



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

OPINION – Manpreet Sethi

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China continues to make strides towards new military capabilities. The latest strategic technology to reportedly have been tested in August 2021 was a nuclear-capable hypersonic missile. China apparently used a rocket to propel a nuclear weapon into the low-earth orbit, which glided at five times the speed of sound, conducted evasive manoeuvres, and routed itself over the South Pole to hit the target. This combination of tactics was planned to evade the US early warning architecture designed to detect threats from the Northern Hemisphere. China claims though that it actually tested a reusable space plane, not a menacing missile.

Irrespective of what was tested, it is clear that China is amassing a formidable array of new capabilities. The US reacted to this test with shock and alarm. The American intelligence community expressed surprise at China's ability to pull this off, while Chairman, Joint Chiefs of Staff, Gen Milley, described this as the 'Sputnik moment'. In response, the US has reportedly conducted three tests of its own hypersonic missiles. Evidently, the US-China nuclear equation is heading deeper into the abyss of arms race.

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Evidently, the US-China nuclear equation is heading deeper into the abyss of arms race. How should India perceive the demonstrated Chinese capability? To start with, New Delhi should neither be surprised nor unduly alarmed at the development.

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should neither be surprised nor unduly alarmed at the development. From the time that the US headed towards BMD development and deployment, Beijing too had started developing capabilities that would deceive, overwhelm, penetrate and defeat the BMD. Building hypersonic delivery systems is one of these efforts and it should, therefore, not be surprised that new capabilities are being tested each time. Russia too is doing the same to build an 'invincible arsenal' against the US BMD.

Neither is there reason for India to be overly alarmed by this technology. The hypersonic missile is a new way of delivering nuclear weapons reliably into a heavily defended environment. Such a missile can go fast, which matters in the case of US-China, given their distance; it can manoeuvre, which is necessary for China to evade the US missile defences; it can hit the target after orbiting the earth, which is needed by China to avoid detection by the US radars. So, the missile is relevant for China to signal credible deterrence against the US.

Given that India's threat environment is so different from what China faces vis-a-vis the US, there is no need for a panic response. Nevertheless, India must continue with its own research and development on hypersonics, which it has been engaged in for some time now.

None of these considerations, however, necessarily apply to India. China is geographically close to India, so missile travel time is anyway short. China does not have a BMD of the US kind, nor an early warning system to threaten Indian missiles. In any case, ballistic missiles are hypersonic on re-entry into the atmosphere as they speed towards the target. If the re-entry warheads were multiple and manoeuvrable, they could anyway overwhelm a BMD.

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on hypersonics, which it has been engaged in for some time now. It is likely that China will enhance its own BMD in the years ahead. Being able to develop and deploy hypersonic missiles might make sense then. Meanwhile, this technology also offers civilian benefits such as reusable space planes that might revolutionise travel. Therefore, the important thing is to keep all options open, without necessarily rushing all investment in this direction. Building technological capability but staying short of overt deployment can have its own security benefits.

Would it matter if China had nuclear capable hypersonic delivery systems and India did not? No. This would not degrade India's nuclear deterrence as long as China remained vulnerable to Indian nuclear delivery, whatever the mode be.

Fortunately, India's delivery options have progressed well. Air delivery of nuclear weapons was the first option available to the country. Initially, given the limited reach of the aircraft's area of operations, it was assumed that using aircraft for delivery of nuclear weapons over targets in China would have to be one-way missions. With aerial refuelling now possible, this is no longer the case.

Meanwhile, land-based missiles of varied ranges and improved accuracies have steadily been developed and deployed. The need of the hour now, from the point of the threat from China, is to quickly induct and deploy Agni-V in requisite numbers. Meanwhile, the sea leg of the triad has been demonstrated with INS Arihant and the K-15 SLBM on it. However, effort must be towards quickly operationalising more nuclear submarines with longer range SLBMs so that the triad can signal greater deterrence credibility. Together, the triadic delivery options would give India the ability to signal assured retaliation capability. So, irrespective of the mode of delivery used by the adversary, it cannot hope to get away without suffering nuclear retaliation.

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Source: <https://www.tribuneindia.com/news/comment/stick-to-the-basics-of-nuclear-deterrence-338191>, 15 November 2021.

OPINION – Valerie Niquet

China's Nuclear Gambit

In July 2021, the United States launched its Nuclear Posture Review, aimed at reportedly reducing the importance of nuclear weapons. Amid this process, Washington's allies worry about possible evolutions in fundamental principles of nuclear deterrence. For that reason, in their joint statement published on October 29, the United States and France reasserted the importance of nuclear capability to "preserve peace, prevent coercion, deter aggression."

In September, pushing the debate already existing in the United States, Beijing's former U.N. representative for arms control, Sha Zukang, mentioned that China might abandon its long-term no first use doctrine, unless Washington decides to declare its own no first use policy.

Recently the world has been focusing on the intimidating expeditions of China's People's Liberation Army Air Force (PLAAF), when over several days in October more than 150 planes entered Taiwan's Air Defense Identification Zone (ADIZ). These maneuvers, however, took place more than 100 nautical miles away from Taiwanese shores, in the southwest corner of Taiwan's ADIZ. This might very well be a Chinese opera, where firecrackers and martial posturing are there to hide the real action: the development of a more robust nuclear power.

China's conventional capabilities, including those of its navy, are indeed increasing rapidly and impressively. The core of China's military strategy, however, relies on its nuclear and delivery

capabilities. China has apparently started to build more than 250 intercontinental ballistic missile silos at three sites in Gansu and Inner Mongolia, a huge jump from the initial 20.

China has always refused to be part of arms control negotiations, arguing that its arsenal is far smaller than those of Russia and the United States. Depending on sources, China's nuclear arsenal is limited to approximately 300 warheads, on par with the French arsenal. The rapid construction of new silos, however, may indicate a massive increase in China's nuclear warheads. The figure could double before the end of 2040, with the accelerated deployment of new multiple-warhead solid fuel ICBMs such as the DF 41.

Despite its official denials, in August China may well have tested a nuclear-capable hypersonic glide vehicle, the DF 17. This type of vehicle is not as rapid as a ballistic missile; however, it can change trajectory to avoid missile defense mechanisms. Launched from an orbital trajectory, it could also escape advanced warning systems. In the 1970s, the Soviet Union deployed a similar type of system and then abandoned it in favor of submarine-launched ballistic missiles. In a reverse move, confronted with the limitations of its SLBM program including in terms of command and control, China might be tempted to rely on a type of less detectable delivery vehicle.

These moves may also signal a change in China's nuclear doctrine. With more warheads, along with more sophisticated and less vulnerable delivery systems, China may be on the verge of acquiring a first-strike capability, a departure from its traditional posture of minimum deterrence. Anxious not to suffer the fate of the Soviet Union, China has always refused to be dragged into an unwinnable arms race with the United States. A guaranteed second-strike nuclear

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capability is enough to achieve China's objectives. But that objective is threatened by U.S. conventional precision strike capabilities, superiority in next-generation ISR, and ballistic missile defense developments at the regional level. This last aspect threatens the deterrent effect of China's nuclear-capable middle-range ballistic missiles, which can target U.S. bases in Asia as well as the United States' closest allies in the region.

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China's nuclear doctrine and objectives have not changed fundamentally. Credible nuclear capabilities have always been part of China's strategy of deterrence and anti-access/area denial (A2/AD) against the United States. By reinforcing the credibility and certainty of its second-strike capability, China expects to deter the United States from intervening in a regional conflict, for example, Taiwan's "reunification" by force or grey zone tactics. China wants to assert its capacity in order to make use of a set of pressure tactics, using public opinion in the United States as well as among U.S. allies such as Japan. In the event of a conflict in the Taiwan Strait, Japan would be very nearly on the frontline. However, Japan is also extremely risk-averse and vulnerable to threats of missile strikes from China.

To win in a regional conflict, China must maintain pressure to dissuade the United States from intervention by using the threat of escalation, to make the idea of intervention impossible to fathom. China is playing on reticence among the U.S. public to engage in asymmetric wars, where one side projects a high level of will when the other seems to be less involved.

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The acceleration of silo construction and the testing of new "game-changing" arms are all part of a nuclear signaling game in times of peace that serve to demonstrate China's determination and impress the adversary. By increasing these capacities, China is testing the sole guarantor of strategic stability in Asia, the United States, and the will of the U.S. to intervene.

In this context, U.S. deterrence can only be effective without conditions or caveats such as "no first use" or "sole purpose." Otherwise, China's leadership might get a false sense of security and be tempted to launch a conventional war to take the initiative. For a leader like Xi Jinping, eager to achieve the "great rejuvenation of the Chinese nation," a change in U.S. nuclear policy might be just the push needed for action – most certainly based on miscalculation, but with dramatic consequences.

Source: *The Diplomat*, <https://thediplomat.com/2021/11/chinas-nuclear-gambit/>, 06 November 2021.

OPINION – Alan J. Kuperman

Bomb-Grade Uranium for Australian Submarines?

In 2016, Japan eliminated its stockpile of nuclear weapons-grade, HEU from its Fast Critical Assembly research reactor by sending the material to the United States for disposal. The cache had been estimated at 215 kilograms, sufficient for at least eight nuclear weapons.

Japan's action contributed to a multi-decade global effort to prevent the spread of nuclear weapons by ridding the world of HEU, either by closing

facilities or converting them to LEU fuel that is unsuitable for weapons. As a senior U.S. official declared, "Japan has been one of the United States' staunchest allies in the global effort to minimize, and when possible eliminate, the use of sensitive nuclear materials...This strong partnership has helped the international community ensure that these materials never find their way into the hands of criminals, terrorists, or other unauthorized actors." How bewildered Japan now must feel by the recent U.S. and U.K. announcement of a deal to sell Australia eight nuclear-powered submarines fueled by weapons-grade HEU.

Each ship's reactor would contain about 500 kg of HEU, so Australia would receive four tonnes of HEU, sufficient for more than 160 nuclear bombs. That is nearly 20 times as much HEU as Japan voluntarily gave up in 2016. The AUKUS deal would also set a dangerous precedent that could reverse decades of progress in eliminating global HEU use.

Other countries that are seeking nuclear submarines — including South Korea and Iran — could insist that they too require HEU fuel, either imported or produced domestically. This would open the floodgates to weapons proliferation, because such countries legally could block inspections of their naval fuel for decades under a loophole in international safeguards agreements. Japan's new Prime Minister Fumio Kishida needs no instruction on the dangers of HEU, considering that he represents Hiroshima, the only place HEU ever has been used in war.

... Kishida has a chance to engage his two "Quad" allies, Australia and the United States, during AUKUS's 18-month consultation period, to suggest

three alternatives. First, Australia could insist that its partners provide submarines fueled by lifetime LEU cores, which the U.S. government has been developing since 2016. Alternatively, Australia could switch to buying nuclear submarines from France, which already has converted its own to LEU fuel. A final option would be for Australia to revert to conventional submarines, which are less expensive and thus could enable a larger fleet that experts say would achieve better coastal defense. ...

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Source: Kyodo News, <https://english.kyodonews.net/news/2021/11/006a0287253b-opinion-bomb-grade-uranium-for-australian-submarines.html>, 11 November 2021.

OPINION – Indrani Bagchi

India Needs to Take a Harder Look at its Nuclear Liability Law

At the COP26 meeting in Glasgow, India hinted that it would be able to meet its climate commitments better if it was allowed membership of the NSG. It was a clever diplomatic ploy, and unlikely to succeed. India's nuclear challenges go beyond the climate crisis. India is at present a member of three of the four global non-proliferation regimes — Wassenaar Arrangement, MTCR and Australia Group.

The fourth one, the NSG, however, continues to elude India, largely because of one country, China, whose opposition is couched in non-proliferation language.

China has also asked for Pakistan to be granted membership along with India, to rob India of the "special" tag that came with the NSG waiver to the India-US nuclear deal back in 2008. China acceded to that waiver, kicking and screaming,

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and has since nursed that diplomatic humiliation — Chinese diplomats walked out of that last meeting of the NSG in Vienna in September 2008, and were sent back after a midnight phone call from Washington. Beijing was determined that India would not get another free pass into the nuclear world.

The NSG membership has proved elusive. The Obama administration wasn't going to do any more nuclear heavy lifting for India, most definitely not by taking on China (Obama himself was a reluctant acceptor of the nuclear deal anyway, author of one of the infamous "killer" amendments to the Hyde Act). Trump didn't care and Biden has too many China challenges on his hands to pick up another one. China's opposition, however, has provided a tailwind to the non-proliferation ayatollahs in different parts of the world, albeit silently. This basically means — in any NSG meeting, China can pull at least five other holdouts to India's membership.

In addition, if India is struggling to access certain specific missile components or power reactor components, say, from Japan, the lack of the NSG membership is trotted out as a reason. For those who say, that the NSG waiver was all we needed, the last decade has shown conclusively that it is not. The lack of membership is still used by many countries against India.

On the climate/clean power front, the Indian government has focused its headlines on solar, wind and green hydrogen, not nuclear. India also has an installed power capacity of 388.1 GW. Out of this, 234 GW is thermal and over 80 per cent of the remainder are solar, wind and hydro. The space for nuclear power is small. And this, while knowing full well that nuclear is the only other source to provide base-load power in addition to thermal, certainly in the absence of credible storage capabilities for other forms of renewable power.

Nevertheless, in May 2017, the Modi government announced its "atmanirbhar" plans by building ten 700-MWe pressurised heavy water reactors (PHWR) — Kaiga 5 and 6 in Karnataka, Chutka 1 and 2 in Madhya Pradesh, Mahi Banswara 1, 2, 3 and 4 in Rajasthan and Gorakhpur 3 and 4 in Haryana — in fleet mode. This was the first big move on nuclear. The first orders for major components by NPCIL to BHEL went out in January 2021. The idea is to roll out one nuclear reactor a year from 2022.

The nuclear establishment of India, ayatollahs in their own right, are on the slow train to mission completion. Some of it can be attributed to their work culture which remains out of public purview.

But some of it can also be attributed to the fact that India, despite the NSG waiver, struggles to access components because, well, there's no NSG membership. This has slowed the nuclear power enterprise. Meanwhile, in the rest of the world, nuclear power is enjoying something of a renaissance, certainly in

design, size and safety.

There is also experimentation going on with SMRs — the Canadians are toying with the idea of 190-MWe integral molten salt reactors. With new and innovative designs, and using something called 'generation IV molten salt reactor technology, the Americans are playing around with these ideas too. So is Russia, which is reportedly considering building smaller floating reactors in the Arctic Ocean. Even the UK is working on 440 MWe modular reactors. China is reportedly testing a thorium nuclear reactor. According to reports, it is unusual in that it has molten salts circulating inside instead of water. Apparently, this can produce safer and cheaper energy with less waste. India's own thorium projects are even more ambitious, but yet to be unveiled to the world. There may be a bunch of other innovations like this happening around the world.

In addition, if India is struggling to access certain specific missile components or power reactor components, say, from Japan, the lack of the NSG membership is trotted out as a reason. For those who say, that the NSG waiver was all we needed, the last decade has shown conclusively that it is not. The lack of membership is still used by many countries against India.

India connected to the grid KAPP-3, the first 700 MWe indigenously developed PHWR, in July 2020. Therefore, it can actually hold its own in the global nuclear power debate on smaller reactors. New Delhi could be a part of this evolving global conversation. An India outside the NSG is a definite minus here. As former environment minister Jairam Ramesh said in an interview, "India should have standardised on its own design of a heavy water reactor. It should not depend on imported reactors. Two standard 700 MW reactors are coming up in Kakrapar and more elsewhere. India should standardise on those reactors. We should build on those reactors."

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But, and this is something we don't acknowledge enough, a big drag is India's Civil Nuclear Liability law (CLNDA). The liability law, passed in 2010, has spooked nuclear suppliers due to two clauses, 46 and 17(b), of which the latter was deemed most problematic. The offending Clause 17(b) said, the operator could seek recourse against supplier/s if "the nuclear incident has resulted as a consequence of an act of supplier or his employee, which includes the supply of equipment or material with patent or latent defects or sub-standard services." This, being over and above the Operator (in India's case, the central Government) having to bear the primary liability.

The French EDF is supposed to be building the world's biggest nuclear reactor — a six-reactor complex (also in fleet mode) in Jaitapur, Maharashtra. Notwithstanding their own problems, they too have been skittish about the liability law, which is one of the big reasons for such a long delay.

This is believed to be in violation of the international Convention on Supplementary Compensation for Nuclear Damage (CSC) which governs civil nuclear liability rules. However, India became a state party to the CSC in 2016, so that couldn't have been such a big problem. The second clause that stuck in the throat was Clause 46, which essentially states that the operator of the nuclear plant could be charged for

compensation under other Indian laws too.

Nevertheless, the CLNDA not only scared away foreign suppliers but put the locks on Indian nuclear supplier companies too. The Indian government clarified the rules in a series of FAQs, issued separately by MEA and DAE in 2015. They said the operator, in India's case, NPCIL, would classify itself as a "supplier" by expanding the definition of a "supplier" thereby putting external suppliers off the hook. An Indian Nuclear Insurance Pool was also set up to cover liability for suppliers. The government, too, went out of its way to reassure suppliers.

It worked to a limited extent. Indian suppliers came back on line, largely because their premier, often the only customer is the government. But foreign suppliers still stayed away. Only Russia and France are still in the game. The Russians are soldiering away at Kudankulam, with a technology well past its prime, not to speak of the fact that it has cost India much more than it should have.

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The Indian government has tried to nurse the project though, and in April 2021, EDF made its "binding" techno-commercial offer to the Indian government to build six Generation III EPR nuclear power reactors. (Just saying, these same EPR reactors have been built in record time in China — Taishan-1 and -2 in Guangdong province. Taishan-1 began commercial operation in December 2018 and Taishan-2 in September 2019.)

Needless to add, these negotiations would have been easier if India's liability law didn't scare companies and countries. It would have also been easier if India was a member of the NSG. We have to acknowledge that apart from France and Russia, no other country has much interest in seeing India in the NSG. Nobody really has any nuclear stakes in India. Russia knows it can take forever to build its reactors. The French are doing what they do best, white wine at champagne prices. Westinghouse was to build two reactors in Kovada, but they have self-destructed. The Japanese are still traumatised by Fukushima. There's nobody else on the horizon. The limited point is, Climate is not going to be enough to get India into the NSG. Other countries have to feel it's in their interest to support India. India has to provide that playing ground to create those interests.

The problem, as always, lies in politics. When the liability law was being drafted, it was in the background of the anniversary of the Bhopal disaster. Both the government (UPA) and the opposition (NDA) tried to outdo each other in competitive nationalism, which meant only an extremely protective stance was acceptable. Also, let's face it, the Indian nuclear establishment is much happier functioning in a hermetically sealed environment. The Indo-US nuclear deal opened one door. The liability law closed it. Everybody was happy.

That cannot go on. The Indian government recently opened up the space sector to the private sector and innovation, they rewrote the retrospective tax law to benefit the private sector. India has to find a fix in its nuclear liability law

that protects sovereignty but enables other countries to build interests in India's nuclear power industry. This will help boost the voices in the NSG room in India's favour when the vote comes up.

Source: *Times of India*, <https://timesofindia.indiatimes.com/blogs/globespotting/india-needs-to-take-a-harder-look-at-its-nuclear-liability-law/>, 07 November 2021.

OPINION – Oxford Business Group

Nuclear Power will Play a Key Role in Emerging Economies' Energy Transition

Nobody really has any nuclear stakes in India. Russia knows it can take forever to build its reactors. The French are doing what they do best, white wine at champagne prices. Westinghouse was to build two reactors in Kovada, but they have self-destructed. The Japanese are still traumatised by Fukushima. There's nobody else on the horizon. The limited point is, Climate is not going to be enough to get India into the NSG.

The ongoing UN Climate Change Conference (COP26) in Glasgow has underlined how increased adoption of low-carbon energy sources will be key to reducing global emissions. While it is not without its detractors, many agree that nuclear power has a role to play in this. Countries such as Austria and New Zealand are staunch opponents of nuclear power, and have resisted attempts to group it alongside renewable energy as a clean alternative to hydrocarbons. On a similar note, the World Bank will not grant the industry multilateral financial aid that is earmarked for clean energy.

A major development will be the widespread rollout of SMRs; at present more than 70 SMR designs are being developed around the world, and two units are already in operation in Russia. Indeed, Russia is a prominent player in the field. While China is the only country in the world currently building a fleet of new reactors, it is Russia which exports and finances the highest number of new builds.

Others, however, have highlighted the industry's low-carbon footprint, as well as the fact that the global industry is modernising fast, for example through increased localisation and innovative manufacturing. A major development will be the widespread rollout of SMRs; at present more than 70

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building a fleet of new reactors, it is Russia which exports and finances the highest number of new builds. The nuclear energy industry is also growing: it is expected to be worth \$49bn by 2025, up from \$36bn in 2017.

Nuclear Power and Emerging Countries: As emerging economies mature – through increased urbanisation and industrialisation, for instance – their power needs will grow commensurately. Many of these economies are looking to nuclear as a low-carbon solution to meeting such needs. According to the WNA, some 30 emerging economies around the world are currently considering, planning or starting nuclear power programmes.

In the short term, these projects will not significantly expand the global nuclear footprint, with principal growth coming in countries which already have well-established nuclear power infrastructure. However, the WNA anticipates that, in the medium to long term, developing nations' nuclear infrastructure will resemble that currently seen in Europe, North America and Japan. Meanwhile, Third Way – a US-based think tank – predicts that the global market for nuclear could triple by 2050, thanks almost entirely to increased demand in emerging regions.

Which Countries are Leading the Way? Different emerging countries are at different stages in terms of developing their nuclear power capacity. For example, the UAE became the first country in the Gulf to open a nuclear power plant following the launch of Abu Dhabi's Barakah Nuclear Energy Plant in August last year, while Belarus, Bangladesh and Turkey are all in the process of constructing their first nuclear power plants. Other countries are in the planning phase. For instance, Saudi Arabia currently aims to construct two reactors, and anticipates that these will generate 17 GW of nuclear capacity by 2040, covering 15% of the Kingdom's energy needs.

Nigeria is similarly moving to boost its capacity. The country has partnered with Russia's Rosatom

State Nuclear Corporation for support. The Russian-Nigerian Joint Coordination Committee on National Atomic Energy was formed in 2009, but so far no concrete progress has been made. Nevertheless, in July this year the agreement was reconstituted by both parties.

Indonesia, meanwhile, is currently the nuclear leader within ASEAN, and is planning to expand its base of three small research reactors. It counts on the collaboration of Rosatom and the Japan Atomic Energy Agency, among others. In Indonesia nuclear is increasingly seen as a good way to meet ever-growing electricity needs, as well as to leverage the country's rich mineral deposits.

Potential Pitfalls: However, Indonesia also offers a case study in the misgivings that have been expressed regarding the development of nuclear power in certain emerging markets. Primarily, the country's

position in the Pacific's "Ring of Fire" makes it prone to earthquakes and volcanoes, which some say increases the possibility of a disaster along the lines of the Fukushima Dai-Ichi meltdown, caused by an earthquake and tsunami that struck Japan in 2011.

Secondly, there is the question of disposing of nuclear waste, a notoriously tricky process. Last year Indonesia's Nuclear Energy Regulatory Agency found extremely high levels of radioactive contamination in a patch of land outside Jakarta, about 3km away from one of the country's research reactors.

Thirdly, there are fears that developing nuclear capacity could facilitate the development of nuclear weapons. In the case of Indonesia, such fears were triggered in February 2020 when Luhut Binsar Pandjaitan, the minister of maritime affairs, argued that Indonesia was not seen as a serious international player due to its lack of nuclear weapons. Pandjaitan, a retired general, has been a key figure in the country's drive to expand its nuclear energy capacity.

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Lastly, there is the question of speed. While plans have been in the pipeline for some years, expanding nuclear capacity can take decades, and it is not clear whether Indonesia will be able to do so in time to meet urgent emissions targets.

However, the increased modernisation and expansion of the global nuclear energy industry – and the agility that will be conferred by the development of SMRs – should help to assuage these and other misgivings. In this light, the coming years will likely see a consolidation of the growing consensus that nuclear power could help developing economies both to meet their energy needs and to reduce their carbon emissions.

Source: <https://oilprice.com/Alternative-Energy/Nuclear-Power/Nuclear-Power-Will-Play-A-Key-Role-In-Emerging-Economies-Energy-Transition.html>, 14 November 2021.

OPINION – Sylvia Mishra

Deep Fakes: The Next Digital Weapon with Worrying Implications for Nuclear Policy

The past decade has witnessed the unprecedented march of technology and the opportunities, dangers, and disruptions that accompany it. In the last 4-5 years, a synthetic media technology (that uses machine learning techniques and is created by generative adversarial networks – GANs) known as deep fakes, has revolutionised the ways that digital media can be altered. The ability of state and non-state actors to generate, forge, and manipulate media has created clickbait headlines and fake news, ‘terrorised women’ by substituting faces to create

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fake porn, and abetted the spread of misinformation and disinformation. An opinion piece in the *Washington Post* has called this worrying trend of mass-scale manipulation the “democratisation of forgery”.

The opportunities and dangers offered by deep fakes are manifold. In the future, societies will possibly benefit from this technology - for example, in the realm of education, healthcare, the arts and criminal forensics, however,

deep fake technology has far greater potential to disrupt the ‘normal’. One of the disquieting ramifications of this emerging and disruptive technology (EDT) is the challenge it poses to nuclear weapons decision-making, in particular its impact on decision-makers and wider society, Nuclear Command, Control, and Communications (NC3), nuclear doctrine, posturing, and signalling.

Implications for Nuclear Weapons Decision-Making:

In the 21st century, nuclear weapons decision-making is markedly different from that of the Cold War era. As great power competition has come back into sharper focus, countries are expanding and upgrading their nuclear arsenals and moving towards incorporating EDTs for

warfighting. On the one hand, the political divide between nuclear haves and have-nots is widening and, on the other, the pursuit of EDTs by non-nuclear states is reducing the technology gap between nuclear and non-nuclear states. Simultaneously, arms control is waning. These

One of the disquieting ramifications of this emerging and disruptive technology (EDT) is the challenge it poses to nuclear weapons decision-making, in particular its impact on decision-makers and wider society, Nuclear Command, Control, and Communications (NC3), nuclear doctrine, posturing, and signalling.

developments are taking place at a time when trust among states and decision-makers is fast eroding, and generational divides among decision-makers are increasing. For example, senior decision-makers may find themselves lacking

knowledge about new EDTs and technical know-how, while younger decision-makers might lack the understanding of nuclear policy-making compressed timelines.

The ability of deep fakes to undermine the confidence in information analysis and outputs provided by digital security platforms can erode trust among states and, in turn, complicate nuclear weapons decision-making, making it difficult for decision-makers to make distinctions between correct and spurious information. Deep fakes expert and computer science professor at Dartmouth University, Hany Farid stated, "The things that keep me up at night these days are the ability to create a fake video and audio of a world leader saying 'I've launched nuclear weapons'". He adds that the technology to do this exists today.

As we witness rapid advancements of deep fake technology, nuclear weapons policy decision-makers are likely to be faced with questions like "will deep fakes undermine understanding about enemy intent and misdirect about an adversary capability?" Furthermore, deep fakes may cause algorithms that offer information on situational awareness to misclassify based on altered inputs. Such scenarios may cause a breakdown in automated NC3 architecture bearing serious consequences. With the corruption and poisoning of data, can adversaries take undue advantage and engage in nuclear brinkmanship? Can non-state actors create misperception and escalation by generating fake videos of a leader suggesting that they have deployed nuclear weapons against an adversary?

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With the corruption and poisoning of data, can adversaries take undue advantage and engage in nuclear brinkmanship? Can non-state actors create misperception and escalation by generating fake videos of a leader suggesting that they have deployed nuclear weapons against an adversary? Even if such fake videos can be quickly detected, it is highly likely that once these videos go online they will sow the seeds of widespread uncertainty.

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During crises, the general population might find it difficult to tell factual from spurious information, exacerbating the situation. In February 2019, India and Pakistan engaged in a conflict under the nuclear shadow as a Pakistan-based terror network JeM conducted a terror attack that killed more than 40 CRPF in Pulwama district, Kashmir in India. The Indian government responded with airstrikes targeting JeM's terror camps and training facilities across the LoC and both countries mobilised their forces, engaged in cross-border firing and shelling along the LoC, and moved tanks to the frontlines. During the crisis, the conflict was escalated

by social media, as leaders in both countries took to open social media platforms like Twitter in order to rally the masses and mobilize public support – both domestic and international. The Pulwama-Balakot crisis revealed that the use of social media during a crisis thickened the fog of war as leaders felt compelled to manage domestic public opinions and expectations. With the combination of social media's reach and the increasing ability of state and non-state actors to manipulate it, social media has the potential to cause real-world harm and impact the outcome of a crisis. With the pace and velocity of war increasing and decision-making timelines

shortening, deep fakes can play a facilitating role in lowering nuclear use thresholds.

In a report titled 'Weapons of Mass Distortion', King's College London's Marina Favaro classifies

deep fake as a 'weapon of mass distortion', arguing that it is capable of reducing situational awareness of a country and could erode Nuclear Command, Control, and Communications (NC3). Targeting NC3, which supports the very foundations of nuclear deterrence and policy-making, can have a catastrophic effect. As deep fakes advance in sophistication, nuclear weapon decision-makers will find it increasingly difficult to trust machine-generated information. The lack of trust in the information received could put decision-makers at a disadvantage during a crisis, both in making decisions quickly and making decisions based on factual information. Furthermore, the asymmetries in understanding the authenticity of information among state actors, domestic and international audiences may also create mistrust and uncertainties that could distort and influence the context in which decisions are being made.

In a recent exercise at an ELN workshop on nuclear weapons decision-making under technological complexity, former high-level decision-makers elaborated on the dangers of the deliberate use of deep fake technology. They discussed how it could compound difficulties in identifying key facts under time constraints and its effect on a decision-maker's ability to 'process and assimilate' and thus make a decision. Other implications of the introduction of deep fakes into classified data feeds is that they could severely undermine decision-makers' ability to factually assess a situation and plan.

As more countries invest in counterforce technologies, deep fake technology could be utilised by states and non-state actors to pursue a predetermined escalatory path or create

situations that necessitate a first-strike attack. The deliberate pursuit of deep fakes to gain

asymmetry advantage in conflict can also significantly impact countries' nuclear doctrines, posturing, and signalling. As deep fake technology matures, it is likely to be salient in military information operations and can also create compulsions of a counterattack based on

lies and fabrications. Countries might feel compelled to resort to non-nuclear preemptive strikes, leading to crisis-escalation amid the challenges of attribution and verification. As verification of the authenticity of audios and videos is a challenge, leaders will probably have to take actions based on "limited information" in the face of a lack of tools or time to distinguish between reliable vs spurious information. With the help of deep fakes, adversaries could also engage in blackmailing, for instance by creating compromising videos using deep fake technology of elected officials or individuals with access to classified information, to use as leverage.

A recent *Forbes* article argued why deep fakes are a net positive for humanity, offering examples of their ability to create fake brain

MRI scans for medical purposes. Another article showcased how with machine learning deep fake technology, a museum in Florida can recreate life-size versions of surrealist painter Salvador Dali telling stories about his life. While there are many potential benefits to deep fake technology, the associated dangers and risks it poses when utilised for nefarious purposes requires urgent attention. Deep fakes are going to create, facilitate and abet chaos in conflict, lower nuclear thresholds, and complicate nuclear weapons decision-making. It is important that the nuclear weapons policy community is cognizant of the

Recent North Korean rocket tests have raised the possibility that Japan's current missile defenses may be rendered ineffective, forcing policymakers here to consider new options including a constellation of small tracking satellites and the ability to attack the missile launch itself in enemy territory.

Japan's Self-Defense Forces currently predict missile trajectories based on radar readings of launch angle and speed. The weapons are then met with a two-tier defense system: the sea-based Aegis missile shield while outside the atmosphere, followed by Patriot Advanced Capability-3 missiles as they reenter.

challenges posed by deep fakes and respond to this technology's uncontrolled use and spread through focused research studies and awareness-building exercises. Soon, it might become pertinent to push for norms of use and legislation to regulate its use, especially during a crisis.

Source: *European Leadership Network*, <https://www.europeanleadershipnetwork.org/commentary/deep-fakes-the-next-digital-weapon-with-worrying-implications-for-nuclear-policy/>, 03 November 2021.

OPINION – Barry Pavel, Christian Trotti

New Tech will Erode Nuclear Deterrence. The US Must Adapt

Nuclear weapons are no longer enough to sustain U.S. strategic deterrence. Senior military leaders and pioneering scholars believe a new technological revolution is now unfolding, and they are right. If we are not attentive now, the United States may lose the ability to deter major attacks in coming years.

The old model of strategic nuclear deterrence is increasingly threatened by a new suite of military technologies, from hypersonic missiles and advanced missile defenses to non-kinetic cyberattacks. Individually, these technologies are potent. But together, they will revolutionize the way that great powers deter and conduct war. To avoid falling behind, the United States must hedge against disruptive capabilities by modernizing its existing nuclear arsenal and undertaking a systematic review of strategic capabilities for the 2030s. This vision for the future balance of strategic forces should then enable defense and diplomatic officials to determine investment priorities accordingly and decide when and how to engage Russia and China to avoid strategic instability in this new era.

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These contemporary trends are best understood through the historical lens of revolutions in military affairs, or RMAs. While the history of warfare is mostly evolutionary, certain technological advancements—such as gunpowder, aviation, and precision-guided munitions—have revolutionized warfare and reshaped military balances and the geopolitical landscape.

Technology is not the only variable; RMAs require a convergence of technology, training, doctrine, and operational concepts, as well as a fundamental shift in underlying assumptions, to produce a new way of competing and fighting. For example, the United Kingdom invented tanks, but Germany revolutionized tank warfare by integrating armor, radio, and airpower with novel concepts for employing them. This produced the blitzkrieg of World War II.

The nuclear revolution was perhaps the most consequential RMA, since nuclear weapons could do what no other weapon had ever done: pose an

instantaneous, existential threat. The preceding paradigm of strategic deterrence was instantly outdated, as large armies and navies no longer sufficed to deter major attacks. The advent and continual evolution of nuclear weapons ultimately precipitated a new approach

to deterrence during the Cold War, wherein only a “triad” of nuclear delivery systems—strategic bombers, intercontinental ballistic missiles, and submarine-launched ballistic missiles—was deemed sufficiently diversified to survive any enemy first strike and retaliate, thereby maintaining stability between nuclear-armed adversaries. These capabilities, which so uniquely affect the very decision to wage war, are termed “strategic forces.”

A new, second RMA in strategic forces is now underway on the backs of an array of emerging technologies like hypersonic weapons, advanced missile defenses, artificial intelligence and

autonomous systems, high-performance data analytics, quantum computing and sensing, space-based sensors and anti-satellite weapons, and cyberweapons. These threaten to undermine the long-standing nuclear deterrence paradigm and alter the balance of power among the United States, Russia, and China. New capabilities can destroy, intercept, or blind traditional delivery systems, potentially enabling a devastating first strike and precluding adversary retaliation. The country that first develops a new model for using these capabilities in tandem with each other, mastering the emerging “strategic forces balance,” may become the next military and geopolitical hegemon.

This RMA poses distinct threats to each leg of the current nuclear triad. First, advanced Russian and Chinese air defenses are already challenging the stealth capabilities of U.S. strategic bombers. One of China’s leading defense companies claims to have developed a prototype radar that relies on quantum physics to detect the incredibly faint (and normally undiscernible) signals of stealth aircraft. Without stealth, U.S. nuclear-armed bombers could operate outside contested airspace and still reach their targets with standoff cruise missiles, but even those missiles may be increasingly less likely to prevail against more sophisticated missile defenses.

Second, in the wake of the United States’ successful kinetic missile defense test last November, ground- and sea-based missile defenses are vastly improving their ability to shoot down ICBMs and SLBMs, threatening the

triad’s ground- and sea-based legs. While it is still relatively easy to overwhelm existing missile defenses, new technological developments in directed energy are very likely to enable a more robust defense against massed ballistic missile attacks. Meanwhile, shooting down a missile is not the only way to stop it; in many cases, it is preferable to destroy the missile before it ever launches. Here again, emerging technologies soon will offer a solution: travelling at over five times the speed of sound, hypersonic missiles supported by synthetic aperture radar satellites are increasingly capable of hitting heavily defended or time-critical targets, thereby enabling preemptive “left-of-launch” strikes against ballistic missile launchers.

Third, and most surprisingly, even the submarine leg of the triad is becoming less survivable. Technological advancements portend swarms of unmanned underwater vehicles, drawing on greater remote sensing capabilities and high-performance data analytics and processing, that will more effectively, continuously, and rapidly track and hunt nuclear-armed submarines. The proliferation of undersea, floating, and space-based sensors will make the oceans far more transparent.

When combined, these technologies could enable a devastating first strike for any nation that seizes this first-mover advantage. Imagine Russia or China uses cyberattacks to blind the U.S. nuclear command, control, and communications architecture, hypersonic weapons to preemptively eliminate ICBM launch sites, underwater drones and advanced sensors to hunt submarines, and advanced air and missile defenses to “mop up”

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any retaliatory strikes. It is questionable whether the triad could survive, and thus its deterrent power would be fatally compromised.

Such a comprehensive first-strike capability is not with us yet, but current technologies foreshadow its looming likelihood. As friends and foes alike adopt these systems, it is imperative for the United States to develop a new paradigm for understanding and utilizing strategic forces. Only from a position of technological and doctrinal advancement vis-

à-vis its competitors can the United States negotiate with them to mitigate strategic instability. Heretofore the realm of academia, now is the time for policymakers to seize the initiative, encourage public and private debates like those of the early Cold War, and realign the nuclear paradigm that still grips the academic and policy communities.

The United States should hedge against this disruptive RMA in the short term by sustaining plans for robust nuclear modernization of the triad. Fortunately, technologies develop at different rates; not all legs of the triad will be threatened simultaneously over the next decade. If one leg is threatened first, the other two legs could provide short-term redundancy in the nuclear deterrence mission. Thus, in its upcoming 2022 National Defense Strategy (NDS) and Nuclear Posture Review (NPR), the Biden administration should continue U.S. nuclear modernization policies, while resisting pressures to reduce to a “dyad,” to decrease the size of the U.S. nuclear arsenal, or to further delay recapitalization programs.

However, modernizing the nuclear triad is only one necessary step; developing a new construct for

strategic forces is essential to sustaining an effective deterrent into the 2030s. Over the long term, U.S. policymakers need to move beyond

the limited parameters of the Nuclear Posture Review, which views new technologies through the lens of the increasingly outdated traditional nuclear paradigm. The strategic forces balance of the future will include both nuclear weapons and a suite of capabilities comprising the emerging non-nuclear technologies outlined above. Integrating

the NPR within the NDS, as the Pentagon announced it would do earlier in the year, is a positive step but is insufficient to develop a new strategic forces paradigm.

Therefore, the Pentagon should replace the nuclear posture element of its NDS review with a broader Strategic Posture Review or “Strategic Deterrence Review” to explore how strategic forces, both existing and emerging, can complement each other, threaten what adversaries value, and thereby realign deterrence for a new era. This more holistic

review can be a foundational pillar in Defense Secretary Lloyd Austin’s “integrated deterrence” concept, by which the U.S. military would develop “the right mix of technology, operational concepts and capabilities – all woven together and networked in a way that is so credible,

flexible and so formidable that it will give any adversary pause.”

Questions this new review should answer include: which capabilities, and in what quantities, would be most survivable and credible against enemy counterforce weapons;

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which targets they should prioritize to have the greatest effect on adversary decision-making in both war and peace; and where and how they would need to be postured, depending in part upon allied and partner willingness to host and/or operate them. And perhaps most importantly, with careful guidance by the senior leadership of the Pentagon, this review should determine what strategic deterrence strategy, policy, and posture constructs accounting for these new capabilities could serve to both protect American and allies' national security while also initiating a new form of strategic stability with Russia and China.

The answers to these questions should inform investment and modernization priorities over the next decade and beyond, while providing the foundation for dialogue with China and Russia to avoid instability in a new era of strategic forces. That, however, is a topic for another day, and will be the subject of further analysis by these authors. It is not too late for the United States to lead the next RMA in strategic forces, just as it capably led the last. But the time for action is now.

Source: Defense One, <https://www.defenseone.com/ideas/2021/11/new-tech-will-erode-nuclear-deterrence-us-must-adapt/186634/>, 04 November 2021.

OPINION – Carlo Trezza

The Environmental Dimension of the Use of Nuclear Weapons

In 2010, Jakob Kellenberger, the then President of the International Committee of the Red Cross, demonstrated extraordinary courage when he gathered all the accredited ambassadors in Geneva and made it clear that his organisation would not be able to ensure the required international standards of humanitarian assistance to civilian populations in the case of the use of nuclear weapons. In his words, "The mere assumption that atomic weapons may be

used, for whatever reason, is enough to make illusory any attempt to protect non-combatants."

That statement was made on the eve of the 2010 NPT Review Conference in New York, and was instrumental to the adoption by that conference of the concept of the "catastrophic humanitarian consequences of any use of nuclear weapons", which nuclear-armed states had traditionally been reluctant to accept. One year earlier, with his historic speech in Prague (in which he promised to "seek the peace and security of a world without nuclear weapons"), President Obama had already prepared the ground for the inclusion of the "catastrophic consequences" principle in the final

document of the New York conference. During three international conferences subsequently convened by Norway, Mexico and Austria, the "humanitarian catastrophic" nature of any use of atomic weapons was further confirmed. This concept should be

reiterated during the upcoming NPT Review Conference, scheduled for January 2022.

As the world's leaders gather to discuss how to tackle climate change, it is also necessary to add that the use of nuclear weapons would have dangerous consequences for the environment. The environmental impact of nuclear weapons has been amply evidenced by the over 2000 nuclear tests carried out in deserted and uninhabited areas, while the dangers of radiation have also been demonstrated by the major accidents at the civilian nuclear power plants of Chernobyl and Fukushima.

Today the environmental impact of a nuclear attack on inhabited centres and industrial areas can only be calculated through simulations. The deadly environmental effects of the two bombs that annihilated Hiroshima and Nagasaki can hardly be considered a precedent since they would pale in comparison to what would happen if only part of the 13,000 nuclear devices currently possessed by the nuclear powers were to be detonated today. Studies on the environmental side of the

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nuclear coin have intensified in parallel with the growing nightmare of climate change and the increase of nuclear risks. While there are debates over the precise modelling (such as a controversy between scientists over whether an India-Pakistan nuclear exchange would be enough to cause a global nuclear winter), multiple studies raise alarming prospects that in the event of a nuclear conflict, there would be shocks akin to climate change, but on a much faster timescale and with an exponential impact.

Nonetheless, the international community and the nuclear-armed states have not yet drawn political conclusions from the anticipated environmental impacts of the use of nuclear weapons. This concept has so far only been mentioned in some official texts (the PTBT, CTBT and Treaty for the Prohibition of Nuclear Weapons), while the ENMOD (Environmental Modification Convention) Treaty adopted in 1978 is mostly focused on prohibiting the hostile use of environmental weather modification techniques but does not address the nuclear threat.

In his memorable statement on 11th November 2017 at the Vatican, Pope Francis expressed his “genuine concern” for the “catastrophic humanitarian and environmental effects of any employment of nuclear devices”. More recently, on 28th October of this year, an event chaired by World Future Council and Parliamentarians for Nuclear Nonproliferation and Disarmament was dedicated to the Climate /Nuclear Disarmament Nexus. Climate protection and nuclear risk reduction were the core subjects debated during the meeting which was called in preparation for the UN Climate Change Conference (COP 26) and the incoming NPT RevCon.

This is the first step. A process similar to the 2010 humanitarian initiative should be launched during

next year’s NPT conference, leading to the recognition of the “catastrophic environmental consequences of any use of nuclear weapons”. Hopefully, on the occasion of that conference, one or more international leaders will have the vision

to promote this topic as Jakob Kellenberger did in 2010. The tragic consequences of climate change will be dramatically amplified if the Damocles sword of a nuclear disaster continues hanging over humanity.

Source: The author is former Ambassador to the CD, Former Chairman of the MTCR, European Leadership Network (ELN). <https://www.europeanleadershipnet>

work.org/commentary/the-environmental-dimension-of-the-use-of-nuclear-weapons/, 12 November 2021.

NUCLEAR STRATEGY

CHINA

China Building Up Nuclear Arsenal ‘in Response to US Pressure’

China is focusing on developing more submarine-launched and ground-based nuclear missiles amid increasing pressure from the United States, Chinese defence analysts have said. A report released by the Pentagon said China had expanded its nuclear capacity on land, sea and air, estimating the country could have up to 700 deliverable nuclear warheads by 2027 and at least 1,000 by 2030.

Chinese foreign ministry spokesman Wang Wenbin said the report had “disregarded facts and was full of prejudice and bias” that aimed at “stirring up the China nuclear threat theory”. He told a scheduled press briefing that Beijing had a “no first use” policy, adding “no country will be threatened by China’s nuclear weapons”. Wang said: “China always firmly pursues a self-defence

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strategy ... and consistently keeps the scale of its nuclear arsenals at the lowest level that is enough to protect national security.”

China is the world's second largest producer of nuclear power and able to develop advanced fast reactors and reprocessing facilities that would allow it to produce a large number of warheads within weeks should a war appear likely, according to a military insider. “China is able to produce 1,000 nuclear warheads, but so far it has not been necessary because of the exorbitant maintenance costs,” the insider, who requested anonymity due to the sensitivity of the topic.

... The Pentagon report said the People's Liberation Army will have at least eight ballistic missile submarines in operation by 2030, including the six Type 094 subs that are currently active and two next-generation Type 096s. Type 094 subs can carry at least 12 JL-2, or Big Wave, submarine-launched ballistic missiles that can strike the western part of the US mainland. Construction work on the Type 096 began last year and once they enter service they will be equipped with the more advanced JL-3, which can strike anywhere in the United States.... The US navy has 14 Ohio-class nuclear subs, while Russia has 11 comparable vessels. The report also said satellite images suggested Beijing was building three solid-fuel Intercontinental Ballistic Missile silo fields, which will cumulatively contain hundreds of new ICBM silos.

Song Zhongping, a former instructor with the PLA's rocket force, also said that the country needs to increase its arsenal to complete the nuclear triad of missiles that can be launched from submarines, from bombers or from the ground. ... The PLA's strategic support force is the key pillar of China's strategic weapons operator, which oversees space, cyber, electronic, information, communications, and psychological warfare

missions and capabilities, as Beijing has ambitions to grab advantage in more domains on the pace with the US, the Pentagon report said.

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Source: Minnie Chan, South China Morning Post, <https://www.scmp.com/news/china/military/article/3154894/china-building-nuclear-arsenal-response-us-pressure>, 04 November 2021.

NORTH KOREA

North Korea Casts itself as Victim of US Vilification over Nuclear Capabilities

North Korea told a U.N. committee that it is subject to arbitrary vilification over its nuclear and weapons programs, questioning why U.S. and South Korean missile tests don't face the same international scrutiny. Speaking at a meeting of the U.N.'s Sixth Committee, DPRK delegate Kim In Chol slammed the U.S. for its “double-dealing attitude” on nuclear capabilities. Kim pointed to different reactions to North and South Korea's recent missile launches, as well as hypersonic glide vehicle tests that the U.S. has conducted, as evidence of the U.N. Security Council and Washington's hypocrisy.

The U.S. State Department did not comment on South Korea's test of a submarine-launched ballistic missile and other weapons in September, but has condemned North Korea's launches for violating international sanctions and threatening the global community. Kim also took aim at AUKUS, the new security pact signed by the U.S., U.K. and Australia that will enable Canberra to acquire multiple nuclear submarines. “The United States, with a permanent seat in the Council, has laid bare its double-dealing attitude as ringleader of nuclear proliferation through its decision to transfer technology for building a nuclear-powered submarine to Australia,” Kim said,

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according to a U.N. statement.

North Korean state media has criticized the pact on several occasions, with the *Pyongyang Times* denouncing the “American-style gangster-like logic” behind AUKUS and warning the submarine deal may trigger an arms race. China has also condemned the new submarine deal, questioning how a non-nuclear weapon state like Australia can possess weapons-grade uranium when the U.S. and its AUKUS allies oppose the DPRK and Iran advancing their nuclear capabilities.

Kim also attacked the multilateral United Nations Command (UNC) based in South Korea, echoing another North Korean diplomat’s call the previous day to dismantle the military institution. “Such an illegitimate and unlawful, bogus entity disgraces the United Nations in contravention of the purposes and principles of the Charter,” Kim said, according to the statement.

Responsibilities of the UNC include overseeing access to the Demilitarized Zone and supervising the Korean War Armistice Agreement that ended active fighting on the Korean Peninsula. A delegate from the U.S. attended committee meeting and defended targeted sanctions against North Korea as “important instruments” to maintain peace and security. The U.S. State Department also stressed Washington’s commitment to the sanctions regime during a press briefing the same day. The comments come after China and Russia sent a draft proposal to UNSC member states outlining sanctions relief measures for North Korea.

Source: Chaewon Chung, NK News, <https://www.nknews.org/2021/11/north-korea-casts-itself-as-victim-of-us-vilification-over-nuclear-capabilities/>, 05 November 2021.

RUSSIA

Putin Says Russian Navy to Get Hypersonic Zircon Missiles in 2022

Tests of Russia’s Zircon hypersonic cruise missile are nearing completion and deliveries to the navy will begin in 2022, President Vladimir Putin said. The move is part of a bid by Moscow to forge ahead in a race with the United States and others to deploy the next generation of long-range weapons that are harder to detect and intercept. Russia last month said it had successfully test launched a Zircon missile from a submarine for the first time.

China has also condemned the new submarine deal, questioning how a non-nuclear weapon state like Australia can possess weapons-grade uranium when the U.S. and its AUKUS allies oppose the DPRK and Iran advancing their nuclear capabilities.

“Now it is especially important to develop and implement the technologies necessary to create new hypersonic weapons systems, high-powered lasers and robotic systems that will be able to effectively counter potential military threats, which means they will further strengthen the security of our country,” Putin said in televised remarks. He said that in testing, the missile had successfully hit both ground and sea targets when fired from under water or from surface ships.

Now it is especially important to develop and implement the technologies necessary to create new hypersonic weapons systems, high-powered lasers and robotic systems that will be able to effectively counter potential military threats, which means they will further strengthen the security of our country,” Putin.

Some Western experts have questioned how advanced Russia’s new generation of weapons is, while recognising that the combination of speed, manoeuvrability and altitude of hypersonic missiles makes them difficult to track and intercept. They travel at more than five times the speed of sound in the upper atmosphere, or about 6,200 km per hour (3,850 mph). This is slower than an intercontinental ballistic missile, but the shape of a hypersonic glide vehicle allows it to manoeuvre toward a target or away from defences.

Source: Reporting by Andrey Ostroukh, writing by Alexander Marrow, Reuters, <https://www.reuters.com/world/putin-says-russian-navy-get->

hypersonic-zircon-missiles-2022-2021-11-03/, 03 November 2021.

Russian Nuclear Weapons Stand Out in Defense Budget Request

Russia plans to gradually increase spending on its nuclear weapons capabilities over the next three years, according to the draft of the national budget currently under debate in parliament. The funding proposal to upgrade Russia's nuclear arsenal comes as the military awaits new hypersonic missiles to replace its Soviet-era strategic weapons. Speaking to lawmakers of the lower chamber on Oct. 28, the head of the Defense Committee, Andrei Kartapolov, described the budget proposal as "balanced." Under the proposal, 2022 and 2023 would each see national defense spending total approximately 3.5 trillion roubles (U.S. \$49.3 billion), and 3.8 trillion roubles in 2024.

Upgrading the country's nuclear arsenal remains a priority for the Kremlin. Kartapolov said 49 billion roubles will be allocated for the nuclear armed complex on an annual basis from 2022-2023. The figure for 2024 will be about 56 billion roubles. "The increase in spending is most likely caused by the need to modernize a large number of nuclear charges produced in the 1980s and the first half of the 1990s," Ruslan Pukhov, head of the Moscow-based Centre for Analysis of Strategies and Technologies, told Defense News.

He noted that the majority of Topol, UR-100N (RS-18A) and R-36 (Ð-36) intercontinental ballistic missile systems are nearing their retirement age. "These are many hundreds of warheads that are being dismantled," he said. "The beginning of the deployment of new multiheaded, heavy Sarmat ICBMs will require a sharp increase in the rate of

production of nuclear warheads, as well as the ongoing construction of submarines with Bulava missiles." The Bulava missile was launched from the submarine Knyaz Oleg during an Oct. 21 test, successfully hitting its target.

The commander of Russia's strategic force, Col Gen. Sergei Karakayev, previously said the country wants to replace all of its Soviet-era missile systems by 2024. For example, Russia's nuclear forces want to replace the R-36 Voyevoda (Satan) missile with the new Sarmat RS-28 weapon. Among other spending priorities is an increase of payment to soldiers serving under contract. The additional spending will gradually increase from 28.4 billion roubles in 2022 to 44.4 billion in 2023 roubles, but will decrease to 1.8 billion roubles starting in 2024. Defense Minister Sergei Shoigu said in March 2020 that there were more than 405,000 soldiers serving under contract in the Russian military; that's nearly half of all service members.

The federal budget bill for 2023-2024 was passed in the first reading in the Duma, which is controlled by the ruling United Russia party, which supports President Vladimir Putin. A second reading of the bill is set for Nov. 23. The bill then goes to the Federation Council, which is the upper house of parliament; it will likely pass the legislation. After that, it heads to Putin's desk for his signature of approval. On Nov. 1, Putin began his annual meetings with senior defense officials to discuss national defense issues. Russian media reported that closed meetings will include budgetary topics.

Source: Alexander Bratersky, Defense News, <https://www.defensenews.com/global/europe/2021/11/01/russian-nuclear-weapons-stand-out-in-defense-budget-request/>, 02 November 2021.

Upgrading the country's nuclear arsenal remains a priority for the Kremlin. Kartapolov said 49 billion roubles will be allocated for the nuclear armed complex on an annual basis from 2022-2023. The figure for 2024 will be about 56 billion roubles.

These are many hundreds of warheads that are being dismantled," he said. "The beginning of the deployment of new multiheaded, heavy Sarmat ICBMs will require a sharp increase in the rate of production of nuclear warheads, as well as the ongoing construction of submarines with Bulava missiles.

BALLISTIC MISSILE DEFENCE

USA-ISRAEL

U.S. Tests Israel's Iron Dome Defense System Against Chinese Missiles, Report Says

The American military has deployed one of its two Iron Dome anti-missile batteries to the U.S. Pacific territory of Guam. The system, which was developed in Israel, is currently being tested in Guam as part of American effort to defend the territory from the threat of Chinese missiles, *The Wall Street Journal* reported. According to the report, Iron Dome would be of little use against ballistic missiles launched from China, but the current test "points to the wide range of U.S. hardware heading to the Asia-Pacific region as the Pentagon addresses a Chinese buildup that it has called its No.1 challenge."

The system could be used against cruise missiles launched from Chinese bombers, although one expert told *The Wall Street Journal* that use of Iron Dome was "very much an interim solution." That echoes information from the 94th Army Air and Missile Defense Command, which recently told Defense News that it was dispatching the battery as part of a "temporary, experimental deployment" focused on "gathering data on sustainment, deployment considerations, and how we integrate Iron Dome with our existing air defense systems."

Developed by Israel's Rafael Advanced Defense Systems and Israel Aerospace, the Iron Dome system is designed to intercept and destroy short-range rockets and artillery shells and has been in use by the Israel Defense Forces since 2011. In February 2019, the United States said it planned to purchase a limited number of Iron Dome batteries to "be assessed and experimented as a system that is currently available to protect deployed U.S. military service members against a

wide variety of indirect fire threats and aerial threats."

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In August of this year, the United States successfully conducted its first domestic live-fire test of Iron Dome at the White Sands missile Range in New Mexico. But the army subsequently decided to go with a system developed Dynetics, an Alabama defense

contractor, rather than the Israeli system. Satellite images released by Colorado-based Maxar Technologies showed that China's military has built mockups in the shape of a U.S. Navy aircraft carrier and other American warships, possibly as training targets to be used in the Taklamakan Desert in China's Xinjiang region. The mockups reflect China's effort to build up its capabilities against aircraft carriers and specifically against the U.S. Navy, as tensions remain high with

Washington over Taiwan and the South China Sea.

The satellite images revealed the full-scale outline of a U.S. carrier and at least two Arleigh Burke-class guided missile destroyers built at what appears to be a new target range complex in the

Taklamakan Desert. The images also showed a 6-meter-wide rail system with a ship-sized target mounted on it, which experts say could be used to simulate a moving vessel.

Source: Sam Sokol, Haaretz, <https://www.haaretz.com/israel-news/report-u-s-testing-iron-dome-anti-missile-system-in-guam-against-chinese-threat-1.10368519>, 09 November 2021.

NUCLEAR ENERGY

CHINA

Homes of 200,000 Residents in Haiyang Now Fully Heated by Nuclear Power

The urban area of a city in eastern China became the country's first to be fully heated by nuclear

power, making it the only “zero carbon” Chinese city, state media reported. More than 200,000 residents of Haiyang city in the eastern coastal province of Shandong have begun to receive nuclear power-generated central heating for winter, the report said, adding that the clean heating was switched on six days ahead of schedule. It is China’s first commercial nuclear heating project.

The development comes in the backdrop of crippling energy shortages that China faced in September and October, partly triggered by coal companies cutting production to meet Beijing’s climate change pledges - peak carbon emission by 2030 and carbon neutrality by 2060.

Trials to generate nuclear power for winter heating in Haiyang had begun earlier. As part of the trial, the Haiyang nuclear power plant in Shandong province officially started providing district heating to the surrounding area in November, 2020. A trial of the project was also carried out in 2019, providing heat to 700,000sq m of housing, including the plant’s dormitory and some local residents, according to the World Nuclear News website. “Consisting of two AP1000 units capable of heating a total of 700,000 square metres, the pilot project began operating at Haiyang nuclear power plant recently and is expected to eventually provide heating for more than 200 million sq m of housing,” Shandong Nuclear Power Co, a subsidiary of State Power Investment Corporation told state media earlier this year.

After the project was fully implemented, the Haiyang Nuclear Power Unit 1 became the world’s largest cogeneration unit, replacing 12 local coal-fired boilers. A cogeneration unit, according to the

IAEA, is one where the heat generated by the nuclear power plants can be used to produce a vast range of products such as cooling, heating, process heat, desalination and hydrogen. The new

project “...is expected to save 100,000 tons of raw coal and reduce 180,000 tons of carbon dioxide and smoke during each heating season,” a report by thepaper.cn said.

...By the end of September, 2020 China had 48 nuclear facilities in operation with an installed capacity of

49.88 GW, ranking third worldwide. At least 14 nuclear units are under construction with installed capacity reaching 15.53 GW. Russia, several east European countries, Switzerland and Sweden have all had nuclear-fuelled district heating schemes, and heat from nuclear power plants has also been sent to industrial sites in several countries, the WNN report added. ...

Source: Sutirtho Patranobis, Hindustan Times, <https://www.hindustantimes.com/world-news/china-homes-of-200-000-residents-in-haiyang-now-fully-heated-by-nuclear-power-101636467847549.html>, 10 November 2021.

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Shidaowan Nuclear Power Plant Reaches Planned Operational Conditions

The No.2 reactor of the Shidaowan nuclear power plant in East China’s Shandong Province, which is the world’s first high-

temperature gas-cooled reactor (HTGR) nuclear plant using a pebble-bed module, has reached the critical stage of success, according to reports. Both the No.1 and No.2 reactors have reached planned normal operating conditions.

The No.1 reactor is heading to the first connection with the power grid after it reached the critical stage in September, said China Huaneng Group

Co, the operator of the plant. The Shidaowan plant is also the world's first commercial use of HTGR nuclear power technology, which is considered a relatively safe technology among the world's latest fourth-generation nuclear reactors.

... The No.1 reactor has completed the necessary tests and is proceeding with subsequent loading, said Huaneng Group, adding that the No.2 reactor will follow the test path of the No.1 reactor, which is scheduled to carry out subsequent tests.

Source: <https://www.globaltimes.cn/page/202111/1238883.shtml>, 14 November 2021.

GENERAL

IAEA at COP26: How Nuclear Power and Technologies can Help Tackle Climate Change

Nuclear is, and will be, part of the solution if we are to achieve the goal of limiting global warming to below 2 degrees Celsius, said IAEA Director General Rafael Mariano Grossi, ahead of 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26). Mr Grossi will attend the COP, taking place in Glasgow, Scotland, from 31 October to 12 November, where he will meet with world leaders, and will host and participate in events and discussions surrounding nuclear solutions to help meet climate goals.

The annual COP brings together countries to negotiate and accelerate action towards the goals of the 2015 Paris Agreement – an agreement adopted by 196 countries aiming to limit global warming to below 2 degrees Celsius, preferably to 1.5 degree Celsius, compared to pre-industrial levels.

During this world forum, heads of state and government are expected to deliver plans to cut emissions, which could impact our everyday lives – from the vehicles we drive to how we heat our

homes. The recent headlines stemming from the UN's Climate Change and Emissions Gap reports, as well as the Greenhouse Gas Bulletin from the World Meteorological Organization, highlight the urgency for swift action to address climate change.

"Woods are burning, floods and hurricanes are multiplying, and temperatures are rising," said Mr Grossi. "Now is the time for action, and this action must be based on science and on facts. According to the best science of our day, nuclear power is part of the solution."

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"Nuclear energy provides more than a quarter of the world's clean power," Mr

Grossi said. "Over the last half century, it has avoided the release of more than 70 giga-tonnes of greenhouse gasses. Without nuclear power, many of the world's biggest economies would lack their main source of clean electricity." "COP26 is a chance we cannot waste," Mr Grossi continued. "It may be one of our last best opportunities to agree on concrete steps to achieve sustainable prosperity for all. In the face of climate change, we are all one nation." He highlighted some examples of how nuclear techniques are being applied to adapt to consequences of climate change, such as tracking and quantifying carbon, water and nutrient movement and by inducing variability in crops to make them tolerant to drought, salinity or pests.

Source: Joanne Liou, IAEA, <https://www.iaea.org/newscenter/news/iaea-at-cop26-how-nuclear-power-and-technologies-can-help-tackle-climate-change>, 29 October 2021.

GHANA

Ghana Steps Forward to Nuclear Power

Ghana plans to start producing nuclear electricity by 2030, according to the head of Nuclear Power Ghana (NPG) in August. By about 2025 NPG expects to have identified the vendor, selected a site and be ready to conclude a contract arrangement. First power is envisaged in 2030 at \$50 to 80/MWh. The country has had a small research reactor operating since 1994.

For more than ten years Ghana has been proactive regionally on nuclear power and following the International IAEA milestones program. The IAEA undertook an Integrated Nuclear Infrastructure Review in the country in 2017, and NPG was set up in 2018 to manage the country's first nuclear power project. Two nuclear cooperation agreements with Rosatom suggest Russia as a likely source of technology, and Ghana is understood to be open to the possibility of a foreign build-own-and-operate project for nuclear power, as now in Turkey.

Source: Excerpted from *Weekly Digest, World Nuclear Association*, 05 November 2021.

RUSSIA

REMIX Fuel Ready for Final Test

A batch of six REMIX fuel assemblies has been made by Rosatom subsidiary TVEL at the

Zheleznogorsk Mining and Chemical Combine, Rosenergoatom announced. They are planned to undergo a full operation cycle in one of Russia's VVER-1000 reactors. Doing this "will give us more information about REMIX fuel behaviour in the reactor core and its influence on reactor physics," said Alexander Ugryumov, vice president for research, development and quality at TVEL. "Thus, we would obtain the necessary data for licensing full refuelling of the core with REMIX assemblies, as well as a reference experience for commercialisation and introduction of such fuel."

This builds on the successful trial of three fuel assemblies, each containing a few REMIX rods at the Balakovo nuclear power plant, which concluded in September after five years. Those assemblies are in storage while high levels of radioactivity dissipate enough for them to be examined in detail. "Introduction of [REMIX fuel] would enable to boost exponentially the feedstock for nuclear power plants due to closing the nuclear fuel cycle, and also to recycle spent nuclear fuel instead of its storage," said Rosatom.

REMIX (from Regenerated Mixture) fuel is made from uranium and plutonium recovered as an unseparated mixture from previously used fuel. They are topped up with low-enriched uranium to give a fuel that performs within the same parameters as fuel made only from fresh low-enriched uranium. This means a reactor would not need any modification to start using REMIX.

The cycle of reprocessing, recycling and top-up can be repeated as many as five times, with waste fission products removed each time and vitrified in glass ready for permanent geological disposal. In theory, a new reactor could operate for its whole design life of 60 years on just three REMIX

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fuel loads, circulating them continuously.

In August last year, Rosatom approved investment to set up a full manufacturing line for REMIX fuel. The uranium-plutonium fuel pellets will be made at the Mining and Chemical Combine in Zheleznogorsk, in the Krasnoyarsk region, where there is already a large storage facility for VVER-1000 fuel. The pellets will be manufactured into finished fuel assemblies at the Siberian Chemical Combine in Seversk in the Tomsk region of Russia.

While REMIX fuel is manufactured at the Mining and Chemical Combine in Zheleznogorsk, the fuel pellets themselves are made at the Siberian Chemical Combine in Seversk, 640 km to the east, where Russia has a large storage facility for used VVER-1000 fuel.

Source: World Nuclear News, <https://www.world-nuclear-news.org/Articles/REMIX-fuel-ready-for-final-test>, 11 November 2021.

UK

COP26 Energised by Nuclear Power as UK Wind Power Fails

While south Scotland including Glasgow was largely nuclear-powered, in the middle of the first week of COP26 the British grid system had minimum wind power coinciding with maximum demand, and Drax power station was paid £4,000/MWh, nearly 100 times the norm before the current UK crisis, for running two coal-fired units. Other fossil fuel generators received similar sums as the UK's extensive wind power capacity was becalmed. A record daily cost of stabilising the grid was also achieved: £44.7 million. The UK's increasing dependence on intermittent renewables undermining its energy security is very relevant to COP26 agenda, as is Glasgow's dependence on nuclear power.

Source: Excerpted from Weekly Digest, World Nuclear Association, 05 November 2021.

UK Government Adopts New Financing Model for Nuclear Power

The UK government has introduced into parliament a bill to adopt the Regulated Asset Base (RAB) model of financing new nuclear projects, both large and small. It is to reduce the cost of financing especially large projects and hence reduce the cost to consumers. Under this model the UK energy regulator (OFGEM) would

Significantly it "will reduce the UK's reliance on overseas developers for financing new nuclear projects by substantially increasing the pool of private investors to include British pension funds, insurers and other institutional investors," BEIS said with apparent reference to contentious Chinese equity in future plants.

establish an estimated cost for a nuclear project and set a fixed rate of return for investors. Payments from retail power consumers would be made during construction and operation to the project company building a plant, with payments increasing over the construction period in line with cumulative

spending. The company then receives a licence from OFGEM to charge a regulated price to consumers in exchange for providing the infrastructure in question. It has been used for the Thames Tideway Tunnel and Heathrow Airport's Terminal 5.

The Department for Business, Energy and Industrial Strategy (BEIS) said that large-scale nuclear power is the only technology available to provide continuous, low-carbon electricity and has key role to play in reducing UK's dependency on fossil fuels. Diminishing the risk for developers "will ultimately lower the cost of financing new nuclear power and reduce the costs to consumers and businesses" by more than £30 billion over the full life of a large nuclear power plant such as Sizewell C, according to BEIS. Significantly it "will reduce the UK's reliance on overseas developers for financing new nuclear projects by substantially increasing the pool of private investors to include British pension funds, insurers and other institutional investors," BEIS said with apparent reference to contentious Chinese equity in future plants.

The Nuclear Industry Association said that it provided "a clear signal to investors that the UK

believes in nuclear as a green technology which is essential to our energy transition. We hope the legislation will proceed swiftly, as investment is urgently needed." It will open the way for the large Sizewell C project – 3340 MWe – to proceed. Beyond that is the planned Bradwell B plant of 2300 MWe in Essex, intending to use Chinese Hualong One technology, and also Wylfa in Anglesey, Wales.

Eielson is currently served by its own 25 MWe coal-fired power plant, which typically runs at 13-15 MWe, using up to 800 tonnes of coal every day. The planned microreactor would supplement this with up to 5 MWe of nuclear power.

The government then announced direct funding of up to £1.7 billion to expedite a final investment decision on the Sizewell C power plant, which is expected to cost £18 billion (\$22 billion). Five years ago, China General Nuclear Corporation agreed to take a 20% stake in the project, following on from its one third share of Hinkley Point C. Like that plant, Sizewell C will provide about 7% of UK's electricity, contributing to climate goals.

Source: Excerpted from Weekly Digest, World Nuclear Association, 29 October 2021.

USA

US Announces Site for First Military Microreactor

The US Air Force has confirmed that it intends to install a very small nuclear power plant at the Eielson base in Alaska. A microreactor could be operational there as soon as 2027. Eielson is currently served by its own 25 MWe coal-fired power plant, which typically runs at 13-15 MWe, using up to 800 tonnes of coal every day. The planned microreactor would supplement this with up to 5 MWe of nuclear power. It would be owned and operated commercially and licensed by the US civil Nuclear Regulatory Commission (NRC). So far only one very small reactor is fully in the NRC's licensing process – Oklo's Aurora 1.5 MWe heatpipe fast reactor. However, several other more conventional US designs are not far behind.

Abbott has posed the question, "Might it be possible for Australia to acquire a retiring [Los Angeles] class boat or two and to put it under an Australian flag and to run it, if you like, as an operational training boat?" Abbott added that he'd make a similar proposal for British nuclear-powered submarines "were I in London."

A separate Department of Defense microreactor initiative is Project Pele, for a moveable unit for forward bases, using a high-temperature gas-cooled design (HTR) able to be set up in three days. These are to be less than 40 tonnes and be sized for transport by truck and C-17 aircraft. BWXT Advanced Technologies and X-energy were selected in March 2021 to develop a final engineering design by March 2022.

Source: Excerpted from Weekly Digest, World Nuclear Association, 29 October 2021.

NUCLEAR COOPERATION

AUSTRALIA–USA

Australia could Push to Acquire Retired US Navy Los Angeles Class Nuclear Submarines

The recently signed Australia–United Kingdom–United States defense agreement, or AUKUS, calls for the United States and Britain to share nuclear-submarine technology with Australia. Although the agreement was light on details of what, when, and how, plans apparently are for Australia to eventually build at least eight nuclear-powered attack submarines. In the interim, former Australian Prime Minister Tony Abbott is now advocating for Australia to obtain used nuclear submarines to get the sharing started so as to spin up the Royal Australian Navy's submarine capabilities and nuclear know-how. Australia has never had a nuclear power plant of any kind.

Speaking at a Wilson Center event in Washington, D.C., Abbott suggested that, in the short term, Australia should consider leasing or purchasing one or more existing U.S. submarines to

develop Australia's capability to operate nuclear-powered submarines. Abbott has posed the question, "Might it be possible for Australia to acquire a retiring [Los Angeles] class boat or two and to put it under an Australian flag and to run

it, if you like, as an operational training boat?" Abbott added that he'd make a similar proposal for British nuclear-powered submarines "were I in London."

"It would, in that capacity, be — if you like — an addition to the order of battle in the western Pacific, should that be necessary," he added. The U.S. Navy has experience turning Los Angeles-class submarines into floating schoolhouses. This past summer, the ex-USS San Francisco completed its conversion from a SSN to a moored training ship, MTS-711, now operating in Charleston, South Carolina. There it joined the converted former USS La Jolla, which began its new life in this training role last year. And while Abbott clearly is calling for a deployable vessel, not an MTS, if two subs were obtained, a moored training ship might be a valuable teaching tool to add.

Potential candidates for such a lease might include: the USS Providence (SSN-719), scheduled to be decommissioned this coming December; and the Oklahoma City (SSN-723), scheduled to decommission in June 2022. Two additional submarines — the ex-Pittsburgh (SSN-720) and the former Louisville (SSN-724) — were decommissioned in April 2020 and March 2021, respectively, but both might be too far along in the disposal process to be diverted and restored. All four submarines are equipped with vertical-launch systems (VLS) for Tomahawk cruise missiles. Pittsburgh and Providence were both commissioned in 1985. Louisville was commissioned in 1986, and Oklahoma City was commissioned in 1988. Two Flight I boats, which lack the VLS and other improvements, also retired in 2021: the Bremerton (SSN-698) and Olympia (SSN-717).

According to *SeaPower* magazine, the next tranche of "688 boats" to face the breaker's yard will be: the USS Chicago (SSN-721), Key West (SSN-722),

San Juan (SSN-751), and Topeka (SSN-754), in fiscal year 2024. The San Juan and Topeka, which entered service in 1988 and 1989, respectively, are the first of the improved "688i" submarines to be scheduled for decommissioning. The "improved" boats have better sensors and quieting technology, and, most notably, moved the dive planes from the sail to the bow, into which they can retract.

Britain has retired four of its seven Trafalgar class attack submarines. A fifth, HMS Trenchant, has been laid up since March, but is not yet officially decommissioned. HMS Talent received a significant upgrade in 2018, and Jane's reported in March 2021 that the boat would be extended one year beyond its previously announced 2021 retirement, while the final sub in the class, HMS Triumph, would get an 18-month reprieve beyond

its planned 2022 retirement. Both extensions were reportedly caused by delays in the follow-on Astute class.

It is not known what anticipated life is left in the nuclear fuel and reactors on any of the U.S. or U.K. boats, but it seems probable the submarines would require major work in that area. Refueling and overhaul (ROH) is an extremely expensive endeavor that requires the submarine's hull to be cut open. During the refueling process, the ship's systems are upgraded and overhauled as well. Considering the limited options, this could be necessary under such a near-term procurement scheme.

The good news is that there is a well-established process in place to do it, although extending the submarine's life beyond what has been realized in the past is another factor to contend with. On the other hand, finding dry dock time and the resources for ROHs for the Los Angeles class boats outside of those already planned would be challenging. And the rules for transferring a nuclear-powered vessel to a foreign power are

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There has already been an appalling backlog of maintenance for America's submarine fleet. The USS Boise (SSN-764), for example, has been waiting its turn for maintenance since fiscal year 2016. Making time for an allies' needs, on top of the Navy's growing demands, could become a major issue. The Congressional Budget Office already estimates that the U.S. submarine fleet's "size will exceed the yards' capacity to maintain it, not only over the next several years but in 25 of the next 30 years." Still, strategic imperatives could trump these concerns, and the United States might make getting Australia in the nuclear submarine game as fast as possible a top priority.

Australia has expressed interest in building its future nuclear-powered submarines domestically, in whole or in part. This may be just as well, given that General Dynamics' Electric Boat division is already at or near capacity building submarines for the U.S. Navy, although British builders might be better positioned to increase their output — if they can avoid further delays in the Astute program.

Australia seems likely to base its submarine on a mature design such as the U.S. Virginia class or U.K. Astute class. Given the long lead time for building such complex and specialized warships — not to mention creating the infrastructure necessary to do so — many analysts think it could take until 2040 or later before the first new nuclear-powered submarine enters Royal Australian Navy service. This makes Abbot's suggestion of buying or leasing an existing sub or two intriguing, to say the least.

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Abbott, a member of the Liberal Party, is a former prime minister who served from 2013 to 2015 — coinciding with the rise of Xi Jinping in China — the same party as current Prime Minister Scott Morrison. While Abbott is not a member of the present Australian government, it seems unlikely he would speak openly about the submarine proposal without at least an informal blessing of Australia's Foreign and Defence Ministries, which are both headed by fellow Liberals.

At the Wilson Center event, Abbott described himself as "like everyone else— until probably the end of 2015, I was a China optimist. We all thought for a long time that China and the West were on ... converging paths." China became the largest customer for Australian exports, he said, but then "weaponized trade against Australia." And now, he noted, "China is stepping up its intimidation of Taiwan all the time. In the few days before my [early October] visit [to Taiwan], there was something like 150 Chinese warplanes dispatched into the Taiwanese air [defense identification] zones. I expect that [such behavior] will get more intense."

Abbott was referring to a speech he gave in Taipei on Oct. 7, during which he used remarkably candid language. "Australia has no issue with China," he said. "We welcome trade, investment, and visits — just not further hectoring about being the chewing gum on China's boot." Abbott was referring to a speech he gave in Taipei on Oct. 7, during which he used remarkably candid language. "Australia has no issue with China," he said. "We welcome trade, investment, and visits — just not further hectoring about being the chewing gum on China's boot." ... Regardless of the percussion

metaphors, it seems Australia may want to consummate its nuclear submarine alliance sooner than some may have expected.

Source: Brian O'rourke, *The Drive*, <https://www.thedrive.com/the-war-zone/43005/australia-could-push-to-acquire-retired-us-navy-los-angeles-class-nuclear-submarines?>, 04 November 2021.

URANIUM PRODUCTION

GREENLAND

Greenland Bans Uranium Mining, Blocking Vast Rare Earths Project

Greenland's parliament has passed a bill to ban uranium mining and exploration in the Danish territory, effectively blocking the development of the vast Kvanefjeld rare earths project, one of the world's biggest. The project was being developed by Australia's Greenland Minerals (ASX: GGG). It was granted preliminary approval in 2020 and was on track to gain the previous government's final endorsement.

While the miner hasn't issued a statement on the matter, its shares were placed on a trading halt, pending "the release of an announcement". Trading will remain suspended until 12 November morning or the publication of the company's statement", it said in a notice to the Australian Stock Exchange.

The decision to ban uranium mining and exploration follows through on a campaign promise from the ruling left-wing party elected in April, which had publicly stated its intention to block Kvanefjeld's development, due to the presence of the silvery-gray, radioactive metal as a by-product. The law, passed by parliament, lines up with the new coalition government's strategy to focus efforts on promoting Greenland as

environmentally responsible. It bans exploration of deposits with a uranium concentration higher than 100 parts per million (ppm), which is considered very low-grade by the World Nuclear Association. The new regulation also includes the option of prohibiting exploration of other radioactive minerals, such as thorium.

Beyond Fishing: Greenland, a vast autonomous arctic territory that belongs to Denmark, bases its economy on fishing and subsidies from the Danish government. As a result of melting ice in the poles, miners have become increasingly interested in the mineral-rich island, which has become a hot prospect for miners. They are seeking anything from copper and titanium to platinum and rare earths, which are needed for

electric vehicle motors and the so-called green revolution.

Greenland is currently home to two mines: one for anorthosite, whose deposits contain titanium, and one for rubies and pink

sapphires. Before the April election, the island had issued several exploration and mining licenses in a bid to diversify its economy and eventually realize its long-term goal of independence from Denmark. The US government recently extended an economic aid package to Greenland as part of the Joe Biden administration's efforts to ensure the supply of critical minerals, particularly rare

earths, from outside China. Former president Donald Trump offered to buy the Arctic island to help address Chinese dominance of the rare earths market. China accounts for almost 80% of the global mined supply of the elements used in everything from hi-tech

electronics to military equipment.

Source: Cecilia Jamasmie, *Mining Dot Com*, <https://www.mining.com/greenland-bans-uranium-mining-blocking-vast-rare-earth-project/>, 10 November 2021.

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NUCLEAR PROLIFERATION

CHINA

Pentagon Sharply Raises Estimate of China's Nuclear Expansion

China is rapidly accelerating the expansion of its nuclear stockpile and is likely seeking to quadruple its number of nuclear warheads by 2030, according to the Pentagon's annual report to Congress on China's military power. *Why it matters:* U.S. officials and experts have raised alarms at reports of China's nuclear expansion and testing of advanced weapons capabilities, including a hypersonic missile this summer, as tensions with Washington have reached new highs.

Driving the News: The Pentagon's assessment found that China may have up to 700 deliverable warheads by 2027 and 1,000 by 2030 — a sharp revision upward from last year, when the U.S. estimated China's stockpile would double from the low 200s over the next decade. The U.S., by comparison, has 5,550 nuclear warheads, while Russia has 6,255, according to the SIPRI. Unlike those two countries, however, China has refused to join talks on arms control.

The Big Picture: The 192-page Pentagon report details China's broader military goals and evolving capabilities, and aligns with warnings from senior U.S. military officials that China poses the most significant threat to U.S. military supremacy out of any potential adversary. China's ambitions include strengthening its ability to "win wars" against a "strong enemy" — which the report calls "a likely euphemism" for the U.S. — coerce Taiwan and other actors in territorial disputes, and "project power globally."

A potential invasion of Taiwan is especially concerning to the U.S., which formally recognizes

the self-governing island as part of China but opposes any attempt by China to retake it by force.

The report assesses that China's "diplomatic, political, and military pressure against Taiwan intensified" in 2020, including with a record number of military incursions into the island's air defense zone.

What they're Saying: Gen. Mark Milley, chairman of

the Joint Chiefs of Staff, said that he does not believe it is likely that China will invade Taiwan within the next 24 months, but that its military is "clearly and unambiguously building" the capability to do so. The top U.S. military officer said at the Aspen Security Forum that there is "no question" the U.S. would have the capabilities to defend Taiwan from a Chinese invasion, but that it would be a choice for the president whether or not to do so. On the broader question of China's military modernization and the challenge it poses for the U.S., Milley stressed: "We're witnessing one of the largest shifts in global, geostrategic power that the world has witnessed."

Worth Noting: The report confirmed that toward the end of the Trump administration, China "perceived a significant threat" that the U.S. would seek to provoke a military conflict in the South China Sea, and that Milley and other senior U.S. military officials intervened to de-escalate tensions. "These events highlighted the potential for misunderstanding and miscalculation, and underscored the importance of effective and timely communication" between the U.S. and Chinese militaries, the report states.

Source: Zachary Basu, Axios, <https://www.axios.com/china-nuclear-expansion-pentagon-report-3a5bc2ed-967f-4942-ba60-1d3eb74ea8d6.html>, 03 November 2021.

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IRAN

IAEA Chief: Iran Inspections Like Flying in Heavy Clouds

The head of the U.N. atomic watchdog has compared his agency's efforts to monitor Iran's nuclear program to flying through dense clouds, warning that the situation can't continue for much longer. The IAEA has been unable to access surveillance footage of Iranian nuclear sites, or online enrichment monitors and electronic seals since February.

Physical inspections of Iran's nuclear facilities have also been problematic even as Tehran has continued to develop new centrifuges and enrich uranium up to purity levels closer to what's required for an atomic weapon. Western nations fear Iran could be developing the skills and know-how to build an atomic bomb, though Tehran denies any such ambitions.

"I would say we are flying in a heavily clouded sky," IAEA chief Rafael Mariano Grossi said of his agency's ability to perform its monitoring function in Iran. "So we are flying and we can continue in this way, but not for too long." Grossi told The Associated Press that he hopes to return to Iran soon "and to have the proper high level talks, eye-to-eye" that would restore the agency's ability to know in real-time what the country is doing.

"This is in their interest as much as it is in the international community's interest, because if they take seriously their intentions to continue with their nuclear program for civil purposes, they have to give the guarantees of what is going on there," he said on the sidelines of the U.N. climate summit in Glasgow. "One has to, at some point, come to grips with this situation," said Grossi.

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"Otherwise we are going to be in a very uncertain territory, and I hope that will not be the case." ...

Source: Frank Jordans, Associated Press, <https://apnews.com/article/europe-middle-east-iran-iran-nuclear-united-nations-ab9a7f1192f14e8e46767f2bb3d1e7ac>, 03 November 2021.

NUCLEAR NON-PROLIFERATION

GENERAL

Nuclear Powers Seek to Agree Positions on Non-proliferation - Russia's Deputy UN Envoy

The world's five nuclear powers are actively trying to agree their positions ahead of the upcoming Review Conference of the Parties to the Treaty on the NPT, Russian Deputy Permanent Representative to the United Nations Office and Other International

Organizations in Geneva Andrei Belousov, who represented Russia at recent meetings of the UN General Assembly's First Committee in New York, told Russian reporters. ...

Belousov pointed out that the nuclear powers had been able to "agree three statements that were announced at a meeting of the UN General

Assembly's First Committee and include a statement on the Treaty on the Prohibition of Nuclear Weapons, a statement on the prohibition of the production of fissile material for nuclear weapons and other nuclear explosive devices and a statement on a zone free of nuclear weapons in Southeast Asia."

Meanwhile, the countries that are parties both to nuclear non-proliferation agreements and accords on the prohibition of nuclear weapons, are also guided by the fact that the first meeting of the Treaty on the Prohibition of Nuclear Weapons is

expected to be held in the first half of March. "These are the landmark events that have determined discussions, first and foremost, on nuclear disarmament and non-proliferation, and also impacted documents regarding nuclear weapons," the Russian deputy envoy said.

The tenth NPT review conference was initially scheduled to take place in New York in May 2020 but was postponed due to the coronavirus pandemic. It is now expected to be held on January 4-28, 2022. The treaty brings together 191 countries.

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Source: TASS, <https://tass.com/politics/1358175>, 06 November 2021.

IRAN

Iran Wants U.S. Assurances it will Never Abandon Nuclear Deal if Revived

Iran said that the United States should provide guarantees that it will not abandon Tehran's 2015 nuclear deal with world powers again, if talks to revive the agreement succeed. Indirect talks between Iran and the United States, which stalled in June after the election of hardline Iranian President Ebrahim Raisi, are set to resume on Nov. 29 in Vienna to find ways to reinstate the 2015 accord. It has eroded since 2018, when then-U.S. President Donald Trump withdrew from it and reimposed sanctions on Iran, prompting Tehran to breach mandated limits on uranium enrichment the following year.

"The U.S. should show that it has the capability and will to provide guarantees that it will not abandon the deal again if the talks to revive the deal succeed," Foreign Ministry spokesman Saeed Khatibzadeh told a virtual news conference. Echoing Iran's official stance, Khatibzadeh said Washington must lift all sanctions imposed on Tehran in a verifiable process and "recognise its fault in ditching the pact".

The U.S. should show that it has the capability and will to provide guarantees that it will not abandon the deal again if the talks to revive the deal succeed," Foreign Ministry spokesman Saeed Khatibzadeh told a virtual news conference.

That ongoing stance is likely to cause concern in the United States and with its European allies - France, Britain and Germany - who deem it unrealistic and want to resume June's talks where they left off without new demands. One Western diplomat said if Tehran was genuinely continuing to demand a guarantee and full lifting of sanctions

then it meant Iran was not serious about talks. Khatibzadeh said Ali Bagheri Kani, who is Iran's top nuclear negotiator, will travel, as deputy foreign minister for political affairs, to the capitals of three European parties to the pact. ...

Source: Reporting by Dubai Newsroom and John Irish in Paris; Editing by Emelia Sithole-Matarise, Toby Chopra and Alison Williams, Reuters, <https://www.reuters.com/business/energy/iran-wants-us-assurances-it-will-never-abandon-nuclear-deal-if-revived-2021-11-08/>, 09 November 2021.

NUCLEAR SECURITY

TURKEY

IAEA Completes Nuclear Security Advisory Mission in Turkey

An IAEA team of experts completed a nuclear security advisory mission in Turkey today, which was carried out at the request of its Government.

The scope of the two-week International Physical Protection Advisory Service (IPPAS) mission included a review of the legislative and regulatory framework for the security of nuclear and other radioactive material, associated facilities and activities, including

transport, and a review of cyber security arrangements, regulatory practices (licensing, inspections and enforcement) and coordination between stakeholders involved in nuclear security. Nuclear material accounting and control measures, which protect nuclear and associated facilities and material from criminals, were also reviewed, as part of a pilot feature envisaged to

be added soon in the scope of all IPPAS missions.

This is the second IPPAS mission in Turkey, following the first in 2003. In July 2015, Turkey ratified the 2005 Amendment to the CPPNM, and its incorporation into the country's nuclear security regime was also included in the scope of the mission. The team observed that Turkey has established a nuclear security regime with essential elements of the IAEA's guidance on the fundamentals of nuclear security. The team offered recommendations and suggestions to support Turkey in further 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 Ivan Gorinov, Division Head of Physical Protection and Nuclear Material at the Bulgarian Nuclear Regulatory Agency, and included six other experts from France, Pakistan, Romania, the United States of America, and the IAEA.

The team met with officials from Turkey's Nuclear Regulatory Authority (NDK), as well as with representatives of other relevant ministries and governmental organizations, including the Ministry of Energy and Natural Resources, the Ministry of Foreign Affairs, the Ministry of National Defence, the Ministry of Transportation and Infrastructure, law enforcement agencies, the coastguard, customs officials, the Presidency Digital Transformation Office, the Energy Market Regulatory Authority, the Informatics and Information Security Research Centre (TÜBYTAK), and the Disaster and Emergency Management Presidency. As part of the review, the team visited four facilities where radioactive materials are in use, including the two campuses of the TENMAK Nuclear Energy Research Institute, the Istanbul Technical University, and the Eczacıbaşı Monrol radiopharmaceutical facility...

Source: <https://www.iaea.org/newscenter/pressreleases/iaea-completes-nuclear-security-advisory-mission-in-turkey>, 12 November 2021.

NUCLEAR SAFETY

JAPAN

U. N. Nuclear Agency Team to Review Plans for Release of Fukushima Water

A team from the U.N. nuclear agency arrived in Japan on Monday to assess preparations for the release into the ocean of treated radioactive water from the wrecked Fukushima nuclear plant. The experts on the team from the IAEA are to meet with Japanese officials and visit the Fukushima Daiichi plant to discuss technical details of the planned release, Japanese officials said.

The government and the plant's operator, Tokyo Electric Power Company (TEPCO) Holdings, announced plans in April to start gradually releasing the treated radioactive water in the spring of 2023 to allow the removal of hundreds of storage tanks to make room for facilities needed for the destroyed plant's decommissioning.

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The plan has been fiercely opposed by fishermen, local residents and Japan's neighbours, including China and South Korea. Japan has requested assistance from the IAEA to ensure the discharge meets international safety standards and to gain the understanding of the international community. A larger 11-member IAEA mission is expected next month. ...

Source: <https://www.thehindu.com/news/international/u-n-nuclear-agency-team-to-review-plans-for-release-of-fukushima-water/article37498602.ece>, 15 November 2021.

NUCLEAR WASTE MANAGEMENT

GENERAL

IAEA Conference on Sustainable Solutions in Radioactive Waste Management Opens

Participants from around the world are discussing solutions for the safe and responsible management of radioactive waste at the IAEA International Conference on Radioactive Waste

Management: Solutions for a Sustainable Future, which opened today at IAEA headquarters in Vienna.

Almost all countries use nuclear technologies to advance sustainable development through cancer therapies, improving crop yields and many other applications. Thirty-two countries also use nuclear power. Safe, secure and responsible management of the waste arising from these activities underpins the continued use of nuclear technology, and conference participants will review progress and the latest practices in dealing with radioactive waste.

Approximately 38 million m³ of solid radioactive waste has been produced globally, of which 30.5 million m³ has been disposed of permanently and a further 7.2 million m³ is in storage awaiting final disposal. Globally, about 95% of the volume of radioactive waste is made up of low level and very low level waste.

High level waste, arising from nuclear plant operations (spent fuel when declared as waste or conditioned waste when the spent fuel is recycled) makes up less than 3% of the total volume of nuclear waste, and requires disposal

in geological repositories several hundred meters underground. Finland's high-level nuclear waste disposal facility at Olkiluoto, which will soon become the world's first operational deep geological repository for high level waste, was highlighted by opening speakers as a proof of progress in waste management and a game changer for the long-term sustainability of nuclear energy.

"We have solutions for a sustainable future, just like the title of this conference says," IAEA Director General Rafael Mariano Grossi said in taped opening remarks to the conference, which runs until 5 November. "Not only are these solutions being implemented today, but the nuclear industry has successfully managed waste processing and disposal for more than half a century." ...As part of this conference, the IAEA called for and received scores of abstracts and papers covering all fields of radioactive waste management, including from research and education as well as industrial, agricultural and medical fields. ...

Source: Nicholas Watson, IAEA, <https://www.iaea.org/newscenter/news/iaea-conference-on-sustainable-solutions-in-radioactive-waste-management-opens>, 01 November 2021.

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Centre for Air Power Studies

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