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INTERVIEW – Manpreet Sethi, Rajesh Rajagopalan

Should India Tinker with its ‘No First Use’ Policy?

Q: What does the Defence Minister’s statement mean, and does it indicate a likely change in India’s NFU policy and nuclear doctrine?

Rajesh Rajagopalan (RR): I am not sure if it is really a revision of India’s NFU policy because all he said was that in future the policy might change. That has always been the case. The doctrine is only valid for as long as the government says it is valid. It would be foolish to suggest that doctrines cannot change or that they will hold for all times and under all circumstances. All he was suggesting was that we cannot guarantee that the doctrine will hold for all times.

This is possibly a signal to Pakistan that it should not take India’s restraint for granted for all times to come, but I think even that would possibly be an exaggerated reading of the statement. I think Rajnath Singh’s statement is somewhat different from former Union Minister Manohar Parrikar’s statement. He had said at a book launch that he doesn’t understand why we have to wait until we hit back. That was a lot more problematic even though it was clarified subsequently that his statement was his personal view rather than the government’s policy. I don’t see Mr. Singh’s

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statement as signifying a change in the doctrine. And obviously if we did change the NFU policy, that would not be particularly useful.

Q: This is not the first time a Minister or senior functionary has made such a statement. There have been periodic debates on a revision of India’s stand, especially on the NFU policy, in strategic circles. Revision of the NFU policy was also in the BJP’s manifesto in 2014, though it wasn’t there in its 2019 manifesto. Is all this indicative of a change at some point?

Manpreet Sethi (MS): I quite agree with how Professor Rajagopalan has interpreted Mr. Singh’s statement. I think it is a very normal

statement. Policy adjustments get made as situations change. I don't see anything in the statement that is indicative of any desire for change as of now. As regards the BJP manifesto that you mentioned, Prime Minister Narendra Modi made it clear that there was not going to be any revision. Individual voices, most of whom are retired officials who occupied positions of power, have brought up this issue of revision of NFU, but they did not mention any revision of NFU when they were in those positions. Late last year, on the occasion of the announcement of the first deterrence patrol of India's ballistic missile nuclear submarine INS Arihant, the Prime Minister once again reiterated that the basic tenet of India's nuclear doctrine will be NFU.

As far as I can see, there is no change in the doctrine on the cards. But having said that, there are always the 'Nuclearazzi', who are out with their microscopes to look at everything that has been said and who read more into statements. I think that's what is happening in the case of India's NFU. I do believe it's a good policy and there's no reason for the country to change it.

Q: *In the last few years, India's conventional posture has undergone a major shift. This was evident in the 2016 surgical strikes and this year's Balakot airstrike. It also disproved the old belief that under a nuclear overhang, the room for conventional manoeuvre is closed. In that context, isn't stability in the nuclear realm better for India so that there is room in the conventional domain?*

RR: Absolutely. I mean obviously we want stability in the nuclear front, but I don't think that stability was under threat. Pakistan repeatedly raises this

bogey of nuclear escalation every time it engages in some action in terms of sending terrorists across. But that is a way of constraining India's response, as a way of preventing India from responding militarily to those kinds of attacks. The idea is that if you raise the issue, if you bring in nuclear escalation as a threat, it will constrain India's response. It is always a false expectation, a false argument, because there is no direct link between conventional escalation and nuclear escalation.

In Kargil, for example, when we started using air power to dislodge Pakistan air forces from mountain heights, initially Pakistan complained about escalation. It said this could lead to nuclear escalation. But pretty soon it was clear that there was no such thing. Similarly, during the 2016 surgical strikes, Pakistan again complained about the possibility of escalation. But in each of these cases we have not seen any escalation. There are several layers in between, and those layers are where Pakistan has benefited because it can't really escalate to something like Balakot or to surgical strikes.

So, yes, we want nuclear stability and that nuclear stability exists. It is just an exaggeration by Pakistan that nuclear stability is always under threat and anything we do will put it under immense strain.

Of late, we have repeatedly shown that we can take action without it escalating anywhere close to the nuclear level.

Q: *Talking about the escalation matrix, the strategic ambiguity can lead to a response from Pakistan and then in turn from China, India's two*

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nuclear adversaries. Pakistan has been trying to put its nuclear weapons at sea. The U.S. has walked out of the Intermediate-range Nuclear Forces treaty. How will these developments impact the region?

MS: First of all, I don't think any ambiguity has been brought into India's doctrine as of now. I think India is very clear on its NFU policy.

On the likely Pakistan reaction, Pakistan is working on what it calls the full spectrum deterrence capability. So, in terms of the arsenal build-up, I don't think there is going to be any major change except that it will likely show urgency or justification for the large stockpile build-up that it is anyway engaged in. More likely, removal of NFU will put India in a problematic situation because for a credible 'first use' you have to build different kinds of capabilities which will mean going on a different trajectory. So, it is most likely that India will get pulled into an arms race if it was to remove the NFU.

In terms of China's reaction, I don't see any material changes happening in response to India's capability build-up. In any case, it has a lead on nuclear and delivery systems. It will definitely use the opportunity to denigrate India's status as a responsible nuclear power. So, India's claim to be a member of the NSG or for a permanent seat at the UNSC will come under strain as a result of that.

Frankly, as far as the response of the rest of the world is concerned, we are already in a situation where arms control is crumbling: the US's nuclear posture review is talking about limited nuclear war

once again. The rest of the world will not care much about this change, except at the rhetoric level where there will be criticism of what is going on. So, my concern is not so much the rest of the world's

response to change in NFU, but what it will be for India itself in terms of investment in financial and technological capabilities to make a first use credible. After all, it's not just a question of dropping the 'No' from NFU, it is a matter of making the first use credible and that is not an easy proposition. There is no chance that India has of carrying out in the first strike a disarming or decapitating strike for the

kinds of adversaries that we have and therefore we will be sucking ourselves into an arms race if we were to go for a first use doctrine.

Q. *Pakistan has been trying to diversify its nuclear arsenal for many years now and has been trying to bridge the gap between conventional and nuclear. I am referring to attempts to put nuclear warheads*

on conventional submarines following India's nuclear triad taking shape. Does this blur the line between conventional and nuclear and create new risks?

RR: Yes, there is a problem when you use dual-use delivery vehicles and weapons systems. This is the problem we have faced in the past. Say Pakistan is

holding its nuclear weapons in some airbase. We may be constrained from attacking that airbase because we wouldn't want Pakistan to mistake a conventional attack on an airbase as an attack on its nuclear weapons. So, whenever you have dual-use weapons, there is a problem. There is a problem when both may misunderstand a

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particular platform, base or a submarine as containing nuclear weapons. One may be constrained from attacking that because we don't want to give the impression that we are going after their nuclear weapons. On the other hand, it is an even bigger problem when Pakistan uses these dual-use systems. If a conventional missile or a short-range missile is launched at us, we wouldn't know whether it is a conventional missile or a nuclear missile and therefore it is possible that one may mistake it as an incoming nuclear attack. Even our own armoury has both nuclear and conventional warheads, which is generally bad practice.

Q. *In 2013, after Pakistan introduced TNWs or battlefield nuclear weapons, India clarified that it will not distinguish between strategic and tactical nuclear warheads and the doctrine of massive retaliation will apply. Following the recent blurring of lines with dual-use technologies, does the nuclear doctrine as it is still hold?*

RR: I don't think that makes a difference. I think whatever the Indian position, any attack would be considered a nuclear attack even if it is a TNW that is used against Indian forces or Indian territory. It will be considered a full-scale nuclear attack. I think that the response to a TNW attack, especially on Indian forces inside Pakistani territory, will make it difficult for India to justify a full-scale massive retaliation that the Indian doctrine suggests. But the Indian doctrine is also sufficiently flexible. Massive retaliation is one of the options it has in case of a nuclear attack. India can decide to use, for instance, another smaller nuclear warhead in retaliation or a limited nuclear strike. So, it doesn't mean the doctrine itself has to change in response

to that. All the doctrine says as of now is, we will not be the first to attack and we will only retaliate. Our posture and doctrine are essentially retaliation only. We will not initiate.

Source: Rajesh Rajagopalan is Professor, Jawaharlal Nehru University, New Delhi. Manpreet Sethi is a Distinguished Fellow, Centre for Air Power Studies, New Delhi. The

Hindu, 23 August 2019.

OPINION – Christopher Clary, Vipin Narang

'No First Use' Nuke Policy isn't Dead, but Losing Sanctity

Defence Minister Rajnath Singh decided to mark the one-year anniversary of former Prime Minister Atal Bihari Vajpayee's death by making some news. He not only went to Pokhran, the site of each of India's nuclear tests, to visit "the area which witnessed Atal ji's firm resolve to make India a nuclear power", but also to remind everyone of Vajpayee's commitment to the doctrine of nuclear no first use. That doctrine, Singh assured his listeners, had been "strictly adhered to" up until now, but he then ominously emphasized, "What happens in future depends on the circumstances." This was not a formal change in doctrine or policy, yet, but it is an unmistakable and remarkable policy statement.

A policy of NFU is, in fact, a promise not to do something in the future: not to use nuclear weapons first in a conflict. Nuclear use is not something considered on any normal day, so a policy of no first use is a commitment that even in the deepest crisis or war, even if a country had reason to fear an adversary might use nuclear

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weapons imminently, even if a country might benefit from nuclear first use, that the country commits to forgo that option. Rajnath Singh was telling the world that while India intended no first use today, nothing binds it to doing so tomorrow. In so doing, Rajnath Singh was in fact saying that a commitment that originated with Vajpayee wasn't much of a commitment at all.

This has been a long time coming. During the 2014 campaign, following speculation that the BJP might revise no first use, the then-candidate for Prime Minister, Narendra Modi, settled the matter by seemingly reaffirming the declaration, calling it a "reflection of our cultural inheritance." This time, however, the BJP has, instead, openly thrown into question India's commitment to adhere to what is now a crumbling pillar of India's nuclear doctrine.

In his remarks, Singh becomes the most recent senior Indian official to question the wisdom, and erode the sanctity, of no first use, and did so in a clearly scripted statement that one has to assume was carefully formulated and sanctioned by the Cabinet Committee on Security. In November 2016, then-defense minister Manohar Parrikar stated, albeit clarified later that it was only in his "personal capacity," that India should not have a public policy on first use. "Why should I bind myself?" he asked. Lt. Gen. (ret.) B.S. Nagal, a former strategic forces commander, similarly argued in favor of a doctrine of "ambiguity." Former national security advisor Shivshankar Menon argued in his 2016 memoir that India's existing doctrine, even with its declaration of no first use, had a "grey area" in the circumstance that Indian officials concluded another nuclear state was preparing for imminent nuclear attack. Preemption might be permissible, Menon argued, and even with a declared doctrine of no first use, India's doctrine was "more flexible" than was widely believed.

Even the old statesman Vajpayee's commitment to NFU had its limits. In 2000, Vajpayee told a crowd in Jalandhar, "We are being threatened [by Pakistan] with a nuclear attack. Do they understand what it means? If they think we would wait for them to drop a bomb and face destruction, they are mistaken."

Well-known nuclear expert Manpreet Sethi reacted to the news by asking, "What's new here?" And perhaps the answer is not much, but for reasons quite different than what Sethi is implying. Sethi, among others, have downplayed any erosion in the government's commitment to NFU as simply

a stream of "personal opinions," though it is now impossible to discount a scripted statement from the sitting defense minister. But in making their argument, those who point to continuity in nuclear policy have left a moth-eaten no first use doctrine, one with so many loopholes and caveats as to have no real meaning. And perhaps that is how the NFU doctrine has always functioned: as reassuring

rhetoric, but almost impossible to make credible in practice. For example, ironically, Indian analysts routinely dismiss China's NFU policy for the same reasons—as empty rhetoric—that others dismiss India's.

Singh's statement ominously contained an element of threat. Maybe Singh's audience is in Beijing, as China considers what nuclear moves to make as Washington and Moscow tear up arms control treaties. Or, as China modernizes militarily and develops a growing array of ballistic missiles, perhaps Beijing should consider the possibility that India will not forever pursue nuclear restraint. More likely, it is no accident that such a statement was made during a period when Indo-Pakistani relations are as bad as they have been in a decade. While the 2016 "surgical strikes" and 2019 Balakot attacks were intended to show that the

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Modi government did not view the status quo as acceptable, Singh's statement also signals that India may consider a wider array of options in the future. Be careful, Singh appears to be saying, do not think that Pakistan's threat of nuclear first use will deter us from a major conventional war if Pakistan continues to sponsor terrorism on our soil: we won't be the first to use nuclear weapons, but neither will we be the second.

Such statements, however, are not cost free. Occurring alongside nearly two decades of Indian investments in precision-strike weapons, new cruise and ballistic missiles, ballistic missile defenses, and a wide-array of terrestrial, airborne, and space-based intelligence assets, India is increasingly capable of—and perhaps interested in—locating and destroying a meaningful part of Pakistan's nuclear arsenal. But in order to do so, it would almost certainly have to act preemptively, as Singh opens the door to.

This worries Pakistan and forces it to take destabilizing steps in both peacetime and war. In peacetime, Pakistan has already undertaken and will continue to pursue dispersal, mobility, and more weapons—in a country riddled with militancy. And in war, if Pakistan fears India will preempt, Pakistan will have stronger incentives to preempt the preemption, and round and round they go until crises become nuclearized at the very outset. Just as there were reports that India's nuclear ballistic missile submarine, INS Arihant, was deployed early in the Balakot crisis, we can expect Pakistan to similarly disperse nuclear assets in future episodes, with uncertain implications for safety and security.

So, in many ways, Singh was stating what Pakistan already believed. But in doing so, he became the highest serving Government of India official to explicitly state that India's NFU policy is neither permanent nor absolute and that one day, at its

own discretion and without warning, it may be tempted to strike first. NFU as official policy may not be dead, but it no longer has any meaning to India's adversaries. This only puts more pressure on Pakistan and China to respond in kind. As India, Pakistan, and China make these moves and countermoves, the question remains: is anyone actually safer?

Source: <https://www.hindustantimes.com/>, 18 August 2019.

OPINION – Narayan Lakshman

Will India Change Its 'No First Use' Policy?

Since conducting its second nuclear tests, Pokhran-II, in 1998, India has adhered to a self-imposed commitment to NFU of nuclear weapons on another country. However, on August 16, Defence Minister Rajnath Singh dropped a hint that in the future, India's NFU promise "depends on circumstances."

When did India's N-weapons Journey Begin?

India embarked on the path of nuclear weapons development after its face-

off with China in the 1962 war, followed by China carrying out nuclear tests in 1964 and in the subsequent years. In 1974, under Prime Minister Indira Gandhi, India conducted its first nuclear tests, Pokhran-I, dubbed as a "peaceful nuclear explosion". Despite more than two decades of international pressure that followed to make India abandon its pursuit of nuclear weapons, India again carried out a test in May 1998, Pokhran-II, involving a fission device, a low-yield device, and a thermonuclear device. Its successful execution meant that India had the ability to introduce nuclear warheads into its fast-developing missile programme.

A fortnight after the Pokhran-II tests, Pakistan also carried out similar tests, confirming progress with its nuclear weapons programme; since that time its nuclear arsenal has expanded rapidly. In 1999,

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India came out with an explicit nuclear doctrine that committed, among other things, to NFU — that is it would never carry out a nuclear first-strike. This doctrine emphasised “minimal deterrence, no first use and non-use against non-nuclear weapon states”, in the words of former National Security Adviser Shivshankar Menon. The NFU promise thus went together with credible minimum deterrence (CMD).

What does CMD Mean for the Indian Nuclear Doctrine?

Credible minimum deterrence does not imply indefinite expansion of the nuclear arsenal; rather it is built on an assured second-strike capability. This implies that in the event of another nation carrying out a first nuclear strike of any magnitude against India, India’s nuclear forces shall be so deployed as to ensure survivability of the attack and the capability to carry out a massive, punitive nuclear retaliation aimed at inflicting damage that the aggressor will find “unacceptable”. Additionally, CMD requires a robust command and control system; effective intelligence and early warning capabilities; comprehensive planning and training for operations in line with the strategy; and the will to employ nuclear forces and weapons.

Currently, the Nuclear Command Authority is responsible for command, control and operational decisions on nuclear weapons; specifically it is the Cabinet Committee on Security and ultimately the office of the Prime Minister of India, that is responsible for the decision to carry out a nuclear attack.

Why might the NFU Policy be Revisited?

Regional geopolitical realities have a significant bearing upon India’s NFU commitment, to the extent that the CMD is what the “enemy” believes deterrence to be, and their belief is manifested in their actions. After the 1998 nuclear

tests in India and Pakistan, the CMD was established in the sense that in the following decade, including the aftermaths of the attack on the Indian Parliament in 2001 and the Mumbai terror attacks in 2008, neither country felt inclined to instigate all-out war.

However, since that time, the deterrent effect of India’s arsenal seemed to have less effect in one significant aspect: Pakistani officials started speaking out about their country’s development of tactical nuclear weapons, or “theatre nukes”, which had a lower yield but could still inflict enough damage to blunt a conventional attack. It is surmised that Pakistan’s talk of TNWs might have emerged as a counter to speculation that India might have developed the “Cold Start”

doctrine. This is a purported classified plan for a conventional military attack by Indian forces on Pakistani soil, likely as a response to a prior sub-conventional attack from across the border (such as a state-sponsored terror-attack).

In this context, in 2013, Shyam Saran, convener of the NSAB, said: “India will

not be the first to use nuclear weapons, but if it is attacked with such weapons, it would engage in nuclear retaliation which will be massive and designed to inflict unacceptable damage on its adversary. The label on a nuclear weapon used for attacking India, strategic or tactical, is irrelevant from the Indian perspective.”

However, there may be some concerns with this idea that India will retaliate massively even if Pakistan uses tactical nuclear weapons — possibly on Indian forces operating on Pakistani soil — against it. First, this strategy would take both countries back into the old-world deterrence paradigm of “mutually assured destruction”, because any surviving forces in Pakistan after India’s retaliation would surely launch a devastating attack against targets across India.

Second, India may have more to gain by pre-

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emptive action. This is the question that analysts Christopher Clary and Vipin Narang have studied, and they argue that one option under consideration could be for “a hard counterforce strike against Pakistan’s relatively small number — perhaps several dozen — strategic nuclear assets on land (and eventually at sea) to eliminate its ability to destroy Indian strategic targets and cities. Such a strategy would be consistent with India’s doctrine of massive retaliation — massive retaliation strategies need not be countervalue — while avoiding the credibility issues associated with a countervalue targeting strategy following Pakistan’s use of nuclear weapons on the battlefield.”

The downside is that New Delhi remaining silent on this, except for occasional hints — such as what the Defence Minister tweeted recently — might compel Pakistan to adjust its nuclear posture accordingly, based on a calculation that India might be willing to carry out a counterforce attack and thereby eliminate the Pakistani nuclear threat entirely. This in turn risks fuelling an arms race or more unstable nuclear weapons deployment patterns in Pakistan.

Will we See India’s Nuclear Doctrine Changing to Accommodate these Realities? The simple answer: unlikely. As Mr. Clary and Mr. Narang argue, India’s adoption of potentially pre-emptive “counterforce options” – i.e. to eliminate Pakistan’s strategic nuclear weapons when it deems the risk of a Pakistani first-strike to have crossed a critical threshold — may require no explicit shifts in its declared nuclear doctrine. In fact, remaining silent on this subject might be calculated as a strategic advantage for India as the country would be assuming deliberate nuclear ambiguity. The downside is that New Delhi remaining silent on this, except for occasional hints — such as what the Defence Minister tweeted recently — might compel Pakistan to adjust its nuclear posture accordingly, based on a calculation that India might be willing to carry out a counterforce attack and thereby eliminate the Pakistani nuclear threat entirely. This in turn risks fuelling an arms race or more unstable nuclear weapons deployment patterns in Pakistan.

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The Balakot strikes that followed the Pulwama attack (both in February 2019) demonstrate that the Narendra Modi government is not shy of taking cross-border military action. If another sub-conventional attack, say a terror attack, occurs on Indian soil anytime soon, these theories will likely be tested. What remains unclear is how high up the escalation ladder both countries will be willing to go.

Source: *The Hindu*, 25 August 2019.

OPINION – Rakesh Sood

An End to Arms Control Consensus

The countdown on the US-Russia INF Treaty began last October when President Donald Trump announced that US was considering a withdrawal. On 02 August 2019, the US formally quit the pact. Concluded in 1987, the agreement had obliged the two countries to eliminate all ground-based missiles of ranges between 500 and 5,500 km, an objective achieved by 1991. Now at risk is the New START signed in 2010 and due to lapse in February 2021.

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In May, Director of the Defence Intelligence Agency Lt. Gen. Robert Ashley declared that “Russia probably is not adhering to the nuclear testing moratorium in a manner consistent with the ‘zero-yield’ standard” imposed by the CTBT. The CTBT has not entered into force but the US is a signatory and Russia has signed and ratified it. Many have interpreted Lt. Gen. Ashley’s statement as preparing the ground for a resumption of nuclear explosives testing. Taken together, these ominous pointers indicate the beginning of a new nuclear arms race.

The decade of the 1980s saw heightened Cold War

tensions. Soviet military intervention in Afghanistan in 1979 provided the US an opportunity to fund a (barely) covert jihad with the help of Pakistan. President Ronald Reagan called the USSR "an evil empire" and launched his space war initiative. Soviet deployments in Europe of SS-20 missiles were matched by the US with Pershing II and cruise missiles.

Cold War Talks: In 1985, the two countries entered into arms control negotiations on three tracks. The first dealt with strategic weapons with ranges of over 5,500 km, leading to the START agreement in 1991 that limited both sides to 1,600 strategic delivery vehicles and 6,000 warheads. A second track dealt with intermediate-range missiles, of particular concern to the Europeans, and this led to the INF Treaty in 1987. A third track, Nuclear and Space Talks, was intended to address Soviet concerns regarding the US's Strategic Defence Initiative (SDI) but this did not yield any concrete outcome.

The INF Treaty was hailed as a great disarmament pact even though no nuclear warheads were dismantled and similar range air-launched and sea-launched missiles were not constrained. Further, since it was a bilateral agreement, the treaty did not restrict other countries, but this hardly mattered as it was an age of bipolarity and the US-USSR nuclear equation was the only one that counted. By 1991, the INF had been implemented. The USSR destroyed a total of 1,846 missiles and the US did the same with 846 Pershing and cruise missiles. Associated production facilities were also closed down. In keeping with Reagan's dictum of 'trust but verify', the INF Treaty was the first pact to include intensive verification measures, including on-site inspections.

With the end of the Cold War and the break-up of the USSR in end-1991, the arms race was over.

Former Soviet allies were now joining the NATO and negotiating to become EU members. The US was investing in missile defence and conventional global precision strike capabilities to expand its technological lead. Importantly, some of these were blurring the nuclear-conventional divide.

US Withdrawal from ABM: In 2001, when the US announced its unilateral withdrawal from the 1972 ABM Treaty, a keystone of bilateral nuclear arms control was removed.

The INF Treaty had been under threat for some time. The US had started voicing concerns about the Novator 9M729 missile tests nearly a decade ago. As Russia began production, formal allegations of violation of the INF Treaty were raised by the Obama administration in 2014. Russia denied the allegations and blamed the US for deploying missile defence interceptors in Poland and Romania, using dual-purpose launchers that could be quickly reconfigured to launch

Tomahawk missiles.

Basically, Russia believes that nuclear stability began getting upset since the US's unilateral withdrawal from the ABM Treaty. As the US used its technological lead to gain advantage, Russia became more dependent on its offensive nuclear arsenal and began its modernisation and diversification.

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The US's 2017 National Security Strategy and the Nuclear Posture Review (NPR) the following year reflected harsher-than-before assessment of its security environment and sought a more expansive role for nuclear weapons, in a break from the policies that had been followed since the end of the Cold War. Russia was seen as a 'disruptive power' pushing for a re-ordering of security and economic structures in Europe and West Asia in its favour.

role for nuclear weapons, in a break from the policies that had been followed since the end of the Cold War. Russia was seen as a 'disruptive power' pushing for a re-ordering of security and economic structures in Europe and West Asia in its favour. China was identified for the first time as a strategic competitor that was seeking regional hegemony in the Indo-Pacific region in the near-term and "displacement of the US to achieve global pre-eminence in the future".

With the geopolitical shift to the Indo-Pacific, the US believes that the INF Treaty was putting it at a disadvantage compared to China which is rapidly modernising and currently has 95% of its ballistic and cruise missile inventory in the INF range. Against this political backdrop, the demise of the agreement was a foregone conclusion.

The 2011 New START was a successor to the START framework of 1991 and limited both sides to 700 strategic launchers and 1,550 operational warheads. It lapses in February 2021 unless extended for a five-year period. Mr. Trump has indicated that a decision on the agreement will be taken in January 2021, after the 2020 election. Given his dislike for it, if he is re-elected, it is clear that the New START will also meet the fate of the INF Treaty. This means that, for the first time since 1972, when the SALT I concluded, strategic arsenals from the US and Russia will not be constrained by any arms control agreement.

Testing of Low-yield Weapons: The 2018 NPR envisaged development of new nuclear weapons, including low-yield weapons. The Nevada test site, which has been silent since 1992, is being

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A new nuclear arms race could just be the beginning. Unlike the bipolar equation of the Cold War, this time it will be complicated because of multiple countries being involved. Technological changes are bringing cyber and space domains into contention. All this raises the risks of escalation and could even strain the most important achievement of nuclear arms control.

readied to resume testing with a six-month notice. The US Senate had rejected the CTBT in 1999 but as a signatory the US has observed it. In addition to pointing the finger at Russian violations, Lt. Gen. Ashley declared that "China is possibly preparing to operate its test site year-round in a development that speaks directly to China's goals for its nuclear force". He suggested that China cannot achieve such progress "without activities inconsistent with the CTBT". Since the CTBT requires ratification by US, China, Iran, Israel and Egypt and adherence by India, Pakistan and North Korea, it is unlikely to ever enter into force. Resumption of testing by the US would effectively ensure its demise.

A new nuclear arms race could just be the beginning. Unlike the bipolar equation of the Cold War, this time it will be complicated because of multiple countries being involved. Technological changes are bringing cyber and space domains into contention. All this raises the risks of escalation and could even strain the most important achievement of nuclear arms control — the taboo against the use of nuclear weapons that has stood since 1945.

Source: Rakesh Sood is a former diplomat and currently a Distinguished Fellow at the Observer Research Foundation. The Hindu, 24 August 2019.

OPINION – Ankit Panda

The Absurd Strategy Behind Russia's Nuclear Explosion

The US and Russia are entering a new arms race, and the costs aren't just monetary. On 08 August 2019, Russian civilians around the remote village of Nyonoksa found themselves downwind of a

military nuclear propulsion experiment gone wrong in the White Sea, just outside the Arctic Circle. According to the Russian ministry of defense, a liquid propellant rocket engine had gone awry and exploded.

This by itself was alarming, but not unprecedented: Liquid propellants, long preferred in many Russian missiles, are volatile and have exploded when prematurely brought into contact with oxidizing agents. What made this month's explosion more significant was Russia's

acknowledgement that a "nuclear isotope power source" was involved. Seven people—including five scientists from Sarov, one of Russia's secret nuclear complexes—were killed in the explosion. Russian state weather monitors reported heightened background radiation levels around the site and beyond. A press release from a Norwegian monitoring agency a week after the incident noted that "tiny amounts of radioactive iodine"—a common byproduct of the sort of nuclear fission that might take place in a reactor—had been detected in northern Norway.

The exact sort of weapon Russia may have been testing is unknown, but the balance of evidence points to a probable culprit: the Burevestnik nuclear-powered cruise missile. Nuclear nonproliferation expert Jeffrey Lewis and his team of researchers out in Monterey, California, have done much of the work in compiling this evidence, which includes the presence of a nuclear fuel carrier ship that was known to have been involved in recovery efforts after a previous failed test of the missile. Known in NATO countries as the SSC-X-9 SKYFALL, the Burevestnik's atomic propulsion is said by Russian state media to give the missile "almost unlimited

range, non-predictable trajectory and high air defense penetration capacity."

Why might anyone want such a weapon? There's an ostensible strategic rationale, even if it's unconvincing. The Burevestnik represents what might be called a second-strike weapon. These are a big deal for any nuclear nation, as they deter first strikes: the kind where an adversary gets the best of you and uses its nuclear weapons to destroy all of yours before you can

use them. The US, for instance, relies on 14 Ohio-class ballistic missile submarines hidden in the ocean depths as a deterrent to a first strike. There's simply no way any nuclear adversary, including Russia, could destroy all of America's land-based intercontinental-range ballistic missiles and nuclear weapon-toting bombers without facing the wrath of at least one Ohio-class submarine and its 24 Trident missiles. A first strike is not something we really worry about today, but it's something that kept people awake during the early years of the Cold War.

Is Russia worried about an American first strike today? Not likely. Vladimir Putin's main concern—he said this when he publicly unveiled the Burevestnik in a March 2018 address to the Russian federal assembly—is missile defense. Russia and China worry that their second-strike capabilities may not constitute a

credible-enough future deterrent. The primary driver for that is concern that American missile-defense technology might experience a huge qualitative leap, rendering the US largely impervious to a ballistic-missile attack. (American homeland missile defense technology today is thoroughly mediocre, but Russian planners would be negligent to assume that this will always remain the case.)

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Enter Burevestnik and its experimental siblings in Russia, including an autonomous thermonuclear warhead-toting “apocalypse torpedo,” a highly maneuverable ICBM-launched hypersonic glider, an intercontinental ballistic missile that can fly all the way around the earth, and an air-launched ballistic missile that travels at ten times the speed of sound. These weapons are designed to give missile defenses a hard time, ensuring that even in a future where American ships and land batteries could shield their territory from most current nuclear missiles, Russia could still prevail.

Burevestnik is likely designed to leverage its killer app—unlimited range—in a particular way. In a crisis, or even during peacetime, multiple Burevestnik missiles could remain in flight at low altitudes, lingering where they can be seen. If most of Russia’s nuclear arsenal were to be destroyed, a low-flying Burevestnik could theoretically stay low and work its way around American sensors.

This concept is dubious: Russia today possesses more than a handful of ways to reliably ensure that its nuclear weapons could hit the US if needed. Burevestnik is less useful at winning a war, or maintaining peace, than at putting an exclamation point on a theoretical global thermonuclear apocalypse. Its strategic value also has ICBM-sized holes in it: Cruise missile defense has long been a major preoccupation for American war planners, and the U.S could theoretically check Burevestnik’s threat by deploying existing short-range missile defenses on sea and land. In the end, much of what may be driving investment and research on this weapon—beyond Putin’s chest-thumping—may be the sprawling and influential Russian defense bureaucracy. (Overspending on exotic military systems is not an exceptionally American trait.)

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That’s the shaky strategic logic behind it. But the common-sense logic, as the radioactive Nyonoksa explosion shows, is even less kind. If a nuclear-powered cruise missile sounds exotic and a little dangerous, that’s because it is. Missiles go boom—usually intentionally, but often enough not—and whatever nuclear power source they might be using onboard wouldn’t be immune. There’s still little consensus among American experts about how exactly the Burevestnik might leverage nuclear power for propulsion. If you thought nuclear fission weapons were complex, nuclear rocket propulsion is more arcane and mysterious still. In the 1950s and 1960s, US scientists drafted fanciful plans to give missiles nuclear engines, on the assumption that they’d be able to fly longer and farther than any weapon yet conceived. But the Americans eventually gave up; the technical challenges and environmental risks weren’t worth it. The Russians haven’t given up just yet, but they may someday.

The Burevestnik appears to matter greatly to Putin, however. His official remarks about the missiles at last year’s grand unveiling are worth reading: They sound like something out of a Silicon Valley product pitch to gormless investors. For the Russian leadership, a weapon like Burevestnik is a prestige project, a way to set Moscow apart from its competition. Claiming it had been successfully tested prior to his speech—a claim that US intelligence agencies deny—Putin noted that “no other country has developed anything like this.” He added: “There will be something similar one day, but by that time our guys will have come up with something even better.”

Of course, Donald Trump couldn’t stomach another head of state flaunting his fancy rocket. The president tweeted on August 12 that the US has “similar, though more advanced, technology.” As nuclear chemist Cheryl Rofer

observed, this was a rare tweet by Trump's standards: one that criticized Russia. ...To the extent he grasps the salient issues, it's likely the president has already asked Pentagon officials why the US doesn't have a nuclear-propelled cruise missile of its own.

A spokesperson for the Kremlin was blasé about the Nyonoksa explosion, stating that "accidents happen." Yes, they do, but nuclear-powered cruise missile programs don't just happen. They represent dangerous and unnecessary choices to goose a nation's theoretical military supremacy, incentivizing other nations to follow suit, risks be damned. The arms control regimes that once moderated US and Russian decisions are already crumbling, and another big one—New START—may expire in 2021. What exactly transpired in the White Sea on August 8 may remain fuzzy, but what is becoming increasingly clear is the risk to life associated with a new generation of nuclear arms proliferation between the US and Russia. With ultranationalist leaders and weapon fetishists in control of Washington and Moscow, buttressed by military yes-men and mercenary defense contractors, there's little to stand in the way of a new, irrationally exuberant buildup of bizarre new nuclear forces.

Source: Ankit Panda is an adjunct senior fellow at the Federation of American Scientists and a senior editor at The Diplomat, <http://www.newrepublic.com>, 21 August 2019.

OPINION – Sheena McKenzie

How to Demolish a Nuclear Power Plant without Blowing it Up

No big red button. No dramatic countdown. No "kaboom!" The engineers who brought down a disused power plant on the River Rhine did so without an explosion. Instead they used robots to gently collapse it like a house of cards. Or at least, as gently as you can flatten an 80-meter

(262-foot) concrete cooling tower. The tower was part of the Mülheim-Kärlich power plant, which was in operation for just over a year in the 1980s. The plant was shut down in 1988 following licensing issues and concerns about the risk of earthquakes in the area. The hefty task of dismantling began in 2004.

Germany decided to phase out all its nuclear power plants in the wake of the Fukushima disaster in 2011. And it's also planning to close all its coal power plants by 2038 in an effort to cut its greenhouse gas emissions, which are currently the largest in Europe. That means there are likely to be many more such demolitions in the coming years.

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are likely to be many more such demolitions in the coming years. Decades ago, Germany's power plants were a symbol of its engineering prowess. Today the country has become a world leader in taking these complex buildings apart.

Robot Power: In May last year, engineers began shortening what was then the 162-meter-tall cooling tower at Mülheim-Kärlich. They attached a robot to the lip, and for the past year it's been munching its way down the building — a bit like a caterpillar devouring a leaf. By June this year, the tower was half its previous height. Engineers still needed to finish the job. But as project manager Olaf Day explained, they didn't have permission from authorities for an explosion, so instead came up with a different plan.

The tower was supported by 36 V-shaped pillars. The team of experts used a giant robotic "hammer" to weaken some of the pillars, and then another high-tech pair of "scissors" to cut them until the tower collapsed, said Day. "It was the first time in the world this demolition method has been used [on a nuclear plant]," he said, adding that the entire "hammer and scissors" process took just under four hours.

There was another benefit to this unique method. Explosives cause "huge amounts of dust that fly everywhere," explained Professor Miranda

Schreurs, chair of environmental and climate policy at the Technical University of Munich. The Mülheim-Kärlich tower, however, just “fell in on itself,” producing minimal dust. While the tower was not deemed radioactive, there’s still an interest in “minimizing potential spread of any harmful materials,” she said.

The New Nuclear Experts:

For more than three decades, the cooling tower dominated the skyline in this small town in western Germany, the legacy of an era when the country generated around 30% of its electricity from nuclear power, according to Schreurs. Back in the 1970s and early 1980s, nuclear energy was seen as a “sign of Germany’s engineering prowess,” Schreurs said. But when the 1986 Chernobyl disaster in nearby Ukraine caused radioactive clouds to drift over western Europe, concerns about the safety of nuclear energy “took on a whole new dimension,” she said.

Following the reunification of Germany in 1990, more Soviet nuclear plants in the former East Germany were decommissioned that “did not meet the West German safety standards,” said Schreurs. Germany has been cooling on nuclear power since 2000, but it was Japan’s Fukushima disaster in 2011 that really swung the government into action. Chancellor Angela Merkel quickly set new deadlines. Of the country’s 17 reactors, eight were immediately shut down. The seven reactors still in operation today are due to close by 2022.

As the plants closed down, a new industry has emerged. Even after a power plant shuts, “you still need people who are experts in radioactive

materials, you still need people who know how to deal with the robots that operate inside nuclear facilities,” said Schreurs. That know-how could be

exported to other countries. There are about 450 nuclear power plants in the world, many of them approaching the end of their lifetimes. “So you’re not going to have the same level of expertise as you have here in Germany,” said Schreurs. “That means Germany will probably play quite an important role in helping other countries to also deal

with decommissioning.”

Mind the Energy Gap: Today Germany gets about 12% of its electricity from its seven nuclear reactors, and over 40% from coal, according to the World Nuclear Association. The big question is whether renewables will reliably be able to fill the gap, particularly in a country with a large energy-intensive manufacturing sector making cars, steel and chemicals.

Germany currently produces more electricity than it needs and exports the surplus to neighboring countries. But one difficulty is that the supply of renewable energy is variable. “The biggest issue in terms of security of supply is when the wind doesn’t blow and the sun doesn’t shine,” said Hanns Koenig, of energy market analysis firm Aurora Energy Research.

That could be resolved by efforts to create a much more integrated European power market, he added. The end of the nuclear era will mark Germany in a different way too.

After the cooling tower came down, Day described the surreal feeling of driving past the site with “no landmark for orientation.” “It was astonishing,” he

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said. "And it must be even more astonishing for the people who have lived here for 30 years."

Source: <http://www.wtop.com>, 16 August 2019.

NUCLEAR STRATEGY

CHINA

Here is China's Plan for a Nuclear War Against America

When one reads enough Chinese naval literature, diagrams of multi-axial cruise missile saturation attacks against aircraft carrier groups may begin to seem normal. However, one particular graphic from the October 2015 issue of the naval journal *Naval & Merchant Ships* stands out as both unusual and singularly disturbing. It purports to map the impact of a Chinese ICBM strike by twenty nuclear-armed rockets against the US.

Targets include the biggest cities on the East and West Coasts, as well as in the Midwest, as one would expect. Giant radiation plumes cover much of the country and the estimate in the caption holds that the strike "would yield perhaps 50 million people killed". The map below that graphic on the same page illustrates the optimal aim point for a hit on New York City with a "blast wave" that vaporizes all of Manhattan and well beyond.

That makes the North Korean "threat" look fairly insignificant by comparison, doesn't it? But what's really disturbing is that the scenario described above envisions a strike by China's largely antiquated DF-5 first generation ICBM. In other words, the illustration is perhaps a decade or more out of date. As China has deployed first the road-mobile DF-31, then DF-31A and now JL-2 (a submarine-launched nuclear weapon), China's nuclear strategy has moved from "assured

retaliation" to what one may term "completely assured retaliation."

Indeed, the actual theme of the article featuring those graphics concerns recent reports regarding testing of the DF-41 mobile ICBM. The author of that article, who is careful to note that his views do not represent those of the publication, observes that when a Chinese Defense Ministry spokesperson was queried about the test on

August 6, 2015, the spokesperson "did not deny that the DF-41 exists". The author also cites US intelligence reports, concluding that four tests have now been conducted, including one that demonstrates MIRV

technology. The author estimates that DF-41 will finally provide China with the capability to launch missiles from north central China and hit all targets in the US (except Florida). With the goal of better understanding the rapidly evolving strategic nuclear balance between China and the US and its significance, this Dragon Eye surveys

some recent Mandarin-language writings on the subject of Chinese nuclear forces.

To be sure, a flurry of Chinese writings on the nuclear balance did follow after the September parade in Beijing that

highlighted Chinese missile forces. Perhaps the most remarkable revelation from the parade was the unveiling of the DF-26, a new, longer-range ASBM, based on the revolutionary shorter-ranged cousin, the DF-21D ASBM. In fact, the November 2015 issue of the aforementioned journal ran a series of articles on the DF-26. In those articles, the weapon is described multiple times as a "nuclear conventional dual-purpose" weapon. The major thrust of the article in that issue on the impact of the DF-26 on nuclear strategy seems to be to try to debunk the argument that China's deployment of this new type of missile

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is “destabilizing.” Like their American counterparts, Chinese strategists seem to be increasingly practiced (at least in a domestic context) at selling the argument that more and new types of weapons enhance deterrence and thus strategic stability.

Despite the developments related above, the balance of opinion in Beijing seems impressively moderate on the prospects for a major nuclear buildup by China. In the allegedly nationalist forum of Global Times one commentator from the China Institute for International Studies (associated with the Foreign Ministry), for example, offered a few illuminating comments about a year ago in an expert forum entitled “How Many Nuclear Warheads Are Enough for China?” He is evidently concerned that “We have heard some new voices calling to ‘build a nuclear force appropriate for a great power.’” Instead, he argues that China must continue to focus on building a “small, elite and effective nuclear forces”. Likewise, a former vice-director of the Chinese Navy Nuclear Security Bureau offers that China is a medium-sized nuclear power, which should learn from the experience of Britain and France and deploy no fewer than four SSBNs—far fewer than operated by either Russia or the US.

Yet one can still find in that same analysis ample concern among Chinese specialists regarding new directions in US military capabilities that could threaten China’s deterrent. Another concern amply evident in Chinese writings concerns tactical nuclear weaponry. Most of this reporting of late concerns a recent upgrade to the American B-61 nuclear bomb. A full-page graphic in the same

issue that discusses the DF-41 missile tests offers many specifics on the B-61, including its “dial-a-yield” feature that enables the operator to choose destruction on a scale ranging from fifty to 0.3 kilotons. That same month, in the magazine

Aerospace Knowledge a “centerfold” featured the SS-26 Iskander, a Russian short-range tactical nuclear weapon. Elsewhere, I have, moreover, documented Chinese discussions of tactical nuclear weapons for anti-submarine warfare, as well as the importance of nuclear-tipped SLCMs for strategy in the late Cold War. Let’s hope that these are just academic discussions in the Chinese

context and do not reflect actual weapons under development.

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American strategists need to keep this Chinese restraint in mind, especially as they weigh both new, expensive weapons systems (missile defense augmentation, the new strategic bomber, SSBN-X and also prompt global strike) and a set of measures to counter Beijing within the maritime disputes on its flanks.

As one can see from this discussion, there is ample reason for anxiety with many new Chinese nuclear systems now coming online, as well as substantial reason for optimism. As an author who frequently rides China’s high-speed rail, I am acutely aware that astronomical sums of

money spent on that system could just as easily have been spent building an enormous arsenal of nuclear weaponry. That was not done and it’s certainly good that Chinese leaders have their priorities straight. American strategists need to keep this Chinese restraint in mind, especially as they weigh both new, expensive weapons systems (missile defense augmentation, the new strategic bomber, SSBN-X and also prompt global strike) and a set of measures to counter Beijing within the maritime disputes on its flanks.

Source: <http://www.nationalinterest.org>, 15 August 2019.

BALLISTIC MISSILE DEFENCE

NORTH KOREA

North Korea Launches Ballistic Missiles into Sea of Japan

Japan's Coast Guard said it detected a suspected ballistic missile launch from North Korea, while Yonhap news agency quoted the South Korean military as saying North Korea had fired two projectiles into the sea off its east coast. A series of launches by North Korea since US President Donald Trump and North Korean leader Kim Jong Un met at the inter-Korean border in June have complicated attempts to restart talks between US and North Korean negotiators over the future of Pyongyang's nuclear weapons and ballistic missile programmes.

South Korea's Joint Chiefs of Staff (JSC) said North Korea fired the projectiles from around Sondok, South Hamgyong Province, according to Yonhap. Sondok is the site of a North Korean military airfield. Japan's Coast Guard warned shipping not to approach any fallen debris. South Korea's presidential office is holding a National Security Council meeting about North Korea's launch, the office said in a statement.

Source: <http://www.firstpost.com>, 24 August 2019.

SAUDI ARABIA

Saudi Arabia's New Ballistic Missile Program will Heighten Tensions with Iran

According to US intelligence reports, Saudi Arabia is developing a domestic ballistic missile program

with the direct support from China, despite Washington's efforts to cease missile proliferation in the Middle East. The Trump administration did not initially disclose its knowledge of this classified development to key members of Congress. Satellite images taken last November revealed that the factory is situated at an existing missile base near the town of al-Dawadmi, 230 kilometers west of Riyadh. A military base deep inside Saudi Arabia appears to be testing and possibly manufacturing ballistic missiles.

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using Chinese technology. Nevertheless, Saudi Arabia rejects all accusations of running a secret ballistic missile base on its soil. It is an undeniable argument that if a country heavily invests in manufacturing ballistic missiles, it usually

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However, it is still unclear where Saudi Arabia gained the technical know-how to build such a facility. Reportedly, Saudi Arabia has significantly escalated its ballistic missile program correlates with an immense interest in nuclear weapons. Thus, it becomes clear that the main priority of the Saudis in developing ballistic missiles is the development of a nuclear weapons program. A nuclear armed Saudi Arabia means nuclear proliferation in one of the most unstable regions of the world.

Saudi Arabia's nuclear ambitions were revealed in the aftermath of Crown Prince Mohammad bin Salman's interview in 2018 when he stated that "Saudi Arabia does not want to acquire any nuclear bomb, but without a doubt, if Iran developed a nuclear bomb, we will follow suit as soon as possible." Although Saudi Arabia is a signatory to the NPT, which prohibits the country from nuclear weapons development, neither President Trump nor any member of his

administration has publicly condemned the kingdom's efforts to possibly acquire a nuclear weapon.

Saudi Arabia has been expressing its willingness to generate nuclear power since 2015, however, the country still has no nuclear power plants. Saudi Arabia has stated plans to construct 16 nuclear power reactors in the next 20 years. The first agreement

in this regard was signed between Saudi Arabia and Russia in 2015. As a result, Russia's Rosatom announced that it is ready to build 16 nuclear power units in Saudi Arabia in a \$100 billion deal.

Saudi Arabia eventually wants to develop its missile systems and acquire nuclear weapon as a hedge against Iran, as it considers the latter a real threat to its national security. Therefore, the kingdom has shown little concern for what the rest of the world thinks regarding its ambitions. In fact, Saudi-Chinese cooperation on missile systems is not a new phenomenon and it dates back to the 1980s when Saudi Air Force commander Prince Khalid bin Sultan traveled to China to buy medium-range missiles capable of carrying nuclear warheads. Indeed, there was a reason for this dialogue, as the decree from 1987, prohibits the US from exporting missile systems to Saudi Arabia.

In recent years, Saudi Arabia has been more open about its missile program. For instance, in 2010, Saudi Arabia opened a central office of missile defense in Riyadh. By doing so it wants to demonstrate its deterrent capabilities and send a signal to Iran of the consequences if the latter doesn't limit its own missile program. On the other hand, developing a local ballistic missile system is also a preventive measure taken by Saudi Arabia due to the frequent rocket attacks carried out by

Iranian-backed Houthi rebels in Yemen. The most recent rocket attack carried out by Houthi rebels hit Abha airport in the southern part of Saudi Arabia.

Another reason behind the ballistic missile program is indeed deteriorated relations with Western allies in the aftermath of the assassination of journalist Jamal Khashoggi. The

widespread criticism of Saudi authorities in Western countries and their reluctance to deepen military cooperation with the kingdom, has pushed Riyadh to seek new "strategic allies" like China, Russia, and Pakistan.

Despite efforts by the US Congress to stop arms export to Saudi Arabia, President Donald Trump declared a emergency to bypass Congress and sent billions of dollars in arms sales to various countries including Saudi Arabia and the United Arab Emirates.

The current geopolitical turmoil in the Middle East reflects deteriorating relations among Western countries and Iran following the termination of the

nuclear deal, the endless military campaign in Yemen and Saudi Arabia's ambitions to halt Iranian influence in the region. A Saudi nuclear program will serve to inflame tensions in the Gulf even more.

Source: <http://www.intpolicydigest.org>, 19 August 2019.

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NUCLEAR ENERGY

INDIA

"Made in India" Written All Over "Little Sun" Being Created in France

he world's best scientists are trying to create a 'miniature Sun' on Earth to tap its fusion energy,

costing over Euro 20 billion and India is a full partner in this mega project. Called The ITER Project or The Path, it has Made in India written all over it. Having committed about Rs. 17,500 crores, Prime Minister Narendra Modi took stock of this mega project on his recently

India, by contributing to about ten per cent of the cost, gets access to one hundred per cent of technology. This is the most expensive mega-science effort India is participating in and globally ITER is the most expensive science project on Earth ever to be undertaken in the 21st century.

concluded trip to France. India, by contributing to about ten per cent of the cost, gets access to one hundred per cent of technology. This is the most expensive mega-science effort India is participating in and globally ITER is the most expensive science project on Earth ever to be undertaken in the 21st century. The total weight of the ITER reactor will be about 28,000 tonnes.

On his visit to France, PM Modi and French President Emmanuel Macron reviewed the ITER project and commended the joint partnership in ITER. Far away in France this team of over one hundred Indians is trying to do the seemingly impossible, tapping the Sun's real energy source to give the world an unlimited supply of clean energy. Being made collaboratively by USA, Russia, South Korea, China, Japan, European Union and India as equal partners or participating in this mega effort are countries that together hold 50 per cent of the world's population accounting for about 85 per cent of the global GDP.

Dr Mark Henderson, a scientist at ITER, said, "This place to me is the coolest place on Earth, because here in the near future we will have a little Sun on Earth and it will be a 150 million degrees Celsius so it will be the hottest place on Earth, ten times hotter than our Sun." He says as per one calculation ten such fusion reactors could power all the energy needs of Italy.

India has contributed the biggest component in the project - the world's largest refrigerator that houses this unique reactor, was made in Gujarat by Larsen & Toubro. It weighs over 3800 tonnes and is almost half the height of the Qutb Minar.

Dr Tim Luce, Chief Scientist at ITER called India "a valuable partner" and said it made key components like the cryostat, which is perhaps one of the biggest thermos bottles in the world. On being asked how much carbon dioxide the main

culprit for global warming would be released from the ITER project Dr Luce quips "only the carbon dioxide the scientists exhale". The radioactive substances generated from reactions would be the sort that can die off in a hundred years. The project is a herculean effort and operations are expected to start by 2025. Later a full scale electricity generating unit called the DEMO reactor is scheduled to be completed by 2040.

Dr Anil Kakodkar wants the DEMO plant in India. "Having done so much on ITER, we should actually prepare ourselves to do the DEMO plant done on Indian soil - an International DEMO plant done on Indian soil - that will enable us to leap frog even faster that's my dream."

Source: <https://www.ndtv.com>, 23 August 2019.

USA

India has contributed the biggest component in the project - the world's largest refrigerator that houses this unique reactor, was made in Gujarat by Larsen & Toubro. It weighs over 3800 tonnes and is almost half the height of the Qutb Minar.

The US Plans to Send Nuclear Reactors to Space

While the nuclear energy industry is struggling to stay afloat in the US, bogged down by public and political mistrust, crushing nuclear waste-

maintenance costs, and a market flooded by cheap natural gas, the country has grand plans for nuclear power outside of its domestic borders. Way outside.

In just a few short years from now, the US will be shipping nuclear reactors to the moon and Mars. According to team members from the Kilopower project, a collaborative venture from NASA and the US Department of Energy, nuclear energy is just a few years from heading into the space age.

"The Kilopower project is a near-term technology effort to develop preliminary concepts and technologies that could be used for an affordable fission nuclear power system to enable long-duration stays on planetary surfaces," says NASA's "Space Technology Mission Directorate." In layman's terms, the focus of the Kilopower project is to use an experimental fission reactor to power crewed outposts on the moon and Mars, allowing researchers and scientists to stay and work for much longer durations of time than is currently possible.

While this may sound like something straight out of a science fiction novel or the Twilight Zone, the Kilopower fission reactor has already passed its initial ground tests with flying colors. Kilopower project lead Patrick McClure says that not only is this project going to become a reality, it will be so in the very near future. In a presentation with NASA's Future In-Space Operations last month McClure said, "I think we could do this in three years and be ready for flight."

NASA's official stance is a bit more conservative, not providing any exact timelines. Its "Space Technology Mission Directorate" simply states that "the Kilopower project team is developing mission concepts and performing additional risk reduction activities to prepare for a possible future flight demonstration," adding that the potential of this demonstration would be to "pave the way for future Kilopower systems that power human outposts on the Moon and Mars, enabling mission operations in harsh environments and missions that rely on In-situ Resource Utilization to produce local propellants and other materials."

While this is not the first time that nuclear energy is being used to power pursuits into the final frontier, the Kilopower project is a much more ambitious and powerful project than any of its predecessors. According to Space.com, "nuclear energy has been powering spacecraft for decades.

NASA's Voyager 1 and Voyager 2 probes, New Horizons spacecraft, and Curiosity Mars rover, along with many other robotic explorers, employ radioisotope thermoelectric generators (RTGs), which convert the heat thrown off by the radioactive decay of plutonium-238 into electricity."

This model, however, would not produce nearly enough energy to power an entire crewed outpost on Mars or the moon, which will have much more significant energy needs. "The power output from

RTGs is relatively low. The one used by Curiosity and NASA's upcoming Mars 2020 rover, for example, generates about 110 watts of electricity at the start of a mission. (This output declines slowly over time.)"

By contrast, the Kilopower prototype is a much more powerful energy source. Futurism reports that

"Kilopower's prototype is about the size of a fridge and fits into a rocket. It could provide a base with around 40 kilowatts of power — roughly enough electricity for eight houses on Earth." The Kilopower prototype is also much more efficient. In last year's KRUSTY (Kilopower Reactor Using Stirling Technology) ground tests, the prototype reactor "converted 30 percent of fission heat into electricity," reports Space.com. "This efficiency dwarfs that of RTGs, which convert about 7 percent of available heat."

If the Kilopower's first in-space tests do indeed launch within the next three years, and if they prove successful, it would usher in an entirely new era for space research, innovation, and industry. The ability to put humans in space for longer durations of time and power larger and more ambitious projects than ever before will bust open the door to countless pursuits that have been purely imaginative until now, making what is already a \$400 billion dollar space industry truly take off.

Source: <http://www.oilprice.com>, 17 August 2019.

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URANIUM PRODUCTION

AUSTRALIA

Australia Considers Lifting its Nuclear Energy Ban

Australia has been historically opposed to nuclear energy - on their own land, that is. While the nuclear option has long been dismissed in the land down under and was officially banned in 2009 in reaction to Japan's Fukushima nuclear disaster, Australia also has a long history of capitalizing on the global nuclear industry as a whole. Last year the country exported over 7,000 metric tons of uranium, earning Australia nearly \$600 million Australian dollars (\$407 million US dollars).

As the Australian edition of *The Conversation* points out, "This uranium produced nearly as much energy as Australia uses in a year, but with less than 10 percent of the carbon dioxide from coal-fired power stations." The comparison to coal is an important one, as Australia's economy itself is coal-fired. According to the Australian

While Australia has doubled down on its current and future coal production, it is also one of the world's largest exporters of uranium, and risks sowing the seeds of serious diplomatic trouble with their Pacific Island neighbors if they don't begin to clean up their carbon act in a hurry. It's therefore unsurprising that there are many proponents of bringing nuclear into Australia's domestic energy mix.

government's own statistics, "Australia is the world's largest exporter of coal. Coal accounts for more than half of Australia's energy exports." The government page "Australia's Energy Production, Consumption and Exports" goes on to say that, "Australia's primary energy consumption is dominated by coal (around 40 percent), oil (34 percent) and gas (22 percent). Coal accounts for about 75 per cent of Australia's electricity generation, followed by gas (16 percent), hydro (5 percent) and wind around (2 percent)."

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therefore unsurprising that there are many proponents of bringing nuclear into Australia's domestic energy mix, and after many years it seems that the nuclear option may finally be back on the legislative table.

In fact, Australia is on the verge of conducting a parliamentary inquiry into the viability of developing a nuclear energy program on Australian soil. A statement by Queensland Liberal National parliamentarian and The Standing Committee on Environment and Energy leader Ted O'Brien, head of the standing committee on environment and energy said that, "this inquiry will provide the opportunity to establish whether nuclear energy would be feasible and suitable for Australia in the future, taking into account both expert opinions and community views."

While political and public opinion of nuclear energy is shifting in Australia, however, there is still more opposition than support of the initiative, with the vast majority of Australians taking a "not in my backyard" approach to the issue. As the Asia Times reports, "a recent survey by

pollster Essential showed community views are increasingly in favor, but still fall below 50 percent. However, when respondents were asked to consider a reactor being built close to their homes, property-obsessed Australians voted 'no' at a rate of 78 percent, the poll showed."

While opposition to nuclear power has long been one of the very, very few bipartisan bits of common ground in Australia, times are changing, and so is nuclear power. The means of nuclear power production themselves have evolved considerably over the last decade, making nuclear cheaper and safer than ever before. In Australia, "the renewed interest [in nuclear energy] is being spurred by Minister for Energy and Emissions Reductions Angus Taylor's enthusiasm for newfangled small modular reactors (SMRs), which are cheaper,

allegedly safer and use less water," says the Asia Times. "Those reactor-types will be a focus of the upcoming parliamentary inquiry. British engineering company Rolls Royce, for one, is leading a UK consortium involved in developing SMRs aimed at producing affordable energy with a lower carbon footprint."

While nuclear seems to be going the way of the dodo in the US (thanks to public and political mistrust not unlike in Australia, astronomical nuclear waste-maintenance costs, and a hyper-competitive energy market flooded by cheap natural gas) Australia will not be an outlier if they decide to embrace nuclear energy.

While nuclear seems to be going the way of the dodo in the US (thanks to public and political mistrust not unlike in Australia, astronomical nuclear waste-maintenance costs, and a hyper-competitive energy market flooded by cheap natural gas) Australia will not be an outlier if they decide to embrace nuclear energy. In fact, far from it. The rest of the world, Russia and China in particular, are all leaning into nuclear energy as one of the most powerful, efficient, and green options for a carbon-choked planet with ever-expanding energy demands. Despite its many drawbacks, it's becoming the common sentiment in the international community that nuclear is simply the best of our bad options.

Globally, interest and advances in small modular and advanced reactors are growing rapidly. The CNSC and the US NRC are working together as regulatory leaders to ensure the development and deployment of these innovative technologies are done safely and efficiently.

Source: <http://www.investingnews.com>, 17 August 2019.

NUCLEAR COOPERATION

INDIA-FRANCE

India, France Sign MoU, Release Joint Statement

PM Modi and Emmanuel Macron expressed satisfaction at the progress in negotiations between NPCIL and EDF since the conclusion of the Industrial Way Forward Agreement between the two parties in 2018 for the construction of six nuclear power reactors in India in Jaitapur, Maharashtra.

The leaders also noted that discussions are underway on the Techno-Commercial Offer and the financing of the project as well as on how to increase localization through manufacturing in India and enhance common understanding on the CLND Act between the two sides.

Both the nations reaffirmed that they were resolved to actively pursue discussions for their early conclusion. They also welcomed the extension of the MoU between the DAE and the French Alternative Energies and Atomic Energy Commission (CEA) concerning cooperation with the GCNEP in January 2019 for another five years, the signing of the Implementing Agreement between the BARC and the CEA on the safety of LWR in September 2018. ...

Source: <http://www.jagranjosh.com>, 24 August 2019.

USA-CANADA

US, Canada to Work Together to Develop Nuclear Technologies

The US Nuclear Regulatory Commission (NRC) and the Canadian Nuclear Safety Commission (CNSC) signed an agreement to collaborate on the technical reviews of advanced reactor and small modular reactor technologies.

The agreement represents a key step in both countries' commitment to a more effective and timely analysis of technologies. This is the first agreement of its kind between the US and Canadian regulators on matters related to nuclear power development.

"Globally, interest and advances in small modular and advanced reactors are growing rapidly. The CNSC and the US NRC are working together as regulatory leaders to ensure the development and deployment of these innovative technologies are done safely and efficiently," CNSC President and CEO Rumina Velshi said. "The signing of this memorandum further strengthens our long-

standing history of collaboration with our US counterparts and ensures the effectiveness and efficiency of our regulatory oversight for the future." Both the NRC and CNSC will work under a previously established steering committee to begin developing the infrastructure needed to evaluate opportunities and best practices in the analysis of advanced reactor and small modular reactor designs.

Source: <http://www.dailyenergyinsider.com>, 19 August 2019.

NUCLEAR SECURITY

MADAGASCAR

IAEA Completes Nuclear Security Advisory Mission in Madagascar

An IAEA team of experts completed a nuclear security advisory mission in Madagascar, which was carried out at the request of the Government of Madagascar. The scope of the two-week International Physical Protection Advisory Service (IPPAS) mission included the legal and regulatory framework for the security of radioactive sources and facilities, including during transport as well as coordination among authorities and other stakeholders involved in nuclear security. As part of the review, the team visited a storage facility for radioactive sources operated by the National Institute of Nuclear Sciences and Techniques (INSTN-Madagascar), medical facilities with radioactive sources, a radioisotope laboratory, and a mine that uses radioactive sources.

The team observed that Madagascar has established a nuclear security regime that incorporates essential elements of the IAEA's guidance on the fundamentals of nuclear security. The team provided recommendations and suggestions to support Madagascar in further

enhancing and sustaining nuclear security. Good practices were identified that can serve as examples to other IAEA Member States to help strengthen their nuclear security activities.

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The team was led by Raphael Duguay, Team Leader of Nuclear Security at the Canadian Nuclear Safety Commission, and included five other experts from Burkina Faso, the Democratic Republic of Congo, Senegal, the US and the IAEA. The team met in the capital Antananarivo

with officials from the Ministry of Mines and Strategic Resources, the Ministry of Transport, Tourism and Meteorology, the Ministry of National Defence, the Ministry of Health, Customs Department, the Civil Protection Corps, the Fire Brigade, the National Office for Risks and Disaster (BNGRC), the Police, the Gendarmerie and the INSTN-Madagascar.

"This is the first IPPAS mission in Madagascar, an important partner of the IAEA. Hosting an IPPAS mission demonstrates strong commitment of the Government of Madagascar to nuclear security and its continued enhancement," said Kristof Horvath, Senior Nuclear Security Officer at the IAEA.

IPPAS missions are intended to assist States in strengthening their national nuclear security regime. The missions provide peer advice on implementing international instruments, along with IAEA guidance on the protection of nuclear and other radioactive material and associated facilities.

"The IPPAS outcome will be incorporated in Madagascar's Integrated Nuclear Security Support Plan," said Dr Joseph Lucien R. Zafimanjato, on behalf of the Director General of the National Institute of Nuclear Sciences and Techniques.

"The mission's recommendations and suggestions will be implemented in a timely manner, contributing to a more secure Madagascar."

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and other radioactive material and associated facilities.

During missions, a team of international experts observes a nation's nuclear security systems and measures, compares them with IAEA Nuclear Security Series guidance and international good practices, and makes recommendations for improvement. IPPAS missions are conducted both on a nationwide and facility-specific basis.

Source: <http://www.iaea.org>, 23 August 2019.

NUCLEAR PROLIFERATION

IRAN

Top Iranian Official: We Should Never Have Signed Obama-Era Nuclear Deal

In an interview with Lester Holt of NBC News, the official, Ali Shamkhani, who rarely speaks to the Western press, said that there were people in Iran who felt that signing the 2015 nuclear pact, known as the JCPOA, was a mistake. Asked by Holt if he was one of those people, Shamkhani said, "Yes. ... I'm just following the viewpoints of my nation, the people of Iran."

Shamkhani is the military adviser to Supreme Leader and since 2013, has also been the secretary of the Supreme National Security Council, making him Iran's top national security official. A former anti-Shah militant and Revolutionary Guard who once commanded Iran's naval forces, he previously served as minister of defense and mounted an unsuccessful campaign for Iran's presidency in 2001.

In his interview with Holt, who is anchoring "NBC Nightly News" from Tehran, Shamkhani painted the US as the aggressor and prime source of tension in the region and warned the US to "act with wisdom." He said the Trump administration's "maximum pressure" campaign against Iran would not bring Iran to heel or bring it back to the nuclear

negotiating table. "The sanctions campaign is not for negotiation, it's for making us surrender," said Shamkhani. "As long as this approach is taken by the US, Iran will never ever seek negotiations."

In 2015, after nearly two years of talks, the Obama administration joined China, Russia and the European powers in signing the JCPOA deal with Iran, an agreement in which Iran accepted limits on its nuclear program. The Trump administration officially withdrew from the deal in 2018. Said Shamkhani: "We had a case of successful negotiations with the JCPOA. How come the US departed from it?" Shamkhani said the Iranian public has long dealt with international sanctions and proof of the failure of Trump administration policy was obvious in the mood on the street.

He denied Iran is seeking nuclear weapons, since he said they are forbidden under Islam and have not provided security to those who have them, like Israel. He also denied that he had a "military wish" for Israel's destruction, saying the Palestinian people would decide Israel's fate. To the Iranians, said Shamkhani, Trump seems to want the

same things as all his predecessors as US president, which is to diminish Iran's influence. But Trump, said Shamkhani, managed to forfeit the "achievement" of "neutralizing Iranian nuclear technology" by gutting the JCPOA. "There is no doubt that the already tarnished image of the US will be even further destroyed in the region and the whole world. Why do they basically threaten to launch a war against us?"

Source: <http://www.nbcnews.com>, 19 August 2019.

NORTH KOREA

North Korea Now Able to Miniaturise Nuclear Warheads

Japan's government will reportedly state that North Korea is capable of miniaturising nuclear warheads in a forthcoming defence report, it has

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emerged. Tokyo will upgrade its estimate of the regime's nuclear capability, having said last year only that the technical feat was a possibility, the conservative *Yomiuri Shimbun* newspaper said without citing sources.

The defence report will maintain Japan's contention that North Korea's nuclear and ballistic missile programmes pose a "serious and imminent threat" to its security after recent meetings between Donald Trump and the North's leader, Kim Jong-un, failed to make progress on denuclearisation.

The report is expected to receive cabinet approval in mid-September, the *Yomiuri* said. North Korea has conducted six rounds of short-range missile launches in recent weeks, in an apparent attempt to pressure Washington into making concessions in any future talks over Pyongyang's nuclear weapons programme.

North Korea's state KCNA news agency said the most recent launch was in protest at joint US-South Korea defence drills that the regime claims are a rehearsal for an invasion. The latest drills, named called 19-2 Dong Maeng, began on 5 August. KCNA said Kim had overseen the launch of the unspecified "new weapon" and expressed "great satisfaction" over his military's "mysterious and amazing success rates" in recent testing activity. "It is our party's goal ... to possess invincible military capabilities no one dare provoke, and to keep bolstering them," it quoted Kim as saying.

Earlier this year a report by the Rand Corporation, a California-based think tank with close ties to the US military, said North Korea could possess as many as 100 nuclear warheads by 2020. "North Korea's ongoing development of nuclear weapons and ballistic missiles increases the possibility of

their use against regional states, furthering instability across the region and beyond, thus affecting vital US interests," the report said.

In 2017, a leaked US intelligence assessment concluded that North Korea had developed the technology to produce nuclear warheads small enough to fit inside missiles, theoretically giving it the ability to send nuclear-armed ICBMs to distant targets, including the US mainland.

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North Korea's short- and medium-range missiles can strike South Korea and Japan, including US military assets in those countries. "The IC [intelligence community] assesses North Korea has produced nuclear weapons for ballistic missile delivery, to include delivery by ICBM-class missiles," the assessment said, according to the *Washington Post*.

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In last year's defence white paper, Japan said North Korean nuclear weapons and missiles posed an "unprecedented serious and imminent threat" to its security, adding that the security environment around Japan

had become "increasingly severe", despite dialogue between Washington and Pyongyang.

Source: <http://www.theguardian.com>, 21 August 2019.

NUCLEAR DISARMAMENT

SOUTH AFRICA

S. Africa Reiterates Commitment to Multilateralism, UN-Led Endeavor in Solving Disarmament Challenge

South Africa reiterated its commitment to multilateralism and the centrality of the UN in solving today's challenges including that of

nuclear disarmament. Speaking at the UN Security Council meeting on "Threats to International Peace and Security," Jerry Matjila, permanent representative of South Africa to the UN, said "South Africa's primary concern on matters of international peace and security is the threat posed to humanity by weapons of mass destruction, particularly nuclear weapons and their means of delivery." "It is our firm view that the only guarantee against the intended or accidental detonation of these weapons is their total elimination," Matjila said.

South Africa's primary concern on matters of international peace and security is the threat posed to humanity by weapons of mass destruction, particularly nuclear weapons and their means of delivery." "It is our firm view that the only guarantee against the intended or accidental detonation of these weapons is their total elimination.

It is equally concerning that some Nuclear Weapons States still insist on the modernization of their nuclear arsenals and their means of delivery in flagrant violation of the letter and spirit of the NPT, he said. "It is indeed deeply troubling that a long-established arms control instrument such as the INF Treaty has unravelled, placing not only the region of Europe but the whole world at risk of a nuclear war," the South African diplomat said, adding that his country also wishes to use this timely opportunity to urge both the US and Russia to resume discussions on the New START Treaty before the Treaty expires in 2021. Such an undertaking by the two premier nuclear powers would be an appropriate and a fitting tribute to the NPT, whose 50th Anniversary we mark in 2020, he said.

As the international community will be commemorating the International Day for the Total Elimination of Nuclear Weapons on September 26 this year, let it serve as a constant and painful reminder to the

international community of its unfulfilled commitments and obligations to eliminate nuclear weapons, as envisaged in the very first resolution adopted by the General Assembly in 1946, Matjila said.

"As we approach the 75th anniversary of the United Nations in 2020, it is our view that we should reflect deeply and reaffirm our commitment towards the realization of a world free of

nuclear weapons," he said. South Africa joins the majority of member states in voicing deepest concern regarding the humanitarian consequences of nuclear weapons as aptly outlined in the Treaty on Prohibition of Nuclear Weapons (TPNW) which opened for signature on September 20, 2017, he said.

Source: <http://www.xinhua.net>, 23 August 2019.

NUCLEAR SAFETY

EUROPE

18 Nuclear Power Plants in the EU are Operating without a Valid License

There are 18 active nuclear power plants currently operating without a valid license in the European Union, according to a report seen by *Business Insider*. Many of the power plants should have already been subject to an Environmental Impact Assessment (EIA), according to a report put together by Germany's Green Party member and nuclear expert Sylvia Kotting-Uhl. An EIA aims to

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identify the environmental consequences of major projects, such as the construction of an airport,

and has proposed some lesser damaging alternatives.

Some of the EU countries running the illegal power plants include the Netherlands, Bulgaria, Ukraine, Belgium, Finland, the UK, Sweden, and Switzerland. The number does not take into account the 34 other illegal nuclear power plants in neighboring European countries that aren't part of the EU.

If these power stations were to fail an EIA following the publication of this report, the EU countries in charge will be facing serious consequences, according to German publication the Spiegel. In France alone, there are 58 pressurized water reactors, which produce over 70% of the country's electricity. Many of them are classified as "high-risk reactors" because they are more than 30 years old. The recommended operating age of a nuclear power plant is 40 years. Should these specific reactors fail the EIA, France would most likely have to temporarily shut down the power plant concerned and buy electricity elsewhere — possibly even from Germany.

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Another nuclear power plant at the Mühleberg site in Switzerland has also been classified as particularly dangerous by an Austrian environmental protection organization called "Global2000". Not only is it a "high-risk reactor", but it's also the same power plant as Fukushima—the Japanese reactor which had a nuclear disaster in 2011. "In the event of a rupture of the nearby dam and consequent flooding, all pumps of this power plant could fail. This would lead to a core meltdown, one similar to the one seen in Fukushima," the environmental protection organization wrote in a report. The Mühleberg power plant will be shut down in December 2019.

The German government announced that it had no specific knowledge of "which European plants are currently operating without a (transboundary) EIA", according to the SPIEGEL. The UN Committee responsible for these investigations is currently examining several nuclear reactors which are said to have been approved in Europe without an EIA.

Source: Sophia Ankel and Alexandra Hilpert, Business Insider Deutschland, 25 August 2019.

JAPAN

Japan may Decommission Reactors at World's Biggest Nuclear Plant

Japan's Tokyo Electric Power Company (Tepco) said it may start to decommission at least one nuclear reactor at its Kashiwazaki-Kariwa power plant, the world's biggest nuclear plant by capacity, within five years of restarting two of the reactors at the site. Tepco President Tomoaki Kobayakawa made the comments in a statement outlining its response to a request for plans on the station's future by the government of the city of Kashiwazaki in Niigata prefecture, where the plant is located.

In 2017, Tepco received initial regulatory approval from the Japanese government to restart reactors 6 and 7 at Kashiwazaki-Kariwa, each with a capacity of 1,356 megawatts (MW). The plant site has seven reactors with a total capacity of 8,212MW, equal to 20 percent of Japan's nuclear capacity. The facility is Tepco's last remaining nuclear plant after it announced plans to shut its Fukushima Daini station, near the Fukushima Daichi plant where a massive earthquake and tsunami caused the meltdown of three of the site's reactors in 2011.

Kashiwazaki's Mayor Masahiro Sakurai demanded

in 2017 that Tepco submit plans to shut at least one of reactors 1 to 5 in return for approval of the restart of reactors 6 and 7, a city official told the Reuters news agency by phone. The Kashiwazaki mayor will take about a month to evaluate Tepco's plan, the official said.

Tepco said that Kobayakawa would brief local officials about its answers to the city's request. Tepco may take steps to decommission more than one of reactors 1 to 5 within five years after the restart of reactors 6 and 7 if it is confident it can secure enough non-fossil fuel energy sources, according to the statement. A Tepco official said the company is aiming to have renewable and nuclear power produce 44 percent of total output by 2030.

Tepco has been trying to convince local authorities near Kashiwazaki-Kariwa, who have sign-off rights on nuclear restarts, that it has overcome operational failings revealed at Fukushima. Eight years ago, nearly 20,000 people died in an earthquake and tsunami that precipitated what became Japan's worst nuclear disaster. At least 160,000 people were forced to leave their contaminated homes. In April, Japan partially lifted an evacuation order in one of the two towns, Okuma, for the first time since the disaster, but many former residents are still reluctant to return. The other town, Futaba, remains off-limits, as are several other towns nearby.

Source: <https://www.aljazeera.com/>, 26 August 2019.

RUSSIA

'Nuclear-Powered' Missile Accident in Russia – What Really Happened?

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A missile engine exploded at a naval test range, west of the city of Severodvinsk on Russia's northern coast at 9am on August 8. At least five people were killed and several others injured. As it is associated with Russia's defence programme, the incident is shrouded in mystery. But shortly after the explosion

the state weather monitoring agency, Roshydromet, reported a spike in radiation 40 km away.

At first, the Russian authorities denied the radiation leak, then later confirmed it. There were conflicting reports of the source of the explosion and a planned, then later cancelled evacuation of a nearby village. Unsurprisingly, tabloid media speculation followed that the Russian authorities may be hiding a Chernobyl-like accident.

Russian authorities have confirmed that the explosion involved "an isotope power source in a liquid propulsion system". There's nothing particularly new about the propulsion system – early ballistic missiles used a pressurised stream of liquid fuel and oxygen which, when ignited, expanded and rushed out of the bottom of the missile, propelling it in the opposite direction.

Missile tests don't usually involve radioactive materials, unless the missile in question is carrying a nuclear warhead (which is prohibited under the UN's Treaty on the Non-Proliferation of Nuclear Weapons). So what is going on? No one outside

of the Russian government and military can yet be entirely certain but, as an academic researcher in nuclear materials, I can do my best to piece together the available evidence.

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of liquid fuel and oxygen which, when ignited, expanded and rushed out of the bottom of the missile, propelling it in the opposite direction.

The “isotope power source” part is new though. Radioactive isotopes are unstable atoms that release excess energy by emitting radiation. So if the missile is powered by isotopes this indicates the Russians have developed a mini-nuclear reactor – able to fit inside a missile – that is capable of using radiation to heat the liquid fuel for propulsion. This has never been achieved before.

This admission prompted American and UK experts to conclude the source of the radiation leak must be a type of long-range missile that Russia has previously claimed would be nuclear powered. It is known by the Russians as 9M730 Burevestnik, and by NATO as the SCC-X-9 Skyfall.

The exact details of the mini-nuclear reactor that may have been developed to power a Russian missile are not known, but there are a few potential types that may be used. The key difference between a nuclear reactor used to generate energy and one that might be used to power a missile is the quantity of material required. The RBMK reactor that blew up at Chernobyl contained 200 tonnes of uranium dioxide fuel. A significantly smaller amount of fuel would be required — perhaps a few kilos at most — to lift a missile.

One possibility is what’s known as a radioisotope thermoelectric generator (RTG). This converts heat from radioactive decay into electricity. Potential candidates for the fuel are plutonium-238, 4.8kg of which powered the Curiosity Rover on Mars, americium-241 – widely used to power smoke detectors – and polonium-210, infamously used in the poisoning of Russian spy Alexander Litvinenko. Strontium-90, which emits both beta and gamma radiation in its radioactive decay, has

been used in both American and Russian applications of RTGs in the past, including inside Russian lighthouses. Given the measured increase in gamma activity at nearby Severodvinsk, the latter is certainly plausible.

The second possibility is that the missile was powered by a nuclear thermal reactor. This is perhaps more likely given the authorities’ description of the accident. These reactors could use the heat generated from radioactive decay to heat liquid hydrogen fuel. Such a system could theoretically use a solid uranium core, a liquid radioisotope core, or even gaseous uranium to power a missile in flight for long distances.

However, none of these technologies have been proven, at least with regard to missiles, and it is not possible to guess the fuel type with any certainty, making the radiation in Severodvinsk difficult to explain.

Whatever the source of radiation, the release seems to be relatively small. To the layperson, 16 times above background rate may sound like a lot, but that background rate is tiny and relatively harmless – for instance the English county of Cornwall has three times the background rate thanks to naturally-occurring uranium-bearing rocks in the earth there. Compare this with the Chernobyl accident, which released radioactivity 7,000 times above background.

Norwegian and Finnish authorities are monitoring the air but have not yet reported anything abnormal. Western scientists are even asking residents of Severodvinsk to donate their car air filters, so that, at some point, we may understand more about what was released and how harmful it might be. That should give some indication as to the threat posed by the testing of such weapons.

Source: <http://www.theconversation.com>, 19 August 2019.

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After a String of Nuclear Incidents, Russia Just Launched a Floating Nuclear Power Plant. Is It Safe?

On 24 August, an unusual kind of vessel set sail from the Arctic city of Murmansk, Russia, for a destination in the country's far east—a floating nuclear power plant equipped with two reactors.

The vessel, dubbed the Akademik Lomonosov, is set to travel about 2,900 miles to the Arctic port town of Pevek, which has a population of about 4,000 people, where it will be loaded with nuclear fuel and put in place to provide power to the region, according to Russia's state nuclear corporation, ROSATOM.

Russia's far east may just be the beginning. ROSATOM has said that it's in talks with potential customers for the floating power unit, and sees "significant market potential" in Southeast Asia, Latin America and Africa. The vessel's reactors can generate 70 megawatts of electric power and 50 gigacalories an hour of heat energy, according to ROSATOM—enough to support a city of up to 100,00 people.

Why are people worried about the floating nuclear power plant?

However, the vessel has sparked concerns about safety as a result of Russia's tarnished nuclear record. Just this summer, there were two deadly accidents involving Russian nuclear power. On July 1, 14 sailors were killed in a fire on the secretive Losharik nuclear submarine; then on Aug. 8, five scientists were killed when a missile test on Russia's White Sea failed.

The Kursk nuclear submarine sank on the Barents Sea on Aug. 12, 2000, killing 118 people on board, and scientists have recent found that an nuclear

sub that sank in the Barents Sea, the Komsomolets—which was lost in 1989—is emitting high levels of radiation.

Then there's Chernobyl, the 1986 nuclear power station meltdown in the former Soviet Union that is perhaps the biggest and most famous civil nuclear disaster in history. It exposed potentially hundreds of thousands of people to radiation.

A high-profile HBO series, Chernobyl, has renewed attention on the devastating consequences of a nuclear accident—and

the potential of political machinations that can get in the way of public safety.

Environmental activist group Greenpeace has publicly raised concerns about the Russian nuclear power vessel. In an April blog post titled, "The next Chernobyl may happen in the Arctic," Konstantin Fomin of Greenpeace called for the program to be brought to a halt. "This is an example of how new technologies are put into use without reflection on their safety," Fomin wrote, adding, "Greenpeace demands the abandonment of expensive and dangerous atomic energy."

ROSATOM insists that the vessel is designed to be safe, and will not harm the environment, writing in a statement that the vessel "is designed with a great margin of safety that exceeds all possible threats and makes nuclear reactors invincible for tsunamis and other natural disasters."

News in Russia has mainly emphasized that that the technology is new and innovative, and that it could help to provide power to remote parts of the country. "This is an absolute breakthrough in small nuclear power," said Pavel Ipatov, the

ROSATOM has said that it's in talks with potential customers for the floating power unit, and sees "significant market potential" in Southeast Asia, Latin America and Africa. The vessel's reactors can generate 70 megawatts of electric power and 50 gigacalories an hour of heat energy, according to ROSATOM—enough to support a city of up to 100,00 people.

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director of special projects for a section of ROSATOM's nuclear power subsidiary, according to Russian news service Vesti.ru. "Russia is the first country which has gotten this technology. It has very good prospects."

Is it Actually Safe? In fact, putting nuclear reactors on ships is not new. Nuclear reactors have been placed on ships, including to provide propulsion, for more than 50 years. A World War II-era cargo ship, the SS Charles H. Cogle, was converted into a nuclear power plant in the 1960s. It was used to provide the U.S. Army with power. The vessel was stationed at the Panama Canal Zone from 1968 to 1976, according to the U.S. Army Corps of Engineers.

Robert Bean, an associate professor of nuclear engineering at Purdue University, tells *TIME* that there is a different set of concerns for nuclear reactors at sea than for reactors on land. Reactors at sea must be protected from storms, and have differing security concerns because they can be approached by other ships.

However, says Bean, the Russians are employing a type of reactor that has been used for a long time on its ice-breaking ships—the KLT-40S—and will be similar to the design of reactors the Russians use in submarines. Bean says that the design is very similar other reactors used around the world.

"I don't see any reason why it's less safe," said Bean. "At first look you go, whoa, it's different. And that's my point—it's different, but I don't think that means it's less safe." "It's always possible that such a thing could happen. However, every reactor is designed to try to prevent that, the procedures are all designed to try to prevent that and when it does happen—for example Fukushima—the very first thing once it was dealt with, every other reactor in the world looked a

their design and said, what could we change, how would we make sure this never happens to us?"

Steven Biegalski, the Chair of Nuclear and Radiological Engineering and Medical Physics Program at Georgia Institute of Technology, tells *TIME* that whether a nuclear reactor is kept on a boat or on land, the priority is the same—making sure that the core is kept cool if it's shut down. "The nice thing is that if you submerge the whole reactor system, including the reactor vessel, under water, it's going to get as much cooling as

you can possibly want," Biegalski says. "If you put the reactor core in an Arctic Ocean off the coast of Russia, would probably provide enough of a cooling sink that you don't have to worry about the reactor concerns."

What is the Biggest Concern?

However, Biegalski tells *TIME* that if there's a reason to be concerned about the reactor, it's because Russia hasn't been open about its

nuclear program and past accidents. "It's not a new concept, it's something that has been done in the past, and if done correctly can be done very safely and without concerns," Biegalski says. "I will say that I am concerned currently about Russia's transparency." While he emphasizes that the design of the reactor is very different than the Chernobyl reactor, he's concerned that Russia didn't learn a big lesson after the 1986 disaster—that failing to notify the international community quickly was "irresponsible." ...

Source: Tara Law, <https://time.com/5659769/russia-floating-nuclear-power/>, 25 August 2019.

NUCLEAR WASTE MANAGEMENT

RUSSIA

Last Cold War Reactor Lifted Onshore

On the night of 08 August 2019, the last of 120 reactor compartments from Cold War submarines

SevRAO, the northern branch of Russia's State radioactive waste management company, informs that bringing the last reactors onshore improves the environmental situation in the Barents Sea. The compartment, holding two reactors, origin from one of the larger nuclear powered submarines of the Northern Fleet. It will now be prepared for long-term storage at the huge pad in Saida Bay which from before holds at least 116 reactor compartments.

was docked and brought safely into the storage pad in Saida Bay on the Kola Peninsula. SevRAO, the northern branch of Russia's State radioactive waste management company, informs that bringing the last reactors onshore improves the environmental situation in the Barents Sea. The compartment, holding two reactors, origin from one of the larger nuclear powered submarines of the Northern Fleet. It will now be prepared for long-term storage at the huge pad in Saida Bay

which from before holds at least 116 reactor compartments. Most Soviet-built nuclear-powered submarines had two reactors each, bringing the total reactors stored at the site up to nearly 200.

Kursk Submarine: Last year, RosRao's Chief Engineer said the very last reactor compartment to be taken onshore would be the one from the Kursk submarine that sank in the Barents Sea in August 2000 during a naval exercise. The submarine was lifted from the seabed two years later and the remaining parts of the hull were scrapped. It is, however, only known that the Kursk compartment became one of the last of the three remaining reactor compartments that were stored on waters just outside the facility.

A satellite photo from last summer shows that the storage pad in Saida Bay soon is filled to capacity. Although the spent nuclear fuel elements are removed, the reactor itself is radioactive and has to be treated with special care to avoid leakages to the environment. When floating, one fear was to see the reactors sink and being flooded with water. The process of scrapping the 120 nuclear-powered submarines that sailed out from bases on the Kola Peninsula during the Cold War started in the early 1990 and has technically and economically been supported by a wide range of

countries, including Norway and the European Union.

The storage site in Saida Bay is financed by Germany as part of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. Italy has paid for the floating dock that brings the reactor-compartments from the waters to the site. Additional to reactors from military submarines, the site will

also hold icebreaker reactors and radioactive sections from military and civilian service vessels, like the Lepse and the icebreakers Sibir and Arktika. The reactor compartments will have to be stored for onshore for many decades before the radioactivity have come down to levels acceptable for cutting the reactors' metal up and pack it for final geological disposal.

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According to the list there are 39 nuclear-powered vessels or installations in the Russian Arctic today with a total of 62 reactors. This includes 31 submarines, one surface warship, five icebreakers, two onshore and one floating nuclear power plants.

Many New Submarines: While the old submarines are scrapped, Russia is today building more nuclear-powered vessels than ever before since the end of the Cold War. The Barents Observer has recently published an

overview listing the increasing number of reactors in the Russian Arctic. The paper is part of Barents Observer's analytical popular science studies on developments in the Euro-Arctic Region. According to the list there are 39 nuclear-powered vessels or installations in the Russian Arctic today with a total of 62 reactors. This includes 31 submarines, one surface warship, five icebreakers, two onshore and one floating nuclear power plants.

Looking 15 years ahead, the number of ships, including submarines, and installations powered by reactors is estimated to increase to 74 with a total of 94 reactors, maybe as many as 114. Additional to new icebreakers and submarines

already under construction, Russia is brushing dust of older Soviet ideas of utilizing nuclear-power for different kind of Arctic shelf industrial developments, like oil- and gas exploration, mining and research. "By 2035, the Russian Arctic will be the most nuclearized waters on the planet," the paper reads.

Also, existing icebreakers and submarines get life-time prolongation. The average age of the Northern Fleet's nuclear-powered submarines has never been older than today. Several of the submarines built in the 1980s will continue to sail the Barents Sea and under the Arctic ice-cap until the late 2020s.

Source: <http://www.thebarentsobserver.com>, 19 August 2019.



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