



## EXECUTIVE SUMMARY

During the year 2019, 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 purview. 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 and technical divisions and specialist committees under the guidance of the Board of AERB, which is the decision making body on policy matters for regulation of nuclear and radiation facilities and associated activities. The Board met two times during the year 2019. The Board was apprised of the periodic safety status of Nuclear Power Projects under construction / commissioning, operating Nuclear Power Plants, Nuclear Fuel Cycle Facilities and large number of Radiation Facilities in the country.

Board was briefed on various activities like harmonisation and merging the licensing regime under various statutes, manually shutdown of KGS-1 for BSD activities after its continuous operation for 962 days, resumption of KAPS-1 operation after replacement of the coolant channels and completion of hot conditioning of primary coolant system of KAPP-3, which is one of the major milestones in the commissioning programme. Board was also apprised on the accidents related to industrial safety in nuclear facilities. The Board expressed that commitment towards safety should be enforced at all levels in the licensee's organisation.

The status on disposal of Disused Radioactive Sealed Sources (DSRS) and the status of various infrastructure projects and implementation of revised IT security policy were also informed to the Board.



*AERB Board Meeting in Progress*



*KAPP-3&4 Main Plant Area*

## 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 reviewed revised Preliminary Safety Analysis Report (PSAR) including reports on geological mapping and construction related documents. Based on satisfactory safety review of the respective stipulations, clearance was granted for commencement of construction and same is in progress at KKNPP-3&4.

AERB granted clearance for Excavation to KKNPP-5&6 on November 14, 2018 with certain stipulations, subsequent, review of FPC is in progress with major focus on design differences w.r.t. KKNPP-3&4. Similarly, PSAR have been reviewed for FPC with a focus on design/layout differences in GHAVP w.r.t. KAPP-3&4 and site-specific features.

Civil construction and erection of equipment / components are under progress at KAPP-4 and RAPP-7&8.

AERB reviewed the progressive submissions w.r.t. authorization of Primary Heat Transport (PHT) System, Hot Conditioning and Light Water Commissioning (LWC) of KAPP-3. Based on satisfactory review clearance was granted on August 07, 2019. Subsequently permission for draining of Light water from PHT system was granted on December 16, 2019.

Commissioning activities are in progress at Prototype Fast Breeder Reactor (PFBR). PFBR proposal for receipt, handling and storage of fresh fuel sub-assemblies (FSA)

was reviewed and accorded clearance for handling and storage of 42 numbers of fresh FSAs at Fuel Building (FB) on June 28, 2019.

Pre-commissioning checks have been completed at DFRP. After safety review, AERB issued clearance for Acid-TBP run of DFRP in March 2019.

Two units of 700 MWe PHWRs are being set up at Kaiga (Units -5&6) by NPCIL. Review of Site Evaluation Report (SER) and reports on other related topical studies are in progress. Review of submissions along with siting application for Away From Reactor (AFR) of KKNPP-1&2, is in progress.

Construction consent was granted to NFC-Kota in February 2018 with certain stipulations, compliance to these stipulations is being verified through periodic RIs. Currently civil and structural works for Plant and Non-Plant buildings are in progress.

## Safety Surveillance of Nuclear Power Plants and Research Reactors

AERB continued its regulatory supervision of 22 operating nuclear power plants in India. 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.

AERB renewed the licences for operation under the Atomic Energy Act, 1962 (and rules framed there under), the Factories Act, 1948 and authorization for radioactive waste disposal/transfer under GSR-125 of RAPS-1&2



and KAPS-1&2. AERB also renewed the licence for operation of KKNPP-1&2 under the Factories Act, 1948.

Total 45 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. The events were rated on INES scale.

*The radioactivity releases from all the NPPs were below the AERB specified limits. Effective dose to member of public in the vicinity of NPP sites was far less than the annual dose limit of 1 mSv.*

During the long EMCCR outage, number of safety upgrades were implemented in KAPS-1&2. KAPS-1 was synchronized to grid on May 24, 2019 after completion of EMCCR activities.

AERB permitted the commencement of 28<sup>th</sup> irradiation campaign of FBTR for irradiation of sodium bonded metallic fuel pins, Tungsten Carbide capsule and long term irradiation of structural materials and actinide samples. Subsequently, permission for commencement of 29<sup>th</sup> irradiation campaign was also granted.

Implementation of identified long term enhancements based on Post Fukushima are in progress at NPPs. As part of it, PCRDs have been installed in few NPPs (MAPS-2, KGS-1&2, NAPS-1, KAPS-1 & RAPS-5) and construction of the OESCs is in progress



*Passive Catalytic Recombiner Devices (PCRD)*



*Containment Filter Venting System (CFVS) at TAPS-1&2*

at Tarapur and Kakrapar sites. Containment inerting system has been indigenously refurbished and the system is put in operation at TAPS-1&2.

## **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. AERB renewed licences for operation of Mohuldih Mine, Beach Sand Minerals (BSM) Facilities at IREL, Manavalakurichi (MK), Chavara & OSCOM and Kerala Minerals & Metals Limited (KMML), Chavara. AERB also renewed the licences for operation of HWP - Hazira and Thal as well as authorization for operation of Sodium Facility for Component Testing (SFCT), IGCAR.

*AERB is responsible for administration of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996 in relation to the factories owned by the Central Government and engaged in carrying out the purposes of the Atomic Energy Act, 1962.*

The licence of Zirconium Complex (ZC), Pazhayakayal was amended in view of enhancement in zirconium sponge production capacity from 250 to 300 MT per year. The licence for operation of HWP-Tuticorin has been amended to include the operation of HWP main plant in addition to operation of Versatile

Solvent Synthesis Pilot Plant (VSSP). AERB has also granted permission for resumption of mining activities at Jaduguda and Bhatin mine, consequent to clearances by State Government and Ministry of Environment & Forests (MoE&F) to these facilities.

AERB reviewed the industrial and fire safety aspects of the facilities under its purview. Fatal accidents at NPP and FCF were investigated and reviewed. The lessons learnt from these accidents were disseminated to all DAE units.

## R&D Facilities

Based on review of submissions, consent for stage-1 commissioning was granted to Medical Cyclotron and its associated beamline at VECC on July 30, 2019. RRCAT applications for trial run operation of TWINDUS LINAC-2 and permission for installation, testing and commissioning of TWINDUS LINAC-3 were reviewed and granted permissions. Also permission for testing of Superconducting RF Cavities in horizontal test stand (HTS) facility was granted on June 20, 2019.

*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 (RF)

AERB carried out safety review of various facilities using radiation sources and equipment in industry, medicine, agriculture and research. RFs are governed by AERB's e-Licensing of Radiation Applications (e-LORA) system. It is a user friendly interface with applicants and licensees of various RFs located across the country. With e-LORA, AERB has strengthened its regulations of diagnostic X-ray equipment which resulted in significant increase in issue of licences of these equipment. Total 77,346 X-ray equipment were licenced in e-LORA till December 2019.

AERB issued about 20,520 licences (licence, authorisation and registration) for operation of various RFs following the graded approach, granted 5,469 permissions for procurement of radioactive sources (imported and indigenous) and 10,458 permissions for procurement of diagnostic X-ray equipment and approved 3,631 Radiation Safety Officers (RSO) for different practices.

*Under the minimum Government, Maximum Governance, AERB simplified the registration process of dental X-ray equipment in e-LORA system. Also, validity of Registration of all types of dental X-ray equipment has been extended from existing five years to ten years.*

Past regulatory experience feedback on radiography practices had necessitated amendment of the Safety Code on 'Industrial Radiography' with a view to infuse more trained manpower in this practice. Accordingly, amendment in this regard has been issued on August 02, 2019.

AERB raised the concern to DAE over disposal of disused sealed radioactive sources (DSRS) used in various RFs and requested to establish a formal mechanism for their proper management. Inputs w.r.t. establishing the mechanism for the management of DSRS was prepared by AERB in line with the National Policy on 'Management of Radioactive Waste' and forwarded to DAE.

Owing to violations of safety requirements by radiography institution, AERB suspended the operation of two Ionizing Radiation Exposure Devices (IRED) for three months and besides this issued show-cause notice to three nucleonic gauge institutions in view of lapses in compliance of requirement w.r.t. safety and security of radiation sources.

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

## Regulatory Inspection (RI) of Nuclear and Radiation Facilities

AERB carried out total 128 RIs of Nuclear and Industrial Facilities covering safety (nuclear, radiological & industrial) and security aspects under the purview of AERB. Apart from this total 1,038 radiation facilities were inspected by officers from Headquarter (HQ) and Regional Regulatory Centres.

*AERB conducted RIs during Biennial Shutdown (BSD) of KGS- 1 & 2 and NAPS-1 to inspect radiological safety aspects.*

A special inspection of KKNPP-1&2 was carried out to cover aspects related to incident reported in various

media and NPCIL press release regarding cyber attack on computers at KKNPP-1&2.

AERB team visited NPCIL HQ at Mumbai to verify compliance to the requirements prescribed for the Responsible Organisation in the AERB safety codes for design, construction and operation of NPPs. The implementation of QA programme was also verified. Under vendor QA programme, special RIs of NFC, Hyderabad and NPC Regional QA office at Hyderabad were also carried out.

In addition to the routine RI programme, AERB continued to post on-site observers at four NPP sites [Rawatbhata, Kalpakkam, Kakrapar and Kudankulam].

## Enforcement Actions in Radiation Facilities

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 programmes.

*Information on Enforcement inspections was shared with local print media and television media to spread awareness among the users on radiation safety*

Special inspection-cum-enforcement were carried out for medical diagnostic X-ray facilities located in the North-Eastern States of the country viz. Manipur, Assam, Meghalaya and Nagaland. In this drive, total 207 X-ray equipment were inspected out of which 11

X-ray equipment were 'Sealed' and issued 'Warning for Seal' to 91 X-ray equipment due to non-compliances / violation of major safety & regulatory requirements.

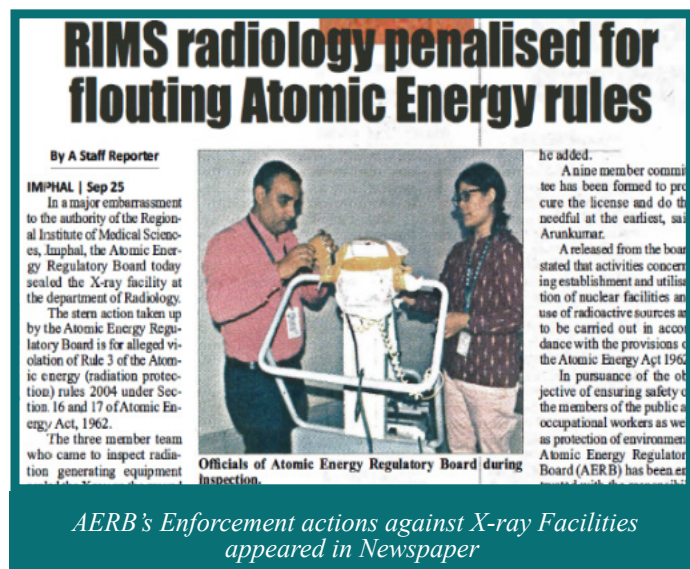
Based on information about unauthorised handling of Ionizing Radiation Exposure Devices (IRED) by industrial radiography institution, AERB carried out surprise inspection at the site and four IREDs were sealed.

*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 seven NPP sites and off-site emergency exercises (OSEE) at one NPP site. In order to further strengthen preparedness, new system for conducting off-site emergency exercises are being evolved through Table Top exercise, Integrated Command Control and Response (ICCR) exercise and field exercise. Trial table-top exercise was conducted at three sites. The first ICCR exercise was conducted at Rawatbhata Rajasthan (RR) and second at Kalpakkam site. All the response agencies including DAE-CMG, DAE-RERD, NPCIL HQ, the District Administration & State Authority, AERB and NDMA actively participated in the exercise at Kalpakkam.

AERB is in the process of consolidating & revising its requirements and guidance for Emergency Preparedness and Response (EPR). The existing requirements are being consolidated/updated through safety code and safety guides in line with the role entrusted to AERB by NDMA through its national disaster management plan (NDMP, 2019).





*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, two new Safety Guides viz. 'Remediation of Areas Affected by Radioactive Contamination' and 'Monitoring and Assessment of Occupational Exposure due to Intake of Radionuclides' were approved and uploaded on AERB website. About 16 regulatory safety documents (REGDOC) are at various stages of development. AERB reviewed and provided comments on 32 draft Safety Standards and Documents Preparation Profiles (DPP) of IAEA.

*The Status of Regulatory Safety Documents are given in Chapter 6.*

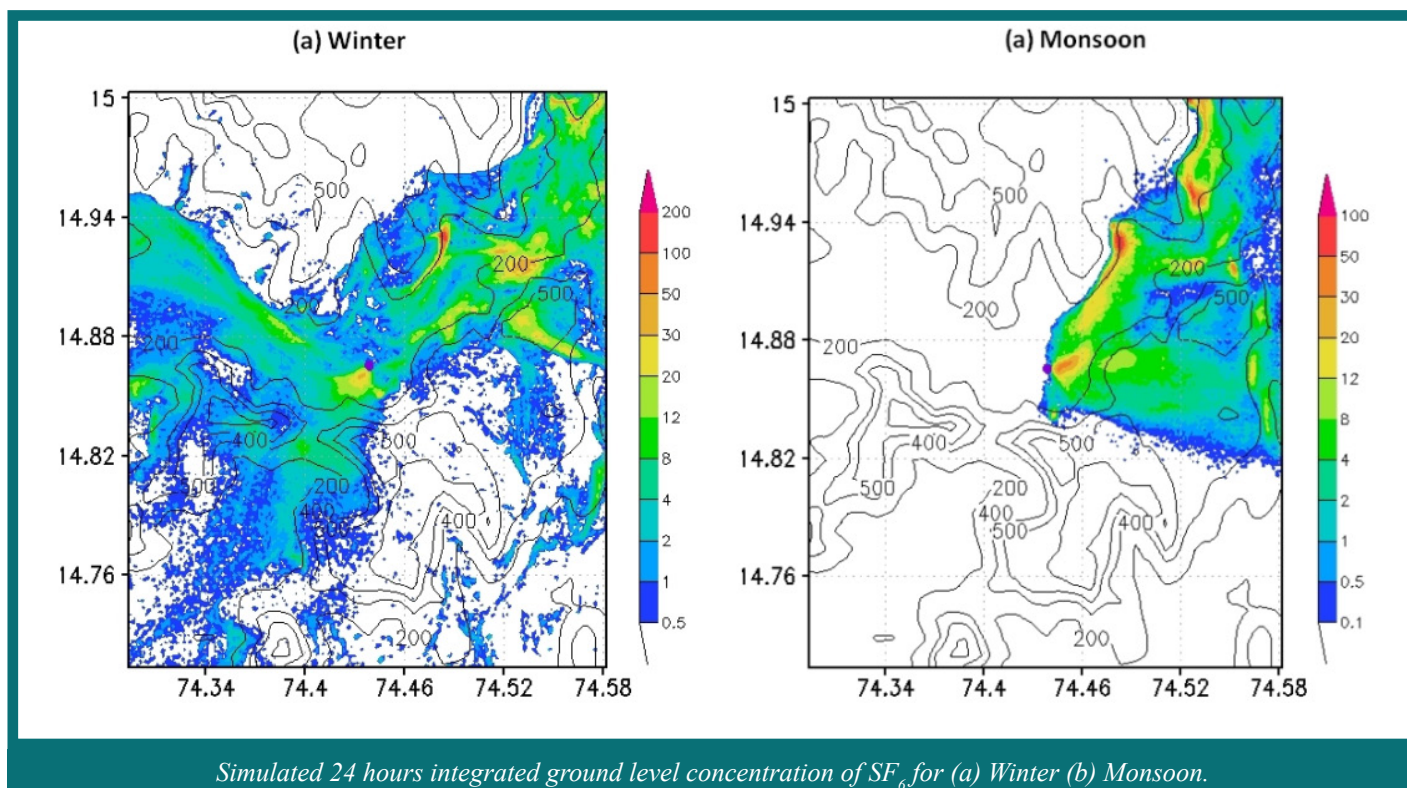
## Safety Analysis, Research and Development

Safety studies were continued in areas covering severe accident, thermal hydraulics safety, reactor physics, probabilistic safety, radiological assessment and environmental safety studies and experimental studies.

At SRI, Kalpakkam studies were carried out on (i) Power and control cable fires with new set of experiments focusing on investigating the effect of hydrocarbon / oil spill fires on power and instrumentation cables at Compartment Fire Test Facility (CFTF); (ii) the in-vessel retention capability of calandria vessel in PHWRs at Core Melt Retention Facility (COMREF); (iii) Condensation Induced Water Hammer (CIWH) in test pipe at Water and Steam Interaction Facility (WASIF) and (iv) design of lab scale experimental setup to study the iodine interaction with paint and iodine adsorption properties on various adsorbents.

AERB continued to contribute in development of 'PRABHAVINI', an integral safety analysis code of DAE, by developing various models such as Accumulator, fission Product-Decay Heat, PCRD and Containment spray models. An in-house computer code has also been developed for analysing flow and power transients in fast breeder reactors.

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. Four new projects were approved and ten on-going projects were renewed.



*The details of various activities of Safety Analysis and Research are presented in Chapter-7.*

## International Cooperation

AERB has programme for Multilateral and Bilateral co-operation with the regulatory bodies of other countries for sharing of experience in the field of regulation of nuclear activities for peaceful purposes and co-operation in nuclear and radiation safety matters. AERB joined the Atomic Energy Research (AER), Hungary as member organisation. AER is an international community of researchers, engineers and operators from countries running the VVER type nuclear reactors.

Shri K. N. Vyas, Secretary, DAE and Chairman, AEC led the Indian delegation to the 63rd Regular Session of IAEA General Conference during September 16 to 20, 2019 which included Chairman, AERB. Shri G. Nageswara Rao, Chairman, also attended the Senior Safety and Regulators' Meeting held during the General Conference. The meeting had sessions dedicated to managing regulatory competence for nuclear safety and nuclear security and application of the concept of graded approach in core regulatory functions.

*AERB already has bilateral arrangements with the regulatory bodies of other countries namely, France, Russia, Romania, Ukraine, the United States of America, United Kingdom, Finland, Canada and Bangladesh. Also, an agreement with IRSN, an external Technical Support Organisation in France is in place.*

India is a Contracting Party to the Convention on Nuclear Safety (CNS) and actively participates in its activities towards fulfilling the obligations of the

convention. AERB submitted National Report for 8<sup>th</sup> Review Meeting of CNS on August 15, 2019. The report updates on how Government of India continues to fulfil its obligations under the Convention.



A bilateral meeting between AERB and STUK, the nuclear regulatory body of Finland was held on November 18, 2019 at Mumbai. The regulators shared their experiences on regulatory review of VVER and EPR type of nuclear reactors, regulation and national practices in radioactive waste management.

After successful completion of first Integrated Regulatory Review Service (IRRS) Mission in 2015 in India, IAEA has scheduled IRRS follow-up mission around November 2020. The follow-up mission has extended its scope to include 'Radiation Source Facilities and Activities' as an additional area of review.

AERB officer participated as team member of IAEA IRRS mission at the United Kingdom.



*Bilateral meeting of AERB and STUK*



AERB provided assistance to Radiation Safety and Nuclear Security Authority (RSNSA), the regulatory authority of Mauritius, in the review and assessment of layout design of radiotherapy and nuclear medicine facilities.

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.

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

## Stakeholders Engagement and Public Outreach Activities

AERB hosted 3<sup>rd</sup> National Conference on Regulatory Interface (NCRI)-2019 at Mumbai for Licensees of Accelerator Facilities and DAE units involved in activities associated with transport of Radioactive Material with an objective to foster an environment wherein the Licensees could interact, discuss and provide valuable feedback to AERB.

AERB also keeps organizing various events for safety promotion for licensees of nuclear and radiation facilities. During the year about 8 theme/discussion meets were organized for nuclear facilities and 2 awareness programmes for radiation facilities covering medical diagnostic X-ray and well logging facilities. AERB and NABL jointly organized a special meet for 'Calibration and Testing Radiological Laboratories' at Mumbai.

AERB and KKNPP jointly organized the workshop on "Transportation and Management of Trauma Victims" for Certifying Surgeons & Para-Medical staff of all DAE units with practical demonstration on rescue operation, transport and management of trauma victims.



*Shri D. K. Shukla, Executive Director, AERB delivering inaugural address in the meet*

As a part of its continued efforts to reach out to the general public, AERB organized an awareness programme on 'Radiation Safety in the use of Radiation Source for Societal Benefits' at Madurai for Licensees of RFs and faculty & students of academic institutions. AERB also participated in one of its kind workshop organized by DAE for journalist and media personnel at Rawatbhata site. The workshop provided a valuable platform to interact with the media personnel and proved to be a useful awareness exercise.

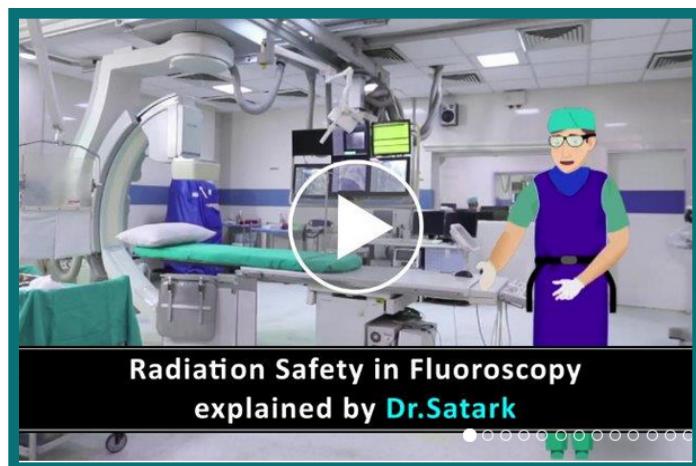
AERB provides information to its stakeholders through other means also like annual report, quarterly e-newsletter, press releases / briefings etc. Dissemination



*Chairman, AERB addressing the gathering during NCRI*



of safety information through its web-site by posting video films, radiation safety awareness posters was continued. One such video film on 'Radiation Safety in Fluoroscopy' was developed and posted on the website. Also, participated in Science and Technology fairs for displaying exhibits on the safety and regulatory aspects of nuclear and radiation facilities. Apart from above mentioned activities, AERB provided timely response to queries posted by the members of public.



Association of Medical Physicists of India (AMPI) organised its 40th Annual Conference 'AMPICON-2019' in Kolkata during November 7 to 9, 2019. The theme of the conference was "Medical Physics in Patient Care". Shri G. Nageswara Rao, Chairman, AERB was the Guest of Honour and he shared the dais with Hon'ble Governor of West Bengal, Shri Jagdeep Dhankhar, who was the Chief Guest.



*Inaugural Ceremony of AMPICON-2019 (Left to Right: Dr. Ashis Mukhopadhyay, Oncologist & Chairman, Organising Committee; Mrs. Sudesh Dhankhar, First Lady of West Bengal; Shri Jagdeep Dhankhar, Hon'ble Governor of West Bengal; Shri G. Nageswara Rao, Chairman, AERB)*

Shri Nageswara Rao, during his address, emphasised benefits accrued to patients from the advances in Radiotherapy, Nuclear Medicine and Diagnostic Radiology. Each technique caters to a specific clinical requirement, from simple diagnostic X-ray unit to life saving interventional units. Chairman, AERB further emphasized on the role of Medical Physicists in delivering the benefits of advanced diagnostic and treatment modalities to patients. Chairman's address underlined the mission of AERB as a regulatory authority in regulating huge number of facilities throughout the country. At the same time, he called upon the utility to bear primary responsibility of safety.

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

## Human Resource Development and Infrastructure

AERB is in the process of augmenting its technical manpower. 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, NFC and transfer of experienced personnel from operating plants and R&D institutes. As on December 31, 2019, the scientific and technical manpower in AERB was 342.

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 /radiation facilities, refresher courses, technical talks, colloquia, participation in DAE's Administrative Training Institute (ATI) etc.

The e-office has been implemented in AERB, and upgradation to the latest version of e-Office was carried out. As part of expansion of infrastructure, in addition to existing two wings (Niyamak Bhavan-A&B) at its HQ, construction of new building (NB-C) has started in September 2019. Construction of ERRC building at Kolkata is completed, while planning for construction of NRRC at New Delhi is in progress.

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



*AERB Officers and Faculty of MDP at YASHADA, Pune*

## Official Language Implementation

AERB conducted various 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 15,607 letters were sent in bilingual.

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

## Finance

AERB receives funds from GoI 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 2019 was Rs. 99.61 crores.

## Conclusion

Throughout the year, AERB has carried out its core regulatory activities through safety surveillance by safety review and assessment, regulatory inspection and developing regulatory documents for stakeholders. AERB actively participated and contributed in several Multilateral international platforms working for promotion of nuclear and radiological safety in facilities /activities across the globe. Organised several safety promotional activities for stakeholders and awareness programmes for public.

## Acknowledgement

AERB appreciates the efforts of individuals who have contributed in preparation of Annual Report 2019 by way of providing inputs, compilation of the report and the editorial team for review and bringing the report to present shape.



*Shri D. K. Shukla, Executive Director, AERB delivering talk in Hindi Seminar*

To celebrate world environment day, AERB organised a Hindi Scientific Seminar focused on the theme 'Atomic Energy and Environment' on June 6, 2019. Tree plantation was also conducted for Green Environment. Four Hindi workshops were conducted during the year.