrogen. That means, according to the IEA, that total electricity generation will increase by two-

and-a-half-times between today and 2050. And of course, that electricity has to be generated at zero carbon emissions. The IEA is clear on many sources of electricity. There should be no new investment decisions for unabated coal plants from now on, for example.

What is nuclear's role? That is not so clear. The IEA says that nuclear energy will make a "significant contribution" to its Net Zero Emissions scenario, and will provide an "essential foundation" in the transition to a net-zero energy system. But IEA language treats nuclear as an 'also-ran'. It says: "By 2050, almost 90 per cent of electricity generation comes from renewable sources, with wind and solar PV together accounting for nearly 70 per cent. Most of the remainder comes from nuclear."

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The World Nuclear Association (WNA) objects to this portrayal. Responding to the report, WNA said that IEA's projection underplays nuclear's potential contribution, compared to other power sources. WNA said the IEA's Net Zero Emissions scenario "puts too much faith in technologies that are uncertain, untested, or unreliable and fails to reflect both the size and scope of the contribution nuclear technologies could make." It described the IEA's lack of ambition in its assessment of the role of nuclear as "highly impractical", given the necessary timeline for reaching Net Zero. The IEA did, however, say that failure to take timely decisions on nuclear power would "raise the costs of a net zero emissions pathway and add to the risk of not meeting the goal." For Sama Bilbao y León, director general of WNA, that was a call to action. She said "Governments must now take action to ensure that nuclear energy can play a major role in the clean energy transition, to which so many of them have now committed."

The IEA's figures, which do anticipate some expansion of nuclear, illustrate this: in its Net-Zero scenario, the amount of energy supplied by nuclear power will increase by 40 per cent by 2030 and double by 2050, which means new nuclear capacity additions will reach 30GW per year in the early 2030s.

Who Estimates What? One thing that all organisations agree on is that global electricity use will grow substantially. That means without ambitious expansion plans nuclear will become less important in the electricity mix. The IEA's figures, which do anticipate some expansion of nuclear, illustrate this: in its Net-Zero scenario, the amount of energy supplied by nuclear power will increase by 40 per cent by 2030 and double by 2050, which means new nuclear capacity additions will reach 30GW per year in the early 2030s. The IEA also assumes extended operations of existing nuclear reactors, as according to the IEA "they are one of the most cost-effective sources of low-carbon electricity."

Nevertheless, because total electricity use is rising, that would see the share of nuclear energy in the global electricity mix falling from 10.5 per cent to 8 per cent. That low ambition contrasts strongly with the global nuclear industry's 'Harmony' goal, which would see nuclear energy provide at least 25 per cent of the world's electricity by 2050. To achieve this goal would require around 1000GW of new nuclear build and maximum contribution from reactors in operation today.

IPCC View: The bedrock of the switch to Net Zero generation is the International Panel on Climate Change (IPCC). How does it see nuclear? It lists nuclear among the "main mitigation options in the

energy supply sector", along with energy efficiency improvements, switching from (unabated) fossil fuels, renewable energy, and carbon capture and storage (CCS). However, it too sees the nuclear proportion declining in the short term.

In the Energy Systems chapter (chapter seven) of its recent assessment it says that in recent years, the share of nuclear energy in world power generation has declined from 17 per cent of generation in 1993 to 11 per cent in 2012. The trend began well before the incident at the Fukushima in March 2011, it says. The IPCC's role is not to advocate specific technologies to address global warming. But it considers some aspects of the nuclear power option.

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First it considers its emissions credentials. Emissions are associated with the manufacturing and installation of power plants, and that applies to any technology, but for nuclear power related emissions incurred, for example, during uranium enrichment, may be significant. But overall it says recent analysis confirms that nuclear can retain its 'low carbon' stamp, despite the emissions inherent in some parts of the fuel cycle such as enrichment and mining. What about resources needed for the long term? Fuel supply is not a problem, the IPCC says — uranium resources are sufficient to fuel existing demand for more than 130 years, "and if all conventional uranium occurrences are considered, for more than 250 years". What is more, "Fast breeder reactor technology can theoretically increase uranium utilization 50-fold or even more". However, the IPCC had a list of practical barriers to expansion that together place nuclear at a disadvantage when compared with other options.

Top of its list was nuclear's economic profile. While it agreed that nuclear power plants have low operating costs, "investments in nuclear power are characterized by very large up-front investment costs, and significant technical, market, and regulatory risks". Without support from governments, investments in new nuclear power plants are currently generally not economically attractive, although it considered that carbon pricing could improve nuclear's competitiveness.

Waste management costs also rated high on the list – although the IPCC acknowledged that a closed fuel cycle with fast breeder reactors would reduce the amount of high-level waste to be disposed of. Proliferation fears, and the need to secure access to fissile materials, was a related barrier. Other barriers relate to nuclear's contribution to overall supply and grid management.

Top of its list was nuclear's economic profile. While it agreed that nuclear power plants have low operating costs, "investments in nuclear power are characterized by very large up-front investment costs, and significant technical, market, and regulatory risks". Without support from governments, investments in new nuclear power plants are currently generally not economically attractive, although it considered that carbon pricing could improve nuclear's competitiveness.

Nuclear's very large potential also can present a practical issue. Investment may also be needed in expanding transmission to serve future nuclear plants if they are located at some distance from load centres. This can also be a slow process. In a UK meeting earlier this year network owner National Grid said it had been working on the connection for Hinkley Point C, currently under construction, for 17 years.

IPCC agreed that nuclear was a reliable – and large scale – supplier, with a 'capacity credit' higher than 90 per cent of its nameplate capacity.

That was similar to that of thermal plants with CCS, geothermal, and large hydro and considerably higher renewable energy generators.

However, in the future grid flexibility may be as important as capacity, and that was not a nuclear strength. IPCC said part-load operation of nuclear plants is possible as in France, but true variable load following "is more challenging and must be considered at the design stage". A high proportion of renewable generation. power, for example, "may not be ideally complemented by nuclear" – although the necessary flexibility could be supplied by third party providers.

SMRs can help address some of these barriers, and indeed the IEA recognises the importance of nuclear innovation with small modular reactors and other advanced reactor designs "moving towards full-scale demonstration, with scalable designs, lower upfront costs and the potential to improve the flexibility of nuclear power in terms of both operations and outputs, e.g. electricity, heat or hydrogen.

Finally IPCC noted the long life of assets in energy supply systems, of which nuclear's potential lifetime of up to a century is an extreme. Although the IPCC did not explicitly raise this as a barrier for nuclear, its implication was that there was a fear of making large investments in plant that may not meet future needs – the need for flexibility being an example. Fears of heavy investment in an asset that was later 'stranded' likely adds to the cost of nuclear investment and makes the Final Investment Decision more problematic. SMRs can help address some of these barriers, and indeed the IEA recognises the importance of nuclear innovation with small modular reactors and other advanced reactor designs "moving towards full-scale demonstration, with scalable designs, lower upfront costs and the potential to improve the flexibility of nuclear power in terms of both operations and outputs, e.g. electricity, heat or hydrogen."

If the nuclear industry aims to convince policymakers and investors that a large step-up in nuclear capacity is not just desirable but achievable, it should not delay. That places a responsibility on companies owning, managing and building plants to show that they can overcome the IPCC's barriers and allow policymakers to invest in new nuclear. Now is the time to show the industry can deliver.

What is the Right Ambition? Given the array of issues laid out by IPCC it is easy to see why the IEA is cautious in its ambition. Given the current imperative towards a larger Net Zero electricity system, is that caution justified? WNA says it is not, and that "By failing to consider with adequate ambition the contribution that nuclear energy could make, the ability to deliver on the IEA's Net Zero scenario has a much higher risk of failure." The IPCC, in contrasts, suggests that the current nuclear target is already ambitious and raising it would be unachievable. IPCC cites studies that says "depending on the assumptions about the technology portfolio, a quadrupling of the low-carbon share over 20 years (2030–2050) would lead on average to the construction of 29 to 107 new nuclear plants per year. While the lower-bound estimate corresponds to about the observed rate of nuclear power installations in the 1980s, the high estimate is historically unprecedented."

If the nuclear industry aims to convince policymakers and investors that a large step-up in nuclear capacity is not just desirable but achievable, it should not delay. That places a responsibility on companies owning, managing and building plants to show that they can overcome the IPCC's barriers and allow policymakers to invest in new nuclear. Now is the time to show the industry can deliver.

Source: https://www.neimagazine.com/features/featuretime-to-show-nuclear-can-deliver-9309592/, 08 December 2021.

OPINION – Christopher McFadden

Russia's S-500 Defense System is Ready to Launch. Is it the Ultimate F-35 Killer?

The F-35 is one of the most advanced flying machines ever developed by human beings. Sleek, stealthy, but very expensive, it should dominate the skies for many years to come. But, has it met its match with the development of the new Russian S-500 surface-to-air missile defense system? Let's take a look.

The F-35 is one of the most advanced flying machines ever developed by human beings. Sleek, stealthy, but very expensive, it should dominate the skies for many years to come. But, has it met its match with the development of the new Russian S-500 surface-to-air missile defense system.

What is the Russian S-500 Defense System?

The S-500 missile defense system, also known as the 55R6M (Triumfator-M) or "Promotey" ("Prometheus"), is a Russian developed surface-to-air (SAM) and anti-ballistic missile system developed to replace the older A-135 missile defense system currently in use. Intended to be used as a supplement, and eventual replacement, to the S-400, it has been in development since 2009, and was originally planned to enter production in 2014 but has been subject to years of delays.

According to some reports, the S-500 is one of the most capable missile defense systems ever developed and may even have space-defense capabilities, too. This cutting-edge piece of military hardware is capable of intercepting an array of aerial threats, ranging from UAVs to hypersonic and ballistic missiles up to a range of around 373 miles (600 km), and analysts claim it could even target satellites in LEO.

It differs in physical appearance from the S-400 by its distinct pair of much larger missiles launch tubes when compared to the S-400's quad setup. However, like the S-400, it will also be truck mounted. This will make the S-500 highly mobile, enabling the system to be deployed and relocated with relative ease.

"The S-500 anti-aircraft missile system has no [analogues] in the world and is designed to defeat the entire spectrum of existing and promising aerospace attack weapons of a potential enemy in the entire range of altitudes and speeds," the Russian Defense Ministry said in a statement. It differs in physical appearance from the S-400 by its distinct pair of much larger missiles launch tubes when compared to the S-400's quad setup. However, like the S-400, it will also be truck mounted. This will make the S-500 highly mobile, enabling the system to be deployed and relocated with relative ease.

A single S-500 platform is, purportedly, capable of tracking up to 10 hypersonic targets, as well as, detect hostile targets even in lower layers of space at altitudes up to 1,243 miles (2,000 km). What's more, is that these targets can be tracked when traveling at speeds of over 4 miles per second (roughly 23,170 km/h). This is thanks to the S-500's suite of distinct radar systems that are geared towards different targets, whether they be planes, helicopters, drones, or missiles. Little information is available on this subject, but most experts believe it likely utilizes the 1N6A(M) battle management radar, a modified 96L6-TsP acquisition radar, as well as the new 76T6 multimode engagement and 77T6 ABM engagement radars. This is primarily because the S-500's main focus though is intercepting intermediate-range ballistic missiles. In fact, its manufacturer, state-owned defense company Almaz-Antey Concern, has claimed that the S-500 could also strike low-orbit satellites and certain types of spacecraft in near space.

Russia is planning to export the system over the next few years, with serial deliveries scheduled for as early as 2025. They have already begun the training of specialists to learn how to operate the new system at the Military Academy of the Aerospace Force in Tver for a few years now.

The deliveries of the S-500 "Prometheus" anti-aircraft missile system to the external market are

expected in the next few years. At present, the permits for it have not been issued, according to Alexander Mikheev, CEO of state arms exporter Rosoboron, who spoke during the closure of the 2021 Dubai Airshow. According to Mikheev, the first operational S-500 missile defense systems could be ready for delivery by as early as the end of 2021. At present, Russia's main export, with regards to air defense hardware, is the Pantsir-S1 (codenamed the SA-22 "Greyhound" by NATO) and S-400 "Triumf" (NATO codename SA-21 "Growler").

The S-400 is widely considered one of the most capable, all-around strategic SAM systems in the world. Designed to provide aerial protection from aerial threats like cruise missiles, tactical and operational ballistic missiles as well as intermediate-range missiles in a radio-jamming environment, and it can also be used against ground installations. The S-500, however, can do everything the S-400 can do, and more.

Entering service in 2007, the S-400 is widely considered one of the most capable, all-around strategic SAM systems in the world. Designed to provide aerial protection from aerial threats like cruise missiles, tactical and operational ballistic missiles as well as intermediate-range missiles in a radio-jamming environment, and it can also be used against ground installations. The S-500, however, can do everything the S-400 can do, and more. Trials of the new system are very impressive indeed.

Both India and China have also expressed interest in the new S-500 system. Amazingly, the S-500 is not the end of the story. Russia is already planning its upgrade, called the S-550. Very little, if anything, is currently known about this newer system, however. For the US, there is one detail in particular about the S-500 that will certainly be making them feel a little nervous.

In 2020, the S-500 was put through its paces at the Army-2020 international arms show outside Moscow. During the trials, the S-500 anti-aircraft missile system struck a target at a range of 299 miles (481 km), which was 50 miles (80 km) further than any existing anti-aircraft missile system. The S-500 is also much quicker than its predecessor, the S-400. According to some reports, it has an average response time of three to four seconds — roughly six seconds faster than the S-400. Some NATO members, like Turkey, have even signed contracts with Russia for the S-400 system way back in 2017, much to the displeasure of other NATO members. India has also signed a $5.43 billion contract for the supply of the S-400 Triumf, which envisages delivery beginning by the end of 2022. Both India and China have also expressed interest in the new S-500 system. Amazingly, the S-500 is not the end of the story. Russia is already planning its upgrade, called the S-550. Very little, if anything, is currently known about this newer system, however. For the US, there is one detail in particular about the S-500 that will certainly be making them feel a little nervous. Claims are circulating, whether unfounded or not, that the S-500 could be a "silver bullet" against stealth fighters such as the F-35. Let's see if there is any justification for such a bold claim.

How can You Track and Defeat a Stealth Aircraft? Before we get into the nitty-gritty of whether or not the S-500 could potentially knock out an F-35, let's first look at what is required to find, track, and destroy a stealth aircraft. A large object, like an aircraft, has some physical properties that can be exploited to identify, track, seek, and destroy them from a distance.

However, it is important to note that stealth technology is not necessarily about "hiding" the aircraft in plain sight, like a magician. It is more about offering the pilot increased freedom of movement, enabling them to decide where to position themselves and engage or disengage on their terms. Stealth technology is also not a singular technology. It is, in fact, a group of active and passive systems that work together to make radar and infrared detection more difficult than it

would otherwise be. Components like radiant-absorbent material (RAM) coating, electronic countermeasures (such as jamming), special composites, fuselage design, and construction are some notable examples.

For example, RAM coating is a special paint that contains tiny spheres coated with a substance such as carbonyl iron or ferrite. This enables the paint to absorb some of the incident energy from radar waves, thereby reducing their radar signature. While traditionally you would need to physically "see" a target to engage it, technological advancements over time have enabled military forces to be able to intercept enemy aircraft from a distance using radar and other sensors. Put into great effect during WW2, radar has been one of the primary remote sensing methods of detecting aircraft for many decades. In fact, it was in response to radar that stealth technologies were originally developed, in an attempt to reduce its effectiveness.

There are some reports that the over-the-horizon Russian "Podsolnukh" ("Sunflower") radar system, is capable of tracking stealth craft over great distances, but this is very much hotly debated. However, there are some periods when a stealth-capable aircraft could "stand out like a sore thumb" on a radar. This is the moment they are preparing to launch their payloads.

The first "true" stealth aircraft to enter service was the now venerable F-117A "Nighthawk," which was used to great effect during the aerial superiority phases of the First Gulf War. However, contrary to what some may believe, a stealth-capable aircraft is not invisible. In fact, "stealth" is something of an umbrella term used to describe a range of design features to reduce a vehicle's infrared, radar, visibility, and other electromagnetic signatures.

Modern stealth-capable craft like the F-35, for example, are primarily designed to be more-or-less, "invisible" to X-band wavelength radar systems. In fact, they will show up on a radar system, albeit producing a much smaller signature. The angular design and special materials used to build the fuselage give stealth-capable aircraft, like the aforementioned F-117A, a radar signature equivalent to a small bird. In theory, however, low-frequency radar systems should be able to detect even an advanced stealth fighter like the F-35, although it is not a foregone conclusion that they could. This is because targets tend to show much larger radar cross-sections under the low-frequency radar. However, so does every other object within range of the radar. This could include birds, passenger planes, etc, all of which make the signal very chaotic ("noisy") and hard to interpret.

Low-band radar systems are also not very accurate, and would only reveal the approximate location of an incoming stealth fighter, like the F-35. There are some reports that the over-the-horizon Russian "Podsolnukh" ("Sunflower") radar system, is capable of tracking stealth craft over great distances, but this is very much hotly debated. However, there are some periods when a stealth-capable aircraft could "stand out like a sore thumb" on a radar. This is the moment they are preparing to launch their payloads. To reduce their radar signature, stealth-capable aircraft usually store their weapons in internal bays. When these bays are opened, and weapons are exposed ready for launch, their radar signatures "spike". Such moments, if an enemy is aware enough, could provide a window of opportunity to detect and counter a stealth aircraft.

However, this would be a fleeting moment that would require very rapid response times from air defense systems. But, radar is not the only way to potentially detect a stealth craft. Another property that can be used is the craft's infrared signature. All things with mass, unless they are at absolute zero, give off some form of infrared light. While measures have been taken in the design of stealth-capable aircraft to reduce this to an absolute minimum, they still emit infrared light that, if it can be identified, can be used to defeat the aircraft.

In fact, most infrared-based tracking systems work by "seeing" the contrast between a potential target and its background. They want the target to basically "stand out". One potential solution is something

called infrared search and track (IRST) technology. While a relatively new development, it has undergone significant improvements over the last few decades.

Much improved sensors and algorithms have helped modern fighter aircraft, like the Eurofighter Typhoon, which is equipped with onboard IRST systems, and is jokingly said to be able to detect "a campfire on the Moon". "IRST looks for temperature differences using liquid hydrogen or nitrogen to cool the sensor to extremely low temperatures which provide a contrast to the outside. Then it relies on the fact that the air is very cold (at altitude) and any fighter airframe moving through the air at several hundred knots, or particularly supersonic, heats up a lot so temperature difference is huge," Justin Bronk, a Research Fellow specializing in combat airpower at the Royal United Services Institute told *Business Insider*.

While not necessarily a weakness, *per se*, the development costs of this craft are extortionate compared to more conventional aircraft. With some examples, like the B-2 "Spirit" stealth bomber costing an estimated $2 billion a unit, such a cost ties up a lot of resources in one place. This limits the number of them that can be deployed, let alone risked in combat.

While, theoretically, such a system could be used to track an F-35 at long range, such systems are fairly small and have a limited "field of view". You would, in other words, need to have a rough idea of where to look for an incoming stealth aircraft. Unlike radar, which can have a very wide sweep, systems like IRST are more directional and work more like a telescope.

Such systems can also be hugely affected by weather and tend to work best at night. Another weakness of stealth-capable aircraft is their specialization. Since their airframes, and overall design, are focused on delayed detection, they are not necessarily good all-rounders as aircraft. Notably, such aircraft are potentially vulnerable during air-to-air combat. Once one is spotted and engaged by fighters, like the Su-27, for example, they have a much lower chance of surviving the encounter.

However, this is putting the horse before the cart somewhat. After all, the whole point of stealth technology is to enable the pilot to decide when, and where, to engage an enemy — if at all. Therefore, such a head-on encounter with air superiority aircraft is highly unlikely. One another limitation of stealth aircraft that can be exploited is their cost. While not necessarily a weakness, *per se*, the development costs of this craft are extortionate compared to more conventional aircraft. With some examples, like the B-2 "Spirit" stealth bomber costing an estimated $2 billion a unit, such a cost ties up a lot of resources in one place. This limits the number of them that can be deployed, let alone risked in combat. In the end, since stealth aircraft are highly capable aircraft, they tend to be used sparingly and for more precision strike roles.

Has a Stealth Fighter Ever been Shot Down? While stealth-capable aircraft are incredibly impressive pieces of technology, they are not immune to being lost in combat. In fact, back in the late-1990s, this is exactly what happened. In March of 1999 during the NATO bombing campaign of Yugoslavia, one USAF F-117A "Nighthawk" was shot down by an S-125 Neva/Pechora surface-to-air missile. The weapons were fired by a Yugoslav army unit (the 3rd Battalion of the 250th Air Defense Missile Brigade), and the pilot managed to eject safely and was later rescued. The downed Nighthawk's "wingman" was also damaged by another surface-to-air missile, but managed to return to base. The offending missile was of Soviet design and is a two-stage rocket designed to counter manoeuvrable targets. The missiles themselves are aimed and guided by a series of radar systems that operate in the C-band, I/D band, and E-band radar ranges. These work together to acquire a target and guide its missiles into the intruder. However, according to some later analysis of the incident, the successful shot appears to have been a mixture of "complacency, strategy, and luck".

Previously, stealth aircraft were never sent along the same route twice when on the campaign. However, on this occasion, the plane did fly along a route used previously. The enemy was aware of

this route and was prepared accordingly. The next factor is that NATO communications had been partially compromised, and human spotters were used to report activities of NATO air force movements too. Since the F-117A's were also flying alone (with no electronic warfare aircraft like the EA-6B "Prowler" as escorts) and "blind" (they do not deploy their radar detection antennae during strike missions), they were effectively sitting ducks. All well and good, but since these are stealth-capable aircraft, how were they detected?

Low-frequency radar. Yugoslav forces deployed the P-18 "Spoon Rest D" early warning radar. These operate in the VHF frequency and are able to detect an aircraft at 200 nautical miles (370 km). By setting this radar to its lowest frequency it was found that even stealth-capable aircraft, like the F-117A, could be detected at a range of around 15 miles (24 km). However, this could not be used as a reliable method to guide a missile to the target. But, at very close range, the radar systems on their SAM units could do the rest. All the Serbs had to do was set up their units in ambush positions and wait. The F-117A crashed in a relatively intact state, and was not, to the surprise of many, destroyed by the USAF to prevent any recovery by enemy forces. This is partly because the F-117A, at this point, was a relatively old aircraft, well known to the public, and often displayed at air shows.

Can the S-500 Take out an F-35 Stealth Fighter?

Since stealth technology has been defeated before by SAM units, you might be wondering if their latest model, the S-500, could do the same with the most modern stealth fighter, the F-35? In order to answer this question, we first need to investigate what types of detection systems the S-500 has. Limited definitive information is available, but from what some have gleaned it does appear to have a suite of different kinds of radar systems. For example, the S-500 comes equipped with a revised 96L6-TsP acquisition radar, and the new 76T6 multimode engagement and 77T6 ABM engagement radars. The former is a direct derivative of the 96L6-1 series used as a battery acquisition radar in the S-400. This radar system is ideally suited for detecting and tracking ballistic missiles flying at high altitudes.

According to some sources, the system features four radar vehicles per battery, including the 91N6E(M) S-band acquisition radar, 96L6-TsP C-band acquisition radar, 76T6 multimode engagement radar, and 77T6 anti-ballistic missile engagement radar. This radar complex reportedly allows the S-500 to detect ballistic and airborne targets at up to 1,243 miles (2,000 km) and 487 miles (800 km), respectively. Otherwise, apart from some comparisons with the existing S-400 system, little else is really known. So, can any of this information help us find out if the S-500 could detect and counter stealth-capable craft like the F-35?

The S-500 comes equipped with a revised 96L6-TsP acquisition radar, and the new 76T6 multimode engagement and 77T6 ABM engagement radars. The former is a direct derivative of the 96L6-1 series used as a battery acquisition radar in the S-400. This radar system is ideally suited for detecting and tracking ballistic missiles flying at high altitudes.

Let's start with radar. Since we could in theory detect a stealth fighter using low-frequency radar (usually less than 1 Ghz), are any of the systems on the S-500 low frequency? The 91N6E(M) is an S-band radar that operates on a wavelength of 8-15 cm and a frequency of 2-4 GHz which means it is not easily attenuated which is well within the usual radar range. The 96L6-TsP C-band acquisition radar operates within the microwave spectrum of between 4 and 8 gigahertz. Such systems are more usually used for satellite communications, Wi-Fi, and some surveillance and weather radar systems. For the S-500, this radar is designed for all-altitude surveillance radar intended specially to detect ballistic missiles as well as hypersonic missiles and aircraft flying at very high altitudes. So far, no dice.

The most interesting part is the reference to the 76T6 multimode engagement radar. This is very new, and very little technical information is available. However, its main role is for airborne target acquisition and tracking. This may well have the ability to identify and track aircraft with low radar cross-sections, like the F-35, but no one

can say for sure. However, like all stealth-capable craft, it could probably pick up the spike generated from the F-35 exposing its weapons systems. However, it would need a very quick reaction time (which, admittedly, the S-500 is supposed to have) to acquire and then deploy ground-to-air missiles to attack such an F-35. By them, an attack may already be over. Whatever the case, in reality, U.S. military officials are certainly taking very seriously the claims that the S-500 has this capability.

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So what about infrared? Sadly we have no reliable information on that fact. Considering that most infrared detection systems are basically directional, you would need to know where to look in the first place. However, the real deterrent offered by a system like the S-500 might ultimately come down to basic economics (and a little blindman's bluff). Stealth-capable aircraft, like the F-35, are incredibly expensive pieces of kit to build and deploy. This means they cannot be deployed in huge numbers and, being such expensive pieces of kit, are unlikely to be put in harm's way just like that. Even a single loss of one, whether by accident or malice, is also very embarrassing for the fielding air force — and potentially damaging to its international reputation.

The S-400 series cost around $300 million per system, which is not cheap. While the F-35 cost an estimated $78 million each, these planes also have significant running costs over their lifetime and cost around $38,000 per hour to fly.

The S-400 series cost around $300 million per system, which is not cheap. While the F-35 cost an estimated $78 million each, these planes also have significant running costs over their lifetime and cost around $38,000 per hour to fly. This "price tag" is also a little misleading as the entire development program has, by some estimates, proved to be incredibly expensive (perhaps as much as $1.7 trillion). What's more, SAM units like the S-400, and by extension, the S-500, are theoretically able to deal with several enemy aircraft simultaneously, and are cheaper to maintain and field over time. Although the missiles they carry do have a hefty price tag, it is not as much as an F-35.

However, this is also their weakness, from a SAM versus F-35 point-of-view. Russia, and other nations, currently do not have large numbers of the S-400 and the S-500 is yet to enter large-scale production. While the systems are impressive on paper, without actual units in operation defending a nation's airspace, any claims of their capabilities (whether true or not), are somewhat academic. You need to actually have the physical working machines in place for them to have any real advantage. According to some estimates, for the S-400 at least, this will take a few more years to build and deploy them in sufficient quantities. The S-500, which is still very much in development, is even fewer in number. With new stealth aircraft, like the new B-21, on the horizon, it may well be likely that the capabilities of the S-500 (if it is a real threat) will have been countered by newly-developed stealth technologies.

The existing fleets of F-35, if not replaced by an even more capable stealth fighter, will likely have been improved by future variants too. War technology is, after all, subject to the ever ongoing pressures of an arms race. So, can the new S-500 shoot down an F-35? The Russian's claim it can. The Americans are likely taking such threats very seriously. But, ultimately, until the two units actually meet in combat (which hopefully will never happen) we will never really know.

Source: https://interestingengineering.com/is-

russian-s-500-defense-system-the-ultimate-f-35-killer, 01 December 2021.

OPINION – Christina Lu

Can the Iran Nuclear Deal be Saved?

Nuclear Talks Stall Under Iranian Demands: After a week of tense negotiations to revive the 2015 Iran nuclear deal, officials were forced to suspend talks on 03 December 2021, raising key questions about whether the agreement can still be salvaged. Negotiators clashed over critical issues in Vienna, including U.S. sanctions and the Raisi administration's new hard-line stance. Western officials accuse Tehran of reneging on earlier concessions and proposing unacceptable alterations to the deal while simultaneously advancing its nuclear program. "Iran right now does not seem to be serious about doing what's necessary to return to compliance, which is why we ended this round of talks in Vienna," said U.S. Secretary of State Antony Blinken. "We will see if Iran has any interest in engaging seriously." With talks expected to resume later, officials are now scrambling to forge a new path forward—but many challenges stand in their way.

For an agreement to be made, Tehran insists Washington must first lift all sanctions, including ones unrelated to its nuclear program. It also wants keep the investments it has made in nuclear projects—and have a guarantee that the US will not abandon the agreement again.

Sticking Points: For an agreement to be made, Tehran insists Washington must first lift all sanctions, including ones unrelated to its nuclear program. It also wants keep the investments it has made in nuclear projects—and have a guarantee that the US will not abandon the agreement again. But European negotiators say these requirements are irreconcilable with the terms of the original deal. "Iran is breaking with almost all of the difficult compromises crafted in months of tough negotiations and is demanding substantial changes to the text," diplomats from Britain, France, and Germany said in a joint statement.

Next Steps? For now, officials are preparing for the worst. Washington is now bracing "for a world in which there is no return" to the deal, according to a senior State Department official. If a final agreement is not struck, U.S. officials are preparing to add sanctions or resort to other diplomatic tools, including isolating the regime. Even if Washington can't provide a guarantee that future administrations will maintain the deal, there are other ways to bridge the gap. There is also another option: a partial nuclear deal. Western officials have weighed offering Tehran slight sanctions relief in exchange for scaling back of its nuclear projects, similar to a pact that was made in 2013. But Iranian negotiators have rejected such an idea, and Israel has warned that such a deal would only reward Tehran for its behaviour and "nuclear blackmail." As negotiations stall, frustration is mounting. "What Iran can't do is sustain the status quo of building their nuclear program while dragging their feet on talks," Blinken said. "That will not happen."

Source: https://foreignpolicy.com/2021/12/06/iran-nuclear-deal-raisi-blinken-eu/, 06 December 2021.

OPINION – Peter Hussey

Minimum Deterrent No More: Where China's Nuclear Build-up is Headed

Nuclear issues are very much in the news now. For the past year, senior U.S. military officials have been quietly warning U.S. policymakers that China's build-up of nuclear weapons is a serious threat to the US.

Then late this summer, satellite pictures of multiple missile fields with hundreds of Chinese missile silos—completed or under construction—were publicly revealed. They number over 350 silos. While skeptics initially dismissed the silos as nothing more than wind farms, it soon became apparent the Chinese were building a massive new nuclear capability that could in short order match or significantly exceed the totality of the U.S.

deployed strategic nuclear force. And thus, a debate began in the US over what it all meant. For example, how many missiles will actually end up being placed in the 350+ silos completed or under construction by China? If the DF-41 ICBM was the Chinese missile of choice, then each missile could carry from six to ten warheads, implying a future nuclear force at the high end of new estimates.

How many missiles will actually end up being placed in the 350+ silos completed or under construction by China? If the DF-41 ICBM was the Chinese missile of choice, then each missile could carry from six to ten warheads, implying a future nuclear force at the high end of new estimates.

Another part of the debate centered on whether the long-held conventional wisdom that China has a very limited supply of nuclear weapons fuel was still valid. Is the scope of Chinese missile deployments going to be controlled by China's warhead fuel supply? Or is China's goal to have as large a nuclear force as possible? In short, is it the nuclear fuel or the missiles themselves that are driving the Chinese build-up? Yet more important than the "what" of the discovered build-up is the "why." What is China trying to achieve politically, diplomatically, and militarily, and what effect would it have on U.S. and allied security?

China could likely produce enough nuclear fuel for 1,270 warheads—nearly the same as the number of nuclear warheads the US now deploys on a day-to-day basis on its intercontinental ballistic missiles.

The good news is that recent discoveries have moved the debate over China's nuclear future from mere guessing to being more grounded in facts. In three key areas, skeptics—that had previously concluded that China's minimal nuclear forces were nothing more than representative of the "peaceful rise" of a growing but benign nation—changed their minds.

In three key areas, China hawks and doves came to hold similar views.

The first occurred in early 2021 when skeptic Tom Cochran of the National Resources Defense Council and hawk Henry Sokolski of the Non-proliferation Policy Education Center published a lengthy assessment of China's nuclear fuel production that concluded that China could likely produce enough nuclear fuel for 1,270 warheads—nearly the same as the number of nuclear warheads the US now deploys on a day-to-day basis on its intercontinental ballistic missiles. But even more interesting, Sokolski and Cochran also assessed that China, under certain reasonable assumptions, could produce 2,500 bombs' worth of nuclear fuel, a dramatic ten-fold increase from the 250 warheads that the U.S. intelligence community believes to be now deployed by China. Subsequently, the U.S. Department of Defense projected that China would deploy 1,000 warheads by the year 2030, a four-fold increase from its previous assessments.

Though many China hawks believed China's plans included deploying warhead numbers in the thousands, nuclear skeptics at the Federation of American Scientists accepted the 1,000 projected deployment, and subsequently changed their description of China's nuclear strategy from "minimal" to "medium." This represents a second important change from the long-held historical narrative widely accepted among disarmament proponents that China held to a strategy of only deploying a benign, restrained "minimum" nuclear deterrent.

The importance of this change is how it is affecting U.S. perceptions of why China maintains nuclear weapons. If China had jettisoned its "minimal" deterrent strategy where only American cities were targeted, (as opposed to holding at-risk U.S. nuclear and

military assets), it became plausible that China was seeking—like Russia—a pre-emptive first strike: an "escalate to win" strategy where China's nuclear forces can serve "coercive" military objectives, and are not solely for defensive deterrent purposes. Unfortunately, despite the positive development where yesterday's skeptics of Chinese military power have accepted more realistic assessments of China's nuclear ambitions, shaky assumptions still are widely held. For example, many skeptics of Chinese military power have historically opposed a robust U.S. nuclear deterrent because it is unnecessary to deter China's "minimal" deterrent and would provoke an arms race with China (and Russia).

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In addition, rather than seeing China as equally responsible for engaging in serious arms control negotiations, China often got a pass. As nuclear experts Mathew Kroenig and Dan Negrea of the Atlantic Council recently explained, while China "is engaging in an across-the-board nuclear arms expansion," China repeatedly refused to even come to the table when U.S. administrations pushed for arms control talks. Part of the reason China feels free to take such a rigid position is there is no pressure on China to change course. Most American groups supporting arms control including unilateral U.S. reductions don't even demand that China offer the transparency necessary to determine the exact dimensions of its nuclear forces—without which arms deals are not credible. How can you verify an agreement where you don't know the accuracy of what the other party is claiming to field? There was a reason former President Ronald Reagan repeatedly warned that when it came to arms deals, it was "trust but verify."

Third, the disarmament community also sticks to a troubling assumption that China's decision to build and deploy 1,000 warheads by 2030 is the fault of the US. They apparently argue that China is building up its nuclear forces because the US built forty-four missile defense interceptors in 2003-2004 to protect itself from rogue states like North Korea and Iran. Thus, China has to overcome such defenses to have a credible deterrent.

Yet if you don't find the missile defense explanation credible, the skeptics have an alternative explanation. The Chinese nuclear expansion is a reasonable Chinese reaction to the United States engaging in what is described as a "nuclear arms race" or the United States threatening a nuclear first strike on China. But this argument falls flat. When completed, U.S. nuclear modernization will leave the US with no more nuclear warheads than it currently deploys under the 2010 New START Treaty, and nearly 90 percent less than at the height of the Cold War. Which raises the interesting question: How can an arms control deal (the 2010 New START Treaty) that skeptics support also fuel an arms race the skeptics oppose? Although it is heartening to see some experts "coming together" in their assessments of China's emerging nuclear strategy, there remain myriad factors that call into question the accuracy of the new intelligence community assessment that China's nuclear build-up will reach only 1,000 warheads at the end of this decade, some nine years hence.

The 1,000-warhead estimate assumes China will add to its arsenal an average of fewer than ten DF-41 missiles and seventy warheads per year. By comparison, sixty years ago, between 1962-1966, the US built 800 Minuteman silos and missiles at an average pace of .6 per day or at a peak pace of 1.8 per day! In light of the U.S. construction capability, I estimate that China—

currently extraordinarily capable of construction projects—could build and deploy missiles for the full 350 missile field in two to four years.

Given China's stance on nuclear transparency and arms control, what are the chances that cooperation with China will lessen the Chinese nuclear threat? As Kroenig and Negrea wryly note, proclaiming that the US "must cooperate with China on global challenges is like saying we must cooperate with burglars to reduce break-ins." Kroenig and Negrea support augmenting Washington's deterrent especially with respect to theatre forces in the Indo-Pacific, "to demonstrate to Xi [Jinping] that his aggressive arms expansion will only make China less safe. Seeing his security situation deteriorate may be the only way to persuade Xi to engage in arms control talks."

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Since 1987, the US has dramatically reduced its nuclear forces by well over 90 percent when one includes the theatre nuclear forces taken down by the INF Treaty and the presidential nuclear initiatives under President George H.W. Bush. On the other hand, China has grown its nuclear forces fifteen-fold and by the end of this decade may increase its forces fifty-fold, unprecedented in the entire nuclear age. China's fast-expanding arsenal of missiles involves a large-scale increase in size as well as mission, scope, and functionality, according to a recent DoD report on China. All of these developments are fortified by China's aggressive missile testing and modernization programs. "In 2020, the PLARF launched more than 250 ballistic missiles for testing and training. This was more than the rest of the world combined," DoD's 2021 Report on Military and Security Developments involving the People's Republic of China states.

According to Admiral Charles Richard, Commander of the U.S. Strategic Command, "We are witnessing a strategic breakout by China. The explosive growth and modernization of its nuclear and conventional forces can only be what I describe as breathtaking. And frankly, that word breathtaking may not be enough.

Others explain that Chinese submarines are fast developing new capabilities to hold the continental US at risk of catastrophic nuclear attack. China already operates six *Jin*-class SSBNs, or nuclear-armed ballistic missile submarines, armed with JL-2 missiles, yet the People's Liberation Army Navy is preparing to produce a far more lethal, longer-range JL-3 nuclear-armed ballistic missile variant.

Finally, as Mark Schneider of the National Institute for Public policy details in a new assessment, even the latest U.S. intelligence community projection of China's nuclear plans is considerably lower than material available in the public sector suggests, including from Chinese government sources: "The reality of what China is doing is far more threatening than the assessment contained in the Pentagon report. According to Admiral Charles Richard, Commander of the U.S. Strategic Command, "We are witnessing a strategic breakout by China. The explosive growth and modernization of its nuclear and conventional forces can only be what I describe as breathtaking. And frankly, that word breathtaking may not be enough." Vice Chairman of the Joint Chiefs of Staff General John Hyten stated that the Chinese orbital hypersonic weapons "look like a first-use weapon." Secretary of the Air Force Frank Kendall has warned that "China is

acquiring a first-strike capability." The Communist Party of China recently threatened Japan: 'We will use nuclear bombs first…. We will use nuclear bombs continuously. We will do this until Japan declares unconditional surrender for the second time."

Source: https://nationalinterest.org/feature/minimum-deterrent-no-more-where-china's-nuclear-buildup-headed-197386?page=0%2C1, 05 December 2021.

OPINION – Angelica Zagorski

The Cyclical Surge of Uranium

The demand for carbon-free energy is powering an increase in uranium mining projects. Nuclear power will play a major role in helping to increase electrification while also phasing out carbon-intensive sources of energy. Governments have been reluctant to support nuclear power because of its rising costs since the Fukushima disaster in 2011, and its potential environmental impacts. But with the world realizing the imminence of the climate emergency, many are seeing uranium's potential of providing reliable low-carbon electricity, which has been a big boost for developers and miners.

Consistently low prices and a lack of investment in new production have shrunk supplies of uranium across the globe. The pandemic amplified this issue through unplanned supply disruptions and increased demand for uranium from financial funds and junior uranium companies – in particular, the transition of the Uranium Participation Corporation to a uranium trust managed by Sprott Asset Management, with a $1.3 billion at-the-market feature.

Consistently low prices and a lack of investment in new production have shrunk supplies of uranium across the globe. The pandemic amplified this issue through unplanned supply disruptions and increased demand for uranium from financial funds and junior uranium companies – in particular, the transition of the Uranium Participation Corporation to a uranium trust managed by Sprott Asset Management, with a $1.3 billion at-the-market feature. Now, the World Nuclear Association is forecasting uranium demand to climb from 162 million pounds in 2021, to 206 million pounds by 2030 and 292 million pounds by 2040. However, the current primary supply is expected to decline 30 per cent by 2035 and 54 per cent by 2040 due to resource depletion. The World Nuclear Association said that intense development of new projects will be needed in the current decade to avoid potential supply disruption. Multiple major uranium projects are waiting to see an improved supply-demand market before they proceed with operations, and now might be the time for them to jump in.

In October 2021, the price of raw uranium was approximately US$48 per pound, just under its nine-year high of US$50.8 per pound reached in September 2021. According to Jeff Hryhoriw, director of government relations and communications at Cameco, all of this reinforces a point Cameco has been making for some time, that uranium fundamentals are pointing emphatically towards higher prices. "In a world where 85 per cent of our electricity still comes from fossil fuel sources, there is no clear pathway to sustainably achieve both electrification and decarbonization while maintaining a stable electricity grid without nuclear energy, powered by uranium, in the toolbox," Hryhoriw said. "Cameco's supply curtailments alone, both planned and unplanned, along with our purchasing activity, have resulted in at least a 145-million-pound swing in the supply fundamentals since 2016."

Cameco supplies uranium to the global nuclear industry and has recently partnered with GE Hitachi, GEH SMR Canada and Synthos Green Energy to potentially deploy BWRX-300 small modular reactors in Poland. This partnership would make it easier for Synthos to obtain affordable, on-demand, carbon-free electricity from a dependable, dedicated source. According to Hryhoriw, "Cameco has strategically positioned itself to benefit from the growing support for nuclear energy. We are well positioned to take advantage of a market where demand for nuclear power, both traditional and non-traditional, is growing, where we believe the risk to the uranium

supply is greater than the risk to uranium demand, and where we believe our strategic decisions and strategic patience provide us with resiliency in the face of unprecedented challenges and will result in the rewards that will come from having low-cost supply to deliver into a strengthening market." Companies like Denison and Defense Metals are following suit by investing to expand uranium production and utility around the globe.

Environmental, social and governance factors play a major role in this trend as not just governments, but many companies are making net-zero pledges to their stakeholders and customers. But there are many question marks when it comes to where uranium will come from in the future as its demand increases.

Defense Metals announced on Sept. 23 that it plans to re-evaluate its Athabasca Basin uranium projects, due to renewed and sustained uranium interest, which has driven uranium spot prices to multi-year highs. The Geiger North and Klaproth projects are surrounded by multiple major mining companies, which the company says gives it a strategic foothold in a proven and prolific uranium mining district. "The renewed interest in uranium has prompted Defense Metals to reassess its considerable land position in the prolific northeast Athabasca Basin," Defense Metals CEO Craig Taylor said at the time. Alongside it, Denison is now conducting a new feasibility study for its Wheeler River uranium project, the largest undeveloped uranium project in the eastern part of the Athabasca Basin in Saskatchewan. According to the 2018 pre-feasibility study, the project would have a projected 14-year mine life with probable reserves of 109.4 million pounds of uranium from 1.4 million tonnes grading at 3.5 per cent.

Environmental, social and governance factors play a major role in this trend as not just governments, but many companies are making net-zero pledges to their stakeholders and customers. But there are many question marks when it comes to where uranium will come from in the future as its demand increases. Because of the increasing perspective that the world needs uranium for nuclear power, increased mining and interest in uranium have driven market prices up. This pushes the uranium production cycle from low prices to a price surge, which then incentivizes mining. As of now, uranium's future is looking brighter than it has over the past decade.

Source: https://magazine.cim.org/en/news/2021/the-cyclical-surge-of-uranium-en/, 06 December 2021.

OPINION – Thalif Deen

Is a Nuclear-Weapons-Free Zone in the Middle East an Exercise in Futility?

Israel's nuclear capability is best characterised, idiomatically speaking, as the "elephant in the room" – an obvious fact but intentionally ignored. A Wall Street Journal cartoon once depicted a group of animals huddled together in the jungle with the elephant complaining: "I don't know why they keep ignoring me when I am in the room." Perhaps Israel prefers to remain tight-lipped in the company of the world's eight other nuclear powers– US, UK, France, China, Russia, India, Pakistan and North Korea—because it has never declared itself a nuclear power.

Last December, President-elect Joe Biden warned that if Iran went nuclear, Saudi Arabia, Turkey and Egypt might go nuclear too — "and the last goddamn thing we need in that part of the world is a build-up of nuclear capability." But like most US politicians and Presidents, including Barack Obama, Biden too believes that Israel's nuclear weapons are best ignored.

In an op-ed piece in the New York Times last August, Peter Beinart, a Professor of Journalism and Political Science at the City University of New York, said US attempts to feign ignorance about Israeli nuclear weapons makes a mockery of America's efforts at nuclear non-proliferation.

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US politicians and Presidents, including Barack Obama, Biden too believes that Israel's nuclear weapons are best ignored.

Back in 2000, says Professor Beinart, when Obama was asked by a reporter if he knew of any country in the Middle East with nuclear weapons, he said: "I don't want to speculate." It is time for the Biden administration to tell the truth, he wrote. But chances are remote. In the militarily and politically volatile Middle East, the nuclear weapons gamesmanship goes in circles and semi-circles reaching a point of no return.

If Israel gets away with its nukes, the Iranians argue, "why shouldn't we go nuclear too", while the Saudis, the Egyptians and Turks warn: "If Iran goes nuclear, we will follow too". Meanwhile, since 1967, five NWFZ have been established worldwide — in Latin America and the Caribbean, South Pacific, Southeast Asia, Africa and Central Asia. But such a weapons-free zone in the conflict-ridden Middle East continues to remain elusive. UN Secretary-General Antonio Guterres points out that the established five zones include 60 percent of the UN's 193 Member States — and cover almost all of the Southern Hemisphere. "Expanding such zones to more regions will strengthen global nuclear disarmament and non-proliferation norms and contribute to building a safer world". That is particularly the case in the Middle East, where concerns over nuclear programmes persist, and where conflicts and civil wars are causing widespread civilian casualties and suffering, undermining stability and disrupting social and economic development, he warned. Abdulla Shahid of the Maldives, President of the UN General Assembly, said nuclear disarmament and non-proliferation regimes remain pivotal in ensuring that such an intolerable reality never manifests.

If the talks are not successful, and Iran moves forward towards becoming a nuclear threshold state, it could produce a dangerous chain reaction which might motivate Saudi Arabia, Egypt, Turkey and perhaps others to also try to go nuclear, seriously destabilising the entire region.

And Nuclear-Weapon-Free Zones are crucial to the success of disarmament and non-proliferation regimes, he said. Like other regions, he argued, the geopolitics of the Middle East is complex. Reaching just settlements that will satisfy all parties requires sound diplomacy and negotiations based on good faith. The addition of nuclear weapons and other weapons of mass destruction to the region's politics will complicate an already challenging process, undermining trust and portending existential consequences. It was in recognition of this that the General Assembly mandated a nuclear-weapons-free Middle East in 1974, he noted, speaking during the second "UN Conference on the Establishment of a Middle East Zone Free of Nuclear Weapons and other WMDs".

Hillel Schenker, Co-Editor, *Palestine-Israel Journal*, told IPS there is no question that a Nuclear and WMD Free Zone in the Middle East is in the interests of all the peoples of the region. However, the issue of a WMD Free Zone is simply not on the political or public agenda in Israel, whose leaders and people find it very convenient to be the only presumed nuclear power in the region, he noted. "And it also doesn't appear to be on the agenda of the Egyptians who used to be the primary advocates for the Zone. Right now, the main possible step to advancing towards this goal is a successful conclusion of the talks being held in Vienna for a revival of the JCPOA, the nuclear agreement with Iran and the Western powers. Although Israeli Prime Minister Naftali Bennett and Foreign Minister Yair Lapid have expressed opposition to a renewed deal, many senior figures in the Israeli security establishment support it, and believe it was a major mistake for former Prime Minister Netanyahu to have urged former President Trump to withdraw from the JCPOA, he added.

If the talks are not successful, and Iran moves forward towards becoming a nuclear threshold state, it could produce a dangerous chain reaction which might motivate Saudi Arabia, Egypt, Turkey and perhaps others to also try to go nuclear, seriously destabilising the entire region, said Schenker. Dr M.V. Ramana, Professor and Simons Chair in Disarmament, Global and Human Security.

Director, Liu Institute for Global Issues at the School of Public Policy and Global Affairs at the University of British Columbia, Vancouver, told IPS

establishing a nuclear weapons free zone in the Middle East is not only a major challenge but it is also important. The challenge is primarily due to Israel's refusal to not just discuss its decades-old nuclear weapons programme but even acknowledge it, while at the same time attacking countries like Iran over even its nuclear energy related programmes, he argued. Being backed by the US, which adopts one rule for Israel and another rule for other countries, it is difficult to involve Israel. The only way to change this state of affairs is for efforts like this to be mounted. Even if they are not successful, they at least raise the issue publicly, Dr Ramana declared.

The strategic significance of hypersonic weapons technology has been exaggerated. Hypersonic missiles do not constitute a "game changer" in offensive military capabilities. The nuclear strike forces of the US, Russia and China already rely on ICBMs which travel at 20 times the speed of sound. The difference now is that shorter-range missiles can also achieve hypersonic speeds inside the Earth's atmosphere.

Source: https://www.sundaytimes.lk/211205/sunday-times-2/is-a-nuclear-weapons-free-zone-in-the-middle-east-an-exercise-in-futility-464271.html, 05 December 2021.

OPINION – Christoph Bluth

Fears of New Superpower Arms Race

According to media reports from Washington, the Biden administration wants to engage China in talks on arms control and non-proliferation. The US President, Joe Biden, and Chinese leader, Xi Jinping discussed the issue during their recent virtual summit. The issue has not previously been high on the agenda in talks between the two countries, but China's recent test of a hypersonic missile that can attack multiple targets in flight has lent a new urgency to US defence thinking. At the same time, Russia's recent test of a Tsirkon hypersonic cruise missile from a submarine in the north of the country has focused US military planners on the prospect of America falling behind its two superpower rivals in what some are seeing as a new arms race.

New Generation of Missiles? Hypersonic missiles are often defined as missiles launched by a rocket into Earth's upper atmosphere at speeds of Mach 5 and above (five times the speed of sound or 6,174 km per hour), before manoeuvring towards a target. Several countries already have ICBMs that travel just as fast – or even faster – but these cannot change trajectory once launched. The new generation of hypersonic missiles are equipped with glide vehicles that approach their targets at high speed in the final phase of flight. Russian President Vladimir Putin announced as long ago as 2007 that his country had developed a completely new technology for ballistic missiles, which he referred to as "hypersonic missiles". And from 2015, Russia has been testing new glide vehicles, called Avantgard, that are mounted on intercontinental missiles and can reach speeds of 7,000 km/h when approaching their targets. Putin said this was a means to counter US missile defence systems, developed after the withdrawal by the Bush administration from the Anti-Ballistic Missile Treaty in 2001.

The latest Chinese tests involved not only a hypersonic glide vehicle, but possibly a "fractional orbital bombardment system" that enables the release of various payloads in flight prior to entering the atmosphere, enabling multiple targets to be reached that can be very far apart from each other. If successful, this would give China a new capability to approach the US mainland from the south. That matters, because American early-warning systems and missiles defences are primarily oriented towards tracking ballistic missiles entering the atmosphere from a northerly direction, based on the expected path of Russian ICBMs.

The precise technology employed by this system is not yet fully understood. General Mark Milley, the chairman of the US joint chiefs of staff, referred to the test as "close to a Sputnik moment" (a reference to the first earth satellite launched by the Soviet Union in 1957). China has denied carrying out such a test.

Implications: The strategic significance of hypersonic weapons technology has been exaggerated. Hypersonic missiles do not constitute a "game changer" in offensive military capabilities. The nuclear strike forces of the US,

Russia and China already rely on ICBMs which travel at 20 times the speed of sound. The difference now is that shorter-range missiles can also achieve hypersonic speeds inside the Earth's atmosphere. The key issue is that US defence capability is not designed to deal with a substantial strike from Russia or China. It is primarily built to counter small salvos of missile launches from "rogue states" such as North Korea and Iran. The US actually relies on deterrence, based on a robust offensive strike capability as a deterrent to prevent a nuclear attack from either Russia and China.

Washington recently signed the AUKUS treaty with Australia and the UK. This is an agreement to deploy more ships and increase submarine patrols in the region, and has involved the US pledging to help Australia develop its own submarine capability. The patrols in the South China Sea are the likeliest flashpoint between China and the US and its allies.

The advent of hypersonic glide vehicles and even a fractional orbital bombardment system does not change that in the slightest. The US already uses the technology of hypersonic glide vehicles – not for use with nuclear warheads, but for conventional strikes as part of the US Global Strike Command. So, while the new technologies being developed by Russia and China do not change the strategic balance as such – and are not a significant threat in and of themselves – they constitute an alarming signal about the growing arms competition between the three powers. Both the development of new technologies and increasing the quantity of available weapons are potential future threats.

Conventional and Regional: While all eyes are on these new long-range hypersonic missiles, the real arms race is more likely to be in regional conventional weapons systems. China is increasingly deploying short- and medium-range ballistic missiles to counter US naval carrier groups in the disputed waters of the South China Sea and around Japan and Korea.

In response, Washington recently signed the AUKUS treaty with Australia and the UK. This is an agreement to deploy more ships and increase submarine patrols in the region, and has involved the US pledging to help Australia develop its own submarine capability. The patrols in the South China Sea are the likeliest flashpoint between China and the US and its allies. In the aftermath of the Trump administration's withdrawal from the INF Treaty, the US could consider deploying new medium-range missiles itself. The INF treaty would not have allowed medium-range missiles to be based in Guam, Japan or South Korea to counter China's ballistic missiles deployed against the US in the coastal regions. Now the US is free to deploy in the region. But to mitigate the build-up of tensions, a more wide-ranging and comprehensive approach – not only to arms control, but to the wider issues of security between the US, Russia and China – is becoming more urgent.

Ryabkov said Russia would be forced to act if the West declined to join it in a moratorium on INF in Europe - part of a package of security guarantees it is seeking as the price for defusing the crisis over Ukraine. Lack of progress towards a political and diplomatic solution would lead Russia to respond in a military way, with military technology.

Source: https://telanganatoday.com/fears-of-new-superpower-arms-race, 03 December 2021.

NUCLEAR STRATEGY

RUSSIA

Russia Says it may be Forced to Deploy Mid-range Nuclear Missiles in Europe

Russia said on Monday (13 Dec) it may be forced to deploy intermediate-range nuclear missiles in Europe in response to what it sees as NATO's plans to do the same. The warning from Deputy Foreign Minister Sergei Ryabkov raised the risk of a new arms build-up on the continent, with East-West tensions at their worst since the Cold War ended three decades ago.

Ryabkov said Russia would be forced to act if the West declined to join it in a moratorium on INF in Europe - part of a package of security guarantees it is seeking as the price for defusing the crisis

over Ukraine. Lack of progress towards a political and diplomatic solution would lead Russia to respond in a military way, with military technology, Ryabkov told Russia's RIA news agency.

Intermediate-range nuclear weapons - those with a range of 500 to 5,500 km (310 to 3,400 miles) - were banned in Europe under a 1987 treaty between then-Soviet leader Mikhail Gorbachev and U.S. President Ronald Reagan in what was hailed at the time as a major easing of Cold War tensions. By 1991, the two sides had destroyed nearly 2,700 of them. Washington withdrew from the pact in 2019 after complaining for years of alleged violations revolving around Russia's development of a ground-launched cruise missile that Moscow calls the 9M729 and NATO refers to as the "Screwdriver".

If NATO is right that Russia has already deployed this system in the European part of the country, west of the Ural Mountains, then Ryabkov's threat is an empty one, according to Gerhard Mangott, an expert on Russian foreign policy and arms control at the University of Innsbruck in Austria.

NATO says there will be no new U.S. missiles in Europe and it is ready to deter new Russian missiles with a "measured" response that would only involve conventional weapons. But Ryabkov said Russia had a "complete lack of trust" in the alliance.

But if Russia's denials are true, he said, then Moscow's warning is "the final signal to NATO that it should enter into talks with Russia about a freeze-freeze agreement." He added: "If NATO sticks with the position not to negotiate about a deal, then we will certainly see Russia deploy the Screwdriver missile at its very western border."

... He repeated a comparison he made between the current tensions and the Cuban missile crisis of 1962, which brought the United States and Soviet Union to the brink of nuclear war. Ryabkov said there were "indirect indications" that NATO was moving closer to re-deploying intermediate-range missiles, including its restoration last month of the 56th Artillery Command which operated nuclear-capable Pershing missiles during the Cold War. NATO says there will be no new U.S. missiles in Europe and it is ready to deter new Russian missiles with a "measured" response that would only involve conventional weapons. But Ryabkov said Russia had a "complete lack of trust" in the alliance. ...

Source: Alexander Marrow and Mark Trevelyan, https://www.reuters.com/world/russia-says-lack-nato-security-guarantees-would-lead-confrontation-ria-2021-12-13/, 13 December 2021.

BALLISTIC MISSILE DEFENCE

INDIA

India Successfully Test-Fires Short Range Surface to Air Missile Off Odisha Coast

The indigenously designed and developed Vertical Launched Short Range Surface to Air Missile (VL-SRSAM) was successfully test-fired off the coast of Odisha. In a major boost to India's Navy, the indigenously designed and developed Vertical Launched Short Range Surface to Air Missile (VL-SRSAM) was successfully test-fired from a static vertical launcher in the Integrated Test Range (ITR), off the Odisha coast at Chandipur. The VL-SRSAM, developed by the DRDO for the Indian Navy, has an operational range of 50 to km distance and features mid-course inertial guidance through fiber optic gyroscope and active radar homing in terminal phase.

Defence Minister Congratulates DRDO, Indian Navy: Defence Minister Rajnath Singh congratulated DRDO, the Indian Navy and the industry for the successful flight test of Vertical Launch Short Range Surface to Air Missile. His office wrote on Twitter, "He (Rajnath Singh) said that this system would further enhance defence capability of Indian Naval Ships against aerial threats." Ahead of the test firing of the tactical missile, Balasore district administration as a safety measure temporarily shifted more than 4,500 people residing within 2.5 km radius of launch pad number 3 of the ITR from where the weapon with a dummy pay load was positioned and launched. A district revenue official said, on the request of ITR authority people residing in six hamlets in close proximity to the ITR launch site had to be temporarily shifted to

nearby shelter centers with compensation. They will return to their homes after the DRDO gives the green signal for it. ...

Source: https://www.republicworld.com/india-news/general-news/india-successfully-test-fires-short-range-surface-to-air-missile-off-odisha-coast.html, 07 December 2021.

Although ICBMs are typically defined as having a range of 5,500 kilometers or more, independent assessments put the full range of the Agni-5 at 8,000 kilometers with a 1.5-ton warhead. The solid-fuelled, canister-launch configuration makes the Agni-5 more mobile and allows for the system to be fired more quickly.

India Tests Missile Capable of Reaching China

India successfully tested an ICBM in an apparent effort to signal advances in its nuclear deterrent to China. The Agni-5 ballistic missile is capable of striking targets at ranges up to 5,000 kilometers with a "very high degree of accuracy," according to an Oct. 27 statement from the Indian Ministry of Defence. The launch was conducted from India's test site on APJ Abdul Kalam Island. The missile, a three-stage, solid-fuelled system launched from a canister, was last tested in 2018. Although ICBMs are typically defined as having a range of 5,500 kilometers or more, independent assessments put the full range of the Agni-5 at 8,000 kilometers with a 1.5-ton warhead. The solid-fuelled, canister-launch configuration makes the Agni-5 more mobile and allows for the system to be fired more quickly.

...Several Indian media outlets quoted unnamed officials as saying that the test was meant to signal India's military capabilities to China as a border dispute between the two countries continues to inflame tensions. Although the Defence Ministry statement did not directly reference China, spokesperson Lt. Col. Abhinav Navneet tweeted on Oct. 28 that the Agni-5 is "capable of neutralizing targets threatening India's Sovereignty & Territorial Integrity." China did not respond to the launch, but when India announced plans to test the Agni-5, Chinese Foreign Ministry spokesperson Zhao Lijian said on Sept. 16 that UN Security Council Resolution 1172 "has clear stipulations" regarding India's development of ballistic missiles and that Beijing hopes all parties will make constructive efforts to maintain peace, security, and stability in South Asia. ...

Source: Kelsey Davenport, https://www. armscontrol.org/act/2021-12/news/india-tests-missile-capable-reaching-china, 03 December 2021.

NUCLEAR ENERGY

GENERAL

How Nuclear Power Figures into a Green Energy Future

NPR's David Folkenflik speaks with former Energy Secretary Ernest Moniz about the role of nuclear power in a green energy future.

David Folkenflik, Host: When I say the words clean energy, you may think about wind turbines or solar panels. What about nuclear power plants? That $1.2 trillion infrastructure bill recently signed by President Biden, it sets aside money to invest in cleaner sources of energy. That includes wind and solar. It also includes nuclear energy. So what role can nuclear power play in helping the country reduce or even eliminate carbon emissions into the environment? We asked Ernest Moniz for his insights. Moniz served as energy secretary under President Obama. He's now president and CEO of the Energy Futures Initiative. And it's important to note he also currently advises and serves on the boards of three companies with stakes in the nuclear and energy sectors. When we talked, I asked him first for his reaction to the recent climate conference in Scotland and the commitment made by the U.S. at that gathering to reduce carbon emissions sharply.

Imean, we've taken a very tough objective for 2030, which is a reduction by about 50% - 50% to 52% to be precise - relative to 2005. And then, of course, for 2050, we've chosen for - to strive for net zero, meaning essentially no additional greenhouse gas load in the atmosphere. And these are tough.

***Ernest Moniz*:** Well, it's very tough. I mean, we've taken a very tough objective for 2030, which is a reduction by about 50% - 50% to 52% to be precise - relative to 2005. And then, of course, for 2050,

we've chosen for - to strive for net zero, meaning essentially no additional greenhouse gas load in the atmosphere. And these are tough. Certainly, to get there, we will absolutely need to continue the strong decarbonization of the electricity sector in particular.

***Folkenflik*:** What do you envision as the role of nuclear energy in our efforts to reach that goal you just described, the net-zero carbon?

***Moniz*:** Well, nuclear energy today is by far the largest source of carbon-free electricity in the United States. That's a fact. That's indisputable. You mentioned the infrastructure bill, and there were two pieces in there for nuclear. One of them was $6 billion to help keep running the existing nuclear plants. And that was in recognition of their contribution to addressing climate. And if nuclear is to be a significant contributor to continuing to address climate change, we will need to build on top of the existing fleet some of these new technologies.

***Folkenflik*:** I grew up in the beaches of Southern California not far from San Onofre Nuclear Power Plant. You recently co-authored an op-ed in the *LA Times* with another former energy secretary, Stephen Chu, arguing for keeping open California's last nuclear power plant, Diablo Canyon, which is set to close in 2025. Why do you think that's a good idea?

***Moniz*:** Well, first of all, we acknowledge right up front that the agreement to terminate Diablo Canyon in 2025, it was a very complex, multi-stakeholder process. And, you know, we're not naive in thinking that - in fact, we say it would be at least as complex to go back and to modify. However, we also say that, you know, even in these few years since that agreement was reached, a lot has changed. Just in the last years, I think we have come close to a consensus that wind and solar and batteries need to be complemented by what is often called firm power. That is power that's available anytime you want it. Wind and solar do suffer the vagaries of the weather, for example. In fact, just recently in the U.K., there was a dramatic problem by the winds in the North Sea being essentially stagnant for quite a while.

***Folkenflik*:** You know, there's also the question - people aren't crazy to be worried about safety issues involving nuclear plants, right. I mean, you think Three Mile Island, you think Chernobyl, you think Fukushima. These things happen. What do you say to address the concerns of Americans who think about the dangers, think about the fact that we haven't figured out how to deal with the toxic waste thereby created in sustaining some of these nuclear power plants?

***Moniz*:** Yeah. The safety issue, first of all, the Chernobyl and Fukushima and Three Mile Island are very, very different types of events. And without underplaying it, but Three Mile Island - it's important to recognize that there was essentially no exposure to the public. Obviously, it was a disaster as far as the reactor goes, and there was certainly occupational exposures. But since then, the Nuclear Regulatory Commission in the United States certainly has upped the ante in terms of safety. And there's every indication that the plants are running quite safely.

And without underplaying it, but Three Mile Island - it's important to recognize that there was essentially no exposure to the public. Obviously, it was a disaster as far as the reactor goes, and there was certainly occupational exposures. But since then, the Nuclear Regulatory Commission in the United States certainly has upped the ante in terms of safety. And there's every indication that the plants are running quite safely.

On the other hand, the radioactive waste, there is no way to avoid that. If you are doing a nuclear fusion plant that is fissioning - breaking up uranium to produce the energy, you will produce fission products. Those are lighter nuclei that are radioactive. They dominate the radioactive and heat profile of the waste for a couple of centuries at least. And there's no way to avoid that. So I agree that addressing the nuclear waste issue is extremely important.

I would mention - and this may sound like science fiction to some, but it's not - there have also been remarkable strides taken in the last years in nuclear fusion where you bring together very light nuclei and fuse them together, releasing an enormous amount of energy. And the fusion process of providing nuclear energy does not have

that long-lived highly radioactive waste problem, nor does it have any risk to the public in terms of safety. So fusion would be a tremendous advance. I believe the scientific question about whether or not we can produce power plants will be answered in this decade. So I'm hoping that towards the end of this decade, we'll be able to demonstrate that process and begin to understand what the costs are in the real world.

***Folkenflik*:** That was former Energy Secretary Ernest Moniz, president and CEO of the Energy Futures Initiative. Secretary Moniz, thanks so much for joining us.

Source: https://www.npr.org/2021/12/04/1061539850/how-nuclear-power-figures-into-a-green-energy-future, 04 December 2021.

Uranium will Rally in the Next 5 Years as a Shift to Nuclear Energy is Inevitable

Uranium surged this year making it one of the hottest commodities in 2021. Uranium spot prices hit a nine year high in September and are up about 50 percent year to date. "We are starting to see countries around the world accepting nuclear energy. Those countries realize if they want to reach a carbon neutral future, nuclear energy has to be part of the equation," emphasized Jon Bey, President and CEO of Standard Uranium.

Bey spoke to Michelle Makori, Lead Anchor and Editor-in-Chief of Kitco News at the Mines and Money London conference. Standard Uranium is a Canadian uranium exploration company. Also, uranium prices skyrocketed this year, because of the launch of the Sprott Physical Uranium Trust this summer. Sprott purchased millions of pounds of uranium this year. Uranium equites and uranium ETF's also rallied significantly in 2021.

"The spot price of uranium was trailing around $34 for a long time, and then Sprott unexpectedly came into the market. Sprott started buying uranium off the spot market, which led it to a nice rally from $34 up to $51," Bey said. "Uranium has come back down to about $46, but it's got a long way to go. The fundamentals, the big picture for the uranium market is strong. There is not enough supply out there to meet demand."

Bey explained why he expects there will be big moves to the upside for uranium prices in 2022. "There's demand coming from all over the world. China has just announced 150 nuclear reactors to be built in the next 15 years. And that's only one region. The U.S. has 95 nuclear reactors in operation," Bey said. "We now have bi-partisan support from both sides of government wanting nuclear reactors to stay operational longer, which is going to drive more demand." Bey discussed his short and long-term outlook on uranium. "Currently, the spot price of uranium is about $46, but in the next six to 12 months, the spot price could be trading in the mid $50's to the mid $60's," Bey said. "I would love to see it trading in the $80's to $90's over the next five years. It would allow our uranium companies to continue to finance, to do our work, and allow those mines to produce for many years and be profitable," he continued.

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"I don't know if uranium will hit its all-time high of $137 per pound like it did in 2007. There were a couple of major incidents that occurred that caused the price to go up then. A flooding of a mine took away a lot of available supply," Bey added. "Realistically, I would love to see the spot price hit the high $70's or $80's and stay there for the long term. This is quite sustainable for many mines." Bey stressed that the need for clean energy will take precedence over the stigmas of nuclear energy disasters. "Climate change, and the growing need for nuclear energy is taking over. For example, in Germany, the price of electricity has gone through the roof for reliance on solar and wind, while their carbon output has not really improved that much," he explained. "Countries around the world are comparing Germany to France. France has gone all in on nuclear energy, they are building more large reactors and moving to small modular reactors. They are producing clean energy and selling that to Germany. As climate change is

tackled, nuclear has to be part of the solution."

It was recently announced at the UN Climate Change Conference (COP26),

that nuclear energy will be included in Environmental, Social, and Governance (ESG) investing. This means for the first-time nuclear energy will be part of EU Taxonomy — which is a classification system of the European Union, establishing a list of environmentally sustainable economic activities. "This will allow funds to invest in nuclear energy when they are investing in ESG. This is a big change," Bey emphasized. "It hasn't happened yet, but it should happen in the immediate future." Bey pointed out that investing in nuclear energy will drive more capital into the uranium space. "It's going to drive more money into ETFs and equities. Hopefully, we will see uranium equities increase along with equities of companies like ours," he said. He spoke about how mining investors can benefit from the trend of people aggressively pushing for nuclear energy. "Investors should examine their portfolios on multiple levels. ...

Source: https://www.kitco.com/news/2021-12-09/Uranium-will-rally-in-the-next-5-years-as-a-shift-to-nuclear-energy-is-inevitable.html, 09 December 2021.

By 2024 you will have nine nuclear reactors plus 12 new additional ones which were approved during the Covid times with a capacity of 9,000 MW. Five new sites are also being identified," in different parts of the country.

As far as the cost is concerned, though it varies from plant to plant and on the age of the plant, Singh said on an average it comes to about Rs 3 per unit and while the Kudankulam plant has about Rs 4 per unit and Tarapur has lesser cost. But in the times to come, with more plants the cost would reduce.

INDIA

India Announces 'First of its Kind' Nuclear Programme, to have 9 Nuclear Reactors by 2024

India will have nine nuclear reactors by 2024 and a new nuclear project, the first in northern India, will come up 150 kms away from Delhi in Haryana's Gorakhpur, the government informed the Rajya Sabha. Minister of State for Personnel, Public Grievances and Pensions Jitendra Singh said, "By 2024 you will have nine nuclear reactors plus 12 new additional ones which were approved during the Covid times with a capacity of 9,000 MW. Five new sites are also being identified," in different parts of the country.

Replying to supplementaries during the Question Hour, he said what is remarkable is that unlike in the past when nuclear plants were limited to a few states like Andhra Pradesh and Tamil Nadu, the department has now moved northwards. ...

Asked whether the government is thinking of phasing out nuclear power plants on account of safety, the minister said, "We have not only increased the number but are also trying to make a pan-India generation project." The minister said that nuclear energy will soon emerge as one of the most important sources of alternative or clean energy for the increasing power demand of the country. As far as the cost is concerned, though it varies from plant to plant and on the age of the plant, Singh said on an average it comes to about Rs 3 per unit and while the Kudankulam plant has about Rs 4 per unit and Tarapur has lesser cost. But in the times to come, with more plants the cost would reduce, he said.

Mr Singh said it was during the tenure of this government that a bulk approval of 10 indigenous reactors was done in a single cabinet decision, which is a record in itself and has never happened in the history of independent India. In order to promote the setting up of new projects and to overcome the financial constraints that are faced in such situations, the PM took an out-of-box decision of allowing the atomic energy department to enter into joint ventures, which was never happening before, and the insurance pool has also been increased, Mr Singh told the upper house.

On the expansion of Kudankulam nuclear plant, the Minister also said that "hopefully in 2021, we plan to start the construction of unit 5 and unit 6 as well." Within the two terms of the present government, he said the Kudankulam plant will have as many as six units whereas in the earlier

UPA government hardly the first unit was in progress. Mr Singh said in 2017-18 there was a generation of 38,336 mega units of power, while this year ending 2020 despite the Covid pandemic it has been 46,472 mega units. During Covid itself we have increased the power generation by more than 4000 mega units in nuclear plans, he said. The minister said in spite of the Covid pandemic, because of the extra impetus given by the PM to the enhancement of atomic energy generation and setting up of new units of the reactor, the Kudankulam plant has been progressively showing new constructions and generation.

The Kudankulam plant will have as many as six units whereas in the earlier UPA government hardly the first unit was in progress. Mr Singh said in 2017-18 there was a generation of 38,336 mega units of power, while this year ending 2020 despite the Covid pandemic it has been 46,472 mega units. During Covid itself we have increased the power generation by more than 4000 mega units in nuclear plans.

On whether the atomic energy sector has suffered cuts in the budget due to Covid, the minister said in 2019, the PM took a decision to give us a ₹ 10,000 crore per year budget and this year also we had a budget of ₹ 17,796 crore. For next 10 years also, there is a plan to increase the budget by ₹ 10,000 crore per year, he said. The minister also informed that earlier, most of our nuclear projects were with the support of Russia and France and now more and more of our reactors are becoming indigenous. "The Budget proposed by DAE for Capital expenditure during 2021-22 was ₹ 17,796.24 crore and approved BE 2021-22 for Capital Expenditure is Rs11,403.20 Crore. There is a shortfall of ₹ 6393.04 crore. "However, it is brought out that due to COVID-19 Pandemic, the situation had not completely normalised at Project sites till the first half of 2021-22. Therefore, no major adverse impact is anticipated on the progress of various ongoing projects, the minister said in his written reply.

Source: https://www.wionews.com/india-news/india-announces-first-of-its-kind-nuclear-programme-to-have-9-nuclear-reactors-by-2024-433654, 03 December 2021.

India can't Meet Net-Zero Target without Nuclear Power, Says Anil Kakodkar

Former Chairman of Atomic Energy Commission says nuclear power alone can provide low-cost power and help in grid balancing. India cannot meet its net-zero emission commitments without nuclear power, says eminent nuclear physicist and former Chairman of the Atomic Energy Commission, India, Anil Kakodkar.

In a conversation with *Business Line*, Kakodkar said he endorsed India's pledges at the global climate conference, including achieving 500 GW of renewable energy capacity and getting half of India's energy requirements from non-fossil fuels, by the year 2030. However, he said that such a large integration of renewable energy into the grid would bring in its wake two problems – grid stability and cost of power. Kakodkar observed that while the cost of solar power at the point of generation had declined to low levels, if one included the costs of measures to maintain grid stability, the total cost to the consumer would not work out cheap. In this context, he said that nuclear power alone could provide low-cost power and help in grid balancing. Stressing that the current pace of nuclear power roll out in the country is "not good enough," he said, "there is a dire need to accelerate it."

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Reactors and Capacity: (India has at present 23 reactors with a total capacity of 7,480 MW, including the 700 MW KAPP-3 that was linked to the grid in January 2021. In addition, there is a plan to build a fleet of ten units of 700 MW of PHWR), which would add another 7,000 MW. And then, 8,000 MW of nuclear power plants are at various stages of construction, including the four Kudankulam units and the 500 MW Prototype Fast Breeder Reactor. The government expects the country to have 22,480 MW by 2031.)

Kakodkar observed that unlike earlier, availability of fuel was no issue. Not only is India able to procure uranium from abroad, but the availability of domestic uranium has also gone up. (India has 3.5 lakh tonnes of uranium ore, containing 2.97 lakh tonnes of uranium, most of it in Andhra Pradesh). He said that rather than one fleet of 10 of 700 MW, the country should be working on (say) four such fleets. Furthermore, he said that by redesigning the fuels so that they take longer time to burn-up (or exhaust themselves), it is possible to make nuclear power plants flexible—their generation could be raised or lowered depending upon the demand. In other words, nuclear power plants can be tweaked to "load-follow mode", something that is common in France, where 75 per cent of the energy is met by nuclear plants. Kakodkar called for "empowered implementation" to avoid delays, because at this scale of operation, even a one-day delay costs a lot of money.

SMRs would not replace the large reactors. However, it would make sense to plan for SMRs on the sites vacated by retired coal power plants. These sites, Kakodkar said, already have facilities such as water sources and railway sidings. An SMR program should run alongside the large nuclear plant program.

Small Modular Reactors: On SMRs — reactors of any size between 100 MW and 300 MW, which are now being talked about as the future of nuclear energy — Kakodkar said that SMRs would not replace the large reactors. However, it would make sense to plan for SMRs on the sites vacated by retired coal power plants. These sites, Kakodkar said, already have facilities such as water sources and railway sidings. An SMR program should run alongside the large nuclear plant program, he said. Asked if barge-mounted SMRs made sense, Kakodkar said that they would be very expensive, but could be used for meeting temporary emergency requirements.

Green Hydrogen: Asked if nuclear energy could be used for splitting water to produce hydrogen, Kakodkar said that high-temperature nuclear reactors could be used to generate heat, which could be used for thermochemical splitting of water into hydrogen and oxygen. Water splits into hydrogen and oxygen when heated — the heat can come from high temperature nuclear plants. This would be a cheaper way of producing hydrogen.

Source: https://www. thehindubusinessline.com/news/science/india-cant-meet-net-zero-target-without-nuclear-power-says-anil-kakodkar/article37827900.ece, 03 December 2021.

UKRAINE

Ukraine Commits to New Reactors from Westinghouse

Energoatom and Westinghouse have followed through on a September agreement and signed a contract to build two AP1000 reactors at Khmelnitsky. These are to cost $5 billion each and have 60% Ukrainian content. Financing will be from US Eximbank. Khmelnitsky units 4 and 5 will use AP1000 components sourced from the aborted VC Summer 2 & 3 project in USA. Components for unit 4 will be almost entirely from there. Energoatom said it expected to complete unit 3, a Russian VVER-1000, before 2025. It plans to build further AP1000 units at Zaporozhe, Rovno and South Ukraine, and beyond that: four AP1000 at Chehyryn in Cherkasy region and four at a new site in western Ukraine.

The goal is to have 24 GWe of nuclear plants operating by 2040, nearly double the present capacity, which comprises Russian reactors, mostly VVER-1000 commissioned in the 1980s. Just over half of Ukraine's electricity is supplied by these. The planned increase in nuclear capacity

is partly with a view to export to Poland and Hungary and partly due to the eastern Donbass coalfields adjacent to Russia being in contested territory. For fifteen years Energoatom has increasingly sourced fuel assemblies for the Russian reactors from Westinghouse in Sweden and about six of the 15 reactors are now supplied from there. There has been a series of plans for a fuel fabrication plant in Ukraine, the latest involving Westinghouse.

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Source: https://world-nuclear.org/our-association/publications/weekly-digest/latest-world-nuclear-association-weekly-digests.aspx, 26 November 2021.

USA

US Public Opinion Firms in Favour of Nuclear

Generally US public opinion regarding nuclear power has been positive for many years, and has firmed up as security of energy supplies became newsworthy. According to the latest study of US attitudes to energy carried out by environmental non-profit Eco America, support for nuclear power has grown 10 percentage points from 2018 to 2021, with 59% overall now saying they are strongly or somewhat in support. The highest levels of support were amongst males (72%) and adults over the age of 60 (69%). Those aged 18-29 were 57% supportive. Less than half of the females surveyed were found to support nuclear energy. The proportion of respondents who think the USA should spend more on nuclear energy R&D has increased since 2018 to 57%.

US attitudes to energy carried out by environmental non-profit Eco America, support for nuclear power has grown 10 percentage points from 2018 to 2021, with 59% overall now saying they are strongly or somewhat in support. The highest levels of support were amongst males (72%) and adults over the age of 60 (69%).

Source: https://world-nuclear.org/our-association/publications/weekly-digest/latest-world-nuclear-association-weekly-digests.aspx, 26 November 2021.

NUCLEAR COOPERATION

RUSSIA–SERBIA

Nuclear Technology Centre Planned for Serbia

Rosatom has signed a framework agreement with the Government of Serbia to build a nuclear technology centre in the country, including a cyclotron for medical isotope production. It comes as part of a growing trend of Serbian interest in nuclear. The new centre should be built "during the next three years" said the Serbian government, noting that it would "return our country to the map of European countries that have capabilities for scientific research in the field of nuclear technologies." ...

No specific site was mentioned for the new facility, but Serbia's Vinèa Nuclear Institute near the capital Belgrade would be a likely choice. It operated two small highly enriched uranium-fuelled research reactors supplied by the Soviet Union until 1984. Their used fuel was removed to Russia in 2010. The framework agreement was signed in Moscow 08 December, 2021, by Rosatom Overseas President Yevgeny Pakermanov and Nenad Popoviæ, Serbian Minister without Portfolio in charge of Innovation and Technological Development and president of the Intergovernmental Committee for Cooperation with Russia. It follows a 2019 intergovernmental development agreement and provides for practical work to begin in 2022. Radioisotopes for medicine and industry would be produced at the facility, alongside alloyed silicon. It would also provide services such as determining the composition of ores and other samples. ...

Source: https://www.world-nuclear-news.org/Articles/Nuclear-technology-centre-planned-for-Serbia, 09 December 2021.

USA–SOUTH KOREA

KHNP to Cooperate with US Nuclear Utility Cooperative

Korea Hydro & Nuclear Power has signed an agreement with US cooperative the Utilities Service Alliance - also known as USA - to cooperate in the development of innovative solutions to enhance nuclear power plant safety and performance within the Alliance's fleet and in the broader international commercial nuclear power industry.

The agreement was signed on 3 December in Washington, DC, by Utilities Service Alliance President and CEO John Christensen and KHNP President and CEO Chung Jae-hoon. The agreement provides a platform for KHNP and Utilities Service Alliance to exchange the latest safety practices and innovations to improve plant performance. Through the agreement, KHNP will work with Utilities Service Alliance, their subject matter experts and key plant leadership from leading US commercial nuclear operators. Under the agreement, KHNP will share its operating expertise from its fleet of 24 operating reactors and its operations and maintenance technologies, equipment and services that the company has established through its nearly 40 years of developing and operating nuclear power plants.

Source: https://www.world-nuclear-news.org/Articles/KHNP-to-cooperate-with-US-nuclear-utility-cooperat, 09 December 2021.

URANIUM PRODUCTION

CHINA

China's CGN Global to Supply Uranium Royalty with Physical Uranium

Uranium Royalty announced on 02 December 2021 that it has entered into a supply stream agreement with China's CGN Global Uranium to purchase 500,000 pounds of U3O8 from CGN delivered at Cameco from 2023 through 2025 at a weighted average price of $47.71 per pound. The company said that 300,000 pounds of U3O8 will be delivered on October 20, 2023, and additional 100,000 pounds of U308 each to be delivered on June 14, 2024 and April 2, 2025.

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CGN Global is the overseas nuclear fuel business platform of China General Nuclear Power Group (CGN), the world's third largest, and China's biggest nuclear power operator with 25 units in operation (28.26GWe installed capacity). CGN is also one of the world's largest nuclear power constructors with 6 units (7GWe installed capacity) under construction and has uranium production ownership interests in the Husab mine in Namibia and the Ortalyk, Irkol and Semizbay operations in Kazakhstan. ...Uranium Royalty is the world's only uranium-focused royalty and streaming company and the only pure-play uranium listed company on the Nasdaq. URC provides investors with uranium commodity price exposure through strategic acquisitions in uranium interests, including royalties, streams, debt and equity in uranium companies, as well as through holdings of physical uranium.

Source: Vladimir Basov, https://www.kitco.com/news/2021-12-02/China-s-CGN-Global-to-supply-Uranium-Royalty-with-physical-uranium.html, 03 December 2021.

NUCLEAR PROLIFERATION

GENERAL

AUKUS Sub Deal Triggers Debate on Nuclear Safeguards

Australia is expected to seek an exemption from the IAEA's safeguards system operated for the deployment of the country's first proposed nuclear submarines, which has raised concerns in the region over a potential weakening of the global non-proliferation regime. Australia unveiled

its AUKUS defense pact with the U.S. and the U.K. in September, with the aim of containing China's growing military might in the Indo-Pacific region. The prospect of a new entrant into the handful of countries deploying nuclear submarines has drawn criticism from some countries at the IAEA, whose safeguards are meant to stop countries that do not have nuclear weapons from developing them.

Australia is likely to become the first non-nuclear-weapons state that is part of the NPT to gain a nuclear sub. The Australian subs are expected to run on highly enriched uranium, which would mean they would not need new fuel rods during their lifetimes. But managing highly enriched uranium poses a challenge under the NPT.

Russia hopes that AUKUS participants "will come to the conclusion that they need to curtail the nuclear submarine project," Mikhail Ulyanov, Russian ambassador to international organizations in Vienna, told the IAEA Board of Governors. Russia is not alone in speaking out against AUKUS. "There is no guarantee that such nuclear material will not be diverted by Australia to the production of nuclear weapons," China's Permanent Mission in Vienna said in a letter to the IAEA dated October, proposing the creation of a special committee open to all IAEA members to discuss safeguards on naval nuclear technology.

Australia has been considered a model signatory to the NPT, becoming one of the first countries to enter into a comprehensive safeguard agreement with the IAEA, and agreeing to additional restrictions ahead of other countries in 1997. Still, concerns persist that suspending safeguards for nuclear submarine fuel could open up a crack in the non-proliferation regime.

Australia is one of roughly 190 signatories to the NPT.... The treaty bans states without nuclear weapons, like Australia, from developing or possessing them. It also requires these countries to submit to IAEA inspections of the location and size of their nuclear material stockpiles, in order to ensure they are put to peaceful uses. "The naval nuclear propulsion reactors and their associated nuclear material to be transferred by the U.S. and the U.K. to Australia cannot be effectively safeguarded under the current IAEA safeguards system," China said in its letter.

Six countries possess nuclear submarines. The U.S., the U.K., France, China and Russia are recognized under the NPT as nuclear-weapon states, while India is not a signatory to the treaty.

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Australia will seek to balance its nuclear submarine program and its commitments under the NPT. The NPT requires non-nuclear weapons states to enter into a comprehensive safeguard agreement with the IAEA. Under this agreement, a state is allowed to suspend safeguards of some nuclear material for a time if the state reaches an arrangement with the IAEA and as long as the material is not used in weapons production. Some experts say Australia may import the uranium in sealed reactors from the U.S. or the U.K., and return the still sealed reactors to those countries when the subs are decommissioned.

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"Some will argue that if Australia can be exempt from safeguards, other countries should have the option too," said Hirofumi Tosaki at the Center for Disarmament, Science and Technology in Tokyo. Australia should conclude an arrangement with the IAEA that narrowly defines the scope of the suspension and other conditions, Tosaki said.

President Xi Jinping told leaders from the Association of Southeast Asian Nations that China is ready to join the Southeast Asia Nuclear Weapon-Free Zone. The treaty, which has been ratified by the 10 ASEAN members, bans parties from developing or deploying nuclear weapons. Some voices in Indonesia's government have called for not allowing Australian nuclear subs to pass through the archipelago nation's waters, on the grounds that the Australian plan will only encourage an arms race in the Asia-Pacific.

China has responded to Australia's plans by giving voice to concerns over nuclear proliferation in the region. On Nov. 22, President Xi Jinping told leaders from the Association of Southeast Asian Nations that China is ready to join the Southeast Asia Nuclear Weapon-Free Zone. The treaty, which has been ratified by the 10 ASEAN members, bans parties from developing or deploying nuclear weapons. Some voices in Indonesia's government have called for not allowing Australian nuclear subs to pass through the archipelago nation's waters, on the grounds that the Australian plan will only encourage an arms race in the Asia-Pacific.

Source: https://asia.nikkei.com/Politics/International-relations/Indo-Pacific/AUKUS-sub-deal-triggers-debate-on-nuclear-safeguards, 01 December 2021.

IRAN

Iran Explosion Near Natanz Nuclear Facility a Controlled Test

A loud explosion was heard near Iran's main nuclear facilities in Natanz, which have previously been targeted by sabotage attacks, but state media said it was part of a controlled test. A major explosion and flash of light in the sky were reported around 8:15pm local time (16:45 GMT) on Saturday in Badroud, 20km (12 miles) from where the enrichment facilities are located.

Early reports speculated a surface-to-air missile defence system targeted a hostile object, most likely a drone. Nournews, an outlet close to Iran's security forces, confirmed an air defence missile was fired and exploded in the sky, but said it was part of a rapid reaction test. State television later confirmed this account, saying the test was part of drills that are regularly carried out under supervision from local air defence authorities. No damages were said to be incurred to the local area as part of the test. ...

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Exposing the Divide: Senior Iranian military officials regularly respond to Israeli threats by saying Israel does not dare attack as it will face a destructive response. Top Israeli officials renewed their threats against Iran when Iran and the world powers party to its 2015 nuclear deal reconvened in Vienna in an effort to restore the accord that the United States unilaterally abandoned in 2018.

The seventh round of the talks, which ended, were not promising, further exposing the divide between Iran and the West. An eighth round is expected. Israel has been the most vocal opponent of the deal, and fervently cheered former US President Donald Trump when he reneged on it, imposing harsh sanctions on Tehran. ...

Source: Maziar Motamedi, https://www.aljazeera.com/news/2021/12/4/iran-explosion-near-natanz-nuclear-facility-a-controlled-test, 04 December 2021.

US, Israel Defense Chiefs Discuss Iran as Nuclear Talks Falter

Defense Secretary Lloyd Austin met with his Israeli counterpart on 09 December, 2021, to discuss concerns over Iran and ways to prevent the country from obtaining a nuclear weapon, the Pentagon confirmed. During the meeting at the Pentagon with Israeli Defense Minister Benjamin Gantz, Austin "confirmed U.S. resolve to prevent Iran from obtaining a nuclear weapon," the Defense Department (DOD) said in a statement.

The two meetings come as indirect talks on restarting a nuclear deal with Tehran have hit a snag, with very little progress being made during negotiations in Vienna. Iran has already restarted production of enriching uranium, amassing a small stockpile of the material of at least 60 percent purity.

Austin and Gantz also "discussed shared concerns regarding Iran's nuclear provocations, support for terrorism, and missile program" and "reiterated U.S. commitment to Israel's security and qualitative military edge," according to the statement. While the DOD confirmed the meeting, a spokesman declined to address a Reuters report that said the two defense leaders would also touch on possible Iran-focused military exercises. "I know there's interest in a certain Reuters report," Pentagon press secretary John Kirby told reporters on 09 December, prior to the meeting. "I will tell you this, we routinely conduct exercises and training with our Israeli counterparts and I have nothing to announce to or speak to or point to or speculate about today."

Reuters reported that the two defense chiefs were expected to talk about possible military exercises meant to prepare for a worst-case scenario to destroy Iran's nuclear facilities should the US and Iran not be able to revive a 2015 nuclear deal abandoned by then-President Trump.

A senior U.S. official told Reuters that on Oct. 25 Pentagon leaders briefed White House national security adviser Jake Sullivan on military options available to prevent Iran from producing a nuclear weapon.

The two meetings come as indirect talks on restarting a nuclear deal with Tehran have hit a snag, with very little progress being made during negotiations in Vienna. Iran has already restarted production of enriching uranium, amassing a small stockpile of the material of at least 60 percent purity. ... Further signalling that the Biden administration is preparing for a possible fallout, the U.S. is considering sending a delegation to the UAE, a close trading partner of Iran, to discuss possible economic sanctions, *The Wall Street Journal* reported.... Nuclear negotiations were expected to resume on 09 December, and the U.S. special envoy for Iran, Robert Malley, is set to join them over the weekend.

Source: Ellen Mitchell, https://thehill.com/policy/defense/ 585144-us-israel-defense-chiefs-discuss-iran-as-nuclear-talks-falter, 09 December 2021.

NUCLEAR NON-PROLIFERATION

GENERAL

Japan PM Calls on Nuclear Weapons States to Boost Transparency

Japanese PM Fumio Kishida on 09 December, 2021, called on all nuclear weapons states to increase transparency in their capability as he pledged his utmost for the adoption of a final document at a U.N. conference on nuclear non-proliferation. Born into a family from the western Japanese prefecture of Hiroshima whose capital was devastated by a 1945 U.S. atomic bombing, Kishida told a nuclear disarmament meeting Japan will take the lead in bringing nations with differing positions on nuclear arms together to focus on promoting coordination in efforts toward a world free of such weapons. "Unfortunately, the reality facing the world is that discussion has not progressed over reducing the number of nuclear weapons, let alone nuclear abolishment. Rather, there are fears that the number of nuclear weapons will increase," Kishida told the virtual meeting of government officials and experts from

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Japan and abroad organized by the Japanese Foreign Ministry.

"The upcoming review conference is an opportunity to make the NPT foundation more solid and to rebuild a relationship of trust between nuclear and non-nuclear weapons states, and its outcome should lead to an exit, or a world free of nuclear weapons," Kishida said. He unveiled a plan to dispatch Minoru Terada, his special adviser on nuclear disarmament and non-proliferation, to relevant countries in a bid to lay the groundwork for the U.N. conference on the NPT in January.

North Korea's nuclear and missile development has been a security concern for Japan, which relies on the nuclear umbrella of long-time security ally the US. The growing influence of China, which has nuclear weapons, also keeps Japan on alert.

The U.N. review conference is held every five years to check its operation. It was initially due to take place in 2020 but was postponed in light of the COVID-19 pandemic. As foreign minister, Kishida attended the previous one in 2015 that ended without a final document due to disagreements. 09 December's meeting is a forum for participants from nuclear and non-nuclear weapons states to exchange views ahead of the January conference. North Korea's nuclear and missile development has been a security concern for Japan, which relies on the nuclear umbrella of long-time security ally the US. The growing influence of China, which has nuclear weapons, also keeps Japan on alert.

In his remarks at the virtual meeting attended by Gustavo Zlauvinen, President-designate of the NPT review conference, Kishida welcomed the U.S. move to resume its disclosure of nuclear weapons stockpiles to increase its transparency. As for the Treaty on the Prohibition of Nuclear Weapons, Japan has not joined it, defying calls from atomic bomb survivors. Kishida has acknowledged the treaty is an important one for a nuclear-free world but does not see it as an effective means to achieve that goal with no nuclear weapons states taking part.

Source: Fumi Matsumoto and Koya Jibiki, https://english.kyodonews.net/news/2021/12/e99d3536f0f0-japan-pm-calls-on-nuclear-weapons-states-to-boost-transparency.html, 09 December 2021.

Kazakhstan Praises Results of Recent P5 Conference on Non-Proliferation of Nuclear Weapons

The Kazakh Ministry of Foreign Affairs released a statement lauding the results of the P5 Conference of the Treaty on the Non-Proliferation of Nuclear Weapons, reported the ministry's press service. The representatives from the five NPT Nuclear Weapon States (NWS) also referred to as P5 including the US, Russia, the UK, France, and China met on Dec. 2-3 in Paris to discuss the agenda of the 10th NPT Review Conference. The NPT conference will take place at the United Nations headquarters on Jan. 4–28, 2022 in New York. As a result of the conference, the states declared their commitment to nuclear-weapon-free zones and support for "a world without nuclear weapons with undiminished security for all," according to the joint communiqué.

Kazakhstan as a staunch supporter of nuclear disarmament and strengthening the global nuclear non-proliferation regime, advocates the universalization of the NPT and strict observance of its provisions by all participating states, adheres to the need to ensure an open, inclusive and transparent dialogue to make the Review Conference a success.

Kazakhstan praised the efforts to reduce the risk of nuclear conflicts. This includes the exchange of information by the parties on updates in their nuclear doctrines and nuclear policy and a discussion by nuclear-weapon states of the importance of the entry into force of the CTBT and reaffirmation of the conference participants' ultimate goal to achieve a nuclear-weapon-free world with undiminished security for all. "Kazakhstan as a staunch supporter of nuclear disarmament and strengthening the global nuclear non-proliferation regime, advocates the universalization of the NPT and strict observance of its provisions by all participating states, adheres to the need to ensure an open, inclusive and transparent dialogue to make the Review Conference a success," reads the document.

Kazakhstan also reaffirmed its commitment to the goal of establishing nuclear-weapon-free zones and called on the global community to support the provisions of the Universal Declaration on the Achievement of a Nuclear-Weapon-Free World. Initiated by Kazakhstan, the declaration was approved by the UN General Assembly and co-sponsored by 35 countries in 2015. The document calls for the total elimination of nuclear weapons as the only absolute guarantee against their use or threat of use.

Source: https://astanatimes.com/2021/12/kazakhstan-praises-results-of-recent-p5-conference-on-non-proliferation-of-nuclear-weapons/, 07 December 2021.

Since 1967, five such zones have been established around the world: Latin America and the Caribbean, the South Pacific, Southeast Asia, Africa and Central Asia. They include 60 per cent of all UN Member States and cover almost all of the Southern Hemisphere. For the Secretary-General, expanding such zones would help build a safer world.

NUCLEAR DISARMAMENT

MIDDLE EAST

UN Chief Calls for Nuclear Weapons-Free Middle East

The UN Secretary-General on 29 November, 2021, called on all Middle East States to transform the vision of a region with no nuclear weapons, or other weapons of mass destruction, into a working reality. Antonio Guterres was speaking in New York at the second session of the Conference on the Establishment of a Middle East Zone Free of Nuclear Weapons and Other Weapons of Mass Destruction. Since 1967, five such zones have been established around the world: Latin America and the Caribbean, the South Pacific, Southeast Asia, Africa and Central Asia. They include 60 per cent of all UN Member States and cover almost all of the Southern Hemisphere. For the Secretary-General, expanding such zones would help build a safer world. ...

The UN chief also reiterated his call for all parties to exercise restraint and avoid escalation.

In this context, he highlighted the JCPOA, known commonly as Iran Nuclear Deal, saying that the return to dialogue is "an important step." The JCPOA was signed by Iran alongside the European Union and five permanent members of the/ Security Council: China, France, Russia, the United Kingdom, and the United States. However, Washington withdrew in May 2018, under the previous administration. Talks over Iran's nuclear programme and a revival of the JCPOA, have resumed in Vienna. "All parties must ensure this valuable instrument remains effective", he argued. For Guterres, the positive consequences of a Middle East free of nuclear weapons would extend beyond nuclear control. "It will strengthen the international bans on chemical and biological weapons. It will build trust, reduce tensions and prevent conflicts and human suffering", he argued. According to him, it would also de-escalate regional arms races and free much needed resources to tackle major challenges, including COVID-19, climate change, and achieving the Sustainable Development Goals.

The President of the General Assembly, Abdulla Shahid, also addressed the Conference, pointing out some progress such as the entry into force of the Treaty on the Prohibition of Nuclear Weapons, the renewal of the START treaty between the United States and Russia, and the ongoing talks on the JCPOA. He cautioned, though, that Member States' destructive capacity "has reached new extremes", with many continuing to invest, innovate and build this type of weapons. "It is not outside the realm of possibility that, on our current trajectory, every minor geopolitical squabble could trigger catastrophic global consequences", he said.

Currently, it is estimated that some 15,000 nuclear weapons exist in the world. The General Assembly mandated a nuclear weapons free Middle East, for the first time, in 1974. Like other regions, Mr. Shahid argued, the geopolitics of this part of the world are complex, and any settlements will require sound diplomacy and negotiations based on good faith.

"The addition of nuclear weapons and other weapons of mass destruction to the region's politics will complicate an already challenging process, undermining trust and portending existential consequences", he argued. Finally, the President of the General Assembly noted that not enough states have signed and ratified the CTBT, twenty-five years after its adoption. He also pointed to the 10th Review Conference of the Parties to the NPT, taking place in New York in January, as an opportunity to renew commitments.

Source: https://www.saudigazette.com.sa/article/614159/World/UN-chief-calls-for-nuclear-weapons-free-Middle-East, 30 November 2021.

The team observed that Senegal has established a nuclear security regime. The team provided recommendations and suggestions to support Senegal in enhancing and sustaining nuclear security. Good practices were identified that can serve as examples to other IAEA Member States to help strengthen their nuclear security activities.

NUCLEAR SAFETY

SENEGAL

IAEA Completes Nuclear Security Advisory Mission in Senegal

An IAEA team of experts completed...a nuclear security advisory mission in Senegal, which was carried out at the request of its Government. The International Physical Protection Advisory Service (IPPAS) mission, conducted from 22 November to 3 December 2021, was the first such mission in Senegal. The scope of the two-week mission included a review of the legislative and regulatory framework for the security of radioactive material; regulatory practices in licensing, inspections and enforcement; and coordination between stakeholders involved in nuclear security. The review also covered security systems and practices in place at selected facilities and activities using radioactive material. The IPPAS team also reviewed the country's implementation of the Convention on Physical Protection of Nuclear Material (CPPNM) and its Amendment, which Senegal ratified in July 2017.

The team observed that Senegal has established a nuclear security regime. The team provided recommendations and suggestions to support Senegal in enhancing and sustaining nuclear security. Good practices were identified that can serve as examples to other IAEA Member States to help strengthen their nuclear security activities. The team was led by Rachid Mellouki, Head of the Physical Protection Unit in the Safety and Security Department of the National Centre for Nuclear Energy, Science and Technology of Morocco. The team included four experts from Burkina Faso, Côte d'Ivoire, Niger and the US, as well as one IAEA staff. They met in the capital Dakar with senior officials from Senegal's Radiation Protection and Nuclear Safety Authority (ARSN), as well as with representatives of other relevant ministries and governmental organizations, including the Senegalese Inter-Ministerial Counterterrorism Prevention and Response and Coordination Body. As part of the mission, the IPPAS team visited six facilities using, storing or transporting radioactive material, including an industrial facility using radioactive material for non-destructive testing and an interim storage facility. ...

Background: The mission was the 96th IPPAS mission conducted by the IAEA since the programme began in 1995. IPPAS missions are intended to assist States in strengthening their national nuclear security regime. The missions provide peer advice on implementing international instruments, along with IAEA guidance on the protection of nuclear and other radioactive material and associated facilities. During a mission, a team of international experts observes a nation's system of physical protection, compares it with international good practices and makes recommendations for improvement. IPPAS missions are conducted both on a nationwide and facility-specific basis.

Source: https://www.iaea.org/newscenter/pressreleases/iaea-completes-nuclear-security-advisory-mission-in-senegal, 03 December 2021.

UGANDA

IAEA Reviews Uganda's Nuclear Power Infrastructure Development

An IAEA team of experts... concluded an eight-day mission to Uganda to review the country's infrastructure development for a nuclear power programme. The Integrated Nuclear Infrastructure Review (INIR) was carried out at the request of the Government of Uganda.

The Government of Uganda is committed to developing the required infrastructure for nuclear power in a coordinated approach with all concerned stakeholders. Uganda drafted an energy policy that includes nuclear power and established a Nuclear Energy Programme Implementing Organization (NEPIO). A NEPIO coordinates efforts among organizations and individuals who have roles to play in the process.

Electricity demand in Uganda, an East African country of 43 million people, has increased significantly in recent years in line with its growing economy. To diversify the national energy mix, which is now mainly based on hydroelectricity, Uganda has taken steps towards the introduction of nuclear power.

The INIR team reviewed the status of nuclear infrastructure development in Uganda using Phase 1 of the IAEA's Milestones Approach. The Ministry of Energy and Mineral Development (MEMD) of Uganda hosted the mission. It concluded that the Government of Uganda is committed to developing the required infrastructure for nuclear power in a coordinated approach with all concerned stakeholders. Uganda drafted an energy policy that includes nuclear power and established a Nuclear Energy Programme Implementing Organization (NEPIO). A NEPIO coordinates efforts among organizations and individuals who have roles to play in the process. Uganda's NEPIO has completed several studies on different infrastructure issues and drafted a Nuclear Power Roadmap for Uganda that makes recommendations for key decisions on the development of the infrastructure for nuclear power in the short, medium and long term. The INIR team made recommendations and suggestions aimed at assisting Uganda in making further progress in the development of its nuclear infrastructure and its readiness to construct the first nuclear power plant in the country.

The team pointed out that the Nuclear Power Roadmap for Uganda needs to be updated and completed by conducting further studies that provide a basis for informed decisions and commitments for the nuclear power programme.

...The INIR team comprised four international experts from Algeria, Morocco, Turkey and the United States of America, as well as seven IAEA staff. It reviewed the status of 19 nuclear infrastructure issues using the IAEA evaluation methodology for Phase 1 of the Milestones Approach. Prior to the mission, Uganda prepared and submitted a self-evaluation report and supporting documents covering all infrastructure issues to the IAEA.

The INIR team highlighted areas where further actions would benefit Uganda. For example, the team pointed out that the Nuclear Power Roadmap for Uganda needs to be updated and completed by conducting further studies that provide a basis for informed decisions and commitments for the nuclear power programme. Further areas the team raised included the need to finalize Uganda's energy policy; to strengthen its plans to join the relevant international legal instruments and to develop an adequate legal framework; to further assess and plan for the development of the human resources necessary for the nuclear power programme; and to further analyse the preparedness of the electrical grid and continue work in the areas of siting, environmental protection, financing, and radiation protection.

The team also identified good practices that would benefit other countries developing nuclear power in the areas of national position, stakeholder involvement and industrial involvement.

Welcoming the outcome of the mission, Hon. Dr. Ruth Nankabirwa Ssentamu, Minister of Energy and Mineral Development said: "The Government of Uganda is well aware of the importance of energy for socio-economic development to improve the lives of all our people. Nuclear power is envisaged to contribute to the electricity generation mix by 2031. As the country implements the National Development Plan III, the Government has taken the initiative to assess its readiness towards construction and operation of the first nuclear power plant by using the IAEA Milestones Approach. This Integrated Nuclear Infrastructure Review mission will assist Uganda in reviewing the current status of development of our nuclear infrastructure and support identifying those areas where further work is required." ...

Nuclear power is envisaged to contribute to the electricity generation mix by 2031. As the country implements the National Development Plan III, the Government has taken the initiative to assess its readiness towards construction and operation of the first nuclear power plant by using the IAEA Milestones Approach.

Source: https://www.iaea.org/newscenter/pressreleases/iaea-reviews-ugandas-nuclear-power-infrastructure-development, 08 December 2021.

USA–TAJIKISTAN

US Hands Over Radiation Detection Equipment Valued at over $1 Million to Tajikistan

U.S. Ambassador John Mark Pommersheim and a representative of the State Committee for National Security of Tajikistan (SCNS), participated in an equipment handover ceremony at the Regional Training Center of Tajikistan's Chemical, Biological, Radiological, and Nuclear Safety and Security Agency in Dushanbe.

The security support and radiation detection equipment and associated trainings, provided by the U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA) Office of Nuclear Smuggling Detection and Deterrence, will help Tajikistan's security forces combat the smuggling of nuclear and radioactive material into and within Tajikistan.

DOE/NNSA contributes a broad range of experience, expertise, and tools to support partners in developing national comprehensive detection programs to prevent and interdict illicit movement of nuclear and radioactive materials. Since 2013, DOE/NNSA has invested over $12 million U.S. dollars in counter-nuclear smuggling projects in Tajikistan. In addition to the new partnership with the SCNS, DOE/NNSA continues to cooperate with the State Customs Service, the State Border Guards, the Ministry of Internal Affairs, and the CBRN Safety and Security Agency under the Academy of Sciences to further develop Tajikistan's ability to combat the smuggling of nuclear and radioactive materials.

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The newly deployed equipment to the SCNS, valued over $1 million USD, includes a state-of-the-art mobile radiation detection unit, portable and handheld detection systems, surveillance gear, and vehicle inspection kits, as well as associated training and maintenance support, that will complement the SCNS's counter-smuggling operations throughout the country. In 2022, DOE/NNSA will also conduct a joint training with the U.S. FBI to strengthen Tajik agencies' law enforcement investigations in response to nuclear smuggling incidents.

Source: https://akipress.com/news: 665682: U_S__h ands_over_radiation_d etection_ equipment_valued_at_over_$1_million_to_Tajikistan/ , 07 December 2021.

NUCLEAR WASTE MANAGEMENT

AUSTRALIA

Australia Chooses Site for National Nuclear Waste Facility

The Australian Government has selected Napandee as the site for its National Radioactive Waste Management Facility (NRWMF), located near Kimba, South Australia (SA). Traditional owners continue to oppose the project, and reportedly plan to launch a judicial review. Environmentalists and others have also spoken out against the project, questioning the safety of moving radioactive waste and jobs claims made by the Government.

The planned site would provide a single, purpose-built facility to consolidate waste in line with international best practice. Australian Governments have been working to create such a site for more than 40 years. It would provide a permanent disposal site for low-level radioactive waste and temporary storage for intermediate-level waste. A separate future facility will permanently store the country's intermediate level waste.

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According to a 2020 joint report, Australia had about 4,146 m^3 of radioactive waste suitable for near-surface disposal that was in civilian programs awaiting disposal, and about 535.1 m^3 that was unsuitable. Currently, Australia's radioactive waste is stored at more than 100 locations across the country including the Australian Nuclear Science and Technology Organisation (ANTSO) Lucas Height's site, other scientific facilities, universities, and hospital basements. Though Australia has almost one third of the world's uranium reserves it lacks nuclear infrastructure such as power plants; though earlier this year it joined an international alliance to acquire nuclear powered submarines. However, according to World Nuclear Association, the country has a well-developed usage of radioisotopes in medicine, research, and industry.

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Napandee, which is 24 km from Kimba, has a total property size of 908.7 ha. The planned facility will be built on the approximately 211 ha of land which the commonwealth has acquired from the landowner. Pitt said it will be built after detailed designs, and technical and heritage studies are completed. The site's delivery and operation will be managed by the Australian Radioactive Waste Agency (ARWA), which is leading the process to responsibly manage the nation's radioactive waste. ARWA has also been responsible for the site selection process. The Government says the agency's commitment to working in a way that respects the views of those who have concerns will be paramount. The announcement is a step towards a A$31m (US$22.2m) Community Development Package to support the local host community.

The Guardian reports that the traditional owners of the land, the Barngarla people, will continue to fight to stop the planned facility. They unanimously opposed the proposal before the recent decision was announced but were reportedly excluded from the related ballot because they do not live in the council area. Now they intend to lodge an application for judicial review of the entire project.

Friends of the Earth Australia highlighted other hurdles for the Government including environmental assessment, assessment by the federal nuclear regulator Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), a state parliamentary inquiry, and upcoming state and federal elections. Jim Green, National Nuclear Campaigner at Friends of the Earth Australia disputed the number of jobs that would be created

and questioned the safety of moving intermediate-level waste to the new site temporarily. ...

Source: Amanda Jasi, https://www.thechemicalengineer.com/news/australia-chooses-site-for-national-nuclear-waste-facility/, 09 December 2021.

RUSSIA–FRANCE–CZECH REPUBLIC

Russia's TVEL Signs Decommissioning Agreements with French and Czech Companies

Rosatom's Fuel Company and decommissioning industry integrator, TVEL JSC on 2 December signed co-operation agreements on decommissioning with France's Robatel Industries and a group of French companies D&S Groupe as well as with Czech Škoda JS. The agreements were signed on the sidelines of the World Nuclear Exhibition (WNE 2021) in Paris.

The agreement with Robatel Industries, signed by TVEL director of decommissioning programmes Vadim Sukhikh and Robatel Industries' director general Christophe Brunel is aimed at joint participation in international projects and mutual strengthening of positions in the world market for renewable energy and radioactive waste management. It focuses on the tasks of compaction, conditioning and packaging of radioactive waste associated with decommissioning. The parties agreed to cooperate in various formats to provide services to potential customers.

By 2021, TVEL enterprises had implemented 39 unique projects spanning nuclear decommissioning, radioactive waste and the rehabilitation of territories on the territory of Russia.

... Sukhikh also signed a cooperation agreement with Julien Feya, president of D&S Groupe aiming at joint development of technologies for decommissioning nuclear and radiation hazardous facilities, engineering and waste management. D&S Groupe has broad expertise and a solid portfolio of completed projects in the field of nuclear waste disposal, radioactive waste management, nuclear and radiation safety. Another agreement with Czech Škoda JS, signed with commercial director Milos Mostecki is for cooperation in the decommissioning and dismantling of nuclear facilities, radioactive waste management and dismantling of nuclear and radiation hazardous facilities in Western Europe. Cooperation aims at joining efforts in order to develop technologies and manufacture equipment for the successful implementation of backend projects in Western Europe.

In 2019, TVEL was appointed as the single integrator of the Russian nuclear industry for the decommissioning of nuclear facilities and radioactive waste management. By 2021, TVEL enterprises had implemented 39 unique projects spanning nuclear decommissioning, radioactive waste and the rehabilitation of territories on the territory of Russia. As an industry integrator, TVEL seeks to strengthen the position of Rosatom in the global market. Currently Rosatom implements projects for the decommissioning of nuclear and radiation hazardous facilities, radioactive waste and used nuclear fuel management in 20 countries.

Source: https://www.neimagazine.com/news/newsrussias-tvel-signs-decommissioning-agreements-with-french-and-czech-companies-9297417, 03 December 2021.

SWEDEN

Decisions Coming on Swedish Waste Facility Applications

The Swedish government has stated that it intends to announce a decision on the expansion of the existing SFR repository for low and intermediate-level waste at Forsmark on 22 December. In a press conference...Minister of Climate and Environment Annika Strandhäll said a decision on the application for a final repository for used nuclear fuel also at Forsmark will be announced on 27 January.

Radioactive waste management company Svensk Kärnbränslehantering AB (SKB) submitted applications to build Sweden's first nuclear fuel repository and an encapsulation plant to the Radiation Safety Authority (SSM) in March 2011. The integrated facility - the encapsulation plant and the Clab interim storage facility at Oskarshamn - is referred to in SKB's application as Clink. The applications have been reviewed by the SSM and the Land and Environment Court. The SSM has considered issues of nuclear safety and radiation at the facilities as laid down in the country's Nuclear Activities Act. The review undertaken by the Land and Environment Court was based on the Environment Code. Both SSM and the Land and Environment Court submitted their respective positive opinions on SKB's applications to the government in January 2018.

The SFR repository at Forsmark, in the municipality of Östhammar, is situated 50 metres below the bottom of the Baltic Sea and began operations in 1988. The facility currently has a total final disposal capacity of about 63,000 cubic metres of waste. SKB applied in December 2014 to triple the size of the facility, to about 200,000 cubic metres. The applications were submitted to the government by the Land and Environment Court and SSM in November 2019. Under the Swedish Environmental Code, before the government makes a final decision, it must consult with the municipalities of Oskarshamn and Östhammar, which have the power to veto the application. In June 2018, the municipal council in Oskarshamn voted in favour of SKB's plan to build the fuel encapsulation plant in the municipality. The municipal council of Östhammar in October 2020 approved the planned repository at Forsmark.

The government announced on 26 August its decision to approve an expansion of the existing Clab interim repository for used fuel while continuing to consider SKB's application for an encapsulation plant and final repository. A new round of consultations on these with SSM and the Nuclear Waste Council subsequently began. The decision came despite industry warnings that separating the applications would create future disruptions to electricity supply due to a lack of interim used fuel storage capacity.

Announcing the dates on which decisions will be made on these applications, the government said in a statement: "The cases have the highest priority and the government works actively to ensure the safe handling of all issues ... Sweden's residents should be able to feel secure that the government has examined all issues and treated them with the respect they demand. The final repository must handle life-threatening radioactive waste for long periods of time and it is extremely important that it is correct."

It added: "In a case involving the storage of nuclear waste, high demands are placed on data and investigations. All issues need to be adequately investigated before the government makes a decision. When the final repository cases were handed over to the government in January 2018, they were not ready for decision. The government has been working on the cases since they came in and is now taking final measures prior to the decision."

Source: https://world-nuclear-news. org/Articles/ Decisions - coming-on-Swedish-waste-facility - applica, 08 December 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 Anil Chopra, PVSM AVSM VM VSM (Retd).

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