



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

Vol 13, No. 03, 01 DEC. 2018

OPINION – Manpreet Sethi

Signalling with INS Arihant: Import of the Message and the Messenger

The announcement on 05 November 2018 regarding the completion of the first deterrent patrol of India's first indigenous nuclear-powered submarine (SSBN), the INS Arihant, has evoked three kinds of reactions: a euphoric one from strategic analysts within the country; expressions of concern by those across the borders from India; and, a fair amount of derision from India-watchers in the US and elsewhere who have cast aspersions on the 'deterrent' value of one SSBN with SLBMs that have limited range. It is worth disaggregating and examining each of these reactions to understand the true significance of this development.

First, the euphoria is understandable. It is indeed no mean achievement that India, with its financial constraints, and having lived most of its life under technology denials, has managed to design and construct a nuclear-powered submarine equipped with nuclear-tipped ballistic missiles in just 20 years after it announced the successful testing of its nuclear weapons capability. As is well known, a SSBN is a complex engineering creature involving conventional and nuclear systems that must remain functional at optimal performance levels in the harsh and rough environment of deep seas. For India to accomplish

It is indeed no mean achievement that India, with its financial constraints, and having lived most of its life under technology denials, has managed to design and construct a nuclear-powered submarine equipped with nuclear-tipped ballistic missiles in just 20 years after it announced the successful testing of its nuclear weapons capability.

CONTENTS

- ☞ OPINION
- ☞ NUCLEAR STRATEGY
- ☞ BALLISTIC MISSILE DEFENCE
- ☞ NUCLEAR ENERGY
- ☞ NUCLEAR COOPERATION
- ☞ NUCLEAR NON-PROLIFERATION
- ☞ NUCLEAR PROLIFERATION
- ☞ NUCLEAR SAFETY
- ☞ NUCLEAR WASTE MANAGEMENT

this feat and display its technological prowess certainly calls for a round of congratulations. It may be recalled that China's first Xia class SSBN had been commissioned in 1987 and it is not known to have conducted any active patrolling over the next two decades. According to media

reports, it is the second generation SSBN of the Jin class that conducted the country's maiden patrol in 2016. By those standards, India has not done badly at all in the construction and operationalisation of its credible nuclear deterrence.

With regard to the second kind of reaction seen in the

Pakistani media that has inclined towards outpouring of concern that strategic stability between the two countries will be upset by this development, two facts require reminding. One,

Pakistan has never been a votary for nuclear stability with India. It has certainly aspired for strategic parity but not stability since its nuclear strategy is premised on the idea of keeping the relationship unstable, teetering on the brink of heightened risks of escalation, so that India would be deterred from action at the conventional level in response to its continued acts of terrorism. Since the fear of nuclear escalation is meant to act as a shield against India's

Induction of capabilities that establish assuredness of retaliation in a nuclear state are actually stabilising developments. Construction of hardened silos, deep tunnels for protection of the arsenal, command and control, and for deception, operationalisation of SSBNs etc are meant to provide the country with a sense of confidence that it will be able to retaliate with nuclear weapons to cause unacceptable damage even in case of a first nuclear strike by the adversary.

superior conventional capability, establishing strategic stability has not been, and will not be, a priority for Pakistan till its strategic calculus of exploitation of the tool of terror changes. Secondly, induction of capabilities that establish assuredness of retaliation in a nuclear state are actually stabilising developments. Construction of hardened silos, deep tunnels for protection of the arsenal, command and control, and for deception, operationalisation of SSBNs etc are meant to provide the country with a sense of confidence that it will be able to retaliate with nuclear weapons to cause unacceptable damage even in case of a first nuclear strike by the adversary. This sense of assurance stabilises crisis stability. Given that Pakistan is constantly taking steps to generate crisis instability, India's SSBNs in conjunction with its NFU nuclear strategy actually enhance strategic stability.

It is a bit of an overstatement to truly describe this development as the establishment of India's nuclear triad. It certainly is a step in that direction, and a steady one at that. But for a nuclear triad to be really operational, India will have to wait a few years till at least 2-3 nuclear boats are commissioned and the ranges of the SLBMs improve beyond at least 3000 km.

The third response to the announcement has revolved around the inadequacy of one boat with missiles of a rather limited range to qualify as effective deterrence. Indeed, it is a bit of an overstatement to truly describe this development as the establishment of India's nuclear triad. It

certainly is a step in that direction, and a steady one at that. But for a nuclear triad to be really operational, India will have to wait a few years till at least 2-3 nuclear boats are commissioned and the ranges of the SLBMs improve beyond at least 3000 km. Agni V missiles, once operational on land, must mutate into sea-based versions to take the ranges to close to 5000 km, so that the SSBNs can stay out of harm's way and threaten effective retaliation against an

adversary inclined towards first use of nuclear weapons, however they may choose to describe the weapon – low yield, tactical, or for battlefield use. Since India makes no distinction in types of nuclear weapons, certainty of retaliation would be further ensured with the presence of effective deterrent patrolling by a sufficient number of SSBNs.

Finally, the significance of the announcement comes from the fact that it is the head of the Indian Nuclear Command Authority (NCA), the prime minister, who chose to make it. This is rather uncharacteristic by Indian standards where the officialdom has opted for a

low nuclear profile and steered away from drawing attention to India's nuclear capability. But it bears understanding that establishing the credibility of nuclear deterrence in the eyes of the adversary demands communication of capability and resolve. In this one masterstroke from the PM himself, India has managed to convey both. It has also underlined its commitment to the NFU and indicated the certainty of retaliation to undercut the possibility of nuclear blackmail – the two counts on which questions were being raised. Is it surprising then that the signals are being read carefully, here,

there, and everywhere else?

Source: <http://ipcs.org/>, 22 November 2018.

OPINION – Satish Chandra

The Trinity of Power

PM Modi announced on November 5 that India's first indigenously designed and built nuclear-powered submarine, the INS Arihant, which is equipped with nuclear-tipped ballistic missiles had just completed a nearly month-long nuclear deterrence patrol. This is a landmark development on many counts.

First, it demonstrates that India, apart from its capability to deliver nuclear weapons both from land and from air, can now also do so from under water. It provides the ultimate credibility to nuclear deterrence as both land and air-launched nuclear weapons are much more susceptible to destruction than those launched from undersea platforms which are difficult to detect. India's nuclear deterrence 20 years after the country went nuclear is now secure as it rests on a triad of land, air and undersea vectors.

Second, it sends out an unambiguous message to those inimically disposed towards India that they cannot trifle with it and efforts at nuclear blackmail will not work.

Third, the Arihant's successful nuclear deterrence patrol signifies India's attainment of complete mastery over all the highly complex systems and procedures entailed in operating the sea leg of the triad. These are much more intricate and exacting than those for land and air vectors. Unlike the latter, they entail not only nuclear-propelled

platforms but also ab initio custody of fully mated nuclear weapons. There is no scope for error. The validation of the scores of procedures and system checks intrinsic to the sea leg of the triad is a cause

of great satisfaction. Clearly, the nuclear deterrence patrol signifies India having come off age as a mature nuclear-armed state.

Fourth, this exercise is testimony to India's technological prowess as it entailed not merely the construction of a sophisticated vessel as the

Arihant, but also developing and appropriately miniaturising a nuclear plant to power it. Over and above this, a high degree of engineering skill and workmanship was required in developing a nuclear missile system capable of firing from underwater

for fitment into it. It is also gratifying that a substantial element of the work in developing and equipping this submarine was undertaken in India, by Indians, and accordingly it has a very substantial indigenous component. The Arihant is believed to be the first in a series of six submarines. These will form the core of India's sea-

based nuclear deterrent and constitute a potent and formidable weapons system which will ensure national security. It is a given that with the serial production of Arihant-type submarines, there will be an even higher element of indigenisation.

In conclusion, it may be underlined that the Arihant's nuclear deterrence patrol does not constitute any shift in India's approach towards nuclear weapons. As per its nuclear doctrine, India remains committed to "the goal of a nuclear weapon free world, through global, verifiable and non-discriminatory nuclear disarmament", to no first use of nuclear weapons, and non-use of nuclear weapons against non-nuclear weapon

It demonstrates that India, apart from its capability to deliver nuclear weapons both from land and from air, can now also do so from under water. It provides the ultimate credibility to nuclear deterrence as both land and air-launched nuclear weapons are much more susceptible to destruction than those launched from undersea platforms which are difficult to detect.

Arihant's nuclear deterrence patrol does not constitute any shift in India's approach towards nuclear weapons. As per its nuclear doctrine, India remains committed to "the goal of a nuclear weapon free world, through global, verifiable and non-discriminatory nuclear disarmament", to no first use of nuclear weapons, and non-use of nuclear weapons against non-nuclear weapon states.

states. In the absence of a nuclear-free world, it continues, however, to regard nuclear weapons as a deterrent designed to prevent a nuclear attack against it and, accordingly, as per its doctrine, it has sought to ensure that its deterrent is "credible". With the Arihant's nuclear deterrence patrol, India has added immeasurably to the credibility of its nuclear deterrence. This will obviously add to national security and will be a factor for peace.

Source: <https://indianexpress.com/>, 19 November 2018.

OPINION – Sandeep Unnithan

Nuclear Capability: The Arihant Watershed

India recently took its first steps towards establishing the third leg of a nuclear triad: the ability to launch nuclear weapons from under the sea. On November 5, PM announced that India's first indigenous SSBN, the INS Arihant, had completed its first deterrent patrol.

India, however, is still years away from a robust third leg. "The triad becomes effective when you have a submarine operational at all times, [and that would require a fleet of four such vessels at the very least]. In our case, a triad is operational only when the Arihant sails.

A strategic deterrent patrol is one where an SSBN with a full complement of nuclear-tipped missiles sails towards its intended area of deployment and within range of an adversary's targets. In case of an attack by a nuclear-armed adversary, India's Nuclear Command Authority (NCA) can order the submarine to launch its weapons.

The prime minister's statement assumes significance because it also hints at having established a command chain- the NCA's ability to communicate with a submarine lurking in the depth of the ocean. In the Arihant's case, the order will be passed via a sophisticated Extremely Low Frequency (ELF) communication system near Tirunelveli in Tamil Nadu.

The Arihant returned to its base in Visakhapatnam on November 4 after a 20-day submerged patrol. The patrol area is a closely guarded secret, but the PM's statement warning of a "fitting response to those who indulge in nuclear blackmail" seems

to suggest that the North Arabian Sea, off Pakistan, rather than the East China Sea, was the Arihant's patrol area. (It will take the submarine nearly a month to make the passage to and from China's shores). Deterrent patrols are meant to dissuade a potential nuclear-armed adversary from launching a nuclear first strike. Once a submarine sails out into the deep ocean, it is extremely difficult to detect, track and destroy, making it the most survivable platform of the nuclear triad that consists of aircraft-dropped and ground-fired nuclear missiles.

All five permanent members of the UN Security Council deploy their SSBNs on deterrent patrols. The robustness of the deterrent is decided by missile ranges, number of weapons and, most critically, the ability to have one platform on continuous patrol. China was the last entrant into this club with its SSBN making its first deterrent patrol as recently as December 2015.

India, however, is still years away from a robust third leg. "The triad becomes effective when you have a submarine operational at all times, [and that would require a fleet of four such vessels at the very least]. In our case, a triad is operational only when the Arihant sails" says strategic analyst Bharat Karnad. The 6,000-tonne INS Arihant was inducted into service in August 2016 and is currently armed with 12 B-05/ K-15 SLBMs (submarine launched ballistic missiles), which have a range of 750 km. Its arsenal of four K-4 SLBMs, with a range of 3,500 km, is yet to pass trials.

Three other SSBNs are being built under the Defence Research and Development Organisation's Advanced Technology Vessel (ATV) project in Vizag. A second SSBN, the Arighat, launched last November, is expected to join the navy in a few years. Two more SSBNs are likely to join within the decade. More submarines with longer-ranged missiles means more deterrent patrols and, hence, a credible third leg. The Arihant's first deterrent patrol, though a

commendable achievement, should be seen as the first steps in that direction.

Source: <https://www.indiatoday.in/>, 10 November 2018.

OPINION – Hina Pandey

Assessing the U.S.-India Nuclear Deal Ten Years Later: Symbolism and Substance

On October 8, 2008, President George W. Bush signed the United States-India Nuclear Cooperation Approval and Nonproliferation Enhancement Act into law. Two days later, a historic agreement was concluded between the world's oldest and largest democracies allowing for bilateral civilian nuclear cooperation whereby American utilities could build nuclear reactors for India and supply them with uranium fuel. This would meet India's rising need for electricity as well as contributing toward its broader mission of diversifying its energy mix to ensure energy security.

Fast forwarding to 2018, Indian critics of the deal question whether this very promise was kept, as the six reactors to be built by American nuclear giant Westinghouse in Andhra Pradesh are yet to be constructed after a decade. From a point of critical inquiry, one might ask: has the bilateral U.S.-India civilian nuclear cooperation even kicked off? However, to view the deal's outcome in such simplistic terms would imply taking a narrow view of the impact it has had on the relationship.

The civilian nuclear deal has facilitated gains for both sides—for India, it brought a recognition of its nuclear legitimacy while for the United States, it mitigated nuclear proliferation concerns about India while also providing the United States with a counterweight to a rising China.

History of U.S.-India Nuclear Engagement: Prior to 2005, Indo-U.S. relations were hostage to a nuclear past, which prevented any significant forward movement in the relationship. Post India's

peaceful nuclear explosion in 1974, the bilateral relationship was put on a hiatus in the nuclear realm, as the United States stopped supplying uranium fuel for India's Tarapur reactor. The United States viewed India's test as a breach of trust because Washington had provided nuclear support to New Delhi under the 'Atoms for Peace' program, which India had promised to use only for civilian purposes. On the other hand, India also felt betrayed because the nuclear fuel contract was suddenly paused by the United States, despite the fact that the nature of India's tests was peaceful.

Subsequently, India experienced three decades of global nuclear commerce isolation due to sanctions and this prevented any further transfer of dual use technologies to India and more specifically, civilian nuclear equipment technology. According to Raymond E. Vickery,

former U.S. Assistant Secretary of Commerce and Trade, "this theme of unreliability based upon the failure to fulfill the fuel supply agreement for Tarapur became a continuing complaint of India in regard to doing business with the United States."

A Nuclear Opening:

Benefits of the Deal: The conclusion of the deal freed both countries of the baggage of this nuclear past and brought them together to tap strategic and economic synergies. While the shared values of democracy have always existed between the two countries, the utility in expanding the canvas of bilateral cooperation truly played out when the nuclear irritant was removed in 2005 and the United States offered India civilian nuclear technology.

Even if the direct commercial benefits of the deal are yet to be seen, it helped India achieve an immense strategic and diplomatic gain—an exclusive waiver from the NSG, giving India the opportunity to do nuclear trade with 46 member countries. This was inconceivable many years prior

Fast forwarding to 2018, Indian critics of the deal question whether this very promise was kept, as the six reactors to be built by American nuclear giant Westinghouse in Andhra Pradesh are yet to be constructed after a decade. From a point of critical inquiry, one might ask: has the bilateral U.S.-India civilian nuclear cooperation even kicked off.

since as a non-NPT member and de-facto nuclear power, India was prohibited to engage in nuclear commerce. What's significant is that not only was the formation of the NSG a reaction to the Indian nuclear tests in 1974, but the United States' own nuclear nonproliferation laws underwent modification in response to these tests. Thus, India's securing an NSG waiver was a huge symbolic win, in a way validating its status as a nuclear power, and this U.S. support has continued in recent years, with the last three American administrations backing India's bid for NSG membership.

One can further argue that the nuclear deal stood for much more than just a commercial partnership between India and the United States in the civilian nuclear realm—it was reflective of a fundamental shift in both countries' perception of each other. Before the deal, the United States was known to extend nuclear technology and cooperation only to allies, such as South Korea and Japan. But with this deal, the United States offered such technology to a non-ally like India. The calculus was to enlist New Delhi's help to balance against China's rise and this strategy has paid dividends with India shoring up its defense capabilities by buying American weapons worth billions, playing more of a net security provider role in the Indian Ocean, and aligning its regional and global interests more closely with the United States.

Additionally, by getting India to put its civilian nuclear reactors under the IAEA safeguards regime, the deal laid the foundation for India to align its nuclear policy posture further with the U.S.-led global nonproliferation regime. This can be seen through India becoming party to multilateral nuclear security and safety initiatives such as the Convention of Supplementary

Compensation on Nuclear Damage and the Convention on the Physical Protection of Nuclear Material, attending nuclear security summits, and establishing the Global Center for Nuclear Energy Partnership, a center for excellence that facilitates the exchange of nuclear best practices among countries. These were direct nuclear nonproliferation gains from the deal for the United States.

By getting India to put its civilian nuclear reactors under the IAEA safeguards regime, the deal laid the foundation for India to align its nuclear policy posture further with the U.S.-led global nonproliferation regime. This can be seen through India becoming party to multilateral nuclear security and safety initiatives.

Though that hurdle was crossed, Westinghouse's recent filing for bankruptcy has stalled progress again, with doubts on whether the company would be able to fulfill its commitment. However, there is still hope for the U.S. nuclear energy industry in India—according to media reports, the Westinghouse bankruptcy issue is nearly resolved and the company has restarted conversations with India on constructing the six nuclear reactors.

Where the Deal Fell Short:

The United States had perceived significant economic gains from civilian nuclear cooperation with India in the long term, which have yet to pan out. When the deal was freshly concluded, the U.S. nuclear energy industry was looking forward to selling nuclear reactors to the Indian market, especially in the context of an expected nuclear energy resurgence with a dozen newcomers sprinting to adapt nuclear energy along with India and China that planned to expand nuclear energy development. The United States viewed the Indian nuclear market as "a rich prize" that could provide U.S. companies to opportunity to make billions of dollars by constructing nuclear power plants in the country. In this context, American companies such as General Electric and Westinghouse were looking at a potential business of \$150 billion from the nuclear markets in India.

However, the agreement to make nuclear reactors was significantly delayed, and finally came only in 2016, because legalities dealing with compensation in case of a nuclear accident needed to be sorted out. India was trying to negotiate with the United States to establish clear liabilities for the operator as well as vendors in case of a nuclear accident and come up with a nuclear insurance pool that would look after compensation for damage. Though that hurdle was crossed, Westinghouse's recent filing for

bankruptcy has stalled progress again, with doubts on whether the company would be able to fulfill its commitment. However, there is still hope for the U.S. nuclear energy industry in India—according to media reports, the Westinghouse bankruptcy issue is nearly resolved and the company has restarted conversations with India on constructing the six nuclear reactors.

Lasting Impact: India's nuclear activities were a concern for the United States for decades and the main cause for their deep estrangement. However, the U.S.-India civilian nuclear deal reversed this estrangement and turned it into engagement, which in the last ten years has evolved into a grand strategic partnership. Some big achievements of the partnership include convergence on regional security issues, India becoming a "major defense partner" of the United States, the various foundational agreements signed that improve interoperability between U.S. and Indian forces, joint military exercises, expansion of trade relations, and cooperation on countering terrorism, to name a few. Had the nuclear irritant not been removed, would the strategic partnership have blossomed as fully? Thus, to measure the success of the nuclear deal simply in commercial terms may not be wise as it paved the way for some symbolism but a lot of substance in U.S.-India relations, elevating it to one of the most promising partnerships in the last decade.

Source: *South Asian Voices*, 30 October 2018.

OPINION – K.S. Parthasarathy

Nehru's Vision, Bhabha's Mission

Pandit Jawaharlal Nehru was born on November 14, 1889. Dr Homi Jehangir Bhabha, 20 years later. This age difference did not hinder their close

interaction, which led to the establishment of India's atomic energy programme on a sound footing. Nehru's faith in science and technology, his genuine respect for Dr Bhabha, and their burning ambition worked synergistically to place India on the nuclear map of the world.

Atomic energy developed and prospered because of Nehru's vision fulfilled by Dr Bhabha's mission. Nehru supported his protégé to solve many, big and small, intractable issues.

Nehru's faith in science and technology, his genuine respect for Dr Bhabha, and their burning ambition worked synergistically to place India on the nuclear map of the world. Atomic energy developed and prospered because of Nehru's vision fulfilled by Dr Bhabha's mission. Nehru supported his protégé to solve many, big and small, intractable issues. When scientists were commissioning the APSARA reactor, there was no canteen in Trombay. Scientists needed transport on a 24-hour basis. Government rules did not then permit such demands.

When scientists were commissioning the APSARA reactor, there was no canteen in Trombay. Scientists needed transport on a 24-hour basis. Government rules did not then permit such demands.

'Incidentally, this provides an example of the way in which the present rules and regulations of government are not really suited for executive work which is to be done at speed and under pressure,' Dr Bhabha reminded Nehru in a

message on July 31, 1956. 'He believed that strength respects strength. He visualised a powerful India.' The loading of the reactor is a difficult operation, and a mistake may seriously set the project back. It is clear that, in the circumstances, everything should be done which should relieve the physical strain,' he cautioned Panditji.

He got Nehru's approval to provide two cars to scientists on a 24-hour basis and lunch and dinner which an appropriate restaurant will supply for them in the reactor building at Trombay. A person privy to the arrangement told this writer that the Trichur Mess (now defunct), a hotel in Matunga, served vegetarian meals and the Taj Hotel, non-vegetarian dishes.

'...I do not see how we can lag behind in this very important matter, because atomic energy is going to play a vast and dominating part, I suppose, in

the future shape of things it will make power mobile, and this mobility of power can make industry develop anywhere. We will not be tied up so much by the accidents of geography,' Panditji asserted after laying the foundation stone of the National Physical Laboratory on January 4, 1947.

This was seven years before the Soviet scientists connected the world's first nuclear power reactor (5MW) to the power grid at Obinsk. Nehru ensured the promulgation of the Atomic Energy Act in 1948 and setting up the Atomic Energy Commission in 1948 and the Department of Atomic Energy in 1954.

With his admirable farsightedness and administrative acumen, Nehru realised that for rapid progress in the field of atomic energy, the DAE must enjoy complete autonomy. Three unique gazette notifications exempted the DAE from executing work through the ministry of works, housing and supply, from making purchases through the directorate general of supplies and disposals and carrying out construction and civil engineering through the central public works department. The DAE need not approach the Union Public Service Commission for recruitment of staff. Within the limits of the budget provision, approved by Parliament, the AEC enjoyed the powers of the Government of India, both administrative and financial, for carrying out DAE work.

Nehru and Dr Bhabha, titans in their fields, had no ego clashes. When Nehru felt that there was a communication gap developing between DAE and others, he asked Dr Bhabha to organise a national conference at Delhi in 1954. Nehru himself presided over the two-day meeting. Leading scientists, engineers, political leaders and administrators attended.

Nehru frankly revealed his mind whenever the need arose. On July 29, 1955, in a message to Dr Bhabha, Nehru wondered how far the international conference to consider the draft statute of the IAEA would consider political questions or purely technical and scientific ones. 'I find that some of the other major countries are sending non-technical people as leaders of their

delegations. It would probably be advisable for you and your scientific colleagues not to get mixed up too much with the political aspects,' Nehru cautioned.

On April 27, 1956, Yuchiro Isobo, assistant managing editor and foreign editor, Tokyo Shimbun requested Dr Bhabha to write an article on the justifiability of the American hydrogen bomb in the Pacific. Dr Bhabha was inclined to recall the stand officially taken by India on the subject. 'I do not think it will be proper for you to write to the newspaper on this subject. If I had been asked to write, I would have refused. If I have to express an opinion, I do so in Parliament or any other suitable place,' Nehru wrote.

'You, as a scientist, can express your opinion from the scientific point of view on suitable occasions. But to do so in a newspaper, would not, I think be appropriate. You might send a reply to Tokyo Shimbun stating that, as a scientist, you would prefer not to engage in newspaper controversies even on this important subject,' Nehru suggested.

They totally and sincerely respected each other's roles. While looking forward to one of Nehru's visits to Trombay and Colaba, Dr Bhabha informed Nehru that they were treating the visit as a purely business trip. 'I hope the lunch at Trombay will afford an opportunity for you to meet and talk to some of our outstanding young scientists. All this, of course, will hardly be possible if you come accompanied by other VIPs, and I hope, therefore, that some advance indication will be given from your end of how you would like this visit to be arranged,' Dr Bhabha requested.

'I do not know if any VIPs might accompany me there. No one will come from Delhi. Perhaps the governor or the chief minister might go with me. You can find that out from them,' Nehru promptly replied.

The letters they exchanged bear testimony to their close relationship. On January 28, 1961, Dr Bhabha reminded Nehru that he has agreed to attend the buffet supper, which Dr Bhabha as the chairman, Atomic Energy Commission, was giving for representatives of foreign governments attending the inauguration at Trombay at the Ashoka Hotel on Sunday, January 29.

'I have also sent separate invitations to Nan, Indu, and Betty. I am merely mentioning this, in case they have gone astray,' Dr Bhabha informed Nehru. Nehru quickly confirmed that Indu and he would come for the lunch. 'Nan would not, as she was accompanying Queen Elizabeth to Agra. Betty may or may not come as she was unwell.'

Nehru addressed Dr Bhabha as 'My dear Homi'. To Dr Bhabha, Nehru was 'My Dear Bhai'. There interpersonal relationship is worthy of emulation at every level in these troubled times.

What Drew the Two Men Together?: Dr Indira Chowdhry, eminent historian and Dr Bhabha's biographer, wrote thus in Mid-Day (February 16, 2009): 'Indira Gandhi recollected that Nehru always found time to talk to Bhabha no matter how late it was not because Bhabha brought to him urgent matters that required his immediate attention but because he found the conversation relaxing.' 'Bhabha recognised that although Nehru was not a practising scientist, his personality revealed the essential attributes of a real man of science.'

Indira Gandhi recollected that Nehru always found time to talk to Bhabha no matter how late it was not because Bhabha brought to him urgent matters that required his immediate attention but because he found the conversation relaxing.' 'Bhabha recognised that although Nehru was not a practising scientist, his personality revealed the essential attributes of a real man of science.'

'Nehru, on the other hand, often spoke about the longing with which he turned to science even after circumstances made him part company with it. It was almost as if Bhabha opened a window to the world of science that he longed for.'

Source: <https://www.rediff.com/>, 14 November 2018.

OPINION – Ivo Vegter

Nuclear Energy is Extraordinarily Safe

A lot of opposition to nuclear power is motivated by fears over the safety of nuclear reactors. Chernobyl and Fukushima scared the pants off people. But they're wrong. Nuclear is by far the safest form of energy on the planet, bar none. South

Africa has had plans to build several new nuclear power stations for a very long time. Since the late 1990s, the government has had plans to build 9,600 GW worth of nuclear power stations, which amounts to about 10 units, or five power stations the size of South Africa's only commercial nuclear power station, Koeberg.

The process was derailed when president Jacob Zuma took office. Three power stations had gone to tender, and two bidders were selected, namely Westinghouse and Areva, from the US and France, respectively. Zuma placed these plans on hold, and at some point allegedly entered into an agreement with Russia's Rosatom to build a fleet of nuclear power stations in South Africa.

This wasn't entirely accurate. South Africa had entered into intergovernmental agreements with the United States in 1995, with South Korea in 2010, and with Russia, China and France in 2014, agreeing to cooperate in the field of nuclear energy. None of

these amounts to an agreement to actually build nuclear power stations in South Africa. Figures of \$76-billion and \$100-billion were bandied about, but these reports appeared to have no basis in any actual proposals. No proposals for nuclear power station builds have yet been requested by government.

In April 2018, two South Africans won a major global environmental prize for bringing and winning a court case against the government over its nuclear procurement programme. They were Makoma Lekalakala, from Earthlife Africa, and Liz McDaid, of the Southern African Faith Communities' Environment Institute.

The high court ruling set aside three of the intergovernmental agreements, involving Russia, the US and South Korea. It also set aside the government's determination that new nuclear generation capacity was required and needed to be procured. This means that any new nuclear

procurement process will have to start from scratch, complete with parliamentary debates and public participation.

The environmental organisations claimed it as a victory, but the case was decided on procedural grounds, not on grounds of nuclear safety. When Cyril Ramaphosa took office in early 2018, he was quick to say South Africa could not afford new nuclear power stations. This is trivially true. The government has no money for anything, really. But again, environmental groups celebrated.

In future columns, I intend to address the question of whether nuclear energy is affordable as part of the energy mix in South Africa, and whether or not renewable energy, or indeed anything else, can substitute for nuclear power if South Africa wishes to reduce emissions from electricity generation.

The opposition to South Africa's nuclear programme has been driven by environmentalists, and nuclear safety is a major reason for public opposition against individual nuclear build locations. To date, five sites have been identified, in Thyspunt near St. Francis Bay in the Eastern Cape, Duynfontein near Cape Town, Schulpfontein and Brazil on the west coast of the Northern Cape not far from Springbok, and Bantamsklip between Hermanus and Cape Agulhas in the Western Cape. The first two have had environmental impact assessments done. "The risks with nuclear are just too high," declared McDaid in a newspaper interview in April 2018.

"I believe that if people have the facts, they will choose differently. This is what we are doing through our campaigning. For example, there is

so much we don't know about the future impacts of nuclear waste, which continues to grow every year. Koeberg alone generates approximately thirty (30) tons of high-level waste per year – all stored at the plant. Furthermore, the Chernobyl disaster, which happened 39 years ago this week, and Fukushima still continue to provide evidence of the enormous risks of nuclear."

If she's so big on facts, let's consider some facts. Starting with the fact that Chernobyl didn't happen 39 years ago, but 42 years ago, on 25 and 26 April of 1986. For someone who spent her life campaigning against

nuclear power, you'd think that this date would be engraved in her mind. To work out how safe energy is, anecdotes are not useful. Like photographs, they can be arresting and scary, but they do not provide any understanding of the big picture. What you really want to do is look at statistics.

Brian Wang, a futurist, lecturer at the Singularity University and the popular author of the NextBigFuture website, has done the rather complicated sums in this very well-sourced article. He calculated the number of deaths attributable to a particular source of energy, per unit of energy produced. The results are dramatic.

Coal kills a lot of people. Not only does it kill coal miners, but it kills the rest of us because of particulate pollution. Coal in the US (10

deaths per TWh) is far, far safer than coal in China (325 deaths per TWh), thanks to better mine safety and clean air regulations, but still, coal is dirty and deadly.

Oil, which accounts for 40% of the world's energy use, comes in second. It is also a pollutant, and drilling for oil is a very dangerous job. Biofuel,

The opposition to South Africa's nuclear programme has been driven by environmentalists, and nuclear safety is a major reason for public opposition against individual nuclear build locations. To date, five sites have been identified, in Thyspunt near St. Francis Bay in the Eastern Cape, Duynfontein near Cape Town, Schulpfontein and Brazil on the west coast of the Northern Cape not far from Springbok, and Bantamsklip between Hermanus and Cape Agulhas in the Western Cape.

Oil, which accounts for 40% of the world's energy use, comes in second. It is also a pollutant, and drilling for oil is a very dangerous job. Biofuel, biomass and peat make up third spot, again largely because of pollution. Hydro is extremely safe, and if you subtract only a single catastrophic dam failure in China in 1975, its death rate drops to 0.1 per TWh, rivalling the safety of wind and solar.

biomass and peat make up third spot, again largely because of pollution. Hydro is extremely safe, and if you subtract only a single catastrophic dam failure in China in 1975, its death rate drops to 0.1 per TWh, rivalling the safety of wind and solar.

Yet the winner, at 2.5 times safer than even solar power, is nuclear power. It provides more than 10% of all the world's electricity, yet it has killed almost nobody. Many opponents of nuclear power point to Chernobyl, as McDaid does. The point isn't that failures are common, they argue, but that when they happen they are so catastrophic. That's like pointing to an aeroplane or train crash, and concluding that flying or rail transport is more dangerous than, say, walking, cycling or driving a car. Even though train or plane accidents can be big and scary, these modes of transport are statistically far safer than any other. The plural of "anecdote" is not "data".

Worse, the examples don't even support the argument. Chernobyl was an old reactor design, built and operated by the engineers of the Soviet Union, which was never renowned for its high regard for safety, and was soon to collapse. Today's third-generation nuclear plants are not built to Soviet safety standards, but are many times safer.

Many environmental groups estimate the past and future death toll of Chernobyl to be as high as a million people. That is absurd. It is way out of line with the official death toll, which amounts to 28 people who died as a result of radiation exposure during or after the Chernobyl disaster, and about 15 cases of thyroid cancer in children. There is a great deal of uncertainty about the

potential future death toll, even among sane experts. To date, Chernobyl has been blamed for a "substantial fraction" of 6,000 reported cases of thyroid cancer, although the actual size of that fraction is not disclosed. There is little evidence of any measurable health effects beyond this.

From decades of research, the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) reported, "...it can be concluded that although those exposed to radioiodine as children or adolescents and the emergency and recovery operation workers who received high doses are at increased risk of radiation-induced effects, the vast majority of the population need not live in fear of serious health consequences from the Chernobyl accident."

Fukushima is an even worse example to illustrate the dangers of nuclear power. On the contrary, it demonstrates how extraordinarily safe nuclear power is. Here we had a 40-year-old power station, older than Chernobyl, run by a cash-strapped and corner-cutting operator, hit by a double whammy of an earthquake and a tsunami, both of which exceeded what the installation had been designed for.

Initially, the plant worked as advertised. When the earthquake struck, the nuclear reactors promptly shut down. A reactor that has been powered down needs several days of cooling, however. The tsunami knocked out the main cooling systems, the diesel tanks for the backup generators, as well as the power lines into the plant. Later attempts to relieve steam pressure resulted in a hydrogen explosion that knocked the outer roof off one of the reactors. This was an

There is a great deal of uncertainty about the potential future death toll, even among sane experts. To date, Chernobyl has been blamed for a "substantial fraction" of 6,000 reported cases of thyroid cancer, although the actual size of that fraction is not disclosed. There is little evidence of any measurable health effects beyond this.

Fukushima is an even worse example to illustrate the dangers of nuclear power. On the contrary, it demonstrates how extraordinarily safe nuclear power is. Here we had a 40-year-old power station, older than Chernobyl, run by a cash-strapped and corner-cutting operator, hit by a double whammy of an earthquake and a tsunami, both of which exceeded what the installation had been designed for.

absolute worst-case scenario.

Six workers died in the resulting clean-up operation, though none died of radiation exposure. Other than that, Fukushima claimed no casualties. In fact, there were no observed health effects at all in the general public, and any effects in workers would not likely be discernible, according to the experts. An observed increase in thyroid abnormalities following the accident was entirely attributed to more intensive screening.

"No deterministic effects from radiation exposure had been observed among the public and none had been expected," UNSCEAR concluded in 2016. In a panic, the Japanese government evacuated 170,000 people from the region around the Fukushima reactor. Only 20,000 of them went willingly. The evacuation, unlike the reactor accident, did have a death toll. More than 50 people died from causes such as hypothermia, deterioration of underlying medical problems, and dehydration.

A study of the health effects of radiation and other health problems in the aftermath of nuclear accidents, with an emphasis on Fukushima, found: "After the accident, mortality among evacuated elderly people needing nursing care increased by about three times in the first 3 months after evacuation and remained about 1.5 times higher than before the accident." In fact, the major lesson from the Fukushima NPP is: "The Fukushima Daiichi NPP accident showed the health risks of unplanned evacuation and relocation for vulnerable people such as hospital inpatients and elderly people needing nursing care, and failure to respond to emergency medical needs at the NPP." The high numbers of deaths anticipated by anti-nuclear campaigners are almost all based on what is known as the "linear no-threshold (LNT) model". It presumes that there is no threshold below which exposure to radiation is safe. It

deduces the effects of low doses on a large population from the measurable effects of high doses on a small population.

If, say, a given high radiation dose causes an increased risk of cancer in 100 out of 1,000 observed people, the assumption would be that a tenth of that dose would cause the same in 10 cases, and a hundredth of that dose would do so in one case.

But that's like saying that because being hit by a bullet fired from a gun kills 50 out of 100 people, a bullet thrown at those same people at one 50th of the speed would still kill one person. Or that because dropping a 10kg weight onto 20 people killed 10 of them, dropping a 100g weight onto 200 people would also kill 10 of them.

Since the 1970s, and at the behest of radiation safety activists, the LNT model has widely been used to set regulatory limits around radiation. In the scientific community, however, it has widely been rejected. Low doses of nuclear radiation simply do not pose the

same risk as high doses. The LNT model doesn't even account for the duration of exposure. In fact, the linear no-threshold relationship is inconsistent with radiation biologic and experimental data, declared a paper published in 2009. It found, not surprisingly, that the body is entirely capable of healing small injuries, and that there exists a threshold below which nuclear radiation is quite safe. In fact, there is some evidence that low doses can be beneficial to humans. We certainly know that while radiation can cause cancer, it is also used medicinally to combat cancer....

...Finally, there is the perennial argument about nuclear waste. "It lasts for thousands of years!" we are told, by people who betray a total misunderstanding of nuclear physics. Generally speaking, it isn't the stuff with long half-lives you need to be worried about. Elements that decay

The Fukushima Daiichi NPP accident showed the health risks of unplanned evacuation and relocation for vulnerable people such as hospital inpatients and elderly people needing nursing care, and failure to respond to emergency medical needs at the NPP." The high numbers of deaths anticipated by anti-nuclear campaigners are almost all based on what is known as the "linear no-threshold (LNT) model.

rapidly initially give off stronger radiation than elements that decay slowly. (This is a gross oversimplification, of course. Much depends on the actual element involved, the type of radiation that is emitted, and the nature of the exposure.) Unlike nuclear waste, toxic waste like lead, chromium and cadmium from solar panels and wind turbines lasts forever. Solar panels produce 300 times more toxic waste for the same energy output than nuclear power stations do.

Nuclear reactors produce very little waste. As McDaid said, all of the high-level waste Koeberg produces is stored on-site. The same is true for Pelindaba, where a research reactor produces radionucleotides, primarily for nuclear medicine. Panicked activists think that nuclear waste might cause a nuclear explosion “if not stored properly”, but that is just insane. Nuclear explosions don’t just happen by accident. If they did, countries would not spend decades, and billions of dollars, trying to build nuclear devices that actually do explode.

Intermediate and low-level waste from Koeberg is stored at a single facility at Vaalputs in the Northern Cape. There, it takes up negligible space, and causes no harm to anyone or anything. The small amount of nuclear waste produced by nuclear reactors is not difficult to store safely or dispose of. What to do with nuclear waste is simply not a good argument against nuclear power.

At a recent seminar, Leon Louw, executive director of the Free Market Foundation, took the provocative view that there should be an occasional Chernobyl, because the cost of preventing any accident at all would be prohibitive. Nobody holds any other form of energy, or indeed any human

Intermediate and low-level waste from Koeberg is stored at a single facility at Vaalputs in the Northern Cape. There, it takes up negligible space, and causes no harm to anyone or anything. The small amount of nuclear waste produced by nuclear reactors is not difficult to store safely or dispose of. What to do with nuclear waste is simply not a good argument against nuclear power.

activity, to such impossibly high standards. “Nuclear is its own worst enemy, banging on about safety,” said Louw, arguing that people are naturally sceptical of an industry that keeps having to advertise its product as safe.

Nuclear energy really is extraordinarily safe. The industry ought to be advertising its other great advantages, such as its reliability, the low cost of the energy it generates, and that it produces zero emissions and almost no other pollution....

Source: <https://www.dailymaverick.co.za/>, 19 November 2018.

NUCLEAR STRATEGY

INDIA

Why INS Arihant Gives India an Edge Against its Neighbours

India’s First Indigenous Nuclear Powered Submarine, Which completed its maiden strategic deterrence mission, will allow the country to absorb a nuclear strike - and respond with a devastating second-strike. On 05 November 2018 India’s first indigenous SSBN (ship submersible ballistic nuclear) INS Arihant completed its maiden deterrence patrol, meaning that the submarine is

fully ready for its role as a strategic deterrent. Deterrence patrol refers to a submarine disappearing into the depths of the ocean, carrying its deadly cargo of nuclear-tipped missiles. The Arihant’s month-long deployment compares favourably with

Deterrence patrol refers to a submarine disappearing into the depths of the ocean, carrying its deadly cargo of nuclear-tipped missiles. The Arihant’s month-long deployment compares favourably with submarines of the US Navy which go on patrols from 30-70 days.

submarines of the US Navy which go on patrols from 30-70 days.

With the completion of the patrol, India’s strategic planners have finally achieved their longstanding

ambition to have a nuclear triad, giving them multiple options if it comes to a nuclear confrontation. A nuclear triad refers to the three components of atomic weapons delivery: strategic bombers, ICBMs and SLBMs.

Of the three elements of the triad, the SLBMs are considered the most important because the nuclear powered ballistic missile submarine - also known as a boomer in the colloquial language of seamen - is the hardest to detect, track and destroy. "No navy can be considered a force to reckon with unless it has nuclear submarines to control oceans," says former Vice Chief of Naval Staff, Admiral K.K. Nayyar.

Source: <https://www.businesstoday.in/>, 20 November 2018.

NATO-RUSSIA

NATO Chief Calls on Russia to Stick With INF Treaty

NATO Secretary General Jens Stoltenberg has warned that the deployment of new Russian SSC-8 missiles puts the "historic" INF treaty in jeopardy. In a speech, he called on Russia to ensure "full compliance" with the treaty but at the same time repeated NATO's pledge not to deploy more nuclear weapons to Europe in case the pact between Washington and Moscow collapses.

Stoltenberg's call on Russia comes after the Trump administration itself has said it wants to abandon the landmark 1987 arms-control agreement. The White House has yet to formally take that step, leaving European allies hoping the deal can still be salvaged. Even under President Obama, US officials said Russia was violating the terms, which ban conventional and nuclear missiles with ranges between 500 and 5,500 kilometers. Following Washington's recent announcement to abandon the treaty, Russian President Vladimir Putin warned Russia would respond "in kind" if new US nuclear missiles were to be placed in

Europe. He added that any European countries hosting US missiles would be at risk of Russian strikes.

Source: Martin Banks, <https://www.defensenews.com/>, 12 November 2018.

USA

Smith Aims to Scrap Trump's Nuclear Weapons Policy

Rep. Adam Smith is set to become the next chairman of the House Armed Services Committee in the new Congress — and other Democratic lawmakers said ...they hope to use their party's takeover of the House to check the Trump administration's expansive policies toward nuclear weapons. Speaking at an event sponsored by the Ploughshares Fund, an anti-nuclear weapons group, Smith said he wants to see a redo of the Trump administration's Nuclear Posture Review, to continue multilateral nuclear pacts and to advance a no-first-use policy toward nuclear weapons for the United States.

Smith said he wants to see a redo of the Trump administration's Nuclear Posture Review, to continue multilateral nuclear pacts and to advance a no-first-use policy toward nuclear weapons for the United States. Smith also reiterated he wants a ban on a new low-yield submarine-launched nuclear weapon, a version of the W76-1 warhead for the Navy's Trident II D5 ballistic missile, dubbed the W76-2. He introduced a bill to that effect in September 2018.

Smith also reiterated he wants a ban on a new low-yield submarine-launched nuclear weapon, a version of the W76-1 warhead for the Navy's Trident II D5 ballistic missile, dubbed the W76-2. He introduced a bill to that effect in September 2018.

It's a tall order. In the House, where Democrats have picked up 34 to 40 seats, Smith's ambitious proposals are likelier to become part of the next annual defense policy bill. However, those proposals would have a rougher road in negotiations with the GOP-led Senate Armed Services Committee; on the Senate floor, where GOP holds a majority; and in the Oval Office, where President Donald Trump wields the veto pen....America's military superiority has "eroded to a dangerous degree," leaving the U.S. in crisis

if faced with more than one conflict at once, a new congressionally-mandated report concluded.

Ploughshares President Joe Cirincione was upbeat a week after Democrats won control of the House and hoped the organization could “test out new ideas” in the new Congress to introduce into the 2020 presidential elections. Cirincione condemned the emergence of “new Dr. Strangeloves” under the Trump administration, which has flirted with withdrawing from the Intermediate-Range Nuclear Forces Treaty and the New START Treaty.

For his part, Smith has promised to rein in nuclear spending and favors a more modest and sensible approach to nuclear weapons, as a credible deterrent and not as an overwhelming force designed to win a nuclear war. But he also hoped to temper expectations for the room full of nonproliferation advocates. For one, he does not categorically oppose nuclear weapons.

“We need a different president. We could pass whatever legislation we want to pass, but executive power is enormous.” Smith said. “We need to exercise oversight, we need to put him in check as much as we can. But we shouldn’t kid ourselves about the reality.” Asked the best way to negotiate to reduce nuclear weapons with a GOP-controlled SASC, Smith said he could argue the trade-offs with conventional weapons like ships and planes. “From a dollar standpoint, you cannot have both,” he said.

The U.S. will need to spend \$1.2 trillion over the next 30 years to modernize and maintain its nuclear weapons, according to a 2017 Congressional Budget Office estimate. Since then, the administration released its new Nuclear Posture Review, which called for a continuation of sustainment and

modernization efforts within the Defense and Energy departments, while also proposing a range of programmatic changes to the nuclear weapons enterprise.

Among them, the administration has sought the W76-2 program, a nuclear-armed, sea-launched cruise missile, and to sustain the B83-1 bomb beyond its planned retirement date.... The NPR, Thornberry said then, “assures that our deterrent will be taken seriously by our adversaries and allies alike, while keeping the total cost below 7 percent

of what the Department of Defense spends to protect the country.”...

Source: Joe Goul, <https://www.defensenews.com/>, 14 November 2018.

For his part, Smith has promised to rein in nuclear spending and favors a more modest and sensible approach to nuclear weapons, as a credible deterrent and not as an overwhelming force designed to win a nuclear war. But he also hoped to temper expectations for the room full of nonproliferation advocates.

BALLISTIC MISSILE DEFENCE

SOUTH KOREA

South Korea to Buy Updated Missile Defense Radar Systems from Israel

South Korea is pressing ahead with plans to buy two Israeli early warning radar systems, announcing on 27 November it would buy the updated Green Pine radars for \$292 million. South Korea’s Defense Acquisition Programs Administrations (DAPA) announced Tuesday it would buy two Green Pine Block C radar systems from Israel’s ELTA Systems, a subsidiary of Israel Aerospace Industries. A Defense Ministry official later confirmed to Reuters the order was worth 330 billion won, or \$292 million.

The missile system, an update of the Green Pine radars South Korea previously purchased in 2009, will boost the nation’s ability to “identify and

The U.S. will need to spend \$1.2 trillion over the next 30 years to modernize and maintain its nuclear weapons, according to a 2017 Congressional Budget Office estimate. Since then, the administration released its new Nuclear Posture Review, which called for a continuation of sustainment and modernization efforts within the Defense and Energy departments.

track ballistic missiles from a remote distance shortly after launch," according to a DAPA statement. The systems should be deployed by the early 2020s.

Reuters noted that the South Korean Defense Ministry pledged in December 2017 to buy more early warning radars, not long after North Korea successfully tested an intercontinental ballistic missile and announced the completion of its "state nuclear force." However, there was no mention of South Korea's socialist neighbor in the Tuesday statement. The EL/M 2080 Green Pine system was developed to operate with the Arrow theater missile defense system, produced by Israel in tandem with the US since 1986 as a response to the increasing missile capabilities of rival Arab states. It's since been sold to Azerbaijan and India in addition to South Korea.

Green Pine is believed to be more effective than the AN/MPQ-65, the radar at the heart of the US' MIM-104 Patriot anti-air system, possibly because while the Patriot system uses a passive electronically scanned array, Green Pine uses an active array. The chairman of the Israeli Space Agency told Space News in 2011 that Arrow also has the capability to shoot down satellites.

Block C, the system's third iteration, is believed to have an improved operational range as well as the ability to track up to 30 targets simultaneously, the *Times of Israel* notes. The radar's range has been variously reported as 800 kilometers by the Times and 500 kilometers by Arutz Sheva.

Source: <http://www.spacedaily.com>, 28 November 2018.

USA

Pentagon to Boost Laser Investments for Missile Defense

The U.S. Defense Department is planning to increase investments in directed-energy systems used for missile defense over the next several budget cycles, according to the department's top technology adviser. Michael Griffin, undersecretary of defense for research and

engineering, said... he expects to have usable directed-energy weaponry in the hands of war fighters in "no more than a few years," but acknowledged the size of a system usable for missile defense requires greater investment.

"You need another factor of three to four to have as space control weapon, a missile defense capability — space-based, boost-phase or midcourse capability — with a large directed-energy weapon. We need to be in the megawatt class to have that," Griffin said at an event hosted by the Center for Strategic and International Studies. "That's not right around the corner but that's not utterly out of reach either. So you're

going to see in upcoming budgets for missile defense a renewed emphasis on laser scaling across several technologies because we feel we have to do that."

Directed-energy weaponry

has been a dream for decades within the department, but Pentagon planners and industry experts have become increasingly confident the use of at least small systems in the near term is realistic. Another potential use for lower-tier systems identified by Griffin is for disrupting swarming unmanned systems, something he called a potential "transformative concern." Using high-powered microwaves to disrupt those swarms may make sense, he

The EL/M 2080 Green Pine system was developed to operate with the Arrow theater missile defense system, produced by Israel in tandem with the US since 1986 as a response to the increasing missile capabilities of rival Arab states. It's since been sold to Azerbaijan and India in addition to South Korea.

Directed-energy weaponry has been a dream for decades within the department, but Pentagon planners and industry experts have become increasingly confident the use of at least small systems in the near term is realistic.

predicted. More broadly, Griffin called for a “proliferation” of sensors in low-Earth orbit to combat hypersonic threats.

...But he underscored a point he made over the summer — that trying to catch a hypersonic weapon with a space-based interceptor simply won't work, given the speed of hypersonic capabilities and how close to Earth they fly. Griffin declined to comment on the status of the long-awaited Missile Defense Review, now expected no earlier than December 2018.

Over the course of the hourlong discussion, Griffin also made an argument for why missile defense decisions should stay at the secretary of defense staffing level, guided by the Missile Defense Agency and broader strategic thinking, rather than be delegated to the armed services... However, Griffin made it clear he thinks that would not work for the development of missile defense capabilities, flatly saying: “I don't think it's going to happen, and if it did, I don't think it is going to be good...”

Source: Aaron Mehta, <https://www.defensenews.com/>, 13 November 2018.

NUCLEAR ENERGY

EUROPE

UN Economic Commission for Europe Puts Nuclear Power on Agenda

The UN Economic Commission for Europe's meeting in Kiev has put nuclear power firmly on the organisation's sustainable development agenda for the first time, as an important energy option. The forum involves multiple UN bodies and is focused on energy policies required. It was made clear that policy support was vital for confident investment in nuclear power so that it can play its necessary role in achieving Sustainable Development Goals. The UNECE drew attention to the fact that the targets of SDG 7 - 'ensure access to affordable, reliable, sustainable and modern energy for all' - will not be reached if present circumstances persist. Energoatom in host country Ukraine said its focus was on SDG 1, 'no poverty', and SDG 8, 'decent work and

economic growth', along with its aim to have 50% of electricity from nuclear power by 2035.

Meanwhile a report commissioned by the European nuclear trade association Foratom shows that nuclear power needs to contribute at least one quarter of the electricity if the EU's anticipated emissions target to 2050 is to be met affordably, in context of growth in annual demand from 3100 to 4100 TWh. It suggests that the power market should be designed to reward the “system value of dependable and flexible resources” to fit in with variable renewables. “The results demonstrate how nuclear can contribute to an ambitious decarbonisation of the European economy.”

Source: World Nuclear Association, 23 November 2018.

POLAND

Poland Spotlight on Nuclear Power Potential

Two weeks ahead of the UN's COP24 conference at Katowice in relation to the Framework Convention on Climate Change, another international gathering in Poland has focused on the country's energy future. At present over 80% of its electricity is from burning coal, but especially as part of the EU, there are increasing constraints on this. The economy is growing and public attitudes are driving demand for low emissions. Wind and solar have little potential to replace coal. In the context of plans for 2030 the minister for energy said that “zero-emission nuclear energy is the option that guarantees to achieve the goals we set. Nuclear energy is also important for state-of-the-art technology” in the economy.

Following over ten years of fluctuating plans, Poland's current projections are for a modest 1.5 GWe of nuclear capacity by 2030 at Lubiatowo-Kopalino or Zarnowiec in the north of the country. Zarnowiec is inland on a lake and is where construction of a nuclear plant started in 1980s, Lubiatowo-Kopalino is on the Baltic coast. Public opinion in Pomerania is positive. The entity PGE EJ1 has been set up as a subsidiary of the main state-owned utility PGE to build the first plant and it will be future operator and licensee. Several

international reactor vendors are keen to bid for the plant, but Rosatom is not under consideration.

Poland also expects to have access to nuclear power from Ukraine from next year through the first stage of an 'energy bridge', with Khmelnistki unit 2 then being disconnected from the Ukraine grid and synchronized with the EU grid to supply 950 MWe to Poland.

Source: World Nuclear Association, 23 November 2018.

TAIWAN

Taiwan Ditches Plan to Phase Out Nuclear Power by 2025

Taiwan has scrapped its target of having no nuclear power by 2025 and is reviewing its energy policy after voters in a referendum on Saturday decided against a government policy of abolishing the energy source.

The plan to phase-out nuclear power stemmed from public concern after the 2011 Fukushima nuclear disaster and has been a key part of the ruling Democratic Progressive party's sweeping energy reforms, which are also aimed at slashing coal use and boosting wind and solar. But the move has been opposed by some business groups concerned about energy security for the country's high-tech manufacturers.

In the referendum, held as part of Taiwan's local elections that delivered a series stunning losses for the DPP and which cast uncertainty on the future of the government ahead of the 2020 presidential and parliamentary elections, 59.5 per cent of voters chose to repeal the law. While the nuclear target has now been dropped and Premier William Lai has asked officials to review the government's energy policy, government policy

remains aimed at achieving a nuclear-free Taiwan, officials said.

In addition to phasing out nuclear – the share of total power generation from nuclear in Taiwan is already below 10 per cent from around 20 per cent in 2014 – the DPP had promised to lift renewables' share of Taiwan's power mix from 6 per cent to 20 per cent over the next seven years via construction of offshore wind farms and massive solar installations. It also pledged to reduce carbon emissions to 20 per cent of 2005 levels by 2030.

Source: <https://www.ft.com>, 27 November 2018.

UK

Reprocessing Ceases at UK's Thorp Plant

Reprocessing operations have ended at the Thermal Oxide Reprocessing Plant (Thorp) at the Sellafield site in the UK after 24 years. The facility will now be used to store used nuclear fuel until the 2070s.

Built at a cost of GBP1.8 billion (USD2.3 billion), the Thorp facility opened in 1994 and has since processed 9331 tonnes of used nuclear fuel from 30 customers in nine

countries around the world. In doing so, it has generated an estimated GBP9 billion in revenue. It is one of only two commercial nuclear fuel reprocessing plants in the world, the other being Orano's La Hague plant in France.

The decision to cease reprocessing at Thorp was taken in 2012 in response to "a significant downturn" in demand, said Sellafield Limited. "The international market for reprocessing has shifted significantly since Thorp's construction, with the majority of customers now opting to store rather than reprocess their fuel."The last batch

In the referendum, held as part of Taiwan's local elections that delivered a series stunning losses for the DPP and which cast uncertainty on the future of the government ahead of the 2020 presidential and parliamentary elections, 59.5 per cent of voters chose to repeal the law.

The decision to cease reprocessing at Thorp was taken in 2012 in response to "a significant downturn" in demand "The international market for reprocessing has shifted significantly since Thorp's construction, with the majority of customers now opting to store rather than reprocess their fuel.

of fuel to be reprocessed began its journey through the plant at 11.32am on 09 November 2018.

Sellafield Ltd said the Thorp plant - the largest structure on the Sellafield site - "will continue to serve the UK until the 2070s" as a storage facility for used fuel. The Sellafield site, it said, "is being reinvented as a centre of expertise for nuclear clean-up". This will "unlock 100 years' worth of opportunity for the site's workforce, supply chain, and community".

...Following its creation in 2004, the UK's Nuclear Decommissioning Authority (NDA) inherited a range of contracts covering the reprocessing and storage of used oxide fuels at the Thorp facilities. These include used light water reactor fuels from Europe and Japan that were being stored at Sellafield pending reprocessing in Thorp, as well as the used fuel from the UK's fleet of Advanced Gas-cooled Reactors.

In June 2012, the NDA concluded that completing existing reprocessing contracts at Thorp remained a "viable and cost-effective strategy". The plant had been expected to complete the reprocessing contracts by 2010, but was unable to due to "operational difficulties both in Thorp and in downstream support plants". Thorp was shut down between May 2005 and December 2007 due to an internal leak of highly radioactive liquor from a fractured pipe. The loss of the pipe, which could not be repaired, meant a work-around method had to be developed to maintain the plant's process flow.

Source: World Nuclear News, 14 November 2018.

NUCLEAR COOPERATION

IRAN-EUROPE

Iran, Europe Agree on Boosting Nuclear Cooperation

Iran and Europe stressed the need for promoting peaceful nuclear cooperation within the framework of JCPOA, IRNA reports. In a statement at the end of a two-day Seminar on Nuclear Cooperation in Belgium on Tuesday, they called for continued collaboration in the field of nuclear

energy. The statement said that the third high-level seminar on Iran-EU nuclear cooperation was held in Brussels from November 26-27.

Referring to presence of officials, including Secretary General of European External Action Service Helga Schmid, deputy foreign minister Abbas Araqchi and Iran's nuclear chief Ali Akbar Salehi, the statement said that senior representatives of Joint Research Center and international cooperation and innovation and research divisions of European Commission presented a report on the measures taken on enforcement of Annex III of JCPOA.

Source: <https://en.trend.az/iran/nuclearp/2986323.html>, 28 November 2018.

JAPAN-USA

Japan and USA Enhance Cooperation in Nuclear Energy

The memorandum was signed on 13 November by Japan's Ministry of Economy, Trade and Industry (METI) and Ministry of Education, Culture, Sports, Science and Technology and the USA's Department of Commerce and Department of Energy.

"Until now, in accordance with 'Statement expressed by the Ministry of Economy, Trade and Industry of Japan and the US Department of Energy on research and development and industrial cooperation in the civilian nuclear sector' announced on 17 October 2017, we have promoted nuclear cooperation between Japan and the United States aiming to advance [our] strategic energy partnership," METI said in a statement. "With this memorandum of understanding, we will further advance cooperative relations between Japan and the United States in the field of nuclear power."

"In order to contribute to solving global issues such as global warming countermeasures and energy security, it is important for Japan and the USA to demonstrate leadership in the field of nuclear power," METI said. "This memorandum confirms the importance of nuclear cooperation between the two countries and further progress."

The memorandum acknowledges the need for nuclear energy as a “source of affordable, reliable, and clean baseload power, with the major premise of ensuring its safety, the desire to promote commercial partnerships in the nuclear energy sector to facilitate economic growth and energy security for both countries”. It also acknowledges “the need to safely and efficiently decommission and remediate nuclear power sites”.

The countries intend to cooperate in areas including nuclear research and development, including innovative reactors. They plan to discuss mid- to long-term planning to create private sector-led innovation, as well as encourage the private sector and university researchers to develop advanced reactors. Other areas of intended cooperation are in decommissioning and back-end fuel cycle management, as well as industrial cooperation for improving safety. Japan and the USA also plan to contribute to the use of nuclear power worldwide. They will also establish a framework for continued dialogue.

Source: <http://www.world-nuclear-news.org>, 15 November 2018.

RUSSIA–ARMENIA

Rosatom may offer Armenia promising and interesting solutions that may correspond to the peculiarities of the country’s electricity needs, Russian ambassador to Armenia Sergey Kopirkin told the reporters. He said Armenian-Russian cooperation in nuclear energy sector is one of the strategically significant cooperation directions between the two countries.

“A project is being carried out to prolong the life of the Metsamor nuclear power plant till 2026. I do not exclude that in a certain phase issue of further prolongation of plant’s activity may raise. But it demands serious, thorough analyses for ensuring the security of the plant,” Kopirkin said.

He also said that issue on creation of Armenian-Russian task group for studying the prospects of cooperation in the nuclear power sector after the end of operation of Metsamor plant is being discussed.

Source: <https://www.aysor.am>, 27 November 2018.

SOUTH KOREA–UAE

UAE, South Korea Hold Nuclear Energy Talks

Top officials from the UAE and Republic of Korea recently held a meeting of the Supreme Joint Committee on cooperation in the peaceful uses of nuclear energy that took place in the South Korean capital of Seoul. Engineer Suhail Mohamed Faraj Al Mazrouei, UAE Minister of Energy and Industry, chaired the meeting, said a statement from the company.

On behalf of the UAE, the meeting was attended by

Engineer Mohamed Al Hammadi, CEO of the Emirates Nuclear Energy Corporation (ENEC); Engineer Mohammed Bin Jarsh Al Falasi, undersecretary of the Abu Dhabi Department of Energy; Christer Viktorsson, director general of the Federal Authority for Nuclear Regulation (FANR); Mr. Nasser Al Nasser, Barakah One Company CEO, as well as officials from the UAE energy sector and members of the UAE embassy in Seoul.

On the South Korean side, the delegation was headed by Lee Taeho, Second Vice Minister of Foreign Affairs, along with senior Korean officials from the Ministry of Foreign Affairs (MOFA), the Ministry of Science, ICT and Future Planning, the Ministry of Trade, Industry and Energy (MOTIE) and the Nuclear Safety and Security Commission (NSSC).

The UAE Minister of Energy and Industry began the meeting by expressing his thanks and gratitude for the greetings and hospitality of the

The memorandum acknowledges the need for nuclear energy as a “source of affordable, reliable, and clean baseload power, with the major premise of ensuring its safety, the desire to promote commercial partnerships in the nuclear energy sector to facilitate economic growth and energy security for both countries.

Korean party, pointing out that this meeting is at the heart of launching a new governmental communication channel between the two countries to achieve further strategic cooperation in peaceful nuclear energy.

During the meeting, the two parties agreed to enhance their bilateral relations in various fields, namely in the field of energy. Al Mazrouei stressed on the importance of the Barakah Nuclear Energy Plant and its role in developing the UAE-Republic of Korea bilateral relationship through the joint venture agreement between ENEC and Kepco.

Al Mazrouei also emphasised on the necessity to expand and deepen the current cooperation between the countries to cover other areas of nuclear energy. The two sides also shared views on the Barakah Nuclear Energy Plant and continued close communication so the plant can start its operations safely and smoothly.

The two parties agreed to support cooperation among academies working on nuclear projects and to discuss the possibility of further collaboration to establish a Research and Development Center in the UAE. The parties discussed the possibility of cooperation in terms of research and development and human resources to strengthen nuclear safety systems in both countries as per their commitment to actively participate in international efforts to enhance nuclear security. The two sides agreed to establish four working groups for high-level consultation to achieve concrete results and to continue the cooperation between them.

On the sidelines of the Joint Committee meeting, Minister Al Mazrouei and his accompanying delegation met with Sung Yun-mo Minister of Trade, Industry and Energy and Lee Hak Soo, CEO of the Korean Water Resources Corporation and discussed means of strengthening cooperation between the two countries to jointly develop nuclear energy plants in a third country based on both their experience in the field of nuclear cooperation. In conclusion, the minutes of the first meeting of the joint committee was signed and Minister Al Mazrouei welcomed the hosting of the next meeting in Abu Dhabi, UAE next year, it

stated.

Source: <http://www.tradearabia.com>, 18 November 2018.

UKRAINE-USA

Ukraine, USA Extend Nuclear Safety Cooperation

Ukraine and the USA have agreed to extend by five years an existing agreement on cooperation in improving nuclear safety and the regulation of civil nuclear facilities in Ukraine. The agreement on Operational Safety Enhancements, Risk Reduction Measures and Nuclear Safety Regulation for Civil Nuclear Facilities was signed in October 1993.

A joint declaration on intentions to extend the agreement by five years was signed in Kiev on 12 November 2018 by Ukrainian Minister for Foreign Affairs Pavlo Klimkin and US Energy Secretary Rick Perry. A agreement to extend the cooperation will be carried out through the exchange of diplomatic notes between the two governments.

In a joint statement the US Department of Energy and Ukraine's Ministry of Foreign Affairs said the extension of the agreement seeks "to continue cooperation in order to, inter alia, enhance the safety of civil nuclear facilities in Ukraine, to develop operational safety procedures and protocols, to improve diagnostic capabilities and to improve regulatory effectiveness." This would be done through "developing appropriate regulatory standards, requirements and procedures". ...

Source: World Nuclear News, 15 November 2018.

NUCLEAR NON-PROLIFERATION

IRAN

Iran Sticks to Nuclear Limit Even as US Oil Sanctions Bite

Iran continued abiding by nuclear limits in its landmark accord with world powers even after President Donald Trump abandoned the agreement, according to international monitors. In its first report since the US re-imposed oil and

banking sanctions on 05 November 2018, the IAEA said Iran is still allowing intrusive inspections while keeping its nuclear capacity and material below thresholds allowed under the July 2015 deal, according to a 5-page restricted report published....

The IAEA conducted snap inspections "to all sites and locations in Iran which it needed to visit," according to the quarterly report. "The agency continues to verify the non-diversion of declared nuclear material. Evaluations regarding the absence of undeclared nuclear material and activities for Iran remained ongoing."

The IAEA Report Also Says: Iran has operated no more than 5,060 centrifuges at its Natanz enrichment plant. Uranium hasn't exceeded the 3.7 percent limit on enrichment purity. Weapons-grade uranium is 90 percent enriched. The low-enriched uranium stockpile hasn't exceeded 300 kilograms (662 pounds). IAEA inspectors have installed automated, real-time enrichment monitoring in Iran that records, measures and stores changes in activity...

Source: Jonathan Tirone, <https://www.stripes.com/>, 12 November 2018.

NUCLEAR PROLIFERATION

NORTH KOREA

North Korea Seen as Reliant as Ever on Nuclear Arsenal as Talks Stall

Amid signs that negotiations between North Korea and the US are stalling, analysts say Pyongyang still sees its nuclear arsenal as a key

tool in securing its national safety and winning concessions from international rivals.

Iran has operated no more than 5,060 centrifuges at its Natanz enrichment plant. Uranium hasn't exceeded the 3.7 percent limit on enrichment purity. Weapons-grade uranium is 90 percent enriched. The low-enriched uranium stockpile hasn't exceeded 300 kilograms (662 pounds). IAEA inspectors have installed automated, real-time enrichment monitoring in Iran that records, measures and stores changes in activity.

retreated from his pledge to expand his operational force of nuclear bombs and ballistic missiles, increasing his leverage under any still-elusive denuclearization deal.

2018. Just as the United States has doubled down on its sanctions on Pyongyang, North Korean leader Kim Jong Un has not retreated from his pledge to expand his operational force of nuclear bombs and ballistic missiles, increasing his leverage under any still-elusive denuclearization deal.

A US think tank...had identified at least 13 of an estimated 20 active, undeclared missile bases inside North Korea, underscoring the challenge for American negotiators hoping to persuade Kim to give up his weapons programs. As time goes by, North Korea's likely expansion of its arsenal could force Washington to rethink its insistence on full

denuclearization, said Moon Hong-sik, a research fellow at the Institute for National Security Strategy in Seoul. "This is the choice the United States has to make: whether they keep pursuing the ideal of 'complete, verifiable, irreversible denuclearization,' or take this dilemma into consideration and make a compromise for limited denuclearization," he said....

US officials have said sanctions forced North Korea to the negotiating table and vowed to keep pressure until complete denuclearization. But North Korea has credited its nuclear and missile breakthroughs for providing it the standing to meet the world's largest powers. Kim's own words suggest Pyongyang will continue with production

and development of the nuclear program even as it negotiates with Washington on denuclearization, experts say. "In the 2018 New Year address, Kim Jong Un called for shifting to full-scale production and deployment of nuclear weapons and missiles," said Joshua Pollack, a senior research associate at the US-based James Martin Center for Nonproliferation Studies (CNS)....

...North Korea has not tested a nuclear bomb or ballistic missile since last year, and has said it has shuttered its main nuclear test site with plans to dismantle several more facilities. North Korea recently warned, however, it could restart its nuclear program if the United States does not drop its campaign of "maximum pressure" and sanctions.

..."North Korea has never promised to shut down this missile base," Blue House spokesman Kim Eui-kyeom said. "It has never signed any agreement, any negotiation that makes shutting down missile bases mandatory... the fact that such a missile base exists shows the necessity for negotiations to be achieved quickly." ...The activity at the missile bases is one of several examples why American officials may be reluctant to lift any sanctions, said Shin Beom-chul, director of the Center for Security and Unification at Seoul's Asan Institute for Policy Studies.

"In short, from the CSIS report we can infer that first, North Korea is not sincere enough with negotiating and second, there's no change in their nuclear capacity," he said. US officials have discussed possible clandestine enrichment sites for nuclear fuel, and in July 2018, analysts at CNS used commercial satellite imagery to conclude that North Korea was "completing a major expansion of an important factory for producing solid rocket motors for... nuclear-armed missiles"....

Source: Reuters, 13 November 2018.

Undeclared North Korea: Missile Operating Bases Revealed

Though the subject of speculation by open-source researchers for years, new research undertaken by Beyond Parallel has located 13 of an estimated 20 North Korean missile operating bases that are undeclared by the government. The first of these reports by Beyond Parallel will focus on the missile base at Sakkanmol, one of the closest to the demilitarized zone and to Seoul, South Korea. These missile operating bases, which can be used for all classes of ballistic missile from SRBM up to and including ICBM, would presumably have to be subject to declaration, verification, and dismantlement in any final and fully verifiable denuclearization deal.

Missile operating bases are not launch facilities. While missiles could be launched from within them in an emergency, Korean People's Army (KPA) operational procedures call for missile

launchers to disperse from the bases to pre-surveyed or semi-prepared launch sites for operations.

The dispersed deployment of these bases and distinctive tactics employed by ballistic missile units are combined with decades of

extensive camouflage, concealment and deception practices to maximize the survival of its missile units from preemptive strikes and during wartime operations. The KPA's Strategic Force—responsible for operating ballistic missiles—is both sizable and capable of inflicting significant damage even when its missiles are armed with only conventional warheads.

Since his assumption of power in 2011, Kim Jong-un's emphasis upon realistic training and increased operational readiness has extended to the Strategic Force. While a considerable body of open-source information is available concerning the development of North Korea's individual missile systems, much less is available

North Korea has never promised to shut down this missile base, "It has never signed any agreement, any negotiation that makes shutting down missile bases mandatory... the fact that such a missile base exists shows the necessity for negotiations to be achieved quickly.

concerning the number, deployment, and organization of the Korean People's Army (KPA) ballistic missile operating bases. The vast majority of the information that is available tends to be internally inconsistent, incomplete, confusing, or simply incorrect.

Media reporting and defector statements have identified in excess of 65 areas or locations as ballistic missile operating bases. While there remains significant uncertainty as to whether all missile operating bases have been identified within the open-source, this number is obviously incorrect and largely a result of inaccurate and frequently internally inconsistent media reporting and defector statements; circular verification; errors in incorrectly identifying surface-to-air missile, coastal defense cruise missile, and rocket launcher bases as ballistic missile bases; use of generalized (e.g., province, county, or nearby city names) and often different location information (e.g., two different counties) for the same facility; challenges in transliterating location data; and difficulty in disambiguating place names.

Compounding these challenges is the fact that the KPA engages in an aggressive camouflage, concealment, and deception (CCD) program with regard to its ballistic missile force, the construction of new missile facilities and abandonment of others, and has at times redeployed ballistic missile units to different bases. Added to this is the confusion in distinguishing among brigade-, regiment-, and battalion-sized units. After extensive research, including interviews with North Korean defectors and government, defense, and intelligence officials around the world, many of these issues have been addressed and it appears that the KPA

currently has approximately 15-20 missile operating bases.

...Missile operating bases are permanent facilities that contain a unit's headquarters, barracks, housing, support, maintenance, and storage facilities. Due to cultural factors and a military policy that states the North remains in a state of war, the majority of KPA missile operating bases display a number of distinct characteristics, including:

They are generally rudimentary in nature, and with the exception of headquarters and cultural structures, possess few large buildings or paved roads. With only a few exceptions, they are located in mountainous terrain, often spread out within narrow dead-end valleys. This often results in their lacking significant physical security measures and having only a basic entrance security checkpoint.

Excluding their associated agricultural support infrastructure, they are physically small.

They almost always consist of a network of underground facilities (UGF) to house the unit's transporter-erector-launchers (TELs) or mobile-erector-launchers (MELs), ready inventory of missiles and warheads, and various other technical/launch support vehicles and equipment. They are not launch facilities. While missiles could be launched from within these bases in an emergency, KPA ballistic missile tactics and doctrine call for TELs and MELs to disperse from missile operating bases to pre-surveyed and semi-prepared launch sites for operations.

These bases simply do not have the appearance of missile operating bases as seen in the United States, Russia, China, or Europe. There has been

After extensive research, including interviews with North Korean defectors and government, defense, and intelligence officials around the world, many of these issues have been addressed and it appears that the KPA currently has approximately 15-20 missile operating bases.

While missiles could be launched from within these bases in an emergency, KPA ballistic missile tactics and doctrine call for TELs and MELs to disperse from missile operating bases to pre-surveyed and semi-prepared launch sites for operations. These bases simply do not have the appearance of missile operating bases as seen in the United States, Russia, China, or Europe.

occasional, and often sensationalist, media reporting based primarily upon defector reports that the KPA has constructed “underground launch pads,” silo-based or semi-enclosed (e.g., false mountainsides that split open) ballistic missile launch facilities in the northern reaches of the nation. However, no such facilities have been confirmed in open-source or satellite imagery to date.

Development: Construction of missile operating bases can be traced back to the mid-1960s and the acquisition of the FROG (Free Rocket Over Ground) series of long-range artillery rockets and the establishment of operating bases around Pyongyang and in North Pyongan province. With production of the Hwasong-5 (R-17E Scud) SRBM beginning in 1986, North Korea based these systems in the Pyongyang area and North Pyongan province.

Subsequently, as the number of available Hwasong-5 missiles and their associated TELs and new MELs slowly increased, a Scud regiment was established and deployed south of Pyongyang in 1988. Accompanying this, and extending into the early 1990s, the KPA initiated the construction of dedicated missile operating bases in North Hwanghae and Kangwon provinces along the demilitarized zone (DMZ).

Some of these and later bases were created by converting existing military facilities to accommodate the ballistic missile units and their equipment. With the introduction of the Hwasong-6 (Scud C), the KPA both reorganized and expanded Scud missile units and established new units. By the mid-1990s, construction of additional missile operating bases was begun within South Pyongan, North Pyongan, Chagang, Ryanggang, and South Hamgyong provinces to house units equipped with the newer Hwasong-7 (Nodong) and Hwasong-9 (Scud-ER) families of medium-range ballistic

missiles (MRBM). Construction of missile operating bases continued into the early 2000s. Since that time, there has been minor but continued development at existing bases and the construction of at least one additional missile operating base to house newer or longer-range ballistic missiles (e.g., Hwasong-11/-12/-13/-14).

Following Kim Jong-un’s ascension to power in December 2011, he instituted widespread changes throughout the KPA emphasizing realistic training and increased operational readiness.

These changes soon resulted in the reorganization of the Strategic Rocket Command into the Strategic Force during 2013 as well as significant infrastructure developments at a number of missile operating bases.

Deployment: The ballistic missile operating bases are small, dispersed throughout the nation, and, with few exceptions, located in narrow mountain valleys. The deployment pattern has

evolved over time, garnering a variety of descriptions, but today it is most commonly described as consisting of the three “belts”: the Tactical (or Forward), the Operational, and the Strategic (or Strategic Rear) based upon their physical distance from the DMZ.

General Arrangement of North Korea’s Ballistic Missile “Belts.” The Tactical Belt extends across North Hwanghae and Kangwon provinces and is 50-90 km north of the DMZ. Missile operating bases situated within the Tactical Belt are reportedly equipped with the Scud family of SRBMs—perhaps with a small number of Nodong MRBMs. The locations chosen for these bases are far enough forward to provide coverage of critical facilities in the northern two-thirds of South Korea, yet far enough from the DMZ to be beyond the range of South Korean and US long-range artillery. The fielding of the longer-ranged Hwasong-6 and Hwasong-9 (Scud-ER) placed the entirety of South

The Tactical Belt extends across North Hwanghae and Kangwon provinces and is 50-90 km north of the DMZ. Missile operating bases situated within the Tactical Belt are reportedly equipped with the Scud family of SRBMs—perhaps with a small number of Nodong MRBMs. The locations chosen for these bases are far enough forward to provide coverage of critical facilities in the northern two-thirds of South Korea, yet far enough from the DMZ to be beyond the range of South Korean and US long-range artillery.

Korea (including the island of Cheju-do) within range of these forward bases.

The Operational Belt extends across the mountainous sections of South Pyongan province and the southern section of South Hamgyong province and is 90-150 km north of the DMZ. This belt is reportedly equipped with Nodong missiles or longer-range systems that cover all of South Korea and Japan. The Strategic Belt extends across the mountainous sections of North Pyongan, Chagang, Ryanggang, and the northern section of South Hamgyong province and is more than 150 km north of the DMZ. The units deployed in this zone were initially equipped with Nodong missiles. However, reports often claim that the Taepodong 1 MRBM and Taepodong 2 ICBM were also deployed here. These bases will likely house the newer Hwasong-11/-12/-13/-14 as they become deployed.

The official designations for any of the missile operating bases, or the units deployed at them, are unknown. They are, however, reportedly assigned cover designations (military unit cover designator—MUCD in US and South Korean terminology) such as the “Fourth Training Center” or “Fifth Training Center.”

The deployment pattern of the KPA’s ballistic missile operating bases is logical for a nation that still believes it is in a state of war and must be ready to defend itself from outside aggression at any time. It is also a recognition of the fact that the Korean People’s Air and Anti-air Force (KPAF) will be unable to deter a combined South Korean and US air and missile offensive against the nation. The dispersed nature, small size of operating bases, and tactics and doctrine employed by ballistic missile units provide the best chances for their survival given the KPA’s technology and capabilities.

Combat Operations: From the little open-source information available on the subject, a preliminary

pattern of KPA wartime ballistic missile operations can be pieced together. If hostilities resume with little or no warning, a TEL or MEL will move out of its UGF to the base’s drive-through arming and fueling facility. Here, a missile will be loaded—if one isn’t already—armed, fueled and system checks will be conducted. The launcher will then move a short distance within the base, launch at pre-assigned targets, and return to its UGF or disperse to a pre-arranged location—potentially to a UGF away from the base.

If, however, a new conflict is anticipated, prior to the start of hostilities, the missile unit and technical support elements will deploy from the base. The TELs or MELs will move out from their UGF to the base’s drive-through servicing (e.g., arming, fueling, and maintenance) facility and then disperse to another UGF or to a network of pre-surveyed launch sites throughout their area of responsibility—often no more than a wide spot in a road. Here, they will then wait for orders to launch.

The deployment pattern of the KPA’s ballistic missile operating bases is logical for a nation that still believes it is in a state of war and must be ready to defend itself from outside aggression at any time. It is also a recognition of the fact that the Korean People’s Air and Anti-air Force (KPAF) will be unable to deter a combined South Korean and US air and missile offensive against the nation.

Once they launch, the TELs or MELs will quickly displace to another pre-surveyed launch position or UGF (other than those at the missile operating base) where they will meet up with the technical support element and its equipment (i.e., reload missiles, warheads, fuel, crane vehicles, etc.). Once serviced and rearmed, the technical support elements will move to another prearranged location while the TEL or MEL will either wait for a launch order or move to another pre-surveyed launch position and wait there for a launch order.

As the conflict develops, rather than returning to an operating base—which will undoubtedly be the target of repeated attacks—both the technical support element and launchers will remain in the field using pre-positioned reloads and supplies while moving frequently to different pre-surveyed locations. The missile operating base, or more likely a preplanned dispersal UGF, will function as a technical support base with technical

support elements and launchers infrequently returning.

These dispersed mode operating procedures concede the absence of air superiority, minimize the loss of the technical support element, and address the reality that a single TEL or MEL with a liquid fuel missile requires approximately 30 minutes from arrival at a pre-surveyed position to prepare, launch, and begin redeployment—a long time on the modern battlefield for a highly visible target. The loss of a single launcher, while significant, does not adversely impact the overall ability of the surviving elements of the unit to conduct combat operations. However, due to its essential role in the larger organization, the destruction or neutralization of the technical support element would severely impact the ability of the parent unit to conduct launch operations. Therefore, additional procedures are in place to facilitate its survival..

These dispersed mode operating procedures concede the absence of air superiority, minimize the loss of the technical support element, and address the reality that a single TEL or MEL with a liquid fuel missile requires approximately 30 minutes from arrival at a pre-surveyed position to prepare, launch, and begin redeployment—a long time on the modern battlefield for a highly visible target.

Source: <https://beyondparallel.csis.org/>, 12 November 2018.

Second Trump-Kim Summit to Go Ahead without List of Nuclear North Korean Weapons, Pence Says

The US will not require North Korea to provide a complete list of its nuclear weapons and missile sites before President Donald Trump and the North's leader Kim Jong Un meet for a second time, Vice President Mike Pence told NBC News....

Since an initial agreement for denuclearization on the Korean Peninsula was reached between Trump and Kim in June, the United States has pressed the North Koreans to provide information on the entirety of its nuclear operations. The Kim regime has refused to provide the details of the country's operations and postponed scheduled meetings with Secretary of State Mike Pompeo in New York City "Now we need to see results," he added during a wide-ranging interview that also touched

on special counsel Robert Mueller's probe into Russia's alleged meddling and the vice president's conversation with Russian leader Vladimir Putin.

"I think it will be absolutely imperative in this next summit that we come away with a plan for identifying all of the weapons in question, identifying all the development sites, allowing for inspections of the sites and the plan for dismantling nuclear weapons,"...South Korea says 'nothing new' in report identifying North Korean bases: "We can't negotiate over things they don't admit having," said Victor Cha, one of the authors of the report. "It should take us back to the initial

US negotiating point: We need a full declaration." Speaking on the sidelines of a meeting of Asian leaders in Singapore, Pence said, "Everything begins with relationships, but now we need to see results.

He added that there had been "tremendous progress" in negotiations thus far — namely North Korea's stoppage of missile

testing and the return of US hostages and the possible remains of American service members in the Korean War. The US will maintain its hardline pressure on North Korea by not lifting its sanctions, Pence added....

Source: <https://www.nbcnews.com/>, 15 November 2018.

NUCLEAR SAFETY

AUSTRALIA

IAEA Mission Says Australia Committed to Strengthening Nuclear and Radiation Safety

An IAEA team of experts said Australia is committed to strengthening its regulatory framework for nuclear and radiation safety. The team also noted areas for further enhancements, including implementation of the framework in a more consistent manner across the country.

The Integrated Regulatory Review Service (IRRS) team on 16 November 2018 concluded a 12-day

mission to Australia. The mission was conducted at the request of the Government of Australia and hosted by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the Commonwealth Government regulator. Under Australia's federal system of government, ARPANSA regulates Commonwealth entities and other entities are regulated within the six states and two territories. The majority of licenced activities in Australia are carried out within states and territories. This was the third IRRS mission to Australia since 2007 and the first to include all nine jurisdictions.

...The IRRS team commended the hosts for inviting a comprehensive review involving all jurisdictions in Australia, adding that it was the first such IRRS mission. The team identified this as a good practice and a model that other federal countries may want to consider when planning for future IRRS missions. Regarding the national framework, the team noted ongoing activities to address consistency in the country's radiation safety programmes, but said further efforts were warranted in several areas.

...Australia uses radiation sources in medical and industrial applications, as well as in science and research, including a research reactor at Lucas Heights, a suburb of Sydney. The country has storage facilities for low and intermediate level radioactive waste, and plans to establish a national radioactive waste management facility.

...The IRRS mission interacted with all nine radiation safety regulators: ARPANSA for the Commonwealth of Australia, Queensland Health, the New South Wales Environment Protection Authority, Victoria's Department of Health and Human Services, South Australia's Environment Protection Authority, Tasmania's Department of Health, Western Australia's Radiological Council,

the Northern Territory's Department of Health, and the Australian Capital Territory's Health Protection Service.

The IRRS review covered areas including: responsibilities and functions of the Government and of the regulatory body; the global safety regime; activities of the regulatory body including authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides; emergency preparedness and response; occupational radiation protection; patient protection; discharges and material clearance; transport; waste management; decommissioning and interface of safety with nuclear security.

The 20-member IRRS team comprised senior nuclear and radiation safety experts and observers from Austria, Brazil, Canada, Finland, France, Germany, India, Ireland, Korea, Norway, Singapore, South Africa, Sweden, the United States of America, and three IAEA staff members....

The team identified good practices, including:

ARPANSA, together with state and territory regulatory bodies, has established comprehensive guidance that addresses existing exposure situations. ARPANSA integrates all types of risks in the management processes, the regulatory activities, and day-to-day work activities in a holistic and comprehensive way. The team provided recommendations and suggestions for further enhancements, including: all relevant authorities should consider formalizing the existing elements of the framework for safety into a comprehensive national policy and strategy for safety.

The Commonwealth Government should make a firm commitment and take actions with specific milestones to address decommissioning of facilities and radioactive waste management. The

The majority of licenced activities in Australia are carried out within states and territories. This was the third IRRS mission to Australia since 2007 and the first to include all nine jurisdictions.

...The IRRS team commended the hosts for inviting a comprehensive review involving all jurisdictions in Australia, adding that it was the first such IRRS mission. The team identified this as a good practice and a model that other federal countries may want to consider when planning for future IRRS missions.

Governments of all jurisdictions should ensure that all parties responsible for the safety of facilities and regulatory activities have the necessary capabilities and human resources to carry out their responsibilities.

ARPANSA should establish criteria to evaluate the effectiveness of licensees' emergency exercises and assign roles and responsibilities for its staff during emergency situations. The final mission report will be provided to the Government of Australia in about three months. The Government of Australia plans to make the report public.

Source: <https://www.iaea.org/>, 16 November 2018.

UK

More than 500 'Nuclear Safety Events' at Trident Base Since 2006

Since 2006 there have been more than 500 safety events recorded at Faslane, the home of the UK's nuclear deterrent, the MoD has revealed. The figure was disclosed by defence minister Stuart Andrew in response to a parliamentary question from Deidre Brock, an SNP MP from Edinburgh. In 2017, Downing Street was accused of covering-up a malfunction in the Trident nuclear deterrent just weeks before a crucial House of Commons vote.

In total 505 "events" were recorded at HM Naval Base Clyde at Faslane, where most of the UK's nuclear submarine fleet is based, over the past 12 years. Mr Andrew's letter explains: "These events may be near-misses, equipment failures, human error or procedural failings.... Two of the incidents listed were recorded with the most serious classification, Category A, and occurred

in 2006 and 2007.

According to the letter, Category A events have "actual or high potential for radioactive release to the environment of quantities in excess of IRR99 notification limits". The defence minister clarified that in "neither event was any radiological contamination evident" and added: "None of the events caused harm to the health of any member of staff on the naval base, or to any member of the public."...Faslane naval base is where the UK's nuclear deterrent is based, However, the figures reveal an increase in recorded incidents in recent years - with 80 being noted in 2016, and 73 in 2017.

..."Many of these incidents involved the Trident submarines which carry Britain's nuclear weapons."The incidents add to the dire warnings in September's public accounts committee report which revealed serious infrastructure problems, including huge delays and overspending."

Source: <https://news.sky.com/>, 17 November 2018.

USA

Report: Nuclear Safety Board is Underperforming

The independent board that provides safety oversight at the nation's nuclear weapons labs has "recently underperformed in its essential mission," even as a massive plan to overhaul the country's nuclear arsenal makes the board's job "as important today as it has ever been." That's the finding of an organizational assessment of the Defense Nuclear Facilities Safety Board. The board itself commissioned the study by a panel of the National Academy of Public Administration, which found that safety board members don't operate collaboratively or transparently.

ARPANSA should establish criteria to evaluate the effectiveness of licensees' emergency exercises and assign roles and responsibilities for its staff during emergency situations. The final mission report will be provided to the Government of Australia in about three months. The Government of Australia plans to make the report public.

In total 505 "events" were recorded at HM Naval Base Clyde at Faslane, where most of the UK's nuclear submarine fleet is based, over the past 12 years. Two of the incidents listed were recorded with the most serious classification, Category A, and occurred in 2006 and 2007.

...The recently released academy report says the volume of public correspondence, reports and recommendations by the safety board to the DOE “has dropped significantly over the past several years, suggesting that there are fewer public safety matters” addressed than in the past. “In addition, there is an overall opinion, articulated by the DOE, the Board, and other key stakeholders that the quality and strategic importance of board member engagement with the DOE has fallen to an all-time low.”

The recently released academy report says the volume of public correspondence, reports and recommendations by the safety board to the DOE “has dropped significantly over the past several years, suggesting that there are fewer public safety matters” addressed than in the past.

The report says the board members – there are currently four, with one vacant seat, with three board members serving beyond the expiration dates for their terms – “do not work in a collaborative, cooperative manner.” The problem “has reverberated across the organization, drawing the staff, comprised of highly skilled nuclear safety experts, into disputes.” The board “must set a positive tone,” the report states, adding that a lack of trust “in working relationships among current board members is an important cause of the agency’s substandard operating performance.” The board now has three Democrats and one Republican.

Among the recommendations are establishment of a mission, vision and principles for the DNFSB and a “refresh” of board membership, by urging the White House and Congress to pursue filling the vacant position and replace the three members serving beyond their regular terms.

In October 2018, President Donald Trump announced intent to renominate board chair Bruce Hamilton and to nominate Lisa Vickers, currently a representative for the DOE’s National Nuclear Security Administration at the Pantex Plant in Amarillo, Texas, to another seat. No more than three members can belong to the same party.

The academy report also calls for the appointment of an executive director for operations to lead the DNFSB staff, to provide a “single point-of-entry” for the board chair, as well as more engagement by the board with Congress and public interest groups.

The academy report also calls for the appointment of an executive director for operations to lead the DNFSB staff, to provide a “single point-of-entry” for the board chair, as well as more engagement by the board with Congress and public interest groups.

The report notes that the DOE recently implemented a controversial rule that requires all information for DNFSB inspectors go through designated DOE liaisons, takes formal board

oversight away from numerous facilities including the Waste Isolation Pilot Plant in Carlsbad and excludes lab workers from the board’s role of protecting “public health and safety.” The rule “presents a new and supremely important challenge to a reinvigorated, relevant and robust DNFSB safety oversight,” the academy report states.

The report also cites the board for a lack of transparency, saying its processes may meet the letter of the federal Sunshine Act but not its spirit. The board held only three public business meetings in 2017 and through September of this year and typically uses “notational voting,” an electronic sharing process. Using technical staff as messengers, the board members mark up safety reports without deliberating as a group. The board does release tallies of votes, but “often without greater context or explanation of the considerations that went into each member’s decision.”

The report says that ramped up production of new plutonium “pits,” the cores of nuclear bombs,

from none in recent years to at least 80 a year by 2030, including at LANL, “represents a significant expansion of production and the associated safety challenges.” A spokesman for the DNFSB provided a statement saying the board has approved a series of three public meeting to discuss the

academy report and identify “those recommendations the entire Board can support as the most critical and pursuing alignment on a path forward.” The meetings will start in December.

Source: Mark Oswald, <https://www.abqjournal.com>, 17 November 2018.

NUCLEAR WASTE MANAGEMENT

USA

The Problem That Won't Go Away

Nuclear energy has been an ever-evolving part of technology since the beginning of the 1940s. It has been contested on several fronts, but the question at hand is not about whether or not we ought to further pursue nuclear energy — its potential to mitigate effects of climate change and its energy source sustainability are enough to continue the research into the matter — but rather the question is about how to combat the growing rate of radioactive waste it produces.

President Donald Trump voiced an opposition this October to fund a deep geological repository in Yucca Mountain, Nevada to permanently store the country's high-level nuclear waste, pushing progress on nuclear waste management further into the future. However, this announcement was contradictory to his previously proposed budget for 2018, which allocated \$120 million to fund this project.

Both President Barack Obama's and Trump's administrations have failed to properly address the issue of radioactive waste build-up due to the force of political pressure and selfish motives. Researchers among the international community have concluded that the most optimal solution, as of late, is the construction of singular, deep geological repositories for permanent storage of high-level waste.

Finland is currently leading the way in the construction of the Onkalo Spent Nuclear Fuel Repository at the Olkiluoto Nuclear Power Plant on Olkiluoto Island, Finland. And other countries such as France and Sweden have taken substantial steps to follow in this lead. However, the United States has halted progress on a similar repository.

In 1987, the U.S. Department of Energy amended the Nuclear Waste Policy Act of 1982 to recommend Yucca Mountain for the location of the nation's repository. The recommendation went to Congress with grand support, but Nevada vetoed the approval. The veto was soon overturned by Congress due to the nation's overwhelming support. However, the U.S. Court of Appeals for the District of Columbia Circuit upheld Nevada's appeal in 2004. The court stated that the repository would be required to ensure prevention of leaks for one million years before it could be approved for licensing.

Finland is currently leading the way in the construction of the Onkalo Spent Nuclear Fuel Repository at the Olkiluoto Nuclear Power Plant on Olkiluoto Island, Finland. And other countries such as France and Sweden have taken substantial steps to follow in this lead. However, the United States has halted progress on a similar repository.

Research has since come far in regards to the type of rock needed to surround such a repository, the materials best suited for immediate storage containers and the methods of reducing waste through nuclear reprocessing facilities to recycle massive amounts of Plutonium and

Uranium. Nevada vetoed the construction of the repository because of disapproval and fear from people living in the area. Nevada's congressmen have fought to keep the repository out of the state in order to gain their public's approval and hope for a re-election.

Similar motives have come from the executive level. Obama and Trump both removed funding recommendations for a singular repository due to their need for support from Nevada congressmen for other political agendas. But the state of spent nuclear fuel and other high-level wastes in the country is not one to take lightly.

Without a permanent deep geological repository for final storage, this waste is left to sit in what is

built to be interim storage at nuclear reactors, of which there are currently 98 licensed to operate all across the U.S., according to the U.S. Nuclear Regulatory Commission. This number is significantly more than any other country's and is roughly 20 percent of all nuclear reactors in the world.

Furthermore, these current interim storage facilities often are only built to properly store high-level waste for up to 50 years and are incredibly more expensive than a single repository would be, according to a 2013 report from the Nuclear Energy Agency. Energy Secretary Rick Perry said, "We have a legal responsibility. We have this waste out there. We need to have this licensing issue addressed."

But this is more than just a legal responsibility; it is an ethical responsibility, regardless of the status of law, to protect the earth and all possibilities of future generations. Without this repository, there is no other solution. What has become a political issue needs to be regarded as what it truly is: a humanitarian and ethical issue. President Trump needs to redirect his focus on the Yucca Mountain repository, ignore political pressures and push for further research and development of radioactive waste in order to ensure future sustainability for lives, the environment and the economy.

Source: <https://www.idsnews.com/>, 25 November 2018.



Centre for Air Power Studies

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

Centre for Air Power Studies

P-284

Arjan Path, Subroto Park,

New Delhi - 110010

Tel.: +91 - 11 - 25699131/32

Fax: +91 - 11 - 25682533

Email: capsnetdroff@gmail.com

Website: www.capsindia.org

Edited by: Director General, CAPS

Editorial Team: Dr. Sitakanta Mishra, Hina Pandey, Anushree Dutta, Dr. Poonam Mann, Wg Cmdr Kaura, Sreoshi Sinha

Composed by: CAPS

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