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**OPINION – Jesper Starn**

**The Birthplace of Flying Shame and Greta Thunberg Warms to Nuclear Energy**

Nuclear energy advocates are sensing an opening in the environment shaming unleashed by Sweden's most famous teenager, Greta Thunberg. On a recent rainy Sunday afternoon, a small group of reactor physicists, operators, politicians and even a former head of the IAEA gathered to whip up support outside of parliament in Stockholm, the place where Thunberg started her protest. Pushing leaflets and handing out balloons in front of a book-stand, their effort is a far cry from the millions marching around the world to demand lawmakers take action for the climate. But it's a signal that Sweden is once again heading for a political showdown over whether to expand nuclear energy, a contentious issue all the way back to 1980 when Swedes voted to phase it out in a referendum.

"Two years ago none of the political parties wanted to talk about nuclear power, now everyone is talking about it," said Marcus Eriksson, president of the Swedish nuclear society and one of the organizers of the event. "It reflects a stronger opinion that the technology has an important role to play to combat climate change." A majority of Swedes now believes that nuclear power could be a

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**CONTENTS**

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

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**Nuclear Solution?** A majority of Swedes said they believed nuclear power could be a means to help reach the climate goals, when asked by pollster Novus....With opinion shifting, the Moderate Party is now seeing an opening to halt

the closure of several of Sweden's older reactors and build support to potentially erect new ones. After a will-they-or-won't-they period of several months, the party is gearing up for a showdown with the government on a three-year-old agreement, according to Lars Hjalmered, a lawmaker and the party's spokesman on energy issues. Hjalmered said that the Moderates, the largest opposition party, will leave the energy accord unless the government comes to the table again. "More and more people are starting to realize that it is a very smart option for the climate," he said.

The accord from 2016 is largely a bipartisan fudge. It states that Sweden should get all of its power from renewable electricity by 2040, but it doesn't ban new nuclear plants or set an end date for the six reactors that are still expected to be in operation by then.

**Nuclear Reliance:** ...That compromise is now weighing on both the Moderates and their opposition colleagues, the Christian Democrats. They would like to renegotiate the current five-party deal to be more supportive of nuclear power or form a new compromise to include the Liberals and possibly the nationalist Sweden Democrats that strongly favors more reactors in Sweden. As parliament stands today, they would need more allies from the center-left to get a majority, and none of the other parties have so far been willing to budge. The ruling Social Democrats, who here in power when a majority of the twelve reactors in Sweden were built, said they are happy to discuss the agreement, but remain committed to the central point of the compromise. "The energy deal stays firm," said Anders Ygeman, minister for energy and digitalization. "Five parties agreed on 100% renewable energy and five parties agreed to not put an end-date for nuclear power. I imagine it would be difficult to change that part of the agreement."

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*Source: Excerpted, <https://www.bloomberg.com>, 24 October 2019.*

### **OPINION – Harbhajan Singh**

#### **India Needs to Amend its Nuclear Doctrine**

India suffered a crushing defeat at the hands of China in the short war of October-November 1962. On October 16, 1964, China carried out its first nuclear test. This added a new dimension to the threat to India's security and provided the impetus to India for developing nuclear weapons as a means of deterring Chinese aggression. Consequently, India tested its first nuclear device on May 18, 1974.

Pakistan began the process for developing nuclear weapons in January 1972 after losing East Pakistan as a result of the 1971 war. It, perhaps, secretly tested its nuclear devices in China in the late 1970s and early 1980s. Pakistan carried out the first nuclear test openly on May 28, 1998, a few weeks after India's second nuclear test. Since then, it has made noteworthy strides in the areas of nuclear weaponisation and missiles. Therefore, it needs to be realised that India developed nuclear weapons primarily to deter China from any military adventure across the Himalayas.

India's nuclear doctrine of the NFU and CMD (Credible Minimum Deterrence) was made public in August 1999. In 2003, the Cabinet Committee on Security debated the 1999 doctrine, but no changes were promulgated. However, it is not essential to publicise a nuclear doctrine. Mere signals resulting in ambiguity can also serve the

required purpose, i.e. information warfare. India has developed a Nuclear Triad capability (ability to launch nuclear missiles from the air, ground and submarines) in order to survive and retaliate with nuclear weapons against a first use nuclear strike, as part of its CMD doctrine. India also has Agni missiles which have ranges covering territories much beyond China. This prevents China and Pakistan from nuclear-blackmailing India.

China is the only other nuclear nation in addition to India that professes to follow the doctrine of NFU. However, Chinese sources have made statements that their NFU commitment is not applicable to the areas which Beijing claims. Also, they have mentioned some red lines, which if crossed, would invite a nuclear attack. In this context, it is relevant to point out that China lays claims to Arunachal Pradesh and certain areas along India's border with Tibet.

Pakistan's nuclear doctrine is India-specific and stipulates deterrence by "guaranteeing an immediate massive retaliation by nuclear weapons" against a ground and air attack which crosses certain red lines. To counter India's Cold Start Doctrine, Pakistan has added the use of TNWs against Indian troops. India has set up an elaborate nuclear command and control organisation with alternative command post, communications and Triad to absorb the first strike. This makes the Indian doctrine quite potent.

However, our nuclear doctrine suffers from some serious infirmities. The current nuclear doctrine only deals with a nuclear conflict scenario. It does not get meshed with the territorial security of the nation, which is the main Indian concern vis-a-vis China and due to which India went nuclear. China has become much stronger in conventional forces. India's strategy has to be to deter/dissuade China from embarking on any large-scale offensive. This

cannot be achieved by increasing ground and air forces. Also, due to the strategic nexus between China and Pakistan, India will have to keep considerable forces on its western front. The Indian strategy to deter China must, therefore, include using our comprehensive military potential, including the use of TNWs.

**Escalation Leading to MAD Scenario:** India's doctrine envisages using 'massive nuclear retaliation' in case an adversary resorts to first use of any kind of nuclear device, even a TNW. It

implies that if Pakistan uses a sub-kiloton nuclear weapon to wipe out an offensive Indian Army division/brigade in the desert of Rajasthan, India would immediately drop a number of strategic nuclear bombs on Pakistan cities and strategic targets. And it is implicit that in return, Pakistan would nuke Delhi, Mumbai, Jodhpur, Chandigarh etc.

Whatever the doctrine, in practice, the moment Indian troops are attacked by a TNW, there would be

intense diplomatic pressure on India to not retaliate with nuclear weapons. Certainly not with strategic weapons and escalate the situation. The Indian leadership is most likely to succumb to such international pressure. A graduated nuclear response with TNWs is likely to be tolerated, though.

Also, in such a scenario, will the Indian political leadership have the courage to bear the consequences of creating a situation for MAD? This is highly doubtful. In view of the above, such a theoretical nuclear doctrine, which envisages raising the stakes from a tactical to a strategic level suddenly, seems "less of deterrence and more of pretence." The adversary's leadership is unlikely to bite it and hence it does not have the required deterrence value.

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During the Cold War, the Warsaw Pact Forces had a marked superiority in conventional forces over NATO and, hence, were expected to overrun vital areas in Europe in a short time. America, therefore, deployed thousands of TNWs with a view to deter the superior Soviet-led conventional forces. In due course, it was realised that the use of TNWs in populated areas would result in colossal damage to the European population and so, they were discarded. As far as India is concerned, our area along the border with Tibet, by and large, has very little habitation and the above-mentioned constraint for the use of TNWs there and in the deserts of Rajasthan is, therefore, not relevant.

Keeping in view the superiority of China in conventional forces, the use of TNWs in our own territory, say in Tawang, Walong or Chushul, against any offensive Chinese forces is a credible and cost-effective option. India cannot mount any worthwhile conventional counter-offensive due to constraints posed by the very high altitude terrain and long lines of communications. Feeling gung-ho as a result of exercises is a different kettle of fish as compared to the actual shooting war.

Keeping in view the threat of TNWs from Pakistan, the Indian nuclear doctrine should state that their first use by an adversary will be responded to in kind and with much greater intensity. As far as diplomacy and world opinion are concerned, the answer is: there is nothing offensive in the proposed doctrine. It is a defensive doctrine to safeguard India's territorial integrity. The TNWs are planned to be used only in our own territory. With such a doctrine, India can certainly deter/dissuade China and Pakistan and reduce

some Army formations and costly air assets. Thus, it can devote greater financial resources towards economic development and alleviating poverty. In the context of wars that India is likely to get involved in, talking about MAD seems a mad idea.

*Source: The Tribune, 23 October 2019.*

**OPINION – Miles A. Pomper**

**Excerpt from “Why the US has Nuclear Weapons in Turkey – and May Try to Put the Bombs Away”**

As the Syrian crisis pits Turkish troops against former US-allied Kurdish forces, Pentagon officials have been reviewing plans to remove 50 nuclear bombs stored at a US air base in Turkey. A congressional directive to the Pentagon to quickly assess alternative homes for US “personnel and assets” currently stationed at Incirlik Air Base is part of a broader bipartisan bill, still being debated, that proposes sanctions against Turkey. President Donald Trump has been forced to issue public reassurances that the weapons are secure.

During the Cold War, the U.S. stationed B-61 nuclear bombs in Turkey, among other NATO countries. Formally, the U.S. controlled the weapons during peacetime, but the host countries' forces trained and equipped planes so they could drop the bombs with U.S. support in the case of war. The idea was to deter Soviet ground forces and reassure U.S. allies by making clear that the U.S. would be willing to risk nuclear war to block a Soviet invasion of a country hosting the bombs. In addition, in the years before the U.S. developed intercontinental ballistic

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missiles, they presented a way for NATO to demonstrate it could act quickly to respond to a Soviet attack.

The 50 bombs still at Incirlik Air Base, in southern Turkey – and others in Belgium, Germany, Italy and the Netherlands – are the last nuclear remnants of that Cold War strategy. The U.S. began pulling nuclear bombs out of NATO countries after the Cold War ended, and since 2000 has removed 40 bombs from Turkey. Two decades ago, the Turkish Air Force stopped equipping its planes to drop B-61s. Now the bombs at Incirlik could only be used if U.S. pilots first flew nuclear-weapon-capable planes there to load them up. The bombs were left in Turkey even after a 2016 coup attempt raised serious concerns about their safety. After that event, the U.S. Defense and Energy departments began planning how to remove them – but didn't actually bring them back to the U.S....

**How Secure are They?:** U.S. nuclear weapons are stored in hardened bunkers, protected by electronic systems and heavily armed U.S. troops. The Pentagon has recently reinforced both of those methods of defense. The bombs themselves also require 12-digit codes to activate them. However, those protections are only strong enough to delay unauthorized use, rather than actually prevent it. If those barriers were overcome, U.S. forces could disable the weapons by destroying electrical components or detonating their chemical high explosive without causing a

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Still the U.S. procedures are not designed to prevent skilled attacks or sabotage, especially from an ally. With enough time, Turkey could make use of the nuclear material – if not to detonate in an actual nuclear explosion, then to “release disastrous and deadly radiation.”

**What's Wrong with Removing them?** Taking the weapons out of Turkey carries some physical risks. The bombs aren't terribly heavy – roughly 700 pounds each – but moving nuclear material requires significant security. In

addition, the Turkish government would have to help – or at least not stand in the way – of landing transport planes or sending cargo convoys by land or sea.

The greater risks are likely to be political. Those concerns have discouraged previous US administrations from removing the bombs, even

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though Turkey's defense community isn't particularly interested in using them. Some NATO members are home to US nuclear bombs. During the Cold War, the US stored nuclear weapons in several NATO member countries. Some of them still remain on foreign soil. One US concern is that Turkey could perceive the move as a push away from NATO.

That could lead to Turkey seeking closer ties with Russia. In addition, pulling the nuclear weapons out of Turkey could prompt requests to remove other bombs from Belgium, the Netherlands and Germany, where they are publicly unpopular.

A new worry just arose, when Turkish President Recep Tayyip Erdogan recently mused whether perhaps Turkey should leave the Nuclear Non-Proliferation Treaty and develop its own nuclear arsenal. U.S. officials have long feared that pulling the American nuclear bombs out could encourage Erdogan to try to turn that bluster into reality. Unintentionally, Trump's efforts to provide reassurance may have made this challenge more difficult. The presence of B-61s in the five countries is an open secret, confirmed by independent observers. But it has nonetheless been NATO policy not to acknowledge the deployments, giving local politicians and the U.S. a shield from parliamentary and public oversight. By publicly confirming that the weapons were in Turkey, Trump has raised the political stakes should he try to remove them, and made it more difficult for the United States and Turkey to strike a quiet deal to that effect.

Source: <http://theconversation.com>, *The Conversation*, 24 October 2019.

**OPINION – Lauren Sukin**

**Elizabeth Warren Wants a Nuclear No First Use Policy, But it won't be Easy to Implement**

While President Donald Trump boasts about the "tippy top" shape of the U.S. nuclear arsenal, Senator Elizabeth Warren (D-MA) has a much more reasonable plan for American nuclear weapons, outlined in her co-sponsored fourteen-word bill that aims to radically alter the conditions under which the United States can use nuclear weapons. The bill (S. 272/H.R. 921) reads simply:

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**If President Warren were committed to adopting this sensible strategy, she wouldn't be the first to make the attempt. Both Presidents Bill Clinton and Barack Obama tried—but failed—to incorporate NFU into their Nuclear Posture Reviews (NPR), the document that defines an administration's official outlook on nuclear weapons. If Warren wants an NFU, she should look to these Democratic presidents' pasts to learn how to make her lofty goal achievable.**

"It is the policy of the United States to not use nuclear weapons first." The idea—called NFU—has been around since the Cold War, but it has never officially been U.S. policy. If President Warren were committed to adopting this sensible strategy, she wouldn't be the first to make the attempt. Both Presidents Bill Clinton and Barack Obama tried—but failed—to incorporate NFU into their Nuclear Posture Reviews (NPR), the document that defines an administration's official outlook on nuclear weapons. If Warren wants an NFU, she should look to these Democratic presidents' pasts to learn how to make her lofty goal achievable.

*The Clinton Administration: Lacking Civilian Leadership:* President Clinton showed an early interest in nuclear reform with his appointment of Les Aspin as Secretary of Defense. Aspin had formerly been the chairman of the House Armed Services Committee, where he had championed the cooperative threat reduction program and

argued that "a world without nuclear weapons would actually be better."

In early meetings, Aspin as well as the Assistant Secretary of Defense for Nuclear Security and Counterproliferation, Ashton Carter, pushed for those writing the NPR to consider options—like the total elimination of nuclear weapons and the adoption of NFU. But the military—which was primarily in charge of the review—had little interest in changing U.S. nuclear posture. When experts gave presentations to the NPR committees and recommended reforms, the military reportedly responded by looking "puzzled beyond redemption." Said one official: "We

certainly weren't about to invite any weirdos from the ACDA [Arms Control and Disarmament Agency]" to the NPR meetings.

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With this as the prevailing attitude, it was clear that without aggressive, hands-on leadership by the Clinton administration, reform wasn't going to happen. General Charles Horner later wrote of the process: "Don't ask the Pentagon to change the Pentagon. I think it has to come from the outside. The Pentagon won't recognize the truth. The executive branch has to provide leadership." But in this case, the executive branch didn't.

Civilians at the top levels, including President Clinton, took a backseat on the NPR. There were other, more pressing, security concerns, and Clinton was generally more focused on domestic issues to start with. Without top-down leadership, Aspin and Carter—for all their good intentions—were unable to exert much control over the NPR process or final product.

Ultimately, Carter tried a last-ditch effort. Sensing the reluctance of NPR committees to adopt any real changes, Carter resorted to creating his own separate, parallel committee, headed by members of his own staff. However, after the commission presented its findings, Carter was pulled into a secret meeting at the Pentagon, where the military establishment told him he should not interfere any further with the NPR. Then, at the end of 1993, Aspin was asked to resign from his office, and it was clear then that the hopes for radical policy change were over.

***The Obama Administration: Too Many Cooks:*** Unlike Clinton, Obama took a very active role in the construction of his NPR. The committees for

the 2010 NPR were interagency, with members from the Departments of Defense, Energy, State, and others. The size and complexity of the project, therefore, demanded executive leadership, and in turn, both President Obama and his Secretary of Defense, Robert Gates, took active roles in organizing the committees and steering the direction of their conclusions. Obama even reportedly edited the final text of the NPR himself. In the end, though, leadership wasn't enough.

The Obama Administration's NPR was wracked by the tension between realists and idealists. On one hand, Obama had promised to bring about major nuclear reforms, such as committing the United States to the total elimination of nuclear weapons. On the other hand, the military continued to press instead for the document to focus on pragmatic, traditionalist approaches to problems like nuclear terrorism and proliferation. Even Obama's own national security personnel disagreed amongst themselves. One history of the process explains that it "was almost immediately bogged down by infighting among the senior officials involved.

The final product was the result of 150 meetings, including 30 convened by the National Security Council, and repeated interventions by Obama himself, all of which constituted a bureaucratic round-robin that revealed the inability to reach consensus." In the end, the review was caught up—and reforms were gutted—in these internal conflicts. In fact, the review was not even released until months after its original deadline. The final draft of the NPR reflected stalemate. There would be arsenal cuts, but slowly. Disarmament would be balanced by increased funding for nuclear modernization. All these compromises made the NPR ambiguous, difficult to interpret, and unsatisfactory to many reformists and traditionalists alike. For example, the NPR's

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approach to nuclear use is ambiguous and sometimes contradictory. The role of nuclear weapons would be reduced and the United States would commit not to “use or threaten to use nuclear weapons against non-nuclear weapons states that are party to the NPT and in compliance with their nuclear non-proliferation obligations,” except that protection could potentially be revoked if those states used chemical or biological weapons. At the same time, nuclear first use would still be acceptable against “states that possess nuclear weapons and states not in compliance with their nuclear non-proliferation obligation” if such states posed a conventional, chemical, biological, or nuclear threat to the United States or any of its allies.

In many ways, the policy was a moving target. For example, Secretary of Defense Robert Gates claimed the United States “would not use nuclear weapons against a non-nuclear state that attacked us with chemical and biological weapons”—even though the NPR had explicitly reserved that right. After the NPR’s release, the public discussion focused on how exactly the United States would decide when nuclear use was allowed. Charles Krauthammer wrote: “Imagine the scenario: Hundreds of thousands are lying dead in the streets of Boston after a massive anthrax or nerve gas attack. The President immediately calls in the lawyers to determine whether the attacking state is in compliance with the NPT.” Former CIA director and member of the Strategic Posture Commission James Woolsey caustically remarked: “If, under Obama’s new policy, an ally is attacked by biological weapons, the United States is going to have to do a study to first see if whoever attacked is observing the NPT.” Others suggested it wouldn’t be the United States running such a study at all, but an international body. With all this complexity, one thing about the new policy was clear: An NFU

policy it was not.

**Lessons for the Next President:** If the next president wants to implement NFU, what should they do differently? First, an improved NPR process would involve hands-on, consistent leadership from civilian executives. Second, the next president will need to bridge differences of opinion between traditionalists and those who are more reform-minded. That means choosing civilian leaders of the NPR effort who have and commit to building a

good rapport with the military establishment and military leaders who are receptive to new ideas while using their expertise to ensure that any adopted policies are beneficial, clear, and implementable. In addition, it would be best if the NPR committees were composed of a small selection of the most qualified officials, ones with the resolve and expertise to seriously—and carefully—

**The next president must commit to a singular, comprehensible vision. While some degree of compromise is always essential, compromise that goes so far as to create unwanted ambiguity is something to be strictly avoided. If the next president—Warren or otherwise—can successfully manage the process of writing an NPR, they will have the opportunity to radically reshape the role of nuclear weapons in American politics.**

investigate new policy ideas and revisit old ones. Finally, the next president must commit to a singular, comprehensible vision. While some degree of compromise is always essential, compromise that goes so far as to create unwanted ambiguity is something to be strictly avoided. If the next president—Warren or otherwise—can successfully manage the process of writing an NPR, they will have the opportunity to radically reshape the role of nuclear weapons in American politics.

Source: *The National Interest*, 24 October 2019.

**OPINION – Mark Hibbs**

**Scratching Erdogan’s Nuclear Itch**

News media reporters can be counted on to scratch their Country X-is-going-nuclear itch whenever its armed forces burst across its borders, and this week was no exception following Turkey’s invasion of Syria. On October 22 the *New York Times* went over the top in headlining that President Recip Tayyip Erdogan “says he wants nuclear weapons” after



he complained in public appearances in September and October that the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) is unfair.

At the United Nations General Assembly on September 24 Erdogan said in fact: "nuclear power should be either free for all or banned." In Turkey the week before, Erdogan said he "cannot accept" that a few powerful states have nuclear weapons on missiles while the rest of the world is denied the right to have them. Turkey would have the legal right to have nuclear weapons if it quit the NPT, a treaty Ankara has been party to since 1980. Alternatively, if indeed Turkey wanted to develop nuclear weapons it could instead stay in the NPT and cheat. Either way, Erdogan's recent statements likely made it more difficult for him to conceal secret nuclear activities. So what to conclude from all the noise before the microphones? Erdogan's words loudly signaled that he intends to heed Turkey's national interests as he defines them, but they hardly amounted to a programmatic announcement that Turkey wants the Bomb.

The Times article is on more solid ground in pointing out that Turkey is on a trajectory toward raising its nuclear industry profile, but it did not identify any specific activities that Turkey is currently or plans to be engaged in that would move Ankara closer to having a nuclear weapons capability. During the last decade, most of the things Turkey has been doing in the nuclear field have been documented by researchers including myself and a few colleagues. The Times mentioned in passing this research, then indirectly cited former IAEA safeguards director Olli Heinonen, without giving

details, as estimating that Turkey could get to the threshold of having a nuclear bomb option in "four

or five years, or sooner, with substantial foreign help." That may sound worrying, but I could draft a list of maybe two dozen other NPT states parties that fall into that same category.

*PIE in the Sky?:* In the meantime Turkey has gone forward with its project to

deploy Russian nuclear power reactors, and that raises the question, also noted by the Times, whether Turkey's VVER spent fuel might become a potential nuclear weapons asset. So far, Russia and Turkey have not specified that the spent fuel will be repatriated to Russia for reprocessing followed by return of separated highly toxic wastes to Turkey.

Would Russia help Turkey in the sensitive areas of spent nuclear fuel management? Russia and other VVER-operating states have shared considerable experience they have gathered about the behavior of nuclear fuel materials. There is

a lot to know, and Turkey will doubtless learn it if its nuclear power program with Russia is successful. But more questionable and even doubtful is whether Turkey will get Russian approval to venture into areas that would generate valuable know-how related to spent fuel reprocessing, by carrying out destructive post-irradiation examinations (PIE) on its Russian-supplied spent

fuel. Doing this requires specialized hot laboratory equipment including glove boxes, hot cells, and robotic devices. Because of its sensitivity, in some cases the United States has been reluctant to share this knowledge and technology with certain partner countries, most notably South Korea.

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From the inception of the Soviet Union's foreign nuclear cooperation activities, Moscow has been very restrictive about cooperating with its VVER recipient states on PIE. This policy appears to have both security/non-proliferation and commercial drivers; in recent years Russia's state-controlled nuclear vendor Rosatom has been challenged by Western companies aiming to make VVER fuel; Rosatom regards PIE data on Russian nuclear fuel as proprietary.

This 2007 report concluded that the only hot lab in eastern Europe outside of Russia that could do a PIE for VVER spent fuel is in Romania, a country that has no VVERs.

Russia is an NPT nuclear weapon state and it has a special responsibility to establish limits on its cooperation with Turkey and other states where it has supplied VVER power reactors. Russia knows this very well: At Bushehr it has been prudently

cooperating with Iran since it took over Germany's defunct nuclear power plant construction project in 1995. The JCPOA in 2015 committed Iran not to reprocess irradiated reactor fuel, and not to carry out any destructive PIE for at least fifteen years. In any case, all the spent fuel from Bushehr-1 is expected to be repatriated to Russia, and it may be therefore assumed that no PIE in Iran for Bushehr would be necessary. Russia will have to decide whether to permit Turkey to do PIE for its spent fuel should the fuel not be sent back to Russia for reprocessing.

Some Western officials speculate that Russia believes its strategic interests are served by permitting its client states to develop dual-use nuclear capabilities and grey areas in their nuclear programs that Russia in its bilateral relationship with these states might exploit in its favor and against Western powers. True or not, ultimately Russia knows that a nuclear power plant

investment has a lifetime of a century or more, and that Moscow may not be able to control its long-term nuclear cooperation clients—North Korea being the best example. Rosatom is not only a state-owned enterprise but also a commercial company doing business worldwide; it has no interest in acquiring an international reputation for abetting the spread of nuclear weapons

capabilities. The same goes for nuclear safety and security. Russia has gone the extra mile to make sure that Iran—the only state with an operating nuclear power reactor that is not a party to the global Nuclear Safety Convention—operates Bushehr-1 safely.

Turkey's prime nuclear R&D center, CNAEM, has a laboratory equipped with a large hot cell. It was set up to facilitate the transport of radioisotopes and it might not be equipped to handle irradiated uranium reactor fuel. Turkey could in

principle import reprocessing-grade hot cell equipment from a foreign supplier to do spent fuel PIE, but that equipment is specifically listed for export control on the dual-use annex of the Nuclear Suppliers Group (Turkey knows this because it is an NSG member). The IAEA is familiar with the CNAEM hot cell and its operation, and this nuclear activity has not deterred the IAEA from giving Turkey the so-called Broader Conclusion for safeguards annually since 2012 as I described in this previous post, meaning that the IAEA is satisfied that all nuclear material in Turkey is in peaceful use. The IAEA re-evaluates Turkey's safeguards compliance every year. With respect to Turkey's Broader Conclusion, it may be assumed that the IAEA will consider Erdogan's recent statements during the course of its next *annual safeguards state evaluation*.

Source: *Arms Control Wonk*, 22 October 2019.

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NUCLEAR STRATEGY

USA-JAPAN

Nuclear Deterrence: Mixed Messages for Japan

The credibility of US extended nuclear deterrence is a critical issue that goes beyond the question of Japanese psychology and perception; it potentially influences the direction of Japan's security policy, compellence and/or attacks by adversaries on Japan, and even Asian stability.

Japan's faith in US extended nuclear deterrence had been shaken even before the Trump era. Since the end of the Cold War, China has steadily modernized and built up its nuclear forces, and the survivability and penetrability of its strategic nuclear forces targeting the United States has improved. In the 2010s, North Korea bolstered non-strategic nuclear forces targeting Japan and moved toward the acquisition of strategic nuclear forces that kept the United States within range. These developments not only heightened Japan's threat perception on China and North Korea but also made Japan increasingly concerned about a possible decoupling between Japan and the United States: "Will the United States defend Japan even if its mainland is exposed to danger?"

In addition, the downsizing of U.S. nuclear forces under the Obama administration caused Japanese conservative politicians and security officials to be skeptical of the appropriateness of the U.S. deterrence posture. In particular, the retirement of TLAM-N, a non-strategic nuclear-armed SLCM

increased concerns about the decoupling between Japan and the United States. This is because it could result in the situation where the U.S. deterrence posture in Asia depends solely on strategic nuclear forces and could create a gap in the U.S. escalation ladder. Moreover, the victory of Donald Trump, who bluntly criticized the Japan-U.S. alliance for its inequality and provided verbal approval of Japan's nuclear armament during the US presidential election

campaign in 2016, triggered a general skepticism that the United States would be reluctant to engage in Japanese security. Immediately after his inauguration as US president, however, Trump issued a reassuring statement following a summit with Japanese Prime Minister Shinzo Abe: "The US commitment to defend Japan through the full range of US military capabilities, both nuclear and conventional, is unwavering." In response to North Korea's launch of ballistic missiles the following day, he added publicly, "The United States of America stands behind Japan, its great ally, 100%." The resolve shown by the new and mercurial US president on extended nuclear deterrence offered Japan a sense of security.

More important to Japan was the fact that the Trump administration reinforced the U.S. commitment by building up its nuclear forces. Stating that "the United States will enhance the flexibility and range of its tailored deterrence options for its and allied security," the Nuclear Posture Review (NPR) in February 2018 announced the development of non-strategic nuclear forces – a low-yield SLBM warhead and new SLCM. The NPR featured these as alternatives to TLAM-N, which had contributed to deterrence

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extended to U.S. allies in Asia. This measure was exactly what Japanese conservative politicians and security officials have sought in order to close the gap in the U.S. escalation ladder.

For this reason, the Abe administration praised the NPR as demonstrated by the Foreign Minister's comment that the NPR clarified "the U.S. resolve to ensure the effectiveness of its deterrence and its commitment to providing extended deterrence to its allies including Japan." To be sure, the U.S. building up its non-strategic nuclear forces creates the strategic issue of lowering the nuclear threshold and political issues over the introduction of nuclear weapons into allies' soil. But, in the current Asian security environment, it also increases the credibility of U.S. extended deterrence.

At the same time, however, the Trump administration has been heightening Japan's concerns about the U.S. credibility. The president's dramatic shift in policy toward North Korea has had a particularly large impact. In a sudden decision in March 2018, he elected to meet with Kim Jong-un. The Trump-Kim summit in June brought an end to the strict Complete, Verifiable, Irreversible Denuclearization (CVID) expression that had hitherto been used to describe U.S. demand's vis a vis Pyongyang's nuclear weapons program. When North Korea launched a number of short-range missiles in the summer of 2019, the Trump administration repeatedly stated

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**On the surface, the Japanese government has acknowledged the U.S. shift in North Korean policy. But the change could leave Japan feeling somewhat skeptical about Washington's will to provide extended nuclear deterrence. The Abe administration had been applying maximum pressure on North Korea in collaboration with the Trump administration, with a focus on CVID. But the United States changed its policy without prior consultation, effectively leaving Japan behind. The Trump administration's acceptance of North Korea firing short-range missiles shows that this concern is hardly misplaced. If the United States were to reach such an agreement, Japan will conclude that Washington has sacrificed the security of an ally for the sake of its own interests. This would decisively increase Japan's feelings of distrust in the United States as a provider of extended nuclear deterrence.**

that it did not see that as a problem.

On the surface, the Japanese government has acknowledged the U.S. shift in North Korean policy. But the change could leave Japan feeling somewhat skeptical about Washington's will to provide extended nuclear deterrence. The Abe administration had been applying maximum pressure on North Korea in collaboration with the Trump administration, with a focus on CVID. But the United States changed its policy without prior consultation, effectively leaving Japan behind. The Japanese reconfirmed Trump's unpredictability and is increasingly worried that he may make a "deal" with North Korea that ignores Japanese security. More specifically, Japan is concerned about the possibility of agreements on freezing strategic nuclear forces that reach the United States, allowing Pyongyang to maintain non-strategic nuclear forces that do not reach the United States but keep Japan within range. The Trump administration's acceptance of North Korea firing short-range missiles shows that this concern is hardly misplaced. If the United States were to reach such an agreement, Japan will conclude that Washington has sacrificed the security of an ally for

the sake of its own interests. This would decisively increase Japan's feelings of distrust in the United States as a provider of extended nuclear deterrence.

In general, the credibility of extended deterrence depends on the intentions and capabilities of the state offering it. As the U.S. president's repeated contradictions of earlier remarks and his broken promises, including his abrupt North Korea policy shift, have increased the uncertainty of U.S. intentions, the credibility of U.S. extended nuclear deterrence has become more dependent on its nuclear capabilities. In these circumstances, if U.S. nuclear forces are not to be strengthened as planned in the NPR, the U.S. commitments to defend Japan and other allies can be seen as empty promises and bluffs. American diplomacy will doubtless be quite unstable in the run-up to the presidential election in 2020, but it will also be important to take careful note of U.S. military trends.

Source: Shingo Yoshida, *The Diplomat*, 17 October 2019.

## **BALLISTIC MISSILE DEFENCE**

### **INDIA**

#### **DRDO Starts Work on 'Next-Gen' Hypersonic Weapon**

The Defence Research and Development (DRDO) has started work to produce a hypersonic weapon – missiles that travel at five times speed of sound, or a little over a mile every second. A wind tunnel to test and fine tune the technology will be operational soon, senior government officials who did not want to be named said. Defence Minister Rajnath Singh is expected to inaugurate the facility soon, they added.

"A hypersonic weapon system is one of the many niche technologies we are exploring seriously," one of the officials said, asking not to be named. Billed as a "next-gen" weapon system, the race to acquire hypersonic weapons technology is heating up. China, Russia, and the United States are testing hypersonic weapons of various types

to enhance strategic nuclear deterrence and strengthen front-line combat units. Existing ICBM re-entry vehicles also travel at those superfast speeds, but the hypersonic glide vehicles now in development are far more manoeuvrable, making their tracking and interception nearly impossible.

... In a bid to boost defence manufacturing in India, the DRDO is also offering 1,500 of its patents, including critical missile technology, life sciences, and naval technology, for use by Indian Industry, DRDO chairman G Satish Reddy said. The patents can be accessed by free of cost even by start-ups and medium and small manufacturing enterprises.

**In a bid to boost defence manufacturing in India, the DRDO is also offering 1,500 of its patents, including critical missile technology, life sciences, and naval technology, for use by Indian Industry, DRDO chairman G Satish Reddy said. The patents can be accessed by free of cost even by start-ups and medium and small manufacturing enterprises.**

Some of the patents offered for free include technologies to manufacture "man-mounted air-conditioning system", aircraft arrester

barrier system, a sliding mechanism for missile containers, lightweight high strength broadband microwave absorbing rubber, silicon-based lubricants for wide temperature range applications, low-density carbon foam, and anti-corrosive paint for application under immersed conditions, among others. "DRDO is determined to encourage industry to develop advanced defence equipment thereby making the Make-In-India programme a success. We have today an 1,800-industry base, we are determined to enlarge this base and take the technological capability to a higher level," Reddy said, explaining the reason behind offering patents at no cost.

Indian industry will not have pay "license fee or royalty" for any of the patented technologies, said a second senior DRDO official who did not want to be named. "DRDO won't be just offering the technology but will also be handholding the industry and help them produce the product," he said. In a related development, DRDO has also tweaked its policy for "Transfer of Technology" (ToT) to the industry. No, ToT fee will be charged from the industry, DRDO Development Partners

developing systems or sub-systems for military applications. And, for other industries, the ToT fee is reduced to 5% against an earlier rate of 20%. Also, no royalty is charged for supply to Indian Armed forces and other Govt departments. A nominal royalty of 2% will be charged for supply in the commercial market and for exports. ...

*Source: Sudhi Ranjan Sen, Hindustan Times, 21 October 2019.*

## **RUSSIA**

### **Russian Nuclear Submarine Aborts Ballistic Missile Test**

A Russian nuclear submarine aborted the test firing of an intercontinental ballistic missile during a military exercise overseen by President Vladimir Putin, the Ministry of Defence said. The nuclear submarine, K-44 Ryazan, part of Russia's Pacific Fleet, was meant to launch two R-29R ballistic missiles from the Sea of Okhotsk on Oct. 17, but fired only one successfully with the other remaining in its tube onboard the submarine the Vedomosti daily reported earlier.

The incident occurred on the same day as Putin oversaw the drills from a command center at the Defence Ministry in Moscow. The aborted drill was part of wider war games for Russia's armed forces, known as 'Thunder 2019,' which were designed to test the readiness of the country's strategic forces for a nuclear conflict. The Defence Ministry confirmed the incident with the ballistic missile, but rejected an assertion by Vedomosti that the failure to launch the second missile had led to an "emergency situation", Russian news agencies reported. "Having assessed the information received just before the launch about the

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technical condition of one of the missiles on the Ryazan submarine, the decision was taken to not use it in a training strike," the defense ministry was cited as saying.

The exercises took place in Russia's Far East and Far North from Oct. 15-17 and involved about 12,000 military personnel, more than 100 aircraft and five

submarines, the defense ministry said in a statement. The naval part of the exercise covered the Barents, Baltic, Black, Caspian and Okhotsk seas. The K-44 Ryazan was first brought into service during the 1980s, but has undergone modernization since then. The launch of the R-29R missiles during the training exercise was necessary to keep them operational, a person close to the Navy's general staff told Vedomosti, saying that they were nearing the end of their service life.

*Source: Alexander Marrow, Reuters, 21 October 2019.*

## **NUCLEAR ENERGY**

### **EUROPE**

#### **Nuclear Needs to be Accepted in Europe if Brussels is Serious About its Climate Targets**

The Taxonomy for Sustainable Investments by the European Commission's Technical Expert Group (TEG) has received a mixed welcome. The technology neutral taxonomy is supposed to make it easier for financing institutions and other investors to find sustainable investment projects that fulfil the criteria for climate mitigation and other environmental objectives. The TEG ran into some internal conflict during the process of preparing the taxonomy. Apparently some TEG members did not want to allow nuclear into the taxonomy with similar criteria that other activities have. The first report by the group, published in June, ended up demanding more

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information on the topic of nuclear energy's environmental credentials.

***Technology Neutral Climate Mitigation, or Not:***

In Autumn, Finland – the current European Council's president – led a proposition to include

“Renewable and climate-neutral activities” as sustainable. In practice, this would mean a much broader toolbox than limiting the tools to “renewable”, which is a somewhat internally inconsistent term in itself, as it ranges from chopping and burning our forests to massive hydro projects to

solar panels on one's roof and wind farms in one's backyard. Europe's three anti-nuclear brothers, Germany, Austria and Luxembourg, ended up voting against Finland's proposition. Now the case is discussed in the “Trilog” of the European Commission, Parliament and Council. What happens next with the taxonomy depends greatly on the outcome of these discussions.

The negotiators should note that there is another central topic that might depend on the result the

Trilog comes up with: that of the level of ambition of Europe's common climate targets and its social and political acceptance. Many European countries are planning to use nuclear energy as a central tool in their energy mix, both to cut emissions (and emissions costs in the ETS) and to improve energy security.

Many of these countries, such as the Czech Republic, Hungary, Bulgaria and Poland, have energy security and economic development of their people at the heart of their policies – of which a key part is the possibility to increase productivity and competitiveness with affordable energy. At least some of these countries have been unenthusiastic on the emission reduction targets planned by other EU countries, as a big part of their domestic energy use is produced with coal

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**Some of these countries have been unenthusiastic on the emission reduction targets planned by other EU countries, as a big part of their domestic energy use is produced with coal and other fossil fuels. They need a viable alternative, and see nuclear as just that.**

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As a latest gesture of tone-deafness, German Green politicians demand that their Federal Government try to prevent France from going

ahead with their preliminary plans to build six more nuclear reactors by 2035, which would likely replace some of their aging plants. German electricity is five to ten times more carbon intensive than French electricity. Perhaps it would be prudent for the

Germans to clean up their own act before advising others what to do.

***European Climate Policy at Stake?***

If use and expansion of nuclear energy is made even harder than it is today by leaving it outside the taxonomy, there is a significant risk that these countries will walk away from the European climate targets. And they have good reasons to do so: the socio-political acceptance for massive emission reductions, and the implied costs, in

these countries is shaky as it is. If these reductions are needlessly made even harder and costlier by limiting the available toolbox to adhere to the political preferences of some rich countries, the thought of having an ambitious climate policy

loses what social licence it might have held. It becomes very unlikely that any serious politician would even try to get such a mandate from the people, and even less likely that he would get it.

It is incongruous to demand ambitious levels of climate policy from a country with one hand and then take away the tools they want to use to achieve it with the other. The scale of the effects of this are staggering, considering that the IAEA estimates that nuclear power avoids almost

2 billion tonnes of CO2 being emitted each year, the equivalent of “taking over 400 million cars off the road per year.” Accepting nuclear energy into our toolkit for climate mitigation improves both the acceptability of more ambitious targets and the likelihood that we will be able to meet them. It is high time we all take climate mitigation seriously and give up opposing every other technology available for the job.

Source: Rauli Partanen, <https://www.sustainability-times.com>, 25 October 2019.

**GENERAL**

**Bill Gates’ Nuclear Reactor Hits a Roadblock**

Bill Gates is optimistic about the future—and the role of nuclear energy as an environmentally friendly energy source—but he faces significant obstacles along the way. His company, TerraPower, is working on new technologies to revolutionize nuclear power. One of them is a traveling wave reactor (TWR). A TWR doesn’t rely exclusively on enriched uranium, which is expensive to acquire and the waste is problematic to store with a half-life of almost 4.5 billion years. Rather, TWR initiates the reaction with enriched uranium then switches to depleted uranium, the waste left over from uranium enrichment. A TWR could run on depleted uranium for decades. Rather than cooling the reactor with water, a TWR uses liquid sodium as a coolant. The reactor can therefore operate at a lower temperature than conventional reactors and is less vulnerable to a Chernobyl-type accident. TerraPower is also developing a molten chloride fast reactor, which uses molten salt as a coolant and as the fuel medium, giving it the potential to significantly boost efficiency.

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**TerraPower had signed a promising agreement with China to build a demonstration reactor, but the project has been shuttered due to China-U.S. trade tensions. The company is now lobbying Congress for a public-private partnership to fund the reactor.**

At TerraPower’s state-of-the-art Bellevue lab, engineers put sophisticated computer models of the company’s technologies through real-world tests without having to use actual radioactive fuel. Powerful cutting-edge computers process the data at a complexity and speed previously unheard of in the nuclear industry. “The new thing is advanced physics, enabled by modern computing power that was really only

available in the last 10 to 15 years,” said Chris Levesque, TerraPower president and CEO. TerraPower recently hit an important milestone: 1,000 hours of continuous operations on an isothermal loop that is testing the effects of moving molten salt through a reactor. This is a significant step forward in the company’s efforts to create a licensed demonstration reactor. One major problem with a TWR power plant is the price. It will cost about \$3 billion to build a demonstration reactor. Even Bill Gates isn’t rich enough to fund it himself.

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Source: *Engineering.com*, 21 October 2019.



**Poland's Richest Man to Work with GE Hitachi on Mini Nuclear Plant**

Synthos, a chemical group owned by Poland's richest man Michal Solowow, has agreed to work with GE Hitachi Nuclear Energy on developing technology for a small modular reactor (SMR), Hitachi said. Poland still generates most of its electricity from coal but more and more companies are exploring low-carbon options. "Utilizing small modular reactors to generate clean energy will improve our chances to move away from coal and have a positive impact on our industry and nation," Solowow was quoted as saying.

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Polish financial newspaper *Puls Biznesu* quoted Solowow saying the Synthos and GE Hitachi joint project to build a 300 MW SMR unit will be completed in the next 10 years with capital spending expected at below \$1 billion. Synthos was not immediately available to comment. Small modular reactors use existing or new nuclear technology scaled down to a fraction of the size of larger plants and would be able to produce around a tenth of the electricity created by large-scale projects.

Poland plans to build its first traditional nuclear power plant over the next 20 years but is struggling to work out a financing model for the project. Some government officials were quoted as saying earlier this year that Poland could also develop small modular reactors, but a specific plan has not so far been set out. Warsaw faces increased pressure from the European Union to cut carbon emissions, but argues that phasing out coal cannot

**Warsaw faces increased pressure from the European Union to cut carbon emissions, but argues that phasing out coal cannot be done overnight. "Small modular reactors can play a significant role in addressing Poland's energy challenges, the modernization of the nation's energy sector and in achieving necessary and responsible deep decarbonization," Solowow said in the statement.**

be done overnight. "Small modular reactors can play a significant role in addressing Poland's energy challenges, the modernization of the nation's energy sector and in achieving necessary and responsible deep decarbonization," Solowow said in the statement. In June Poland led a handful of eastern EU states in blocking a push by France and most others to commit the bloc to net zero emissions by mid-century. "It is not so easy to switch onto renewable energy sources and nuclear energy is an alternative which might be used," Poland's Finance Minister Jerzy

Kwiecinski told public radio. GE Hitachi Nuclear Energy is a global nuclear venture between Japan's Hitachi and General Electric of the United States.

*Source: Agnieszka Barteczko, <https://www.reuters.com>, 22 October 2019.*

**INDIA**

**7 Nuclear Reactors Under Construction, 17 More on the Way: Atomic Energy Secretary KN Vyas**

To increase standardisation and bring modularity in building atomic power reactors, the Nuclear Power Corporation of India Limited or NPCIL is going for fleet mode construction for future projects, Department of Atomic Energy Secretary KN Vyas said on. Speaking at the India Energy Forum's Nuclear Conclave, Mr Vyas

said 17 new reactors are now in the pipeline, with seven already under construction. India plans to build 21 new nuclear power plants by 2030, the atomic energy agency had said last year, adding that work has been going on as per schedule. "We are going in for fleet mode for construction,

thereby reducing construction costs and speeding up construction time," Mr Vyas, who is also the Chairman of the Atomic Energy Commission, said. He said India is an old player in the nuclear energy sector with the first research reactor in Asia being commissioned in the country. "Our learning curve was steep and we could ramp up the reactor construction to 22 reactors over the last few decades, the seventh largest fleet in the world," Mr Vyas added.

Though the overall contribution to the electrical grid does appear insignificant, this has been due to the smaller capacity reactors built initially to gain experience in this complex technology, without international support, he noted. Participating in the event, Minister of State in the Prime Minister's Office Jitendra Singh said awareness needs to be created among the public about busting the myths associated with the use of nuclear energy.

He said nuclear energy is a source of energy to meet the rising energy demands of the country and it is an instrument of 'ease of living' in one's day-to-day life. Former Atomic Energy Commission Chairman Anil Kakodkar said the access to the imported uranium can accelerate the nuclear programme's size as well as large scale thorium deployment. Referring to the waiver of the NSG to India in 2008, he said the nuclear programme now has much less constraints. He talked about short-term actions on the part of DAE, such as early movement on the Fast Breeder Reactor or FBR deployment and early deployment of indigenous Light Water Reactors.

Source: <https://www.ndtv.com>, 19 October 2019.

## **RUSSIA**

### **What You should Know about Rwanda's Newly Approved Nuclear Deal with Russia**

The Rwandan cabinet has approved an intergovernmental cooperation agreement with

Russia to advance the peaceful use of nuclear energy as a tool for socio-economic transformation in the East African nation. With the application of atomic energy, the nuclear power deal is set to modernize vital sectors such as agriculture, electricity generation, health, geology and mining amongst others in Rwanda. The agreement was first signed in Moscow last December but was revisited in May 2019 when Rosatom Global, the Russian government nuclear parastatal, said it will help Rwanda set up the nuclear plant by 2024. The roadmap signing in

May took place between Rosatom Deputy Director General Nikolay Spasskiy and Ambassador of Rwanda to Russia, Dr Jeanne d'Arc Mujawamariya.

In line with the agreement, a Centre for Nuclear Science and Technology and a Nuclear power plant in Kigali by Russian scientists. This will

facilitate experiments and scientific research. The approval of this nuclear deal comes ahead of the first Russia-African Forum in the city of Sochi, which President Paul Kagame has confirmed attendance, accompanied by a delegation of senior government officials.

Russia which is among the leading producers of nuclear energy in the world has signed similar cooperation agreements with other African countries despite questions over the appropriateness of the technology in the continent. In Ghana, The Ministry of Environment, Science, Technology and Innovation (MESTI), through the Ghana Atomic Energy Commission (GAEC), also signed a Memorandum of Agreement with Rosatom for the construction of a Nuclear Power Plant in the West African country.

Rosatom trains local specialists in nuclear physics and energy in several African nations and runs a scholarship programme in Kenya. Considering its relatively low cost, low pollution, and high energy density, nuclear energy has recently gained more popularity amongst nations who are willing

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to diversify their country's source of energy and explore the socio-economic benefits that nuclear energy presents besides energy independence.

*Source: Treasure Nnabugwu, <http://venturesafrica.com/>, 22 October 2019.*

### **Russia 'Ready to Help' Develop Nuclear Energy in Philippines, Envoy Says**

A Russian official clarified that an agreement to explore the possibility of constructing floating nuclear power plants for the Philippines was preliminary and could not advance without approval from the government in Manila. Russia is ready to assist the Philippines in its energy needs, pending approval, Moscow's envoy to Manila, Igor Khovaev, told reporters.

"We have the most sophisticated technologies in this field and we are ready to help the Philippines in developing your nuclear energy," Khovaev said, adding, "provided that our Philippine partners want to do that." He confirmed that a memorandum of intent between the Philippines energy department and the Rosatom State Atomic Agency to study the possibility of nuclear power plants here, including floating ones, was signed during President Rodrigo Duterte's visit to Russia earlier this month.

Duterte had earlier said the deal was still under study by his cabinet, as it might not be legal under the nation's constitution, which bars nuclear weapons in Philippine territory. "The Constitution would not like it. That is why I have to talk to the cabinet. I cannot affirm or deny that, because that's part of the proposals," Duterte said on Oct. 6, according to CNN Philippines. The president had just returned from a five-day trip to Russia. The Russian firm announced in April 2018 that it had constructed the world's first floating nuclear power unit, dubbed "Academik Lomonosov." It sailed to

the Arctic port of Murmansk and from there left on a 4,000-mile journey to Pevek, another Russian city, in August 2019.

No country in Southeast Asia has a functioning civilian nuclear power plant. A previous attempt to bring nuclear power to the Philippines never materialized. Under the late dictator Ferdinand Marcos, the country began construction of the Bataan Nuclear Power Plant in 1976, in an area about 100 km (62 miles) west of Manila. The plant, constructed above a major fault line, was mothballed amid safety concerns in the wake of the 1986 Chernobyl disaster.

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Khovaev said the Bataan plant was outdated, making its revival unlikely, but he said both countries could explore future cooperation. "What I want to emphasize is that it is up to you, Filipinos, to decide whether you need nuclear energy or not," he said. "If you decide that you need it, we'll be ready to help. The final say

always belongs to you." He noted that Russia had developed nuclear plants in about 30 countries around the world, and said it was one of the most sophisticated and safe technologies in the world. "And of course any possible cooperation with Russia in this field will be in full compliance with current international law and the relevant criteria and requirements of the International Atomic Agency," he said.

*Source: Jojo Rinoza, <https://www.benarnews.org/>, 22 October 2019.*

## **NUCLEAR COOPERATION**

### **RUSSIA-ETHIOPIA**

#### **Russia, Ethiopia Sign Nuclear Energy Cooperation Agreement at Historic Summit**

Russia and Ethiopia signed an intergovernmental agreement on cooperation in the use of nuclear energy for peaceful purposes, Russia's state

nuclear corporation Rosatom said. The deal, inked on the sidelines of the first Russia-Africa Summit in Sochi, will serve as a starting point for active dialogue between the two countries in the nuclear field, the company said in a statement. It created the legal basis for cooperation between Russia and Ethiopia in creation and improvement of Ethiopia's nuclear infrastructure, regulation in the field of nuclear safety, protection and control of nuclear materials and radiation sources.

The document also laid the legal groundwork for production of radioisotopes and their use in industry, medicine and agriculture, as well as education and training for specialists. In addition, the agreement allows studying the possibility of building a center for nuclear science and technology in Ethiopia, Rosatom said.

Source: <https://www.iol.co.za>, 24 October 2019.

## **RUSSIA-NAMIBIA**

### **Russia Invites Namibia to Cooperate in Production of Nuclear Fuel**

Russian President Vladimir Putin invited Namibian President Hage Geingob to establish cooperation in production of uranium fuel. According to the Russian leader the development of mineral resources, in particular, uranium resources of Namibia could be an important part of the interaction in the energy sector.

"Russia ranks fifth in the world among producers of uranium raw materials. Russia, as a world leader in nuclear energy, nuclear fuel production, and Namibia, as the largest producer of uranium, could establish close cooperation and become good partners," the Russian president said at a meeting with his Namibian counterpart.

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Putin added that Russia is also interested in projects of Namibia's diamond industry. According to him, "there are potentially interesting proposals in the diamond complex." "Our largest producer of rough diamonds, Alrosa, is ready to host a Namibian delegation in Moscow to discuss issues of mutual interest," Putin said. Among possible areas of cooperation he named "joint exploration of areas potentially rich in vanadium, copper, gold, and other minerals."

"There is a legal basis for it [this type of cooperation - TASS] - in 2016, an agreement was signed on cooperation in the field of geology and subsoil use, a memorandum of understanding between Zarubezhgeologia and a Namibian company," Putin noted. The Russian leader also recalled that the United Carriage Company is negotiating with a company from Namibia the modernization of the country's railways, the supply of freight cars and components. "The possibility of large-unit assembly on the spot right in your country is also being considered," Putin told the president of Namibia.

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Among other promising projects, the Russian president named "the construction of ground-based infrastructure for air travel", cooperation in hydropower and the agro-industrial sector. "It implies importing Namibian agricultural products, in particular meat and fish products. We are also counting on the possibility of deliveries of our livestock products to Namibia, and the expansion of exports of grain and fertilizers to Namibia from Russia," Putin said.

Source: <https://tass.com/economy/1084780>, 23 October 2019.

NUCLEAR SECURITY

USA

**US Military Retires Floppy Disks Used by Nuclear Weapons System**

The US Air Force has finally retired the 8-inch floppy disks that could be used in the launching of nuclear missiles from silos around the country, according to a report from defense site C4isrnet. The archaic Strategic Automated Command and Control System switched its storage component from the floppy disks to a “highly-secure solid state digital storage solution” in June, the report said, quoting Lt. Col. Jason Rossi, commander of the Air Force’s 595th Strategic Communications Squadron.

A 60 Minutes tour of the US nuclear control center in 2014 gave the public a glimpse behind the curtain of how the defense sector works. It also revealed that in the event that the US president ordered the launch of a nuclear warhead, the command would rely on 8-inch floppy disks and a 1970s era IBM Series/1 mainframe computer. Rossi told C4isrnet that though the overall computer system is old, its age provides security. “You can’t hack something that doesn’t have an IP address. It’s a very unique system — it is old and it is very good,” Rossi told the publication.

The Air Force is reportedly seeking a replacement for the SACCS system but hasn’t revealed much more information. Rossi told C4isrnet that enhancements were made recently to better enable speed and connectivity. The Air Force didn’t immediately respond to a request for comment.

Source: Shelby Brown, <https://www.cnet.com>, 18 October 2019.

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NUCLEAR PROLIFERATION

TURKEY

**No Longer the Obedient NATO Ally, Erdogan Floats Nuclear Option**

It’s no secret that Turkish President Recep Tayyip Erdogan sees his country as the pre-eminent Muslim power in the Middle East. He regards his vision of political Islam as competing with that of Saudi Arabia and the United Arab Emirates. He frequently accuses the United States of trying to belittle his country, and ruminates about a “greater Turkey.” But does Erdogan believe that Turkey has the right or need to acquire nuclear weapons to cement its status?

Last month the Turkish leader suggested as much, saying that “some countries have missiles with nuclear warheads, not one or two. But we can’t have them. This, I cannot accept.” He went on to single out Israel, saying: “We have Israel nearby, almost as neighbors. They scare others by possessing these. No one can touch them.” It was the first time Erdogan, who was speaking at a provincial rally of his governing AKP party, had raised the subject. It may have been the Turkish leader riling up his nationalist base. It may also have been a warning that, should Iran and Saudi Arabia move toward becoming nuclear-armed states, Turkey would not stand idly by.

Last year, Saudi Arabia’s Crown Prince Mohammed bin Salman told CBS News that the Kingdom “does not want to acquire any nuclear bomb, but without a doubt if Iran developed a nuclear bomb, we will follow suit as soon as possible.” And, in part, the Turkish leader’s remarks may have simply been his trademark blunt — and sometimes incendiary — rhetoric. Erdogan has compared both modern Germany and Israel with the Nazis, and has threatened to unleash hundreds of thousands of Syrian refugees on Europe. But it’s a long leap from a couple of lines at a party meeting to a program to develop nuclear weapons. Turkey is developing

(with Russian help) a nuclear power program, but it is a signatory to the Nuclear Non-Proliferation Treaty, and there is a whole world of difference between energy and weapons. Ziya Meral, senior associate fellow at the Royal United Services Institute (RUSI) in London, says that, at the moment, "there is no tangible sign that Turkey is set to pursue nuclear weapons, nor that we are witnessing a substantial shift in Turkey's decades-long policy of not pursuing them."

"In practical terms, it would take a decade with substantial financial commitment and against substantial global pressure, both of which would make [nuclear weapons] truly costly and damaging," Meral told CNN. Meral says this appeals to religious and conservative circles as well as an influential strand of opinion that welcomes Erdogan taking a stand against what are perceived as the double standards of the West. Under Erdogan, Turkey is no longer the obedient NATO ally guarding the alliance's southern flank against Russian expansionism. Partly in response to Europe's less than wholehearted embrace, Erdogan has imagined a new place for Turkey, one where it will pick and choose its allies and project power thousands of miles from its coast. This expansionist role includes a garrison of troops in Qatar, a growing naval role in the Red Sea, support for Libya's government against the Saudi/UAE-backed forces of Khalifa Haftar and Turkey's largest overseas military base in Somalia. The sea-change in Erdogan's policy came in the wake of the Arab Spring, when he visited Cairo, Tunis and Tripoli to tout the virtues of the "Turkish model" to societies very much in flux, or even chaos: a Muslim society in a secular, free-market state. That didn't work out so well — but the civil war

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**US President Donald Trump's former national security adviser, General H.R. McMaster, regards this as profound, describing it as the greatest geopolitical shift in the post-Cold War era. He told an audience last month that under President Erdogan, Turkey "wants to see itself as shifting away from Europe and being more in the Middle East and more Eastern leaning so that it can play situations to its own advantage."**

that erupted in Syria only deepened Erdogan's determination to project Turkish influence. US President Donald Trump's former national security adviser, General H.R. McMaster, regards this as profound, describing it as the greatest geopolitical shift in the post-Cold War era. He told an audience last month that under President Erdogan, Turkey "wants to see itself as shifting away from Europe and being more in the Middle East and more Eastern leaning so that it can play situations to its own advantage."

It's a view echoed by commentator Aaron Stein, who wrote in foreign policy website War on the Rocks that Erdogan: "Seemed to be using nuclear weapons as a straw man to make a broader argument about Ankara's place in the world, and how the American and Western systems with which Turkey had long associated itself are unfair and require change." "He was expounding on a more personal, deeply held grievance about Turkey's global role," Stein says. Erdogan has already taken this tack when complaining about western "financiers" undermining the Turkish economy. Last year, as the Turkish lira crumbled on international markets, he said those who plotted against Turkey in a failed coup attempt were instead trying to target the country through its economy. And during his spat with the Trump administration over the detention of American pastor Andrew Brunson, Erdogan declared: "This is not some random country. This is Turkey."

Erdogan is, first and last, a Turkish nationalist; no sleight — perceived or otherwise — will go unanswered. Now in power for nearly 17 years, President Erdogan is Turkish policy. Power has been concentrated in a small circle around him; Ankara's foreign policy is driven by his instincts. They may change depending on

tactical advantage (the fall-out and subsequent make-up with Moscow, for example, and the exploitation of Jamal Khashoggi's murder to seek to humiliate the Saudis). But fundamentally, Erdogan sees the world in terms of competing powers — the US, China, Russia — that Turkey must deal with to its own advantage. Inevitably, this means a decoupling from Washington.

Richard Haass, the president of the Council on Foreign Relations, said on Twitter earlier this month that the US was “long overdue to give up fiction” that Erdogan's Turkey was an ally. “US should withdraw all nuclear weapons, reduce reliance on Turkey's bases, and restrict intelligence sharing and arms sales. Should also articulate red lines in Syria,” Haass tweeted. Arguably more important than a provocative line about nuclear weapons in a speech to the party faithful was the sight of Presidents Erdogan and Putin in August as they enjoyed an ice cream while admiring Russia's new Su-57 combat jet. In a dig over the US threat to withhold F-35 sales to Ankara, Erdogan turned to Putin and was heard asking: “So now, we are going to buy this one?” As Stein concludes: “Ankara is not leaving NATO, nor will it turn East. Instead, the current leadership rejects the current rules of the road and wants to change them. That may actually be worse for Washington.”

*Source: Tim Lister, CNN, 21 October 2019.*

## **NUCLEAR NON-PROLIFERATION**

### **GENERAL**

#### **'Tough Times for Arms Control,' NATO Chief Says**

NATO Secretary-General Jens Stoltenberg has said that arms-control regimes need to adapt to “new realities” to remain effective, citing Russia's disregard for its international commitments and the emergence of new actors and technologies. “These are tough times for arms control,” Stoltenberg told the NATO-organized High-Level Public Diplomacy Arms Control Conference in Brussels on October 23, adding that “the global

arms-control regime that has served us so well is eroding.”

The NATO chief emphasized that the Western military alliance's commitment to arms control, disarmament, and nonproliferation while pointing to Russia's “negative record on arms control,” which he said included its deployment of new missile systems in violation of the INF Treaty. Earlier this year, Washington withdrew from the INF Treaty following years of accusations that Moscow had developed a ground-launched cruise missile in violation of the pact's restrictions. The move, reciprocated by Moscow, sparked concerns of a new arms race between the world's leading nuclear-armed powers.

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Russia in 2007 suspended its participation in the Conventional Forces in Europe Treaty, which limits the number of conventional military equipment in Europe, while NATO allies continue to comply with the accord, Stoltenberg said. Besides, Moscow has “a record of circumventing” Organization for Security

and Cooperation in Europe (OSCE) rules known as the Vienna Document, which provides for inspections of military activities and exercises, he added. Stoltenberg also accused North Korea and Iran of “blatantly ignoring or breaking the global rules and spreading dangerous missile technology around the world.”

The “rise of China” also has implications for the existing arms-control regime, he said, noting that the country now had the world's second-biggest defense budget after the United States and was “increasing the size and the sophistication of its missile arsenal. “NATO needed to “act together to reflect these new realities,” Stoltenberg said. “We need to preserve and implement the [Nuclear] Nonproliferation Treaty. We need to adapt nuclear arms-control regimes to new realities. We need to modernize the Vienna Document. And we need to consider how to develop new rules and standards for emerging technologies, including advanced missile technology,” he said.

*Source: Radio free Europe Radio Liberty, 24 October 2019.*

NUCLEAR DISARMAMENT

GENERAL

**New Anti-Nuclear Campaign to Stop Funding of Nuclear Weapons**

A coalition of anti-nuclear organizations is launching a campaign to get governments and investors to stop funding the development of nuclear weapons. Alyn Ware, global co-ordinator of Parliamentarians for Nuclear Non-proliferation and Disarmament, told a news conference that the global nuclear weapons budget is estimated at \$100 billion annually, over half spent by the United States. He said the campaign to "Count the Nuclear Weapons Money" is aimed at curtailing a dangerous nuclear arms race by cutting off the budgets and investments that fund the weapons. Ware said the campaign wants the money used to tackle climate change, poverty and inequality. He said "the nuclear weapons industry is powerful and wealthy" but the campaign can take back the power by supporting legislative efforts to cut budgets and stop investments.

Source: <https://www.citynews1130.com/>, 24 October 2019.

**QATAR**

**'Disarmament Key to Achieving Peace'**

Qatar has reiterated its commitment to continue efforts towards elimination of nuclear weapons and non-proliferation to achieve security and stability in the region and the world. This came in a statement by Abdulrahman Salim al-Ali, a member of Qatar's delegation participating in the First Committee of the 74th session of the United

Nations General Assembly. Al-Ali noted the international community's efforts to eliminate the threat posed by nuclear weapons since the adoption of the first General Assembly resolution on disarmament.

"Given the inability to establish a specific time frame for nuclear disarmament and the implementation of article VI of the Treaty as a result of the insistence on the possession of nuclear weapons, the strict and full compliance

with all the obligations contained in the international instruments on nuclear disarmament and non-proliferation is a non-negotiable international legal obligation," he said.

Qatar's statement said that the proliferation of nuclear weapons in the Middle East

contributes to the increased risks arising from tensions and conflicts in the region, noting that it is still the only region in the world that has not made progress on denuclearisation. He stressed that complete and comprehensive nuclear

disarmament would not be possible without the Middle East being free of nuclear weapons. He renewed Qatar's support for holding a UN conference next November under the chairmanship of Jordan on establishing a zone free of weapons of mass destruction in the Middle East, in accordance with UN General Assembly Resolution 546/73. He stressed the importance of

implementing the legal obligations of international conventions in the field of nuclear disarmament, the importance of responsible development of peaceful nuclear energy programmes and adherence to comprehensive safeguards measures in co-operation with the International Atomic Energy Agency, in order to

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ensure the highest standards of safety and security in a world where nuclear proliferation is a big concern for all.

*Source: Gulf Times, 27 October 2019.*

## **SAUDI ARABIA**

### **Saudi Arabia Calls to Make Region Free of Nuclear Arms**

Stressing that the establishment of a zone free of nuclear arms and weapons of mass destruction in the Middle East is a collective responsibility at an international level, Saudi Arabia urged the international community, the United Nations and parties to the Treaty on the NPT to fulfill their obligations towards the establishment of this zone. This came during the kingdom's speech delivered by member of the kingdom's permanent delegation to the United Nations First Secretary Mohammed Al-Qahtani.

Qahtani said that the kingdom reaffirms that Israel's continued refusal to accede to the NPT and subject all its nuclear facilities to the International Atomic Energy Agency IAEA comprehensive safeguards constitutes a serious threat to international peace and security, as well as a violation of dozens of relevant UNSC resolutions.

The delegate also pointed out that the kingdom stresses the importance of a "comprehensive international agreement" on Iran's nuclear program to ensure that it is prevented from obtaining nuclear weapons in any way.

Qahtani welcomed the call by the UN Secretary General to hold the Conference on the

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Establishment of a Middle East Zone Free of Nuclear Weapons and Other Weapons of Mass Destruction next November under the chairmanship of Jordan. He urged all state parties invited to this conference to participate without any preconditions. Saudi Arabia, on the other hand, affirmed the inherent right of all countries to peacefully use nuclear energy in accordance with the standards and procedures of the IAEA.

The Kingdom also urged industrialized countries to cooperate in removing obstacles to technology transfer to developing countries.

*Source: <https://aawsat.com/>, 23 October 2019.*

## **NUCLEAR SAFETY**

### **ARMENIA–JAPAN**

#### **Armenian President Discusses Nuclear Safety with Japan's NRA**

Armenian President Armen Sarkissian has visited the Nuclear Regulation Authority and had a meeting with the agency's chairman Toyoshi Fuketa during his trip to Japan. During the meeting Sarkissian praised Japan for its knowledge and skills in nuclear energy management and

maintenance of safety, and said: "The issue is a very delicate one for our country. Armenia, like Japan, has a nuclear power station, and the question remains the same – how to manage nuclear fuel and waste".

Fuketa said they are constantly re-equipping the power stations and the equipment, conforming them to existing risks. He said they are ready to share knowledge and

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lessons they've learned as a result of the Fukushima disaster, namely the practice of raising the safety levels. They also discussed protection from natural disasters, nuclear safety regulations and other issues concerning nuclear fuel and waste management. The Armenian President attached importance to cooperation and exchange of practice in preventing natural disasters and liquidation of consequences. The sides reached agreements regarding mutual visits and exchange programs for personnel. The Nuclear Regulation Authority is an administrative body of the Cabinet of Japan. Sarkissian originally traveled to Tokyo for Emperor Naruhito's enthronement ceremony.

*Source: Armen Press, 24 October 2019.*

## **GENERAL**

### **Nobel Laureate Wants to Blast Nuclear Waste with Lasers Until it's Safe**

Nuclear power could become increasingly important as the world continues to combat climate change, but atmospheric carbon isn't the only existential threat to the future of humanity. The waste produced by nuclear power is dangerous for millions of years, and no one can decide what to do with it. Nobel laureate Gérard Mourou is using his notoriety to call attention to an interesting solution. Mourou believes that it may be possible to transmute nuclear waste into a safer form. This isn't medieval alchemy, though. It's science and lasers.

Mourou shared half of the 2018 Nobel Prize in physics with Donna Strickland. The pair won for their work inventing a process called Chirped Pulse Amplification (CPA) at the Laboratory for

Laser Energetics at the University of Rochester. CPA creates very short laser pulses with ultra-high intensity. The original research focused on applications like laser machining and eye surgery, but scientists could also use it to observe atomic processes that happen at almost unfathomable speeds. If we could speed it up a bit more, Mourou says CPA could have a use in processing nuclear waste, too.

**Fuketa said they are constantly re-equipping the power stations and the equipment, conforming them to existing risks. He said they are ready to share knowledge and lessons they've learned as a result of the Fukushima disaster, namely the practice of raising the safety levels.**

Nuclear waste currently sits in drums in secure facilities across the world, and it'll be dangerous for many years to come no matter where we store it. The most hazardous waste, uranium 235 and plutonium 239, have a radioactive half-life of about 24,000 years. So, these materials won't be safe for millions of years. According to Mourou, it may be possible to turn that waste into something you can hold in your hand with a laser.

**To transmute nuclear waste into something safe, Mourou says you'd need to increase the pulse rate by roughly 10,000 times. That might sound like a tall order, but CPA itself was an order of magnitude increase over previous lasers. Another innovation like CPA, and we could be in the ballpark. With an ultra-fast laser pulse, it may be possible to bombard nuclear waste and knock protons out of the nucleus. That turns a dangerous substance like uranium 235 into something comparatively harmless like lead.**

Currently, CPA can produce laser pulses as brief as one attosecond — that's a billionth of a billionth of a second.

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of magnitude increase over previous lasers. Another innovation like CPA, and we could be in the ballpark. With an ultra-fast laser pulse, it may be possible to bombard nuclear waste and knock protons out of the nucleus. That turns a dangerous substance like uranium 235 into something comparatively harmless like lead. Other experts have chimed in to note that the physics makes sense on a theoretical level. However, the logistics of developing the right laser technology, separating out radioactive nuclei, and irradiating them is still beyond our reach.

Source: Ryan Whitwam, <https://www.extremetech.com/>, 25 October 2019.

**NUCLEAR WASTE MANAGEMENT**

**RUSSIA**

**Russia is Importing Toxic Nuclear Waste from Germany, Greenpeace Warns**

A European uranium enrichment firm has resumed shipments of a highly toxic and radioactive waste product from Germany to Russia, Greenpeace Russia warned. The enrichment firm Urenco and Russia's state nuclear company Rosatom halted the radioactive waste imports from Germany in 2009 over revelations that the waste was stored in the open.

German media reported that Urenco had resumed exports of the toxic compound used to enrich uranium, sending up to 3,600 metric tons to central Russia in May-October 2019. "Russia should not become a radioactive burial ground for the rest of the world," Greenpeace's energy campaigner Rashid Alimov said, demanding the release of government documents and punishment of officials responsible for resumed shipments.

Urenco plans to send 12,000 metric tons of uranium hexafluoride to Russia in 2019-2022, the Die Tageszeitung newspaper reported, citing officials' communications. Greenpeace estimates that Russia has stored 1 million metric tons of the uranium hexafluoride, a waste product known as "tails." Vyacheslav Alexandrov, the head of the state-run radioactive waste management operator's Novouralsk branch where Urelco had reportedly sent the "tails," said Russia prohibits nuclear-waste imports and expressed surprise over Greenpeace's warning. In comments to the Znak.com news website, Alimov agreed with Alexandrov that "Russia formally observes the law" but contended that about 90% of the imported toxic "tails" remain in Russia after enrichment.

Source: <https://www.themoscowtimes.com/>, 23 October 2019.

**SWEDEN**

**Swedish Regulator Gives Go-Ahead to Expand Nuclear Waste Plant**

Sweden's radiation safety authority supported an application to expand and continue the operations of a radioactive waste repository on the country's eastern coast. The government still has to take the final decision on the application for the repository near Sweden's Forsmark nuclear plant, which is run by Swedish Nuclear Fuel and Waste Management (SKB) and stores low and medium level radioactive waste. SKB plans to expand the existing facility to receive demolition waste from the decommissioning of four nuclear power plants in Sweden which have already shut. Swedish utility company Vattenfall plans to close two more reactors at its Ringhals site by the end of 2020.

Source: Lefteris Karagiannopoulos, [https://www.reuters.com](https://www.reuters.com/), 22

October 2019.

**USA**

**All Pueblo Council of Governors Opposes Largest Nuclear Waste Transport Campaign in Nation's History**

The All Pueblo Council of Governors, representing the collective voice of the member 20 sovereign Pueblo nations of New Mexico and Texas, convened affirming commitment to protect Pueblo natural and cultural resources from risks associated with transport of the nation's growing inventory of high level nuclear waste from sites across the country to proposed semi-permanent sites in southeastern New Mexico and mid western Texas. The Council adopted a resolution expressing opposition to the license applications by private companies, Holtec International and Interim Storage Partners LLC, authorizing transport nuclear material, construction, and operation of a proposed multi-billion dollar consolidated interim storage facilities in Lea County, New Mexico and Andrews County, Texas.

Concerns from the Council include the lack of federal tribal consultation regarding determination of transport routes and availability of resources, training, and infrastructure for tribal emergency preparedness, response, and risk management in potential incidences of accidental radiological release during shipment. The resolution urges a requirement for meaningful government-to-government consultation with Pueblos by federal regulators on transport concerns, and calls upon the leadership of New Mexico's Congressional Delegation to take proactive steps in support of Pueblos.

"We are very concerned that this project, proposing the transport of nuclear material currently stored at 80 commercial reactors in 35 states across the country, lacks meaningful consultation afforded our Pueblos and subjects our communities, environment, and sacred sites to unimaginable risk over many decades", said Chairman E. Paul Torres of the All Pueblo Council of Governors.

The All Pueblo Council of Governors joins growing local opposition and concern on the project including New Mexico Governor Michelle Lujan Grisham, the New Mexico State Land Office, three

of New Mexico's Congressional Delegation members, and many environmental groups. The City of Albuquerque, the City of Bernalillo, and the City of Las Cruces have each passed resolutions opposing the project. Many local concerns have also pointed to the absence of federal prospects for a permanent repository.

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"Every community deserves to live free from the impacts of radiation, but transportation of nuclear materials puts native communities at risk of radiation contamination along the route to Holtec's proposed storage facility. Our communities have already borne the brunt of the nuclear fuel cycle, and this country is still failing to address those

contaminated sites. I stand with the All Pueblo Council of Governors to protect our resources and our families from the brutal consequences of storing nuclear materials at a temporary facility New Mexico or Texas," said Congresswoman Deb Haaland.

Source: <https://newsmaven.io>, 22 October 2019.



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

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