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**OPINION – Robert A. Wampler**

**The United States and the North Korea Nuclear Threat**

President Donald Trump and North Korean leader Kim Jong Un will hold their second summit meeting in Hanoi, Vietnam on February 27-28, 2019. Their first summit, held in Singapore on June 12, 2018, produced a joint statement expressing agreement to work on new relations between the two countries and “complete denuclearization” of the Korean peninsula, but with little in the way of specifics as to how these aspirations would be attained.

Since the first summit, Trump’s own intelligence community has continued to warn that North Korea has not halted work on its nuclear weapons or missile technology programs, despite Tweets from the President claiming success for his personal diplomacy with Kim Jong Un, and expressing disdain for the findings of the intelligence community. On the eve of the summit, both administration officials and North Korea experts have been reported to express concern that Trump, in his eagerness to make the summit a success, may make concessions such as agreeing to the withdrawal of U.S. troops from South Korea.

**Efforts to implement the Singapore agreement have also proven difficult to achieve, whether in terms of what each side means by “denuclearization,” or the linkages between steps each side needs to take, be it normalization of relations and the easing of sanctions by Washington, or verifiable steps by Pyongyang to begin dismantling its nuclear weapons and missile programs. Similar obstacles will likely face any agreement coming from the Hanoi summit.**

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In order to provide some essential historical context for the Trump-Kim summit and a better

understanding of how previous administrations have sought to tackle the complex diplomacy surrounding efforts to reduce the North Korean nuclear and missile threat, the National Security Archive's Korea Project is posting today a selection of declassified documents taken from previous Electronic Briefing Books dating back to 2003. These eleven postings cover U.S. efforts to meet North Korea's military threat from the Nixon through the Clinton administrations. Links to these earlier postings, which also provide more detailed discussion of the historical context of the documents, can be found in the sidebar on this webpage. Among the key points in these materials:

- The high probability that any military action against North Korea would be difficult to contain and would result in casualties on an immense scale, with Secretary of Defense Dick Cheney at one point arguing that discussion of possible military action should not be allowed to endanger diplomatic efforts to halt North Korea's nuclear program [Documents 1, 2, 6-C-2, 10, and 23]
- The critical role China must play in diplomatic negotiations to move North Korea away from its nuclear ambitions [Documents 4, 9, and 26]
- The challenging interplay of bilateral and multilateral diplomacy involving the U.S., South Korea, Japan, and China as they have sought to orchestrate their engagement with North Korea with the proper mix of carrots and sticks [Documents 5, 6, 14, 16, and 21]
- The emergence of concerns in the late 1990s that North Korea might be on the brink of economic collapse, and what this could mean for stability and security on the peninsula, as well as possibly providing leverage in negotiations with North Korea [Documents 15, 18 and 19]
- The attention to detail combined with sensitivity

to nuance and unknowns that have marked intelligence assessments of the situation inside North Korea. [Documents 11 and 12]

As these documents make clear, diplomacy aimed at ending North Korea's nuclear and missile threats is a complex and challenging undertaking. The old saying that the devil is in the details will certainly apply here: any substantial agreement with Pyongyang will have to master the finer points of aligning strategic interests and goals not just between the United States and North Korea, but also involving South Korea, Japan, and China.

Source: <https://nsarchive.gwu.edu>, 26 February 2019.

OPINION – Ernesto Zedillo Ponce de León

New Era of Nuclear Rearmament

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Thirty years ago, when the Berlin Wall was brought down marking the end of the Cold War, the threat of conflict between two nuclear-armed, ideologically opposed superpowers receded, and my generation, which had grown up in the shadow of the bomb, breathed a sigh of relief. Although the nuclear threat did not vanish then, it certainly

became subdued as the process of disarmament and control seemed to move forward along a clear path of no return.

Today, the geopolitical and security climate is far removed from the heady days of 1989. Walls are back in fashion, and a new nuclear arms race risks taking the whole world back to the old tensions and conceivably to an even more dangerous situation than during the Cold War era, when deterrence provided effective stability – although a perverse one by being based on the threat of mutual destruction. After the end of the Cold War, deterrence had persisted, but was auspiciously accompanied by incremental disarmament. Now the foundations of deterrence are seriously being

eroded while disarmament is being stopped, giving way to a new era of rearmament. Arms control is fast unraveling and incredibly the United States, the unquestionable victor of the Cold War, is leading the march to destroy it.

**Rapid Reignition:** This process is not new, but has accelerated over the last two years. The unravelling goes back to 2002, when the United States withdrew unilaterally from the Anti-Ballistic Missile Treaty that had been in force for three decades. At the time, the decision was justified as necessary to allow the United States to build a missile defense system, not against existing nuclear powers but rather against rogue states that might get access to nuclear weapons. Not credible to Russia, this action triggered the decision to start rebuilding its nuclear capacities. The US government has now admitted explicitly in its recently released Missile Defense Review that its anti-ballistic systems are intended to defend against other nuclear powers, like Russia and China. This clarity of intent leads to the obvious question: If the United States can protect itself against a retaliatory nuclear attack, why would it not be tempted to attack first? The likelihood of the latter scenario severely undermines deterrence, with consequences for reigniting the arms race.

Avoiding such reignition has not been helped by other actions taken over the years by the US government, for example the 2010 decision to spend \$1 trillion over 30 years to modernise the US nuclear arsenal, a program embraced by the Trump administration and enlarging its planned budget by more than 60%. The commitment to the

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nuclear renovation program was part of the bargain to get the New START – Strategic Arms Reduction Strategy – ratified by the US Senate in early 2011. This US-Russia agreement provided for a significant reduction of the strategic nuclear capabilities of both countries. Yet the treaty expires in 2021, and the US government has refused to consider its extension.

The most important evidence of President Trump’s disregard for nuclear disarmament and non-proliferation had been, until recently, his decision to withdraw from the Iran nuclear deal in 2018. This perplexing step now has strong competition as the most wrongheaded one of the nuclear policies of his administration. The United States’ recent suspension of the INF Treaty, followed almost immediately by Russia’s, could be an inflection point in a global arms race with widespread consequences for international security. The treaty, agreed to by Reagan and the Soviet Union’s Gorbachev in 1987, was the first to eliminate a whole category of nuclear weapons.

There is evidence that both sides have violated the INF Treaty in recent years. If both countries fail to reconsider their suspension of the treaty, it will further accelerate a sinister missile competition, a threat not only to the United States and Russia’s security but also to many other countries. For one thing, Russia will now be legally unconstrained from deploying land-based nuclear missiles aimed at Europe. For another, China will take notice that the United States could install intermediate-range missiles within range of its territory. This would threaten the security of several key US allies in the region, a scenario that could accelerate nuclear and

conventional weapons proliferation in Asia. At this rate, it won't be long before several signatories to the Treaty on the Non-Proliferation of Nuclear Weapons reconsider their commitment to such a remarkable multilateral instrument.

**Fixing and improving the INF Treaty could then be part of an agenda to revitalize the process of incremental arms control by all nuclear powers. The goal would not be to abolish nuclear weapons, an objective that unfortunately is chimerical any time soon, but rather to minimize the risks that they pose for international peace and security.**

**Damage Control:** There is still a six-month window of opportunity for the United States and Russia to start seriously addressing their mutual accusations of non-compliance with the INF Treaty. Their goal should not just be to avoid the treaty's definite demise, but also to pursue a more ambitious agreement on land-based intermediate-range missiles that would include other nuclear powers, especially China. Fixing and improving the INF Treaty could then be part of an agenda to revitalize the process of incremental arms control by all nuclear powers. The goal would not be to abolish nuclear weapons, an objective that unfortunately is chimerical any time soon, but rather to minimize the risks that they pose for international peace and security.

The Elders, a group founded by the great statesman Nelson Mandela and chaired by Kofi Annan during the last years of his admirable life, is working toward this goal and offers four pillars to explain its minimisation agenda:

- **Doctrine:** Every nuclear-armed state should make an unequivocal "no first use" declaration.
- **De-alerting:** As many weapons as possible must be taken off their current high-alert status.
- **Deployment:** The proportion of nuclear weapons currently operationally deployed must be drastically reduced.
- **Decreased numbers:** As was done before, the total count of nuclear warheads in existence

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should be vastly reduced.

The international arms-control architecture is at risk of collapsing. Each and every nuclear-armed state has a grave responsibility to prevent this catastrophe from happening. The responsibility of the United States is unquestionably

more significant. Even the great victor of the Cold War is condemned to lose any nuclear war simply because if that happens, everyone loses.

Source: <https://yaleglobal.yale.edu>, 17 February 2019.

**OPINION – Lawrence Wittner**

**Don't Expect Rulers of Nuclear-Armed Nations to Accept Nuclear Disarmament Unless they're Pushed to Do So**

At the beginning of February 2019, the two leading nuclear powers took an official step toward resumption of the nuclear arms race. On February 01, 2019, the U.S. government, charging Russian violations of the INF Treaty, announced that it would pull out of the agreement and develop new intermediate-range missiles banned by it. The following day, Russian President Putin suspended his government's observance of the treaty, claiming that this was done as a "symmetrical"

response to the U.S. action and that Russia would develop nuclear weapons outlawed by the agreement.

In this fashion, the 1987 Soviet-American INF Treaty which had eliminated thousands of destabilizing nuclear weapons, set the course for future nuclear disarmament agreements between the two nuclear superpowers, and paved the way for an end to the Cold War was formally dispensed with. Actually, the scrapping of the treaty should



not have come as a surprise. After all, the rulers of nations, especially “the great powers,” are rarely interested in limiting their access to powerful weapons of war, including nuclear weapons. Indeed, they usually favor weapons buildups by their own nation and, thus, end up in immensely dangerous and expensive arms races with other nations.

Trump exemplifies this embrace of nuclear weapons. During his presidential campaign, he made the bizarre claim that the 7,000-weapon U.S. nuclear arsenal “doesn’t work,” and promised to restore it to its full glory. Shortly after his election, Trump tweeted: “The United States must greatly strengthen and expand its nuclear capability.” The following day, with his customary insouciance, he remarked simply: “Let it be an arms race.” Naturally, as president, he has been a keen supporter of a \$1.7 trillion refurbishment of the entire U.S. nuclear weapons complex, including the building of new nuclear weapons. Nor has he hesitated to brag about U.S. nuclear prowess. In connection with his war of words with North Korean leader Kim Jong-un, Trump boasted: “I too have a Nuclear Button, but it is a much bigger and more powerful one than his.”

Russian leaders, too, though not as overtly provocative, have been impatient to build new nuclear weapons. As early as 2007, Putin complained to top-level U.S. officials that only Russia and the United States were covered by the INF Treaty; therefore, unless other nations were brought into the agreement, “it will be difficult for us to keep within the [treaty] framework.” The following year, Sergey Ivanov, the Russian defense minister, publicly bemoaned the INF agreement, observing that intermediate-range nuclear weapons “would be quite useful for us” against China.

By 2014, according to the U.S. government and arms control experts, Russia was pursuing a cruise missile program that violated the INF agreement, although Putin denied that the missile was banned by the treaty and claimed, instead, that the U.S. missile defense system was out of compliance. And so the offending missile program continued, as did Russian programs for blood-curdling types of nuclear weapons outside the treaty’s framework. In 2016, Putin criticized “the naïve former Russian leadership” for signing the INF Treaty in the first place. When the U.S. government pulled out of the treaty, Putin not only quickly proclaimed Russia’s withdrawal, but announced plans for building new nuclear weapons and said that Russia would no longer initiate nuclear arms control talks with the United States.

**The leaders of the seven other nuclear-armed nations have displayed much the same attitude. All have recently been upgrading their nuclear arsenals, with China, India, Pakistan, and North Korea developing nuclear weapons that would be banned by the INF Treaty. Efforts by the U.S. government, in 2008, to bring some of these nations into the treaty were rebuffed by their governments.**

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weapons that would be banned by the INF Treaty. Efforts by the U.S. government, in 2008, to bring some of these nations into the treaty were rebuffed by their governments. In the context of the recent breakdown of the INF Treaty, China’s government (which, among them, possesses the largest number of such weapons) has praised the agreement for carrying forward the nuclear disarmament process and improving international relations, but has opposed making the treaty a multilateral one—a polite way of saying that nuclear disarmament should be confined to the Americans and the Russians.

Characteristically, all the nuclear powers have rejected the 2017 UN treaty prohibiting nuclear weapons. But the history of the INF Treaty’s emergence provides a more heartening perspective. During the late 1970s and early 1980s, in response to the advent of government

officials championing a nuclear weapons buildup and talking globally of nuclear war, an immense surge of popular protest swept around the world. Antinuclear demonstrations of unprecedented size convulsed Western Europe, Asia, and North America. Even within Communist nations, protesters defied authorities and took to the streets. With opinion polls showing massive opposition to the deployment of new nuclear weapons and the waging of nuclear war, mainstream organizations and political parties sharply condemned the nuclear buildup and called for nuclear disarmament.

Consequently, hawkish government officials began to reassess their priorities. In the fall of 1983, with some five million people busy protesting the U.S. plan to install intermediate-range nuclear weapons in Western Europe, Reagan told his secretary of state: "If things get hotter and hotter and arms control remains an issue, maybe I should...propose eliminating all nuclear weapons." Previously, to dampen antinuclear protest, Reagan and other NATO hawks had proposed the "zero option" – scrapping plans for U.S. missile deployment in Western Europe for Soviet withdrawal of INF missiles from Eastern Europe. But Russian leaders scorned this public relations gesture until Gorbachev, riding the wave of popular protest, decided to call Reagan's bluff. As a result, recalled a top administration official, "we had to take yes for an answer." In 1987, amid great popular celebration, Reagan and Gorbachev signed the INF Treaty. Although the rulers of nuclear-armed nations are usually eager to foster nuclear buildups, substantial public pressure can secure their acceptance of nuclear disarmament.

Source: <https://hnn.us/article/17117>, 07 February 2019.

**OPINION – Stephen Collins**

**Why Trump Failed to Convince North Korea to Give up its Nuclear Weapons, and how he can Do Better at the Next Summit**

President Trump and North Korean leader Jong Un will meet in Vietnam in late February 2019 for a second summit, with the goal of ending a nuclear

standoff between the two countries. After the first meeting between the two leaders in Singapore in the summer of 2018, Trump declared a breakthrough in U.S.-North Korean relations. He tweeted that there is "no longer a Nuclear Threat from North Korea."

Eight months later, however, it is clear that North Korea's nuclear weapons arsenal have not been curtailed in any significant way. The arsenal is estimated to include as many as 60 weapons and the rockets to deploy them are able to reach any spot in the U.S. The U.S. intelligence community's Worldwide Threat Assessment, released in January 2019, declares that North Korea has retained its nuclear arsenal. The Pentagon's 2019 Missile Defense Report calls the regime an "extraordinary threat" to the United States.

Why have the nuclear negotiations failed to yield progress in the nuclear disarmament of North Korea? My research on diplomacy has led me to believe the stalemate is a result of Trump's trade strategy toward North Korea's neighbor and trading partner, China, and the U.S.' sanctions strategy towards North Korea. Both will need to change if progress is to be made.

**China's Role:** Trump decided to launch a trade war with China in 2018, immediately following his summit with North Korea. That's a problem because Chinese cooperation is key to Trump's effort to impose maximum pressure on North Korea to give up its nuclear weapons. More than 90 percent of all North Korean trade is conducted with China alone – giving Beijing, by far, the greatest economic leverage over Pyongyang. China began wielding this leverage in 2017 as it started enforcing UN trade sanctions on North Korea. However, in the past year, China has retaliated against Trump's tariff hikes on Chinese exports in part by relaxing its enforcement of sanctions on North Korea.

Coal imports, construction projects and tourism from China to North Korea have all increased. There has been a sharp spike in oil and gasoline smuggling operations into North Korea, mostly from Chinese ships. U.S. allies and major trade partners, including Europe and Japan, share many

of Trump's concerns about China's suspect trade practices and how it harms their economies. But they believe less combative approaches to China are preferable. A shift away from the confrontational approach would likely lead to increased Chinese cooperation with the sanctions campaign on North Korea.

**Beyond Sanctions:** The U.S.

strategy towards North Korea is based solely on forcing the country to surrender its entire nuclear program before offering relief from sanctions. Studies have shown that sanctions alone can be insufficient to convince a foreign government to abandon a program that it has long viewed as essential for its survival. Kim Jong Un has vowed that North Korean disarmament will not happen without the U.S. making concessions. The U.S. could just as easily use gradual relief from sanctions as leverage in exchange for disarmament steps. In the past, when North Korea took nuclear disarmament steps in 1994 and 2008, they did so partially in response to offers of sanctions relief and aid from the United States, South Korea, Japan and other allies.

There are steps beyond sanctions relief that can also prod North Korea towards disarmament. Security guarantees are among the most important incentives to offer during negotiations. North Korea has made it clear, that any substantial disarmament will come only after the U.S. and its regional allies promise never to attack North Korea. A large economic, energy and food aid package from the U.S. and its allies could markedly improve the quality of life in North Korea. The country urgently needs assistance, and the ability of the U.S. to meet this need gives Washington leverage over Pyongyang. In his

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recent speech, Kim Jong Un declared that economic growth is the nation's top priority. Per capita income in the country is just one-tenth that of South Korea, and 40 percent of the population suffers from malnutrition.

**Sharing the Burden:** Aid would not be cheap. A study estimated that an effective aid package would cost US\$30 billion. However, the costs could be spread over

time, and would be shared across donor nations. This happened in 1994, when nearly 50 countries contributed financially to a deal which, although it eventually broke down, significantly curbed North Korea's nuclear activities for many years.

Trump's second summit with North Korea provides him a second chance to reconsider his unyielding trade approach to China, and his reluctance to use incentives to encourage North Korean disarmament. Persuading China to resume its cooperation with the embargo would increase for Kim the costs of resistance, and adding incentives would enhance the benefits of compromise. Taken together, these measures could increase the chances that North Korea will finally begin dismantling its nuclear arsenal.

Source: <https://theconversation.com>, 13 February 2019.

**OPINION – Tristan Kenderdine**

**Global Ambitions Fuel China's Nuclear Power Strategy**

Over the past several years, there has been a monumental shift in China's energy policy towards nuclear power. And Beijing's nuclear ambitions aren't limited to its own borders. Its 'Made in China 2025' blueprint envisages vastly expanding China's role in nuclear power generation in developing economies worldwide.

Western environmental and energy policy communities have long berated China for refusing to abandon its reliance on thermal coal. But China's commitment to expanding renewables has actually been extraordinary. Solar energy only became a viable solution in most OECD economies in 2013 after China poured into the market and made cells affordable. A similar story occurred in 2016 with batteries for electric vehicles and hybrids. It is true that China's coal emissions have not peaked. While renewables are taking a larger share in China's energy mix, they are still mired in curtailment and subsidies. Fossil fuels are slated to dominate China's energy generation until at least 2030.

Still, one important policy change will affect not only China's emissions targets, but also the future energy options of less developed countries: China's subsidised inland nuclear power reactors. China nearly doubled its nuclear-generated electricity output between 2013 and 2016. It has surpassed Japan to become the world's fourth-largest nuclear-power country, with a total operating installed capacity of 42.9 gigawatt electrical (GWe) in 2018. Nuclear is set to expand to as much as 281.8 GWe by 2030. This would take nuclear-generated electricity from 2 per cent to up to 20 per cent of China's energy mix.

Expanding on its 45 current reactors, China has 43 more under construction, with a further 92 slated to begin construction by 2020. China plans to reach a total of 56 working reactors by 2020, to be the world's second-largest nuclear country. To achieve these goals, investment of around 540

billion yuan (US\$80 billion) is needed, according to Zhefu Holding Group, a private company that makes nuclear equipment. A technological gap must also be breached, with the rollout of China's third- and fourth-generation nuclear reactors.

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throughout the developing world. This means both exporting nuclear energy components and equipment, as well as exporting the factories and technologies to manufacture them. While initial nuclear exports have targeted advanced economies such as France and the United Kingdom, the

majority of the rollout will be directed toward the Middle East, Africa and South America. Beijing's ambitions for nuclear power-generation indeed go well beyond its domestic economy. Internationally, exports of China's nuclear reactors to Belt and Road economies are designed to replicate the export-oriented development policies of countries such as Germany, Japan and South Korea. A single nuclear plant generates approximately 30 billion yuan (US\$4.5 billion) in economic output value, the export equivalent of 300,000 vehicles.

The Made in China 2025 blueprint is the vehicle for China's nuclear power industry to go global through the promotion of advanced nuclear power equipment. Two indigenous large-sized pressurised water reactors — CAP1400 and Hualong One — have been selected as the leading technology to

Inland civil nuclear systems require river water for coolant, a problem China is solving by using the Yangtze River basin. The deployment of next-generation nuclear reactors using river water for coolant has no precursor in terms of scale. But if China's model proves successful, it will likely be replicated across river systems

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facilitate the global strategy. The development of high-temperature reactors and fast-neutron reactors are also seen as important for the industry's global influence. The development of small modular reactors is planned to allow China to acquire intellectual property rights in the area of civil nuclear power ship technology and produce a 100 billion yuan (US\$15 billion) market for offshore oil drilling.

**Elsewhere, the China National Nuclear Corporation is to build Argentina's fourth nuclear power plant under a US\$6 billion deal. China General Nuclear Power will also build four Hualong One nuclear reactors in Kenya, to be operational by 2030. If China intends to sell nuclear equipment abroad, it must first understand the technological and safety risks in its own backyard and ensure that its technology is dependable.**

Armed with third-generation nuclear power technology, China has already signed contracts or is discussing cooperation with 20 countries including Argentina, Egypt and the United Kingdom. China has also signed agreements with Saudi Arabia and Iran to provide energy equipment plants to feed into the countries' planned nuclear plants. Exported nuclear plants along the Belt and Road are expected to reach 100 by 2030.

**Experts argue these days that the impending demise of the INF Treaty forecasts the end of arms control in general and a new round of nuclear competition – with the big difference that the new arms race will be less about numbers and more about quality, and that it will involve China as well.**

Cooperation with developed economies in civil nuclear power will likely have geopolitical strings attached. For example, projects in the United Kingdom and France would reduce the two United Nations Security Council members' room to complaint if other countries, like Iran or Egypt, accepted similar offers for China to build civil nuclear projects. Chinese enterprises developing nuclear power will also experience enhanced market competitiveness with other nuclear powers — Russia, the United States, France, Japan and South Korea — if Hualong One is successfully built in the United Kingdom.

In less-developed economies, China has already begun administrative processes to export nuclear equipment and nuclear equipment capacity plants. A civil nuclear memorandum of understanding with

South Africa is designed to tap into China's experience, especially in personnel training, technical support and nuclear facility monitoring. Elsewhere, the China National Nuclear Corporation is to build Argentina's fourth nuclear power plant under a US\$6 billion deal. China General Nuclear Power will also build four Hualong One nuclear reactors in Kenya, to be operational by 2030.

If China intends to sell nuclear equipment abroad, it must first understand the technological and safety risks in its own backyard and ensure that its technology is dependable. A domestic nuclear accident coinciding with a flood on the Yangtze River could be catastrophic. It must also ensure that it promotes effective safety protocols and standards alongside its exports of energy equipment. For civil nuclear power to solve China's environmental policy woes, it must be policy-complete enough not to export environmental risks.

Source: [www.eastasiaforum.org](http://www.eastasiaforum.org), 21 February 2019.

**OPINION – Ulrich Kühn**

**Five Ways to Save INF's Legacy**

Not only in Washington and Moscow, many analysts and experts argue these days that the impending demise of the INF Treaty forecasts the end of arms control in general and a new round of nuclear competition – with the big difference that the new arms race will be less about numbers and more about quality, and that it will involve China as well. But it does not have to be that way. There are at least five underexplored arms control options that could save the legacy of INF.

**Option 1. Walk in the Woods:** Could be termed the ‘German Grand Coalition’ proposal as it comes from two leading German politicians, both respected foreign and security policy experts in the two major parties currently ruling Germany. Roderich Kiesewetter (CDU) and Rolf Mützenich (SPD) suggested to move Russia’s treaty-busting missiles beyond the Ural Mountains – that is to the Asian side of Russia. While somewhat resembling a proposal that some of the older ones will remember as the 1982 Nitze-Kvitsinsky “Walk in the Woods” formula, the Kiesewetter-Mützenich proposal, stressing the need to strictly verify Russian compliance with such arrangement, comes as a quid pro quo.

In exchange for Russia’s geographical restraint, the two policymakers suggest

America allows for inspections of its disputed Aegis Ashore missile defense installation in Deveselu, Romania. The drawbacks to this proposal seem obvious: U.S. officials have time and again rejected the idea of bringing Aegis Ashore into the equation; in turn, Moscow will be anything but hell-bent on alienating China by moving its new INF systems into the Asian theater.

**Option 2. Concessions in the European Theatre:** Perhaps a slightly more viable proposal which does not involve the contentious missile defense issue comes from the Washington-based Arms Control Association. Accordingly, NATO, as a bloc, would declare not to deploy any new INF-range ground-launched missiles in Europe as well as additional (permanently deployed) new nuclear capabilities in Europe so long as Russia is removing the SSC-8 missile from Western Russia and pledging not to deploy any other INF-prohibited systems in the European theater. Most likely not legally binding, such an understanding would somewhat mirror similar pledges NATO and Russia made in the conventional realm in the 1997 NATO-Russia Founding Act and at the sidelines of the 1999 OSCE Istanbul Summit. Again, the downside of this proposal is Russia’s close relationship with China and the question of how

to verify the absence of such weapons systems.

**Option 3. Nuclear Pause Agreement:** Back in 2017, a former high-ranking U.S. military suggested a framework that very much focuses on crisis stability by making sure that mating INF-range systems with nuclear warheads could not take place in a matter of hours. Under such a framework, nuclear warheads for sub-strategic (below 5,500 km) ground-launched and air-launched systems alike (including missile defense interceptors and drones) would be stored at least a day separation by ground transportation away (and a couple of hours by aircraft). Obviously, the question of verification would be extremely sensitive and would have to make sure that the strategic forces of the United States and Russia remain outside

**U.S. officials have time and again rejected the idea of bringing Aegis Ashore into the equation; in turn, Moscow will be anything but hell-bent on alienating China by moving its new INF systems into the Asian theater.**

the framework. Another problem comes with the exclusive focus on nuclear warheads. While militaries on both sides are aware of the increasing conventional firepower of both the United States and Russia, only a few seem to understand the implications for strategic stability. In the end, further fielding conventional-tipped delivery vehicles could as much have a negative impact on stability, particularly in Europe.

**Option 4. INF à Trois:** While quite prominent in the media due to Trump’s direct reference, including China in an ‘INF à trois’ arrangement seems not a very promising option, at least from the outset. Over 90 percent of China’s missiles – essential for defending Chinese homeland and adjacent waters – fall in the ranges banned by INF. Washington would have to offer a lot to convince Beijing of the merits of joining such an endeavor. Perhaps the only way to get China on board would be to broaden the scope of a trilateral arrangement and to allow for unprecedented flexibility. In concrete terms that would mean to include sea- and air-based systems, i.e., those systems where America still enjoys superiority vis-à-vis Beijing, to add missile defense interceptors and drones as well as anti-access/area denial (A2/AD) systems. The latter systems are particularly

relevant in regional theaters, for instance in Eastern Europe and in the South China Sea. Finally adding strategic systems, a trilateral U.S.-Russian-Chinese framework could have equal ceilings for strategic (beyond 5,500 km) and sub-strategic (below 5,500 km) systems, with verification and the freedom to mix.

**Option 5. Cruise Missiles Ban:**

Finally, the most ambitious – and also least realistic – option would be a global ban on cruise missiles, thus directly addressing a weapons category deemed most destabilizing due to its flight characteristics. Aside from the fact that modern militaries rely heavily on standoff weapons for various purposes, the fact that the number of states with standoff capabilities is continuously growing would make such an enterprise extremely hard to achieve.

As all five options demonstrate, the end of INF does not have to be the end of arms control. There are still six months left to explore a number of diplomatic opportunities. And even if the treaty ends, there are ways to build on INF’s legacy. The options are there – it is up to bold and responsible politicians to turn forward-looking proposals into viable policies.

Source: <https://valdaiclub.com>, 13 February 2019.

**NUCLEAR STRATEGY**

**RUSSIA**

**After Putin’s Warning, Russian TV Lists Nuclear Targets in U.S.**

Russian state television has listed U.S. military facilities that Moscow would target in the event of a nuclear strike, and said that a hypersonic missile Russia is developing would be able to hit them in less than five minutes. The targets

included the Pentagon and the presidential retreat in Camp David, Maryland.

**The end of INF does not have to be the end of arms control. There are still six months left to explore a number of diplomatic opportunities. And even if the treaty ends, there are ways to build on INF’s legacy. The options are there – it is up to bold and responsible politicians to turn forward-looking proposals into viable policies.**

The report, unusual even by the sometimes bellicose standards of Russian state TV, was broadcast on Sunday evening, days after President Vladimir Putin said Moscow was militarily ready for a “Cuban Missile”-style crisis if the United States wanted one.

With tensions rising over Russian fears that the United States might deploy intermediate-range nuclear missiles in Europe as a Cold War-era arms-control treaty unravels, Putin has said Russia would be forced to respond by placing hypersonic nuclear missiles on submarines near U.S. waters.

**The United States says it has no immediate plans to deploy such missiles in Europe and has dismissed Putin’s warnings as disingenuous propaganda. It does not currently have ground-based intermediate-range nuclear missiles that it could place in Europe.**

The United States says it has no immediate plans to deploy such missiles in Europe and has dismissed Putin’s warnings as disingenuous propaganda. It does not currently have ground-based intermediate-range

nuclear missiles that it could place in Europe. However, its decision to quit the 1987 INF Treaty over an alleged Russian violation, something Moscow denies, has freed it to start developing and deploying such missiles.

Source: <https://www.reuters.com>, 25 February 2019.

**USA**

**Washington’s Stealthy Move towards a Potential First Strike against Russia and China**

There is a lot of talk lately in the liberal media about how President Trump and his Neocon advisors Bolton (NSA) and Mike Pompeo (Secretary of State) along with his acting Defense Secretary Shanahan, are moving the country and the world dangerously closer to a catastrophic global nuclear

war with the administration decision to terminate the Reagan-era treaty banning intermediate range nuclear missiles.

It is true that the INF Treaty, concluded by President Reagan and Russian President Gorbachev in 1987, did greatly reduce the chances of nuclear war by removing U.S. missiles from Europe and Asia that had the ability to strike the Soviet Union in minutes. It's also true that with the INF gone, Russia will, as it is already doing, inevitably develop countermeasures, such as designing and deploying fleets of quick-launch, virtually unstoppable hypersonic cruise missiles that could head towards the U.S. before attacked, assuring the destruction of the United States in response to any first strike. (Russian or Chinese hypersonic cruise missiles that travel perhaps 6000 mph, pose no first strike threat unless based along the U.S. border, as they give the US plenty of time to launch a counterattack – probably the reason the U.S. never put much effort into developing them.)

What is not true is the notion that it is just Trump who has pushed the nuclear doomsday clock closer to midnight. President Obama advanced that clock's minute hand more than Trump back in 2014 – and set the stage for a termination of the INF – with his deceptive and outrageously costly program to “refurbish and upgrade” the U.S. nuclear arsenal. Continued by President Trump, Nobel Peace Laureate Obama's 10-year, \$1.3-trillion program began moving the country in entirely the wrong direction two full years before Trump's election, expanding instead of reducing the U.S. nuclear stockpile. As nuclear strategists both here and abroad instantly understood, the new U.S. program actually represents an abandonment of the MAD stand-off which, by making nuclear war unthinkable, has successfully

prevented any nuclear bombs from again being used in war for 74 years. Instead, the new US nuclear program moves this country towards a policy of making the use of nukes “thinkable.”

What Obama did, specifically, was to approve the development of the B61-12, a “small” nuclear

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bomb that can have its power dialed up or down anywhere from 0.3 kilotons to 50 kilotons, with the largest setting being an explosion some 3-4 times more powerful than the bombs that destroyed Hiroshima and Nagasaki at the end of World War II.

While the new bomb was given the same appellation as a US weapon first produced in 1968, which itself was a version of a bomb called the TX-61 first deployed in 1963, and while it has a hyphenated number 12 placed after the B61 to suggest it is simply the 12th iteration

**What Obama did, specifically, was to approve the development of the B61-12, a “small” nuclear bomb that can have its power dialed up or down anywhere from 0.3 kilotons to 50 kilotons, with the largest setting being an explosion some 3-4 times more powerful than the bombs that destroyed Hiroshima and Nagasaki.**

of the weapon, knowledgeable nuclear weapons critics say it's actually a new weapon, and that the name given to it is consciously intended to deceive us. We Americans, after all, have never favored nuclear war-fighting. We have never favored being the initiator of wars, either (that's why many feel President

Roosevelt allowed the Japanese to attack Pearl Harbor – because he couldn't get majority support for the U.S. just joining the war against Germany unless it was in response to an attack).

Not only that, but the new B61-12 is being designed by Boeing (Pentagon acting Secretary Shanahan's old employer) specifically for use in the Block 4 version of the F-35, which makes it all the more dangerous. That is because while the F-35 is properly being branded by its critics as a “flying turkey” because of the many problems with its cost, its glitch-plagued avionics and even the durability of its airframe, it is good at one thing, and that is the stealth technology that allows it to avoid radar detection. (The B61-12 is designed



to fit inside the fuselage of the Block 4 version of the F-35, not under the wings like the old B61 bombs carried by the F-16 and other nuclear-capable fighter planes, since carrying the weapon externally defeats the stealth feature of the F-35, making it a sitting duck for Russian or Chinese anti-aircraft missiles.) The F-35's stealth feature, combined with its ability to deliver the B61-12 bomb, makes the combination of plane and nuke, in the words of military experts familiar with nuclear strategy, a "first strike" weapon – one that could be used to initiate a devastating war on an enemy.

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The B61-12 with its dial-able explosive power, also represents a step towards nuclear war for another reason: In the minds of ... (among whom I would include both Obama and Trump) who develop and approve nuclear war strategy in the White House and the Pentagon, it renders America's nuclear weapons useable and nuclear war "thinkable." The theory behind smaller bombs is that the U.S., which has not got a good track record at winning wars fought by soldiers on the ground, at least since World War II, could fare better if it could introduce nuclear weapons to a conflict, presumably by doing some limited damage and forcing the opponent to rethink any notion of continuing to fight.

This kind of crazy and immoral thinking goes by the name of "coercive diplomacy," a term coined by the Harvard professor and nuclear strategy theorist Schelling. First developed in the mid-1960s, Schelling's lunatic theory is now being resurrected thanks to Presidents Obama and Trump and psycho national "security" advisors like Bolton and Pompeo. As Trump is widely quoted as having asked his national security team, "Why do we have nukes if we can't use them?" In quoting him, most U.S. pundits have mocked the notion, but the truth is, the U.S.

**The U.S. (which has never renounced a nuclear first strike and never promised not to use nukes against a non-nuclear adversary) is in the process of building a weapons system – the F-35 and its nuclear payload, the B61-12 – that is premised on the idea of using nuclear weapons – either for "coercive diplomacy" or for a first strike.**

(which has never renounced a nuclear first strike and never promised not to use nukes against a non-nuclear adversary) is in the process of building a weapons system – the F-35 and its nuclear payload, the B61-12 – that is premised on the idea of using nuclear weapons – either for "coercive diplomacy" or for a first strike. As it was explained to me, there is no way that the F-35 is a defensive airplane. In defending the U.S. against foreign bomber attack, what is called for is a fast, highly maneuverable jet capable of carrying plenty of anti-aircraft

armament. That would be the F-16 and other high-performance planes already available and proven. It doesn't need stealth features like we see with the F-35 and F-22 which merely interfere with performance, but do help with sneak attacks.

Most Americans believe, mistakenly, that the U.S., like Russia and China, has always vowed not to use nuclear weapons first, but only in retaliation. The reality is the U.S. government not only has never renounced initiating nuclear war. As Michio Kaku and Daniel Axelrod documented in their excellent book *To Win a Nuclear War*, and as Daniel Ellsberg more recently documented covering a later period in his book *The Doomsday Machine*, the U.S. has repeatedly come close to launching, and has even more often threatened to launch a nuclear war. It has also at staggering cost for years sought to develop

advanced offensive and defensive weapons that would enable it to launch such a war while suffering "only acceptable losses" of Americans (at one point that number was considered to be 20 million men, women and children). Only the inability to assure that retaliatory losses would not be greater has prevented those criminal attacks, which, with combined deaths well in excess of 100 million, would have made Hitler's crimes look minor in comparison.

Think about that the next time you pay your taxes, a sizable percentage of which will be going towards funding the \$1.5-trillion F-35 and the \$1.3-trillion “refurbishment” of the U.S. nuclear arsenal, including the development and production of the profoundly dangerous B61-12 nuclear bomb. Think too about the reality that it is not just Trump, and not just Republicans, who are aggressively pursuing the insane idea of preparing for a “winnable” nuclear war. It’s our last “hope and change” president, Obama, and the Democratic Party too, that have been and are behind this criminal insanity.

Source: <https://www.nationofchange.org>, 18 February 2019.

**The 9M730 Burevestnik, known as SSC-X-9 Skyfall under its NATO reporting name, is designed as a nuclear-powered and nuclear-armed intercontinental cruise missile capable of traveling “unlimited distances.” It is even able to circle around the globe for days, if required.**

examining the prototype at an undisclosed location. The weapon itself was partially covered in the footage.

The weapon’s ambitious concept was unveiled by President Putin during his State of the Nation address last March 2018. The

9M730 Burevestnik, known as SSC-X-9 Skyfall under its NATO reporting name, is designed as a nuclear-powered and nuclear-armed intercontinental cruise missile capable of traveling “unlimited distances.” It is even able to circle around the globe for days, if required. The military says that its ability to traverse virtually any distance will be coupled with an equally astounding “unlimited ability to maneuver.” It will make the missile extremely hard to intercept while penetrating an enemy’s defenses.

**BALLISTIC MISSILE DEFENSE**

**RUSSIA**

**No Limits for ‘Russian Tomahawks’? What We Know about Moscow’s New Nuclear Cruise Missile**

Russia’s new nuclear cruise missile has entered the final stage of development following reports of successful tests. Officials say Burevestnik (‘Storm Petrel’) will have “unlimited” range and can outmaneuver any known defenses. The missile’s nuclear power unit was successfully tested back in January 2019, Russian media reported on February 15, 2019, citing sources. This “crucial” stage of testing “confirmed” that the reactor allows the missile to travel to an “unlimited range.” The military didn’t officially confirm the story, and it is not clear where and when the test reportedly took place. The videos released by the missile’s development team earlier showed how the engineers, dressed in all white and wearing safety masks, were carefully

**Burevestnik will indeed be unprecedented, given its features and capabilities. At the same time, its purpose is somewhat similar to the US long-range Tomahawk naval cruise missiles, except that their maximum range is limited to 2,500km (1,550 miles). The Russian missiles’ ‘sister’ project, the Poseidon nuclear-powered drone submarine, will undergo its sea trials in the summer of 2019.**

went through a “partially successful” test on January 29, 2019 at a site in southern Russia. The report, which cited US government sources, noted that “no country to date” has deployed a nuclear-powered cruise missile due to “engineering challenges” and safety concerns.

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project reportedly underwent successful nuclear power unit testing as well. Earlier reports suggested that the drone, which was described as a large nuclear-capable torpedo, would be able to travel at a speed up to 200kph (125mph) and dive as deep as 1km.

Source: <https://www.rt.com>, 17 February 2019.

## **USA-INDIA**

### **US in Talks with India over Missile Defence Collaboration: Pentagon**

The US has discussed a potential missile defence collaboration with India, a top Pentagon official has said, underlining that America wants to build a “much deeper and broader relationship” with the country. Under Secretary of Defence for Policy Rood, however, said that it is early to determine how far India, which already has substantial domestic missile defence capabilities, will go regarding the defence collaboration. “We have talked to the Indians about missile defence as potentially an area as well to collaborate on. It’s early days to determine how far that will go,” Rood said speaking at a think-tank here on February 07, 2019. “The Indians have substantial capabilities domestically of their own and they’ve done some development of missile defences. So the degree to which they’re interested in acquiring or working collaboratively with us in the US remains to be seen,” Rood said when asked about reports that India is interested in purchasing the Terminal High Altitude Area Defense system popular as THAAD from the US.

The previous Obama administration was not very forthcoming in sharing its advance missile defense system with India, following which New Delhi went ahead to procure it from Russia. As part of its Indo-Pacific strategy, the Trump administration now seems to be more than inclined to let India procure its missile defense system with talks between the two countries having already started. Making an

appearance before the prestigious Hudson Institute think-tank, Rood said the US is certainly open to this kind of collaboration with India. “And if that isn’t one of the areas they choose to go in, there’s quite a bit of other meaty areas that we can pursue. Maybe I should have chosen a term rather than meaty, quite a few Indians are vegetarian as you know,” Rood said jokingly.

The US has had a very positive relationship with the Indian government, he said. “And we’re building a, what we hope is a much deeper and broader relationship with them, all the way from the presidential level with Prime Minister Modi on down,” he said. “We have had excellent meetings and we’re expanding our agenda. There’s more meat to it, if you will. So I’m really feeling very good about the overall trajectory of that relationship,” said Rood who has been personally involved through successive administrations in building India-US relationship: in both the Bush administration, the Obama administration, and now in the present Trump administration.

The US has also agreed to sell two advanced missile defence systems to India for two Boeing-777 Head-of-State aircraft for an estimated cost of USD 190 million, a decision that will enhance the security of the planes flying the president and the prime minister. The Pentagon on February 06, 2019 said the sale will support the foreign policy and national security of the US by helping to strengthen the US-Indian strategic relationship.

The US is the second-largest arms supplier to India. It has already recognised India as a “major defence partner”, a status that which commits the US to facilitate technology sharing with India. In 2018, the US granted India Strategic Trade Authorisation-1 (STA-1) status. India is the only South Asian country to get STA1 status and third

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Asian country after Japan and South Korea. The status eases India's defence procurement from the US. Last year, India and the US signed the COMCASA (Communications Compatibility and Security Agreement) to facilitate interoperability between the two militaries and sale of high end technology.

Source: <https://economictimes.indiatimes.com>, 08 February 2019.

**The physical footprints of traditional, large nuclear power plants – coupled with substantial construction and operation costs – have presented challenges to the energy generation sector, while fossil fuel-based energy sources pose significant concerns in regards to pollution and overall environmental impact. The combination of these factors has led to the rapid development and deployment of modular nuclear reactors.**

reactors and SMRs are amply-equipped to replace the power generation capabilities of “traditional” power plants, such as coal-fired units. Thanks to their efficient designs and the ability for components to be factory produced, additional modular reactor units can be added to a site incrementally should a capacity increase be required.

Examples of potential applications include

remote sites in the far reaches of the world, such as maritime shipping locations and military installations, where a single SMR could power an entire community. More recent development projects, particularly in China, are slated to bring larger modular reactors to the forefront as a commercial-scale power generation option to meet growing energy demands.

**SMRs Offer Substantial Benefits:** SMRs are an attractive option for power generation in a wide variety of instances, particularly in remote or unusual environments. Factory-made designs are efficient and cost-effective as they enable offsite manufacturing in a controlled environment. SMR production is faster than that of larger scale reactors and due to their compact size, they are easier to place on site. Factory production capability also means high quality control measures can be implemented that were not previously possible with largely on-site based construction methods. In financial

metrics, the quick construction track and small modules create the opportunity for a fast recuperation on initial investments in SMRs.

The application flexibility provided by SMRs is exceptional. They can be used in areas where

**The application flexibility provided by SMRs is exceptional. They can be used in areas where conventional nuclear power plants cannot typically be constructed, such as remote locations lacking the network infrastructure for a large plant, sites without access to bodies of water for cooling, and areas requiring a small supplementary power source to assist the existing power grid, among others. Their modular design allows additional units to be added as and when required.**

## NUCLEAR ENERGY

### GENERAL

#### Small Modular Reactors and the Future of Nuclear Power

According to the World Nuclear Association, there has been a ‘revival of interest in small and simpler units for generating electricity from nuclear power.’ The physical footprints of traditional, large nuclear power plants – coupled with substantial construction and operation costs – have presented challenges to the energy generation sector, while fossil fuel-based energy sources pose significant concerns in regards to pollution and overall environmental impact. The combination of these factors has led to the rapid development and deployment of modular nuclear reactors.

Modular reactors are a new-generation breed of nuclear reactors that provide economic affordability and flexible power generation. A common type of modular reactor found today is the SMR, defined by the IAEA as a unit of 300 MWe or less. Modular reactors and SMRs are suitable for a wide range of users and applications and utilize high-quality components that deliver enhanced safety performance. Most modular



conventional nuclear power plants cannot typically be constructed, such as remote locations lacking the network infrastructure for a large plant, sites without access to bodies of water for cooling, and areas requiring a small supplementary power source to assist the existing power grid, among others. Their modular design allows additional units to be added as and when required. For example, if a small town was to rely on one SMR for its energy supply and that town was to grow as the area develops, additional units can easily be added to the existing infrastructure to meet these demands. SMRs also have the potential to be used in both civil and military settings. A small reactor could be fitted to power a submarine or surface vessel, giving it an almost infinite range.

In order to deliver high-output power generation in a small package, SMRs must operate at a higher temperature than typical nuclear reactors. To create the highest possible level of safety, engineers have taken steps to address any points of concern in the SMR operating environment. An example of this comes through bolstering the strength and durability of the electrical penetration assemblies (EPAs) that supply power and data transmission into the reactor's first loop. Rather than using polymer-sealed assemblies that cannot withstand high temperatures, SMR engineers have made glass-to-metal sealed EPAs a standard in SMRs. Glass-sealed assemblies can withstand temperatures of several hundred degrees Celsius without issue and handle extreme pressure levels. This makes them ideal for supporting reliable day-to-day SMR operation while also providing maximum protection to maintain infrastructure integrity and mitigate any potential severe accident scenario.

In addition to bolstering safety, glass-sealed EPAs offer a factor of simplicity that is well-aligned with the overall benefits of SMR construction and usage. Advanced EPAs on the market today utilize strong connectors that can join 140 electric compactors together in a single step. It is simply plugged in, securely locked, and then ready for operation. Supplying individual wires to a junction

box can take hours of strenuous work. By choosing a connector-based plug and play option, the process can be completely streamlined to prevent any slowdowns or missteps stemming from an otherwise complicated installation.

***Modular Reactor Projects and Advanced Components Deliver Intrigue for the Future:***

While small modular reactors offer terrific promise and intrigue for efficient and flexible nuclear power generation, new projects in China are aiming to ambitiously utilize modular technology on an even larger scale as they look towards a low-carbon emissions future. A natural progression can be seen in the work of the ongoing partnership between Chinergy Co., Ltd, and Jiamusi Electric Machine Co., Ltd. The companies cooperated to develop and construct the Shidaowan twin high temperature reactor (HTR)

in the Shandong province of China. The reactor is slated to be connected to the power grid and go online in 2019.

The current Shidaowan HTR, as with all high-temperature gas-cooled reactors, fell under the classification of being a

small modular reactor because of its power generation capability of less than 300MWe: the twin reactors at Shidaowan will power a single steam turbine capable of producing 210 MWe. However, the benchmark has already been set higher. Chinergy and Jiamusi Electric Machine are working towards a new undertaking known as the HTR-PM600 project. Here, the modular reactor is getting added muscle and will emerge as an intriguing option for large-scale commercial power generation. A total of six identical modules will be coupled to a single steam turbine.

While the HTR-PM600 project is in the early stages, Chinergy has begun preliminary development work at a site in Wan'an, Fujin province. Location selection for a second HTR-PM600 unit is ongoing and has a list of potential sites that includes Sanmen in Zhejiang, Xiapu in Fujian, and Bai'an in Guangdong. The first units

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are planned to be built in pairs for a total output of 1200MWe and completion is currently scheduled for 2022-2023.

A common thread between the projects is the use of glass-to-metal sealed electrical penetration assemblies in the primary loop of the modular reactor infrastructure for information and control signal transmission. Supplied by glass specialist SCHOTT AG from southern Germany for both projects, the successful integration of glass-to-metal sealed EPAs in the Shidaowan project paved the way for planned repeated integration in the HTR-PM600 units.

As with all modular reactors, the Shidaowan twin-reactor HTR facility and HTR-PM600 units differ from regular reactors because their components are manufactured or replicated in-plant for fast replacement and greater long-term cost-efficiency. SCHOTT provided design recommendations and technical consultation as they worked in close collaboration with the teams at Chinergy and Jiamusi Electric Machine. The result was the achievement of a tailored solution that meets the unique installation requirements and can withstand the high temperature, high pressure environment of the HTR's primary loop.

The incorporation of glass-to-metal sealed EPAs in the primary loop of these new HTR units is a promising step forward for shaping the future of next generation nuclear power. Glass-sealed EPAs already represent a superior solution for "traditional" nuclear power plants, as they maintain uncompromised seal integrity for a qualified lifetime of 60 years. In comparison, polymer-based seals are organic and age naturally, resulting in degradation and the need for multiple replacements over the lifetime of the reactor. This presents both a cost burden and potential safety risk. In HTR applications, glass-sealed EPAs are the only viable feedthrough option for the primary loop as polymer cannot withstand the high temperature and pressure of the working environment.

**Future Outlook:** As advancements continue to be made in modular reactors across a wide range of applications, the combination of unique and innovative assembly and operation of SMRs along with the superior safety and performance of glass-

to-metal sealed EPAs represents a viable option for the advancement of nuclear power in the years to come. With carbon emissions mitigation becoming a topic of greater importance with each passing day, utilities and governments cannot afford to brush aside nuclear power as an energy option of the past. The nuclear industry worldwide will be watching as advanced modular reactor projects in China aim to take significant steps towards delivering commercial-scale power generation with modern nuclear technology.

Source: <https://www.hazardexonthenet.net>, 17 February 2019.

### NUCLEAR COOPERATION

#### ARGENTINA-INDIA

##### India Looks to Boost Ties with Argentina through MoU on Defence Cooperation

President of Argentina, Mauricio arrived in India along with a large delegation from Argentina's nuclear sector. Argentina's President and delegates will participate in the first meeting of a joint committee on nuclear issues. Argentina's ambassador Chuburu said: "Argentina is also keen to pitch medium and small nuclear plants made by a state-run firm to India". "We are [expecting to sign] seven or eight agreements, in areas such as defence, tourism, technology, education culture, and pharmaceuticals. We hope the MoU we are signing in defence will open a lot of possibilities in different areas," said Chuburu informing that an Indian delegation will also visit Argentina in March 2019 to boost defence relations.

The Argentinian Ambassador emphasised saying, "We are developing modular power plants called Carem. There will be talks in this regard and on other civilian uses of nuclear technology, such as irradiation of vegetables and medicine. There are a lot of things in which we think there is a good possibility of getting together and working with India." Argentina's state-run INVAP built a plant at BARC in Mumbai for molybdenum enrichment based on India and Argentina's nuclear cooperation agreement. ...

Source: <https://eurasianimes.com>, 18 February 2019.

URANIUM PRODUCTION

GENERAL

**Uranium Market Revival: Nuclear Power as a Renewable Energy Source**

**Nuclear Power Demand:** As the world's exponential population growth over the coming decades leads to widespread urbanization, the demand for energy is expected to rise at the same time that countries around the world are increasing efforts to reduce carbon dioxide emissions. The trend toward a greener, cleaner energy future means that the primary energy sources for the future global energy mix are set to change as the reliance on fossil fuels decreases in favor of low-carbon emitting sources. It stands to reason that as the demand for global energy increases, so too must the number of low-carbon emitting energy sources.

**Nuclear power is one of the world's most commonly used low carbon-emitting sources of electricity. "It is the second largest source of low-carbon electricity production globally (after hydropower), and provided over 30 percent of all low-carbon electricity generated in 2016.**

Nuclear power is one of the world's most commonly used low carbon-emitting sources of electricity. "It is the second largest source of low-carbon electricity production globally (after hydropower), and provided over 30 percent of all low-carbon electricity generated in 2016," according to the WNA. "Almost all reports on future energy supply from major organizations suggest an increasing role for nuclear power as an environmentally benign way of producing reliable electricity on a large scale." Today, about 11 percent of global electricity is generated by about 453 nuclear power reactors, with about 60 more reactors now under construction. In 2017, nuclear power provided 2,487 TWh of electricity, up from 2,477 TWh in 2016. 2017 also represented the fifth consecutive year that global nuclear generation had risen since 2012.

Tomorrow, that number is destined to rise further, especially as rapidly urbanizing countries like China and India begin to overtake the United States as the world's largest energy consumers. Nuclear power "is especially suitable for meeting

large-scale, continuous electricity demand where reliability and predictability are vital – hence ideally matched to increasing urbanization worldwide," notes the WNA. China is quickly bringing new nuclear power plants online in lieu of coal-fired plants in order to reduce carbon emissions and improve the country's air quality. The WNA predicts that 25 percent of global energy supply will come from nuclear plants by 2050.

**Uranium Supply and Demand:** Nuclear power generation requires enriched uranium. Market watchers know that after reaching a high of US\$135 per pound in 2007, the uranium market price has been in a nearly decade long slump since the early

2011 Fukushima disaster with spot prices dipping as low as US\$18 per pound in December 2016. However, renewed optimism in the future of nuclear power in the global energy mix and supply side disruptions from the largest uranium producers have pushed both spot and long-term

contract prices up over the past year with more gains expected in 2019 and beyond. In 2017, uranium producer Kazatomprom cut its output by 2,000 tonnes and in early 2018 Cameco (TSX:CCO,NYSE:CCJ) suspended operations at its Saskatchewan-based McArthur River, the world's largest uranium mine. Placing even further pressure on the market, when Cameco decided to close up shop at McArthur it also became one of the world's largest uranium buyers, scooping up U3O8 on the spot market to fulfill its contracts.

**Uranium Price Forecasts:** These supply cuts by two of the world's uranium giants alongside new buyers like uranium fund Yellow Cake are expected to further reduce utilities inventories. This potential supply crunch that could lead to a new round of contracts which may push prices up this year and beyond. Nick Carter, executive VP of uranium at UxC told Northern Miner his firm sees "a continued upward trend in the spot price over the rest of the year, as producers buy lower-cost inventories and utilities in the next 11 months."

In 2019, the nuclear industry market research firm predicts the spot price could reach into the low to mid US\$30s and gradually climb into the low US\$40s in the next five years. The long-term price movement is often slow to follow spot, but UxC thinks we may see a long-term price of US\$36 per pound by the end of 2019, moving into the mid-\$40s five years from now. The Bank of Montreal is more bullish in their uranium price forecast, projecting a long-term contract price of \$55 per pound by 2023.

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**Uranium Companies to Get a Boost:** The upward price movement is a good sign the uranium market has reached the bottom of the trough and is in the midst of a rebound. This positive sentiment bodes well for uranium stock valuations, and many in the business of uranium mining and exploration are excited by the turnaround. “The disaster at Fukushima cooled the uranium market significantly, but we’re coming out of that now. More reactors are coming online and more are planned to come online in the future,” Azincourt Energy (TSXV:AAZ,OTCMKTS:AZURF) CEO Alex Klenman told Investing News Network (INN) at the Vancouver Resource Investment Conference (VRIC) 2019. Klenman added that the shutdowns by both Cameco and KazAtomProm are “equivalent to Saudi Arabia shutting off all oil production. All of the fundamentals are there to continue to drive uranium prices up.”

**As the world transitions to a clean renewable energy future, nuclear power will play a key role in that transition. Increased demand for nuclear power-generated electricity around the globe alongside a developing supply crunch is breathing new life into the uranium market and this is bound to factor into uranium equity valuations in 2019.**

Azincourt is developing a portfolio of uranium properties to fulfill the growing demand for clean energy sources and holds interests in two highly prospective uranium plays in Canada’s prolific Athabasca Basin: East Preston and Patterson Lake North. The projects place the C\$4 million market

cap company in a neighborhood dominated by billion-dollar market cap players. Azincourt’s East Preston joint venture covers over 25,000 hectares of the eastern portion of the Preston project, one of the largest tenure land positions in the Patterson Lake region. The company also holds a 10 percent interest in the Patterson Lake North uranium project, a joint venture with Fission 3.0 (TSXV: FUU), as operator. It sits immediately adjacent to Fission Uranium’s (TSX: FCU) Patterson Lake South property, which hosts the high-grade Triple R uranium deposit.

Other uranium companies well-positioned to capitalize on renewed sector growth include leading US-based Energy Fuels (TSX:EFR, NYSE AMERICAN: UUUU), which was recently added to the Russell 3000 Index, an elite list of America’s top companies; Plateau Energy Metals (TSXV:PLU), which controls all reported uranium resources known in Peru through its Macusani uranium project; and Blue Sky Uranium (TSXV:BSK), which controls more than 5,000 square kilometers in Argentina where nuclear power currently accounts for 7 percent of the nation’s energy mix.

**Takeaway:** As the world transitions to a clean renewable energy future, nuclear power will play a key role in that transition. Increased demand for nuclear power-generated electricity around the globe alongside a developing supply crunch is breathing new life into the uranium market and this is bound to factor into uranium equity valuations in 2019.

Source: <https://investingnews.com>, 19 February 2019.



NUCLEAR PROLIFERATION

NORTH KOREA

**Will Kim Give Up N Korea's Nuclear Crown Jewel Yongbyon?**

For much of the past four decades, North Korea's nuclear ambitions have focused on a sprawling complex nestled in the mountains north of Pyongyang. All of that could come to an end after President Trump and leader Kim meet. The dismantlement of the Yongbyon Nuclear Scientific Research Center has emerged in recent months as a potential outcome from a second summit between the leaders planned for February 27-28, 2019 in Vietnam. Moon Chung-in, a special adviser to South Korea's president, told Bloomberg last week that Kim had agreed to close the plant and allow inspectors — possibly giving the US valuable insights into Kim's weapons programs.

A deal to shutter Yongbyon would represent Trump's first tangible victory toward reducing Kim's nuclear capacity since he granted an unprecedented meeting last June 2018— even though North Korea has made similar promises before. The move could potentially deprive Kim of enough plutonium to make roughly one atomic bomb a year, and possibly other materials needed to make smaller, more powerful nuclear weapons. Still, that would fall far short of the “final, fully verified denuclearization” that Secretary of State Pompeo and other Trump administration officials have demanded. Even if he closes Yongbyon, arms control experts say Kim probably has at least one other secret plant that can produce enough uranium to make as many as six nuclear bombs a year.

Chun Yungwoo, a former South Korean nuclear envoy who helped broker one of the deals to shut Yongbyon, said the regime has shifted its focus to building better warheads and intercontinental

ballistic missiles that could hit the US. North Korea probably has enough fissile material to continue most of its nuclear weapons program, even if it closed all its other fuel-production facilities, Chun said. “Ten years ago, that was our main concern,” he said. “The relative value of Yongbyon and the enrichment plants outside of Yongbyon is now negligible.”

Trump told reporters at the White House on February 19, 2019 that he was in “no rush whatsoever” to reach a deal with Kim because he has a strong relationship with the North Korean leader and that sanctions against the country remained in place while the two sides talk. Meanwhile, the US's special representative for

North Korea, Stephen Biegun, was traveling to Hanoi to prepare for the summit, the State Department said.

Yongbyon, located about 100 kilometers (60 miles) north of the capital, carries symbolic value as the long-time crown jewel of North Korea's nuclear weapons program. First constructed

in 1979, its reactor has produced little electricity, but supplied the plutonium and research facilities needed for North Korea to test its first atomic bomb in 2006. Kim put Yongbyon back on the table in a meeting with South Korean President Moon in September 2018, when he expressed a willingness to accept the “permanent dismantlement” of the plant in exchange for “corresponding measures” by the US. Moon Chung-in, the president's adviser, said Kim also agreed during that meeting to “accept verification” of its demolition. Closing Yongbyon, as well as a lab that might produce tritium — a radioactive isotope of hydrogen that helps in miniaturizing warheads — would be a success, according to Siegfried Hecker, who was among a group of nuclear scientists who observed a uranium-enrichment operation at the facility during a 2010 inspection tour.

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**Nuclear Bombs:** “Shutting down and dismantling the Yongbyon nuclear complex is a big deal,” said Hecker, who has visited the site four times. “It will stop the production of plutonium and tritium. And it will greatly diminish the ability to make highly enriched uranium.”

Still, inspecting the dozens of buildings at Yongbyon could take weeks and full dismantlement would drag on even longer. Disagreements might arise over how much of the complex is covered by any deal. South Korea and other advocates of a gradual approach to talks with North Korea argue that Yongbyon’s dismantlement would build trust and encourage more significant concessions by Kim. Biegun, the US envoy, said last month that the North Korean leader has committed to the dismantlement of enrichment facilities “beyond Yongbyon” in conversations with Pompeo and South Korean officials.

How much Trump administration can accomplish by next week remains uncertain. Biegun told visiting South Korean lawmakers last week that it would be hard to resolve remaining disputes in advance and that talks were likely to stretch beyond the summit. In exchange for dismantling Yongbyon, Kim would probably demand relief from international sanctions — the US’s main point of leverage in negotiations. The demolition would require delicate negotiations on where and when inspectors can roam, an area where similar talks collapsed a decade ago. The regime might divert nuclear materials to other facilities.

North Korea twice agreed to halt operations and let in nuclear inspectors in exchange for aid before Kim Jong Un took power, once in the mid-1990s and again in the mid-2000s. Both times, North Korea walked away and returned to military provocations after disagreements over how to implement the deal. “We do want to make sure that the ‘shutdown of Yongbyon’ is as

comprehensive as possible and as irreversible as possible,” said Melissa Hanham, a non-proliferation expert and director of the One Earth Future Foundation’s Datayo Project. “We don’t want to repeat the mistakes of the past.”

Source: <https://www.business-standard.com>, 20 February 2019.

## USA–RUSSIA

### Have We Entered a New Arms Race?

The withdrawal of the United States from the INF received a standing ovation by some members of Congress at this year’s State of the Union. However, the U.S. withdrawal from the INF treaty could have

a potential for a new nuclear arms race and divide the U.S. from its European allies. Former Sen. Richard Lugar, R-Ind., warned President Trump last October 2018 to not withdraw from the treaty. In a statement released by the Lugar Center he said, “Withdrawal from the treaty would diminish U.S.

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standing and options in the European theater, which has been vital to our own security for over a century.” Now, almost three decades after the end of the Cold War, Russia and the U.S. may find themselves in a renewed arms race. The INF Treaty, signed in 1987 by former Soviet leader Mikhail Gorbachev and former president Ronald Reagan, was meant to ban the development and use of land-based ballistic missiles with ranges of 310 to 3,420 miles.

Unsurprisingly, both Russia and the U.S. are accusing each other of violating the treaty by developing ballistic missiles that fit the banned range capability. CIA Director Haspel confirmed Russia’s violation of numerous treaties including the INF at a recent Senate hearing. Meanwhile, Russia accuses the U.S. of installing defense systems capable of launching intermediate-range missiles in Romania. The most pressing ramification of this decision is that it drives a

wedge between the U.S. and our European allies. The lifting of the ban on land-based intermediate range missiles puts all of Europe at risk of a nuclear strike. With the exception of Alaska, the U.S. is well protected by the Pacific Ocean from any land-based intermediate range missile attack.

It is an all too common trend in the Trump administration to put America first and leave our allies out to dry. However, in the long-term, decisions like this one are not putting America first. One day our allies will not hesitate to do the same to us in our time of need. Withdrawing from the INF treaty does not mean the world is at the brink of nuclear war. It does mean that both Russia and the U.S. will now openly develop intermediate range missiles once again. The broader consequences of this decision lie in the foreign policy philosophies of certain officials in the Trump administration such as NSA Bolton. On several occasions, Bolton has spoken out against arms control agreements, including the Iran Deal and another U.S.-Russia arms reduction agreement called the New Start Treaty, which expires in 2021. Bolton's isolationist zeal has led him to speak out against the NATO and the UN, which are bastions of global stability. His views are alarming considering that he has the ear of Trump, who is known to make erratic decisions when it comes to world affairs.

Although the INF treaty did not do much to stop Russia from violating it, scrapping the treaty in its entirety will not deter Russia from stockpiling nuclear weapons either. The treaty also failed to consider rising third-party nuclear powers such as China, Iran and possibly North Korea. Many of the Cold War nuclear arms

reduction treaties need to be adapted to present day to include countries besides the U.S. and

Russia. Additionally, serious steps need to be taken to abolish nuclear weapons. The rise of many third-party nuclear powers is a sign that there is an increased likelihood of a nuclear catastrophe happening. The United States and Russia have to prevent another nuclear arms race in order to focus

on more imminent existential threats like climate change.

Source: <https://www.idsnews.com>, 18 February 2019.

**Withdrawing from the INF treaty does not mean the world is at the brink of nuclear war. It does mean that both Russia and the U.S. will now openly develop intermediate range missiles once again. The broader consequences of this decision lie in the foreign policy philosophies of certain officials in the Trump administration such as NSA Bolton.**

**NUCLEAR NON-PROLIFERATION**

**USA-SAUDI ARABIA**

**U.S. Senate Proposal would Block Saudi Path to Atomic Weapon in Nuclear Deal**

U.S. senators from both parties introduced a resolution on February 12, 2019 requiring that any deal to share U.S. nuclear power technology with Saudi Arabia block the kingdom from making a nuclear weapon. Under the measure, any U.S. civilian nuclear cooperation agreement, or 123 agreement, with Saudi Arabia would prevent enrichment of uranium or reprocessing of

plutonium made in reactors - two routes to making nuclear weapons. It is unclear whether a majority of the 100-member Senate would support the resolution of Democrats Jeff Merkley and Ed Markey and Republican Rand Paul. The resolution is also non-binding on the U.S. government. But with

significant support, it would signal concern in Congress over Saudi-led bombing campaigns in Yemen and over the killing of U.S.-based Saudi

**Many of the Cold War nuclear arms reduction treaties need to be adapted to present day to include countries besides the U.S. and Russia. Additionally, serious steps need to be taken to abolish nuclear weapons. The rise of many third-party nuclear powers is a sign that there is an increased likelihood of a nuclear catastrophe happening.**

journalist Jamal Khashoggi in the Saudi consulate in Istanbul in October.

U.S. Energy Secretary Rick Perry has been holding quiet talks with officials from Saudi Arabia on sharing U.S. nuclear technology. U.S. President Trump hosted nuclear power executives on February 12, 2018 for talks on keeping the industry competitive on exports with France, China, and Russia. The Trump administration is trying to advance nuclear energy technology domestically and abroad as the industry suffers from plentiful supplies of cheap natural gas and high safety costs at home. A resolution could pressure the administration to push for a deal with tougher standards. "If Saudi Arabia is going to get its hands-on nuclear technology, it's absolutely critical that we hold it to the gold standard for non-proliferation," Merkley said in a release. "The last thing America should do is inadvertently help develop nuclear weapons for a bad actor on the world stage."

Riyadh has said it wants to be self-sufficient in producing nuclear fuel and that it is not interested in diverting nuclear technology to military use. But Saudi Crown Prince Salman told CBS in 2018 the kingdom will develop nuclear weapons if arch-rival Iran does. In previous talks, Saudi Arabia has refused to sign an agreement with Washington that would deprive it of enriching uranium. The Saudi embassy in Washington did not immediately respond to a request for comment. In 2018, Saudi Arabia put the United States on a shortlist with South Korea's state-run utility KEPCO, along with France, China and Russia to bid for a nuclear power project. The winner will likely be selected in 2019. U.S. reactor builder Westinghouse, owned by Brookfield Asset Management Inc, would likely sell nuclear technology to Saudi Arabia in any deal.

Chris Crane, president and chief operating officer of Exelon Corp, the largest U.S. nuclear power operator, told reporters Trump was supportive in February 12, 2019 meeting with the executives but wanted them to clarify their expectations. Crane was joined by Daniel Poneman, head of uranium enrichment company Centrus Energy

Corp and deputy energy secretary under former President Barack Obama, and John Hopkins, head of NuScale Power, a company developing small modular reactors.

Source: <https://in.reuters.com>, 13 February 2019.

## NUCLEAR DISARMAMENT

### GENERAL

#### Disarmament Efforts Must Include China as well as US, Russia: Merkel

China must be involved in international disarmament efforts, German Chancellor Angela Merkel said on February 16, 2019, amid rising concern about Beijing's missile arsenal and the suspension of a key US-Russia arms treaty. "Disarmament is something that concerns us all

and where we would of course be glad if such talks were held not just between the United States, Europe and Russia but also with China," said Merkel.

The United States began pulling out of a landmark Cold War missile control agreement with Russia, the INF Treaty, this February

2019 in response to Moscow's deployment of the 9M729 missile, prompting Russia to announce its own withdrawal.

While pointing the finger at each other, both Washington and Moscow have also voiced concern that the INF — a bilateral treaty between the US and Russia — does nothing to constrain rapidly growing military power China.

According to a new report by the Institute for Strategic Studies, up to 95 per cent of China's arsenal of ballistic and cruise missiles would be in breach of the INF if Beijing were party to it. Given this, "it is difficult to envision a scenario under which China would today enter a regime such as the INF Treaty," the report said. Germany is organising an international conference in Berlin in March 2019 to start talks about how to create an arms control regime to replace the one forged in the bipolar Cold War era.

Source <https://www.business-standard.com>, 16 February 2019.

**If Saudi Arabia is going to get its hands-on nuclear technology, it's absolutely critical that we hold it to the gold standard for non-proliferation, The last thing America should do is inadvertently help develop nuclear weapons for a bad actor on the world stage.**



## Global Campaign Against Nuclear Weapons Launched

The ICRC is deeply concerned about a worrying erosion of the nuclear disarmament and arms control framework. Recent decisions contribute to a worrying trend toward a new nuclear arms race and, consequently, an increased risk of nuclear weapons use. The ICRC calls on concerned States and those in a position to influence them to reverse this distressing trend. To stem the rising tide of nuclear risks in world politics, the ICRC, the International Federation of Red Cross and Red Crescent Societies (IFRC) and the wider International Red Cross and Red Crescent Movement are launching a global campaign. The campaign aims to draw further attention of the public to the catastrophic humanitarian consequences of a nuclear war, and ultimately encourage people to urge their governments to sign and ratify the Treaty on the Prohibition of Nuclear Weapons. “Any risk of nuclear weapons use is unacceptable. The Treaty represents a beacon of hope and an essential measure to reduce the risk of a nuclear catastrophe”, said ICRC President Peter Maurer. Seventy countries have so far signed the TPNW, while 21 have ratified or otherwise acceded to the Treaty.

“In many countries, Red Cross and Red Crescent National Societies are working with governments, national parliaments and civil society to facilitate rapid accession to the Treaty. We will continue working with our network to advocate for a world without nuclear weapons. Nothing could prepare the world for the horrors of a nuclear war. After 74 years, we still haven’t learnt the lesson of suffering, devastation and death of Hiroshima and Nagasaki”, said IFRC President Francesco Rocca. Citizens, parliaments and civil society all have a crucial role to play in efforts to reduce the risk of nuclear weapons use. At this moment of growing international tension, I call on everyone to act with urgency and determination to bring the era of nuclear weapons to an end”, said Maurer.

**The well-documented evidence of the catastrophic humanitarian consequences of nuclear weapons casts significant doubt on whether these weapons could ever be used in accordance with international humanitarian law. On this basis, the International Red Cross and Red Crescent Movement has consistently called for nuclear weapons never to be used again and for their complete prohibition and elimination.**

Nuclear weapons are the most devastating and destructive weapons ever invented. The Japanese Red Cross and the ICRC witnessed this first-hand in Hiroshima and Nagasaki in 1945, as they tried to bring relief to the dying and injured. The nuclear blasts killed tens of thousands of people, destroying medical facilities, and leaving behind appalling conditions for survivors. To this day, Japanese Red Cross hospitals continue to treat victims of cancer, including leukemia, attributable to radiation from the 1945 atomic blasts. The well-documented evidence of the catastrophic humanitarian consequences of nuclear weapons casts significant doubt on whether these weapons could ever be used in accordance with international humanitarian law. On this basis, the International Red Cross and Red Crescent Movement has consistently called for nuclear weapons never to be used again and for their complete prohibition and elimination.

Source <https://www.ekkleisia.co.uk>, 12 February 2019.

## NUCLEAR SAFETY

### GENREAL

#### Can Thorium Offer a Safer Nuclear Future?

Is thorium the great hope for a clean, viable and safe nuclear-fuel alternative to uranium, or is it an impractical and overly expensive option that could never be adopted by the nuclear industry? Nuclear energy has numerous advantages, but there are drawbacks as well: nuclear waste poses a significant environmental threat, meltdowns are a possibility and nuclear materials can be used to create weapons of mass destruction. However, advocates of using thorium as a nuclear fuel instead of uranium point out that it solves many of these problems.

**Can Thorium be Weaponized?** Although some wonder if thorium can be used in nuclear weapons and are concerned about the possibility of a thorium bomb, thorium actually can’t be

weaponized because it doesn't produce enough recoverable plutonium, which is required for building nuclear weapons. Moreover, the waste from thorium reactions is dangerous for a few hundred years, instead of the 10,000 or so years for uranium waste — a thorium reactor could even consume much of the existing uranium waste. Thorium reactors can't undergo a meltdown, according to SmartPlanet. Thorium is also far more abundant in the world than uranium, with supplies in places like Australia, India and Idaho. Additionally, it is far more efficient — dig thorium out of the ground and it's ready to be put in the reactor, whereas only 3-5% of mined uranium needs no further processing.

**Original Development and History:** If it's so great, why aren't we using it? When nuclear power was being developed in the 1950s, it was part of a broader Cold War strategy. Governments were paying for the research and it was in their interest to develop uranium as the primary nuclear fuel because it could also be used in weapons development. However, critics of the thorium alternative point out that it's more expensive than uranium because it can't sustain a reaction by itself and must be bombarded with neutrons. Uranium can be left alone in a reaction, while thorium must be constantly prodded to keep reacting. Although this allows for safer reactions (if the power goes out it simply deactivates), it's a more expensive process. Thorium is a popular academic alternative: in the lab it works well, but it hasn't been successfully — or profitably — used on a commercial scale yet.

**Current Usage of Thorium:** India is the market leader in trying to harness thorium for the energy grid. It has the largest proven thorium reserves and the world's only operating thorium reactor, Kakrapar-1, a converted conventional pressurized water reactor. China is working to develop the technology as well, while the United States, France

and Britain are studying its viability. Flibe Energy, which is based in Huntsville, Alabama, recently noted the company is looking to establish a liquid

fluoride thorium reactor in the U.S. within the next decade, with Wyoming as a possible location.

Proponents of renewable energy concede that thorium is preferable to uranium, but argue that the millions in subsidies thorium will require to become commercially viable would be better spent on solar, wind and other alternative energy sources. While nuclear advocates are more hospitable to thorium, they are hesitant to put all their eggs in one basket at this point. The element hasn't shown itself to be feasible as a profitable commercial energy source, whereas uranium has. Despite a history of reactor meltdowns and near-meltdowns, there's a renewed emphasis on nuclear power in the world today, and nuclear industry advocates don't see now as the time to try an unproven alternative.

The bottom line is that when it comes to thorium versus uranium, thorium is more abundant, as well as cleaner and safer, but given current capabilities, it produces more expensive energy than uranium and still leads to environmental waste issues. Thorium could be part of the answer to the world's energy needs, but it currently lacks a track record of cost-effective energy generation. In the meantime, nations like China and India are taking the lead in developing thorium-based nuclear systems.

Source: <https://news.thomasnet.com>, 21 February 2019.

**Nuclear energy has numerous advantages, but there are drawbacks as well: nuclear waste poses a significant environmental threat, meltdowns are a possibility and nuclear materials can be used to create weapons of mass destruction.**

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## NUCLEAR WASTE MANAGEMENT

### GENERAL

#### Scientists Offer New Technology to Absorb Liquid Radioactive Waste

Scientists at the Academy of Sciences' Kola Scientific Center offer new nanomaterials to purify

liquid radioactive waste. The Center's representative Anatoly Vinogradov told TASS the new unique materials are similar to natural minerals, Trend reports. "The most important part of work is to make synthetic titanosilicates, similar to Kola minerals from the Ivanyukit and Lintisit Group, which are used as sorbents, they are highly effective in processing of gained liquid radioactive waste," the scientist said.

This work followed research at the Kola school of crystal and mineral studies, led by the Kola Scientific Center. In 2018

only, the school's experts across the world opened 18 new rare minerals. More than half five dozen new minerals have been discovered over recent years. Some of the minerals have unique characteristics to be used for the industry's advance sectors. "By using the natural analogues, our scientists have succeeded in getting analogues of natural minerals from available resources and industrial waste," he continued.

Among most interesting new materials are the

sorbents, which contain radionuclides. They can "extract" radioactive substances from waste, and further storage would not harm the environment. Heating turns the sorbents into ceramic materials, which are resistant to water, acids, alkalis, high temperatures. "It takes millenniums to decompose

such ceramic materials, as they consist of analogues to natural minerals, which are hard to decompose, - Rutile, Purochlore, Hollandide and others," the expert continued. "Our tests have confirmed the new sorbents are effective and promising."

The scientists now face a task of making test consignments of new sorbents. For that, they make a facility jointly with the Kola Mining and Metallurgical Plant and the Apatit plant. The facility will go operational within 2019. "Thus, we shall begin big tests of the new materials to purify radioactive wastes, industrial waste from non-ferrous metals, and in other spheres," the expert said.

Source: <https://en.trend.az>, 20 February 2019.

**New materials are the sorbents, which contain radionuclides. They can "extract" radioactive substances from waste, and further storage would not harm the environment. Heating turns the sorbents into ceramic materials, which are resistant to water, acids, alkalis, high temperatures.**



Centre for Air Power Studies

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Centre for Air Power Studies

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