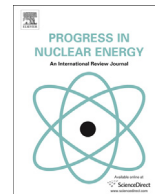




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## Regulatory aspects of nuclear power program in India

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## ABSTRACT

The Atomic Energy Regulatory Board (AERB) is the regulatory body in India for ensuring that the use of ionizing radiation and nuclear energy does not cause undue risk to the health of workers, members of the public and to the environment. AERB is responsible for prescribing and enforcing of rules, regulations and requirements pertaining to safety of nuclear and radiation facilities and radiological safety. This paper describes the regulatory process followed by AERB for ensuring the safety of nuclear power plants (NPPs) during their construction as well as operation. The regulatory process for nuclear and radiation safety in the country had evolved organically, over a long period since the beginning of the nuclear program in the country, addressing the requirements and situations of the applications of the technology in the country. Some of the recent initiatives taken by AERB in this direction are brought out. In the coming days AERB is expected to face new challenges such as coping with the demands of a fast growing nuclear power program, simultaneous review of a large number of new projects of diverse designs and long term operation of the existing NPPs. The paper also gives some insights into how AERB is preparing itself to address these future challenges.

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## 1. Introduction

The installed electricity generating capacity in India as of March 2016 is 298 GW (Source: CEA, India). With this capacity, India is among the top five producers of electricity globally. The annual per capita electricity consumption, for 2015–16 was 1075 kWh (Source: CEA). The contribution from nuclear energy to the overall installed capacity is currently about 2%. To enhance the power generation capacity, India is in the process of setting up Light Water Reactors with foreign collaboration while continuing its own programme of PHWR based NPPs and indigenously designed light water reactor based NPPs. The contribution of nuclear energy is also proposed to be enhanced to about 63 GW by 2032.

The Government has accorded 'in-principle approval' of the sites for setting up several new NPP units of indigenous 700 MWe PHWRs and imported LWRs of 1000 MWe or higher. India has at present a cumulative experience of over 430 reactor years of safe operation of its nuclear power plants. At present, there are 21 operating NPPs in India with a total installed capacity of 5680 MWe. This includes two Boiling Water Reactors at Tarapur, eighteen Pressurised Heavy Water Reactors (6 units at

Rawatbhata, 4 at Kaiga and 2 each at Kalpakkam, Narora and Kakrapar and 2 at Tarapur sites) and one Pressurised Water Reactor at Kudankulam. RAPS unit 1, though identified as an operational unit, is remaining shutdown since October 2004. One Pressurised Water Reactor of 1000 MWe at Kudankulam is currently undergoing commissioning and initial power operation. Construction of the 500 MWe indigenously developed Prototype Fast Breeder Reactor is completed and the reactor is due to enter the commissioning phase soon. Four more units, RAPP-7&8 and KAPP-3&4, each of 700 MWe indigenous Pressurised Heavy Water Reactors are undergoing construction at Rawatbhata and Kakrapar sites respectively.

In addition, regulatory clearances have been issued for sting of four units of Pressurised Heavy Water Reactors of 700 MWe each at the Gorakhpur site in the northern State of Haryana and four more units of Pressurised Water Reactors of 1000 MWe each at Kudankulam.

The focus in assuring safety in a nuclear power plant is essentially to have the siting, design and operation of NPPs such that the accidents are prevented and the consequences of the accidents are mitigated, should they occur. These include practical elimination of the accident sequences that can result in unacceptable radiological consequences. In case such unlikely situations arise during operation of these facilities, their progression should be terminated or controlled at the earliest, in a manner

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**List of abbreviations**

AEC	Atomic Energy Commission	MoU	Memorandum of Understanding
AERB	Atomic Energy Regulatory Board	MWe	Mega Watt electrical
ALARA	As Low As Reasonably Achievable	NEA	Nuclear Energy Agency
ARL	Application for Renewal of License	NPCIL:	Nuclear Power Corporation of India Limited
BHAVINI	Bharatiya Nabhikiya Vidyut Nigam Limited	NPP	Nuclear Power Plant
BWR	Boiling Water Reactor	OEF	Operating Experience Feedback
CEA	Central Electricity Authority	PFBR	Prototype Fast Breeder Reactor
CNS	Convention on Nuclear Safety	PHWR	Pressurised Heavy Water Reactor
DG	Diesel Generator	PIE	Postulated Initiating Events
ECCS	Emergency Core Cooling System	PSAR	Preliminary Safety Analysis Report
EDG	Emergency Diesel Generator	PSR	Periodic Safety Review
FBR	Fast Breeder Reactor	PWR	Pressurised Water Reactor
FOAK	First Of A Kind	RAPP	Rajasthan Atomic Power Project
FSAR	Final Safety Analysis Report	RAPS	Rajasthan Atomic Power Station
GW	Giga Watts	SARCAR	Safety Review Committee for Application of Radiation
INES	International Nuclear and Radiological Event Scale	SARCOF	SAfety Review Committee for Operating Plants
IRRS	Integrated Regulatory Review Service	SC	Safety Code
IRS	International Reporting System	SG	Safety Guide
KAPP	Kakrapar Atomic Power Project	SRI	Safety Research Institute
LWR	Light Water Reactor	SSC	Systems, Structures and Components
MAPS	Madras Atomic Power Project	TAPS	Tarapur Atomic Power Project
MDEP	Multinational Design Evaluation Programme	VVER	Voda-Voda Energo Reactor (Water-cooled Water moderated Energy Reactor)

that safety of the public and the occupational workers is ensured by keeping the radioactivity confined.

## 2. Atomic energy regulatory board and its regulatory structure

The main legal framework for nuclear power and applications of radiation in India is provided by the Atomic Energy Act, 1962 and the Rules and Notifications issued under it. The Act provides for the development, control and use of atomic energy for the welfare of the people of India and for other peaceful purposes. In addition to the Atomic Energy Act, the provisions of several other legislations related to environment, land use, etc. have also to be met for locating and operating Nuclear Power Plants (NPPs). The provisions of these Acts are enforced by respective Ministries/Departments/Authorities at the Centre or the State, as the case may be. Apart from the Atomic Energy Act, 1962, the other important legislations that have a bearing on the establishment and operation of NPPs in India include the Indian Electricity Act, 2003, Environment Protection Act, 1986, Factories Act 1948, Disaster Management Act, 2005, Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981, Water (Prevention & Control of Pollution) Cess Act, 1977, Indian Explosive Act, 1884, Indian Boilers Act, 1923 and Civil Liability for Nuclear Damage Act, 2010.

The regulatory framework for safety in the nuclear power programme in India had evolved organically in conjunction with the development of the programme itself, with the involvement of the scientists and engineers. In the initial years, safety regulation of the facilities, mainly the research reactors, was essentially based on the principle of self-regulation, wherein the responsibility for safety was placed on the facilities themselves. While this had worked well, the need for a separate mechanism for overseeing as to how the facilities are fulfilling their responsibility for safety in their activities was realized, which led to evolution of a safety review committee structure. Subsequently as the nuclear power

programme was expanding, the need for having a separate body for discharging the regulatory roles and responsibilities was realized. Towards this end, the Atomic Energy Regulatory Board (AERB) was constituted in 1983, under the provisions of the Atomic Energy Act, 1962, through a Presidential Notification ([Atomic Energy regulatory Board, 2008](#)).

The authority of AERB emanates from sections 16, 17 and 23 of the Atomic Energy Act, 1962 read along with the Presidential Notification establishing AERB and the Rules and Notifications issued under the Act, which include.

- Atomic Energy (Radiation Protection) Rules, 2004
- Atomic Energy (Safe Disposal of Radioactive Waste) Rules, 1987
- Atomic Energy (Factories) Rules, 1996.

With the statutory and legal provisions of the Atomic Energy Act, 1962, the Rules thereunder and the powers conferred to it by its constitution, AERB has the necessary legal authority for its regulatory activities. The mandate assigned to AERB is that of safety regulation and no responsibility assigned to it is in conflict with its regulatory role. These ensure functional independence of AERB as regulator ([IAEA, 2015](#)).

AERB has the powers and responsibilities to lay down the regulatory and safety requirements, conduct safety reviews and assessments, enforce compliance to the requirements, and issue regulatory consents to the facilities. AERB is also responsible for managing the technical competence, public information on issues of nuclear and radiation safety issues as well as carrying out and promoting research and development in the areas of safety and regulation. AERB is responsible for the safety supervision of the nuclear and radiation facilities/activities in India. The Mission of AERB is to ensure that the use of ionizing radiation and nuclear energy in India does not cause undue risk to the health of people and the environment.

AERB currently has a full time Chairman, an ex-Officio Member, four external Members and a Secretary. AERB reports to the Atomic

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