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OPINION – Rakesh Sood

Nuclear Deterrence 3.0

When Trump leaves office and Biden takes over, humanity should breathe a huge sigh of relief. Trump is the only recent President to threaten the use of nuclear weapons. In August 2017, Trump warned North Korea, “They will be met with fire and fury like the world has never seen....” Even as President-elect, Trump had already put the nuclear option on the table. Responding to a question on whether he would rule out using nuclear weapons, in April 2016, he said, “Would there be a time when it could be used? Possibly. Possibly.” This is one reason why the Doomsday Clock, established in 1947 by a group of scientists who developed the first nuclear weapons but now wanted to convey the risk it posed to humanity, was calibrated in 2020 to 100 seconds to midnight, the closest to a global catastrophe that it has ever been.

Despite this stark warning from the Doomsday Clock, many nuclear strategic experts tell us that we should feel more secure. After all, the nuclear taboo has held since 1945 despite the Cold War. US-USSR/Russia arms control agreements have helped reduce nuclear weapons stockpiles from nearly 65,000 in late-1970s to less than 15,000. The NPT that entered into force in 1970 for 25 years with about 50 states was

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extended indefinitely in 1995 and is the most widely accepted treaty, with 190 adherents.

The Treaty on the NPT may well be the most universal treaty but it has reached the limits of its success. The five nuclear-weapon-states party to it (USA, Russia, UK, France and China) blithely ignore their responsibility for nuclear disarmament, convinced that NPT legitimises their possession of nuclear weapons and the four non-NPT countries (Israel, Pakistan, India and North Korea) have built weapons for their own security reasons. Indeed, in a direct violation of the spirit of the NPT, Trump said blithely to Bob Woodward, “I have built a

nuclear — a weapons system that nobody's ever had in this country before. We have stuff that you haven't seen or heard about." William Lambers, a nuclear weapons specialist, has observed that "while for over 60 years presidents in both parties worked to reduce nuclear weapons and the likelihood of their use, Trump has begun unravelling these efforts."

Today's politics is marked by growing major power rivalry, sharpening nuclear multipolarity. More usable weapons and blurring of the nuclear-conventional line creates a permissive scenario, raising the likelihood of the non-use taboo being breached.

Deterrence 1.0, which governed the US-Soviet Union nuclear rivalry during the Cold War, was characterised by arms control agreements and efforts to curb global proliferation. Deterrence 2.0 characterised the post-Cold War era of unipolarity, when the US largely determined the global nuclear agenda. The US strengthened its Conventional Prompt Global Strike (CPGS) system, which was intended to reduce the salience of nuclear weapons. However, this had an unintended consequence as China and Russia embarking on their own nuclear modernisation programmes. During this period, new nuclear-weapons states emerged: India and Pakistan (that were not signatories to the NPT); and North Korea (which withdrew from the NPT).

In the current changed political reality, old instruments of US-Soviet arms control and non-proliferation no longer work. Secondly, new developments in cyber and space technologies as well as hypersonic missiles and missile defence systems are challenging old deterrence equations. In Covid terminology, the challenge has mutated and old prescriptions do not help. Today's politics is marked by growing major power rivalry,

sharpening nuclear multipolarity. More usable weapons and blurring of the nuclear-conventional line creates a permissive scenario, raising the likelihood of the non-use taboo being breached. Old arms control agreements are under strain and some (such as the ABM, INF and the Treaty on Open Skies) have collapsed. The stage is set for

Deterrence 3.0 except that this time, it is not a 'known-unknown' but an 'unknown-unknown.'

Indications are that US President-elect Joe Biden is inclined towards the Russian proposal to extend New START. This treaty

lapses on 5 February 2021. This will provide some breathing room. But, will this be enough to restore nuclear sanity? Traditional arms control and non-proliferation believers believe 'Yes' but the Doomsday Clock indicates otherwise. Bridging this gap is necessary and while it does not mean discarding old instruments or treaties, it does mean realising their limitations in today's nuclear world.

This is why the world needs Deterrence 3.0.

Deterrence 3.0 has to create a new consensus for a multipolar nuclear world, a world not of nuclear parity but asymmetry in terms of both sizes and nature of arsenals. This asymmetry in turn exacerbates mistrust, where some countries believe that ambiguity and

unpredictability strengthen their deterrence. Such need to preserve ambiguity makes cooperative verification difficult, especially when cyber and AI developments are heightening risks of an accidental nuclear collision.

The Biden administration therefore provides an opportunity to step back from the Trump administration's hyperbole of 'fire and fury.' We should use this opportunity to create a platform where the nine nuclear-weapon-states can at least

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meet, have intensive discussion and agree that preventing the use of nuclear weapons is a shared responsibility. They should also exchange views on how to step back from escalatory postures; and share experiences on fail-safe, critical and secure communication channels to be employed in times of crisis. Deterrence 3.0 recognises that nuclear weapons cannot be wished away. What is critical is to reduce their salience in security doctrines and ensure that they are never used.

There are two complementary approaches, one doctrinal and the other technical. The first is the policy of no-first-use. In other words, nuclear weapons would be used only for retaliatory purposes. This diminishes the role of nuclear weapons.

The second is de-alerting or increasing the lead-time between the decision to use a nuclear weapon and the time that it takes to implement the nuclear strike. The issues of hair-trigger-alert (which enables nuclear weapons to be launched in minutes) and highly centralised control has been the subject of debate and discussion in the US in recent years.

In Asia, where several nuclear weapons states are locked in decades-long conflicts, Deterrence 3.0 is crucial in ensuring that conflicts do not escalate to the use of nuclear weapons. This includes China and India, as well as nuclear flashpoint regions such as South Asia and the Korean Peninsula. In the India-China context, the nuclear dimension has never surfaced because both countries maintain a no-first-use policy. However, in South Asia, both India and Pakistan have experienced many close shaves: Kargil in 1999, the terrorist attacks on the Indian Parliament (2001) and in Mumbai (2008), and the latest incident in Pulwama, Kashmir, in 2019, leading to the crash of an Indian jet in Pakistan-administered Kashmir. Given these close shaves, the world must once again focus on the dangers of an accidental nuclear exchange.

The goal of Deterrence 3.0 is to ensure that once

again, the Doomsday Clock is recalibrated far away from midnight. We will all sleep better when that happens.

Source: Observer Research Foundation, <https://www.orfonline.org/research/nuclear-deterrence-3/>, 24 December 2020.

OPINION – Manpreet Sethi

India's UNSC Tenure 2021-2022: Securing National Interest through International leadership

New year starts for India by joining the UNSC as an elected non-permanent member for two years. This is the eighth time that India will be part of this forum constituted to maintain international peace and security. The last time India occupied this high chair was a decade ago. The global political environment then was quite different from now. Today, trust levels amongst major powers are low, nationalistic hedging is high, and global security appears out of focus.

Besides the fraught state of international affairs, India is also beset with immediate regional security concerns. To the ever-present challenge of Pakistan's terrorism has been added an aggressive and expansionist China. As

a new great power, Beijing appears keen to rewrite rules of engagement and is flexing its economic and military muscle to simultaneously seduce and bully nations. The US, on the other hand, while militarily still the strongest, is economically beleaguered and domestically distraught. Priorities of the new US administration on global front are yet unclear. Meanwhile, the UK and France are struggling with domestic concerns, and Russia's interests and reach are closer home and limited than before. All in all, international peace and security appears caught in myopic games of great powers. Their positions on geopolitical hotspots and wider problems of climate change, terrorism, migration, maritime and outer space security, nuclear risks, etc, reflect this reality.

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India's tenure at the UNSC, therefore, comes in challenging times. But this also presents an opportunity to change trendlines through its actions and interventions. Of course, all nations use these platforms to secure national interests. India will do so too. It will have a chance to checkmate specific inimical and malafide moves attempted by adversaries by either nixing such moves or by raising uncomfortable issues for others.

More importantly, though, India will be able to leverage its tenure to recall into attention the relevance and benefits of cooperative security. Given that contemporary threats are global in reach and character, no nation can fence itself off and be safe. India is singularly well placed to bring this into active consciousness since it values oneness of life as part of its culture, and prioritises peace over security as part of its strategic culture.

Unfortunately, this thought is not popular in current times of emphasis on realpolitik. But, securing long-term national interest has never been purely a function of military capabilities or shallow diplomatic cleverness. Leadership of issues of common concern is critical. India has the opportunity to build networks with like-minded nations to ensure constructive outcomes. In fact, the intention should be to so frame choices as to offer a platform for all to WIN—Work to ensure fairness and equity in multilateralism; Inculcate respect for rule of law; and Nurture peace and security. While there are many issues that fit this framework, five specific ones of greatest national concern and international appeal are identified below in ascending order of danger to humanity.

Non-traditional security threats to maritime and outer space could be the first two subjects.

Concerns around growing marine pollution or over-fishing pose a threat to fragile ecosystems, just as growing space debris and traffic pose a threat to peaceful use of outer space. Adherence to rules derived from laws or codes of conduct or even norms that govern these domains would benefit all stakeholders.

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A third issue of concern is trans-national terrorism. As terrorist activity breaches new frontiers, no country can afford to adopt an ostrich like approach. India should use its tenure to force a search for solutions, especially on reining in terror finance infrastructure, cyber threats and use and misuse of information and communication technologies by state and non-state actors.

Fourthly, biological warfare merits attention. The pandemic has sensitised all to possibilities of malicious use of pathogens. While the Biological and Toxin Weapons Convention does exist, its limitations have shown up in the past year. The issue needs some rethinking and action.

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India has a unique opportunity at UNSC to foster an attitude that upholds international peace as a way of securing national interests through choice of subjects and tenor of engagement. Presciently, Prime Minister Narendra Modi's guide to India's UNSC participation underscores the five S

approach—Samman (respect), Samvad (dialogue), Sahyog (cooperation), Samriddhi (prosperity) and Shanti (peace).

Also high on India's agenda is the concept of NORMS or new orientation for a reformed multilateral system. This includes UNSC expansion and injecting greater transparency and effectiveness into its working processes. While efforts on this continue, India's case for permanent membership would be better strengthened by showcasing sincere leadership on international security concerns, especially in a polarised environment.

Therefore, India's immediate focus should be on nudging inter-state relations into a working relationship to facilitate cooperative action. As a member of the comity of nations, India's interests cannot be divorced from others on common goods. While some national security concerns need to be handled individually, others need a global solution. India should use its position at the UNSC to safeguard its room of manoeuvre on the first, and propel collective action on the second.

Source: Sunday Guardian Live, <https://www.sundayguardianlive.com/opinion/indias-unsctenure-2021-2022-securing-national-interest-international-leadership>, 02 January 2021.

OPINION – Rebecca Davis Gibbons

Nuclear Diplomacy in the Biden Administration

The Biden administration not only inherits a country where COVID-19 is surging and jobs are haemorrhaging, but he also takes over a perilous global landscape when it comes to nuclear arms control and disarmament. The Trump years saw the dissolution of the Intermediate-Range Nuclear Forces Treaty, and US withdrawal from the Joint Comprehensive Plan of Action (i.e. the Iran nuclear deal) and the Open Skies Treaty. President Trump has not extended New START, the last remaining arms control treaty, leaving 16 days for the new administration to work out an extension before the treaty expires.

The loss of arms control occurs amidst two opposite trends in nuclear disarmament diplomacy. On the one hand, the great powers are engaged in renewed global competition that includes nuclear weapon modernization plans. On the other, a large number of states partnering with a network of transnational activists are calling for all states to renounce nuclear weapons. The treaty enshrining this idea, the TPNW will come into force on January 21, 2021, now that it has achieved its 50th ratification.

President-elect Biden has more experience with nuclear issues than most incoming presidents, and yet even those with significant expertise would face strong headwinds in advancing nuclear diplomacy over the next four years. What can we expect from the Biden administration in terms of arms control, nonproliferation, and disarmament? Where are

the opportunities for progress? The actions the Biden administration might take on this front and the difficulty in achieving them fall into three general categories; relatively easy, challenging, and wishful thinking. As may be expected, the challenging and the wished-for items outnumber the easy tasks.

Relatively Easy: Let's begin with the small number of relatively easy steps the Biden administration is likely to take to improve nuclear diplomacy. The first and most obvious action is extending New START for a full five years. Soon after this extension, the Biden administration should begin planning for a follow on agreement. Arms control agreements usually require years to negotiate so preparations must begin right away.

Next, the Biden administration likely will begin planning for the twice-postponed NPT Review Conference (RevCon), now scheduled for August 2021. The RevCon offers the Biden administration a golden opportunity to boldly recommit the United States to multilateralism and global leadership. Improving US rhetoric and showing a willingness to engage with the other NPT members will be relatively easy in this setting, but achieving a

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consensus outcome document or an otherwise successful conference fits in the “very challenging” and perhaps even “wishful thinking” category.

One of the ways for the Biden administration to improve the atmosphere at the NPT RevCon is to change the tenor of US rhetoric surrounding the TPNW. During the Obama and Trump administrations, US officials denigrated the treaty and its backers. The Biden administration can reduce negative rhetoric about the treaty and note areas of common ground. While the United States is not ready to eschew nuclear deterrence, the Biden administration should acknowledge that it appreciates the ultimate goal of the TPNW and it understands why so many states seek to ban nuclear weapons. One specific area of common ground is victim assistance.

The TPNW calls on parties to assist victims of nuclear weapons use and testing; the 2020 Democratic party platform commits to “expanding the Radiation Exposure Compensation Act to include those harmed by our nation’s nuclear weapons efforts including uranium miners exposed to radiation on the job.” By providing global leadership in this area, the Biden administration can improve relations within the NPT context by finding common ground with TPNW supporters.

The Challenges: Next, we move to three challenging steps the Biden administration is likely to attempt: Reviving a nuclear deal with Iran, reducing the role of nuclear weapons in US defence policy, and establishing strategic stability

talks with China.

President-elect Biden has committed to rejoin the Joint Comprehensive Plan of Action, known as the Iran deal, if Iran comes into compliance. Since one year after the Trump administration left the deal in May 2018, the Iranian government has slowly taken actions that contravene the deal. For example, today Iran possesses at least twelve times the enriched uranium it was allowed under the deal.

More alarmingly, on December 7, a leaked IAEA report indicated Iran was installing three more advanced centrifuge cascades at its Natanz facility. Iran announced it would pursue 20%

enrichment at its Fordow facilities. These steps occur in a period of increasing US-Iranian tension as the Trump administration has deployed an aircraft carrier to the region and Iran is still reeling from the assassination of its top nuclear scientist. June elections in Iran complicate matters further as Iranian President Rouhani will be more

constrained in dealing with the United States during an election season in which hardliners attempt to limit Rouhani’s bargaining space. Both sides seek concessions before returning to the negotiating table—Iran wants the removal of sanctions and perhaps compensation for the US withdrawal and President-elect Biden

wants Iran to return to abiding by the provision of the original deal. Achieving a new deal will require deft diplomacy, and may not be able to be achieved until after the Iranian election, if at all.

The Biden administration will begin a nuclear posture review at the beginning of the

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administration. The challenge of this exercise will be in attempting to lessen the role of nuclear weapons and perhaps even making a sole purpose pledge for nuclear weapons, while also recognizing the role for nuclear deterrence. Biden came out in favour of a sole use doctrine in his March/April 2020 *Foreign Policy* piece, writing "I believe that the sole purpose of the U.S. nuclear arsenal should be deterring—and, if necessary, retaliating against—a nuclear attack. As president, I will work to put that belief into practice, in consultation with the U.S. military and U.S. allies."

President Obama also initially favoured a policy of sole purpose but came up against opposition from allies and military leaders. President-elect Biden will also oversee the continuation of the US nuclear modernization program, though he may try to curtail aspects of the program with the goal of reducing US reliance on nuclear weapons. For instance, Biden is against the development and deployment of new low-yield nuclear weapons, called for in the Trump administration's nuclear posture review.

A final challenge is persuading China to commence bilateral strategic stability talks with the United States. China is improving all aspects of its military posture and there are no regular bilateral talks between US and Chinese leaders on risk reduction and strategic stability. With both powers operating in the China Sea, a lack of dialogue on defence issues is irresponsible and dangerous. These talks may help prod China into eventual arms control talks with the United States and Russia.

Wishful Thinking: The "wishful thinking" category includes some type of nuclear deal with North Korea, arms control that includes a broader swath of capabilities than previous agreements, and taking actions that promote the longevity of

the nuclear nonproliferation regime.

Like the four presidents before him, President-elect Biden will seek to address the growing threat of North Korea's nuclear weapons program. Biden is likely to work multilaterally on this issue, but even with partners and seasoned diplomats, it is hard to imagine a deal at this point in which the Kim regime will renounce its nuclear program. Perhaps some sort of cap would be more plausible.

In seeking follow-on arms control agreement with Russia, the Biden administration will likely seek to expand what is covered by the treaty. While a deal is possible, it is unlikely to be able to account for the full gamut of capabilities with strategic effect, to include new nuclear weapons, so-called tactical weapons, hypersonic missiles, cyber capabilities, and ballistic missile defence systems.

Finally, the Biden administration has the opportunity to take steps that will promote the longevity of the nuclear nonproliferation regime in the medium- to long-term. The regime has required the leadership of great powers:

first to help establish treaties and agreements and then to promote them and adapt them as weaknesses become apparent.

Currently, the United States, China, and Russia are not working together to shore up the regime for the long-term by taking such actions as promoting the universalization of the Additional Protocol and the norm against nuclear testing. Their only area of consensus in recent years appears to be denigrating the TPNW, a position that is not constructive for improving relations among NPT members. For the regime to persist, the great powers must work together to universalize existing agreements, set a path toward eventual disarmament, and in the long run, even find a way to bring in the non-NPT parties. Some of these steps are far off, but they will require years of persistent leadership. The Biden administration

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could begin taking those steps, but with so many other immediate challenges to address, promoting regime longevity fits into the wishful thinking category.

Source: *European Leadership Network*. <https://www.europeanleadershipnetwork.org/commentary/nuclear-diplomacy-in-the-biden-administration/>, 06 January 2021.

OPINION – Henry Rome

Iran is Escalating its Nuclear Program. Biden should not Rush to Respond

Technicians work inside of a uranium conversion facility producing unit in 2005 outside the city of Isfahan, Iran. After the 2015 Iran nuclear deal put limits on the program, Iran's government has been increasing uranium enrichment since the United States pulled out of deal.

Iran appears intent on generating a nuclear crisis early in Joe Biden's presidency. On 04 January, the Iranian government said it began enriching uranium to the 20% level, which is close to the purity used in a nuclear weapon. It is preparing further steps in the coming months, according to a timeline passed by parliament.

Iran aims to compel Biden to immediately and unconditionally remove the sanctions that President Trump began to impose three years ago after he pulled the United States out of the Iran nuclear deal. Supreme Leader Ayatollah Ali Khamenei repeated this demand, calling on the U.S. to lift sanctions on Iran "immediately."

Biden should not play into Iran's pattern of nuclear threats combined with artificial deadlines. Biden and his team will have time — and economic leverage — on their side. The incoming administration should take advantage of its strong position to diligently pursue its goal of strengthening and lengthening nuclear

restrictions and should resist the pressure to act hastily.

Biden will inherit significant economic leverage over Iran. However misguided and erratic Trump's approach was toward Iran, the president renewed and strengthened the U.S.'s most comprehensive sanctions regime. Trump failed to convert this leverage into diplomatic progress because he did not have a clear strategy or a realistic path to achieving it. While Trump repeatedly urged Iran to negotiate and "Make the Big Deal," Secretary of State Mike Pompeo's demands for Iran amounted to a call for regime change. Trump also hired John Bolton, an outspoken supporter of regime change, to serve as national security adviser. Tehran had little incentive to talk, let alone offer concessions, to an administration that ultimately sought its surrender or demise.

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Biden will flip this logic. The president-elect has outlined concrete diplomatic objectives concerning Iran — including reaffirming the importance of the 2015 nuclear agreement. The nuclear deal, signed by Iran and six world powers, imposed limits on Iran's nuclear program in exchange for international sanctions relief. Biden and

his team, which played key roles in securing that agreement when he was vice president, have proved they can negotiate in good faith and keep their word. By taking a more realistic approach, Biden can unlock the power of the leverage Trump accumulated.

U.S. economic might should not be underestimated. Combined with Iran's endemic corruption and the coronavirus pandemic, U.S. sanctions have cratered the Iranian economy, driven up inflation and eroded the purchasing power of average Iranians. The U.S. measures have effectively cut off Iran from the international financial system and targeted key sectors, including energy and manufacturing. Oil exports, Iran's most important source of hard

currency, remain largely crippled by the threat of U.S. sanctions. The government has tried to boost the non-oil sector and focus on trade in goods that are not as easy for sanctions to interrupt. But Iranian President Hassan Rouhani's latest budget proposal continues to rely significantly on oil. Budgeting has a habit of focusing minds, and the message from Rouhani's plan could not have been clearer: The long-term stability of the economy depends in large part on relations with Washington.

Tehran will try to prevent Biden from taking advantage of this leverage by creating an atmosphere of imminence and crisis. Even as Tehran reacted to the siege at the U.S. Capitol, President Rouhani repeated his call on Biden to lift sanctions, saying, "If you won't fulfill your commitments, we won't bow to you." Tehran's efforts can be divided into three categories.

First, the Iranian president and his aides are urging Biden to move quickly, before Iran's June presidential elections. Rouhani, a relative moderate, is serving his final term. A more conservative leader will likely prevail in the election, potentially creating a window of opportunity to deal with Rouhani on his way out the door. But, as analyst Ariane Tabatabai and I have argued, the impending election will not fundamentally alter Tehran's strategic outlook or its openness to negotiations. Rouhani's successor will not necessarily be more hostile to diplomacy even if he is more anti-American. Washington should not expect that its policies can dictate the outcome of the Iranian election, and it should not allow the election to dictate its own policies.

Second, Tehran is trying to create a ticking clock with its nuclear program. The parliament passed legislation that sets up a series of dates when Iran is to take new nuclear steps. The most provocative next step, a significant reduction in international

inspector access, is slated for late February. But these deadlines are purely artificial. Iran's nuclear policy is ultimately under the control of Khamenei, not the rambunctious, hawkish parliament or the lame-duck president. Deadlines can and will be fudged depending on the overall political environment.

Third, Tehran continues to bolster its forces and lash out in the region, a not-so-subtle reminder to Biden about its capability to cause trouble. Washington noted with increasing concern that Iranian-backed forces were planning to attack U.S. soldiers based in Iraq to mark the anniversary of the assassination of Iranian Maj. Gen. Qassem Soleimani. (Foreign Minister Javad Zarif responded with the bizarre suggestion that "Israeli agent-

provocateurs are plotting attacks against Americans" in Iraq.)

On 04 Jan, armed Iranian forces boarded a South Korean tanker and are apparently holding it hostage until Seoul facilitates the release of some \$7 billion of Iranian assets frozen in Korean banks. The following day,

Iran launched significant exercises with military drones.

But these shows of force may end up being self-defeating, as they turn more countries against Tehran. For example, increased Iranian provocations may push Gulf Arab states closer to Israel, strengthening the agreements normalizing relations between these countries and Israel that were brokered by the Trump administration last year.

Even if Iran does escalate its nuclear program or its provocative regional activity, Biden has tools to deflect the pressure. He plans to strengthen relations with key U.S. allies, including France, Germany and the United Kingdom, which are party to the nuclear agreement. Under Trump, European states spent as much time condemning Washington as they did Tehran. With unity

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between the U.S. and Europe, new Iranian provocations will only further isolate Tehran. The three European states issued a sharp condemnation of Iran's latest nuclear steps, a sign of future U.S.-European unity. Russia and China, the other signatories to the agreement, will also oppose Iranian efforts to significantly expand its nuclear program. Israel will remain laser-focused on Iran and probably will set clear red lines to box in Iranian activity.

How Biden decides to proceed with Iran will depend in part on his other priorities, as well as the views of U.S. allies. During the presidential campaign and transition, Biden and his aides indicated a desire to bolster the verification provisions of the nuclear deal and extend the duration of its physical restrictions. They have also expressed an intention to conduct broader, regional negotiations. All of these steps will require painstaking multilateral diplomacy. Ultimately, Biden should not feel rushed for these critical negotiations — and he should leverage his sanctions inheritance to advance these objectives.

Source: Henry Rome , National Public Radio, <https://www.npr.org/2021/01/08/953923631/opinion-iran-is-escalating-its-nuclear-program-biden-should-not-rush-to-respond>, 08 January 2021.

OPINION – Tsvetana Paraskova

Net-Zero Emissions Might not be Possible without Nuclear Power

Declining solar, wind, and battery technology costs are helping to grow the share of renewables in the world's power mix to the point that governments are pledging net-zero emission electricity generation in two to three decades to fight global warming. Yet, electricity grids will continue to require stable baseload to incorporate

growing shares of renewable energy sources and ensure lights are on even when the sun doesn't shine, or the wind doesn't blow. Until battery technology evolves enough—and costs fall far enough—to allow massive storage and deployment of net-zero electricity to the grid, the systems will continue to need power from sources other than solar and wind.

And these will be natural gas and nuclear power, regardless of concerns about emissions from the fossil fuel natural gas and potential disasters at nuclear power facilities such as the ones in Chernobyl or Fukushima. As natural gas is increasingly considered as just another fossil fuel, nuclear power generation provides carbon-free electricity to the countries that have it, and could be the key to ensuring a stable power grid capable of taking in growing shares of solar and wind power generation.

The United States, where nuclear energy currently provides more than half of the carbon-free electricity, is supporting the development of advanced nuclear reactors as part of the clean energy strategy.

But Europe, which has set a goal to reach carbon neutrality by 2050, could find itself with growing emissions from the power sector in a decade, as many nuclear reactors are slated for decommissioning. The gap left by lost nuclear power is most easily filled by natural gas-powered electricity generation—and this, if it happens, could undermine the net-zero goals of the EU and the bloc's ambition to be a world leader in the fight against climate change.

U.S. Power Grid will Need Nuclear for Net-Zero Emissions: A 2020 report from the University of California, Berkeley, said that rapidly declining solar, wind, and storage prices make it entirely feasible for the U.S. to meet 90 percent of its power needs from zero-emission energy sources by 2035 with zero increases in customer costs

Under Trump, European states spent as much time condemning Washington as they did Tehran. With unity between the U.S. and Europe, new Iranian provocations will only further isolate Tehran.

As natural gas is increasingly considered as just another fossil fuel, nuclear power generation provides carbon-free electricity to the countries that have it, and could be the key to ensuring a stable power grid capable of taking in growing shares of solar and wind power generation.

from today's levels.

Still, natural gas-fired generation will be needed for 10 percent of America's power needs. According to the report, in 2035 it would be possible that "during normal periods of generation and demand, wind, solar, and batteries provide 70% of annual generation, while hydropower and nuclear provide 20%." Even with an exponential rise in renewable power generation, the U.S. grid will need nuclear power and hydropower to be stable with such a large share of solar and wind.

The U.S. Backs Advanced Nuclear Reactor Technology:

The U.S. Department of Energy is funding programs of private companies under DOE's new Advanced Reactor Demonstration Program (ARDP). "Taking leadership in advanced technology is so important to the country's future because nuclear energy plays such a key role in our clean energy strategy," U.S. Secretary of Energy Dan Brouillette said at the end of December when DOE announced it was financially backing five teams to develop and demonstrate advanced nuclear reactors in the United States. "All of these projects will put the U.S. on an accelerated timeline to domestically and globally deploy advanced nuclear reactors that will enhance safety and be affordable to construct and operate," Secretary Brouillette said.

According to Washington DC-based Nuclear Energy Institute (NEI), a policy organization of the nuclear technologies industry, nuclear energy provides nearly 55 percent of America's carbon-free electricity. That is more than 2.5 times the amount generated by hydropower, nearly 3 times the amount generated by wind, and more than 12 times the amount generated by solar. Nuclear energy can help the United States to get to the deep carbonization needed to hit climate goals.

Europe could See Rising Emissions without Nuclear Power:

While the United States is doubling down on efforts to develop advanced and

cheaper nuclear reactors, including microreactors and such with new types of technology, Europe could be headed to growing emissions from the electricity sector as nuclear power facilities are scheduled to be decommissioned over the next decade, according to a Reuters analysis from last month.

In many cases, it will be natural gas that will come to the rescue to power grids to ensure grid stability and enough capacity during peak demand because solar and wind generation is variable and dependent on the weather. For example, Germany, the biggest economy in Europe, is boosting its renewables targets, but it is also phasing out nuclear by next year, while its deadline to phase

out coal-fired generation is 2038—more than a decade later compared to phase-out plans in the UK and Italy, for example, where the deadline is the mid-2020s.

The UK, which left the EU last year, included support for nuclear power generation as one of the ten pillars in 'The Ten Point

Plan for a Green Industrial Revolution' unveiled in November.

The UK's National Grid has issued several warnings about tight supply since the fall of 2020, due to low renewable output amid high demand. "National Grid's announcement underscores the urgency of investing in new nuclear capacity, to secure reliable, always-on, emissions-free power, alongside other zero-carbon sources. Otherwise, we will continue to burn gas and coal as a fallback and fall short of our net zero ambitions," Tom Greatrex, Chief Executive of the Nuclear Industry Association, said in response to one of those warnings.

But it's in the UK that one major nuclear power plant project has notoriously seen a delay of nearly a decade—Hinkley Point C, originally planned in 2007 to help UK households to "cook their 2017 Christmas turkeys", is now set for start-up in the middle of the 2020s. Nuclear power

While the United States is doubling down on efforts to develop advanced and cheaper nuclear reactors, including microreactors and such with new types of technology, Europe could be headed to growing emissions from the electricity sector as nuclear power facilities are scheduled to be decommissioned over the next decade.

development and plant construction is expensive, but it could save the plans for low-carbon emission power generation in many developed economies, including in the United States.

Source: <https://oilprice.com/Energy/Energy-General/Net-Zero-Emissions-Might-Not-Be-Possible-Without-Nuclear-Power.html>, 07 January 2021.

NUCLEAR STRATEGY

CHINA

China's Advanced DF-17 Hypersonic Missile Likely to have been Part of Recent Military Drill

China's military has carried out training that may have involved its most advanced hypersonic missile, the DF-17, which analysts say is capable of striking US bases in the region. Footage aired on Chinese state television shows a new and unidentified type of missile vehicle being used to transport a weapon in a recent assault exercise conducted by a PLA Rocket Force missile brigade. Military analysts said the missile being transported in the footage was likely to be the DF-17.

The hypersonic missile drew attention when it made its debut in October 2019 at a huge military parade marking the 70th anniversary of Communist Party rule in China. In the report on state broadcaster CCTV, footage shows the brigade conducting the assault exercise at night, in an undisclosed location. China's PLA ground forces hold attack drill.

Wang Chunhong, an officer in charge of training in the brigade, told the broadcaster that the new weapon system reduced the time needed to

launch a missile. ... In a separate video posted on the Chinese military's official website, 81.cn., the missile is seen from an aerial view that shows a cover enclosing the missile launcher inside the transporter. ... The DF-17 is believed to be the world's first active hypersonic glide vehicle weapon, and powerful enough to penetrate US missile shields in the region. With a maximum range of 2,500km (1,550 miles), it could reach US military bases in Yokosuka, Japan and South Korea from China.

Source: *South China Morning Post*, <https://www.scmp.com/news/china/military/article/3116545/chinas-advanced-df-17-hypersonic-missile-likely-have-been-part?>, 05 January 2021.

NORTH KOREA

Kim Jong Un Vows to Strengthen North Korea's Nuclear Arsenal

North Korean leader Kim Jong Un vowed all-out efforts to bolster his country's nuclear deterrent during a major ruling party meeting where he earlier laid out plans to work toward salvaging the broken economy.

Separately, Kim's powerful sister criticized South Korea's military for saying it had seen an apparent military parade taking place in Pyongyang. Kim Yo Jong, who was described last year

as being in charge of inter-Korean relations, said in a statement Wednesday that such close tracking proved Seoul's "hostile approach" toward its rival.

The eight-day Workers' Party congress that ended Tuesday (12 Jan) came as Kim Jong Un faces what appears to be the toughest moment of his nine-year rule. ... During the congress, Kim doubled

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During the congress, Kim doubled down on his ambitions to expand the North's military capabilities and announced plans to develop more sophisticated nuclear assets, including longer-range missiles that could potentially target the American homeland, spy satellites, new tactical nuclear weapons and nuclear-powered submarines.

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Source: <https://www.hindustantimes.com/world-news/kim-jong-un-vows-to-strengthen-north-korea-s-nuclear-arsenal-101610500807603.html>, 13 January 2021.

USA

US Strategic Command Chief Defends ICBM Replacement Program

The US Defense Department must be allowed to press forward with replacing its Cold War-era Minuteman III intercontinental ballistic missiles, the head of U.S. Strategic Command said. "You cannot life-extend Minuteman III," said Adm. Charles Richard, who spoke with reporters during a Defense Writers Group event. "It is getting past the point of [where] it's not cost-effective to life-extend Minuteman III. You're quickly getting to the point [where] you can't do it at all."

Richard's comments come about two weeks before the Jan. 20 inauguration of President-elect Joe Biden, who is expected to review the nation's nuclear arsenal and could possibly roll back changes made under the Trump administration. Although the next-generation ICBM program — known as the Ground Based Strategic Deterrent — was supported by the Obama administration, arms control groups have urged lawmakers to consider delaying the GBSD effort to save money.

Richard told reporters that is not an option, given the age and obsolescence of the system of the LGM-30G Minuteman III. "That thing is so old that in some cases the [technical] drawings don't exist anymore, or where we do have drawings, they're

like six generations behind the industry standard," he said. "And there's not only [no one] working that can understand them — they're not alive anymore."

The Air Force chose Northrop Grumman to build GBSD in September, awarding the company a \$13.3 billion contract for the engineering and manufacturing development stage of the program. Boeing, the only other competitor for the program, opted not to bid for the contract over concerns that Northrop's acquisition of Orbital ATK — a key propulsion supplier — had tilted the competition in Northrop's favor.

GBSD is set to begin replacing the Minuteman III in 2029. The Air Force has touted GBSD as more accurate and reliable than its predecessor. Another important characteristic is its enhanced security, said Richard, who contrasted the "60-year-old ... circuit switch system" of the Minuteman III to the modern and resilient cyber architecture that GBSD will have.

... Defense experts anticipate that — like most other new presidential administrations — the Biden administration will likely conduct a nuclear posture review to reassess the United States' nuclear capabilities and ensure the military is poised to deter Russia, China, North Korea, Iran and other actors with nuclear weapons. ...

Source: *Defence News*, <https://www.defensenews.com/air/2021/01/06/us-strategic-command-head-defends-icbm-replacement-program/>, 07 January 2021.

NUCLEAR ENERGY

GENERAL

Nuclear Power in the World Today

Nuclear technology uses the energy released by splitting the atoms of certain elements. It was first developed in the 1940s, and during the Second

World War research initially focused on producing bombs. In the 1950s attention turned to the peaceful use of nuclear fission, controlling it for power generation. For more information, see page on History of Nuclear Energy.

Civil nuclear power can now boast more than 17,000 reactor years of experience, and nuclear power plants are operational in 31 countries worldwide. In fact, through regional transmission grids, many more countries depend in part on nuclear-generated power; Italy and Denmark, for example, get almost 10% of their electricity from imported nuclear power.

When the commercial nuclear industry began in the 1960s, there were clear boundaries between the industries of the East and West. Today, the separate American and Soviet spheres no longer exist, and the nuclear industry is characterised by international commerce. A reactor under construction in Asia today may have components supplied from South Korea, Canada, Japan, France, Germany, Russia, and other countries. Similarly, uranium from Australia or Namibia may end up in a reactor in the UAE, having been converted in France, enriched in the Netherlands, deconverted in the UK and fabricated in South Korea.

The uses of nuclear technology extend well beyond the provision of low-carbon energy. It helps control the spread of disease, assists doctors in their diagnosis and treatment of patients, and powers our most ambitious missions to explore space. These varied uses position

nuclear technologies at the heart of the world's efforts to achieve sustainable development.

Number of Operable Reactors Worldwide: Around 10% of the world's electricity is generated by about 440 nuclear power reactors. About 50 more reactors are under construction, equivalent to approximately 15% of existing capacity.

In 2019 nuclear plants supplied 2657 TWh of electricity, up from 2563 TWh in 2018. This is the seventh consecutive year that global nuclear generation has risen, with output 311 TWh higher than in 2012.

World Electricity Production by Source 2018: Twelve countries in 2019 produced at least one-quarter of their electricity from nuclear. France gets around three-quarters of its electricity from nuclear energy, Slovakia and Ukraine get more than half from nuclear, whilst Hungary, Belgium, Sweden, Slovenia, Bulgaria, Switzerland, Finland and Czech Republic get one-third or more. South Korea normally gets more than 30% of its electricity from nuclear, while in the USA, UK, Spain, Romania and Russia about one-fifth of electricity is from nuclear. Japan was used to relying on nuclear power for more than one-quarter of its electricity and is expected to return to somewhere near that level.

Nuclear Energy and Covid-19: Coronavirus disease 2019 (Covid-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The spread of the novel coronavirus has required dramatic action to be taken in all aspects of life worldwide.

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Maintaining reliable electricity supply is vital. Nuclear energy provides about 10% of the world's electricity, and so nuclear reactors have a key role to play. Reactor operators have taken steps to protect their workforce and have implemented business continuity plans to ensure the continuing function of key aspects of their operations. These actions are outlined in more detail in our dedicated information paper COVID-19 Coronavirus and Nuclear Energy.

Beyond power generation, nuclear technologies have medical applications that will help combat Covid-19. The IAEA is providing diagnostic kits, equipment and training in nuclear-derived detection techniques to countries asking for assistance in tackling the worldwide spread of the novel coronavirus causing Covid-19.

Need for New Generating Capacity: There is a clear need for new generating capacity around the world, both to replace old fossil fuel units, especially coal-fired ones, which emit a lot of carbon dioxide, and to meet increased demand for electricity in many countries. In 2018, 64% of electricity was generated from the burning of fossil fuels. Despite the strong support for, and growth in, intermittent renewable electricity sources in recent years, the fossil fuel contribution to power generation has remained virtually unchanged in the last 10 years or so (66.5% in 2005).

The OECD International Energy Agency publishes annual scenarios related to energy. In its *World Energy Outlook 2020* there is an ambitious 'Sustainable Development Scenario' which is consistent with the provision of clean and reliable energy and a reduction of air pollution, among other aims. In this decarbonisation scenario, electricity generation from nuclear increases by almost 55% by 2040 to 4320 TWh, and capacity grows to 599 GWe. The World Nuclear Association has put forward a more ambitious scenario than

this – the Harmony programme proposes the addition of 1000 GWe of new nuclear capacity by 2050, to provide 25% of electricity then (about 10,000 TWh) from 1250 GWe of capacity (after allowing for retirements). This would require adding 25 GWe per year from 2021, escalating to 33 GWe per year, which is not much different from the 31 GWe added in 1984, or the overall record of 201 GWe in the 1980s. Providing one-quarter of the world's electricity through nuclear would substantially reduce carbon dioxide emissions and improve air quality.

Source: World Nuclear Association, <https://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx>, November 2020.

INDIA

Indian Reactor Connected to the Grid

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Kakrapar 3 was synchronised with the grid at 11.37am on 10 January, the *Press Trust of India* reported. "A true example of indigenous technology developed and built in India with 15 more such units to follow in fleet mode," Anil Kakodkar, former secretary of the Department of Atomic Energy, was quoted as

saying.

In April 2007, the Indian government approved plans for the first four of eight planned 700 MWe PHWR units: Kakrapar units 3 and 4 and Rajasthan units 7 and 8, to be built by Hindustan Construction using indigenous technology. In mid-2009, construction approval was confirmed, and late in 2009 the finance for them was approved.

Site works at Kakrapar were completed by August 2010. First concrete for Kakrapar 3 and 4 was in November 2010 and March 2011, respectively, after AERB approval. The AERB approved Rajasthan 7 and 8 in August 2010, and

site works then began. First concrete for those units was in July 2011. Construction had been expected to take 66 months. India plans to put 21 new nuclear power reactors - including 10 indigenously designed PHWRs - with a combined generating capacity of 15,700 MWe into operation by 2031, the DAE announced in January 2019. ...

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Source: World Nuclear News, [https://www.world-nuclear-news.org/Articles/Indian-reactor-connected-to-the-grid#:~:text=Unit%203%20of%20the%20Ka krapar,criticality%20in%20July%20last%20year,11 January 2020](https://www.world-nuclear-news.org/Articles/Indian-reactor-connected-to-the-grid#:~:text=Unit%203%20of%20the%20Ka%20rapar,criticality%20in%20July%20last%20year,11%20January%202020).

CHINA

Construction of New Chinese Power Plant Begins

In May 2015, the National Energy Administration approved the project to carry out site protection and related demonstration work. On 2 September last year, the executive meeting of the State Council approved the construction of units 1 and 2 as the first phase of the plant. China's National Nuclear Safety Administration issued a construction permit for the two units on 30 December. At 9.30am the following day, Yuan Jiajun, secretary of the Zhejiang Provincial Committee of the Communist Party of China and director of the Standing Committee of the Provincial People's Congress, issued a construction start order and a ceremony was held to mark the official start of construction of unit 1.

This project marks the first Chinese nuclear power project involving private capital, with Geely Technology Group taking a 2% stake in the plant. CGN holds 46% of the shares of the project company Cangnan Nuclear Power, with other state-owned enterprises holding the remainder.

CGN Chairman and General Manager Yang

Changli said the company "will use the strength of the entire group to give full play to the advantages of more than 30 years of continuous nuclear power construction and the construction experience of the Hualong One, carry out the political responsibility for nuclear safety, and work with all participating units to build the San'ao nuclear power project into a quality project".

In September, China's State Council also approved the construction by China National Nuclear Corporation and China Huaneng Group of two Hualong One reactors as the second phase - units 3 and 4 - of the Changjiang plant in Hainan province. Construction of those two units has yet to start. ...With the official start of construction of unit 1 of the San'ao plant, CGN now has seven nuclear power reactors under construction with an installed capacity of 8.21 GWe. It currently has 24 units in operation, with an installed capacity of 27.14 GWe.

Source: World Nuclear News, [https://www.world-nuclear-news.org/Articles/Construction-of-new-Chinese-power-plant-begins#:~:text=The%20first%20safety%20related%20concrete,Nuclear%20\(CGN\)%20has%20announced,04 January 2021](https://www.world-nuclear-news.org/Articles/Construction-of-new-Chinese-power-plant-begins#:~:text=The%20first%20safety%20related%20concrete,Nuclear%20(CGN)%20has%20announced,04%20January%202021).

Nuclear Power in China

The impetus for nuclear power in China is increasingly due to air pollution from coal-fired plants. Nuclear power has an important role, especially in the coastal areas remote from the coalfields and where the economy is developing rapidly. Generally, nuclear

plants can be built close to centres of demand, whereas suitable wind and hydro sites are remote from demand. Moves to build nuclear power commenced in 1970 and about 2005 the industry moved into a rapid development phase, in the 11th

Five-Year Plan.

Technology has been drawn from France, Canada and Russia, with local development based largely on the French element. The latest technology acquisition has been from the USA (via Westinghouse, owned by Japan's Toshiba) and France. The State Nuclear Power Technology Corporation (SNPTC) made the Westinghouse AP1000 the main basis of technology development in the immediate future, particularly evident in the local development of CAP1400 based on it, and more immediately the CAP1000.

This has led to a determined policy of exporting nuclear technology, based on China's development of the CAP1400 reactor with Chinese intellectual property rights and backed by full fuel cycle capability.

In 2015 the Hualong One reactor became the main export product. The policy is being pursued at a high level politically, as one of 16 key national science & technology projects, utilising China's economic and diplomatic influence, and led by the initiative of CGN commercially, with SNPTC and more recently CNNC in support.

Prior to 2008, the government had planned to increase nuclear generating capacity to 40 GWe by 2020 (out of a total 1000 GWe planned), with a further 18 GWe nuclear being under construction then. Projections for nuclear power then increased to 70-80 GWe by 2020, 200 GWe by 2030 and 400-500 GWe by 2050. In April 2015 CNEA said that by 2030 per capita annual electricity consumption would be 5500 kWh, and installed nuclear capacity would be 160 GWe, providing 10% of electricity (with coal 64.6%). By 2050, per capita consumption would be 8500 kWh, and installed nuclear capacity 240 GWe providing 15% of electricity (coal 50.5%).

National policy moved from 'moderate development' of nuclear power to 'positive development' in 2004, and in 2011-12 to 'steady development with safety'. The nuclear capacity

target for 2020 became 58 GWe in operation and 30 GWe under construction, though the China Electricity Council in 2019 said that 53 GWe in operation was more likely.

In December 2011 the National Energy Administration (NEA) said that China would make nuclear energy the foundation of its power-generation system in the next "10 to 20 years", adding as much as 300 GWe of nuclear capacity over that period. In September 2013 SNPTC estimated that 4-6 new units per year would be needed to 2015 then 6-8 units during the 13th Five-Year Plan period (2016-2020), increasing to 10 units each year after 2020. The NEA confirmed

that China could manufacture eight full sets of reactor equipment per year, and in 2014 it announced that China was aiming for world leadership in nuclear technology.

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The 13th Five-Year Plan formalized in March 2016 included the following nuclear projects and aims:

- Complete four AP1000 units at Sanmen and Haiyang.
- Build demonstration Hualong One reactors at Fuqing and Fangchenggang.
- Start building the demonstration CAP1400 reactor at Rongcheng (Shidaowan).
- Accelerate building Tianwan Phase III (units 5&6).
- Start building a new coastal power plant.
- Active preparatory work for inland nuclear power plants.
- Reach target of 58 GWe nuclear operational by end of 2020, plus 30 GWe under construction then.
- Accelerate and push for building demonstration and large commercial reprocessing plants.
- Strengthen the fuel security system.

In July 2013 the National Development and

Reform Commission (NDRC) set a wholesale power price of CNY 0.43 per kWh (7 US cents/kWh) for all new nuclear power projects, to promote the healthy development of nuclear power and guide investment into the sector. The price is to be kept relatively stable but will be adjusted with technology advances and market factors, though many consider it not high enough to be profitable. It was reported that the price for power from Sanmen might be about 5% higher, but in 2019 it was CNY 0.42/kWh. Haiyang was selling power for CNY 0.414/kWh and Taishan CNY 0.435/kWh in 2019.

Nuclear power is already competitive, and wholesale price to grid has been less than power from coal plants with flue gas desulfurization, though the basic coal-fired cost is put at CNY 0.3/kWh*. In March 2015 a new round of electricity market reform was launched, to prioritise clean power generation, and this allowed nuclear power companies to negotiate prices with customers.

Wind cost to grid is CNY 0.49 - 0.61 per kWh, depending on region (and FIT, now CNY 0.54 per kWh), solar is CNY 0.9 (desert) to 1.3 (east). CGN Power reported that in 2015 Hongyanhe grid tariff was CNY 0.4142/kWh, and Ningde CNY 0.43/kWh.

In October 2018 the NDRC's Energy Research Institute said that China's nuclear generating capacity must increase to 554 GWe by 2050 if the country is to play its part in limiting the global temperature rise to below 1.5 °C. The share of nuclear power in the country's energy mix would thus increase from 4% to 28% over this period. The study said that assuming an all-in cost of CNY 20,000 (approximately \$3000) per kW of capacity in large plants, an investment of more than CNY 8.7 trillion (\$1.3 trillion) would be required. Based on capacity additions over the past few years, the total investment demand to 2050 was considered to be feasible

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Source: World Nuclear Association, <https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx>, January 2021.

USA

US Awards \$20m for Advanced Nuclear Reactor Concepts

The US Government has announced \$20 million (£14.8m) in awards for advanced reactor concepts for nuclear power stations. The funding is being provided under the new Advanced Reactor Demonstration Programme (ARDP), which has been designed to help domestic private industry demonstrate advanced nuclear reactors in the US.

The Office of Nuclear Energy has selected three teams to receive the funding for the ARDP's Advanced Reactor Concepts-20 (ARC-20) programme, which aims to assist the progression of advanced reactor designs in their earliest phases.

They include novel advanced reactor designs by General Atomics, ARC

Nuclear and the MIT, with the funding helping them mature their concepts for demonstration by the mid-2030s. They intend to develop a fast modular reactor conceptual design with verifications of key metrics in fuel, safety and operational performance and a conceptual design of a seismically isolated advanced sodium-cooled reactor facility that builds upon the initial design of a 100MW reactor facility.

Energy Secretary Dan Brouillette said: "ARDP is significant because it will enable a market for commercial reactors that are safe and affordable to both construct and operate in the near and mid-term. "All three programmes under ARDP pave the way for the United States to be highly competitive globally."

Source: Priyanka Shrestha, <https://www.energylivenews.com/2021/01/11/us-awards-20m-for-advanced-nuclear-reactor-concepts/>, 11 January 2021.

NUCLEAR COOPERATION

INDIA-PAKISTAN

India, Pakistan Exchange List of Nuclear Installations

Pakistan and India on 1st January conducted the annual practice of exchanging the list of their nuclear installations under a bilateral arrangement that prohibits them from attacking each other's atomic facilities. The exchange was made in accordance with Article-II of the Agreement on Prohibition of Attacks against Nuclear Installations and Facilities between Pakistan and India, signed on December 31, 1988, the Foreign Office (FO) said in a statement here.

It said that "the list of nuclear installations and facilities in Pakistan was officially handed over to a representative of the Indian High Commission at the Ministry of Foreign Affairs today, at 1100 hrs (PST)." "The Indian MEA in New Delhi handed over the list of Indian Nuclear installations and facilities to a representative of the Pakistan High Commission at 1130 hrs (IST)," it added.

The agreement contains the provision that both countries inform each other of their nuclear installations and facilities on January 1 every year. This has been done consecutively since January 1, 1992, according to the FO. The exchange of information comes despite the ongoing tensions between India and Pakistan. ...

Source: *Hindustan Times*, <https://www.hindustantimes.com/india-news,01 January 2021>.

NUCLEAR PROLIFERATION

IRAN

Iran Resumes 20% Enrichment at Fordow amid Rising Tensions with U.S.

Iran has resumed 20% uranium enrichment at an underground nuclear facility, the government said, breaching a 2015 nuclear pact with major powers and possibly complicating efforts by U.S.

President-elect Joe Biden to rejoin the deal. Benjamin Netanyahu, prime minister of Iran's arch foe Israel, said the move was aimed at developing nuclear weapons and Israel would never allow Tehran to build them.

The enrichment decision, Iran's latest contravention of the accord, coincides with increasing tensions between Iran and the United States in the last days of President Donald Trump's administration. Tehran started violating the accord in 2019 in a step-by-step response to Trump's withdrawal from it in 2018 and the reimposition of U.S. sanctions lifted under the deal.

The agreement's main aim was to extend the time Iran would need to produce enough fissile material for a nuclear bomb, if it chose

to, to at least a year from roughly two to three months. It also lifted international sanctions against Tehran. "A few minutes ago, the process of producing 20% enriched uranium has started in Fordow enrichment complex," government spokesman Ali Rabiei told Iranian state media.

The U.N. nuclear watchdog confirmed that Iran had started the process of enriching uranium to 20% purity at its Fordow site. "Iran today began feeding uranium already enriched up to 4.1 percent U-235 into six centrifuge cascades at the Fordow Fuel Enrichment Plant for further enrichment up to 20%," the IAEA said in a statement on a report that was sent to member states.

The step was one of many mentioned in a law passed by Iran's parliament last month in response to the killing of the country's top nuclear scientist, which Tehran has blamed on Israel. ...Tehran insists it can quickly reverse its breaches if U.S. sanctions are removed. Biden, who takes office on Jan. 20, has said the United States will rejoin the deal "if Iran resumes strict compliance" with the pact. The Biden transition team declined to comment about Iran's enrichment move.

Tehran insists it can quickly reverse its breaches if U.S. sanctions are removed. Biden, who takes office on Jan. 20, has said the United States will rejoin the deal "if Iran resumes strict compliance" with the pact.

Tehran's move could hinder efforts to salvage the nuclear pact as its breaches have increasingly worried some of the deal's other parties, which have urged Iran to act responsibly. However, it could also be accumulating bargaining chips that could be negotiated away in talks with the Biden administration.

In Brussels, a European Union Commission spokesperson said that the "move, if confirmed, would constitute a considerable departure from Iran's commitments". On Jan. 1, the IAEA said Tehran had told the watchdog it planned to resume enrichment up to 20% at the Fordow site, which is buried inside a mountain. "The process of gas injection to centrifuges has started a few hours ago and the first product of uranium hexafluoride (UF₆) gas will be available in a few hours," Rabiei said.

Iran had earlier breached the deal's 3.67% limit on the purity to which it can enrich uranium, but it had only gone up to 4.5% so far, well short of the 20% level and of the 90% that is weapons-grade. U.S. intelligence agencies and the IAEA believe Iran had a secret, coordinated nuclear weapons programme that it halted in 2003. Iran denies ever having had one. In Jerusalem, Netanyahu said Iran's enrichment decision could be explained only as a bid to "continue to carry out its intention to develop a military nuclear programme". "Israel will not allow Iran to produce nuclear weapons," he added.

Source: Reuters, <https://www.reuters.com/article/us-iran-nuclear-enrichment/iran-says-it-resumes-20-enrichment-at-fordow-amid-growing-tensions-with-us-, 04 January 2021>.

Iran Stokes Western World Fears with Step towards Weapons Material

Since 1970 the NPT has curbed the aspirations of countries wanting to develop nuclear weapons by promoting cooperation on peaceful nuclear energy and dissuading activities which are potentially weapons-related. With very few exceptions (eg

North Korea, Pakistan) this has restricted nuclear weapons to six countries.

Iran has been the focus of attention since a major clandestine uranium enrichment program became evident in 2002. In 2006 the UN Security Council called on Iran to suspend its uranium enrichment. This was ignored. Quite independently of this, since 2011 Iran has had a large Russian nuclear power reactor operating, providing about 3% of its electricity. All the fuel is provided by Russia. A second such reactor is under construction.

Following considerable international expressions of concern about the uranium enrichment program, and related sanctions, Iran and the permanent members of the UN Security Council plus Germany (P5+1) with the European Union signed the Joint Comprehensive Plan of Action (JCPOA) in July 2015. Under its terms, Iran

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agreed to limit its uranium enrichment to 3.67% U-235. The UN's International Atomic Energy Agency has now informed its Member States that Iran began feeding uranium already enriched up to 4.1% U-235 into six centrifuge cascades at one of its three enrichment plants for further enrichment up to 20%. While enriching from 4% up to 20% U-235 is quite a major step, less energy is required to upgrade 20% enriched uranium to weapons grade.

The UK, French and German foreign ministers have now said "We are deeply concerned by the commencement by Iran on the 4th of January of uranium enrichment up to 20% at the underground facility of the Fordow Fuel Enrichment Plant. This action, which has no credible civil justification and carries very significant proliferation-related risks, is in clear violation of Iran's commitments under the JCPOA and further hollows out the Agreement."

Source: World Nuclear Association, <https://www.world-nuclear.org/our-association/publications/weekly-digest/latest-world-nuclear-association-weekly-digests.aspx, 08 January 2021>.

Iran Missile Program must be 'On the Table' in Nuclear Talks, Biden National Security Adviser Says

Tehran's ballistic missile program "has to be on the table" if the U.S. re-enters the Iran nuclear deal, Jake Sullivan, U.S. President-elect Joe Biden's national security adviser, said – an issue that Iranian President Hassan Rohani said was non-negotiable as recently as last month.

Addressing the one-year anniversary of the U.S. killing of Qassem Soleimani, head of Iran's Revolutionary Guards' Quds Force, Sullivan told CNN's Fareed Zakaria that Iran is closer to a nuclear weapon now than it was before and that the U.S. is no safer now than it was before Soleimani's killing, highlighting continued Iranian provocation against American interests in the Middle East.

"President Biden has said that if Iran comes back into compliance with its terms under the nuclear deal so that its program is back in a box then we would come back in, but that would become the basis for this follow-on negotiation," Sullivan said, noting that talks around the ballistic missile program would be part of the negotiations after re-entry into the nuclear deal.

Sullivan noted that talks can extend beyond the permanent five members of the UN Security Council and involve regional players, as well, saying that "[i]n that broader negotiation, we can ultimately secure limits on Iran's ballistic missile technology, and that is what we intend to try to pursue through diplomacy that involves the direct nuclear file and a broader set of regional issues."

The deal was narrowly focused on Iran's nuclear program, Sullivan said, while the U.S. would maintain all its abilities to push back Iran on all

other matters. "It's not like we went into this thinking 'hey, we'll get the nuclear issue plus we'll just assume Iran will change its behavior overnight,'" he said. ...Sullivan admitted that did not come to pass, but argued that it was never fundamentally part of the deal that the U.S. expected to happen. "As we go forward, we will continue to look at each of the significant issues we face with Iran, each of the threats and challenges that Iran poses in its own distinct way, without presuming that by doing a

deal on one aspect we're necessarily going to make progress on another," he said.

Biden previously promised to rejoin the Iran nuclear deal while building on the agreement, specifically vowing to take on the ballistic missile program. Rohani said last month that the ballistic missile program had nothing to do with the nuclear issue. "There is one JCPOA that has been negotiated and agreed — either everyone commits to it or they don't," Rohani said....

Source: Haaretz, <https://www.haaretz.com/us-news/.premium-iran-missile-program-must-be-on-the-table-in-nuclear-talks-biden-adviser-says-1.9420133?mkt,03 January 2021>.

EU Says it will Redouble Efforts to Save Iran Nuclear Deal

The European Union said it would redouble its efforts to save the Iran nuclear agreement despite what it calls Tehran's "important breach" of commitments made in the 2015 deal by starting to enrich uranium to new levels.

EU spokesman Peter Stano said that Iran's actions "will have serious implications when it comes to nuclear nonproliferation." Stano said it was in everyone's interest to rescue the deal and said

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the 27-nation bloc “will strengthen” its attempts to make sure all adhere to the commitments made in the landmark deal.

...Increasing enrichment at its underground Fordo facility puts Tehran a technical step away from weapons-grade levels of 90%. Iranian Foreign Minister Mohammad Javad Zarif said the action was “fully reversible” if other partners in the deal fully complied too, without elaborating.

Iran informed the IAEA of its plans to increase enrichment to 20%. Iran’s decision to begin enriching to 20% purity a decade ago nearly triggered an Israeli strike targeting its nuclear facilities, tensions that only abated with the 2015 atomic deal, which saw Iran limit its enrichment in exchange for the lifting of economic sanctions.

Source: AP News, <https://apnews.com/article/donald-trump-europe-iran-iran-nuclear-tehran-05-January-2021>.

NORTH KOREA

No Signs of N. Korean Tests Ahead of Biden Inauguration, US General Says

North Korea does not appear to be preparing a major provocation at the onset of the administration of President-elect Joe Biden, according to the top U.S. general in South Korea, amid concerns Pyongyang could soon conduct a missile or other weapons test. “We’re not seeing any indicators that suggest that there would be a major provocation — but that’s today. That could change next week,” General Robert Abrams, the commander of U.S. Forces Korea, told an online forum.

North Korea has often timed major tests, including of ballistic missiles or nuclear weapons, around U.S. presidential transitions, an effort to demonstrate its military capabilities and

possibly gain leverage in future negotiations with Washington.

North Koreans “too often have devoted themselves to the search for obstacles to negotiations instead of seizing opportunities for engagement,” Deputy Secretary of State Stephen Biegun says. But so far North Korea has been quiet since Biden’s election win. Instead, Pyongyang has focused on its economy, which has been battered by coronavirus-related border closures, ongoing international sanctions, and recent major floods.

In October, North Korea used a military parade to unveil a massive new intercontinental ballistic missile, which appears designed to overwhelm U.S. missile defenses. Some suspect Pyongyang may test the missile in the coming months. Ship-based approach could strengthen US missile defense system

Abrams said the United States is closely watching North Korea during its upcoming Eighth Party Congress, an important political meeting that could provide a hint of Pyongyang’s foreign and domestic policy direction. ... Abrams said the United States and its ally, South Korea, have a “very

large quiver full of a lot of different arrows” with which to respond, but cautioned there is not a “one-size-fits-all” response to North Korean provocations. “We are much more nuanced than that. We deal with every

situation separately and with a discreet level of analysis and appropriate response. Sometimes the best response is to do nothing,” he said.

... Biden has said he won’t rule out meeting Kim face-to-face, but has suggested that would only come as part of broader, working-level talks. Biden, who helped oversee former President Barack Obama’s policy of “strategic patience” toward North Korea, has repeatedly criticized Trump’s personal outreach to Kim, saying the strategy is

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ineffective and aimed more at creating headlines than addressing the North Korean nuclear issue. At his election rallies, Biden frequently called Kim a “thug,” “tyrant,” and “dictator.” In response, North Korean state media slammed Biden as an “imbecile,” a “fool of low IQ,” and a “rabid dog”.

Source: VOA News, <https://www.voanews.com/east-asia-pacific/no-signs-n-korean-tests-ahead-biden-inauguration-us-general-says/>, 05 January 2021.

URANIUM PRODUCTION

GENERAL

Report: World’s Uranium Resources Enough for the Foreseeable Future

Sufficient uranium resources exist to support the long-term, sustainable use of nuclear energy for low-carbon electricity generation as well as for other uses such as industrial heat applications and hydrogen production. However, the impact of the ongoing COVID-19 pandemic on the industry and recent reductions in uranium production and exploration could affect available supplies. Timely investment in innovative mining and processing techniques would help assure that uranium resources are brought to market when they are needed.

These are among the main findings of the latest edition of Uranium – Resources, Production and Demand, also known as the ‘Red Book’, an essential global reference prepared jointly by the OECD Nuclear Energy Agency (NEA) and the IAEA.

Global Uranium Resources: The Red Book shows that global uranium resources have increased, but more modestly than in previous years. The world’s conventional identified uranium resources amounted to 8,070,400 tonnes of uranium metal

(tU) as of 1 January 2019. These represent all reasonably assured and inferred uranium resources that could be recovered at market prices ranging from 40 to 260 USD/KgU (equivalent to 15 to 100 USD/lb U3O8).

Compared to the total reported in the 2018 edition, this is an increase of only 1%. A small portion of the overall changes in identified resources relates to new discoveries. Additions to the uranium resource base could come from yet undiscovered or unconventional resources, such as uranium from phosphate rocks.

Continuing a downward trend over several years, worldwide domestic exploration and mine development expenditures decreased to approximately \$0.5 billion in 2018, a significant drop from \$2 billion in 2014. This trend is not expected to result in shortfalls but could signal market issues in the longer-term.

Global uranium mine production decreased by 10.8% from 2017 to 2018 due to production cuts resulting from poor market conditions but increased slightly by 1% to 54,224 tU in 2019. Furthermore, planned uranium production cuts in early 2020 were deepened by the onset of the COVID-19 pandemic, and its effects could be felt through 2021 and beyond.

While some uranium producers reduced activities at some facilities, others opted to close operations until market conditions improve sufficiently to justify re-opening. The resources and annual production capacity of these temporarily closed operations, referred to as idled mines....

...Depending on developments in the nuclear energy sector, reactor-related uranium requirements could range from 56,640 tU/yr in a low demand scenario to 100,224 tU/yr in a high

Biden has said he won’t rule out meeting Kim face-to-face, but has suggested that would only come as part of broader, working-level talks. Biden, who helped oversee former President Barack Obama’s policy of “strategic patience” toward North Korea, has repeatedly criticized Trump’s personal outreach to Kim.

The world’s conventional identified uranium resources amounted to 8,070,400 tonnes of uranium metal (tU) as of 1 January 2019. These represent all reasonably assured and inferred uranium resources that could be recovered at market prices ranging from 40 to 260 USD/KgU (equivalent to 15 to 100 USD/lb U3O8).

demand scenario by 2040. While nuclear capacity projections vary considerably from region to region, growth in the nuclear sector and in uranium requirements are projected to be the largest in the East Asia region.

Given these projections, the uranium resource base described in the Red Book is more than adequate to meet low and high case uranium demand through 2040 and beyond. Meeting high case demand requirements through 2040 would consume about 28% of the total 2019 identified resource base recoverable at a cost of < \$130/kgU (\$50/lb U3O8) and 87% of identified resources available at a cost of < \$80/kgU (equivalent \$30/lb U3O8).

Future supplies would benefit from timely research and innovation efforts to further improve uranium exploration and develop new, more cost-effective extraction techniques. Strong market conditions will be instrumental in achieving the required industry investment to develop and deploy new technologies.

Source: <https://www.esi-africa.com/industry-sectors/generation/report-worlds-uranium-resources-enough-for-the-foreseeable-future/>, 12 January 2021.

NUCLEAR SAFETY

CHINA

Chinese Nuclear Firm is Told it must Resolve Bradwell Safety Issues

The Environment Agency has told the Chinese nuclear developer behind plans to build a new reactor in Essex that it must resolve at least six safety issues before it can move forward. The issues identified by the environment watchdog in its early assessments of the plans for the site in Bradwell include concerns over how China General Nuclear Group (CGN) will dispose of radioactive waste.

The agency has opened a consultation calling for views on its assessment and there is likely to be

strong criticism from environmentalists and local community groups who oppose the new plant. CGN is helping to build the first new nuclear power plants in the UK in a generation as a junior partner at EDF Energy's Hinkley Point C site in Somerset and at EDF's planned plant at Sizewell C in Suffolk, both of which will use a reactor type designed by the French energy company.

The Chinese state-owned company also plans to build a nuclear power plant using its own reactor design, the UK Hualong pressurised water reactor, at Bradwell. It hopes to have the design approved by UK authorities by 2022. The plans have raised concerns among those who believe that Chinese-owned companies should not be involved in the UK's critical national infrastructure over security and surveillance concerns following the Huawei controversy.

Alan McGoff, of the Environment Agency (EA), said he expects CGN to resolve the potential issues identified by the agency "over the next year or so", but warned that the agency will accept the reactor design "only if we are satisfied that all the issues have been addressed".

The EA has been scrutinising the plans since 2017 and has also identified concerns over how CGN plans to use its operational experience "to inform and improve the design", its plans to respond to safety and environment protection assessments, and its use of high-efficiency particulate air filters.

Source: MSN News, <https://www.msn.com/en-gb/news/uknews/chinese-nuclear-firm-is-told-it-must-resolve-bradwell-safety-issues/ar-BB1cEPom?ocid=MEDDHP&li=AAAnZ9Ug>, 12 January 2021.

NUCLEAR WASTE MANAGEMENT

USA

Construction of Low Activity Waste Facility Near Completion at Nuclear Waste Site

The U.S. DOE announced Jan 7 that workers have substantially completed construction of the low

The plans have raised concerns among those who believe that Chinese-owned companies should not be involved in the UK's critical national infrastructure over security and surveillance concerns following the Huawei controversy.

activity waste facility at the Hanford Vit Plant in Mesa, Washington. The completion of construction, which was performed by Bechtel National Inc. (BNI), moves the facility closer to be able to process the 56 million gallons of radioactive waste that is stored in underground tanks at the site.

The low activity waste facility has been under construction for 18 years. Along with other facilities constructed at the site, the low activity waste facility will serve to process waste via the direct-feed low-activity waste (DFLAW) approach. Through this approach, radioactive waste will be converted to glass where it can be disposed of safely through a process known as vitrification.

...To date, engineering, procurement and construction has been completed on 17 facilities at the Hanford waste treatment plant, which will be used in the DFLAW approach. Through this approach, pretreated waste from Hanford tanks

will be piped to the low activity waste facility where it will be vitrified, or immobilized in glass. The facilities include the analytical laboratory, effluent management facility and 14 support structures consisting of electrical power, backup power, water purification, compressed air, steam, communication and control, and fire water systems. These facilities are now in the start-up, testing and commissioning phases to prepare for operations, including heating up large melters that will vitrify millions of gallons of low-activity tank waste.

The DFLAW focus now shifts to preparing for the start of cold commissioning of the low activity waste facility where a waste-like simulant will be run through the facility to test systems, plant monitoring, and management of systems.

Source: Adam Redling, <https://www.cdrecycler.com/article/hanford-nuclear-waste-facility-construction/>, 11 January 2021.



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