RSIS S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES
Nanyang Technological University, Singapore

RSIS COMMENTARY

www.rsis.edu.sg No. 104 – 29 July 2024



# Keeping Non-Proliferation Intact while Combatting Climate Change

*By Alvin Chew and Olli Heinonen*

## SYNOPSIS

*Safety, Security, and Safeguards, commonly known as the 3S, is an integrated conceptual framework promulgated by the International Atomic Energy Agency for the civilian application of nuclear energy. With the development of new nuclear technologies and as more countries express interest in adopting nuclear energy, it is even more crucial to strengthen the 3Ss so that nuclear energy can be a viable solution to combat climate change.*

## COMMENTARY

There are currently thirty-two countries operating civilian nuclear power plants. This figure is set to increase as several newcomer countries have decided to incorporate nuclear energy into their energy mixes, primarily for energy security and to replace fossil fuels to curb carbon emissions. For developed countries such as Japan, nuclear energy not only produces clean electricity but also has the potential to produce clean hydrogen, which can further help to decarbonise hard-to-abate sectors of their economies. Other new applications are water desalination, heat production for industrial processes, and maritime use of reactors.

While climate change could drive a possible nuclear renaissance, many countries are also attracted to the prospect of Small Modular Reactors (SMRs) with advanced technologies and design features that will make nuclear reactors safer and more secure. The International Atomic Energy Agency (IAEA), in an effort to align nuclear energy with the United Nations Sustainable Development Goals (SDGs), has been successful in promoting the critical role of civilian nuclear energy in combatting climate change.

## A Nuclear Watchdog

Nuclear technology not only has to be safe and secure but it also has to be safeguardable to ensure that fissile materials remain within the domain intended for peaceful purposes. This is because fissile materials in civilian nuclear application can be diverted to the development of nuclear weapons. Therefore, steps must be taken to regulate the flow of nuclear materials.

Following US President Dwight Eisenhower's "Atoms for Peace" speech at the United Nations General Assembly in 1953, the IAEA was established in 1957 as a body to promote the peaceful use of nuclear technology. To achieve this mission, the IAEA needs to regulate global civilian nuclear activities to ensure that nuclear materials will not be diverted for military purposes.

The Non-Proliferation Treaty (NPT), entered into force in 1970, and the IAEA has been entrusted with the mandate of safeguarding nuclear materials within civilian applications. Its role as a nuclear watchdog underpins its international reputation as the "Atoms for Peace" organisation. To this day, the IAEA carries out inspections of all civilian nuclear activities and facilities via safeguard agreements with its member states.

## Safeguards Compliance

The NPT, with 191 signatories, divides the world into Nuclear Weapons States (NWS) and Non-Nuclear Weapons States (NNWS). China, France, Russia, the UK, and the US are the five countries accorded NWS status because they had tested the nuclear bomb before 1967. All other signatories are classified as NNWS.

Article 3 of the NPT requires every NNWS to conclude safeguards agreements with the IAEA to prohibit the diversion of nuclear materials from peaceful to non-peaceful uses. In addition, two states with nuclear weapons, India and Pakistan, are non-signatories to the NPT but have placed some of their civilian nuclear installations under the IAEA safeguards.

The IAEA safeguards apply to nuclear fuel "from cradle to grave", i.e., from uranium ore concentrate, through various stages of nuclear fuel manufacturing, their use in reactors, recycling of uranium and plutonium, to final disposal of the nuclear waste. At the onset, the amount of fuel to be loaded into the reactor has to be accounted for.

Until now, conventional light water reactors have used mainly low-enriched uranium of up to 5 per cent of the U-235 isotope. However, many SMRs that are more compact yet designed to operate with longer fuel cycles will require higher levels of enrichment. Some new reactor concepts require fuel enriched up to 20 per cent of U-235, which raises new proliferation concerns. If uranium is enriched to a level of 20 per cent of U-235, one has, at that stage, made almost 90 per cent of the effort to produce weapons-grade uranium. This development, therefore, calls for the enhancement of the IAEA verification regime at uranium enrichment plants.

The push by the nuclear industry to develop advanced Generation IV reactors, such as the Molten Salt Reactor (MSR), promises the commercial market "inherently safe"

options over the conventional light water reactors presently in operation. Coupled with the possibility of siting them underground, these reactors are also more secure from sabotage and terrorist attacks.

Nevertheless, the amount of plutonium left in the spent fuels that could be used in conventional light water reactors is well-established, and the IAEA inspectors can verify the exact quantity in the spent fuel elements. However, there is yet no known methodology, that meets the IAEA verification goals, to ascertain the exact quantity of plutonium in some advanced reactors, such as the MSR.

## Implications for ASEAN

Some countries in Southeast Asia, including Indonesia and the Philippines, are deemed to have the potential to harness nuclear power for electricity generation. As the region is committed to curbing its carbon emissions, the nuclear option is considered viable for these countries.

While smaller reactors are likely to be the preference for newcomer countries, there is also great interest in advanced reactor technology marketed as safer and more secure. However, the safeguard requirements to control the proliferation of nuclear weapons cannot be overlooked. It should be noted that all the ASEAN member states are signatories to the NPT.

In addition, SMRs are being considered for use in maritime applications, notably for maritime propulsion, replacing conventional marine oil, which emits considerable amounts of greenhouse gases. If they are used, these nuclear-propelled vessels may visit countries that do not have nuclear power plants and limited infrastructure, which would require further development of the IAEA's international nuclear safety, security and safeguards regime.

## Conclusion

Nuclear energy has undoubtedly emerged as a viable option to tackle the global impacts of climate change. The nuclear industry is now abuzz with the development of advanced reactor technologies that are safer and more secure. However, for nuclear technologies to be widely adopted, they need to be developed in tandem with the IAEA, and nuclear regulators need to be provided with updates of the 3S for these newer reactor technologies.

In dealing with climate change, the world must not forget the potential proliferation of nuclear weapons arising from poor regulation of the use of nuclear energy.

*Alvin Chew is a Senior Fellow at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore. Olli Heinonen is a Distinguished Fellow at the Stimson Center in Washington, D.C., and former Deputy Director General of the International Atomic Energy Agency (IAEA).*