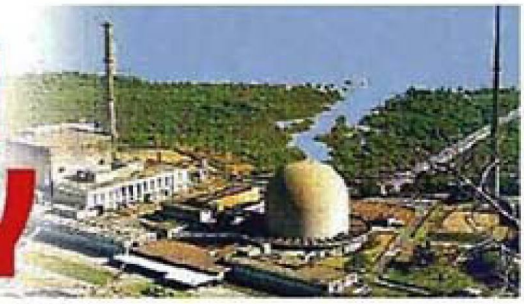
NUCLEAR SECURITY



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

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OPINION – Corey Hinderstein

How Quickly Could Iran Get a Nuclear Bomb?

On Sunday [5th Jan], Iran updated its public stance toward the nuclear limits it accepted in 2015 as part of the Joint Comprehensive Plan of Action, or JCPOA. "Iran's nuclear program no longer faces any operational restrictions, including enrichment capacity, percentage of enrichment, amount of enriched material, and research and development," its official statement said. This announcement was greeted with the expected questions:

Is Iran rushing to a nuclear bomb? How quickly could Iran get enough material for a bomb, often referred to as "breakout time"? To understand breakout time, and why it matters that Iran is no longer observing these limits, you must first understand uranium enrichment. Sure, give me Uranium Enrichment 101.

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In its natural state, uranium contains less than 1 percent U235, the type of uranium that fuels a nuclear explosion. Enrichment produces one output stream in which the U235 level is higher than in the natural state ("enriched") and another in which the U235 level is lower ("depleted"). The fuel for nuclear power plants usually contains about 3 to 5 percent U235. Uranium is considered highly enriched, or HEU, above 20 percent, and weapons-grade uranium normally refers to material that is at least 90 percent U235. The same equipment that enriches uranium to 5 percent will take it to 90 percent; it is just a question of how it is operated. Gas centrifuges are the most common technology used to enrich uranium, including by Iran.

Okay, I Get it. So what is Breakout Time? The amount of time it would take a country to produce enough nuclear material for its first nuclear weapon. It doesn't include the time it would take to design, manufacture, or assemble the bomb's components or the nuclear weapon itself. Producing the nuclear explosive material is the

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long pole in the tent for producing a weapon, which is why it is so closely scrutinized.

How is Breakout Time Calculated? The calculations depend on how much uranium is available, in what form, its enrichment level, and the number and type of gas centrifuges available. One can picture these variables like sliders on different bars. If all go up (more material, at higher enrichment levels, with more installed centrifuges) then breakout time goes down. If they all decrease, breakout time grows. If you want to hold breakout time steady, you can move some up and others down (for example, allow more stockpiled material but reduce the number of centrifuges).

The amount of time it would take a country to produce enough nuclear material for its first nuclear weapon. It doesn't include the time it would take to design, manufacture, or assemble the bomb's components or the nuclear weapon itself. Producing the nuclear explosive material is the long pole in the tent for producing a weapon, which is why it is so closely scrutinized.

The calculations also assume the use of all available material and technology. If Iran were to try to produce material using only secret sites that are not under UN monitoring, breakout time would be much longer.

At the beginning of the JCPOA negotiation, Iran's breakout time was unacceptably short: on the order of weeks. The guidance to the U.S. negotiators was to seek a deal that would push that breakout time to one year, and keep it there for a decade or more. The negotiators accomplished this through a combination of limits on Iran's enriched uranium stockpile (300 kg), the enrichment level (no more than 3.67 percent) and the number of centrifuges (5,060) which were limited to their first-generation (least capable) design. This marked a significant change from the pre-JCPOA situation: 12,000 kg uranium enriched to as high as nearly 20 percent and 19,000 centrifuges of various types, with ongoing research and development to improve the machines' efficiency.

Source: https://www.defenseone.com/ideas/2020/01/how-quickly-could-iran-get-bomb/162283/, 08 January 2020.

OPINION – Nathanael Johnson

The Cost of Germany Turning Off Nuclear Power: Thousands of Lives

Back in 2011, Germany decided that it was done with nuclear power. The Fukushima Daiichi plant had just melted down in Japan, and the threat of disaster seemed overwhelming. Chancellor Angela Merkel's government, which had intended to keep Germany's plants open, did an about face and voted to shut down all of the country's 17 plants by 2022 The only politicians opposing the measure were those who wanted to shut down the plants even faster.

At the time, nuclear provided a quarter of German electricity. In the years since, Germany has closed 11 plants, and is scheduled to shutter the remaining six in the next two years. Multiple studies since then suggest that Germany did more harm than good. In the latest of these studies, a working paper recently published by the National Bureau of Economic Research, three economists modeled Germany's electrical system to see what would have happened if it had kept those nuclear plants running. Their conclusion: It would have saved the lives of 1,100 people a year who succumb to air pollution released by coal burning power plants. When we think of the risks that come with nuclear power, it's usually in terms of the danger posed by the reactors not the risks of shutting them down. But those risks are real nonetheless.

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Germany's move away from nuclear power is hardly unique. After the Fukushima disaster, Japan closed most of its nuclear reactors, replacing the energy with mostly coal and gas generation. In the United States, nuclear energy is waning with little political will to extend the life of aging reactors. Two nuclear plants closed last year, and 10 more are slated to retire in the next five years. It's not in decline everywhere, though: Dozens of reactors are under construction in the rising economies of Asia.

In Germany, the plan was to replace nuclear energy with renewables, and that's just what happened. The authors of this new paper show that electricity generated by wind turbines, dams, and solar panels between 2011 and 2017 was more than enough to fill the hole left by nuclear shutdowns in that same time period. So what's the problem? Well, if renewables hadn't needed to fill that hole, they would have cut much deeper into fossil fuel energy. If Germany had kept its nuclear fleet running while still building up renewables, it would be burning 25 percent less gas and a third less coal for electricity, according to the paper. In other words, Germany's energy system is getting better, but it's just getting better slowly, and that delay is costing lives.

Mark Delucchi, a research scientist at the University of California, Berkeley, criticized the study for focusing too narrowly on a fairly obvious question. "Everyone already knows that it is likely that the social costs of coal use exceed the social costs of nuclear use," he said, in an email. The more important question is how much nuclear energy the world should have in the long term as it shifts from fossil fuels entirely, Delucchi said.

One of the paper's authors, Stephen Jarvis, a graduate student at the University of California, Berkeley, acknowledged that the public health costs of burning coal instead of generating nuclear power is well known — at least among academics. But the paper does bring something new to the discussion by quantifying the effects of air pollution. "[M]ost of the discussion of the phase-out, both at the time and since, has been focused on electricity prices and carbon emissions – air pollution has been a second order consideration at best," Jarvis said, in an email. "Hopefully this study can go some way to remedying that."

Few people really grasp how damaging air pollution can be. It's a much quieter, more insidious threat than a nuclear explosion, the authors point out. Compared with the headline-grabbing power of nukes, it's all too easy to underestimate a threat slowly spreading across the sky — whether it's from dirty air or greenhouse gases.

Four nuclear reactors are under construction in the UAE. The nuclear power plant is named Barakah – Arabic for Divine Blessing. Why have the Emirates invested in four new nuclear reactors, will their operation further destabilise the volatile Gulf region, and what are the key safety, proliferation, security, and environmental risks?

Source: https://grist.org/energy/the-cost-of-germany-going-off-nuclear-power-thousands-of-lives/, 08 January 2020.

OPINION – Paul Dorfman

Gulf Nuclear Ambition

Four nuclear reactors are under construction in the UAE. The nuclear power plant is named Barakah – Arabic for Divine Blessing. Why have the Emirates invested in four new nuclear reactors, will their operation further destabilise the volatile Gulf region, and what are the key safety, proliferation, security, and environmental risks?

Nuclear Safety: The South Korean winning bid for the construction of the UAE reactors was spectacularly low, about 30 percent lower than the next cheapest bid, with the chief executive of a French nuclear corporation comparing the Korean reactor to a car without airbags and seat belts. This is because the Barakah reactors don't contain essential safety features such as either additional reactor containment or a 'core-catcher' – both of which are expected in all new nuclear reactors in Europe.

The decision not to include additional defence in the Barakah reactor containment building is important, since they're designed to defend against

significant radiation pollution release in the event of an accidental or deliberate large airplane crash or military attack – issues that recent events have brought into stark relief.

Nuclear Proliferation: The Gulf faces unique challenges when it comes to nuclear power. The tense geopolitical environment makes nuclear power an even more controversial issue here than elsewhere, since Gulf states are worried that neighbours could use their civilian nuclear programs for military ends.

Unless enrichment of uranium and reprocessing technologies are effectively regulated against diversion of civil materials for military purposes, the reality is that new nuclear power plants can provide the cover to develop and make nuclear weapons. Whether that capability is turned into actual weapons depends largely on political inclination.

UAE has just renewed its Memorandum of Understanding on nuclear fuel cycle management with Tenex, a subsidiary of the Russian state nuclear corporation ROSATOM. The World Nuclear Association have confirmed that Tenex will also provide 50 percent of Barakah's enrichment capability, worth some $500 million, indicating the emergence of a potential back-channel for the Emirates to obtain advanced nuclear fuel cycle technologies.

UAE's neighbors, the Saudi's, have made it clear on more than one occasion that there's another reason for their interest in nuclear energy technology which was not captured by the royal decree on their nuclear program –the relationship of the civil program to nuclear weapons. This is hardly news to US government officials negotiating the Nuclear Co-operation Agreement. As a former high-level US State Department official noted: "I have not heard them say out loud 'We want to pursue enrichment to have a nuclear weapons option,' but I think it's fairly clear that is on their minds."

Enrichment Capability: Although the UAE suggest otherwise, there remains the possibility that the Emirates may also decide to pursue advanced nuclear fuel cycle capabilities. One issue will be the fate of separated plutonium, and whether overseas reprocessing will encourage the UAE to use plutonium-based fuels at Barakah. These fresh plutonium-bearing MOX fuels, pose a more serious proliferation risk than spent fuel or low enriched uranium fuels, and up to 30 percent of the Barakah APR1400 reactor cores can be loaded with MOX fuel with minor modifications.

Here it's worth noting that UAE has just renewed its Memorandum of Understanding on nuclear fuel cycle management with Tenex, a subsidiary of the Russian state nuclear corporation ROSATOM. The World Nuclear Association have confirmed that Tenex will also provide 50 percent of Barakah's enrichment capability, worth some $500 million, indicating the emergence of a potential back-channel for the Emirates to obtain advanced nuclear fuel cycle technologies.

Nuclear Security: As recent military strikes in the region infer - including those against Saudi oil refineries - the Gulf is one of the world's most volatile regions. In the case of the UAE, nuclear safety revolves around the broader issue of security, especially since some armed groups may view UAE military operations as a reason to target nuclear installations, or intercept enriched uranium fuel or waste transfers nationally or regionally.

Such back-draft from foreign policy and politics more generally, will increasingly dovetail with regional nuclear safety considerations. Disconcertingly, Yemeni rebels have already claimed to have fired a missile at the Barakah nuclear power plant site in 2017. UAE subsequently denied the claim, insisting it had an air defence system capable of dealing with any threat.

Yet the protection of the UAE nuclear plant with fighter aircraft or surface-to-air missiles may not be an easy task, and time available to scramble fighter aircraft or fire surface-to-air missiles may prove limited.

Maritime Transport: Added to which, a significant

increase in the maritime transport of radioactive materials into and through the Arabian Gulf will occur once Barakah begins operation. Maritime transports will include uranium hexafluoride through to finished fuel rods, radioactive waste, and irradiated nuclear fuel (INF). High level waste (HLW) and INF cargo will travel out of the region. HLW, intermediate level waste, and low level waste will require storage in the Emirates – presenting major terrestrial and maritime target potential, whether directly intended or un-intentional.

Incidents involving nuclear transport ships can include collision, ramming, grounding, fire and explosion, foundering, equipment and material failure, and as a result of hostile action. Such incidents can occur in ports and approaches and at sea.

The very high forces during collision or ramming events may be sufficient to breach nuclear waste flask containment and, if followed by fire, the sustained temperatures involved could result in a significant airborne release of radioactivity, with the fire plume simultaneously providing an efficient dispersal mechanism by which a very significant radioactive release could be delivered directly to a human population.

So why has UAE cast significant resources at nuclear power, a quintessentially late-twentieth-century technology, when other more efficient, less risky, technically and economically viable options already exist? Since new nuclear makes little apparent sense in the Gulf, which has some of the best solar energy resources in the world, the nature of the interest in nuclear may lie hidden in plain sight.

Nuclear Paradox: So why has UAE cast significant resources at nuclear power, a quintessentially late-twentieth-century technology, when other more efficient, less risky, technically and economically viable options already exist? Since new nuclear makes little apparent sense in the Gulf, which has some of the best solar energy resources in the world, the nature of the interest in nuclear may lie hidden in plain sight.

That being so, it seems reasonable to suggest that nuclear suppliers should commit not to supply the UAE enrichment or reprocessing capabilities. Correspondingly, it may prove wise for intelligence capabilities to monitor any UAE efforts to draw back on its commitment not to acquire advanced fuel cycle capabilities, and look for signs as to whether the Emirates may be carrying out research on weaponisation. But the key paradox for the Emirates, and other nuclear states, is this. Due to risk of deliberate or accidental harm to their own nuclear facilities, the boundaries of their own safety are being pushed beyond the limits of logic.

Source: https://theecologist.org/2020/jan/10/gulf-nuclear-ambition, 10 January 2020.

OPINION – Richard Stone

'National Pride is at Stake.' Russia, China, United States Race to Build Hypersonic Weapons

High in the sky over north-western China, a wedge-shaped unmanned vehicle separated from a rocket. Coasting along at up to Mach 6, or six times the speed of sound, the Xingkong-2 "waverider" hypersonic cruise missile (HCM) bobbed and weaved through the stratosphere, surfing on its own shock waves. At least that's how the weapon's developer, the China Academy of Aerospace Aerodynamics, described the August 2018 test. (China did not release any video footage.) The HCM's speed and manoeuvrability... would enable the new weapon to "break through any current generation anti-missile defense system."

For decades, the U.S. military—and its adversaries—have coveted missiles that travel at hypersonic speed, generally defined as Mach 5 or greater. ICBMs meet that definition when they re-enter the atmosphere from space. But because they arc along a predictable ballistic path, like a bullet, they lack the element of surprise. In contrast, hypersonic weapons such as China's waverider manoeuvre aerodynamically, enabling them to dodge defenses and keep an adversary

guessing about the target.

Since the dawn of the Cold War, the Pentagon has periodically thrown its weight behind the development of manoeuvrable hypersonic weapons, only to shy away when technological hurdles such as propulsion, control, and heat resistance proved daunting. "You see a flurry of activity, a lot of investment, and then we conclude it's a bridge too far," says aerospace engineer Mark Lewis, director of defense research and engineering for modernization at the U.S. Department of Defense (DOD). "The community was underfunded and largely forgotten for many years," adds Daniel DeLaurentis, Director of Purdue University's Institute for Global Security and Defense Innovation.Top of FormBottom of Form Now, DOD is leading a new charge, pouring more than $1 billion annually into hypersonic research. Competition from ambitious programs in China and Russia is a key motivator.

It's a race to the Moon sort of thing," says Iain Boyd, an aerospace engineer at the University of Colorado, Boulder. "National pride is at stake." This new arms race promises to upend strategic calculations. Russian officials have cast nuclear-armed hypersonic craft as a hedge against future U.S. prowess at shooting down ICBMs, which could undermine nuclear deterrence.

Although hype and secrecy muddy the picture, all three nations appear to have made substantial progress in overcoming key obstacles, such as protecting hypersonic craft from savage frictional heating. Russia recently unveiled a weapon called the Kinzhal, said to reach Mach 10 under its own power, and another that is boosted by a rocket to an astonishing Mach 27. China showed off a rocket-boosted hypersonic glide vehicle (HGV) of its own, the Dongfeng-17, in a recent military parade. The US, meanwhile, is testing several hypersonic weapons. "It's a race to the Moon sort of thing," says Iain Boyd, an aerospace engineer at the University of Colorado, Boulder. "National pride is at stake." This new arms race promises to upend strategic calculations. Russian officials have cast nuclear-armed hypersonic craft as a hedge against future U.S. prowess at shooting down ICBMs, which could undermine nuclear deterrence.

China's military, in contrast, sees hypersonic weapons (as well as cyberwarfare and electromagnetic pulse strikes) as an "assassin's mace": a folklore term for a weapon that gives an advantage against a better-armed foe, says Larry Wortzel, a senior fellow at the American Foreign Policy Council who serves on the U.S.-China Economic and Security Review Commission. If tensions were to spike over Taiwan or the South China Sea, for instance, China might be tempted to launch pre-emptive strikes with conventional hypersonic weapons that could cripple U.S. forces in the Pacific Ocean, Wortzel says. China's hypersonic weapons, he warns, "seem deliberately targeted at upending the tenuous strategic stability that has been in place since the end of the Cold War."

For now, manoeuvrability at hypersonic speeds makes the weapons nearly impossible to shoot down—"unstoppable," as a headline in *The New York Times* put it last summer. But, "Unstoppable today does not mean unstoppable tomorrow," says Shari Feth, a materials engineer at the U.S. Missile Defense Agency (MDA). She's at the vanguard of U.S. efforts to field countermeasures against hypersonic weapons.

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The US has spent decades trying to get hypersonic flight right. The first vehicle to exceed Mach 5 was a two-stage rocket, dubbed Project Bumper, launched in 1949. After four failed tests, the V-2 rocket lifted off from a missile range in New Mexico, releasing a second-stage sounding rocket that attained Mach 6.7. Project Bumper and subsequent efforts laid bare the daunting challenges. "This is a very unforgiving realm," says Lewis, who served as chief scientist of the U.S. Air Force from 2004 to 2008. "You're flying under extraordinary conditions"—extreme velocities, forces, and temperatures. The hypersonic threshold of Mach 5 is arbitrary, but at those speeds, he says, "temperatures start to get high enough to worry about." The heating depends on factors such as the vehicle's speed and contours.

When a space shuttle returning from orbit hit the upper atmosphere at Mach 25, its blunt leading edges heated to 1400°C, which a skin of carbon-carbon composites helped it withstand. Newer hypersonic craft tend to have sharper edges—in part to assist with manoeuvrability—that can exceed 2000°C. Turbulence can make things worse. At hypersonic speeds, the boundary layer around the vehicle thickens, and a smooth, laminar flow can suddenly break up into eddies and swirls that cause temperature spikes on the vehicle's skin. "We've devoted a lot of fundamental research to figure out when that occurs," Lewis says. A vehicle's survival, he says, requires resilient super alloys and ultra–high-temperature ceramics and perhaps novel coolants. For example, a team at the U.S. Naval Research Laboratory has devised a liquid sodium system that drains heat from a leading edge through continuous evaporation and condensation.

High air speeds also pose challenges for engines on HCMs, which unlike HGVs have their own power plants. HCMs use a supersonic combustion ramjet, or "scramjet," to accelerate. "It's the simplest type of jet engine you could ever imagine ... just an open tube" in which air mixes with fuel, Lewis says. "It's also perhaps the most complicated type you can imagine because of the extreme conditions under which it operates." At hypersonic speeds, air molecules spend milliseconds in the engine tube—scant time for fuel and air to mix properly. And when a vehicle pitches and yaws, airflow into the engine changes, which can result in uneven combustion and thrust. Tweaks to get a better burn have ramifications for, say, how the aircraft withstands shock waves. "Everything is incredibly coupled. You are designing a fully integrated vehicle," Lewis says. It took the United States 46 years to realize its first working scramjet: NASA's $230 million X-43a, an uncrewed vehicle that flew in 2004.

The US has not yet fielded either. After decades of fits and starts, any advantage that U.S. hypersonic R&D once held has largely eroded away. Its wind tunnels and other testing infrastructure are aging. And challenges such as tweaking designs to ensure engine walls don't melt have slowed progress on scramjets.

HGVs pose other challenges. The rocket that carries the glider reaches speeds far greater than those of an HCM, meaning engineers must use materials that are even more resistant to heat. Still, HGVs are easier to manoeuvre because they lack a scramjet, with its acute sensitivity to pitch and yaw. "It almost becomes a religious discussion—rockets versus air breathing," Lewis says. "The ultimate answer is we probably want both." The US has not yet fielded either. After decades of fits and starts, any advantage that U.S. hypersonic R&D once held has largely eroded away. Its wind tunnels and other testing infrastructure are aging. And challenges such as tweaking designs to ensure engine walls don't melt have slowed progress on scramjets, Lewis says. "Today we are further away from routine scramjet flight than we were 10 years ago."

From a base in the Ural Mountains on 26 December 2018, Russia's armed forces launched a ballistic missile carrying an HGV called Avangard. After separating from its carrier in the stratosphere, the HGV zigzagged 6000 kilometres across Siberia at a searing Mach 27, Russian officials claimed, then

smashed into a target on the Kamchatka Peninsula. Afterward, a beaming Russian President Vladimir Putin called Avangard "the perfect New Year's gift for the country." Russia's defense ministry announced last month that it has put the nuclear-armed HGV into combat duty—allowing Putin to claim that Russia is the first country armed with hypersonic weapons.

Russian boasts along with Chinese advances have sounded the alarm in the US. Congress will pour more than $1 billion into military hypersonic research this year and has created a new university consortium to do basic studies. "Our work on hypersonics has really ramped up," says Jonathan Poggie, an aerospace engineer at Purdue. His team models low-frequency shock waves "that pound on a vehicle like a hammer." The rising military stakes have prompted the Pentagon to consider classifying some basic hypersonic research. DOD "is very concerned about educating our enemies," Poggie says. "They are in the middle of trying to draw these red lines," Boyd adds. But, "If we overclassify," he warns, "there are a number of domino effects. You'd be stifling innovation. Inevitably, that means fewer new ideas."

A veil of secrecy is also descending in Russia, which has produced "a rich body of hypersonic literature," Lewis says. Security officials there recently charged two scientists with treason for sharing findings with European collaborators; the data had been approved for release but then declared secret 5 years later.

China, in contrast, has been surprisingly open about its research. "The Chinese are trying to establish prestige in the field," Lewis says. The nation has invested heavily in facilities, including sophisticated wind tunnels and shock tubes that use blast waves to study hypersonic flows. "Ten years ago, they were duplicating what others had done," Boyd says. "Now, they're publishing innovative ideas." At a 2017 hypersonic conference in Xiamen, China, Chinese scientists presented more than 250 papers—about 10 times the number presented by U.S. researchers. "You see papers you'd think they wouldn't publish in the open literature," Poggie says.

One is a recent analysis from the China Aerodynamics Research and Development Center showing that the plume of ionized gas, or plasma, left by a hypersonic vehicle is more visible on radar than the vehicle itself. That implies radar could give early warning of an incoming weapon. Other nations are chasing the trio of leaders—or teaming up with them. Australia is collaborating with the US on a Mach 8 HGV, and India with Russia on a Mach 7 HCM. France intends to field an HCM by 2022, and Japan is aiming for an HGV in 2026, the U.S. Congressional Research Service noted in a July 2019 report.

The US is largely defenseless against such weapons, at least for now, in part because it can't track them. U.S. military satellites are vigilant for flashes that reveal launches of ICBMs and cruise missiles. But they would probably lose track of even a rocket-boosted hypersonic weapon soon after it detaches from its booster, analysts say. To avoid "shooting blindly … you need to continue to track it when it starts doing these maneuvers in the atmosphere," says Thomas Karako, director of the Missile Defense Project at the Center for Strategic & International Studies. To remedy that shortcoming, the Pentagon plans to launch hundreds of small satellites with sensors capable of tracking heat sources an order of magnitude cooler than rocket boosters. "By proliferating them, you make it impossible to take them all out," Karako says. The full Hypersonic and Ballistic Tracking Space Sensor network could be up and running by 2030, he adds. (The satellites would also be used to help guide U.S. hypersonic weapons.) Once you have such sensors, "we can find a way to build the interceptors," Karako says. Current missile defense interceptors aim to destroy ICBMs near their apex in the upper atmosphere, much higher than a hypersonic weapon flies, and they aren't maneuverable enough to hit a swerving target. "You'll need interceptors with more divert capability than we have," Karako says.

MDA is exploring various approaches that would enable interceptors to "overmatch" incoming weapons, Feth says. One possibility, she says, is to fly faster—a tall order that would demand new lightweight, heat-resistant composites and alloys.

Interceptors could destroy a hypersonic vehicle either by colliding with it or by detonating a warhead nearby. But MDA is also exploring using directed energy: lasers, neutral particle beams, and microwaves or radio waves. Directed-energy countermeasures were floated in the 1980s as elements of the United States's "Star Wars" missile defense shield—then abandoned. Four decades later, "They are more plausible," Karako says.

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Still, MDA recently scrapped plans to test a prototype 500-kilowatt airborne laser by 2025 and to develop a space-based neutral particle beam. Even as defense scientists search for ways to thwart a hypersonic attack, diplomats and non-proliferation experts are discussing how to limit—or even outlaw—the disruptive technology. "Hypersonic weapons are primed for arms control," argues Ankit Panda, senior fellow on the Defense Posture Project at the Federation of American Scientists, a think tank. The United Nations Office for Disarmament Affairs weighed in last year with a report exploring arms control scenarios, blasting what it called a "blinkered pursuit of a novel technology with as-yet-unproven military utility," Arms control treaties, however, are hardly in vogue these days. And with China, Russia, and the US egging each other on with one high-profile test after another, the hypersonic arms race seems likely to accelerate.

Source: Richard Stone, https://www.sciencemag.org/news/2020/01/national-pride-stake-russia-china-united-states-race-build-hypersonic-weapons, 08 January 2020.

OPINION – Yiswaree Palansamy

As 2020 Comes a-Knocking, Whither Malaysia's Nuclear Power Plan?

Whatever happened to Malaysia's plan to have our own nuclear plants by 2030? As the year 2020 approaches, I for one cannot help but notice how this project has yet to see the light of day. The plan was first introduced in 2012, and was led by the Malaysia Nuclear Power Corporation (MNPC) that was established a year prior. Fast forward to today, the government has decided not to develop nuclear power, and consequently, Minister of Energy, Science, Technology, Environment and Climate Change, Yeo Bee Yin announced that the MNPC will be shut down. Unsurprisingly, the decision has been praised by anti-nuclear groups while criticised by nuclear advocates.

Before we address the differing opinions, one thing should be made clear. Regardless of the divide, it is undeniable that nuclear energy is the cleanest and most efficient energy available. However, whenever nuclear energy is brought up as a topic, the two concerns inextricably linked to the technology; safety and nuclear waste would also get the limelight as part of the discussion.

Are the anti-nuclear groups right, or are we moving backwards as a country, due to our choice to not develop nuclear power? Before we address the differing opinions, one thing should be made clear. Regardless of the divide, it is undeniable that nuclear energy is the cleanest and most efficient energy available. However, whenever nuclear energy is brought up as a topic, the two concerns inextricably linked to the technology; safety and nuclear waste would also get the limelight as part of the discussion.

Safety: Two of the biggest nuclear meltdowns in history has opened the eyes of many as to how dangerous nuclear power plants can be in the event of an accident. One, in 1986, Chernobyl, in the then Soviet Union era, and the other in 2011,

in Fukushima, Japan. In the case of Chernobyl, it was a combination of factors, including operators who had disregarded safety measures, coupled with greedy politicians who cut corners in developing their nuclear plants. In other words, it was purely a man-made accident and not one which happened owing to a technical glitch.

The Fukushima incident on the other hand, is widely reported as a nuclear meltdown that was caused by a natural disaster – an earthquake and a tsunami. However, there may be more to that story when conflicting reports showed that the incident was in fact preventable. In fact, three directors of the Tepco, who were responsible for maintaining the Fukushima nuclear plant, were charged for criminal negligence. Barely three months ago, the directors were acquitted by the Japanese court, though the prosecution is still in the midst of appealing the acquittal. Regardless of whether both incidents were due to negligence or an "act of God", it does not change the fact that when it happened, hundreds of thousands of people had died.

With so much of safety concerns coupled with the issue of nuclear waste, does this mean Malaysia made the right call by halting all development on exploring nuclear power? The answer may not be so simple. If we look beyond Chernobyl, Fukushima and Germany and see what other countries are doing as well, the answer may not be as straightforward anymore.

Nuclear Waste: Putting aside the issue of safety, the other problem is the production of nuclear waste in the process of generating nuclear energy. While nuclear energy itself is "green" and efficient as it can generate electricity without the greenhouse gas emission, the by-product is extremely radioactive and dangerous. Therefore, when nuclear waste is produced during the process, the disposal of the said material is always a concern, due to its hazardous, radioactive nature. Currently, one of the best ways to dispose of nuclear waste is to find a suitable location to bury it, until its radioactivity dissipates. This, however, is much harder than it sounds. To put things in perspective, reference can be made to Germany's situation. After the Fukushima incident, Germany made plans to phase out the use of nuclear energy, with the expectation to have all of its nuclear plants shuttered by 2022. However, till today, Germany has yet to find a "burial ground" for all the nuclear waste it produced over the years. It was reported that the amount of nuclear waste it has produced to date, to be the size of six London's Big Ben Tower.

So What's the Alternative? With so much of safety concerns coupled with the issue of nuclear waste, does this mean Malaysia made the right call by halting all development on exploring nuclear power? The answer may not be so simple. If we look beyond Chernobyl, Fukushima and Germany and see what other countries are doing as well, the answer may not be as straightforward anymore. For example, Chernobyl and Fukushima nuclear power plants shared a common feature. They are both Uranium-fuelled nuclear reactors. A possible alternative is actually available – instead of using Uranium, Thorium can be used instead. A Thorium-based molten salt reactor does not have the risk of exploding like the Uranium based reactors in Chernobyl and Fukushima. Claims are made that it is, in fact, meltdown-proof. Thorium-based reactors also produce less amount of nuclear waste, while being only radioactive for 500 years, as opposed to Uranium nuclear waste that may be radioactive and hazardous for 10,000 years.

Granted, there has yet to be a single operational Thorium reactor in the world, but this is not science fiction. The technology is one that is currently being developed by many countries, including India, China, and the US. In fact, Andrew Yang, the 2020 Democratic presidential candidate for the U, made an electoral promise to have the US government invest US$50 billion (RM204.4 billion) in the development of Thorium-based molten salt nuclear reactors, and to have them ready by 2027. The irony of this technology is that it is actually not something new. It was discovered and tested in 1968, but was not funded for further

development because Thorium cannot be used to make nuclear weapons, as opposed to Uranium. Apart from Thorium being an alternative, there may also be a possible scientific breakthrough on nuclear waste disposal in the future. 2018 Nobel Prize winner, Gerard Mourou, claimed that there may be a solution to cut the radioactivity of nuclear waste to just minutes using laser options.

Yes or No? The point of the discussion on the possible alternatives is not to show that there is a conclusive solution to the problem, but to demonstrate that there are avenues in science that have yet to be explored. History should only serve as a lesson in moving forward. In a race against time where non-renewable energy like fossil fuel will deplete one day, every country in the world has a part to play in the preservation of our earth. For Malaysia, perhaps the government should reconsider its decision to shut down MNPC, so that we can continue to invest in our future. Even though the original Vision 2020 plan could not be achieved, I hope the government will still see and plan ahead with a 20/20 vision, as we make our way into 2020.

Source: https://www.malaymail.com/news/malaysia/2020/01/03/as-2020-comes-a-knocking-whither-malaysias-nuclear-power-plan/1824208, 03 January 2020.

OPINION – Editorial, *The Japan News*

US Resilience Put to the Test as World Faces Many Changes

Where is the US heading? The world is closely watching the U.S. Presidential election in November. A verdict will be handed down on U.S. President Donald Trump, who proclaims an "America First" policy and displays an unpredictable and impulsive political style. The international order focusing on U.S. military and economic power has been shaken, and cooperation among its allies, as well as wider multilateral cooperation, has been experiencing a conspicuous decline. In the U.S.-China conflict, common ground cannot be seen. The world situation is increasingly uncertain. Trump puts top priority on his re-election and makes efforts to produce "results" that he can use to appeal to his supporters. As U.S. foreign policy is thus promoted from that perspective, it will be unavoidable for every other country to be affected.

Something to be wary of is that North Korea may take advantage of a chaotic situation to repeat its military provocations and try to win concessions, such as a lifting of sanctions. North Korean leader Kim Jong Un, who is the chairman of the Workers' Party of Korea, warned at a plenary session of the party's Central Committee at the end of 2019 that Pyongyang will hold a "new strategic weapon." There is a fear that North Korea could change its current position of not producing or using nuclear weapons nor conducting nuclear tests. Since the U.S.-North Korean summit meeting in 2018, Pyongyang has refrained from nuclear tests and test-launching intercontinental ballistic missiles.

There is a fear that North Korea could change its current position of not producing or using nuclear weapons nor conducting nuclear tests. Since the U.S.-North Korean summit meeting in 2018, Pyongyang has refrained from nuclear tests and test-launching intercontinental ballistic missiles. However, that does not mean Pyongyang's nuclear threat has been reduced.

However, that does not mean Pyongyang's nuclear threat has been reduced. It is vital to maintain the system of sanctions on North Korea until Kim takes a step toward the abandonment of its nuclear development. The history of past agreements on North Korea's denuclearization should not be forgotten, such as the Agreed Framework reached between the United States and North Korea in 1994 and a joint statement adopted after six-party talks in 2005. Both were broken by North Korean betrayal. It is necessary that the international community strengthen its solidarity and insist that Pyongyang refrain from military provocations. Among other things, it is indispensable for both the United States and North

Korea to make efforts to accumulate concrete measures toward denuclearization through their working-level negotiations.

The US has promoted its sense of value - spreading to the world democracy, the rule of law and free trade, and sharing prosperity - since the end of World War II. But that sense of value is being shaken under Trump. It is Trump's perspective that China has abused multilateral frameworks and that the US has suffered a loss as a result. In a quest for U.S. profits, it is better to conclude new agreements that are favourable for Washington through bilateral negotiations. Stationing the U.S. military overseas and intervening in conflicts are also up for reconsideration as not being worth the cost.

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Admittedly, attempts by prior U.S. administrations to encourage China to adopt democracy and fair trade did not succeed. People in the US have become weary of its wars against terrorism in Afghanistan and in the Middle East. Such circumstances may explain why Trump, despite continuing with his highly unconventional words and deeds, securely enjoys a certain amount of support.

It is quite reasonable for governments and people to consider, first and foremost, the interests of their own countries. This is true not only in the US. Yet international cooperation does not necessarily run counter to national interests. Multilaterally promoting rule-based trading systems, measures to cope with global warming and efforts to prevent terrorism will lead to more benefits for all countries. Regional stability maintained through alliances is also in the interest of the US. The present state of affairs - in which Trump is damaging the U.S. alliances with Japan, with South Korea and with the NATO, by unilaterally demanding that allies assume more burdens - cannot be overlooked.

Historically, the US has repeatedly chosen policies of active intervention in international affairs on the one hand, or isolationist policies on the other. It took the lead in World War II and in the establishment of the UN, but was hit hard by the Vietnam War and became inward-looking. With the end of the Cold War and in the Gulf War, the US demonstrated its overwhelming presence once again. The diversity of its people gathered from various racial and ethnic backgrounds and its frontier spirit of boldly challenging technological innovation are strengths that no other country but the US has. Just as the global community is in a period of change, now is the time when the resilience of the US is being put to the test. If Trump's assertion spreads widely and the whole nation turns its back on international cooperation, it will become even more difficult, and take more time, to correct its course of action.

The U.S.-Russia framework of nuclear disarmament has been unable to deal with China's expansion of armaments and is now on the brink of collapse. Building a new system of disarmament to fit the changing times is necessary. The NPT RevCon to be held in 2020 is also a point at issue. There is a possibility of nonnuclear countries growing resentful of stagnation in nuclear disarmament, thus intensifying their confrontation with nuclear nations.

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nations. Should the conference break down, the NPT's credibility will decline further. The important thing is that the US and Russia, first of all, must avoid a nuclear arms race and make efforts in confidence-building and disarmament negotiations. On top of these efforts, those two countries plus China must explore a new trilateral disarmament system.

The advancement in military technologies is remarkable. Schemes have taken concrete shape such as conducting operations in multiple domains simultaneously, particularly in outer space and cyberspace, together with operations on land, at sea and in the air. Development of weaponry utilizing artificial intelligence and of unmanned military aircraft is also advancing. Existing regulations have been unable to keep up with the sophistication and complexity of arsenals. It is feared that a situation may unfold in which the exchange of attacks and counterattacks escalates beyond expectation. The mapping out of international rules is a matter of urgency.

Source: The Japan News, https://www. greenwichtime. com/opinion/ article/U-S-resilience-put-to-the-test-as-world-faces-14946940. php, 03 January 2020.

NUCLEAR STRATEGY

NORTH KOREA

North Korea can Use Iran to Justify Nuclear Deterrent Strategy

North Korea specialists say that Pyongyang will possible attempt to use the strain between the U.S. and Iran to justify a strengthening of its nuclear deterrence, within the wake of the U.S. drone-strike-assassination of Iranian army chief Qasem Soleimani. Two days after the drone strike, North Korea condemned the assault by state-run media.

Thae Yong-ho, the previous deputy ambassador of North Korea to the UK who famously defected along with his household to South Korea in 2016, wrote on his private web site that Pyongyang is fearful that phrase of the drone assault will unfold amongst its folks. Thae additionally criticized North Korea for what he mentioned was a distortion of info, saying the North had claimed "the Center East shall be a grave for the U.S." and that "pro-U.S. nations are placing the U.S. in a tricky scenario by remaining passive as Washington asks them to ship troops." He additionally mentioned that Kim Jong Un, was significantly shocked by the assault and the assassination in Iraq would possibly now cement his convictions that solely nuclear weapons will defend him.

Cho mentioned that within the wake of the drone assassination, which has been broadly seen as a pre-emptive strike, if North Korea begins its common provocations, the U.S. will now don't have any selection however to take a hard-line stance, and even North Korea's allies, China and Russia, will be unable to facet with Pyongyang.

Cho Hanbum of the Korea Institute for Nationwide Unification informed RFA's Korean Service the assassination truly places North Korea in a tough place. Cho mentioned that within the wake of the drone assassination, which has been broadly seen as a pre-emptive strike, if North Korea begins its common provocations, the U.S. will now don't have any selection however to take a hard-line stance, and even North Korea's allies, China and Russia, will be unable to facet with Pyongyang. Cho believes North Korea will as a substitute give attention to gaining an higher hand in denuclearization and sanctions aid negotiations with the U.S. slightly than threatening provocations. However Cho's colleague Hong Min, the director of the institute's North Korea Analysis Division, mentioned that the North may as a substitute use the drone-strike as an excuse to launch provocations. Hong mentioned that North Korea has declared a long-term struggle with U.S. below a so-called "frontal breakthrough" technique, nevertheless it has not deserted negotiations.

He added that the U.S. could be displeased to see Pyongyang disrupt these negotiations. "North Korea might hope internally that the US will shortly

manage its inside points and give attention to negotiations with the North," mentioned Hong, including "[but] as a result of Iranian scenario [that will likely] be placed on the again burner." "So, North Korea might enhance its degree of provocation early in order that the U.S. should give attention to negotiations," mentioned Hong. Hong added that if not for the drone-attack, North Korea would start low-intensity provocations in late February or early March, when the annual U.S.-South Korean joint army workout routines are in full swing. Nevertheless, Hong mentioned, now it's doable that North Korea may attempt to attract U.S. consideration by unveiling its strategic weapons at an earlier date.

U.S.-Based Specialists Weigh In: A number of U.S.-based specialists additionally informed RFA that the drone-strike would embolden North Korea's resolve to carry on to its nuclear program. "The U.S. motion reinforces North Korea's decades-old paranoia about Washington's intentions for Pyongyang and bolsters the regime's narrative of a 'hostile' United States," mentioned Jung H. Pak, from the Brookings Establishment's Heart for East Asia Coverage Research. "The killing of Iran's prime basic doesn't basically have an effect on the [North Korean] regime's strategic targets or its strategies, and if something, additional legitimizes Kim's choice to refuse to 'cut price' away the nuclear weapons," mentioned Pak.

Patrick Cronin of the Hudson Institute mentioned the drone-attack impacts North Korea in two main methods. "On the one hand, Pyongyang is reminded that it's susceptible and will chorus from deadly makes use of drive," mentioned Cronin. "Then again, North Korea will proceed to construct up its nuclear arsenal to discourage potential regime-change assaults," he mentioned.

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Authorities Encourages Residents' Self-Reliance to Beat Sanctions: In the meantime in North Korea, authorities are forcing residents to attend ideological training periods the place they're informed to bear the difficulties of residing below worldwide sanctions utilizing self-reliance. The periods started after the Korean Employees' Get together held a plenary assembly to determine one of the best ways to take care of the sanctions, that are aimed toward depriving North Korea of international money and assets that might be funnelled into its nuclear program. "Lately, they're conducting these ideological periods at each manufacturing unit and ladies' group," mentioned a resident of North Pyongan in an interview with RFA's Korean Service Sunday. "The core thought of the get together's plenary assembly was that folks ought to persevere by financial sanctions with the facility of self-reliance," mentioned the supply.

However the supply mentioned the persons are scoffing on the thought. "[They say] if they simply sit there and imagine what the Central Committee is saying, they may starve to dying, so that they have to save lots of {dollars} on their very own," the supply mentioned. "They are saying they don't imagine in Kim Jong Un. They imagine in hundred greenback payments, so they're saying that if they've {dollars}, they'll overcome any hardship," the supply mentioned. One other supply, additionally from North Pyongan, informed RFA, "There's a saying circulating amongst residents that 'even a Kisaeng should work the farmland along with her hoe'." Kisaeng had been ladies skilled to be courtesans for upper-class males in the course of the Joseon Dynasty (1392-1897) and earlier. The saying means the financial scenario is so dangerous that even those that cater to the rich battle to outlive. The second supply defined the saying within the present context, saying, "If authorities officers or wealthy folks don't make sufficient cash due to sanctions, ladies who stay off of them should work laborious and undergo so much." The second supply mentioned that the training periods point out to the people who sanctions won't possible be ending quickly.

"The extra that this kind of ideological training is emphasised, the extra folks understand that the confrontation between North Korea and the U.S. shall be extended, and the U.N. financial sanctions

won't be simply lifted," mentioned the second supply. "If we quit nuclear weapons and missiles, international financial help, together with from South Korea, will start on a big scale, so there's lots of resentment and criticism about how the get together is dealing with the scenario."

Source: Miriam Jackson, https://theunionjournal.com/north-korea-can-use-iran-to-justify-nuclear-deterrent-strategy/, 08 January 2020.

BALLISTIC MISSILE DEFENCE

INDIA

Agni-V ICBM to Enter in Service in 2020

As per reliable reports, the country's latest generation of nuclear-capable ICBM Agni-V may enter in service in 2020 after a few additional firing tests. On December 10, 2018, India has successfully test-fired its ICBM Agni-V, according to a statement from the Ministry of Defence (MoD). The last launch operations of premier weapon Agni-V were carried out and monitored by the SFC in the presence of Scientists from DRDO and other associated officials.

The exact range remains classified, but it is assumed that the missile could have a range from 6,000 to 8,000 kilometres, and can carry a 1,500 kg nuclear warhead. India has reportedly also been working on MIRV for the Agni-V in order to ensure a credible second-strike capability. The Agni-V can be mounted on a launcher vehicle which is known as the Transport-cum-Tilting vehicle-5. It is a 140-ton, 30-metre, 7-axle trailer pulled by a 3-axle Volvo truck

Development of the Agni-V began in 2008. The ICBM features indigenously designed navigation and guidance systems including a ring laser gyroscope based inertial navigation system. According to military sources, the Agni-V ICBM is a three-stage solid-fuelled missile with an approximate range of 5,500-5,800 kilometres. The exact range remains classified, but it is assumed that the missile could have a range from 6,000 to 8,000 kilometres, and can carry a 1,500 kg nuclear warhead. India has reportedly also been working on MIRV for the Agni-V in order to ensure a credible second-strike capability. The Agni-V can be mounted on a launcher vehicle which is known as the Transport-cum-Tilting vehicle-5. It is a 140-ton, 30-metre, 7-axle trailer pulled by a 3-axle Volvo truck according to DRDO.

Source: http://www. indiandefensenews.in/2020/01/agni-v-intercontinental-ballistic.html, 04 January 2020.

RUSSIA

Russia's New Hypersonic Weapon Flies at Mach 27

Russia's new Avangard hypersonic weapon system is now operational. Avangard, which Russian President Vladimir Putin only announced in March 2018, travels at Mach 27 and is designed to take out U.S. ballistic missile defenses ahead of a wider nuclear attack. Avangard is just the latest in a series of hypersonic weapons under development by the U.S., Russia, and China. *The Diplomat* reports that the first regiment of Avangard-equipped missiles, likely the 13th regiment of the Dombarovskiy (Red Banner) Missile Division, achieved operational status at its base near Orenburg, Russia. The regiment received two older UR-100NUTTkH (NATO: SS-19 Stiletto) intercontinental ballistic missiles refitted with one Avangard hypersonic glide vehicle each. Avangard will later be deployed on larger, longer-range R-28 Sarmat ICBMs.

Avangard is a unique weapon system commonly called a boost glide hypersonic weapon. Unlike traditional intercontinental ballistic missiles, which boost their nuclear warheads high into low-Earth orbit and then send them streaking down toward their targets, Avangard uses the ICBM booster to reach an altitude of just 62 miles, or a third of low-Earth orbit. Once at altitude, Avangard zooms down toward its target at Mach 27, or 20,716 miles an hour.

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their nuclear warheads high into low-Earth orbit and then send them streaking down toward their targets, Avangard uses the ICBM booster to reach an altitude of just 62 miles, or a third of low-Earth orbit. Once at altitude, Avangard zooms down toward its target at Mach 27, or 20,716 miles an hour.

Avangard's usefulness is that it never actually reaches space, where America's ballistic missile defenses are designed to shoot down incoming nuclear warheads. In other words, Avangard comes in under the ballistic missile shield, below its engagement range. This gives Russia the ability to quickly destroy the Ground Based Midcourse Defense interceptors based at Fort Greely, Alaska, and Vandenberg Air Force Base, California. Although this sounds ominous, it's not as bad as you might think. The U.S. built up its ballistic missile defenses against countries like North Korea and Iran, to stop a limited missile attack against the homeland. The system was never meant to defend against a Russian missile attack—Russia simply has too many missiles. Russia places great faith in the strategy of assured destruction—that is, it deters nuclear attack by maintaining a large enough arsenal to destroy any enemy that launches first.

Russia feels threatened by U.S. defenses, which it believes could be scaled up to put a serious dent in a Russian retaliatory strike. In other words, Avangard won't come out of nowhere to pave the way for a Russian first strike. If Russia attempted such a strike, the U.S. would have plenty of weapons to retaliate—and Russian missile defenses could only at best save Moscow. Avangard simply assures the Russians that they can neutralize American missile defenses, re-leveling the playing field between Washington and Moscow. However, since the U.S. has no plans to scale up its defenses to threaten Russia's nuclear deterrent, Avangard really addresses nothing except Moscow's paranoia. It's an impressive technical achievement but solves a problem that doesn't actually exist.

Russian President Putin announced Avangard in March 2018, along with a slew of other weapons designed to maintain Russia's edge in military hardware. Russia's deployment of Avangard follows 30 years of research into hypersonic vehicles that started during the Soviet era. The weapon is built out of composite materials designed to deal with the extreme heat generated by friction as the weapon travels through the atmosphere. Russian Deputy Defence Minister Yury Borisov stated in 2018 the outer skin of the hypersonic weapon reaches up to 3,632 degrees Fahrenheit. Russian media sources claim Avangard carries a nuclear warhead rated at "more than 2 megatons TNT equivalent." That's the equivalent of 2,000 kilotons of TNT explosives. By comparison, the atomic bomb dropped on Hiroshima in 1945 was only 16 kilotons. This suggests that Avangard is not a particularly accurate weapon; with a 2-megaton warhead, if the hypersonic weapon lands a few miles off the mark, it will probably still destroy the target. According to *The Diplomat*, Russia will stand up a second regiment of six Avangard systems by 2027 and ultimately build up to 60 of the hypersonic weapon systems.

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Source: Kyle Mizokami,__https://www. popularmechanics. com/military/weapons/ a30346798/russia-new- hypersonic- weapon-mach-27/, 30 December 2019.

UAE

The United Arab Emirates and Missile Defense

It is a known fact that Middle East is not only gearing up its offensive capabilities but also its defensive capabilities as a deterrence against enemy missile threats. The Gulf Cooperating Countries (GCC) have always been crucial allies

of the US and one of the aims of the US is to integrate the missile defence system architecture of each of the GCC member into a regional umbrella that would help the US to form a strong defensive deterrent against the Iranian missile threat. One of the GCC members, the UAE is the only Middle East country that possesses the THAAD system that it received from the US. UAE in the recent past has been subjected to missile threats from Yemen and the missile defence systems have helped UAE to counter these threats.

One of the GCC members, the UAE is the only Middle East country that possesses the THAAD system that it received from the US. UAE in the recent past has been subjected to missile threats from Yemen and the missile defence systems have helped UAE to counter these threats.

***The Need for UAE Missile Defense Capabilities*:** That UAE feels threatened by Iranian missile program and the possibility of Iran to develop nuclear weapons. However, UAE is not only facing threats from Iranian missile systems, but they are also facing threats from Yemeni Houthis who constantly fire ballistic missiles at UAE and Saudi Arabia. These missiles though are being claimed to be provided by Iran to back the Shia Houthis, an accusation denied by Iran though, UAE irrespective of who provides the missile system to Houthis faces imminent threat.

UAE not just faces threats from ballistic missiles but is also facing threats from cruise missiles. In fact, in December 2017, reports confirm that Houthis have fired cruise missiles at UAE's Barakh nuclear power plant. However, UAE is believed to be possessing one of the most advanced missile defence capabilities in Middle East and defends itself with the Patriot systems (nine batteries) for medium to high altitude threats while the THAAD (two batteries) for targeting exa-atmospheric targets such as the long range intercontinental missile systems developed by Lockheed Martin.

Among the Patriot variants, UAE possesses the Patriot Gem-3 and the PAC-3 missiles that ensure terminal point defence. The country also possesses capabilities to defend air borne threats like the MIM 23-HAWKS providing UAE the capability to defend low and medium altitude airborne threats.

Along with this, UAE also possesses the AN/TPY-2 Surveillance Transportable Radar. This radar will further increase the capability of the missile defence system for better interception. Though the radar system is primary radar system for the THAAD, the same would also operate with the PAC-3 systems. The radar has been developed by Raytheon and according to the then vice president of Global Integrated Sensors at Raytheon Integrated Defence Systems in 2011: "the radar will provide UAE with unprecedented surveillance and defensive capabilities."

Among the Patriot variants, UAE possesses the Patriot Gem-3 and the PAC-3 missiles that ensure terminal point defence. The country also possesses capabilities to defend air borne threats like the MIM 23-HAWKS providing UAE the capability to defend low and medium altitude airborne threats. In addition, the UAE in December 2017 has also been in talks with South Korea to bolster military cooperation and have had discussions to carry out tests in UAE of South Korean anti-missile system that is being developed as a component of the Korean Air and Missile Defence (KAMD) program.

A Regional Framework: In 2015, the then assistant secretary at the US Bureau of Arms Control, Verification and Compliance, noted: "it is increasingly important to think strategically about the deployment of…missile defence assets in a regional context." A regional GCC missile defence architecture is crucial from both technological point of view as well as strategic point of view. Regional GCC missile defence architecture is believed by the US to strengthen the capabilities of the US to better defend the region, its allies and forward deployed forces by encouraging cooperation by allowing effective burden sharing. But how far will

this regional framework become a success story is only to be seen.

The GCC comprises UAE, Qatar, Saudi Arabia, Bahrain, Kuwait, and Oman. Saudi Arabia and UAE are facing similar missile threats from the same sources- Iran and Yemen. The cooperation would include "information sharing" and "early warning and tracking data." The Trump administration has also emphasized on the need to integrate the GCC missile defence architecture as the countries are using US missile defence systems and related assets. Therefore, it only makes sense to integrate them for better defensive capabilities. However, while UAE and Saudi Arabia share cordial relations, they have severed ties with Qatar in the recent past.

Qatar has also sought for Chinese missile systems and the same concern leaves the US worried. In addition, the UAE has also started to enhance their ties with Russia. It is a known fact that several Middle East countries have showed interest in the S-400 anti-missile system as well, although with the actions by Turkey's Erdogan, this dynamic may be in even greater flux than before.

At the same time, UAE's belief of a unified GCC is also to include Iraq into the architecture, a plan which the United States is not appreciative of, owing to the security conditions in Iraq at the moment. There remains a rift on the difference of opinion on Iraq and its inclusion in GCC defense considerations. It would be obvious that if all the GCC members would have to be integrated into a regional missile defence architecture with Iraq too as a member of GCC, it would also mean that Iraq would need to be integrated as well into the missile defense architecture. This would mean that the US would need to provide missile defence and related asset systems to Iraq. Such an option may not be acceptable to the US.

Moreover, Qatar is moving towards buying the Russian S-400 anti-missile system- a move that may hinder the progress of the regional architecture as the US would be apprehensive of Russia befriending Qatar to gain access to US missile defence technologies and developing counter-measures for the same. In addition, Qatar has also sought for Chinese missile systems and the same concern leaves the US worried. In addition, the UAE has also started to enhance their ties with Russia. It is a known fact that several Middle East countries have showed interest in the S-400 anti-missile system as well, although with the actions by Turkey's Erdogan, this dynamic may be in even greater flux than before. In addition, though UAE and Saudi Arabia are cooperating on Yemen and in Syria, it must be noted Saudi Arabia being the bigger power in GCC is often viewed with suspicion by other GCC members to the fear of Saudi dominance in the region. Thus, the UAE is clearly enhancing its missile defence capability. It is significantly investing in acquiring sophisticated missile defense systems as part of its overall defense modernization approach.

The Government of India is set to commission at least one new nuclear reactor every year In April 2020, a 700 MW pressurised heavy water reactor will be commissioned in Kakrapar, Gujarat. After this, Kakrapar-4 nuclear reactor will be commissioned in the middle of 2021. This would then be followed by commissioning of RAPP-7 nuclear reactor in Rajasthan's Rawatbhata by middle of 2022.

Source: Debalina Ghoshal, https://sldinfo.com/2020/01/the-united-arab-emirates-and-missle-defense/, 03 January 2020.

NUCLEAR ENERGY

INDIA

Centre to Commission One Nuclear Power Reactor Every Year to Boost Commercial Use of Atomic Energy

In a big boost for India's civil nuclear energy sector, the Government of India is set to commission at least one new nuclear reactor every

year, reports *Times of India*. In April 2020, a 700 MW pressurised heavy water reactor will be commissioned in Kakrapar, Gujarat. The development was announced by senior official of the DEA Shrikrishna Gupta in the presence of Union Minister for DEA Jitendra Singh. Kakrapar-3 nuclear reactor will be commissioned in the middle of the year. After this, Kakrapar-4 nuclear reactor will be commissioned in the middle of 2021. This would then be followed by commissioning of RAPP-7 nuclear reactor in Rajasthan's Rawatbhata by middle of 2022.

At present, 22 nuclear reactors are operational in India under the ambit of NPCIL. These reactors have a cumulative installed capacity of 6780 MW. Meanwhile, it should be noted that India's Kaiga-1 nuclear reactor has set a world record with 962 days of continuous and uninterrupted operation. Also, Tarapur atomic power reactors 1 and 2 have completed 50 years in operation. These were the nation's first nuclear reactors and were commissioned in October 1969.

Source: https://swarajyamag.com/insta/centre-to-commission-one-nuclear-power-reactor-every-year-to-boost-commercial-use-of-atomic-energy, 01 January 2020.

JAPAN

Fukushima Unveils Plans to become Renewable Energy Hub

Japan aims to power region, scene of 2011 meltdown, with 100% renewable energy by 2040. Fukushima is planning to transform itself into a renewable energy hub, almost nine years after it became the scene of the world's worst nuclear accident for a quarter of a century. The prefecture in north-east Japan will forever be associated with the triple meltdown at the Fukushima Daiichi nuclear power plant on 11 March 2011, but in an ambitious project the local government has vowed to power the region with 100% renewable energy by 2040, compared with 40% today.

The 2011 accident, triggered by a powerful earthquake and tsunami, sent large quantities of radiation into the atmosphere and forced the evacuation of more than 150,000 residents. The 300bn yen ($2.75bn) project, whose sponsors include the government-owned Development Bank of Japan and Mizuho Bank, will involve the construction of 11 solar and 10 wind farms on abandoned farmland and in mountainous areas by the end of March 2024, according to the Nikkei Asian Review.

Japan's conservative government is pushing to restart idle reactors. It wants nuclear power, which generated almost a third of the country's power before Fukushima, to make up between 20% and 22% of its overall energy mix by 2030, drawing criticism from campaigners who say nuclear plants pose a danger given the country's vulnerability to earthquakes and tsunami.

A 80km grid will connect Fukushima's power generation with the Tokyo metropolitan area, once heavily dependent on nuclear energy produced at the prefecture's two atomic plants. When completed, the project will generate up to 600 megawatts of electricity, roughly two-thirds the output of an average nuclear power plant. Despite the Fukushima disaster, the world's worst nuclear accident since Chernobyl in 1986, Japan's conservative government is pushing to restart idle reactors. It wants nuclear power, which generated almost a third of the country's power before Fukushima, to make up between 20% and 22% of its overall energy mix by 2030, drawing criticism from campaigners who say nuclear plants pose a danger given the country's vulnerability to earthquakes and tsunami. All of Japan's 54 reactors were shut down after the Fukushima meltdown. Nine reactors are in operation today, having passed stringent safety checks introduced after the disaster.

Renewables accounted for 17.4% of Japan's energy mix in 2018, according to the Institute for Sustainable Energy Policies, well below countries in Europe. The government aims to increase this to between 22% and 24% by 2030 a target the prime minister, Shinzo Abe, has described as ambitious but which climate campaigners criticise

as insufficient. Abe insists nuclear energy will help Japan achieve its carbon dioxide emissions targets and reduce its dependence on imported gas and oil, but his recently appointed environment minister, Shinjiro Koizumi, has called for the country's nuclear reactors to be scrapped to prevent a repeat of the Fukushima disaster. "We will be doomed if we allow another nuclear accident to occur. We never know when we'll have an earthquake," Koizumi said when he joined Abe's cabinet in September.

The government is unlikely to meet its target of 30 reactor restarts by 2030 given strong local opposition and legal challenges. Japan faces mounting international criticism over its dependence on imported coal and natural gas. It received the "fossil of the day" award from the Climate Action Network at last month's UN climate change conference in Madrid after its industry minister announced plans to continue using coal-fired power. Japan is the third-biggest importer of coal after India and China, according to the US Energy Information Administration. Its megabanks have been urged to end their financing of coal-fired plants in Vietnam and other developing countries in Asia.

Source: Justin McCurry, https://www.theguardian.com/environment/2020/jan/05/fukushima- unveils-plans-to-become-renewable-energy-hub-japan, 05 January 2020.

UAE

Arab World's First Nuclear Reactor to Open in UAE

The United Arab Emirates' first nuclear power plant will start operating within a "few months" after repeated delays to meet safety and regulatory conditions, two energy officials said. The first of the four nuclear reactors at the Barakah plant had been due to come online in late 2017, but was delayed several times. "Operation (of the first reactor) is scheduled to start within a few months," Awaidha al-Marar, chairman of Abu Dhabi's department of energy, told reporters. He said that the first nuclear fuel will be loaded within the next few months to prepare the reactor for operation. It is set to be the first operational nuclear reactor in the Arab world.

Chairman and CEO of Abu Dhabi National Oil Co. Sultan al-Jaber confirmed that the plant is on course to be operational this year. "To complement our clean energy portfolio, this year in 2020 we will become the first country in the region to deliver safe, commercial and peaceful nuclear power," Jaber told the opening ceremony of the Abu Dhabi Sustainability Week.

The nuclear plant west of Abu Dhabi was built by a consortium led by the Korea Electric Power Corporation in a deal worth over $20 billion. When fully operational, the four reactors should produce 5,600 megawatts of electricity, around 25 percent of the UAE's needs, according to the energy ministry. The UAE, a leading oil producer, says it wants 50 percent of its energy to be generated by clean sources by 2050.

Late last month, UAE newspaper *Al-Ittihad* had quoted officials at state-owned Emirates Nuclear Energy Corp. (ENEC) as saying the first reactor will become operational in the first quarter of this year. ENEC had previously said that it expected the nuclear reactor to be online in late 2019 or early 2020. The nuclear plant west of Abu Dhabi was built by a consortium led by the Korea Electric Power Corporation in a deal worth over $20 billion. When fully operational, the four reactors should produce 5,600 megawatts of electricity, around 25 percent of the UAE's needs, according to the energy ministry. The UAE, a leading oil producer, says it wants 50 percent of its energy to be generated by clean sources by 2050.

ENEC said on its website it has been closely cooperating with the IAEA and WANO to ensure that the nuclear programme conforms with international standards. Since 2010, the UAE has welcomed more than 40 international missions and reviews from the IAEA and WANO, highlighting its commitment to transparency, ENEC said.

Source: https://thearabweekly.com/arab-worlds-first-nuclear-reactor-open-uae, 13 January 2020.

NUCLEAR COOPERATION

INDIA–PAKISTAN

India and Pakistan Exchanged List of Nuclear Installations

India and Pakistan today [1st Jan 2020] exchanged, through diplomatic channels simultaneously at New Delhi and Islamabad, the list of nuclear installations and facilities covered under the Agreement on the Prohibition of Attack against Nuclear installations between India and Pakistan.

The Agreement, which was signed on 31 December 1988 and entered into force on 27 January 1991 provides, inter alia, that the two countries inform each other of nuclear installations and facilities to be covered under the Agreement on the first of January of every calendar year. This is the twenty eighth consecutive exchange of such list between the two countries, the first one having taken place on 01 January 1992.

The Akkuyu NPP is the largest joint project between Russia and Turkey. The $20-billion project is fully funded by Russia, while in the future Russian companies are set to have a 51 percent stake in it. The rest will be acquired by third-party investors, according to an agreement the two sides signed in 2010.

Source: https://www.mea.gov. in/press-releases. htm?dtl/30858/ India+and+ Pakistan+ exchanged +list+of+ Nuclear+ Installations, 01 January 2020.

RUSSIA–TURKEY

More Nuclear Energy for Turkey as Russia Starts Work on 2nd Power Unit for Akkuyu Plant

The construction of a new power unit at the Russian-built Akkuyu nuclear power plant (NPP) in Turkey, the first of its kind in the country, is set to start in the first quarter of 2020. *"Works at the site have already begun... We may hold an official concrete pouring ceremony by March,"* Alexey Likhachev, director general of Russian nuclear energy corporation Rosatom, told journalists on 30 December.

Pouring concrete at such sites usually marks the official start of construction. In August, Akkuyu Nuclear, a part of Rosatom charged with implementing the construction in Turkey, was granted a general licence, allowing them to start work on the second reactor. The Akkuyu NPP is the largest joint project between Russia and Turkey. The $20-billion project is fully funded by Russia, while in the future Russian companies are set to have a 51 percent stake in it. The rest will be acquired by third-party investors, according to an agreement the two sides signed in 2010.

Source: https://www.rt.com/business/477082-russia-turkish-nuclear-plant/, 30 December 2019.

NUCLEAR PROLIFERATION

IRAN

Iran Announces it will No Longer Adhere to 2015 Nuclear Deal Limits

The Iranian government announced it would no longer adhere to limits imposed by the 2015 nuclear deal in the wake of national outrage over the US's assassination of one of the country's top officials, Maj. Gen. Qassem Soleimani, in Baghdad on 03 January. It's Iran's latest step in pulling away from the deal, which eased sanctions against the country in exchange for compliance with nuclear restrictions. It comes nearly two years after President Donald Trump withdrew the US from the agreement and began imposing harsh sanctions on the country, arguing that the deal was ineffective and that Iran was supporting militant groups like Hezbollah. "The Islamic Republic of Iran will end its final limitations in the nuclear deal, meaning the limitation in the number of centrifuges," the government said in a statement. "Therefore Iran's nuclear program will have no limitations in production including enrichment capacity and percentage and number of enriched uranium and research and expansion." The announcement does not mean Iran is fully scrapping the deal, known as the JCPOA, Iranian foreign minister Javad Zarif said.

According to Zarif, Iran will continue to allow the IAEA, the international nuclear watchdog organization, to review its nuclear research, and would be willing to re-join the agreement if sanctions against it are removed. These assurances are not likely to pacify the country's critics, but the fact that the announcement leaves room for a new deal and contains some safeguards against the open weaponization of the country's nuclear work suggests a measured approach from Iran on nuclear policy in a moment marked by a tense process of military escalations with the US.

Both the US and Iran have already walked back pledges made in the 2015 nuclear deal. The Obama-era deal between the US, Iran, Britain, France, Russia, China, Germany and the European Union put tight restrictions on Iran's nuclear program and in return, eased some international sanctions against the country. Trump argued that the deal was ineffective — and despite US allies' insistence that Iran was keeping up its part of the deal, he withdrew the US from the agreement in 2018 and reimpose sanctions on Iran's oil sector. The administration continued to impose more sanctions targeting Iran's ability to trade and acquire currency and its oil exports in efforts to pressure Iran to negotiate what it said would be a new, better nuclear deal. Iranians have retaliated by bombing oil tankers, shooting down a US military drone, and slowly ramping up its missile activities, among other moves.

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In July 2019, the Iranian government made it clear it planned to stop adhering to some elements of the nuclear deal by stockpiling more low-enriched uranium than the agreement allows. Many of the other parties in the deal had tried to keep it alive, but failed to effectively combat the US's sanctions. ...[The recent] announcement was in alignment with these aggressive moves. But many experts noted that given the US's surprising assassination of Soleimani and Iran's furious response, Iran's departure from the nuclear deal could have been more aggressive. It still appears willing to negotiate, but unless the US is will to change its position, any negotiations are unlikely to bear fruit.

Source: Riley Beggin, https://www.vox.com/world/2020/1/5/21050627/iran-nuclear-deal-limits-soleimani, 05 January 2020.

Statement from President Donald J. Trump Regarding Executive Order to Impose Sanctions with Respect to Additional Sectors of Iran

Today, I am holding the Iranian regime responsible for attacks against United States personnel and interests by denying it substantial revenue that may be used to fund and support its nuclear program, missile development, terrorism and terrorist proxy networks, and malign regional influence. I have issued an Executive Order authorizing the imposition of sanctions against any individual or entity operating in the construction, manufacturing, textiles, or mining sectors of the Iranian economy or anyone assisting those who engage in this sanctioned conduct. This order will have a major impact on the Iranian economy, authorizing powerful secondary sanctions on foreign financial institutions. Iran continues to be the world's leading sponsor of terrorism.

The Iranian regime has threatened United States military service members, diplomats, and civilians, as well as the citizens and interests of our allies and partners, through military force and proxy groups. The United States will continue to counter the Iranian regime's destructive and destabilizing behaviour. Iran will never be allowed to have a nuclear weapon. These punishing economic sanctions will remain until the Iranian regime changes its behaviour. The United States is ready

to embrace peace with all who seek it.

Source: Dan Vergano, https://www.whitehouse.gov/briefings-statements/statement-president-donald-j-trump-regarding-executive-order-impose-sanctions-respect-additional-sectors-iran/, 10 January 2020.

Donald Trump Says 'Time has Come' for Europe to 'Break Way' from Iran Nuclear Deal

Europe must "break away from the remnants" of the Iran nuclear deal (JCPOA), President Trump said on 08 January as he announced fresh sanctions on Tehran following a missile attack on a US base in Iraq. "Peace cannot prevail in the Middle East as long as Iran continues to foment violence," he said, calling on Britain, France, Germany and the other JCPOA signatories to seek a new agreement with Iran. "Soleimani's hands were drenched in both American and Iranian blood. He should have been terminated long ago."

The time has come for the UK, Germany, France, Russia and China to... break away from the remnants of the Iran deal or JCPOA." Trump also gave a blunt warning to Iran, saying: "Our missiles are big, powerful, accurate, lethal and fast." NATO gave a positive response to Trump's comments.

Trump contradicted Iranian claims that US soldiers were killed in the attacks overnight on bases near Erbil, in Iraqi Kurdistan, and in the Ain Assad airbase in Iraq's Anbar province. "The American people should be grateful and happy," he said. "No Americans were harmed in last night's attack by the Iranian regime. We suffered no casualties ... only minimal damage was sustained."

'Our Missiles are Big': Trump said he will ask NATO "to become much more involved in the Middle East process." He also admonished European allies, saying: "Nations have tolerated Iran's destructive and destabilising behaviour. Those days are over." He added: "The time has come for the UK, Germany, France, Russia and China to... break away from the remnants of the Iran deal or JCPOA." Trump also gave a blunt warning to Iran, saying: "Our missiles are big, powerful, accurate, lethal and fast." NATO gave a positive response to Trump's comments. Secretary General of NATO Jens Stoltenberg spoke to Trump on the phone on 8th January and the pair "agreed that NATO could contribute more to regional stability and the fight against international terrorism," a statement said.

'Slap in the Face': Earlier, Germany and the UK condemned the Iranian missile strike. German Defence Minister Annegret Kramp-Karrenbauer said the government "rejects this aggression in the sharpest possible terms". China also warned against a military escalation in the Middle East. Iranian Ayatollah Ali Khameini described the attack on bases in Iraq as a "slap in the face" that was "not sufficient" retaliation for the death of General Soleimani. In a speech regularly interrupted by cries of "Death to America" and "Death to Israel" in Qom, he said that governments and people "do not approve" of U.S. presence in the Middle East. "America is the enemy, you know this very well," he said. In a further tribute to Soleimani, who was killed in a U.S. drone strike January 3, he described the general as a "great martyr" and a "kind brother". "His martyrdom means that our revolution is alive. There are some people who want to pretend that the revolution has died in Iran. His martyrdom indicates the fact that the revolution is alive."

Iranian President Hassan Rouhani said that Iran would seek to "force America out of this region". "The real revenge and the ultimate response by regional nations is when America is expelled from this region and its hand of aggression is cut off forever.

Hassan Rouhani Wants to 'Force America Out': Iranian President Hassan Rouhani said that Iran would seek to "force America out of this region". "The real revenge and the ultimate response by regional nations is when America is expelled from this region and its hand of aggression is cut off forever." He also said that European nations should be thankful that Soleimani fought Islamic

State and other Islamist militant groups in Iraq and Syria. But while the attack will serve to increase tensions in the region following the death of Soleimani, experts told Euro news that it was unlikely to lead to all-out war between Iran and the U.S.

"By striking so quickly and overtly, while also sending the message that Iran "does not want war," I think Tehran wants to swiftly close the door to any further escalation, rather than letting tensions linger for months," said Michael Horowitz, head of intelligence at LeBeck International in Bahrain. "The ball is in Trump's court. Going by his response to the attack (stating that "all is well"), and given that there were no US casualties, I think there is a higher chance that the US will not respond in an escalatory manner — but Trump has also proven to extremely unpredictable." And defence analyst Paul Beaver told Euro news that the missile strike might lead to the "opening stages of a non-military response" rather than an escalation of war from both sides.

The Iranians fired a total of 15 missiles, two U.S. officials said. Ten hit Ain al-Asad and one the base in Irbil. Four failed, said the officials, who were not authorised to speak publicly about a military operation. Two Iraqi security officials said at least one of the missiles appeared to have struck a plane at the Ain al-Asad base, igniting a fire.

Iran's Most Direct Assault on the US Since 1979: The missile strike was Iran's most direct assault on America since the 1979 seizing of the U.S. Embassy in Tehran, and Iranian state TV said it was in revenge for the U.S. killing of Soleimani. Foreign minister Javad Zarif tweeted shortly after the rocket launch, saying that the action were "measures in self-defence" under Article 51 of the UN Charter. He added that Iran does "not seek an escalation." After the strikes, a former Iranian nuclear negotiator posted a picture of the Islamic Republic's flag on Twitter, appearing to mimic Trump who posted an American flag following the killing of Soleimani and others. Gen. Mark Milley, chairman of the Joint Chiefs of Staff, says he believes Iran's missile on two Iraqi bases were intended to kill Americans. Strikes on two Iraqi bases were intended to kill Americans. Milley said 11 ballistic missiles that landed at al-Asad air base in western Iraq inflicted moderate damage, such as destroying or damaging tents and a helicopter.

United States Targets: Ain al-Asad airbase was first used by American forces after the 2003 U.S.-led invasion that toppled dictator Saddam Hussein, and later saw American troops stationed there amid the fight against the Islamic State group in Iraq and Syria. It houses about 1,500 U.S. and coalition forces. The U.S. also acknowledged another missile attack targeting a base in Irbil in Iraq's semi-autonomous Kurdish region.

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Source: Orlando Crowcroft & Alastair Jamieson with AP, AFP. https:// www. euronews. com/ 2020 / 01 / 08 / iran-launches-missile-attack-against - us- forces- inside - iraq, 08 January 2020.

NORTH KOREA

Kim Jong Un Signals End to Nuclear Moratorium, Threatens to Unveil New Weapon

Negotiations have stalled since Mr Trump walked out of a summit with Mr Kim in Hanoi last February over a lack of agreement on what denuclearisation steps to trade for sanctions relief. North Korean leader Kim Jong Un signalled the end of a self-imposed nuclear moratorium while threatening to show off a "new strategic

weapon" in the near future, as he closed a party conference that wrapped up a year of nuclear stalemate.

In state media reports...he also accused the US of stalling for time "under the signboard of dialogue" and responding to his goodwill gesture of suspending the testing of nuclear weapons and ICBMs with more sanctions and joint military exercises with South Korea. This broke a promise by US President Trump to suspend the drills. "Under such condition, there are no grounds for us to be unilaterally bound to the commitment any longer," Mr Kim was cited as saying in a speech on 07 January by the state-run Korean Central News Agency. "This is chilling our efforts for worldwide nuclear disarmament and non-proliferation." Mr Kim also urged the country to "actively push forward the project for developing strategic weapons", and warned that "the world will witness a new strategic weapon... in the near future". But he appeared to leave some room for the resumption of talks with the US, saying that the attitude of the US would determine how far North Korea would strengthen its nuclear deterrent. Negotiations have stalled since Mr Trump walked out of a summit with Mr Kim in Hanoi last February over a lack of agreement on what denuclearisation steps to trade for sanctions relief.

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On Tuesday [31 Dec 2019] night, Mr Trump voiced confidence that Mr Kim would keep his promise of denuclearisation. "He did sign an agreement talking about denuclearisation, and that was signed - number one sentence: denuclearisation," said Mr Trump, referring to the pact inked during their first summit held in Singapore in June 2018. "I think he's a man of his word." US Secretary of State Mike Pompeo, in an interview with Fox News, also expressed hope that Mr Kim will "make the right decision" and "choose peace and prosperity over conflict and war". Urging Pyongyang not to test any new strategic weapon, South Korea's Unification Ministry said... that such a move "would not help denuclearisation negotiations and efforts to build peace on the Korean peninsula". Mr Kim held the meeting of the ruling Workers' Party - the highest form of policy discussion - ...the first time in three decades that the meeting had stretched over more than two days.

The North Korean leader's speech on Tuesday [31 Dec 2019] appeared to replace his annual New Year's Day address, usually a highly anticipated event, during which he was expected to announce a "new path" away from talks with the US. If so, this would be the first time since 2013 that he has not addressed the public on the first day of the New Year. Experts said Mr Kim might have replaced the New Year's address with a long party conference to buy time for his next move, after the lapse of his self-imposed year-end deadline for the US to come up with a better denuclearisation-for-sanctions proposal. ...

Source: Chang May Choon, https://elevenmyanmar.com/news/kim-jong-un-signals-end-to-nuclear-moratorium-threatens-to-unveil-new-weapon, 03 January 2020.

NUCLEAR SAFETY

CANADA

Pickering Nuclear Alert was Part of Training Exercise and Meant for Internal List, Ford's Office Says

An emergency alert that woke thousands to warnings of an unspecified "incident" at a GTA nuclear power plant Sunday [12 Jan 2020] morning was sent out by "human error" during a training exercise, Queen's Park says. The alert, which was sent to cellphones through the provincial emergency reporting system around 7:30 a.m., was meant to be sent to an internal list, the office of Premier Doug Ford told the Star.

In a statement, Solicitor General Sylvia Jones said

the alert was "issued in error to the public during a routine training exercise being conducted by the Provincial Emergency Operations Centre," adding: "There was no incident at the Pickering Nuclear Generating Station that should have triggered public notification. Nor was there ever any danger to the public or environment. "The Government of Ontario sincerely apologizes for raising public concern and has begun a full investigation to determine how this error happened and will take the appropriate steps to ensure this doesn't happen again."

The first mass alert — which said emergency staff were responding to a situation at the plant but said "there has been NO abnormal release of radioactivity" — was followed by a second about two hours later. The follow-up clarified there was no active emergency at the plant and that the previous alert "was issued in error." "There is no danger to the public or environment. No further action is required," the second alert read. Media correspondents at the Ontario Power Generation wrote, "There is no danger to the public. There was no radiological event. The alert was issued in error. OPG is working with the province to investigate further," in a statement to The Star.

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The false alarm sparked anger and people are now demanding answers. Pickering Mayor Dave Ryan tweeted he is troubled by the emergency alert and demanded that "a full investigation take place." His tweet read: "Like many of you, I was very troubled to have received that emergency alert this morning. While I am relieved that there was no actual emergency, I am upset that an error such as this occurred. I have spoken to the Province, and am demanding that a full investigation take place."

Toronto Mayor John Tory also joined Mayor Dave Ryan in calling for a full investigation to take place into why the error occurred. His tweet read: "I join @MayorDaveRyan in calling for a full investigation into why this error occurred because there are far too many unanswered questions."

The first emergency alert said it applied to people living within 10 kilometres of the Pickering Nuclear Generating Station. The power plant sits just five kilometres from Toronto's eastern edge on the north shore of Lake Ontario; that 10-kilometre radius includes parts of eastern Scarborough.

In the event of a nuclear emergency, detailed evacuation plans exist for residents living within the 10-kilometre zone. In 2015, residents and businesses inside that radius received free supplies of potassium iodide (KI) pills, which help prevent thyroid cancer in the event of a radioactive release. Anyone living within 50 kilometres of either the Pickering plant or the nearby Darlington Nuclear Generating Station, which sits 30 kilometres further east, can also request a supply of pills using the website preparetobesafe.ca.

The website reads: "In the very unlikely event of a nuclear emergency and a release of radioactive iodine to the public, KI pills will help prevent the development of thyroid cancer, and are especially effective at safeguarding children's thyroid glands. It is important for each household (within 10 km of a nuclear plant) to have a supply of these pills because they are most effective if taken just before or soon after exposure to radioactive iodine.

"The distribution of KI pills is not due to any change in the risk of a nuclear emergency and is not meant to cause alarm. We believe that staying safe means being prepared, even for the most unlikely of events." About 4.5 million people live within 50 kilometres of the two plants. The Pickering facility, which has been operating for 48 years, is one of Canada's largest and oldest nuclear power plants.

Source: Abhya Adlakha, Robert Benzie, https://www.thestar.com/news/gta/2020/01/12/emergency-alert-reports-no-abnormal-release-of-radioactivity-in-unspecified-incident-at-pickering-nuclear-generating-station.html, 12 January 2020.

UAE

UAE Affirms Commitment to Safe Nuclear Power Production

The Barakah Nuclear Energy Plant, in Al Dhafra, has been inspected by international bodies more than 40 times over the past decade, according to Hamad Al Kaabi, Ambassador and Permanent Representative of the UAE to the IAEA. Al Kaabi said the IAEA and the WANO had conducted the missions at the plant to ensure that the construction, commissioning and operation meets with global requirements and also those set out by the UAE's independent nuclear regulator, the Federal Authority for Nuclear Regulation (FANR). In a statement made to the *Emirates News Agency* (WAM), Al Kaabi said: "The UAE is committed to upholding its 2008 nuclear policy principles of transparency, safety and security, sustainability and international cooperation to ensure the UAE Peaceful Nuclear Energy Programme is developed in line with the highest standards."

The plant's four APR1400 design nuclear reactors, with a total capacity of 5,600MW, will supply up to 25 percent of the UAE's electricity needs once fully operational. It is expected to save the country up to 21 million tons of carbon emissions every year, equivalent to removing 3.2m cars from the roads.

Construction of the $25 billion (AED91bn) facility, the UAE's first nuclear power plant, began in 2011. The plant's four APR1400 design nuclear reactors, with a total capacity of 5,600MW, will supply up to 25 percent of the UAE's electricity needs once fully operational. It is expected to save the country up to 21 million tons of carbon emissions every year, equivalent to removing 3.2m cars from the roads. Al Kaabi added: "The Emirates Nuclear Energy Corporation (ENEC) and its subsidiaries comprise a multinational team of nuclear energy professionals who prioritise the safety of its employees, the community and the environment above all other factors, and throughout the entire lifespan of the programme."

Source: https://www.arabianbusiness.com/energy/436265-uae-affirms-commitment-to-safe-nuclear-power-production, 29 December 2019.

UK

MoD: 40 Nuclear Lapses in Three Years 'Show how Safe Scotland Is'

RECORDS detailing 40 safety lapses within three years on nuclear convoys prove how secure Scotland is, the Ministry of Defence has said. A Freedom of Information request has revealed convoys carrying nuclear bombs and radioactive materials have been stopped by everything from faulty windscreen wipers to brake trouble since 2016. The MoD transports serve HM Naval Base Clyde, home to the UK's Trident nuclear submarine fleet. Hazardous material is carried to the Argyll and Bute base north of Helensburgh via Scotland's road system and moves through some of the country's most populous areas. In one "incident" earlier this year, the convoy was held up in traffic for one hour after a serious accident blocked both carriageways. In others, drivers had to drop their speeds during high winds which posed a threat to high-sided convoy vehicles. Glasgow Anniesland MSP Bill Kidd, who is co-president of the Global Council of Parliamentarians for Nuclear Non-proliferation and Disarmament (PNND), called the 40 lapses "shocking".

He said: "People will be shocked to learn that Scotland's roads are regularly being used by military convoys with nuclear warheads on board. Any one of these safety lapses is concerning, but people will be surprised that these issues are so common. "It is bad enough that Scotland is forced to house these weapons of mass destruction, but these safety incidents are deeply worrying. "There must be absolutely no complacency when it comes to handling nuclear weapons." Responding, the Ministry of Defence said the records prove just how seriously it takes nuclear safety.

A spokesperson said: "Public safety is our absolute priority and robust arrangements are in place to ensure the safety and security of all convoys. "The incidents reported include minor issues such as replacing a windscreen wiper blade on a single vehicle in a 20 vehicle convoy. "This demonstrates that, regardless of how minor the occurrence, every incident is recorded. "None of these reported occurrences posed any risk to the

public." But Kidd said even simple faults on nuclear convoys could have a catastrophic impact. Kidd is, the convener of the Scottish Parliament's cross-party group on nuclear disarmament. He stated: "The MoD has a history of secrecy, complacency and reluctance to report its faults – safety lapses such as these simply cannot be swept under the rug. It remains the case that the only way to fully guarantee public safety is to remove these immoral, strategically useless weapons once and for all – and the SNP will continue to fight every step of the way against spending £205 billion on nuclear weapons." While the UK's only nuclear arsenal is based in Scotland, responsibility for that system lies with Westminster.

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Source:Kirsteen Paterson, https: //www. thenational. scot/news/18127504. mod-40-nuclear - lapses-show - safe - scotland - is/, 30 December 2019.

NUCLEAR SECURITY

GENERAL

Finding the Right Fit: How Nuclear Security is Incorporated into Research Reactors

Research reactors benefit society in many ways. However, they can only fulfil their mission if their nuclear material is well protected and does not fall into the hands of terrorists. One of the ways in which countries protect their nuclear material today is by working with the IAEA to integrate nuclear security systems and measures into their research reactor designs. This is also one of the many topics to be discussed at the upcoming International Conference on Nuclear Security: Sustaining and Strengthening Efforts on 10 to 14 February.

But Integration has not Always been the Case: "More than 30 years ago, when most research reactors were built, they were designed for education, industry and research according to safety standards but without comprehensive security specifications built in," said Juan Carlos Lentijo, IAEA Deputy Director General and Head of the Department of Nuclear Safety and Security. "Security of nuclear material and installations has long since emerged as a key concern, and now most of the research reactors built back then have been retrofitted." Achieving the goals of nuclear security — to prevent, detect and respond to criminal or intentional unauthorized acts involving nuclear or other radioactive material — is complicated by the specific characteristics and wide diversity of research reactor types and their related facilities. For older research reactors, additional complications stem from inherent facility vulnerabilities resulting from changing threat environments, inadequate security measures and equipment and the attractiveness of nuclear and other radioactive material for unauthorized removal and sabotage.

Achieving the goals of nuclear security is complicated by the specific characteristics and wide diversity of research reactor types and their related facilities. For older research reactors, additional complications stem from inherent facility vulnerabilities resulting from changing threat environments, inadequate security measures and equipment and the attractiveness of nuclear and other radioactive material for unauthorized removal and sabotage.

A research reactor facility may have been originally laid out with buildings allowing maximum accessibility and minimal physical protection measures. For example, research reactors built using an open pool-type design allow for easy access to the nuclear material found in the reactor's core. This is an efficient design for educational purposes but could pose a security risk. While each research reactor has its own nuclear security requirements, there are some common challenges, such as large groups of individuals accessing a research reactor for up-close, hands-on educational purposes. Unlike nuclear power plants, which are operated by a relatively

consistent staff for years at a time, research reactors are often used by students and researchers who carry out short-term projects and who move on once their work is completed. This requires nuclear security measures that allow for education and research to continue without access delays, while still maintaining a high level of protection. Given the variety of materials used, power levels, fission products, configurations, funding arrangements and staffing of a research reactor, standardization of nuclear security systems and measures is not possible, said Doug Shull, a senior nuclear security officer at the IAEA.

While each country is responsible for nuclear security within its own borders, many draw on the IAEA's advice on the level of nuclear security systems and protective measures available and its assistance with physical protection upgrades, insider threats and nuclear security culture programmes.

"When it comes to research reactors, there is no one-size-fits-all approach for protection. It has to be evaluated and implemented on a case-by-case basis," Shull said. "Each reactor has a unique design and features that require the design of physical protection systems to allow the facility's mission to be accomplished while ensuring protective measures are effective in a security event." While each country is responsible for nuclear security within its own borders, many draw on the IAEA's advice on the level of nuclear security systems and protective measures available and its assistance with physical protection upgrades, insider threats and nuclear security culture programmes.

As the IAEA continues to seek ways to expand its support, one of the latest tools it is developing is the Hypothetical Atomic Research Institute (HARI) facility description. The HARI is a reference document describing many aspects, including security, that are related to research reactors and their associated facilities and that can be used to provide a country with a greater insight into nuclear security recommendations.

Integrated Security Support Plans: For many countries, a key part of incorporating nuclear security at research reactors is within the scope of IAEA Integrated Nuclear Security Support Plans (INSSPs). These tailored plans help countries set up their nuclear security regimes. They are coordinated, upon a country's request, with the IAEA to help a country review its nuclear security regimes and identify areas in need of improvement. They also highlight opportunities for assistance to support the development of an effective and sustainable nuclear security regime. Thanks to its flexibility, an INSSP may be tailored to identify the specific needs of a State's research reactor programme. These may include specific training activities in nuclear security and support in developing administrative procedures, exercises or physical protection upgrades.

... Nigeria has one research reactor, which has been in operation since 2004, and developed its INSSP in 2010. The INSSP helped Nigeria take steps, with the IAEA's support, to strengthen nuclear security at the country's research reactor in line with the IAEA's Nuclear Security Series publications. This systematic approach also focused on training research reactor personnel and on regulatory capacity building. As the IAEA continues to seek ways to expand its support, one of the latest tools it is developing is the Hypothetical Atomic Research Institute (HARI) facility description. The HARI is a reference document describing many aspects, including security, that are related to research reactors and their associated facilities and that can be used to provide a country with a greater insight into nuclear security recommendations, as well as building knowledge and gaining practical experience in addressing nuclear security recommendations. The HARI will be an additional tool that countries can use to address their priorities, whether they have been identified through an INSSP, peer review missions or other avenues.

Source: Inna Pletukhina, https://www.iaea.org/newscenter/news/finding-the-right-fit-how-nuclear-security-is-incorporated-into-research-reactors, 06 January 2020.

NUCLEAR WASTE MANAGEMENT

GENERAL

Chemists Report a New Use for the Waste Product of Nuclear Power Generation

Chemists have found a new use for the waste product of nuclear power—transforming an

unused and stockpile into a versatile compound which could be used to create valuable commodity chemicals as well as new energy sources. Depleted uranium (DU) is a radioactive by-product from the process used to create nuclear energy. With many fearing the health risks from DU, it is either stored in expensive facilities or used to manufacture controversial armour-piercing missiles. But, in a paper published in the *Journal of the American Chemical Society*, Professor Geoff Cloke, Professor Richard Layfield and Dr. Nikolaos Tsoureas, all at the University of Sussex, have revealed that DU could, in fact, be more useful than we might think. By using a catalyst which contains depleted uranium, the researchers have managed to convert ethylene (an alkene used to make plastic) into ethane (an alkane used to produce a number of other compounds including ethanol).

Chemists have found a new use for the waste product of nuclear power—transforming an unused and stockpile into a versatile compound which could be used to create valuable commodity chemicals as well as new energy sources.

Their work is a breakthrough that could help reduce the heavy burden of large-scale storage of DU, and lead to the transformation of more complicated alkenes. Prof Layfield said: "The ability to convert alkenes into alkanes is an important chemical reaction that means we may be able to take simple molecules and upgrade them into valuable commodity chemicals, like hydrogenated oils and petrochemicals which can be used as an energy source. "The fact that we can use depleted uranium to do this provides proof that we don't need to be afraid of it as it might actually be very useful for us." Working in collaboration with researchers at Université de Toulouse and Humboldt-Universität zu Berlin, the Sussex team discovered that an organometallic molecule based on depleted uranium could catalyse the addition of a molecule of hydrogen to the carbon-carbon double bond in ethylene—the simplest member of alkene family—to create ethane.

Prof. Cloke said: "Nobody has thought to use DU in this way before. While converting ethylene into ethane is nothing new, the use or uranium is a key milestone. "The key to the reactivity were two fused pentagonal rings of carbon, known as pentalene, which help the uranium to inject electrons into ethylene and activate it towards addition of hydrogen."

Source: University of Sussex, https://phys.org/news/2020-01-chemists-product-nuclear-power.html, 10 January 2020.

Centre for Air Power Studies

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

Centre for Air Power Studies
P-284
Arjan Path, Subroto Park,
New Delhi - 110010
Tel.: +91 - 11 - 25699131/32
Fax: +91 - 11 - 25682533
Email: capsnetdroff@gmail.com
Website: www.capsindia.org

Edited by: Director General, CAPS

Editorial Team: Dr. Sitakanta Mishra, Hina Pandey, Dr. Poonam Mann, Sreoshi Sinha, Zoya Akhter, Carl Jaison

Composed by: CAPS