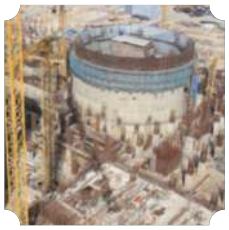










CHAPTER 1

SUMMARY

During the year 2015-16, the Atomic Energy Regulatory Board (AERB) continued to carry out its principal mandate of monitoring the safety of all facilities and activities involved in nuclear energy and applications of ionizing radiations that are under its purview. AERB continued the regulatory activities in its endeavor to achieve its mission and to strengthen itself as a more effective and efficient regulator.

AERB continues its regulatory supervision of the nuclear power plants, front-end and back- end nuclear fuel cycle facilities, research facilities under its purview and the radiation facilities which are involved in applications of ionizing radiation in industry, medicine, agriculture & research.

AERB carried out its functions with the support of its secretariat and specialist committees under the guidance of the Board. The Board met three times during the year and reviewed the safety status of operating Nuclear Power Plants (NPPs), Nuclear Power Projects under construction / commissioning, Nuclear Fuel Cycle Facilities & Radiation Facilities. Based on satisfactory review, the important decisions taken by the Board were as follows:

AERB Board Meeting in Progress

1. Issue of License for regular operation of KKNPP Unit -1 for a period of five years (up to July 2020)
2. Issue of Siting consent for Gorakhpur Haryana Anu Vidyut Pariyojna Unit 1 to 4, Haryana.
3. Approval for the publication of the following Safety Codes related to Medical, Industrial, Agriculture and Research Applications and Transport of Radioactive Material,
   - Safety Code on Industrial Radiography,
   - Safety Code on Radiation Processing Facilities
   - Safety Code Radiation Safety in Manufacture, Supply and Use of Medical Diagnostic X-ray Equipment
   - Safety Code on Safe Transport of Radioactive Material

Safety Surveillance of Nuclear and Radiation Facilities

All Nuclear Power Plants (NPPs) in operation and under construction, nuclear fuel cycle facilities and radiation facilities undergo in depth safety reviews by AERB during various stages namely siting, construction, commissioning and operation, as relevant. AERB issues regulatory consents for siting, construction, commissioning, operation and decommissioning, as applicable, based on requisite safety reviews and assessments. During the operational phase of the facilities, AERB monitors safety of the facilities and activities through periodic regulatory inspections, review of the specified periodic reports, and comprehensive safety reviews as part of periodic renewal of licenses. AERB follows well established processes for regulatory inspections, safety reviews (multi-tier) and assessment of the facilities and activities. AERB also carries out research & development activities and safety analysis in support of its regulatory functions.

Safety Surveillance of Nuclear Power Projects under construction

During the year, AERB issued License for regular operation of Unit -1 of Kudankulam Nuclear Power Plant (KKNPP-1) after satisfactory completion of the requisite commissioning tests and steady operation of the unit at the rated power for the specified period.

Unit 2 of the Kudankulam Nuclear Power Plant (KKNPP-2) is under commissioning. During 2015-16, AERB issued clearance for Hot-Run of the unit. AERB reviewed the results of the Hot-Run, the pre-service inspections of important equipment and systems and status of the compliance to the recommendations and stipulations of AERB. AERB also took up review of the applications for Initial Fuel loading (IFL) and First Approach to Criticality (FAC) of the Unit-2 of KKNPP.

(After satisfactory resolution of various issues related to these, AERB issued clearances for IFL and FAC on May 24, 2016 and June 27,2016 respectively. The unit achieved criticality on July 10, 2016).

AERB had earlier issued the Siting Consent for Units 3 & 4 of Kudankulam Nuclear Power Project (KKNPP-3 & 4), 1000 MWe VVER type reactors of similar design as KKNPP -1 &2, in February, 2011. After satisfactory completion of the review of relevant aspects, AERB issued the clearance for Site Excavation of KKNPP-3&4, which is the first sub stage of construction clearance.

After satisfactory completion of review of Site Evaluation Report and associated submissions, AERB issued the Siting Consent for four units of 700 MWe PHWRs (GHAVP-1 to 4) at Gorakhpur in July, 2015. Review of the application for construction consent for the first two units is in progress.

Four units of 700 MWe PHWR are under construction, two each at Kakrapar and Rajasthan sites. The AERB had issued clearances for erection of Major Equipment in these units during the year 2014 and 2015, respectively. Currently, AERB is reviewing the safety aspects with respect to design of these projects according to the relevant sub stages of construction clearances as well as compliance to the relevant codes & standards, and recommendations /stipulations of AERB in the construction consents.

The 500 MWe Prototype Fast Breeder Reactor (PFBR) is undergoing preparations for taking up commissioning activities. AERB has been reviewing the preparedness of PFBR project for taking up of commissioning activities and safety review of the commissioning procedures

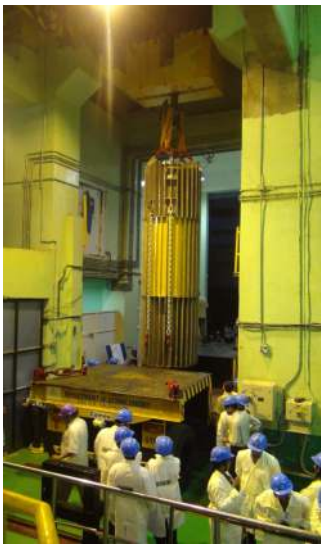
AERB is currently reviewing the Application and other related submissions with respect to Siting Consent for six units of Evolutionary Pressurised Reactor (EPR) each of 1650 MWe proposed to be setup at Jaitapur, Maharashtra and the Application seeking Siting Consent for the proposed FBR-1&2 that is proposed to be set up at Kalpakkam in Tamil Nadu.

The Bhabha Atomic Research Centre (BARC), jointly with NPCIL, is developing the design of Indian

Installation of Pre Service Inspection (PSI) fixture for Reactor Pressure Vessel (RPV) Inspection in KKNPP-Unit # 2

Bird Eye view of KAPP 3 & 4 Project Site

Bird Eye view of RAPP-7 & 8 Project Site



Pre-Commissioning activities in progress at PFBR site

Pressurised Water Reactor (IPWR). IPWR is an indigenous PWR design with a power rating of 2700 MWt – 900 MWe, incorporating advanced safety features, including passive safety systems similar to the ones developed for the Advanced Heavy Water Reactor (AHWR). The IPWR also incorporates layout features of the 700 MWe PHWRs being constructed in India. AERB has taken up pre-consenting review of the design of IPWR. In this regard, AERB has reviewed the technical design document (TDD) of IPWR based on the request from BARC.

The details of safety surveillance of Nuclear Power Projects during the year 2015-16 are given in Section 2.1 of Chapter-2.

Safety Surveillance of Nuclear Power Plants in Operation

There are twenty one nuclear power plants in operations. AERB continued its regulatory supervision of these plants. The radioactivity releases from all the nuclear power plants were below the limits specified in the technical specifications for operation. Effective dose to public in the vicinity of NPP sites was far less than the annual limit of 1 mSv (1000 micro-Sievert) prescribed by AERB. Public dose limit of 1000 micro-Sv per year is an International benchmark, based on the recommendation of International Commission on Radiological

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Protection (ICRP). The radiation exposure to occupational workers in these plants was also well below the prescribed limit of 30 mSv in a year, with maximum individual radiation dose as 18.71 mSv. AERB dose limit of 30 mSv in a year for the occupational workers is more conservative as compared to the ICRP recommended limit of 50 mSv in a year.

On March 11, 2016, there was an incident of leakage from a coolant channel at KAPS Unit-1. Following the leak from primary coolant system; the reactor underwent an automatic shutdown. The safety systems, viz. emergency core cooling and containment isolation got actuated and performed as intended. Following the event, plant emergency was declared, which was terminated after safely discharging the fuel from the leaky channel and isolating this channel from the primary coolant system on March 21, 2016. There was no fuel failure. The event did not result in any radiation over-exposure to plant personnel. The radioactivity releases were within the specified limits for normal operation. During the course of the plant emergency, the environmental surveillance carried out within the site, as well as in the off-site domain up to 30-km from the plant, confirmed that there was no increase in the background radiation levels and there was no radioactive contamination. Currently, the unit is under shutdown for investigations. Based on the incident, AERB has stipulated expeditious inspection of coolant channels in all other operating reactors as well as thorough review of design and leak detection capability of Annulus Gas Monitoring System (AGMS) to detect any vulnerability of such events in other operating units.

As a part of the operating experience feedback programme, all the NPPs are required to carry out investigations of various events occurring in the plant (significant events) for identifying the root causes, so as to take corrective actions to obviate recurrence of such events. Reports on such events and the investigations and corrective actions are required to be reported to AERB as per the specified reporting criteria. These reports are reviewed in detail in AERB to see the adequacy of investigations, corrective actions, lessons learned and the need for any regulatory actions. During the calendar year 2015, there were 42 significant events reported from the operating NPPs. The events are also rated as per the International Nuclear and Radiological Event Scale (INES) which rates the events on a scale of 1-7,based on the their consequences. All the events were of INES level-0(corresponding to deviations below scale).The event of leakage from a coolant channel at Unit-1 of Kakrapar Atomic Power Station (KAPS -1) which took place on March 11, 2016 was provisionally rated as Level-1 (corresponding to Anomaly). The event is under investigation.

During the year, AERB reviewed the applications for renewal of license for operation of TAPS-1&2, MAPS and RAPS-5&6 and the license for operation of these reactors were extended.

Site Emergency Exercises were conducted at all NPP sites and Off-Site Emergency Exercises were conducted at Tarapur, Kalpakkam, Narora and Kaiga site. AERB officials carried out special regulatory inspections on emergency aspects and participated in these emergency exercises as observers. AERB also participated in emergency exercises conducted by IAEA under the 'Convention on Early Notification of Nuclear Accident and Convention on assistance in Nuclear Accident or Radiological Emergency'.

The details of safety surveillance of operating Nuclear Power Plants during the year 2015-16 are given in Section 2.2 of Chapter-2.
The Status of Environmental Safety and Occupational Exposures are given in Chapter 5.
The Status of Emergency Preparedness of the Nuclear Facilities is given in Chapter 6.

Safety Surveillance of other Nuclear Facilities

During the year, AERB continued to review the safety aspects of the Nuclear Fuel Cycle and Research & Development (R&D) facilities under its purview. These facilities include the atomic minerals exploration units of Atomic Minerals Directorate for Exploration and Research (AMD) facilities, mines & uranium ore processing mills of Uranium Corporation of India Ltd. (UCIL), thorium mining, mineral separation plants & mills of Indian Rare Earths Ltd. (IREL), Nuclear Fuel Complex (NFC) at Hyderabad, Zirconium Complex (ZC) at Pazhayakayal, Heavy Water Plants (HWP), diversified projects of Heavy Water Board, R&D units at Variable Energy Cyclotron Centre (VECC), Raja Ramanna Centre for Advanced Technology (RRCAT) and industrial units of Electronics Corporation of India Limited (ECIL).In addition, AERB also reviewed the radiological safety aspects in the facilities handling Beach Sand Minerals (BSM) and other Naturally Occurring Radioactive Materials(NORM).

AERB issued/renewed License for operation of Bagjata, Jaduguda Mill and Turamdih Mill of Uranium Corporation of India Ltd. (UCIL), the Heavy Water Plants (HWP) at Manuguru, Kota, Baroda, Hazira and

various plants operational at HWP-Talcher. AERB has also issued the License for regular operation of INDUS-2 Accelerator (2.5 GeV, 200mA) at RRCAT- Indore, plants of Electronics Corporation of India Ltd (ECIL), Hyderabad.

The back end nuclear fuel cycle facilities namely, Demonstration Fast Reactor Fuel Reprocessing Plant (DFRP) and Fast Reactor Fuel Cycle Facility (FRFCF) at IGCAR, Kalpakkam, Tamil Nadu are under construction. AERB is reviewing the design safety aspects of these facilities with respect to clearances for relevant stages of construction. AERB is also reviewing an Application for Construction Consent for a demonstration facility for Metallic Fuel Fabrication (DFMF) that is proposed to be set at IGCAR, Kalpakkam, Tamil Nadu.

AERB also reviewed and issued consent /clearance for various research facilities at Indira Gandhi Centre for Atomic Research (IGCAR) and facilities of Board of Radiation and Isotope Technology (BRIT).

The details of safety surveillance of these Facilities during the year 2015-16 are given in relevant sections of Chapter-2.
The Status of Environmental Safety and Occupational Exposures are given in Chapter 5.
The Status of Emergency Preparedness of the Nuclear Facilities is given in Chapter 6.

Safety Surveillance of Radiation Facilities

AERB carried out safety review of various facilities using radiation sources in industry, medicine, agriculture and research. During the period, AERB issued 14092 consents for operation (license, authorization and registration), 167 type approvals, 2862 approval of radiation safety officers for different practices and 2829 permissions for procurement of radioactive sources (imported & indigenously manufactured).

During the year, AERB carried out 759 regulatory inspections covering the radiation facilities. AERB carries out inspection of radiation facilities in accordance with graded approach based on the radiological hazard potential.

As part of its e-Governance initiatives, and with the objective to enhance the efficiency and transparency in the regulatory processes, AERB has put into operation a web-based system called "e-Licensing of Radiation Applications (e-LORA)" which enables automation of the regulatory processes for various Radiation Facilities located across the country. AERB has completed the development phase of e-LORA on December 31, 2015. With the e-LORA fully functional, AERB today has a

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user friendly interface for the applicants and licensees with AERB. The automation has also helped AERB in disposition of the applications at a much shorter time interval in comparison to earlier practice. Around 35,000 X-ray equipment has been declared in the e-LORA system of which, around 23,500 equipment are licensed. In recognition of this initiative, AERB received the "SKOCH Smart Governance Award - 2015".

With several other initiatives along with e-LORA, AERB has strengthened its regulation of diagnostic X-ray equipment and have resulted into a significant increase in regulation of these equipment. As a part of the nation-wide campaign taken up by AERB to ensure increased compliance and regulatory coverage of Medical diagnostic X-ray equipment, AERB carried out surprised inspection of these facilities in major cities/towns in the country and suspended operation of some of the medical diagnostic facilities in view of their non-compliance with the specified regulatory & radiation safety requirements.

incident is being closely monitored by AERB. AERB has issued show-cause notice to the concerned industrial radiography institution for committing violations of stipulated regulatory provisions and lack of physical security measures provided for radiography exposure devices during storage.

AERB continues to reinforce its regulatory inspections at institutions possessing disused sources, to ensure the safety of source while at the same time ensuring that the security arrangements at these institutions remain appropriate.

Following certain news reports regarding use of dental X-ray examinations with the aim of age determination or birth registration, AERB issued an advisory to medical/dental fraternity and the general public against indiscriminate use of dental x-ray examinations solely for the purpose of non-diagnostic applications such as age determination or birth registration.

The details of safety surveillance of these Facilities during the year 2015-16 are given in Chapter-3. The Status of Occupational Exposures and Environmental Safety are given in Chapter 5.

During the year, AERB has signed MoU with the Government of West Bengal for establishment of Directorate of Radiation Safety (DRS). The objective underlying the setting-up of the State-level DRS is to strengthen the safety regulatory control over medical diagnostic X-ray facilities in view of the large number of diagnostic X-ray units/facilities spread across the country and the accelerated growth in their numbers. As on date, AERB has signed agreements with of 13 States and presently DRS are authorised to carry out regulatory inspections of diagnostic radiology facilities in the States of Kerala, Chhattisgarh, Arunachal Pradesh, Mizoram, Punjab and Tripura.

An incident involving theft of two numbers of industrial gamma radiography exposure devices (IGREDs) was reported from an industrial radiography inspection facility at, New Delhi. The incident was reported to AERB after two days of noticing the theft and is under investigation by the Law & Enforcement Authority of Sarita Vihar, New Delhi. The above theft

Industrial Safety

AERB is responsible for administration of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996 in all the units of DAE under its purview. In this regard, AERB discharges its regulatory functions identified under the Factories Act, 1948 for these facilities, including issuance of Licenses, review of industrial and fire safety aspects, authorizing Competent Persons, Certifying Surgeons, conduct of inspections to verify compliance to the specified safety requirements etc. AERB also reviews the construction safety aspects of nuclear projects by carrying out inspections of the facilities under construction.

During the year 2015-16, four fatalities of construction workers were reported from IGCAR, Kalpakkam, RAPP 7&8 Project site, Rawatbhatta and

from NFC, Hyderabad. All these accidents were investigated and reviewed in AERB. Based on these reviews, AERB stipulated additional measures for strengthening safety management and supervision of the construction sites. AERB took enforcement actions of stopping the construction activities at these sites till the site implemented the recommendations made by AERB and put in place the required safety management systems and supervision. Based on the submission of compliance reports and review by the sites, AERB carried out a special inspection at these sites, before permitting resumption of construction activities. The lessons learnt from these incidents were disseminated to all DAE units.

The details of monitoring of Industrial safety status in DAE units during the year 2015-16 are given in Chapter-4.

Safety Document Preparation

During the year, eleven new regulatory safety documents were published, out of which four were Safety Codes and seven Safety Guides/Guidelines. Six regulatory safety documents were under development and four were translated into Hindi. As of now, AERB has published 156 regulatory safety documents for nuclear and radiation facilities including industrial safety.

AERB has now established a mechanism for obtaining comments from the general public on Safety Codes. From October 2015 onwards, the draft safety codes are being posted on the website of AERB for public comments.

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Research & Development (R & D) and Safety Studies

AERB carries out independent safety analysis and research on important areas of nuclear and radiation safety which facilitate the regulatory review and constitute one of the inputs for regulatory decision making during licensing process. During the year, AERB had focused on areas covering Severe Accident (SA) studies for PHWR and VVER, hydrogen distribution & Mitigation studies, reactor physics studies, source term estimation for radiological impact assessment, environmental safety, coupled thermal-hydraulics & structural studies, and probabilistic comparison of risk in Multi-unit NPP sites. AERB also participated and contributed in various internal collaborative exercises aimed at new knowledge development.

AERB continued to promote and fund several research projects on reactor safety, radiation safety, front end and back end fuel cycle safety related problems and industrial safety at various reputed universities and academic institutions under the Safety Research Programme. During the period six new projects were approved and twelve on-going projects were renewed.

The details of various activities of safety analysis and research are presented in Chapter-8.

International Cooperation

During the year, AERB took several initiatives to enhance its contribution in harmonization of international regulatory practices and methodologies. AERB continued its participation in international cooperation activities with organizations such as International Atomic Energy Agency (IAEA), Organisation for Economic Cooperation and Development (OECD)/Nuclear Energy Agency (NEA), CANDU Senior Regulator's meeting, the VVER regulators forum and Multinational Design Evaluation Program.

AERB successfully hosted a four-day international workshop on NPPs -SAFETY & SUSTAINABILITY, combining the international Workshops CANSAS-2015 (CANDU Safety Association for Sustainability) & IW-NHNRTHS-2015 (International Workshop on New Horizons in Nuclear Reactor Thermal Hydraulics Safety) during December 8-11, 2015. AERB also hosted the 14th AERB-USNRC bilateral meeting and workshop at Mumbai during October 27-29, 2015. As a full member of the Multinational Design Evaluation Program (MDEP), AERB actively participated and contributed in the deliberations and activities.

AERB signed an arrangement for regulatory cooperation with Canadian Nuclear Safety Commission (the nuclear regulatory authority of Canada). AERB already has bilateral arrangements with the regulatory bodies of other countries namely, France, Russia, Romania, Ukraine, the United States of America and Finland.

India is a contracting Party to the Convention on

Nuclear Safety (CNS). AERB led the Indian Delegation to the Organizational Meeting of the CNS, in preparation of the Indian participation in the forthcoming 7th Review Meeting of CNS.

Details on AERB's contribution in various international forum are presented in Chaper-10.

Human Resource Development

Availability of adequate number of competent staff and maintaining the competence for current and future needs of AERB is important for efficient and effective discharge of its mandate. AERB has augmented the technical manpower substantially by inducting post-graduates through AERB Graduate Fellowship scheme (AGFS) in IIT Bombay and IIT Madras and through training schools of BARC, IGCAR and NFC and transfer of experienced personnel from operating plants and R&D institutes. During the period, the scientific & technical manpower in AERB has increased from 251 to 264. The total strength of manpower in AERB is 326.

For effective management of competency of AERB staff, competency mapping analysis was carried out for AERB Officers. Based on the outcome of the gap analysis, training programmes has been initiated to bridge the gaps. In addition, AERB continued to train its staff by organizing various training programmes, workshops, on the job training at NPP sites etc. Three officers of AERB have achieved higher qualifications in the areas of engineering. AERB officials also acted as faculty members in various national and international training programs.

Under bilateral exchange of technical information and cooperation in nuclear safety matters with the US Nuclear Regulatory Commission (USNRC), AERB deputed two officers for a one year assignment to the USNRC. The above assignment provided a unique opportunity for the officers to experience the functioning of the NRC with regard to regulation of operating NPPs and NPPs under construction by interacting with the staff of the NRC on daily basis & participating in their activities.

To promote excellence and recognize outstanding achievements of the staff engaged in the AERB regulatory and associated research & development activities, AERB has instituted a yearly award scheme from the year 2012. AERB award scheme comprises of individual awards as well as group achievement awards. Awards for the year 2014-15 were distributed during the Annual Day Celebrations of AERB held on November 16, 2015.

Public Outreach Activities

AERB has the mandate to keep the public informed on major issues of radiological safety significance. AERB provides all necessary information to its stakeholders through its periodic newsletters, annual reports, annual bulletin, website, press releases/ briefings etc. The AERB annual reports, contain information on safety status of nuclear & radiation facilities and findings of regulatory reviews. It also includes information on safety significant events reported by licensee and the regulatory inspections. AERB website plays a pivotal role in keeping the public informed on issues related to radiological safety, major regulatory decisions and special technical reports etc. The AERB Bulletin, which is the popular version of the Annual Report of AERB, presents the most important activities in a more understandable and public friendly format.

AERB sought the views/ comments from public and other interested parties on the draft of the newly developed safety codes towards assessing the effectiveness of such process.

Information on operating nuclear power plants including, validity of operating license, Regulatory Inspections, Significant Events, radioactive effluent discharges, occupational exposures, rated power capacities of all operating NPPs etc are provided on the AERB's website and are updated on quarterly basis.

During the year, 12 Press releases were issued on the different topical issues including; License for Regular Operation of Kudankulum NPP Unit -1, Consent for Siting of four more Indigenous Nuclear Power Units in Haryana, enforcement actions taken by AERB during surprise inspection campaign at various medical diagnostic facilities in the major cities/towns in India, release of e-LORA modules and on incident of leak from one of the coolant channel occurred at Kakrapara Atomic Power Station (KAPS) Unit-1.

Subsequent to the incident of leak from one of the coolant channel at KAPS-1, AERB promptly issued a press release on the safety status of the plant and functioning of respective safety systems. Thereafter, AERB

kept the public/media engaged by issuing updates on the incident through its website. The proactive steps taken by AERB for communicating the safety status paved way for fruitful interaction between media and AERB and helped to a large extent in allaying the apprehensions of fear and rumors among public.

Nine awareness programs focusing on the aspects of enhancing radiation safety awareness were conducted for target audience including the radiation workers, manufacturers/ suppliers of equipment, personnel from the industry, university faculty and students

AERB continued strengthening its public outreach activity with an aim to reach out to all sections of society (public, stakeholders, including manufacturers & suppliers, operator etc.) and bring awareness on the aspects of nuclear, radiation & industrial safety. Nine awareness programs focusing on the aspects of enhancing radiation safety awareness were conducted for target audience including the radiation workers, manufacturers/ suppliers of equipment, personnel from the industry, university faculty and students.

AERB published advertisements in print media on aspects of obtaining requisite consents for possessing or use of radioactive sources/radiation generating equipment and requirements for medical diagnostic X-ray units. AERB also participated in some of the science and technology fairs for displaying exhibits on the safety and regulatory aspects of Nuclear & Radiation Facilities.

Apart from above mentioned activities, AERB timely provided response to the parliament questions and on queries posted by the members of public under the “Right to Information Act”, 2005 enacted by the Parliament of Government of India.