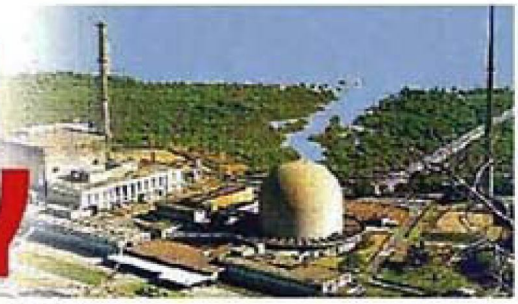
NUCLEAR SECURITY



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

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OPINION – Shashtri Ramachandran

Why India Doesn't Need NSG Membership

Unlike Groucho Marx, who refused to join any club that would make him a member, India is eager for membership of elite clubs where it cannot get in. The NSG is one such chimera that India continues to chase. The chase provides a periodic diplomatic interlude where an NSG meeting is an explicit reminder of India being kept out of the club by China. It gives New Delhi a chance to point out that China wants to keep out India until it can admit Pakistan. This helps India to show China as a supporter of Pakistan.

So it was after NSG meeting in the Kazhakstan capital of Nursultan (Astana). India's admission was not on the agenda. But, China's foreign ministry spokesman was asked about India's membership; and, his clichéd response – that there will be no discussion of India's membership until a procedure finalised for non-NPT countries – was dutifully reported as Beijing again blocking India's entry to make sure that India's claims get linked to Pakistan's.

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In June 2016, in its bid for NSG membership, India made a spectacle of itself. Its campaign played out in four Asian capitals: Seoul, where the NSG plenary was held; Beijing; New Delhi; and, Tashkent, where Prime Minister Narendra Modi went to meet Chinese President Xi Jinping. All of it was in vain. Three years after those moves based on a gross miscalculation, India still nurses fond hopes of breaking into the NSG with US support, which New Delhi feels would make Beijing relent at some point. However, that is unlikely to happen, and for a variety of reasons. NSG membership is not something given across the counter on US certification endorsed by China. In the NSG of 48 nuclear equipment and material suppliers, all decisions are unanimous.

The US created the NSG, after India's 1974 nuclear test, solely to deny advanced technology to India, and isolate and contain India. China became a member only in 2004. Thus, at one

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level, making India a member would undercut the very objective of creating the NSG. At a larger level, India's entry would make nonsense of the so-called non-proliferation considerations that is the basis of the club. As the Seoul plenary statement said, "Participating governments reiterated their firm support for the full, complete and effective implementation of the NPT as the cornerstone of the international non-proliferation regime."

This implies that NSG members, who in the past were arm-twisted into signing the NPT, did not roll over to ease India's entry. Unlike in 2008, in 2016, the US had no reason to pull out the stops for India. In 2008, the US ensured a one-time waiver for civil nuclear trade to give life to the India-US nuclear deal. The fact that India's bid in 2016 ended as a diplomatic fiasco revealed the limits of US power in dealing with China. It also clarified that NSG entry is not a matter of negotiating on two – India-US and India-China – bilateral tracks.

The 2008 waiver ensures India's access to technology; and, no foreign reactor supplier is actually waiting for India's NSG membership. Former heads of the Atomic Energy Commission have also said that India can live without NSG membership. It does not matter in terms of uranium supply. Nor is NSG membership necessary to sustain any of India's ongoing nuclear project. It has little or nothing to do with India's nuclear programme: and, membership would not bring in its wake a flood of technology goodies.

In the aftermath, New Delhi should have shed the fallacies, which it is still clinging to for being admitted to the NSG. India no longer needs NSG membership. There is no material benefit to be gained that has not been won by the waiver of 2008, which then Prime Minister Manmohan Singh managed through telephone calls and some deft diplomatic moves by his top officials such as Shyam Saran.

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Three, much has changed since 2008. President Trump's priorities are different from those of presidents Bush (2008) and Obama (2016). The Bush administration went all out to get the waiver for India. Trump is unlikely to bat for India – or, in fact, for anything other than US' interests – in his dealings with China; and, the civil nuclear deal means almost nothing to him. For India, NSG membership does not matter. Besides, it may not happen anytime soon. In that case, why is China taking such a hard line against India?

It cannot be only to aid Pakistan's entry, although to say that helps India's posturing. Seasoned observers say that China is taking a tough line now possibly for driving a harder bargain with India at a later date on another issue. It could make a show of climbing down and easing India's entry, for instance, in return for New Delhi not acting as the spearhead of US-led military interests in the "Indo-Pacific". China can also seemingly "sacrifice" its stand for something else, such as New Delhi taking a softer line on the South China Sea issue. It is a bargaining chip, which China keeps drawing attention to at every NSG meeting. Therefore, in the emerging transactional relationship with China, the less interest New Delhi shows in NSG membership, the stronger would be its hand for dealing with Beijing on a range of issues that involve give and take.

Source: The writer is an independent political and foreign affairs commentator. https://www.outlookindia.com/, 24 June 2019.

OPINION – Quamrul Haider

Combating Climate Change: Why Thorium is a Safer Nuclear Option

The picture is crystal clear. Human activity will soon drive the climate crisis all across our planet to the tipping point unless we rapidly transform the ways

in which we produce and consume energy. While renewable energy technologies and energy efficiency measures can help dramatically cut emissions of greenhouse gases, they are not the panacea for the climate change related problems that we have created.

If fission-based nuclear power plants are to play a major role in combating global warming, then we want them to be free from fears of a catastrophic, runaway chain reaction. Even more, we want a nuclear fuel that would produce manageable amounts of radioactive waste. We also want a fuel that does not possess the threat of falling into the wrong hands and becoming a deadly weapon of mass destruction.

The scope and impacts of climate change, therefore, demand that we consider other possible low or zero greenhouse-gas-emitting sources of energy, including nuclear power. Indeed, nearly every major authority on climate change, including the International Energy Agency and the UN's Intergovernmental Panel on Climate Change (Fourth Assessment Report), has said that to achieve deep decarbonisation, nuclear energy must be part of the solution.

All nuclear power plants in operation today rely on controlled fission, which involves neutron-induced splitting of one of the isotopes of uranium into two lighter fragments and two or three neutrons. Despite being a clean source of energy, there exists bitter controversy surrounding the risks of harnessing energy released during fission. Some of the risks are core meltdown (as seen in the 2011 Fukushima disaster), hazards of disposing of radioactive waste, harmful effects of radiation and nuclear proliferation. These risks have made nuclear power a contentious topic bordering between our greatest hopes and deepest fears for the future.

In the event of a runaway chain reaction, uranium-based reactors have the potential to become supercritical and get out of control, thereby causing a catastrophic accident. Since thorium reactors would operate sub-critically, runaway chain reactions that cause nuclear meltdowns would not occur.

If fission-based nuclear power plants are to play a major role in combating global warming, then we want them to be free from fears of a catastrophic, runaway chain reaction. Even more, we want a nuclear fuel that would produce manageable amounts of radioactive waste. We also want a fuel that does not possess the threat of falling into the wrong hands and becoming a deadly weapon of mass destruction.

Many countries are addressing the worrisome problems associated with uranium-fuelled reactors and exploring the possibilities of other forms of safe, clean and incontrovertible nuclear fuel. An alternative that is receiving serious attention from the nuclear stakeholders is using thorium, instead of uranium, as nuclear fuel.

Thorium is a non-fissile, "fertile", slightly radioactive element. Being non-fissile, it cannot be split to create a nuclear chain reaction, so it must be bred through nuclear reactors to produce fissile uranium. Thorium enjoys several advantages over uranium. First, the risk of nuclear proliferation of thorium is less than that of uranium. This comes mostly from the fact that plutonium, an essential ingredient of nuclear weapons, is not produced in thorium reactors. Thorium fuel cycle would also minimise toxicity and decay heat problems associated with current reactors.

Secondly, in the event of a runaway chain reaction, uranium-based reactors have the potential to become supercritical and get out of control, thereby causing a catastrophic accident. Since thorium reactors would operate sub-critically, runaway chain reactions that cause nuclear meltdowns would not occur.

Thorium has other advantages too. The inventory of radioactive waste produced by thorium would be much less than uranium. A thorium reactor burns nearly all of its fuel. As a result, it will

produce less waste. While some trace elements in spent uranium fuels remain radioactive for many thousands of years, levels in spent thorium fuels drop off much faster. Moreover, unlike conventional reactors that run at potentially explosive, pressurised environments at much higher temperatures, thorium-fuelled reactors can be operated at atmospheric pressure.

Thorium reactors use a combination of thorium and liquid fluoride salts to power the reactor. Fluoride salts have very high boiling points, meaning even a large spike in heat will not cause a massive increase in pressure. This feature greatly limits the chance of a containment explosion. Besides, the reactors don't require massive cooling, meaning they can be placed anywhere and can be air-cooled. Thorium is roughly three-four times more abundant in nature than uranium. The most common source is a mineral called monazite, which contains about 12 percent thorium phosphate. Large known deposits are in India, Australia and Norway. Some of the largest reserves are found in Idaho in the USA.

With large, easily accessible reserves of thorium and relatively little uranium, India has made utilisation of thorium for large-scale energy production a major goal in its nuclear power programme. The country has successfully developed a thorium fuel cycle at the nuclear power plant in Kalpakkam, Tamil Nadu. China hopes to build a fully functional thorium-fuelled reactor within the next 10-15 years. Norway is currently in the midst of testing thorium as a fuel in existing nuclear reactors. Other countries with active thorium research programmes include the United Kingdom, Canada, Japan, Germany, Russia and Israel.

If thorium is a safe and versatile nuclear fuel, then why do we use unsafe uranium? The real reason we use uranium over thorium is a result of the Cold World-era politics. Nuclear superpowers backed uranium-based reactors because they produce plutonium—handy for making nuclear weapons. The fact that thorium reactors fail the weapon-making test meant the better reactor fuel got the short shrift.

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Nevertheless, if the choice is between keeping nuclear power facilities running or shutting them down and replacing them with coal-fired power plants, the nuclear option with thorium as fuel is ideal for the climate. It is the best supplement to sustainable green energy, filling the gap until nuclear fusion reactors are built.... Finally, regardless of the fear among the public and many activists about nuclear power, thorium reactors are a safer, realistic solution to humanity's greatest problem. Without nuclear power, we would foreclose our ability to avert the environmental disaster that we brought upon us.

Source: Quamrul Haider is a professor of physics at Fordham University, New York. The Daily Star, 24 June 2019.

OPINION – Chang Se-moon

Nuclear Phase-Out (I): How did it Start?

The nuclear power phase-out in this article means President Moon's policy of ending the use of nuclear power plants as a source of electricity generation in Korea.... In June 2017, only a month after taking office, President Moon announced that he would "review policy on nuclear power plants entirely," and that Korea would "abandon a development policy centered on nuclear power plants and exit the era of nuclear energy."

He also stated that plans for new reactors would be cancelled and the operating periods of existing units would not be extended beyond their design lifetimes. In July 2017, the Moon administration announced its plan to stop construction of the Shin

Kori units 5 and 6. Approximately, 40 percent of their construction had been completed at the time of the announcement. The suspension of construction incurred losses amounting to no less than $120 million to their builders.

Following an October 2017 survey in which 60 percent of citizens favored a resumption of construction of units 5 and 6 ¯ while 40 percent opposed ¯ the Moon administration announced in December 2017 that construction of the Shin Kori units would resume, but construction of 6 other units, including Shin Hanul 3 and 4 that had been were planned since 2008, would be cancelled. Stated in simple terms, the Moon administration is in the process of phasing out nuclear power as a source of energy in Korea....

Currently, Shin Kori 5 and 6 are the only nuclear power plants under construction in Korea. Equipment manufacturing for the units is expected for completion by early 2020. After that, there will be no more work or project for future nuclear power plants, meaning that the nuclear power industry will be essentially going out of business in Korea.

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Why did President Moon decide to phase out nuclear powered energy in Korea? My understanding is that Moon has deep concerns over safety relating to nuclear power. I can cite two examples that could have been the basis for his concern. ... The Fukushima nuclear accident led to a re-examination of nuclear safety and nuclear energy policy in many countries. For instance, Germany approved plans to close down all its reactors by 2022. Austria, China, Israel, Italy, Malaysia, Sweden, the Philippines. Switzerland, Thailand, and United Kingdom, and the Philippines all reviewed their nuclear power programs, but, importantly, not phased out.

How does nuclear power compare with other sources of energy in safety? In terms of lives lost per unit of energy generated, the neutral Wikipedia summarizes that "nuclear power has caused fewer accidental deaths per unit of energy generated than all other major sources of energy generation. Energy produced by coal, petroleum, natural gas and hydropower has caused more deaths per unit of energy generated due to air pollution and energy accidents."...

...Wikipedia further states that "When the combined immediate and indirect fatalities from nuclear power and all fossil fuels are compared, including fatalities resulting from the mining of the necessary natural resources to power generation and to air pollution, the use of nuclear power has been calculated to have prevented about 1.8 million deaths between 1971 and 2009," in comparison to the scenario in which the same amount of energy would "otherwise have been generated by fossil fuels, and is projected to continue to do so."

Although some suggest Wikipedia not to be quoted in scientific studies, I have found many accurate and thoughtful statements only in Wikipedia, including quotations in the above. Stated in simple terms, what do proponents and opponents say about nuclear energy? Proponents of nuclear energy support it "as a sustainable energy source that reduces carbon emissions and increases energy security by decreasing dependence on imported energy sources," while opponents consider nuclear energy as threats to the environment and leading to greater risk of "nuclear weapons proliferation and terrorism."

Source: Chang Se-moon is the director of the Gulf Coast Center for Impact Studies, http://www.koreatimes.co.kr/, 23 June 2019.

OPINION – Jack Winnick

Why Scrapping the Iran Nuclear Deal was the Right Move

Iran's Foreign Minister has admitted they cheated on the now defunct nuclear enrichment program. They violated the amount of low-enriched uranium-235, he says, as well as the rate of its

production. In addition to non-compliance with caps on its stockpiles of low-enriched uranium: (660 lb); they also violated their stockpile limit of heavy water - set at 286 tons - and halting sales of surplus material overseas. The allowed U-235 enrichment level is 4%, enough to power a nuclear reactor but far below that needed for a weapon (80-90%).

Under the deal, approved by then-President Obama, limited inspection of Iran's reactors, enrichment facilities and heavy-water production plants was allowed. But we now know, according to the Iranians themselves, that they have been violating the deal. Which means there is really no limit to what other dishonesty has been going on.

Consider the fact that Iran comprises a land area of 636,000 square miles, nearly equivalent to the state of Alaska. How much equipment and facilities could be hidden in such a vast and varied landscape? Iran is filled with mountain ranges, lakes and rivers, along with vast areas of farmland and timber. The Iranians have already shown that they can assemble vast complexes of state-of-the-art chemical and nuclear plants hidden out of sight of the world, and, of course, our inspectors. There is literally no way to prevent them from continuing their chicanery, nuclear agreement or not.

A typical nuclear power reactor can utilize fuel that is enriched to 3-4% U-235. Naturally-occurring uranium contains about 0.7% of the fissile 235 isotope; most of the remainder is the relatively stable U-238. To bring the U-235 to a level where it can be used in a power plant or weapon, enrichment is necessary. The most-used process is called "centrifugation." It is straightforward but difficult and energy-intensive.

... With uranium the process is complicated by the fact that the two isotopes are nearly the same in atomic weight: 235 v. 238. To accomplish the separation, the uranium in its raw form, usually the oxide, is converted to the fluoride, the lightest molecular compound that can be made. That part is easy, but even as fluorides the molecular weights are nearly the same, meaning the densities of the streams are near identical.

Multiple stages are necessary even to reach the 3-4% level of U-235 permitted under the old treaty. To reach weapons levels of 90%, many more stages are needed, hundreds or thousands depending on the level. The famous Stuxnet computer worm, developed by the Israelis with the help of the U.S., disabled Iran's centrifuge program between the years 2000 and 2005 by hacking into their operating system. The Israelis apparently used a double agent to manually insert a thumb drive into the computer; the centrifuges literally spun themselves to ruin.

A common misconception deals with the minimum amount of U-235 needed for a weapon. This so-called critical mass is the amount of fuel needed to initiate and sustain a chain reaction. Simply put, the fuel in a nuclear bomb, U-235 atoms, explodes by absorbing neutrons, splitting into other atoms, and generating immense amounts of energy, consistent with the loss of mass. A chain reaction can only continue as long as the number of neutrons emitted in each fission, slightly more than two, is greater than those consumed and lost. Neutrons are lost as the fuel assembly expands in the intense heat. It is crucial, then, to enclose the reacting mass exposed to the emitted neutrons as tightly as possible. In practice, the uranium is wrapped in a blanket of beryllium. This metal, which is widely available, has the property of reflecting, rather than absorbing or transmitting the neutrons. It keeps them bouncing around inside the reacting mass, continuing the chain reaction. The whole process is begun by triggering an outer wrap of conventional explosive. An initiator within the fuel then starts the chain reaction.

The critical mass is often quoted as about 100 lbs. of 90%-enriched U-235. But this is only true for a non-enclosed device. In practice, the fuel would be compressed into a sphere, as described above. The actual critical mass for a working device is more like 12 lbs. for uranium fuel, and as little as 5 lbs. for plutonium. The heart of the weapon could be as small as a soccer ball. This, of course, comprises only a small part of the entire

device; it does not include the electronics and materials of construction. Note that this eliminates the possibility of a suitcase bomb, often used in fictional TV and film dramatizations.

A plutonium bomb is within the means of a rogue nation like Iran. With plutonium as fuel, rather than uranium, the destructive capabilities of a bomb are magnified. Iran's intentions in this direction are indicated by its production and storage of tons of heavy water, whose only use is in a reactor that produces plutonium from the U-238, which is in the fuel along with the U-235. The technology for the separation of the plutonium produced in such a reactor is well-known and available to Iran.

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All this means that Iran could very likely be in business in just a few years. We know where much of the Iranian nuclear facilities are located; they could be destroyed if hostilities broke out. But, as mentioned earlier, other processing and assembly plants are probably already under construction at hidden sites. As far as delivery of a nuclear weapon, the scenario is equally frightening. Iran already has an IRBM with a payload of 1000 lbs., able to reach Tel Aviv or any of several U.S. military bases.

In other words, we have much to fear from Iran in terms of nuclear warfare, in addition to other forms of terrorism. It is clear that the treaty that was just ended by our president was not in our best interest; in fact, the entire world was at risk. Iran is a rogue State, determined and increasingly able to cause terrible destruction. We are wise to give them the level of suspicion we should have given Hitler in the 1930's.

Source: *Jack Winnick has worked for NASA at the Johnson and Kennedy Space Centers and for the U.S. Nuclear Regulatory Commission at the Oak Ridge National Laboratory. https://www.americanthinker.com/, 23 June 2019.*

OPINION – Scarlett Evans

Could Small Nuclear Reactors be the Answer to Powering Off-Grid Mines?

At this year's Prospectors & Developers Association of Canada convention, Canadian Nuclear Laboratories (CNL) extolled the benefits of small nuclear reactors as an alternative to diesel generators for powering remote, off-grid operations. Here, Scarlett Evans looks at the benefits of such a shift, and what it could mean for the wider energy landscape.

Global energy consumption is on the rise, driven by the rapid industrialisation of developing economies such as China and India. Yet the discovery of high-grade ore deposits is simultaneously declining, and mining corporations are having to turn to previously inaccessible locations for new sources of materials. These off-grid sites are often powered by diesel generators, fulfilling the need for consistent power supply but proving problematic in terms of logistics and environmental impact. Now, Canada's leading nuclear science and technology corporation CNL has suggested small modular reactors (SMRs) could be the future.

Why Choose SMRs? Seeking to reduce harmful emissions while maintaining consistent power has long led industry members to explore nuclear alternatives to traditional energy sources, and a new branch of technology developers are now looking to harness this power in micro form. The creation of smaller standardised units – typically generating between 3MWe and 10MWe – are easier to install and far safer to operate than their larger counterparts, and offer the opportunity to limit emissions and maintain climate change commitments.

"Increasingly, nuclear technology is being seen as a viable clean energy alternative for industrial applications," CNL vice-president of business development Corey McDaniel says. "Heavy industry, such as mining, is energy intensive and requires a reliable source of electricity, but also in many cases, heat and steam. Next-generation nuclear energy offers the versatility to meet these needs, and does so in a low-carbon, environmentally-sustainable way." CNL president and CEO Mark Lesinski says SMRs could act as not only replacements for diesel generators, but could also be deployed alongside renewables, saying they could offer "reliable baseload power to these otherwise intermittent forms of energy."

SMRs are already used to power marine vessels such as submarines and icebreakers, and there are more than a hundred new designs under development by industry members and government bodies. There is even a particular subgroup intended for diesel engine replacements.

SMRs are already used to power marine vessels such as submarines and icebreakers, and there are more than a hundred new designs under development by industry members and government bodies. There is even a particular subgroup intended for diesel engine replacements. While the designs are yet to reach commercial markets, serious steps are being made to get the technology ready for full-scale deployment with the addition of safety and operational improvements.

Dr Jonathan Cobb, senior communication manager for the World Nuclear Association says there are two main problems with diesel engines that nuclear reactors can remedy. The first is their environmental impact, polluting not only in their greenhouse gas emissions but also other forms of air pollution, such as particulates and nitrogen oxides. "Like their larger nuclear power plant counterparts," Cobb says, "SMRs don't produce greenhouse gas emissions and other aerial pollution produced by fossil fuel generators."

The second problem is that the requirement of a constant supply of diesel fuel can prove logistically problematic if deployed in a remote location where fuel is not readily available. By contrast, Cobb says the fuel cores in SMR's and microreactors "would last at least three years, and in some of the designs could be used for up to 10 years."

An Economic Choice: The recently-released Canadian SMR Roadmap from Natural Resources Canada and the Canadian Nuclear Association (CNA) showed the switch to SMRs could also have significant financial benefits, with a cost advantage over diesel of between 20%-60%. The roadmap also concluded that the Canadian domestic market was globally one of the most promising for SMRs, with the unit's offering a potential value of $5.3bn between 2025 and 2040. Globally this figure is far bigger, with a conservative estimated value of $150bn between 2025 and 2040 – indicating the scale of a potential export market.

The roadmap also concluded that the Canadian domestic market was globally one of the most promising for SMRs, with the unit's offering a potential value of $5.3bn between 2025 and 2040. Globally this figure is far bigger, with a conservative estimated value of $150bn between 2025 and 2040 – indicating the scale of a potential export market.

Hatch nuclear specialist Brian Gihm writes that SMRs are far more stable and predictable in terms of long-term energy prices than traditional energy sources, as costs of nuclear plants are usually fixed at the time of installation and will not be affected by fluctuations in crude-oil price. In addition, as the majority of developers are looking to use SMRs at remote sites, energy costs will be treated as an operational rather than capital expense, offering potentially significant savings to new operations.

What is there Left to Do? The roadmap concluded that a demonstration project would be crucial in advancing SMR technology to the next stage – a point supported by responses from industry members who participated in the roadmap study. The report characterised the deployment of SMRs as a 'paradigm shift' similar to the "shift of steam engines from mineshafts into ships and vehicles, or the movement of computers from mainframe to desktop and then to laptop." However, the road ahead is not yet entirely clear. ...

According to Stewart, conversations between nuclear and mining industries are already underway, seeking to deploy smaller reactors of around 10MWe-50MWe at remote sites currently reliant on diesel fuel, while efforts are being directed towards the development of SMRs for on-grid power in the provinces of Ontario and New Brunswick.

"Those two provinces already have reactor operations and licensed nuclear sites," Stewart says, "and their power utilities are formalizing relationships with SMR technology developers." Yet full deployment cannot yet be expected, and Stewart says SMRs need to integrate with the rest of Canada's energy system to meet the country's power needs. Such integration will require the development of suitable locations, transport, construction, staff, regulation, waste management, and a host of other services. The roadmap also said that collaborative activities are required in four main areas: demonstration and deployment, capacity-building and stakeholder engagement, policy, and international partnerships to position Canada for leadership in global value chains. ...

Source: https://www.mining-technology.com/, 24 June 2019.

OPINION – Haley Zaremba

Can Artificial Intelligence Save the Nuclear Industry?

Attitudes about nuclear energy are changing, with pundits on both sides of the aisle touting its benefits for extremely efficient and relatively clean energy. Despite an ever more positive public opinion, the nuclear industry in the US, the largest in the world, is currently experiencing a downturn, even going so far as to need government subsidies to keep afloat.

In fact, at present the fastest growing sector of the nuclear industry is profiting not off of growth, but off of the nuclear sector's slow death in the US. According to reporting by Bloomberg, "the fastest growing part of the nuclear industry in the US involves a small but expanding group of companies that specialize in tearing reactors down faster and cheaper than ever before." this statement begins the article appropriately entitled "Fastest-Growing Nuclear Business Is Tearing Down US Plants".

Tearing down old nuclear reactors is no easy feat, however. Not only is it historically extremely expensive, it's also highly hazardous. Even in nuclear plants in good condition, it's a job that requires the utmost level of care and a ton of specialized gear in order to protect workers from radioactive materials. "Those who do handle radioactive material must first don protective suits that are inherently cumbersome and are further encumbered by the air hoses needed to allow the wearer to breathe," a report from the Economist details. "Even then their working hours are strictly limited, in order to avoid prolonged exposure to radiation and because operating in the suits is exhausting. Moreover, some sorts of waste are too hazardous for even the besuited to approach safely."

Some remotely operated robots have already become a standard fixture in the decommissioning of nuclear facilities, but the machines widely in use are not yet sophisticated enough to easily and efficiently do the complex tasks necessary to clean up a nuclear reactor. One team at Lancaster University has been working on a new, semi-autonomous robot that would be able to perform the kind of actions that the current robots can't, making nuclear cleanup an even easier and less dangerous job.

And then there are reactors that have experienced a recent accident or meltdown—they need cleanup more than any other, but who should be the workers who have to risk their own health for the health of the masses? According to some forward-thinking scientists and other experts in the field, there is a clear and humanitarian answer to this question is - Robots.

Some may remember that this idea is not a totally new one, and a robot was sent into the Fukushima nuclear power plant in Japan shortly after an earthquake-related nuclear disaster took place there in 2011. Some remotely operated robots have already become a standard fixture in the decommissioning of nuclear facilities, but the machines widely in use are not yet sophisticated

enough to easily and efficiently do the complex tasks necessary to clean up a nuclear reactor. One team at Lancaster University has been working on a new, semi-autonomous robot that would be able to perform the kind of actions that the current robots can't, making nuclear cleanup an even easier and less dangerous job.

Some discerning readers may find the idea of leaving such a hazardous task in non-human hands disturbing. And as well they should. "It's very unlikely that a truly autonomous robot will be trusted with nuclear decommissioning tasks any time soon," reassures a report from ExtremeTech. "After all, AI is still far from perfect, and the stakes are as high as they get when you're dealing with highly radioactive materials in large enough quantities to cause runaway nuclear reactions." The semi-autonomous robot developed by the Lancaster University group "splits the difference" by giving the robot some AI capabilities but ultimately leaving a human operator in charge.

According to ExtremeTech, "the team created imaging software that lets the robot "see" the world around it and identify objects like pipes, handles, and other materials common inside nuclear decommissioning sites." The robot is still in a development phase and has yet to be tested in a scenario with real radioactive materials, but it is likely a pioneer in what will become an industry-wide standard of operation. With the nuclear power industry set for major growth in Asia, and studies showing that the US has enough Uranium to stay powered for hundreds more years, nuclear waste cleanup will not only continue to be a growing sector, and an extremely costly one at that, but it will be more important than ever.

Source: https://oilprice.com/, 22 June 2019.

NUCLEAR STRATEGY

GENERAL

Here's how Many Nuclear Warheads Exist and Which Countries Own Them

The number of warheads has decreased over the past year, even as countries continue to modernize their nuclear forces, according to an annual assessment of global nuclear arms.

13,865 warheads in existence at the start of 2019 were owned by nine nations: the US, Russia, the United Kingdom, France, China, India, Pakistan, Israel and North Korea. The year before hosted an arsenal of 14,465 warheads. "A key finding is that despite an overall decrease in the number of nuclear warheads in 2018, all nuclear weapon-possessing states continue to modernize their nuclear arsenals.

The SIPRI Yearbook 2019 ...found that 13,865 warheads in existence at the start of 2019 were owned by nine nations: the US, Russia, the United Kingdom, France, China, India, Pakistan, Israel and North Korea. The year before hosted an arsenal of 14,465 warheads. "A key finding is that despite an overall decrease in the number of nuclear warheads in 2018, all nuclear weapon-possessing states continue to modernize their nuclear arsenals" Jan Eliasson, SIPRI Governing Board chair ambassador and former deputy secretary-general of the United Nations, said in a news release.

The US and Russia were the only nations that decreased their warhead inventory, by 265 and 350 respectively, according to the report. The U.K., China, Pakistan, North Korea and possibly Israel all increased their number of warheads, SIPRI found. India and France saw no changes to the size of their arsenals.

...One big cause of the decrease in arsenal size, according to SIPRI, is the implementation of the New START Treaty between the US and Russia, meant to reduce and set limits on ballistic missiles. The two nations produce more than 90 percent of the world's nuclear arms. The US and Russia announced in 2018 that they had met the limits of the New START Treaty. But if an extension is not implemented, the treaty will expire in 2021.

What's the US Up To? The US is in the process of

modernizing its nuclear arsenal per the Trump administration 2018 Nuclear Posture Review, which put forth measures to continue a modernization program started by the Obama administration. However, the NPR moves away from reducing nuclear weapons and instead sets a plan to develop new versions while and modifying others.

The US hopes to achieve its goals by expanding nuclear options to include low-yield nuclear weapons, which will expand capabilities associated with submarine-launched ballistic missiles. This would add to a US arsenal that already contains 1,000 gravity bombs and air-launched cruise missiles with low-yield warhead options, according to the SIPRI report. The NPR claims these new capabilities are necessary without evidence that the existing arsenal is insufficient. The SIPRI report notes that America's focus on its nonstrategic nuclear arsenal could push other nations in that same direction.

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Where does Russia Stand?

"Russia's decisions about the size and composition of its non-strategic nuclear arsenal appear to be driven by the USA's superiority in conventional forces and not by the US non-strategic nuclear arsenal or by weapons yield," according to the SIPRI report.

"Instead, pursuit of a new [submarine-launched cruise missile] to 'provide a needed non-strategic regional presence' in Europe and Asia could — especially when combined with the parallel expansion of US long-range conventional strike capabilities — strengthen Russia's reliance on non-strategic nuclear weapons and potentially could even trigger Chinese interest in developing such a capability," the report adds. SIPRI data shows Russia has about 4,330 nuclear warheads; approximately 1,830 of them are categorized as nonstrategic....China has an estimated 290 nuclear warheads. Though China is working to expand its nuclear forces, the report notes, it has said it's committed to a no-first-use policy. However, the report added that China has taken steps to improve its retaliation response.

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Rivals India and Pakistan each provide little information about the size of their nuclear arsenals. However, they have made separate statements about missile tests. India has an estimated 130-140 warheads, and Pakistan has an estimated 150-160 warheads. Both nations are estimated to have increased their arsenal by 10 to 20 warheads in the last year. North Korea has provided little transparency about it nuclear weapons capabilities, besides announcing missile tests afterward. It's estimated the country has 20-30 warheads, which would be an increase of 10-20 warheads from a 2018 estimate.

The SIPRI report cites a lack of transparency from most nations in regard to nuclear stockpiles. The US, the U.K. and France have disclosed some information about their respective arsenals. Information from other nations is mainly based on missile tests and the supply of military fissile materials.

Source: Kelsey Reichmann, https://www.defensenews. com/, 16 June 2019.

INDIA

Work Begins on India's Next Gen Nuclear-Powered Submarines

Work has started on the Rs 1 lakh crore project to produce next generation nuclear-powered submarines for the Indian Navy, with a defence public sector unit working on a special alloy for the hull. A scale model is likely to be tested soon

as part of the design process. The project to build advanced nuclear submarines designed for longrange underwater patrols and armed with conventional weapons has been granted over Rs 100 crore seed money by the government for the initial phase with of with officials predicting a development period that is expected to stretch beyond 2025. The plan to build six SSNs kicked off in 2015 when the NDA government gave a go ahead to a long-pending project for the Indian Navy. Then Navy Chief Admiral Sunil Lanba confirmed in 2017 that the project is underway.

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Sources said considerable progress has been made in the design phase of the new boats with a scale model likely to be fabricated and tested shortly. These scale model tests will be critical to check development, accuracy and quick success would mean that the Directorate of Naval Design (Submarine Design Group) is on the right track.

Defence Public Sector Unit Mishra Dhatu NigamNSE -1.03 % (MIDHANI) is also working on indigenising a new material for the hull that will be designed to dive to depths much beyond the Arihant class of indigenous nuclear-powered and armed submarines. Details of the new, more powerful nuclear reactor, which is being designed for the programme are not yet known. Sources explained that while lessons learnt from the Arihant build are being incorporated, a totally new material will be used for the SSN project given the unique requirements of the Navy for depth and speed. ...

Source: https://economictimes.indiatimes.com/, 24 June 2019.

RUSSIA

Russia Threatens Military Response to any NATO Action over Nuclear-Ready Missile

Moscow has said it will take "countervailing military measures" should NATO fulfil any threat related to Russia's nuclear-ready cruise missile system. NATO Secretary-General Jens Stoltenberg said that Russia must dismantle the short-range system, or the alliance will be forced to respond, adding that NATO-member defense ministers would now look at next steps "in the event that Russia does not comply." No detail is yet known over what NATO might do although Stoltenberg said the alliance would not engage in any arms race.

According to the Kremlin-owned news agency TASS, Russian Deputy Foreign Minister Sergei Ryabkov told reporters that NATO's comments "reek of propaganda" and were falsely attempting to portray NATO's threat as a "military and political response to Russia's actions." The translation of Ryabkov, provided by TASS, added that Russia would respond to any military action from the 29-nation alliance. "When these threats begin to materialize into real action, we will have to take countervailing military measures," he said.

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Earlier this year, the U.S. said it would quit a decades-old missile treaty with Russia if the latter failed to destroy the missile, labeled the SSC-8 by NATO. Russia's short and medium range missiles are viewed as a particular threat to neighboring countries as they can be quickly launched, leaving the target country or region with almost no response time. The 1987 INF Treaty between the U.S. and Russia sought to eliminate nuclear and conventional missiles, as well as their launchers, with short ranges (310–620 miles) and intermediate ranges (620–3,420 miles).

NATO has said Russia's SSC-8 violates those terms and that Moscow has been deploying the system at locations which threatens countries across Europe. Russia has been given until the end of August to just five weeks to scrap the system and save the treaty.

Source: David Reid, https://www.cnbc.com, 26 June 2019.

BALLISTIC MISSILE DEFENCE

EUROPE

No Alternative to BMD in Central Eastern Europe

NATO's BMD is part of the Alliance's response against the increasing threat posed by the proliferation of ballistic missiles and changes in the political climate. In central eastern Europe (CEE) a key component of this system capable of eliminating a limited ballistic missile attack—is being deployed at two bases: in Deveselu, Romania (operational) and Redzikowo, Poland (under construction). Although they are operated by US personnel, they constitute part of the overall NATO system.

In central eastern Europe (CEE) a key component of this system capable of eliminating a limited ballistic missile attack—is being deployed at two bases: in Deveselu, Romania (operational) and Redzikowo, Poland (under construction). Although they are operated by US personnel, they constitute part of the overall NATO system.

As the official name of the Deveselu/Redzikowo bases indicates (Naval Support Facility-NSF, in Deveselu, the first Aegis Ashore Missile Defense Facility), it is part of a larger system that includes ship-based Aegis assets. For the time being, only the US has the complete technology in NATO to build and operate this key BMD layer.

BMD capability in Europe combines assets commonly funded by all NATO-members and voluntary contributions provided by some NATO-member countries, including BMD assets deployed on ships (radars, communications, command-and-control systems, advanced alert and detection capabilities, missiles/launchers) and/or ground-based ones. The Deveselu component of the BMD system achieved initial operating capability almost three years ago.

The US Angle: No Threat to Russia: The US deploys the most sophisticated, multi-layered BMD system in the world. For Europe, Redzikowo and Deveselu constitute the main components of a regional BMD system. For the US they are part of a larger, global shield intended to protect US and allied interests in most European NATO-member states. The 2019 US Missile Defense Review states: "The US relies upon nuclear deterrence to address the large and more sophisticated Russian and Chinese intercontinental ballistic missile capabilities."

It implies that the BMD system deployed in Deveselu/Redzikowo cannot maintain a protective envelope against a massive ballistic missile attack with dozens of missiles launched simultaneously by an adversary. Thus, the Russian accusations that the system is aimed against them are groundless, DoD sources said. The US complains that, by deploying 9M729 missiles, Russia violates the 1987 INF Treaty. Russia denies this a and counters by saying that the US is violating the Treaty as the Mk41 launchers deployed in Deveselu and Redzikowo are capable of launching ground-to-ground missiles and thus pose a threat to Moscow.

The Russian Angle: Suspicion: Russia followed deployment of the systems in CEE with increasing suspicion. It mostly coincided with the post-2014 period, as tension between Russia and NATO increased due to events in Eastern Ukraine and the annexation of the Crimea. The Alliance stated that: "NATO missile defense is neither designed or directed against Russia and nor will it undermine Russia's strategic deterrence capabilities. It is intended to defend against potential threats emanating from outside the Euro-Atlantic area." Nevertheless, Russia deployed ballistic missiles, other assets in Kaliningrad, some 150 miles from Redzikowo.

"Russia cannot understand what tasks the Aegis Ashore system will accomplish for terrestrial use in ballistic defense. Perhaps the problem is that we understand the threats differently from the US and its allies," Sergei Riabkov, deputy minister for foreign affairs was quoted by TASS news agency as saying. Riabkov added: "It is also unclear for Russia how the US can guarantee that the universal Mk41 launchers included in the Aegis

Ashore system [in Deveselu and Redzikowo] will not be used to launch ground-to-ground missiles. We have often discussed this issue with our American colleagues during the INF negotiations."

Valery Gerasimov, Russian chief of general staff and first deputy defense minister on INF talks and the controversial Mk41 launcher issue, said, "Indeed the Russians point to something that is theoretically possible." The construction of the Mk41 land-based vertical launchers allows containers with BGM-109 Tomahawk cruise missiles to be put into their slots without major problems, according to Polish defense portal defence24.

In March 2018 Poland signed a contract with the US to buy MIM-104 Patriot missile systems, hosting the second BMD layer in the country. They will form the basis of the Wisla medium-range air defense program. The Polish defense ministry announced in May 2019 that it ordered 73 Jelcz vehicles to be integrated with the Patriot air defense system.

The Polish Angle: Go On with BMD Deployment: In March 2018 Poland signed a contract with the US to buy MIM-104 Patriot missile systems, hosting the second BMD layer in the country. They will form the basis of the Wisla medium-range air defense program. The Polish defense ministry announced in May 2019 that it ordered 73 Jelcz vehicles to be integrated with the Patriot air defense system. The contract value is approximately PLN171 million ($44 million).

Once in place, NATO's Allied Air Command will assume operational control of the unit, US European Command (EUCOM) said. Romania has bought MIM-104 Patriot systems. Together with Poland, Romania constitutes the backbone of CEE ballistic missile defense with the Aegis Ashore envelope protecting not only CEE but most of Western Europe.

In the first stage, in 2021 to 2022, Poland will receive two Patriot batteries with Raytheon's PAC-3 Missile Segment Enhancement (MSE) missiles—the latest version, dedicated almost entirely to the anti-ballistic mission, and the Northrop Grumman Integrated Air and Missile Defense Battle Command System (IBCS). According to sources familiar with the deal, Polish companies will produce components for launchers, transport vehicles, and communication systems.

Romania: Backbone of CEE BMD: The Deveselu facility is scheduled to undergo technical work during a temporary shutdown. The US deployed a THAAD missile defense system to Romania to maintain cover while technical work is underway on the Aegis Ashore Ballistic Missile Defense site. Once in place, NATO's Allied Air Command will assume operational control of the unit, US European Command (EUCOM) said. Romania has bought MIM-104 Patriot systems. Together with Poland, Romania constitutes the backbone of CEE ballistic missile defense with the Aegis Ashore envelope protecting not only CEE but most of Western Europe.

Europe-US Tension: In the context of the current tension between Europe, the EU, and the US an April 2019 study published by the London-based International Institute for Strategic Studies dealt with the hypothetical scenario of the US leaving NATO. The question is if that would lead the two US missile defense facilities in Romania and Poland to close down or be reactivated with European NATO personnel.

And would the latter be achieved by European hardware and/or a mixed US-European team under European leadership using US-manufactured equipment based on multi- or bilateral agreements? In short, is there a way for Europe short-term to replace the two American systems in Poland and Romania plus the Turkey facility supporting the two Aegis Ashore BMD-installations?

Source: Peter Dunai, https://www.ainonline.com/ , 22 June 2019.

NUCLEAR ENERGY

CHINA

China Eyes 30 "New Silk Road" Nuclear Reactors by 2030

A senior Chinese official and former chairman of the state-owned China National Nuclear Corporation, Wang Shoujun, said that the country

needs to give more support to its nuclear programs and take advantage of "the opportunities provided by the Belt and Road Initiative (BRI)," according to RT. Shoujun said at the China People's Political Consultative Conference: "Going with nuclear power has already become a state strategy, and nuclear exports will help optimize our export trade and free up domestic high-end manufacturing capacity."

Shoujun added that the country needs to improve research and development of its nuclear sector, as well as localize the production of key nuclear power components. His aim is to grow both the domestic and foreign nuclear markets to "make the most of the country's comprehensive advantages in costs and technology." He also said that the country could build as many as 30 overseas nuclear reactors over the next decade as part of the BRI, which projects could bring in more than $145.5 billion to China by 2030. 41 BRI nations already have nuclear power programs or are planning to develop them. Shoujun says China only needs a 20% market share to create 5 million new jobs in the sector. The country's "new Silk Road" BRI megaproject was announced 6 years ago by President Xi Jinping and covers 152 countries in Europe, Asia, the Middle East and Africa. ...

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Source: ZeroHedge, https://oilprice.com, 25 June 2019.

GENERAL

Speech: The Sustainability of Used Nuclear Fuel Management

World Nuclear Association's working group on Sustainable Used Fuel Management promotes sound, safe, sustainable and proliferation-proof used fuel management. Its mission is to shape industry positions with a view to engaging in the international debate on sustainable management strategies for the back end of the fuel cycle. Addressing the theme of the conference, learning from the past, enabling the future, one can say that this aligns with the working group's activities of collecting, analysing and distributing leading practice from the past and present, and using it to generate recommendations for the future.

Perhaps the main message from the past is that nuclear energy is an environmentally responsible power generating source that is aligned to the 'polluter pays' principle. This ensures that nuclear operators make adequate financial provisions to responsibly manage and dispose of radioactive waste and used fuel. Used fuel management should be conducted in accordance with five defined areas that conform with international requirements:

- It must be demonstrated to a practical extent that chosen options for used fuel management are technically feasible;
- A used fuel management strategy must be applicable to present needs while also providing adequate protection to human health and the environment;
- All areas of used fuel management, from generation up to and including ultimate fuel disposal, should be performed in accordance with a well-defined plan;
- Realistic financing models should be established to cover all potential foreseen and unforeseen costs through the entire used fuel management programme;
- The used fuel management programme considered today must not inflict a greater impact on the health of future generations than current accepted standards and practices allow.
- Accompanying this is a need for political and regulatory stability.

Upon removal from the reactor core, used fuel embarks on the final stage of its life cycle, with the nuclear industry implementing various strategies based on government policy to ensure

a safe and cost-effective overall management, which is divided into two tracks: the open cycle and the closed cycle.

There is presently a broad consensus among technical experts that the preferred method of ensuring long-term safety for high-level waste and used fuel is isolation in a deep geological repository, a solution used for other forms of toxic waste. Geological disposal facilities for long-lived waste, if properly sited and constructed, will provide passive multi-barrier isolation of radioactive materials.

Unlike other sources of power generation, such as coal and natural gas, used fuel may be recycled (reprocessed) to provide added value as an additional energy resource. Currently, the countries which operate reprocessing facilities are France, India, and the Russian Federation. The UK previously operated reprocessing facilities for light water reactor fuel until recently (closed in 2018) and will still operate the Magnox reprocessing plant until around 2020. China is operating a pilot plant and is looking to deploy an industrial facility. Japan is planning to commission in 2021 its Rokkasho-Mura plant. India, too, has and is developing reprocessing facilities for both thermal and fast reactor used fuel. Russia is developing new reprocessing technologies and is increasing its reprocessing capacity.

Currently, the countries which operate reprocessing facilities are France, India, and the Russian Federation. The UK previously operated reprocessing facilities for light water reactor fuel until recently (closed in 2018) and will still operate the Magnox reprocessing plant until around 2020. China is operating a pilot plant and is looking to deploy an industrial facility. Japan is planning to commission in 2021 its Rokkasho-Mura plant.

Used nuclear fuel has been, and is still, successfully transported by truck, rail and ship using specially designed casks. To date this transport has been to reprocessing plants and to centralised interim storage facilities. The transporting of used nuclear fuel is a well-proven activity based on meticulous planning. To date it has enjoyed an excellent safety record, something the industry attaches immense importance to maintaining.

Until a deep geological repository is operational, used nuclear fuel, if not reprocessed, will have to be placed in interim storage at the reactor site or in a centralised facility. While interim storage is technically feasible, it does raise a concern that this storage of the fuel is not the final solution for it. This is why IAEA Member States should proceed with siting, constructing and operating a deep geological repository without unnecessary delay. Or they should consider used fuel reprocessing.

And if we look at the data in the IAEA's Status and Trends Report, and indeed this is backed up by the Sustainable Used Fuel Management working group's own survey in 2017, the start of final disposal is not imminent. Projects in France, Sweden and Finland are the most advanced: countries where engaging and communicating across a wide range of audiences and platforms to engage citizens in developing deep geological repository projects. Again, referring to the theme of the conference, there are lessons from the past that can enable the future.

Keeping on the communications theme, it should be mentioned that the accumulation of used fuel is seen by many as a significant reason to oppose nuclear energy - notwithstanding the proven solutions that exist. In this context, the IAEA, OECD-Nuclear Energy Agency and European Commission should be commended for their collaborative publication: Status and Trends in Spent Fuel and Radioactive Waste Management, which dispassionately explains the status quo with regard to used fuel, and in an accessible way. World Nuclear Association was proud to have been invited to be part of the steering committee for this publication.

Showing the ability to successfully manage used nuclear fuel will help ensure nuclear energy is able to continue to play an important function to

decarbonise our electricity generation to protect people and the planet from the dangers of air pollution and climate change. To meet the growing demand for sustainable energy, we will need nuclear to provide at least 25% of electricity by 2050 as part of a clean and reliable low-carbon mix. Achieving this means nuclear generation must triple globally by 2050. The Harmony programme is a global initiative of the nuclear industry that provides a framework for action, working with key stakeholders so that barriers to growth can be removed.

Showing the ability to successfully manage used nuclear fuel will help ensure nuclear energy is able to continue to play an important function to decarbonise our electricity generation to protect people and the planet from the dangers of air pollution and climate change. To meet the growing demand for sustainable energy, we will need nuclear to provide at least 25% of electricity by 2050 as part of a clean and reliable low-carbon mix.

While we can claim to have solutions today to manage used fuel, we can never stand still. Striving for continuous improvement is the only guarantee of sustainability. The global nuclear industry is continually innovating to promote enhanced fuel performance, along with better management of radioactive waste while augmenting the nuclear safety culture. These advancements achieved today will provide the impetus for tomorrow's improvements in nuclear energy and radioactive waste management.

There is a natural progression of innovation solutions in the nuclear industry and for used fuel management. These solutions may include the development of multi-national repositories, development of enhanced fuels and reactors designs, additional or advanced recycling capabilities and services, enhanced interim storage and transportation systems, etc.

In conclusion, it must be recognised that the infrastructures and technologies are available to provide for the efficient and safe management of radioactive waste and used nuclear fuel. While the timeline varies from country to country when a deep geological repository will be sited, constructed and operational, there are adequate interim storage methods available to store used nuclear fuel until such time these facilities become operational. However, one must caution that unnecessary prolonged delays will erode public confidence that used fuel can be satisfactorily managed and potentially undermine nuclear power's role in combating climate change.

continued delay in siting, constructing and operating a deep geological repository has the potential to erode public confidence. The global nuclear industry has full capacity to mitigate both foreseen and unforeseen risks and uncertainties, all while it continues to develop implementable innovative used fuel management programmes to constantly increase efficiency and safety.

The industrial infrastructures and technologies are readily available (or planned) to assist in the efficient and safe management of all stages of used fuel cycle. Proposed timelines for the operation of deep geological repositories varies from country to country, but interim methods are available or being enhanced to safely store used nuclear fuel until such time these foreseen facilities are operational. However, continued delay in siting, constructing and operating a deep geological repository has the potential to erode public confidence. The global nuclear industry has full capacity to mitigate both foreseen and unforeseen risks and uncertainties, all while it continues to develop implementable innovative used fuel management programmes to constantly increase efficiency and safety.

Source: Mikhail Baryshnikov and Cecile Evans, chair and deputy chair of the Sustainable Used Fuel Management Working Group. World Nuclear News, 26 June 2019.

SWEDEN

Paradigm Shift as Swedes' Support for Nuclear Power Soars

Despite suffering major dents following accidents in Harrisburg, Chernobyl and Fukushima, public support for nuclear power in Sweden has reached a new peak, while also signalling a divide between left-wing and right-wing voters. An overwhelming majority of Swedes want to keep the nuclear power plants currently in operation. The support for new nuclear power plants is also on the rise, and is now two times larger than the support for phasing out nuclear power, a recent survey from pollster Novus has shown.

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Despite numerous environmental efforts and political campaigning by the left-of-the-centre parties currently in power, seven out of ten Swedes want to keep nuclear power. Four in ten also want to build new plants. By contrast, support for phasing out nuclear power is only at 16 percent, whereas another 13 percent are uncertain.

In a similar study from November 2017, only three in ten Swedes wanted to expand nuclear power, whereas two in ten wanted to get rid of it altogether. The support for nuclear power is thus back to its highest level, previously measured in 2010. From 2011 onward, the support for nuclear power plummeted in connection with the Fukushima accident, and only recently started to recover. According to Novus, this is the third consecutive survey that shows increasing support for the construction of new NPPs.

The support for nuclear power is the lowest among the left-of-the-centre voters of the Social Democrats, the Left and the Greens. There, the idea of a fossil free society has the most supporters, although many scientists argue it is only realistically possible through expansion of nuclear power. By contrast, the support for nuclear power is considerably higher among right-of-the-centre voters, despite the fact that they don't support the idea of immediately phasing out fossil fuels for the sake of the environment.

Sören Holmberg, professor emeritus in political science at the SOM Institute at Gothenburg University, has attributed the spike to the Christian Democrats' proposal to expand nuclear power in the run-up to the 2018 election. He also stressed a striking dichotomy in Swedes' attitudes, which is a relative novelty in the nuclear power debate.

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...For a long time, resistance to nuclear power was greater than the support for it, not least after the Chernobyl catastrophe in 1986. Around the turn of the millennium, however, popular opinion turned more nuclear-positive. According to Sören Holmberg, support for nuclear power reached its peak in 2010, but nosedived following the Fukushima disaster.

Sweden currently has eight nuclear power reactors providing about 35 percent of its electricity. In 1980, following the nuclear accident in Harrisburg, US, the Swedish government decided to phase out nuclear power. The country's 1997 energy policy prolonged the

operating life of existing reactors. Nevertheless, the Barsebäck NPP was closed in 2005, despite the fact that 94 percent of the residents wanted it to stay. Sweden also has a tax discriminating against nuclear power, which makes up about one-third of NPPs operating costs. By contrast, wind and biomass power plants are heavily subsidised.

Source: https://sputniknews.com/, 24 June 2019.

NUCLEAR COOPERATION

SOUTH KOREA–UAE

South Korean Consortium, UAE's Nawah Sign Maintenance Deal for Barakah Nuclear Plants

South Korean consortium, UAE's Nawah sign maintenance deal for Barakah nuclear plants...signed a five-year deal with UAE's Nawah Energy to maintain Barakah nuclear power plants, South Korea's energy ministry said...under the deal, the consortium of Korea Hydro & Nuclear Power and KEPCO KPS will be in charge of conducting maintenance on four nuclear power plants that are being built in Barakah by state-run KEPCO. The deal could be extended upon agreement between the UAE nuclear operator Nawah and the South Korean side, the ministry said in a statement. The first of four Barakah nuclear reactors is expected to start operations between the end of 2019 and early 2020....

This type of reactors allows less on-site construction, have higher efficiency and higher nuclear security, according to the press release of Energoatom. According to the data provided by Energoatom, the estimated value of the global SMR market by 2025 will be approximately 1 trillion US dollars.

Source: https://energy. economictimes. indiatimes. com/, 24 June 2019.

USA–UKRAINE

Ukraine, US Sign Partnership Agreement on Small Modular Reactors

A partnership agreement between energy enterprises of Ukraine and the US had been signed, according to a press release published by the National Nuclear Energy Generating Company of Ukraine. The agreement was signed between Energoatom, Ukraine's national nuclear consultant State Scientific and Technical Centre for Nuclear and Radiation Safety (SSTC-NRS), and US company Holtec International at the Holtec International headquarters in Camden, in the US state of New Jersey. The agreement established an international consortium to explore the environmental and technical feasibility of SMR-160 SMR system that can be built and operated at any site in the country while assuring public health and safety.

SMR is a type of nuclear reactor which is smaller than conventional reactors and can be brought to a site to be assembled. This type of reactors allows less on-site construction, have higher efficiency and higher nuclear security, according to the press release of Energoatom. According to the data provided by Energoatom, the estimated value of the global SMR market by 2025 will be approximately 1 trillion US dollars. Ukraine is heavily dependent on nuclear energy, with 15 reactors of four nuclear power plants generate about half of Ukraine's electricity.

Source: http://www.xinhuanet.com/, 12 June 2019.

NUCLEAR NON-PROLIFERATION

IRAN

Iran to Scale Back Nuclear Deal Compliance Unless Europe Moves – Diplomat

Iran may further scale back compliance with its nuclear deal soon unless European countries shield it from U.S. sanctions through a trade mechanism, the head of Tehran's Strategic Council on Foreign Relations was quoted as saying.... Tehran said in May 2019, it would reduce compliance with the nuclear pact it agreed with world powers in 2015 in protest at the US' decision to unilaterally pull out of the agreement and reimpose sanctions last year.

"If Europeans don't take measures within the 60-day deadline (announced by Iran in May), we will take new steps," the semi-official news agency ISNA quoted Kamal Kharazi as saying. "It would be a positive steps if they put resources in (the planned European trade mechanism) Instex and ...make trade possible."

Source: https://af.reuters.com/, 23 June 2019.

Iran is about to Exceed Uranium Limits. Is the Nuclear Deal Dying?

Iran is on the verge of crossing a key line included in the nuclear deal it reached with the U.S. and other powers in 2015. ...soon it's expected to announce that its uranium stockpiles have exceeded limits set by the deal. "I think it's a major bridge for them to go across," says David Albright, president of the Institute for Science and International Security, which monitors Iran's nuclear program. Albright and other experts believe that breaching the limit could spell the beginning of the end for the nuclear agreement, which the U.S. exited in May 2018.

The nuclear deal is full of numbers and figures, but its purpose is simple: to slow down Iran's nuclear program. Before the deal, Iran was within a few weeks of getting enough highly enriched uranium for a nuclear bomb if it chose to. The deal pushed that timeline back from weeks to about a year.

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Under the multilateral Joint Comprehensive Plan of Action, Iran was forced to get rid of lots of low-enriched uranium. Low-enriched uranium is kept at levels far below the 90% level considered suitable for building nuclear weapons. But large quantities of low-enriched uranium can be refined to bomb-grade relatively quickly. So the deal capped Iran's stockpile of low-enriched material to just 300 kilograms, or 661 lbs.

But that was then. Last year, President Trump pulled out of the deal. Without the economic benefits Iran was promised in exchange for limiting its nuclear program, it has begun going back on the agreement. In May, it announced it would begin accumulating more low-enriched uranium. "We will exceed the 300-kg limit," Behrouz Kamalvandi, the spokesperson for the Atomic Energy Organization of Iran, told reporters. By the organization's calculations, Iran will cross the line on June 27.

Albright says from a technical perspective, crossing the line is not that big a deal. Low-enriched uranium cannot be directly turned into a weapon. "Not much is going to change," he says. "They're going to have to produce around a ton, or a thousand kilograms, before you really start to get nervous." But the 300-kg limit is not the only number in the agreement. Iran has warned it will begin crossing other lines in coming weeks as well.

A big part of why things are falling apart now goes back to the sanctions the U.S. reimposed last year. They punish anyone who does business with Iran, including companies in other places that remain in the agreement: Europe, China and Russia.

It plans to increase the levels at which it enriches its uranium fuel, and to walk back modifications it planned to make to a key nuclear reactor at Arak. "With the threats now that Iran might start violating some of the core principles of the deal, this deal that's been on life support might be dead," says Corey Hinderstein, the Nuclear Threat Initiative's vice president of international fuel cycle strategies. ... She says that a big part of why things are falling apart now goes back to the sanctions the U.S. reimposed last year. They punish anyone who does business with Iran, including companies in other places that remain in the agreement: Europe, China and Russia.

European companies had hoped to do business

with Iran. But in the face of U.S. sanctions, "We've seen those companies have to step back and say, 'We can't afford to lose the U.S. market,' " Hinderstein says. Iran is now stepping across one line in the deal at a time, in an effort to pressure European nations to provide promised economic relief. European negotiators are racing to complete a package of humanitarian aid by early July, says Aniseh Bassiri Tabrizi with Great Britain's Royal United Services Institute. "They are working towards that end goal, to showcase to the Iranians that they are actually working in practical terms to address some of these issues," Tabrizi says.

If that aid — which includes things like medical supplies — can be delivered without U.S. objection, then it may open the possibility of more economic benefits flowing to Iran. But Tabrizi says it remains to be seen whether it will be enough. "Iran has made it clear that it needs also to be able to continue to export its oil, to see the incentive of remaining a party of the nuclear deal," she says. For now, Hinderstein says, Iran is still about a year away from getting material together for a bomb — should it decide to do so. "We still have some time to work with," she says. But with each line that Iran crosses, the timeline shrinks, and the nuclear deal fades further.

The nuclear deal is full of numbers and figures, but its purpose is simple: to slow down Iran's nuclear program. Before the deal, Iran was within a few weeks of getting enough highly enriched uranium for a nuclear bomb if it chose to. The deal pushed that timeline back from weeks to about a year.

Source: Geoff Brumfiel, https://www.npr.org, 26 June 2019.

NUCLEAR PROLIFERATION

NORTH KOREA

N Korea Not Ready to Denuclearise: US Intelligence Agency Chief

The US intelligence community does not believe North Korean leader Kim Jong Un is ready to denuclearise, US DIA Director- Lieutenant General Robert Ashley told Fox News ..."We still continue to assess within the intelligence community that Kim Jong Un is not ready to denuclearise," Ashley said. Trump will visit South Korea...after an exchange of letters with Kim boosted hopes for a resumption of talks aimed at ending North Korea's nuclear programme. The US is demanding that North Korea abandon its nuclear weapons entirely before international sanctions are lifted. North Korea is seeking a step-by-step approach.

Trump is set to arrive in South Korea for a two-day visit ...and will meet President Moon Jae-in on 30 June 2019 following a summit of G20 leaders in Japan....The announcement came hours after US Secretary of State Mike Pompeo said he hoped a letter Trump sent to Kim could pave the way for a revival of talks that have been stalled since February 2109 failed summit in Vietnam.

...North Korean state media said Kim and Xi discussed the political situation surrounding the Korean Peninsula and reached unspecified consensus on important issues. Xi is expected to meet Trump during the G20 summit and analysts say the Chinese president intends to use his trip to North Korea as a way of signalling to Trump his influence with Kim.

Source: https://www.aljazeera.com/, 25 June 2019.

NUCLEAR SECURITY

EU–USA

EU and US Hold CBRN Capacity Building Dialogue

The EU and the US held a CBRN Capacity Building Dialogue on 14- 15 May, 2019 in Brussels, Belgium, to coordinate efforts in reducing WMD threats and strengthen CBRN security globally. In a globalized world, where the free movement of persons and goods is increasing, the risk of transnational CBRN threats is increasing as well. Differing national approaches to CBRN preparedness may leave gaps that state and non-state actors could exploit to traffic or use WMD and related materials.

As such, the EU and the US have been actively

administering programs that assist third countries in building capacity to prevent, detect, and respond to WMD threats as well as implement strategic trade controls. The May 14-15 Dialogue enabled a constructive exchange of information, facilitated closer coordination between the two sides on their respective programmes and projects, and prioritized areas for collaboration.

The dialogue was chaired by Eddie Maier, Directorate-General for International Cooperation and Development (DEVCO) for the EU, and Renee Sonderman, Bureau of International Security and Non-proliferation (ISN), US Department of State for the US. The EU delegation included representatives from the European External Action Service (EEAS) and the Joint Research Centre. The US delegation included representatives from the Departments of State, Defense, and NNSA.

Source: Statement by the Bureau of International Security and Nonproliferation – USA. https://www.state.gov/, 11 June 2019.

NUCLEAR SAFETY

AUSTRALIA

Two Workers Exposed to Unsafe Radiation dose at Lucas Heights Nuclear Facility

Production has ceased and an urgent investigation has been launched after two employees at a newly opened Australian nuclear medicine facility at Lucas Heights were exposed to an unsafe dose of radiation. Just two weeks after it was granted a licence to enter into full domestic production, the Australian Nuclear Science and Technology Organisation (Ansto) has confirmed production at its new $168m nuclear medicine facility has been halted after "a safety incident".

Three of its workers were "attended to by radiation protection personnel" after the incident, in which contamination was detected on the outside of a container holding 42 millilitres of the radioisotope molybdenum-99 (Mo-99). Two of those workers received a radiation dose above the legal limit roughly equivalent to a conventional cancer radiation therapy treatment.

Ansto said three of its workers were "attended to by radiation protection personnel" after the incident, in which contamination was detected on the outside of a container holding 42 millilitres of the radioisotope molybdenum-99 (Mo-99). Two of those workers received a radiation dose above the legal limit roughly equivalent to a conventional cancer radiation therapy treatment, an Ansto spokesman said. Fault at Lucas Heights nuclear reactor halts production of medical isotope

..."Early calculations indicate that the radiation dose received by two of the workers involved in medicine processing was equivalent to that of a conventional radiation therapy treatment...Located at the Lucas Heights nuclear facility in Sydney's south, the $168m nuclear medicine facility was announced by the federal government in 2012 with the goal of tripling Australian production of Mo-99, the parent isotope of Technetium-99m. The isotope is used in hospitals and nuclear medicine centres to diagnose a variety of heart, lung, organ and musculoskeletal conditions. The facility only received approval to enter into full domestic production on 13 June 2019.

It is the second contamination scare at the Lucas Heights facility in only a few months. In March 2019 three staff at the Lucas Heights nuclear facility were taken to hospital after they were exposed to sodium hydroxide when a cap came off a pipe in the nuclear medicine manufacturing building.

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Source: Michael McGowan, The Guardian, 24 June 2019.

CHINA

Chinese Nuclear Power Plants Open Up to Public to Prove Confidence in Safety

Honghe Hope Junior High School has a special course - every freshman must learn some basic knowledge about nuclear power in their first year in school. The school is just a 10-minute drive from Hongyanhe Nuclear Power Plant, located in a suburb of Dalian, Northeast China's Liaoning Province. The plant, operated jointly by China General Nuclear, State Power Investment Corporation Limited (SPIC) and the Dalian government, started to generate power in 2013.

In recent years, the nuclear power industry in China has become increasingly open. This confidence comes from the strict management and high level of safety measures during production. By 13 June 2019, the Chinese mainland has 47 nuclear reactors in operation. Eleven reactors are now under construction, according to statistics from the website of China's National Nuclear Safety Administration. Nuclear electricity production accounted for 4.22 percent of the country's total energy in 2018.

The school, which is administered by Wafangdian city under Dalian, had been running in the area long before the nuclear power plant began construction in 2007. When plans to build the nuclear power plant were announced in the early years of the century, some residents were fearful.

...To dispel people's misunderstanding, the Hongyanhe Nuclear Power Plant Company and Wafangdian education bureau together compiled a textbook to explain the science behind nuclear power. The nuclear power course was launched in the spring of 2013, and in September of that year, the course has been adopted by all 31 schools in Wafangdian.

Each year, more than 6,000 students would learn about the necessity to develop nuclear power and why it is safe. At the end of the course, they will be given the chance to visit the nuclear power plant and see how it worked with their own eyes. "When the children learned what nuclear power is, they could teach their parents," Jiang said, "Now many local residents actually work in the plant."

Wafangdian's course is a successful case of Hongyanhe trying to show the facts about nuclear power plants, which used to be seen as mysterious and even frightening to the public. In recent years, the nuclear power industry in China has become increasingly open. This confidence comes from the strict management and high level of safety measures during production. By 13 June 2019, the Chinese mainland has 47 nuclear reactors in operation. Eleven reactors are now under construction, according to statistics from the website of China's National Nuclear Safety Administration. Nuclear electricity production accounted for 4.22 percent of the country's total energy in 2018, according to China's Blue Book on Nuclear Energy. In 2018, no nuclear events above Level 1 on the International Nuclear Event Scale occurred in China. China's first nuclear power unit, Qinshan 1 in East China's Zhejiang Province, was integrated into the national grid network in 1991.... China's Nuclear Safety Law, which came into effect on January 1, 2018, demands that governments disclose information on nuclear safety and let the public know about significant nuclear events that concern public interest. ...

Source: Shan Jie in Dalian and Yantai, http://www.globaltimes.cn/, 17 June 2019.

NUCLEAR WASTE MANAGEMENT

FINLAND

World's First Underground Nuclear Waste Storage Moves Forward in Finland

Finland's plan to establish the world's first underground nuclear waste disposal tool a step forward when its builder Posiva announced a 500-million-euro ($569.55 million) investment in facilities needed for nuclear waste burial. Posiva, owned by Finnish utilities Fortum and Teollisuuden Voima, plans to bury used nuclear fuel around 400

meters (1,312 feet) deep in Onkalo bedrock on Olkiluoto island, some 230 km northwest of Helsinki.

Finland's government has already granted a construction license for the above-ground encapsulation plant and disposal facility Posiva needs to treat the highly radioactive waste before taking it to the underground waste repository. "We expect to award contracts for the most significant works in the near future," Posiva President Janne Mokka said in a statement. He estimated the facilities could be operational by mid 2020s. In Posiva's disposal process, the waste will be packed in sealed copper canisters before being transferred into tunnels and further into deposition holes lined with bentonite buffer.

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Finland is not alone in trying to solve the problem of its accumulating nuclear waste. The IAEA estimates that there is now a global stockpile of around a quarter of a million tonnes of highly radioactive spent fuel in some 14 countries. "The majority of this spent fuel remains in cooling pools at reactor sites that lack defense-in-depth such as secondary containment and are vulnerable to loss of cooling, and in many cases lack independent back-up power" ....

The scheme for the storage of spent fuel in a nuclear power plant was two-fold — one facility is located within the reactor building/service building, generally known as the spent fuel storage pool/bay, and the other is located away from the reactor, called the AFR Spent Fuel Storage Facility, but within the plant's premises.

Source: https://www.reuters.com, 25 June 2019.

INDIA

Away-From-Reactor (AFR) Facility Safe

...While anti-nuclear groups are opposing the proposal to set up an 'Away From Reactor' facility on the premises of the KKNPP, ahead of a scheduled public hearing on 10 July 2019, the KKNPP Director has allayed apprehensions that the facility would harm the residents. In a statement, Sanjay Kumar, Site Director, KKNPP, said all nuclear power stations in operation in India and other countries had facilities to store new as well as spent (used) fuel. The scheme for the storage of spent fuel in a nuclear power plant was two-fold — one facility is located within the reactor building/service building, generally known as the spent fuel storage pool/bay, and the other is located away from the reactor, called the AFR Spent Fuel Storage Facility, but within the plant's premises.

The AFR Spent Fuel Storage Facility is not needed from day one and can be constructed as and when a need arises. There are two AFRs in operation at Tarapur near Mumbai in Maharashtra and one at Rawatbhata near Kota in Rajasthan. An AFR is being constructed at Rawatbhata.

The spent fuel storage pool inside the reactor building has a limited capacity and is used for immediate storage of the spent fuel removed from the reactor during refuelling. The fuel remains in the pool initially for a few years for it to be cooled sufficiently before it is shifted to the facility. The AFR Spent Fuel Storage Facility is functionally similar to the 'Spent Fuel Pool' inside the reactor building, except in terms of capacity.

"AFR design is specific to fuel type. The proposed AFR facility is designed for storing spent fuel discharged from reactors at Kudankulam Units 1 and 2 and cannot be used for storing spent fuel from other reactors elsewhere in India whose design is different. The proposed AFR facility at KKNPP reactors 1 and 2 is for storage of spent fuel only and not for storage of nuclear waste, as perceived by a few. The requirements for spent

fuel storage and waste management are different," the official said.

"The design ensures that there would not be any adverse impact of the facility on the personnel, the public and the environment. The radiation dose on account of AFR to the public would be negligible, even [when] compared to the exposure from natural radiation background sources like soil, sun etc. This has been established at the Tarapur and Rawatbhata sites, where AFRs have been in operation for many years," Mr. Kumar said.

Source: The Hindu, 14 June 2019.

Centre for Air Power Studies

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

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

Edited by: Director General, CAPS

Editorial Team: Dr. Sitakanta Mishra, Hina Pandey, Anushree Dutta, Dr. Poonam Mann, Wg Cmdr Kaura, Sreoshi Sinha

Composed by: CAPS

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