Nuclear Safety in India: The Balancing Rope of Domestic Energy Demand and International Safeguards Regime

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Abstract

Ever since the Fukushima incident, civilian nuclear energy in India has been a matter of great contestation, leading to several debates on domestic plant safety, disaster preparedness and ability to contain any such radioactive leakage through natural or man made disasters. In this regard, India ratified the Additional Protocol under the condition that civilian nuclear facilities will be separated from the military facilities and be compliant with IAEA safeguards. This compromise, while not being a signatory to the Non Proliferation Treaty and considered as a Non Nuclear Weapons State, has been a challenge and forced acceptance of opening up nuclear facilities which were earlier a state protected entity without external access. This paper offers a brief outlook into the history of Additional Protocol as an international safeguards measure adopted by India while examining the relevant provisions within the context of Additional Protocol. Further, an overview of India's energy demand and consumption specific to the nuclear sector is analysed. Finally, a legal framework of nuclear safety in India covering separation, inspection and sampling of nuclear facilities to arrest proliferation and maintain plant safety will be addressed.

INTRODUCTION

A US $150 billion dollar nuclear power programme is getting off the ground. India wants to dramatically increase its nuclear capacity to 63,000

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megawatts (MW) by 2032[2], from 5,780 MW, by adding nearly 30 reactors at an estimated cost of $85 billion as part of a broader push to move away from fossil fuels, cut greenhouse gas emissions and avoid the dangerous effects of climate change. India has less than two dozen small reactors at six sites with a capacity of 4,780 MW, or 2 per cent of its total power capacity. It currently has nuclear energy agreements with 11 countries and imports uranium from France, Russia and Kazakhstan[3]. A proposed power plant in Gujarat will accelerate India's plans to build roughly 60 reactors, making the energy deficit state as the world's second-biggest nuclear energy market after China[4]. Nuclear energy presently accounts for 2% of the total installed capacity of 272.5 GW. Capacity addition in the XII plan is in accordance with the government's Low Carbon Growth Strategy for sustainable development of the power sector in the long run.

The XII plan estimates a capacity addition of conventional power of about 76,000 MW by 2017, to meet the projected energy demand in the country. Emphasis has been given to clean energy sources of nuclear, hydro and Renewable Energy Sources (RES) such as small hydro, biomass, solar and wind in order to reduce greenhouse gas emissions. Initial estimates of domestic uranium reserves (61,000 tonnes) are sufficient to operate 10,000 MW of heavy water reactors for about 40 years. India's nuclear capacity would reach to 20,000 MW by 2020 as per Department of Atomic Energy (DAE) and the National Electricity Plan[5]. The DAE also estimates that the nuclear share would grow to 8.6% by 2032 and 16.6% by 2052. On the basis

2 For an estimate of trends and projections in nuclear energy, see Reference Data Series No. 1, *Energy, Electricity and Nuclear power estimates for the period up to 2050*, IAEA, 2013 Ed and *Technology Roadmap Nuclear Energy*, NEA-IEA 2015 Ed. For a global list of nuclear power reactors and its performance indicators, see Reference Data Series No. 2, *Nuclear Power Reactors in the World*, IAEA, May 2015 .

3 *Cabinet nod to Indo-Australian nuclear deal*, The Hindu, December 30, 2015 available at http://www.thehindu.com/news/national/cabinet-gives-nod-to-indoaustralian-civil-nuclear-cooperation-deal/article8045395.ece last accessed on October 10, 2015.

4 *India closing in on Westinghouse deal to build 6 nuclear reactors*, Business Line, December 24, 2015 http://www.thehindubusinessline.com/economy/india-closing-in-on-westinghouse-deal-to-build-6-nuclear-reactors/article8024682.ece last accessed on October 15, 2015.

5 See National Electricity Plan, Central Electricity Authority, January 2012. Available at http://www.indiacore.com/bulletin/2012-jan-national-electricity-plan.pdf Last accessed on April 20, 2016.

of the assumption of a successful Fast Breeder Reactor (FBR) Program[6], nuclear power is expected to reach to 200,000 – 275,000 MW in 2040. With the comprehensive capabilities in all aspects of nuclear power, India is poised for a large expansion program, but the challenge is to pursue the three-stage program, develop and commercially deploy technologies for utilization of thorium and ensure the country's long-term energy security[7].

On 18 July 2005, a joint India-U.S. statement proposed to separate India's nuclear facilities into civilian and military/ strategic, placing more Indian facilities and materials under IAEA (International Atomic Energy Agency) safeguards[8]. On July 26, 2006 President Bush and Prime Minister Singh issued a joint statement on their growing strategic partnership[9], emphasising their agreement on civil nuclear cooperation while the US Congress passed the U.S.-India Peaceful Atomic Energy Cooperation Act and U.S. Additional Protocol Implementation Act[10], which exempted this cooperation from exports of nuclear materials, equipment, and technology of the Atomic Energy Act of 1954[11]. In 2006, India had committed to negotiating an Additional Protocol (AP) with the IAEA as part of the US-India nuclear deal[12].

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6 Fast Breeder Reactors provide an opportunity for exploiting India's thorium reserves Therefore, India envisaged a three-stage indigenous nuclear power program:
Phase I*:* Build Pressurised Heavy Water Reactors (PHWRs): PHWRs use uranium fuel and the spent fuel rods are reproduced to extract plutonium.
Phase II: Reprocess spent fuel and utilize recovered plutonium to build FBR initially (FBR uses a plutonium core and depleted uranium blanket to breed more plutonium than the original output).
Phase III: Increase capacity later, with sufficient stock of plutonium (the plutonium core and thorium blanket yield U-233, and further uses the U-233 core and the thorium blanket).

7 For detailed domestic energy capacity projections developed by NITI Aayog for Renewable and Clean Energy technologies, see India Energy Security Scenarios (IESS), 2047, Version 2.0, Energy Division, NITI Aayog, Government of India, August 2015 available at http://niti.gov.in/ebook/Sector%20Insights%20I%20-%20Energy%20Demand/index.html#page/1 Last accessed on April 23, 2016.

8 Joint Statement by President George W. Bush and Prime Minister Manmohan Singh, 18 July 2005: http://2001- 2009.state.gov/p/sca/rls/pr/2005/49763.htm last accessed on October 19, 2015.

9 For a detailed account of Indo-US relations, see Rajesh Kumar Mishra, *Indo-US Nuclear Deal and Non-Proliferation*, Strategic Analysis, Vol. 29, No. 4, Oct-Dec 2005.

10 Senate Report 109-288, July 20, 2006, available at http://www.gpo.gov/fdsys/pkg/CRPT-109srpt288/html/CRPT-109srpt288.htm last accessed on December 16, 2015

11 Also see IDSA Task Force Report, Development of Nuclear Energy Sector in India, IDSA, November 2010 Also see Key world Energy Statistics, International Energy Agency 2014.

12 For a list of safeguards status compiled by M V Ramana, see http://fissilematerials.org/blog/2014/07/india_ratifies_an_additio.html last accessed on November 23, 2015.

In 2008, India received a waiver for civilian nuclear exports with the Nuclear Suppliers Group (NSG). In this regard, DAE Chairman Kakodkar had called for India to get a 'clean exemption' from the NSG, without any conditions, to allow it to participate in international civilian nuclear trade[13]. The 2008 decision was based on a formal pledge by India stating that it would not share sensitive nuclear technology or material with others and would uphold its voluntary moratorium on nuclear testing. On 24 June 2011, the NSG tightened its guidelines requiring NPT membership, a comprehensive safeguards agreement and adherence to the Additional Protocol specifically for trade in enrichment and reprocessing equipment and technology[14].

THE ECONOMICS OF NUCLEAR TRADE

The demand for uranium depends largely on installed and operating reactors, regardless of economic fluctuations. The demand for uranium is therefore much more predictable than with other mineral commodities. About two-thirds of world production in 2014 came from Kazakhstan, Canada and Australia, while more than half of the world's commercial reactors are in the United States, France and Japan[15]. Today the market is dominated by eight major companies: AREVA, Cameco, Rio Tinto, KazAtomProm, BHP Billiton, Navoi, Paladin and Uranium One. Together, these eight companies provided 82% of world uranium production in 2012.[16] In July 2015, India announced that it would create a strategic uranium reserve between 5,000 – 15,000 metric tonnes[17]. In India, the Uranium Corporation of India Ltd (UCIL) was established in 1967 to mine and process uranium with the nation's first uranium mine at Jaduguda, Jharkhand beginning operations in 1967[18].

To detail all the nuclear facilities is beyond the mandate of this paper. However, to ascertain the energy expansion plan, the civilian nuclear facilities are described here. In addition to the reactors under construction, a start of work on 19 new nuclear power reactors with a total capacity of 17400

13 We Want Clean NSG Exemption — Kakodkar," The Hindu, February 21, 2008 available at http://www.thehindu.com/todays-paper/tp-national/we-want-clean-nsg-exemption-kakodkar/article1206194.ece last accessed on October 21, 2015.

14 Nuclear Suppliers Group homepage, History: http://www.nuclearsuppliersgroup.org/en/history1 last accessed on November 19, 2015.

15 Cindy Vestergaard, *Governing Uranium Globally*, DIIS Report 2015:09 .

16 *supra 15,* p. 36; Also see Chaim Braun (2006) The Nuclear Energy Market And The Nonproliferation Regime, The Nonproliferation Review, 13:3, 627-644.

17 *supra 15*, p. 25

18 *supra 15,* p. 29.

MW is planned in the XII Five Year Plan. These include eight Pressurised Heavy Water Reactors (PHWR) of 700 MW each; two Fast Breeder Reactors (FBR) of 500 MW each and one Advanced Heavy Water Reactor (AHWR) of 300 MW with indigenous technologies; and eight Light Water Reactors (LWR) each of 1000 MW or above with foreign technical cooperation. These reactors are expected to be completed progressively in the XIII Plan/ XIV Five Year Plans. More reactors are also planned for the future, based on indigenous technologies as well as with foreign technical cooperation[19].

SAFEGUARDS LEGAL FRAMEWORK AND ADDITIONAL PROTOCOL

The International Atomic Energy Agency (IAEA) is the world's nuclear inspecttorate, applying technical measures referred to as 'safeguards' to verify the accuracy and completeness of the declarations States make regarding their nuclear material and activities[20]. The 1957 Statute of the IAEA provides the fundamental basis for the establishment of safeguards which today have become grounded within the 1970 Nuclear Non-Proliferation Treaty (NPT)[21] and regional Nuclear Weapons-Free Zones (NWFZs) and been adopted in multilateral trading guidelines. The IAEA safeguards system has evolved greatly over the years from the 'item-specific' approach of the 1960s to one that is becoming increasingly 'integrated' and 'state-level,' applying to all nuclear material in the State as a whole[22]. IAEA Information Circular INFCIRC/153 of 1972 defines the starting point of full-scope safeguards (i.e. the application of the full set of accountancy and control provisions on nuclear material inventory). Paragraph 34(c) is commonly referred to as the starting point of safeguards[23].

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19 Lok Sabha unstarred question number 858, available at http://dae.nic.in/writereaddata/parl/budget2014_2/lsus858.pdf last accessed on November 22, 2015.

20 A comprehensive outlook of the nuclear industry and its legal framework vis-à-vis IAEA is well detailed in Cindy Vestergaard, *Governing Uranium Globally*, DIIS Report 2015:09 For more information on IAEA, see their website https://www.iaea.org/about last accessed on November 29, 2015.

21 For a detailed analysis of NPT, see Lewis A. Dunn (2009) THE NPT, The Nonproliferation Review, 16:2, 143-172.

22 *supra 15,* p. 42.

23 *When any nuclear material of a composition and purity suitable for fuel fabrication or for being isotopically enriched leaves the plant or the process stage in which it has been produced, or when such nuclear material, or any other nuclear material produced at a later stage in the nuclear fuel cycle, is imported into the State, the nuclear material shall become subject to the other safeguards procedures specified in the Agreement.*

Full safeguards come into force when nuclear material pure enough to be fabricated or enriched 'leaves the plant or process stage', historically interpreted as the output of conversion plants (i.e., UO_2 or UF_6).

Until the 1990s, virtually all IAEA safeguards were focused on accounting for nuclear materials associated with facilities that states have declared to the Agency. Inspections following the first Gulf War in Iraq revealed Iraq's nuclear weapons programme, as well as undeclared nuclear activity in Egypt, Iran, Libya, North Korea, South Korea and Syria. The IAEA began moving towards detecting undeclared activities. Since then, there has been a widespread political debate on the nuclear haves and have-nots incorporating international safeguards standards. The 'ambivalence' of nuclear technology and build up of arsenal amidst the sanctions and technology denial regime by global community is well documented and addressed by Itty Abraham. He argues that impact of sanctions and denial created a context where the decision to "go" nuclear by nation-states could begin from the premise that there was nothing further to lose and must be viewed in light of the contradictions of contemporary nuclear nonproliferation policy and theory[24]. Increasingly, nation-states, acting as rational actors more often than we think, do not want a global inspectorate to audit nuclear energy programs. This clandestine yet resilient approach has in a way led to a lack of consensus on providing access and participation to export control regimes such as the Nuclear Suppliers Group at IAEA. The only road forward for others to follow suit in signing and ratifying the Protocol Additional to Safeguards Agreements, also known as Additional Protocol, is through diplomatic pressure and making win-win adjustments with these Nuclear Weapons States.

In 1997, the IAEA passed the Model Additional Protocol (INFCIRC/540), an addition to the safeguards agreement, which grants broader information on (and IAEA access to) a State's domestic uranium production, as well as data on trade in secondary materials that may contain uranium or thorium.

Although the Model Additional Protocol[25] does not require full material accountancy, its ratification is having a positive impact on accountancy and controls, given its requirements for States to report the location, operational status and annual production from uranium mines. During complementary access visits, the IAEA can take samples of Uranium Ore Concentrate to reconcile a state's declaration with actual composition and purity on site[26].

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24 Itty Abraham, *'Who's Next?' Nuclear Ambivalence and the Contradictions of Non-Proliferation Policy*, Economic & Political Weekly, Vol XLV No 43, October 23, 2010. Also see, Itty Abraham, The Ambivalence of Nuclear Histories, Osiris Vol. 21, Global Power Knowledge: Science and Technology in International Affairs (2006), pp. 49-65

25 Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, IAEA Doc INFCIRC/540 (September 1997).

26 *Supra* 15, p.95.

The non-NPT states of India, Israel and Pakistan have INFCIRC/66-type safeguards agreements which are 'facility' or 'item specific' and therefore do not cover the totality of the State's nuclear activities[27]. INFCIRC/66-type agreements have normally been entered into as a unilateral voluntary measure by a State or upon the conclusion of a supply agreement between two or more States that requires the application of IAEA safeguards.

Articles 2(a)(v) and (vi) of an AP require annual reporting of uranium and thorium holdings, along with reporting on exports and imports of pre-34(c) source material for non-nuclear purposes[28]. Thirty years after INFCIRC/153 was established, the IAEA reinterpreted paragraph 34(c) for the first time, affecting safeguards implementation in non-nuclear weapons states with refining or conversion facilities and a CSA (Comprehensive Safeguards Agreement)[29]. With the introduction of 'Policy Paper 18' in

27 This is modeled upon IAEA Information Circular INFCIRC/66.Rev.1

28 The issue of how to address uranium recovered from secondary sources was debated during INFCIRC/153 negotiations in 1970-1971. At the time, the main discussions regarding paragraph 34(a) and exports of pre-34(c) material between countries desiring reporting on all material containing uranium or thorium, irrespective of intended use, and others that wanted reporting to be conditional on their being a nuclear purpose. Several states such as Australia, Canada, South Africa and the United Kingdom were concerned that costs could be levied on the mineral sands and phosphates industries if reporting applied to non-nuclear industries, while others were concerned that, if export notifications rested solely on nuclear purposes, there might be no presumption of reporting to the IAEA on all pathways of uranium production. In the end, the exclusion of material 'for specifically non-nuclear purposes' in Paragraphs 34a and 34b was agreed to in 1972, with the Additional Protocol removing the exemption twenty years later. See Craig Everton, Stephan Bayer and Michael East, Safeguarding Uranium Production and Export – Conventional and Non-Conventional Resources, paper for the 7th INMM-ESARDA joint workshop on "Future Directions For Nuclear Safeguards and Verification", Aix-en-Provence, France, October 2011.

29 If a Comprehensive Safeguards Agreement was intended to verify the accuracy of a state's declared nuclear activities, the Additional Protocol was designed to verify the completeness of its declaration. It contains two principle features: First is an "expanded declaration" provided to the IAEA by the state, containing information on activities that might be relevant to the development of nuclear arms but not subject to reporting requirements under the state's Comprehensive Safeguards Agreement. The second feature is broader IAEA "complementary access" to undeclared locations in a state "to assure the absence of undeclared nuclear material and activities." On the basis of information obtained in this way, the IAEA can draw a "broader conclusion" about a state's nuclear activities than would be possible under the Comprehensive Safeguards Agreement alone, and formally express confidence that all nuclear activities in a state subject to a Comprehensive Safeguards Agreement are dedicated to peaceful purposes. For a detailed description see Mark Hibbs, The Unspectacular Future of the IAEA Additional Protocol, Proliferation Analysis, April 26, 2012 available at http://carnegieendowment.org/2012/04/26/unspectacular-future-of-iaea-additional-protocol# last accessed on February 26, 2016

2003, full safeguards were brought forward to the production of uranyl nitrate or the first practical point before that. In Canada, this meant moving the starting point of full material accountancy to when drums of UOC (Uranium Ore Concentrate) are added to production lines, which marked the first time that Agency safeguards captured a refinery plant in Canada (i.e. Cameco's Blind River refinery). The new starting point obviated having to report the tens of thousands of drums stored at the site. UOC, commonly referred to as 'yellowcake', therefore, remains a 'pre-34(c)' material that is not subject to the full scope of IAEA accountancy and control provisions[30].

As against other instruments to assist in proliferation reporting[31], India decided to ratify an Additional Protocol to the Agreement between the Government of India and the IAEA for the Application of Safeguards to Civilian Nuclear Facilities. While an India-specific Safeguards Agreement signed with the IAEA on 2nd February 2009 is already in force[32], the Additional Protocol (AP) was signed between the Government of India and the IAEA on 15 May 2009 and was ratified on 23 June 2014. As per the procedure for ratification, India deposited the instrument of ratification with the IAEA and with this, the AP came into force on 25 July 2014[33].

On March 23, 2009, The Board of Governors of IAEA approved the AP for India. This step partly fulfills India's obligation to segregate its nuclear facilities into civilian and military facilities, while agreeing to place the civilian facilities under international safeguards[34]. On May 29, the Permanent Representative of India to the Conference on Disarmament voiced India's position on remaining outside NPT stating that nuclear weapons are an integral part of our national security and will remain so

30 *supra 13,* p. 44, 45, 46

31 States with Comprehensive Safeguards Agreements (CSAs) which decide to conclude and bring into force additional protocols must accept all provisions of the Model Additional Protocol. States with item-specific or voluntary offer agreements (VOA) may accept and implement those measures of the Model Additional Protocol that they choose. See https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol last accessed on November 30, 2015

32 Rajya Sabha unstarred question number 903, Additional Pact with IAEA, available at http://www.dae.nic.in/writereaddata/parl/budget2014_2/rsus903.pdf last accessed on December 10, 2015

33 For a country wise status of AP, see https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol/status-of-additional-protocol last accessed on December 02, 2015

34 Daniel Horner, "Additional Protocols for UAE, India Approved by IAEA Board," NuclearFuel, March 23, 2009

pending the global elimination of all nuclear weapons[35]. In October 2009, India submitted a separation plan to put its 14 civilian nuclear facilities under International Atomic Energy Agency (IAEA) safeguards by 2014[36]. On 01 December 2014, India voted for a resolution at the IAEA calling for an immediate halt to uranium enrichment by Iran. According to news reports, New Delhi's vote against Tehran was in large part due to the Indian government's concern that any other posture (voting against or an abstention) would have raised questions about India's safeguards agreement with the IAEA[37]. It is interesting to note that India's AP does not allow the IAEA complementary access nor reporting on information related to nuclear fuel cycle-related Research and Development or uranium mining, however, it does require to report on exports of pre-34(c) material beyond a significant quantity (ten metric tonnes of uranium)[38].

The AP will cover only those facilities, which are monitored by the IAEA, and will have no bearing on the non-safeguarded facilities, which are used for building weapons. Unlike the "model" document that the IAEA has signed with several Non-Nuclear Weapon States, the AP inked with India is far less intrusive. "It essentially will ensure the collection of data of India's nuclear exports, to guarantee that the material is not diverted for unauthorised use. The new arrangement would also facilitate regular entry and exit of the IAEA personnel by providing them with multi-entry visas, apart from guaranteeing "free communication" generated by the surveillance or measurement devices of the IAEA that are already in place in facilities that are under international safeguards. It fulfills India's commitment anchored in the Indo-U.S. joint statement of July 2005, which stated unambiguously that New Delhi would conclude "*an additional protocol*" with the IAEA. The safeguards agreement with the IAEA covered

35 Statement by India in the CD Plenary after the Adoption of Decision on Programme of Work Contained in CD/1863," 29 May 2009, via: www.reachingcriticalwill.org last accessed on December 12, 2015.

36 International Atomic Energy Agency, "Agreement between the Government of India and the International Atomic Energy Agency for the Application of Safeguards to Civilian Nuclear Facilities," INFCIRC/754/Add.3, 16 December 2010, www.iaea.org last accessed on October 15, 2015.

37 Pranab Dhal Samanta, Iran Vote: India Prompted by Safeguards Pact with IAEA, The Indian Express, December 1, 2009 available at http://archive.indianexpress.com/news/iran-vote-india-prompted-by-safeguards-pact/548332/ last accessed on December 21, 2015.

38 For a similar format found in the US Additional Protocol as a provision of national security exclusion principle, see Theodore Hirsch, The IAEA Additional Protocol – What it is and why it matters, The Non Proliferation Review, Volume 11, Issue 3, September 2004, pages 140-166.

20 facilities that include the Nuclear Fuel Complex in Hyderabad, Tarapur atomic power plant, Rajasthan Atomic Power Station, both units at Kudankulam, and the Kakrapar Atomic Power Station[39]. energy supply, demonstrating India's support for nuclear non-proliferation and the safeguards system[40].

On 14 April 2010, while attending a Nuclear Security Summit in Washington, Prime Minister Singh announced the establishment of a Global Center for Nuclear Energy Partnership as a state of the art facility based on international participation from the IAEA and other interested foreign partners. The Center will consist of four schools dealing with Advanced Nuclear Energy System Studies, Nuclear Security, Radiation Safety, and the application of Radioisotopes and Radiation Technology in the areas of healthcare, agriculture and food[41].

India on August 31, 2011 brought into force Regional Cooperation Agreement (RCA) with 21 countries in the Asia Pacific Region and the IAEA for collaboration in peaceful uses of nuclear energy[42].

INDIA SAFEGUARDS FRAMEWORK

The general legal framework for licensing installations and activities in relation to radiation sources or radiation generating equipment are unified by the Atomic Energy Act, 1962[43] (AEA) and by the Atomic Energy

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39 India more open to n-inspections, The Hindu, June 23, 2014 available at http://www.thehindu.com/news/national/india-more-open-to-ninspections/article6139494.ece last accessed on November 19, 2015.

40 Rajya Sabha unstarred question number 470, available at http://dae.nic.in/writereaddata/rsus470.pdf last accessed on October 27, 2015.

41 K.P. Nayar, Ice-Breaker Centre, The Telegraph, April 14, 2010, Also see Rajya Sabha unstarred question number 2018, available at http://dae.nic.in/writereaddata/rssq2018.pdf and for more on GCNEP, see http://www.gcnep.gov.in last accessed on November 09, 2015.

42 *Fifth Agreement to Extend the 1987 Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA*). For a list of agreements India has signed with IAEA, see https://ola.iaea.org/ola/FactSheets/CountryDetails.asp?country=IN Established in 1972, the RCA Programme is funded by the IAEA Technical Cooperation Fund (TCF) under the IAEA Technical Cooperation Programme, extra budgetary resources from the Member States and donors. See http://www.barc.gov.in/rcaindia/rca_evolution_1.html For more information on RCA, see http://www.rcaro.org last accessed on December 22, 2015.

43 Full text of the Atomic Energy Act is available at http://dae.nic.in/?q=node/153 last accessed on November 18, 2015.

(Radiation Protection) Rules 2004. According to Section 3 of the AEA "to produce, develop, use and dispose of atomic energy" is restricted to the Government or to a Corporation established by the Government. Sections 14, 16 and 17 of the Act prohibit any such activity except under a written consent[44]. The Constitution Order (S.O. 4772)[45] authorises Atomic Energy Regulatory Board (AERB)[46] to maintain nuclear safety. The AERB derives this mandate from Rule 33 of the Atomic Energy (Radiation Protection) Rule of 2004 and its constitution order[47]. Clause 2(i) requires the regulatory body to develop Safety Codes, Guides and Standards for siting, design, construction, commissioning, operation and decommissioning of the different types of facilities, recognising international and national requirements[48].

In accordance with these mandates, the Central Government has promulgated the Atomic Energy (Radiation Protection) Rules, 2004, the Atomic Energy (Working of the Mines Minerals and Handling of the Prescribed Substances) Rules, 1984, the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, the Atomic Energy (Factories) Rules, 1996 and the Atomic Energy (Radiation Processing of Food and Allied Products) Rules, 2012 that formulate the policy and regulatory framework for control of activities and for ensuring safety in the activities relating to use of atomic energy.

AERB has also been empowered to perform the functions under the Sections 10(1) (Powers of entry) and 11(1) (Powers to take samples) of Environmental Protection Act, 1986[49] (EPA) and Rule 12 (Agency to which information on excess discharge of pollutants to be given) under the Environmental Protection (Amendment) Rules 1987. Further, Rules 2(b) and 3 of the Manufacture, Storage and Import of Hazardous Chemicals Rules 1989 under the EPA has notified AERB as the authority to enforce directions and

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44 Within the AERB terminology the general term 'consent' is used to cover the written permissions issued by the regulatory body, including license, approval, authorization and registration.

45 The Constitution Order came into effect on 15 November 1983 and is available at http://www.aerb.gov.in/AERBPortal/pages/English/Constitution/gazzette_aboutUs.action last accessed on October 17, 2015

46 Integrated Regulatory Review Service (IRRS) Mission Report to India By IAEA, Department of Nuclear Safety and Security AERB, IAEA-NS-IRRS-2015/04 p. 39

47 *supra 46,* p. 67

48 Regulatory safety documents issued by the AERB are classified in the following decreasing order of hierarchy: Safety codes, Safety standards, Safety guides, Safety manuals and Technical documents.

49 Full text of the Environmental Protection Act is available at http://envfor.nic.in/legis/env/env1.html last accessed on December 11, 2015

procedures as per the Atomic Energy Act 1962. Under the Civil Liability for Nuclear Damage Act, 2010[50] and the Civil Liability for Nuclear Damage Rules, 2011, AERB also has the responsibility of notifying the occurrence of any nuclear incident[51]. Further, Section 41B of The Factories Act, 1948[52] makes it mandatory for the authorised parties to inform the public about possible risks associated with its facilities and activities[53].

The overall policy objectives for radiation safety and industrial safety in relation to the nuclear and radiation facilities in India are embedded in the Atomic Energy Act, 1962, the Atomic Energy (Radiation Protection) Rules, 2004, the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, the Atomic Energy (Factories), Rules, 1996, and AERB's Safety Codes, Standards and the Code of Ethics issued by AERB. These policies are pursued in the regulation of nuclear and radiation safety in the facilities and activities coming in the jurisdiction of AERB and are synonymous with the requirements of the IAEA's standards on 'Governmental, Legal and Regulatory Framework for Safety, (IAEA GSR Part–1) and the IAEA standard 'Fundamental Safety Principles (IAEA-SF-1)[54].

On the issues of safety, health and environment at work place, in relation to the factories owned by the Central Government on carrying out the objectives of the "National Policy on safety, health and environment at work place" issued by the Ministry of Labour and Employment, Government of India and the provisions of the Atomic Energy (Factories) Rules, 1996 are followed. In the conduct of regulatory activities, the Regulatory Body shall be governed by the provisions of the 'Right to Information Act, 2005, as applicable to the 'public authority'[55] for quick dissemination of information.

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50 Gazette Notification of the commencement of the Nuclear Liability Act, Government of India, http://lawmin.nic.in/ld/regionallanguages/THE%20CIVIL%20LIABILITY%20OF%20NUCLEAR%20DAMAGE%20ACT,2010.%20(38%20OF2010).pdf last accessed on September 5, 2015

51 The Regulatory Body takes necessary steps to keep the public informed on safety issues of radiological safety and significance. It shall also be responsible for notifying to the public, the 'extraordinary nuclear events', occurring in the nuclear facilities in India, as mandated by the Civil Liability for Nuclear Damage Act, 2010.

52 Full text of the Factories Act is available at http://www.ilo.org/dyn/travail/docs/663/ last accessed on December 08, 2015

53 *supra 46,* p.30

54 Policies Governing Regulation of Nuclear and Radiation Safety adopted by the Board of AERB on 8 July 2014, AERB July 2014, Published on 25 November 2015, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/documents/irrs.pdf last accessed on October 7, 2015

55 *supra 46,* p. 2-3

INTERNATIONAL OBLIGATIONS

India uses the IAEA safety requirements and guides as the basis for developing its national safety requirements. Furthermore, it is an active contributor to the process of establishing those standards by participation to the IAEA Nuclear Safety Standards Committee (NUSSC), Radiation Safety Standards Committee (RASSC), Transport Safety Standards Committee (TRANSSC) and Waste Safety Standards Committee (WASSC), as well as allocating significant resources for the working groups on development and revision of IAEA standards. AERB maintains records from domestic nuclear power plants, nuclear power projects, regulatory processes and various international co-operation arrangements (e.g. IAEA-IRS, INES, Convention reports, OECD-NEA committees and working groups, Regulators Forums, Peer Reviews, bilateral agreements, etc.)[56].

Although, India is not yet a contracting party to the Join Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (Joint Convention), these other obligations strengthen its cause of safety and security. The other Conventions are detailed below.

a. Convention on Physical Protection of Nuclear Material[57]
b. Convention on Early Notification of a Nuclear Accident[58]
c. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency[59]
d. Vienna Convention on Civil Liability for Nuclear Damage[60]
e. Convention on Nuclear Safety[61]

All Indian NPPs have been peer-reviewed by World Association of Nuclear Operators (WANO) missions, including respective follow-up missions. The visiting IRRS team was also briefed that India is committed to the IAEA post-Fukushima action plan[62].

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56 *supra 46,* p.18

57 In force from 11 April 2002

58 In force from 28 February 1988

59 In force from 28 February 1988

60 India is signatory to the Convention

61 This includes Article 19 (viii) covering the matters for on-site management of spent fuel and radioactive waste. In force from 29 June 2005

62 *supra 46,* p. 17. The situation in Japan provides the greatest uncertainty due to the 2011 Fukushima Daiichi nuclear accident. Since the crisis, none of Japan's fifty reactors (43 of which are operable) have restarted and Tokyo Electric Power (TEPCO) has not consumed any uranium.

SAFETY AND SECURITY

As a state controlled entity, only the Government (or a Government company or a corporation established by the Government) is allowed to construct and operate a Nuclear Power Plant (NPP). Therefore, the ultimate responsibility of radioactive waste management and disposal lies with the Government of India.

Areas in and around the nuclear power plants have witnessed violent protests, as reported at Kudankulam[63] and Jaitapur[64]. Fishermen staged a unique form of sea rally at Jaitapur demanding that the NPP be stopped from any further development and while at Kudankulam government offices were damaged by protesters. However, a starred question in the Lok Sabha on Shore Protection Measures related to the safety of atomic power stations located near the seacoast is interesting to note. The reply, which was tabled in the Lower House[65] stated that atomic power stations in coastal areas are designed taking into account the technical parameters related to earthquake, tsunami, storm surges, wave run up, floods, tides etc. The shore protection measures provided include construction of civil structures like breakwaters, bunds, walls etc. to minimise the effect of these natural events. The shore protection measures are designed and constructed to withstand the possible impact of natural events. Surveillance of these protection measures is carried out periodically and maintenance activities are undertaken as and when required. Nuclear power plants in the country are not located in volatile geographic locations. They are located in stable geographic locations, in low to moderate seismic zones and at sufficient elevations to withstand the maximum postulated extreme natural events. In the context of tsunami, the nearest major tsunami genic fault lies at a distance of 1300 km from the eastern coast (Kudankulam & Kalpakkam) and 900 km from western coast (Tarapur & Kakrapar) which is too large to

63 Kudankulam protests: One person killed; government offices torched, Economic Times, September 11, 2012 available at http://articles.economictimes.indiatimes.com/2012-09-11/news/33763288_1_kudankulam-protests-anti-nuclear-protest-nuclear-power-plant last accessed on November 21, 2015

64 Jaitapur Nuclear Power Project: Fishermen Stage 'Sea Rally', The Hindu, 30 May 2015 available at http://www.thehindu.com/news/national/jaitapur-nuclear-power-project-fishermen-stage-sea-rally/article7261408.ece last accessed on November 28, 2015

65 Statement referred to in reply to Lok Sabha starred question no.134 for answer on 06.03.2013 by M.I. Shanavas, MP regarding shore protection measures, available at http://dae.nic.in/writereaddata/parl/bud2013/lss134.pdf last accessed on 10 September 2015. For a complete list of statements tabled, questions raised both starred and unstarred in Lok Sabha and Rajya Sabha and their responses received on nuclear issues, see Patil, Brahma, Setana, Year 2013 Select Questions and Answers from the Indian Parliament on Nuclear Issues, Centre for Nuclear & Arms Control, IDSA, 2013

cause any significant impact to the nuclear facilities on Indian shores which have been adequately protected against such natural events.

The employment of threat, risk and vulnerability assessments identifies the level of protection required and forms the basis for implementing security measures to avert any major crises in the area of nuclear usage[66]. To strengthen the safeguards regime, a comprehensive understanding and increased collaboration is necessary across all stakeholders[67]. With the advent of Additional Protocol, the expansion and increased clarity of nuclear facilities is profound. The Government considers the national policy and strategy for safety as being established through legislation within the Atomic Energy Act (AEA) 1962, associated Atomic Energy Rules and the AERB Safety Codes and Standards. Exercising its power of authority given by the Act, the Government has issued the Atomic Energy (Radiation Protection) Rules, 2004; the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987; the Atomic Energy (Factories) Rules, 1996; the Atomic Energy (Working of the Mines Minerals and Handling of the Prescribed Substances) Rules, 1984, and the Atomic Energy (Radiation Processing of Food and Allied Products) Rules, 2012; which represent the basis of the regulatory framework for the safety of the activities relating to use of nuclear energy and regulatory control. For example the Atomic Energy (Radiation Protection) Rules, 2004 establish a sound basis for the application of graded approach in the licensing process. The rules specify different categories of facilities and activities, depending on the associated radiological hazard and risk, and establish different types of supervision to the various categories of facilities and activities. These rules also introduce the principle of 'exemption' of sources or practices with lower risk from regulatory control[68].

Section 4 of India's Code of Radiological Safety in Uranium Mining and Milling[69] has an explicit provision entitled 'Nuclear Security'. This section asks the authority concerned to make an assessment of '(a) Impact of site and surroundings on nuclear security and (b) Physical protection system, physical barrier, communication etc. Integrating the '3S' (safety, security

66 This is a paradox to initiate a dialogue with scientists on permissible limits of radioactivity and energy research.

67 James M. Acton (2007) Strengthening Safeguards and Nuclear Disarmament, The Nonproliferation Review, 14:3, 525-535 Also see Stephen V. Mladineo & Sarah L. Frazar (2013) The Importance of Safeguards Culture, The Nonproliferation Review, 20:3, 509-523

68 *supra 46,* p. 7

69 See AERB Safety Guidelines No. AERB/FE-FCF/SG-2, Radiological Safety in Uranium Mining and Milling, August 2007t

and safeguards) where possible strengthens and coordinates national (and commercial) governance when measures for one can be used to support measures for another. For example, radiological surveys of equipment and personnel exiting the facility assist in monitoring and limiting the spread of contamination and can be used to support supplementary measures under an elevated threat environment or during a security event. Verification of locks and seals similarly protect against spills and leakage while also reinforcing barriers to unauthorised access. Licenses for security may be separate or combined with licenses issued for safety and environmental protection. Further, inventory controls contribute to an effectively implemented safeguards system[70].

APPEALS AND DECISIONS

The appeals against decisions of the AERB lie with the Atomic Energy Commission (AEC) whose decision shall be final and binding. However, the AERB decisions could be appealed against in the court. An example of that is the appeal against the AERB decision on commissioning of Kudankulam NPP. The respective AERB decision was appealed to the High Court and later on before the Supreme Court of India. Both courts confirmed the AERB's decision[71]. On the nuclear safety and regulatory competence, Supreme Court of India in Kudankulam judgement (*G. Sundarrajan v. Union of India & others*: 2013 6 SCC 620, Civil Appeal No. 4440 of 2013) was categorical that it has full faith in the scientific competence of the Indian nuclear establishment and stated that nuclear energy projects are pursued as part of a national policy and the court has no role to determine its fairness[72]. In November 2015, the Kerala High Court upheld the constitutional validity of Nuclear Liability Act 2010 when the Act was challenged on the grounds of being *ultra vires*[73].

In 2011, the Nuclear Safety Regulatory Authority (NSRA) Bill was drafted by the DAE and submitted to the Union Cabinet for approval. The objective of the NSRA Bill was to establish a separate statutory framework

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70 *supra 46,* p. 8

71 M.P. Ram Mohan & Akshay Shandilya (2014): Nuclear energy and risk assessment by Indian courts: analysis of judicial intervention in the Kudankulam Nuclear Power Project, Journal of Risk Research, Vol. 18, Iss. 8, 2015

72 Ram Mohan M.P. & Rajesh Babu R. (2015) Special Issue on 'Nuclear energy and Indian society: public engagement, risk assessment and legal frameworks', Journal of Risk Research, 18:8, 1009-1011

73 The judgment is available at http://judis.nic.in/judis_kerala/qrydisp.aspx?filename=422240 last accessed on December 28, 2015

for nuclear safety regulation in India. As the bill lapsed in the previous Lok Sabha, it will be reintroduced shortly[74].

LICENSING

As the Competent Authority for regulation, the AERB grants licences in accordance with sections 16 and 17 of the Atomic Energy Act. The Atomic Energy (Radiation Protection) Rules (2004) clearly state the requirement for a license for all facilities and activities governed by the Act to be 'radiation installations and installations for the handling of radioactive sources'[75]. Using the powers of the Act and the Atomic Energy Rules, the AERB has issued a number of Safety Codes and Standards. The AERB safety code on 'Regulation of Nuclear and Radiation facilities' states the requirements to be met by the licensed facility[76]. The Rules state that the Licensee has prime responsibility for safety, and the license is not transferable without prior approval of the competent authority (AERB) and it covers all stages of the lifetime of a facility[77].

As part of the regulatory framework, the licensing of nuclear facilities is covered by the Atomic Energy (Radiation Protection) Rules (2004), which identify the AERB as the single competent authority with responsibility for regulation of radiation safety on civil nuclear installations[78]. In addition to radiation safety, the AERB has been empowered to administer the provisions of the Factories Act, 1948 (industrial safety in the NPPs) and perform certain functions of the Environment (Protection) Act, 1986[79].

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74 *supra 46,* p. 9

75 See GUIDE NO. AERB/RF-RS/SG-1, Security of Radioactive Sources in Radiation Facilities, issued in March 2011, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SG-RF-RS-01.pdf last accessed on December 10, 2015

76 A nuclear power plant (NPP) is awarded an authorisation license to a maximum period of 5 years. An NPP operating licence must be renewed at the end of 5 year term through the license renewal process. The licensee is also required to conduct a full scale Periodic Safety Review (PSR) along with a 'Limited Environmental Impact', which has to be demonstrated in the safety report and submit it as part of the renewal process, which takes 10 years for old plants and 5 years for new plants..

77 *supra 46,* p. 7.

78 See AERB SAFETY GUIDE NO. AERB/SG/G-8, Criteria for Regulation of Health and Safety of Nuclear Power Plant Personnel, The Public and The Environment, issued in June 2001, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SG-G-08.PDF last accessed on October 30, 2015

79 *supra 46,* p. 10.

According to the legal and regulatory requirements in place, decommissioning is the responsibility of the owner of the facility. To commence decommissioning, the owner is required to obtain a decommissioning license. A preliminary decommissioning plan (decommissioning concept) should be developed at the design stage of the facility. The plan is required to include the feasibility analyses of facility decommissioning options and to verify that the facility could be safely decommissioned after its shutdown. The preliminary decommissioning plan is required to be reviewed on a periodic basis and should cover characterisation of the radioactive inventory, decontamination and dismantling activities, waste management requirements, safety assessments, human resource requirements etc.

Basic decommissioning requirements are set out within the Code on Waste Management[80]. They are further developed in the AERB Safety Guide on Decommissioning of Nuclear Power Plants and Research Reactors[81]. To provide financial security, the Government in December 1988 established a decommissioning fund to ensure that sufficient financial resources will be available for the safe decommissioning of the NPPs. In this respect, the state utility Nuclear Power Corporation of India (NPCIL)[82] charges a decommissioning fee, which currently amounts to 0.02 rupee per KWh of the generated electricity. The AERB has produced a comprehensive set of around 150 regulatory safety codes and guides and other guidance that have been published on its website[83]. The approach that is used by the AERB in this area is considered comprehensive and complies with the international practice.

WASTE DISPOSAL

The AERB Safety Codes on *Design of Pressurised Heavy Water Reactor based Nuclear Power Plants* and *Design of Light Water Reactor based Nuclear Power Plants*, lays down mandatory nuclear safety requirements that define the necessary elements to ensure safety. Further, Safety Code on *Nuclear Power Plant Operation* deals with various aspects necessary for the safe operation

80 (AERB/SC/RW).

81 (AERB/NPP&RR/SG/RW-8).

82 For more information, see http://www.npcil.nic.in/ last accessed on December 28, 2015.

83 For a complete list of Codes and Guides, see http://www.aerb.gov.in/AERBPortal/pages/English/publication/publicationNW_new_publications.action Also see AERB Safety Guide No. Aerb/Sg/G-6, Codes, Standards and Guides to be prepared by the Regulatory Body for Nuclear and Radiation Facilities, June 2001, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SG-G-06.PDF last accessed on January 11, 2016.

of a NPP, such as responsibility of licensee, requirements across plant management, commissioning programme, operating personnel, plant operations, operational experience feedback, plant modifications, radiation protection, emergency preparedness, plant life management, probabilistic safety assessment and decommissioning requirements. Safety Code on *Radiation Protection for Nuclear Fuel Cycle Facilities* stipulates the requirements for providing adequate assurance for radiation safety of the occupational workers, members of the public and the environment against the undue exposure to ionising radiation. Safety Code on *Management of Radioactive Waste*[84] establishes the requirements, which need to be fulfilled for safe management of solid, liquid and gaseous radioactive waste disposal. India follows a closed nuclear fuel cycle and it treats the spent fuel as a resource to meet the future energy needs. The approach is related to the reduction in the volume of high level waste (HLW). This HLW generated will be vitrified and stored for about sixty years in the storage facilities. After generation of adequate quantities of HLW, India would consider creating deep geological repositories for storing this HLW[85].

All guidance documents are prepared on the basis of AERB Safety Guide on 'Development of Regulatory Safety Documents for Nuclear and Radiation Facilities[86]. The AERB Safety Code on 'Site Evaluation of Nuclear Facilities'[87] establishes the requirements for evaluation of a site[88] from the perspective of safety considerations on site related hazards, site characteristics and related phenomena, assessment of the impact of facility, assessment of the capability for implementing emergency plans in public domain over the projected lifetime of the facility, etc.

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84 The list of AERB Safety Codes are complemented with AERB Safety Guidelines, Safety Guides and Safety Manuals and are periodically updated for better engagement of plant safety. These are comprehensively detailed in the IRRS report. See, *supra 46,* p. 111-122 .

85 *supra 46* p. 12.

86 (AERB/NRF/SG/G-6 (Rev.-1)] For the entire safety manual on Regulation of Nuclear and Radiation Facilities in the G series issued in August 2000, available at http://aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SC-G.PDF and for Regulatory Inspection and Enforcement In Radiation Facilities, see Manual No. AERB/RF/SM/G-3, December 2014, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SM-G-03.pdf last accessed on December 14, 2015.

87 [AERB/NF/SC/S (Rev. 1)] For a elaborate description on the Safety Code, see *supra 46,* p. 65 .

88 In case of an event, accident or for precautionary measures, emergency planning zones are defined consistently with IAEA safety standards for the Precautionary Action Zone (PAZ) and the Urgent Protective Action Zone (UPZ).

INSPECTIONS

AERB guidance documents contain provisions for performing unannounced inspections; however, there was no specific guidance for the purpose, frequency, number, or location of unannounced inspections. Section 23 of the AEA invokes the Administration of Factories Act, 1948 and empowers the AERB for enforcement of industrial safety in units under control of the DAE[89]. The legal basis for carrying out inspections[90] is also derived from India's Atomic Energy Act, 1962, Factories Act 1948, Atomic Energy (Radiation Protection) Rules, 2004, Atomic Energy (Safe Disposal of Radioactive Wastes) Rules 1987 and Atomic Energy (Factories) Rules 1996. Provisions require that licensees provide prompt access to all areas for inspection. The competent authority (Chairman AERB) has also delegated the power to lead inspectors to implement on the spot enforcement action in consultation with the Chairman or Vice-Chairman AERB in accordance with the Atomic Energy Act, 1962[91].

Recently, the siting code[92] (for 2014) was updated, based on lessons learned from the Fukushima accident. In addition to the siting code, a design code for Light Water Reactors which contains the most recent design

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89 The AERB can take the following enforcement actions depending on significance of the non-compliance as identified:

a) Sending an enforcement letter.

b) Sending a written warning/directive.

c) If there is a safety risk due to delay, or in the case of an occurrence of undesirable facts important from the point of view of nuclear safety, radiation protection, physical protection, and emergency preparedness, the AERB can order the NPP to curtail the authorized activities in case of situations deemed to be serious and considered to pose imminent radiological hazards to workers, the public or the environment.

d) Revoke, suspend or modify the Operating Consent of a licence employee who has substantially infringed their duties to satisfy professional, physical or mental requirements.

e) Initiation of penal action.

90 See AERB SAFETY GUIDE NO. AERB/SG/G-4, *Regulatory Inspection and Enforcement in Nuclear and Radiation Facilities*, issued in September 2002, available at http://www.aerb.gov.in/AERBPortal/pages/English/t/publications/CODESGUIDES/SG-G-04.PDF last accessed on December 23, 2015.

91 s*upra 46,* p. 55.

92 Siting code comprises of site evaluation, design basis flood and seismic design basis as the primary features in a nuclear power plant to ensure its safety and security. This is the first step in a five-pronged approach of a NPP prior to design, construction, commissioning, operation and decommissioning. Siting code, governed by the AERB Safety Guide *Quality Assurance in Siting of Nuclear Power Plants (AERB/NPP/SG/S-10)* together with design code addresses the aspect of extreme rare events and includes requirements in the areas of multi-unit effects, emergency preparedness, periodic assessment of external hazards, assessment of safety margins and cliff-edge effect. For a detailed analysis, see *supra 68,* p. 88.

requirements from the IAEA is also published. The AERB published a revised document dealing with 'Criteria for Planning, Preparedness and Response for Nuclear or Radiological Emergency' even earlier than the IAEA[93]. However, to commensurate with the size of India's nuclear programme, the AERB should conduct even more on-site inspections and have a rapid response team to instantly respond to any untoward incident at the nuclear facilities. The increased frequency of inspections would allow for additional independent verification and more effective regulatory oversight of NPPs[94]. Also, AERB should establish a communications strategy to effectively engage with the media, and communicate and consult with the general public and the population in the vicinity of NPPs. This includes consultation with the general public on draft safety codes and standards[95].

CONCLUSION

As more countries engage in building up NPPs and expand their nuclear trade footprint, the accountability regime to prevent proliferation should be strengthened with new legal and extra-legal instruments[96]. While AP appears to provide stronghold in terms of inspection and sampling at facilities, AP alone will be of little help to ensure that nuclear energy is used only for peaceful purposes. Better intra-state coordination, robust nuclear specific domestic legislations and stronger diplomatic linkages are necessary and so are the ever reticent export control regimes. The Indo-US deal is a testimony to this fact and also a stratagem of global acceptance and inclusive scarce resource trading on uranium and its related products. As India plans to expand its civilian nuclear power generation, the international safety framework provides leverage to countries that possess uranium in large quantities for trade and clears roadblocks in the international nuclear regime. As technology advances, Additional Protocol might enter into a fifth tier of safeguards and this should become a best practice that is quickly emulated and implemented across the entire nuclear fuel cycle[97] for increased clarity and supervision.

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93 *supra 46,* p. 66

94 *supra 46,* p. 56-57

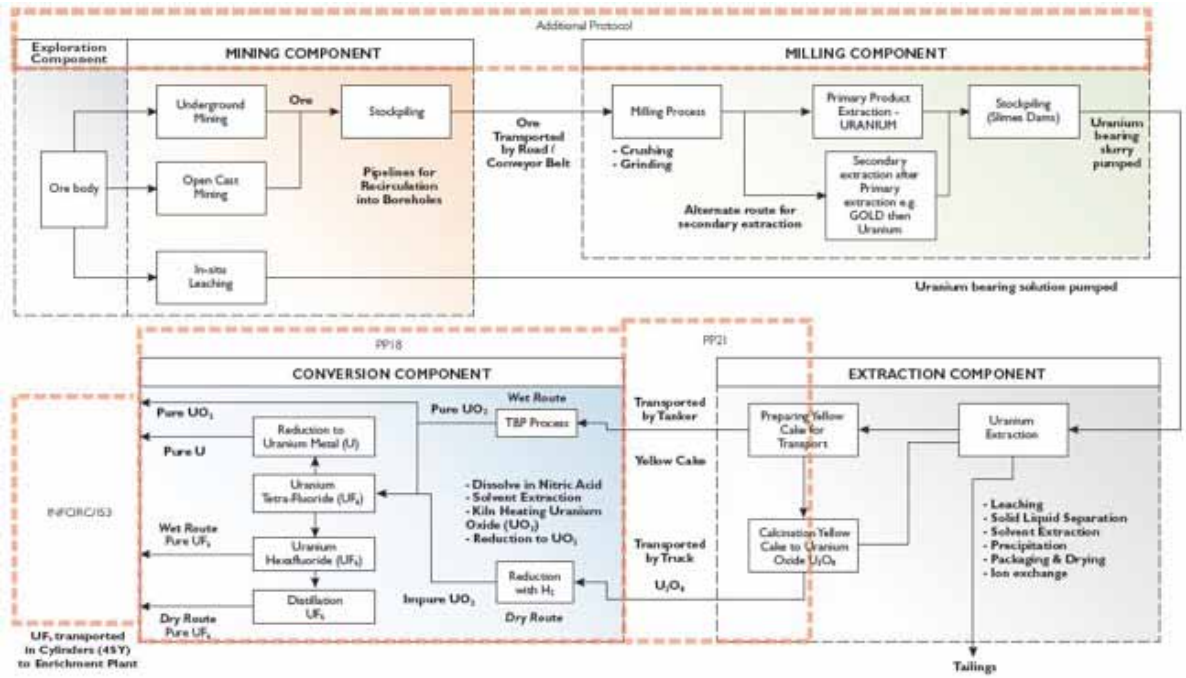
95 There is no AERB public information to the local communities around NPPs. The decisions and their bases are not published individually. The AERB should improve its engagement with the media, communication and consultation with the general public in the vicinity of the NPP sites, including consultation while drafting AERB safety standards.

96 IAEA, Annual Report 2014, GC (59)/7, 15-25521, p. 74-91

97 For a complete schematic illustration of the nuclear fuel complex, see Annexure I

ANNEXURE I

Application of Safeguards to the Front-End of Nuclear Fuel Cycle



The overview of the process flows diagram comes from Annex III of the IAEA Tecdoc DRAFT, 'Nuclear Security in the Uranium Extraction Industry', forthcoming 2015. Source: DIIS REPORT 2015:09, pg 47

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