During the year 2018, Atomic Energy Regulatory Board (AERB) continued to monitor safety aspects of all facilities and activities involved in nuclear energy and applications of ionising radiations that are under its preview. AERB continued the activities to achieve its mission and to strengthen itself as a more effective and efficient regulator.

AERB continued to carry out its functions with the support of its secretariat, technical divisions and specialist committees under the guidance of the Board. The Board met four times during the year 2018. The Board was apprised of the periodic safety status of nuclear and radiation facilities including the review of the reported fatal accidents and the authorisations issued. The Board was briefed on the roadmap of AERB for its Regulatory Processes for the coming years. Top level document on Integrated Management System (IMS) at AERB was approved by the Board. The next level documents towards implementation of IMS in AERB are also in the process of development.

The Board was briefed on the R&D studies involved in arriving at the Root Cause Analysis of Pressure Tubes leakage events at Kakrapar Atomic Power Station (KAPS-1&2). Board Members visited to Kakrapar site to see the status of restoration and

The Board approved following major reports and documents;
1. Proposal for Regular operation of Kudankulam NPP Unit-2 and grant of Licence
2. Construction consent to NFC-Kota
3. Clearance for Excavation of KKNPP-5&6 and GHAVP-1&2
4. Annual Report of AERB for the year 2017
5. Level-I document for implementation of Integrated Management System in AERB
6. Concept note on Expansion of AERB through Regional Regulatory Centres
preparatory activities for resuming operation of KAPS Units.

The Board was informed on some of the important coordination activities undertaken by AERB to strengthen the regulatory interface with Directorate General of Civil Aviation (DGCA) on transport of radioactive material including in-transit storage, with National Accreditation Board for Testing and Calibration Laboratories (NABL) on Accreditation of Calibration Laboratories and with Directorate General of Foreign Trade (DGFT), Ministry of Commerce and Industry (MoCl) with regard to issue of Notification for import of Radiation Generating Equipment.

**Safety Surveillance of Nuclear Power Projects**

AERB granted clearance for First Pour of Concrete (FPC) to KKNPP Unit-3&4 on June 23, 2017 with certain stipulations, and subsequently, based on satisfactory safety review of the respective stipulations, clearance was granted for commencement of construction of Containment slab, Reactor building internal structures and slabs and walls of other associated buildings. Based on satisfactory review of excavation application, AERB granted clearance for Excavation w.r.t. KKNPP-5&6 on November 14, 2018.

AERB had earlier accorded permission for commissioning of Secondary Sodium Pumps in both the loops in SGB-1&2 of PFBR during December 2017. Activities related to integrated preheating of Main Vessel (MV), Safety Vessel (SV), secondary sodium circuit and SGDHR circuit were in progress with heat input from hot nitrogen circulation through annular space.

Safety review of various submissions of the twin units of 700 MWe pressurized heavy water reactors (PHWR) at Kakrapar, Gujarat (KAPP-3&4) and Rawatbhata, Rajasthan (RAPP-7&8) was in progress. Civil construction activities were in advanced stage at both the sites.

Review was in progress for application seeking clearance for FPC for GHAVP-1&2, with a focus on design differences w.r.t. the earlier projects. The application and associated documents for Siting Consent for twin units of 700 MWe PHWRs at Kaiga (Kaiga-5&6) was reviewed to ascertain adequacy of the submissions with respect to regulatory requirements.

**Safety Surveillance of Nuclear Power Plants and Research Reactors**

22 nuclear power plants are in operation in India. AERB continued its regulatory supervision of these plants. The radiation exposure to occupational workers in these plants was below the prescribed limit. The station’s submissions were extensively reviewed in multi-tier systems as per the established mechanism in AERB.

*The radioactivity releases from all the nuclear power plants were below the AERB specified limits.*

*Effective dose to members of public in the vicinity of NPP sites was far less than the annual dose limit of 1 mSv (1000 micro-Sievert) prescribed by AERB*

AERB performed independent assessment of various aspects related to KGS-1’s continuous operation of 962 days. The continuous long term operation of KGS-1 provided first-of-a-kind opportunity for generating the data on performance of plant systems, structures and components during continuous run. This will provide useful insights for further developing the regulations for NPPs in India.

In the year 2018, 33 significant events were reported from the operating NPPs. The event reports were reviewed in AERB to see the adequacy of investigations, corrective actions, lessons learnt and the need for any regulatory actions.

KAPS-1&2 units had experienced the events of failure/leak from the coolant channel on March 11, 2016 and July 01, 2015 respectively. Subsequent to these events, En-Masse Coolant Channel Replacement (EMCCR) was taken up in KAPS-1&2. KAPS-2 was synchronized to grid on September 22, 2018 after completion of EMCCR activities. In KAPS-1, first phase of EMCCR campaign, which involves cutting, removal & disposal of coolant channels has been completed. Second phase of EMCCR campaign was in progress.

**Safety Surveillance of Nuclear Fuel Cycle Facilities and other related Industrial Facilities**

AERB continued to review the safety aspects of the Nuclear Fuel Cycle facilities under its purview. During this year, AERB renewed licences for operation of Narwapahar Mine, Tummalapalle mine, Turamdih mine, Banduhurang mine, Bhatin mine and Turamdih mill of UCIL. AERB also renewed the licences for operation of Versatile Solvent Synthesis Pilot Plant (VSSP) at HWP-Tuticorin, various facilities at IREL Udyogamandal and Compact Reprocessing of Advanced Fuel in Lead mini Cell (CORAL), IGCAR.

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.

Equipment erection of Medical Cyclotron has been completed by VECC and the permission for pre-commissioning trials was granted for 18 MeV energy.

The existing commissioning consent for Agricultural and Radiation Processing Facility (ARPF) of RRCAT, based on application of RRCAT, was amended for 10 MeV energy, 300 mA beam current and 5 kW beam power after review.

AERB reviewed the industrial and fire safety aspects of the facilities under its preview. There were two fatal accidents one at HWP-Manuguru and another at Turamdih mill of UCIL. These accidents were investigated and reviewed in AERB. Based on review, AERB stipulated additional measures for strengthening safety management at these facilities. The lessons learnt from these accidents were disseminated to all DAE units.

The details on Safety Surveillance of Nuclear Power Projects, Operating Plants, Research Reactors and Nuclear Fuel Cycle Facilities and other related Industrial Facilities are given in Chapter 1.

**Safety Surveillance of Radiation Facilities**

AERB carried out safety review of various facilities using radiation sources in industry, medicine, agriculture and research. During the year, AERB issued 17,557 consents for operation (licence, authorisation and registration), 3,626 approvals of Radiation Safety Officers (RSO) for different practices and 4,528 permissions for procurement of radioactive sources (imported and indigenously manufactured).

‘e-Licensing of Radiation Applications (e-LORA)’ is a user friendly interface with applicants and
licensees of various radiation facilities, located across the country. With e-LORA, AERB has strengthened its regulations of diagnostic X-ray equipment and have resulted into significant increase in regulation of these equipment. Total 61,488 X-ray equipment were licenced in e-LORA till December 2018.

As an initiative towards maximum governance, minimum government and in order to follow graded approach in regulation, AERB revised the siting consent requirement for all radiation facilities except RAPCOF and PARF more than 10 MeV energy. AERB also simplified the licensing requirements for Dental radiography practice without compromising the radiological safety by making Personnel monitoring (TLD badges) requirement as recommendatory and frequency of quality assurance (QA) of dental equipment has changed to once in five years from once in two years.

Owing to serious violations of safety requirements and pending non-compliances, AERB suspended the operation of a gamma radiation processing facility (GRAPF) for a period of 6 months and also withdrew RSO approval for a one year period.

*The details of safety surveillance of radiation facilities during this period are given in Chapter-2.*

**Regulatory Inspection of Nuclear and Radiation Facilities**

AERB carried out 30 regulatory inspections for nuclear facilities under construction, 78 regulatory inspections (planned and surprise) of operating NPPs and research facilities, 51 inspections of industrial and fuel cycle facilities and 910 radiation facilities.

Additional inspections (special as well as unannounced) were carried out for KGS Unit-1 in view of its continued operation for a long period (962 days), to gather first-hand information on the status of various safety related systems. A special inspection of FRFCF, IGCAR was conducted to assess the accident scenario and the measures taken by safety management system of the facility. One special inspection each was conducted at Jaduguda and Bhatin mines to check the preparedness for restart of production / operation after 4 years of suspension.

In addition to the routine regulatory inspection programme, AERB continued to post on-site observers at four nuclear power plant sites [Rawatbhatta, Kalpakkam, Kakrapar and Kudankulam]. The officers observed activities at the operating as well as under construction plants at these sites.

**Enforcement Actions Diagnostic Radiology**

As part of the nation-wide campaign to ensure increased compliance and regulatory coverage of medical diagnostic X-ray equipment, AERB has been carrying out the unannounced and routine inspections cum safety awareness programme.

AERB carried out unannounced inspections of medical diagnostic X-ray facilities located in Mumbai, Navi Mumbai and Thane region in addition to major cities/towns in Gujarat and Kerala state. In this drive, total 141 X-ray facilities were inspected and due to non-compliances 23 X-ray equipment were sealed and warning was issued for sealing of 89 X-ray equipment.
The details of regulatory inspection of nuclear and radiation facilities, and enforcement actions in radiation facilities during this period are given in Chapter-3.

Emergency Preparedness

Annual site emergency exercises were conducted at 6 nuclear power plant sites and AERB officers witnessed two of these exercises. Off-site emergency exercises (OSEE) to be conducted once in two years, were carried out at Narora, Kakrapar and Kaiga sites, where AERB officers participated as observers. The observer’s reports on emergency exercises and their findings were discussed for appropriate corrective actions and guidance.

First full-fledged off-site command and control emergency exercise was conducted at Rawatbhata Site (RAPS-3&4) to assess the decision making capabilities of the responders and the actual response time considering prevalent environmental parameters. All the response agencies including CMG-DAE, NPCIL, NDMA, District officials etc. participated in the exercise.
The Status of Environmental Safety and Occupational Exposures are given in Chapter 4. The Status of Emergency Preparedness of the Nuclear Facilities is given in Chapter 5.

Regulatory Safety Document Development

During the year, one new Safety Guide viz. ‘Deterministic Safety Analysis for PHWRs’ [AERB/SG/D-19] was approved and uploaded on AERB website. AERB reviewed 3 draft safety standards and 7 draft Documents Preparation Profiles (DPP) of IAEA and commented. AERB has published total 166 regulatory safety documents till date.

The Status of Regulatory Safety documents are given in Chapter 6.

Safety Analysis, Research and Development

Safety Studies in areas covering severe accident, thermal hydraulics safety, reactor physics, probabilistic safety, radiological assessment and environmental safety and integrated risk assessment for multi-unit NPP site were continued.

Experiments on power and control cable fires were conducted in the Compartment Fire Test Facility (CFTF) at SRI, Kalpakkam. Experimental facilities were being set up at SRI, Kalpakkam for investigating coolant channel heat-up and Annulus Gas Monitoring System (AGMS) related safety issues and Water and Steam Interaction Facility (WASIF) to investigate Direct Contact Condensation (DCC) phenomena.

AERB contributed in development of DAE computer code for Severe Accident Simulation (PRABHAVINI). In-house Nuclear Plant Analyzer Code (NuPAC), computer code system to perform coupled Thermal Hydraulics Neutronics analysis of large loosely coupled power reactors for system induced transients involving core neutronic asymmetry was developed. Software tool has been developed for estimating the ‘Source Term’ as per Radiological Impact Assessment (RIA) task force guidelines.

An accident scenario was postulated for Rajasthan Atomic Power Station (RAPS) and the source term was estimated for emergency exercise. Analysis for postulated initiating event for design extension condition (DEC) with core melt scenario for PHWR-700 was carried out based on the radiological impact assessment guidelines.

AERB continued to promote and fund research projects on nuclear safety, radiation safety, front and back end fuel cycle safety related problems and industrial safety, at academic institutions under the Safety Research Programme. Five new projects were approved and four on-going projects were renewed.

The details of various activities of safety assessment and research are presented in Chapter-7.

Public Outreach Activities

AERB hosted 2nd National Conference on Regulatory Interface (NCR1) -2018 at Mumbai to obtain feedback and suggestions from licensees of nuclear facilities and to exchange information on the current regulatory requirements, issues / challenges faced by the licensees in fulfilling the requirements, which would be utilized to improve the regulatory processes. Actions were taken on feedbacks received during NCRI-2017.

A two-day discussion meet was conducted on the subject viz. ‘Radiological Impact Assessment and Operational Intervention Levels (OIL) during Emergency Exposure Situation’.

In a first-of-a-kind initiative, two training-cum-awareness programmes were organised on ‘Security of Radioactive Sources at Radiation Facilities’ for Police officials in Maharashtra with an objective to make aware/understand the role of law enforcement agency on security of radioactive material and to brief on endorsement of Security Plan for Category-1 facilities as per AERB Guidelines. One programme was conducted at Maharashtra Police Academy (MPA), Nashik and another at Police Training Centre (PTC), Marol,
Mumbai. Ten programmes focusing on the aspects of enhancing radiation safety awareness were conducted for target audience.

AERB provides information to its stakeholders through other means also like annual reports, quarterly e-newsletter, press releases / briefings etc. Six press releases were issued during this period. Quarterly publication of e-Newsletter was started afresh from July 2018. It is being uploaded on AERB website in English as well as in Hindi.

AERB advertisements were published in print media on regulatory requirements for handling of ionising radiation sources in major newspapers. Safety and regulatory requirements of X-ray facilities were Broadcast as Radio Jingle in FM stations of major cities.

AERB also participated in science and technology fairs for displaying exhibits on the safety and regulatory aspects of nuclear and radiation facilities.

Dissemination of safety information through its web-site by posting video films, radiation safety awareness posters was continued. One such video film on Radiation Safety aspects for staff working in radiology department and three posters were posted on the website.

MoU with Govt. of Andhra Pradesh and Karnataka were signed for setting up the Directorate of Radiation Safety (DRS) to spread awareness on radiation protection, safety regulations through training and awareness programmes.

Apart from above mentioned activities, AERB provided timely response to queries posted by the members of public.

A ‘Help Desk’ facility was set up to provide support to end users and also draw various inputs for improving the licensing system for radiation facilities through e-LORA.

The details of AERB initiatives for engaging with stakeholders and public accountability are presented in Chapter- 8 and 9.

International Cooperation

AERB has programme for bilateral cooperation with the regulatory bodies of other countries for sharing of experience in the field of regulation of nuclear activities for peaceful purposes and cooperation in
nuclear and radiation safety matters. AERB already has bilateral arrangements with the regulatory bodies of other countries namely, France, Russia, Romania, Ukraine, the United States of America, Finland, Canada and Bangladesh. AERB also has an agreement with IRSN, an external Technical Support Organization in France.

During the year, bilateral arrangement was signed between AERB and the Office for Nuclear Regulation (ONR) of Great Britain and renewed bilateral agreement between AERB and USNRC.

AERB organized three day workshop on ‘Aircraft Impact Assessment (AIA)’ with USNRC as a part of Bilateral Arrangement.

AERB participated in various technical meetings organised by IAEA on a range of topics for NPPs, fuel cycle facilities, radiation facilities, transportation of radioactive materials and illicit trafficking of radioactive materials. Under the aegis of IAEA, AERB participated in Coordinated Research Project (CRP). AERB experts participated in the IAEA IRRS mission of other countries.

The details on AERB’s contribution at various international fora are presented in Chapter-10.

Human Resource Development and Infrastructure

AERB is in the process of augmenting its technical man power. This year AERB has inducted postgraduates through AERB Graduate Fellowship Scheme (AGFS) in IIT Bombay and IIT Madras and through training schools of BARC, IGCAR and transfer of experienced personnel from operating plants and R&D institutes. As on December 31, 2018, the scientific and technical manpower in AERB was 340.

As a part of competence development, AERB continued to train its staff by organising training programmes, management development programmes (MDP), workshops, on-job training at nuclear facilities, refresher courses, technical talks, colloquia, participation in DAE’s Administrative Training Institute (ATI) etc.

To establish communication with distant centres, video conferencing systems has been commissioned at AERB HQ in Mumbai and SRI office at Kalpakkam. The system is being used frequently for conducting meetings with SRI and various units of DAE. As a drive toward paperless office, e-office systems for administrative approvals as well as file
management has been implemented. Other e-office systems are in the process of implementation in phased manner.

Construction of Southern Regional Regulatory Centre (SRRC), Chennai was completed and SRRC building was inaugurated on November 29, 2018. Construction of Eastern Regional Regulatory Centre (ERRC), Kolkata is in progress and is nearing completion.

The details on human resources development and infrastructure and staff welfare activities are presented in Chapter-11.

Official Language Implementation

AERB conducted programmes as a part of the actions towards implementation of official language, Hindi, in various official works. DAE incentive scheme for working in Hindi has been introduced and employees are actively participating in the scheme. Total 18,142 letters were sent in bilingual and 106 were sent exclusively in Hindi.

A meet on ‘Experience Feedback from ACPSR & Associated Groups Involved in Safety Review of Kudankulam Atomic Power Units - 1&2’ was organized in Hindi. Four Hindi workshops were conducted on behalf of the Joint Official Language Coordination Committee.

The details on Official Language Implementation are presented in Chapter-12.

Finance

AERB receives funds from Department of Atomic Energy (DAE) for meeting its expenditure both capital and revenue. Central Government allocates the budget under separate head of accounts of AERB. Annual expenditure during the year 2018 was Rs. 90.76 crores.

Apart from employee salary and other office expenses, AERB utilized funds for procurement of software for analysis work and radiation instrument, conducting awareness programmes/safety meets, broadcasting of Radio Jingle in FM stations, grant-in-aid towards financial assistance for projects of AERB interest, up-gradation of IT related activities, R&D activities and construction of Regional Regulatory Centres of AERB.