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Nuclear India

The energy perspective

Global governance needs to address the aspirations of an array of developing countries seeking to build new or expand existing nuclear power plants. While these countries advocate the right to peaceful use of nuclear energy, multilateral institutions insist on stringent regulations to protect the world from nuclear disaster. India has a large nuclear energy capacity already in place. How is India's nuclear industry dealing with the challenges of transportation safety and other nuclear safety hazards?

Brief Points

- India sees nuclear technology as a key resource for meeting its growing energy needs, while recognizing the importance of building a robust nuclear security system.
- As an active participant in the Nuclear Security Summit process, India is steadily building up a cadre of dedicated nuclear security experts who can contribute to developing new strategies and benchmarks.
- India seeks to contribute to a more robust nuclear governance architecture that includes peer reviews, best practice exchanges, and realistic security exercises and assessments.

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India's Nuclear Energy Program

As of 2017, India has a total of 21 power-generating nuclear reactors at seven sites, with a total capacity of 5.8 GW, amounting to about 3.5% of India's total power-generating capacity (Nuclear Power Corporation of India Limited).

India has an ambitious nuclear energy program to meet its growing energy needs. Much of the debate on the U.S.-India Civil Nuclear Agreement focused on a waiver granted by the Nuclear Suppliers Group (NSG), allowing India to access civilian nuclear technology and fissile materials from other countries. However, the agreement has also been vital in facilitating a civil-military nuclear Separation Plan, and a routine of regular International Atomic Energy Agency (IAEA) inspections.

India is contemplating large-scale expansion of nuclear power, and will continue to build new nuclear power facilities. With increasing nuclear capacity installed, and a rapidly growing industrial and scientific base, India's capabilities for the development of sensitive nuclear technologies can only grow.

India looks at nuclear technology as a key resource for meeting its energy requirements, while also recognizing the need for strong institutional, legal, and physical infrastructure related to nuclear security to ensure the safety of its nuclear facilities.

The Fukushima incident highlighted the need to review India's measures and mechanisms for nuclear safety. This review was carried out with support from the IAEA and the World Association of Nuclear Operators, the key international institutions that provide support for the development and implementation of stringent nuclear safety standards.

The Global Nuclear Scenario

According to the IAEA (2013), the total stockpile of enriched uranium in China, France, Russia, the United Kingdom and the USA was 40,558 tons, while the cumulative production of uranium was 2,700,000 tons from 1947–2012. The cumulative reactor requirement during the same period was 2,150,000 tons. The balance, 550,000 tons, is potentially available for military purposes, as the civilian sector requires only minute supplies.

There are 442 nuclear power reactors in a total of 32 countries worldwide, while another 66 reactors are being constructed in 15 countries. More than 100 research reactors are operating or using High-Enriched Uranium (HEU). The global stockpile of HEU and plutonium is 1,390,000 kg and 490,000 kg respectively, which is enough material for thousands of weapons.

A plethora of multilateral agencies and non-governmental organizations across the globe have made tremendous efforts to advocate for nuclear non-proliferation and disarmament, as well as to develop safety measures to prevent accidents in nuclear reactors and during the transportation and storage of fissile materials and nuclear waste.

ICAN and other civil society organizations have managed to bring the humanitarian effort to ban nuclear weapons to the world's attention, while the Nuclear Non-Proliferation Treaty (NPT) and its review mechanism have become infamous for deadlock. Meanwhile, the existing nuclear safety regime and the nascent international nuclear security regime have received far less attention, despite the progress that has been made in these fields.

Although they have evolved in a fragmented and uncoordinated fashion, the mechanisms and agreements on nuclear safety that are being established today may one day develop into a global nuclear governance regime. Supported by reviews and monitoring, the work towards common standards, regulations and best practices for nuclear safety promotes transparency while also building trust.

US President Barack Obama pushed nuclear security to the centre of the global nuclear governance agenda through the Nuclear Security Summit process. India has been an active participant in this process since its inception in 2010, taking part in every summit.

India's Approach to Nuclear Safety

India's Atomic Energy Act of 1962 permits only state-owned companies to engage in the production of nuclear power. Due to widespread concerns about the hazards of using High-Enriched Uranium (HEU) in research reactors, India shut down its HEU-fuelled research reactor and, as of today, none of India's research reactors operate on HEU. Inspired by the Nuclear Security Summit process, India has also developed plans for a Global Centre of Nuclear Energy Partnership (GCNEP).

India's approach to the security of nuclear materials is through the pursuit of a closed fuel cycle. An open fuel cycle would involve disposal of spent fuel without extracting plutonium. Such a disposal would result in the creation of a plutonium mine for posterity. The security risks are aggravated further if such a disposal is designed to be retrievable. To ensure that there is no build-up of a plutonium stockpile, India is strictly observing the principle of "reprocess to reuse".

Reprocessing of spent fuel and fast reactor build-up are synchronized to preclude build-up of plutonium stockpiles. Technology has been developed for vitrification of high-level waste from reprocessing. Vitrified waste, after it has been packed in stainless steel overpacks, is stored in a Solid Storage Surveillance Facility (SSSF). At Kapakkam, a 500 MW Prototype Fast Breeder Reactor (PFBR) is under development. Sodium has been loaded into the reactor, and fuel for the first core has been delivered to the site.

To address the issue of security of nuclear materials in the long term, India is working to develop proliferation-resistant fuel cycles. This effort includes developing technologies for reprocessing so that plutonium is separated along with uranium, and working to establish thorium-based reactor systems. India has large reserves of thorium and is therefore creating new technology for its use in nuclear power generation. There are no fissile isotopes of thorium, so thorium cannot be used directly for energy production, but in a reactor, the very common isotope thorium 232 may be converted into uranium 233, which is a fissile material.

India has a shortage of domestic deposits of uranium, and is dependent on imports for about 40% of its uranium supplies, with the remaining 60% sourced from uranium mines in south central and eastern India (World Nuclear Association 2016). The ore is processed in nearby mills to produce so called

Nuclear power plants under construction. Photo: Petr Pavlicek / IAEA imagebank@Flickr

"yellowcake", which is transported for further processing elsewhere. India's main nuclear fuel cycle facilities are located in Hyderabad at the Nuclear Fuel Complex, a facility owned by the Department of Atomic Energy (DAE). Here, "yellowcake" is refined to uranium dioxide, UO2. This form of uranium is used in the production of nuclear fuel, which also takes place at the Hyderabad complex. Six of the Hyderabad facilities are under IAEA safeguards.

Transport Security in India

Spent nuclear fuel and other highly radioactive sources are attractive targets for terrorists. Hence, while in transit, these materials are difficult to protect unless adequately safeguarded. Nuclear materials that are in transit are significantly more vulnerable than those sources which are housed in secure and immovable nuclear facilities. Risks involved during the transit of nuclear and radioactive materials raise the bar for potential terrorist attacks at any point during the movement of nuclear cargo. Improvement in the overall nuclear security measures, including transportation of nuclear materials, is a cardinal prerequisite for sustainable nuclear security. Focused on this essential prerequisite, the 2014 Nuclear Security Summit, in its Communiqué, persuaded States to share best practices and extend cooperation in enhancing transport security in moving nuclear and radioactive materials with effective technologies. The 2014 Nuclear Security Summit encouraged the "establishment of effective national nuclear material inventory management and domestic tracking mechanisms, where required, that enable States to take appropriate measures to recover lost and stolen materials" (Nuclear Security Summit 2012: 4).

Initiated by Japan, the Transport Security Gift Basket expressed member states' (France, the Republic of Korea, the United Kingdom, the United States and Japan) "commitment to strengthen security in the transport of nuclear and other radioactive materials to meet the intent of the Seoul Communiqué" (Partnership for Global Security 2014: 1). This was further followed up in the 2016 Nuclear Security Summit, when more states joined and produced four good practice guides for air, rail, road, and sea transport modes, subject to respective country requirements.

India has rendered support to the international initiative of transport security by upholding the belief that the state plays a critical role in enhancing safe passage of nuclear and radioactive (N&R) materials in transit. India has expressed a commitment to put several measures for strengthening transport security of N&R materials into practice. India's regulatory agency, the Atomic Energy Regulatory Board (AERB), has established robust regulatory mechanisms for the security of N&R materials from 'cradle to grave'. In India, the radiation sources and radioactive facilities are much greater in number than nuclear facilities because of their wide applications for industrial and medical purposes. India accords strict regulation of its radioactive sources from cradle to grave, which encompasses the entire fuel cycle.

On the basis of the IAEA guidelines, the AERB has published two Guides on the Security of Radioactive Sources and Radiation Facilities AERB/NRF-TS/SC-1 (Rev.1) and Security of Radioactive Material during transport AERB/NRF-TS/SG-10. These Guides provide a detailed manual of developing safety codes, safety standards and related guides for the purpose. The AERB Guides expound several requirements and the implementation procedures essential for effective transport security. The Guide on the secure transport of radioactive materials provides explicit details necessary for the design and testing of special forms of radioactive material, and different types of packages for their transport. Further, the Guide details control measures to be implemented during transport, including the limits on the levels of radioactive contamination, radiation level and temperature at the external

surface of the package, and best practices for marking and labeling these packages. India recognizes the importance of having an effective interface between nuclear security and safety for establishment of a robust nuclear security regime. India's approach to transport security of N&R materials adopts a three-tiered defence strategy to prevent any unauthorized movement of N&R material: from the regulatory control as the first line of defence, to speedily detecting and recovering material that has been breached out of the regulatory control, and effectively monitoring material in transit from the regulatory control into the public domain.

All movement of N&R materials are regulated by measures listed in the IAEA's nuclear security series No. 15, which details physical protection of materials in transit. For this purpose, the AERB has instituted a three-tier review process. The first tier is comprised of the Committee for Reviewing Security Aspects of Nuclear Facilities, and the Committee for Review of Nuclear Security Aspects of Radiation Facilities and Transport of Radioactive Materials – the committees responsible for all nuclear fuel fabrication facilities, and the regulatory aspect of all the nuclear power plants and regulatory facilities. The second tier constitutes the Safety Review Committee for Operating Plants (SARCOP), the Advisory Committee for Project Safety Review (ACPSR) and the Safety Review Committee for Application of Radiation (SARCAR) that monitors the Safety-Security Interface related aspects. The third-tier review is conducted by the AERB, with necessary advisory support from the Advisory Committee on Security (ACS). The AERB has also developed a number of guideline documents that are not publicly available but are put into practice for ensuring robust transport security. For the operators, the AERB has adopted a stringent licensing process for the installation, as well as the safe and secure source storage of radioactive material. Additionally, AERB has instituted a new mechanism of web-based licensing, 'electronic Licensing of Radiation Application' (e-LORA), which awards approvals for transport of radioactive material after having undergone safety and security verification requirements.

India is in the process of building a robust nuclear security architecture with independent oversight, drawing on successive Nuclear Security Summits (2010–2016). It believes that the process initiated by the Summits should be sustained and further advanced through an effective global nuclear security system. This requires generating awareness about the importance of nuclear security, disseminating best practices, and knowledge sharing. The aim is to build a strong security culture that includes peer reviews, best practice exchanges and realistic security exercises that permeate all aspects of the nuclear security regime.

India and Global Nuclear Governance

India recognizes the importance of strengthening the global nuclear security architecture to combat the risks associated with the growth of nuclear energy worldwide. To realize this ambition, India has proclaimed its willingness to work with the international community with a multilateral approach in consolidating a nuclear security regime. India supports the objective of the Global Initiative to Combat Nuclear Terrorism (GICNT), to integrate its collective capabilities and resources for strengthening the global nuclear security architecture. By hosting the Implementation and Assessment Group (IAG) of the GICNT in February 2017, India provided a platform that promotes sharing of information, knowledge, expertise and best practices in non-proliferation, counter-proliferation and counterterrorism. ■

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