



सत्यमेव जयते
Government of India



AERB BULLETIN

2019



FUNCTIONS OF THE ATOMIC ENERGY REGULATORY BOARD

Chairman AERB is the Competent Authority under the following Rules issued under the Atomic Energy Act, 1962:

Atomic Energy (Radiation Protection) Rules, 2004

Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substance) Rules, 1984

Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987

Atomic Energy (Factories) Rules, 1996.

- Develop safety policies in the areas of nuclear, radiation and industrial safety for facilities under its purview.
- Develop Safety Codes, Guides and Manuals for siting, design, construction, commissioning, operation and decommissioning for nuclear and radiation facilities.
- Grant consents for siting, construction, commissioning, operation and decommissioning, after appropriate safety review and assessment of nuclear and radiation facilities.
- Ensure compliance with the regulatory requirements prescribed by AERB during all stages of consenting through a system of review and assessment, regulatory inspection and enforcement.
- Prescribe the acceptance limits of radiation exposure to occupational workers and members of public and acceptable limits of environmental releases of radioactive substances.
- Review the emergency preparedness plans for nuclear and radiation facilities and during transport of large radioactive sources, irradiated fuel and fissile material.
- Review the training program, qualifications and licensing policies for personnel of nuclear and radiation facilities and prescribe the syllabi for training of personnel in safety aspects at all levels.
- Take such steps as necessary to keep the public informed on major issues of radiological safety significance.
- Maintain liaison with statutory bodies in the country as well as organisations abroad regarding safety matters.
- Promote research and development in the areas of safety.
- Review nuclear and industrial safety aspects in nuclear facilities under its purview.
- Review safety related nuclear security aspects in nuclear facilities under its purview.
- Notifying to the public, the 'nuclear incident', occurring in the nuclear installations in India, as mandated by the Civil Liability for Nuclear Damage Act, 2010.



AERB Board Meeting in Progress

About AERB

The Board of AERB comprises of a Chairman, five members and a non-member Secretary. AERB secretariat currently has a staff strength of more than 342 personnel organized in 8 Technical Divisions at Headquarter in Mumbai, Safety Research Institute (SRI) at Kalpakkam and Regional Regulatory Centres (RRC) at Chennai, Kolkata and New Delhi.

AERB carries out its functions through highly qualified work force and specialist committees under the guidance of the Board. Apex level committees include Safety Review Committee for Operating Plants (SARCOP) and Safety Review Committee for Applications of Radiation (SARCAR). In addition, there are advisory committees, viz. Advisory Committee for Project Safety Review (ACPSR), Advisory Committee on Nuclear and Radiological Safety (ACNRS), Advisory Committee on Security (ACS) and Advisory Committee on Occupational Health (ACOH). The ACPSR advises AERB on issuance of consents at different stages of projects of the Department of Atomic Energy (DAE) under the purview of AERB, after reviewing the submissions made by the project authorities, based on the recommendations of the associated Project Design Safety Committees (PDSC).

The SARCOP carries out safety surveillance and recommends enforcement of safety stipulations in the operating units of DAE under the purview of AERB. The SARCAR recommends measures to enforce radiation safety in medical, industrial and research institutions, which use radiation and radioactive sources. AERB receives advice on development of safety codes / guides and on generic and specific safety issues concerning the safety of nuclear and radiation installations from ACNRS, Advisory Committee on Security (ACS) advises AERB on nuclear security aspects and Advisory Committee on Occupational Health (ACOH) advises AERB on occupational health safety matters.

The administrative and regulatory mechanisms are in place to ensure multi-tier review of all safety matters by experts in the relevant fields available nationwide. These experts are chosen from reputed academic institutions, R&D organisations, industries and Governmental Agencies.

The Atomic Energy Regulatory Board (AERB) was constituted on November 15, 1983 by the President of India by exercising the powers conferred by Section 27 of the Atomic Energy Act, 1962 (33 of 1962) to carry out certain regulatory and safety functions under the Act.

AERB's safety and regulatory requirements are brought out in a set of Codes and Guides. About 165 such documents have been developed and published by AERB over the years. Nuclear and radiation facilities and activities require Consents from AERB for various stages during the lifetime of the facility viz. Siting, construction, commissioning, operation and decommissioning. These Consents are granted after ensuring that the regulatory requirements are met. At each stage a comprehensive multi-tier safety review by relevant safety committees are carried out before issuing consent.

Preface

We at AERB are pleased to see the encouraging response to the annual edition of AERB Bulletin to enhance its transparency and public outreach. This is the eighth issue of Bulletin, which attempts to present information contained in the Annual Report 2019 in a more accessible and attractive format.

During the year, AERB continued its regulatory safety oversight on all regulated installations and activities i.e. the entire gamut of nuclear fuel cycle facilities, namely uranium mines and mills, thorium mines and mills, fuel fabrication facilities, heavy water plants, nuclear power plants and research reactors, as well as the large spectrum of facilities involved in the application of radiation in the field of medicine, industry, agriculture and research, the facilities processing Naturally Occurring Radioactive Materials and activities such as radioactive waste management and transport of radioactive material in public domain, following a graded approach to safety regulation in line with international regulatory practices.

As part of pre-commissioning activities for Kakrapar Atomic Power Project (KAPP-3), hot conditioning of primary coolant system, which is one of the major milestones in the commissioning programme, has been completed. AERB officers witnessed the commissioning activities as an independent observers. After completion of En-Mass coolant Channel Replacement activities and satisfactory review and approval by AERB, KAPS-1 was restarted and synchronized to the grid on May 24, 2019.

In order to further strengthen preparedness, new system for conducting off-site emergency exercises are being evolved through Table Top exercise, Integrated Command Control & Response (ICCR) exercise and field exercise. The first ICCR exercise was conducted at Rawatbhata Rajasthan (RR) and second at Kalpakkam site. All the response agencies, AERB and NDMA actively participated in the exercise at Kalpakkam.

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. AERB continued to contribute in development of 'PRABHAVINI', an integral safety analysis code of DAE. An in-house computer code has also been developed for analysing flow and power transients in fast breeder reactors.

As a requirement under the Convention on Nuclear Safety (CNS), to which India is a party, AERB coordinated the preparation of National Report which has been submitted to IAEA on August 15, 2019. Preparations were going on for forthcoming IAEA IRRS follow-up mission.

The 63rd Regular Session of the IAEA General Conference and the Senior Safety and Security Regulators' Meeting was held at Vienna, Austria in September 2019. Chairman, AERB attended this prestigious event.

With continued efforts towards, 'Minimum Government, Maximum Governance', AERB has further simplified the licensing requirements for dental X-ray equipment and amend the Safety Code on Industrial Radiography with a view to infuse more trained manpower to further elevate the level of safety in this practice. AERB initiated suitable measures to resolve the large number of excessive exposure cases got accumulated in diagnostic radiology practice. AERBs sustained and continuous efforts, through a multipronged approach, to bring the diagnostic X-ray facility under regulatory umbrella have been vindicated by the order of National Human Rights Commission while disposing off a petition.

AERB views public outreach as an essential element to build a long lasting trust and confidence with media and the public, at large. This annual bulletin is aimed to provide in a nutshell the major activities of AERB during 2019. Efforts have been made to include more visuals and to keep the technical content simple. AERB would be happy to elicit feedback on this attempt and suggestions for further improving this bulletin.

Mission and Vision of AERB



MISSION



To ensure that the use of ionising radiation and nuclear energy in India does not cause undue risk to health of people and the environment



VISION



To be a knowledge organization of high international standards with state of the art scientific capabilities and to maintain high level of professionalism, credibility, transparency and accountability in the domain of its regulatory responsibilities

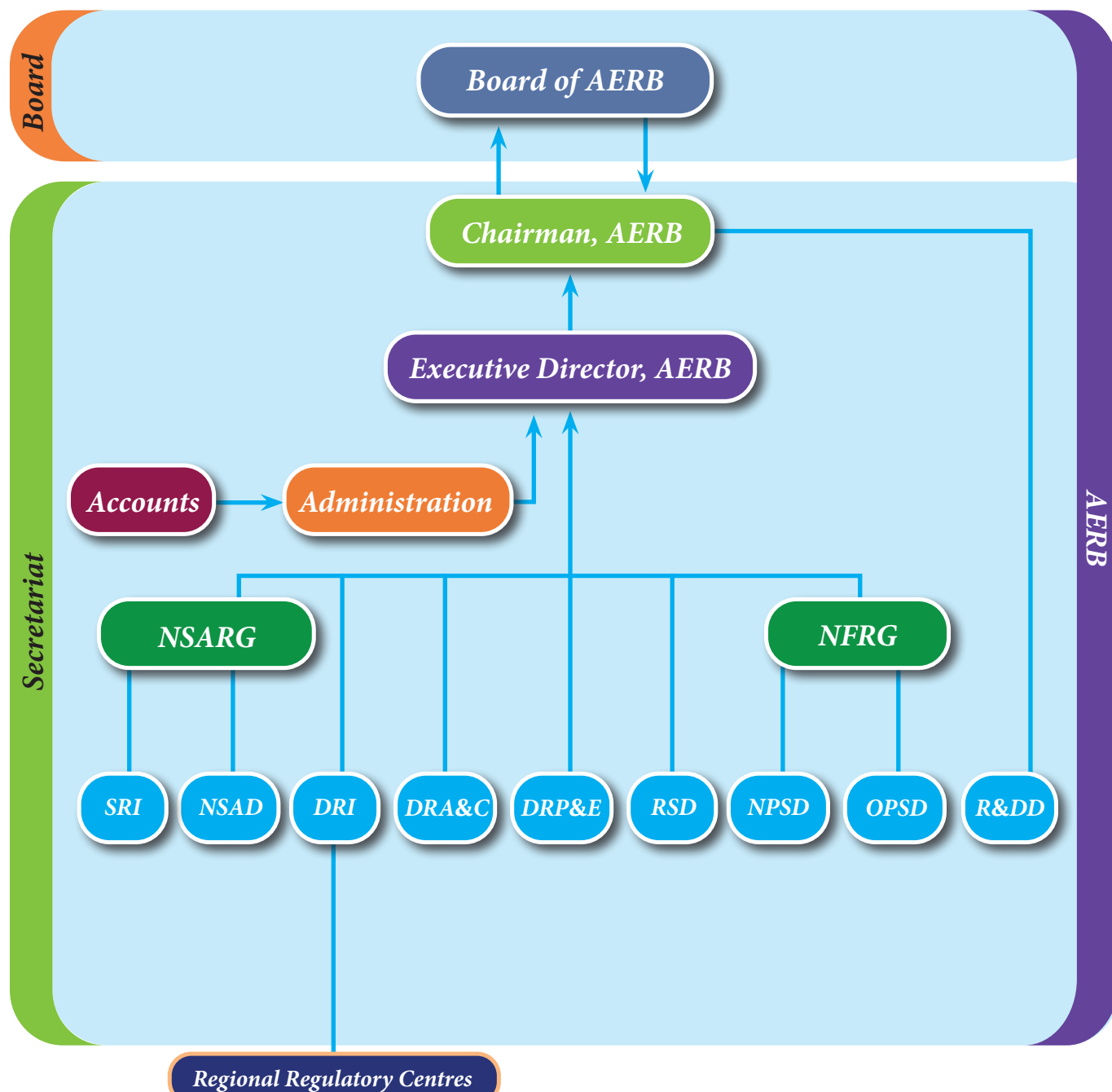


Organisational Strategies

With focus on enhancing the effectiveness in regulation of safety of occupational personnel, the public and the environment towards fulfilling its mission, AERB is pursuing the following strategies which are consistent with the organisational policies in the next three years (i.e. 2019 to 2021).

- Further strengthen role of AERB's staff in efficiently and effectively carrying out the core regulatory processes to obtain best outcome from multi-tiered regulatory review mechanism.
- Remain at par with International benchmark in Scientific and Technical capabilities required for regulatory work.
- Identify areas for upgrading in-house competencies through competency mapping and to strengthen the required competence. To provide opportunities to the staff to grow further in terms of their capabilities and gain diverse experience.
- Update and revise regulatory documents with an aim to harmonize and simplify the regulatory requirements including need to prepare for regulation for diverse technologies of NPPs and Radiation Facilities.
- Strengthen regulatory inspection process by further improving planning, execution and its assessment.
- Strengthen the regulatory interfaces with other concerned agencies as part of national coordination for effective implementation and enforcement of regulatory provisions.
- Remain transparent to stakeholders and put in all efforts to sustain credibility in exercising regulatory responsibilities.
- Create awareness among public and professionals about radiation hazards as well as radiation protection aspects.

Organisation Chart of AERB



● Southern Regional Regulatory Centre, Chennai ● Eastern Regional Regulatory Centre, Kolkata ● Northern Regional Regulatory Centre, New Delhi

NFRG : Nuclear Facilities Regulations Group
 NSARG : Nuclear Safety Analysis and Research Group
 DRI : Directorate of Regulatory Inspection
 DRP&E : Directorate of Radiation Protection and Environment
 DRA&C : Directorate of Regulatory Affairs and Communications

OPSD : Operating Plants Safety Division
 NPSD : Nuclear Projects Safety Division
 NSAD : Nuclear Safety Analysis Division
 RSD : Radiological Safety Division
 R&DD : Resources and Documentation Division
 SRI : Safety Research Institute

Changes in Organisation

Shri Guntur Nageswara Rao takes over the reins of AERB

Shri Guntur Nageswara Rao, has taken charge as the new Chairman of Atomic Energy Regulatory Board (AERB) on January 4, 2019, consequent to the retirement of Shri S.A. Bhardwaj, former Chairman, AERB.

A graduate in Electrical Engineering, Shri Nageswara Rao, had served as Director in the Nuclear Power Corporation of India Ltd (NPCIL) until 2014. He has

also made significant contributions for the Nuclear Fuel Cycle Facilities in India including the Nuclear Fuel Complex and the Heavy Water Board. Shri Nageswara Rao is a recipient of many accolades including the Nuclear Excellence Award from the World Association of Nuclear Operators (WANO) and the Outstanding Service Award from the Indian Nuclear Society (INS).

Farewell to Shri S. A. Bhardwaj

Shri Shiv Abhilash Bhardwaj, Chairman, AERB laid down the office of Chairman, AERB on January 4, 2019. Shri Bhardwaj who took over as Chairman, AERB on September 1, 2015 had a vibrant and dynamic tenure at AERB. Under his leadership, AERB has taken significant initiatives to make AERB a more competent, knowledge based organisation by putting extra emphasis on training, strengthening in-house technical capabilities by involving middle level officers in reviews and assessments. Lot of efforts were put in harmonizing the regulatory safety documents.

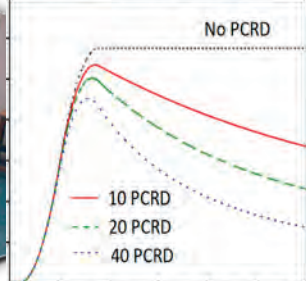
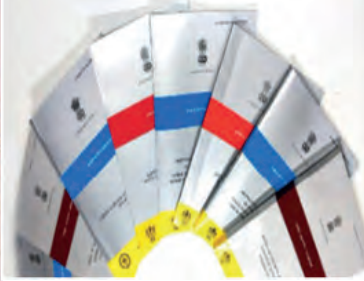


Shri S. A. Bhardwaj, Former Chairman, AERB felicitating Shri G. Nageswara Rao, Chairman, AERB



Key Information of The Year 2019

342 Staff Members	2 Board Meetings	31 Meetings (Project Safety Committee)
96 Meetings (Operating NPP)	13 Meetings (FCF & other Industrial Facilities)	21 Meetings (Radiation Facilities)
3 Renewal of Licence (NPP)	5 Renewal of Licence for Fuel Cycle and R&D Facilities	20,520 Licence (Radiation Facilities)
5,469 Permissions for procurement of Radioactive Sources		77,346 X-ray Equipment Licensed in e-LORA till Dec. 2019
87 Operating Personnel Licensed (FCF)	181 Operating Personnel Licensed (NPP)	3,631 Approvals for RSO (RF)
53 Inspectors (NFs)	11 Inspectors (NFs and RFs)	54 Inspectors (Radiation Facilities)
27 Inspections (NPP-under Construction)	64 Inspections (Operating NPP)	37 Inspections (FCF & other Industrial Facilities)
1,038 Inspections (Radiation Facilities)		53 Enforcement Inspections of Diagnostic X-ray Facilities
12 Safety Meet/Theme Meeting for Nuclear and Radiation Facilities	165 Regulatory Safety Documents (till date)	128 RTI Queries Replied



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Nuclear Power Projects

Safety Review and Licensing

AERB has established a regulatory framework, which involves stipulating the safety requirements, issuance of regulatory consents, verification of compliance through safety reviews & inspections during various stages from siting, design,

construction, commissioning and operation etc. All nuclear power projects undergo an elaborate and in-depth safety review during their various consenting stages, as illustrated below.



SITING

To ensure that the chosen site meets Site Evaluation Criteria and is suitable for the proposed type and capacity of plant from environmental considerations



CONSTRUCTION

To ensure that the proposed plant design meet regulatory requirements, and the proposed construction meets quality requirements



COMMISSIONING

To ensure that the commissioning programme and procedures meet regulatory requirements; performance of the plant is as per design intent; results of commissioning tests confirm adequacy of the plant design for operation; and safety analysis for as-built facility has been carried out



OPERATION

To ensure that plant operational limits & conditions meet regulatory requirements; adequate level of safety is maintained by proper operational & maintenance procedures & administrative control; organisational structure, training & qualification of operating personnel meet the requirements and conditions for renewal of consent as prescribed by AERB

Siting	Construction	Commissioning
<ul style="list-style-type: none"> Jaitapur, Maharashtra 6 x 1650 MWe EPR 	<ul style="list-style-type: none"> Kudankulam, Tamil Nadu 4x1000 MWe PWRs 	<ul style="list-style-type: none"> Kakrapar, Gujarat 2x700 MWe PHWRs
<ul style="list-style-type: none"> Kaiga, Karnataka 2 x 700 MWe PHWRs 	<ul style="list-style-type: none"> Gorakhpur, Haryana 4x700 MWe PHWRs Rawatbhata, Rajasthan 2x700 MWe PHWRs 	<ul style="list-style-type: none"> Kalpakkam, Tamil Nadu 1x 500 MWe PFBR

Regulatory Decisions

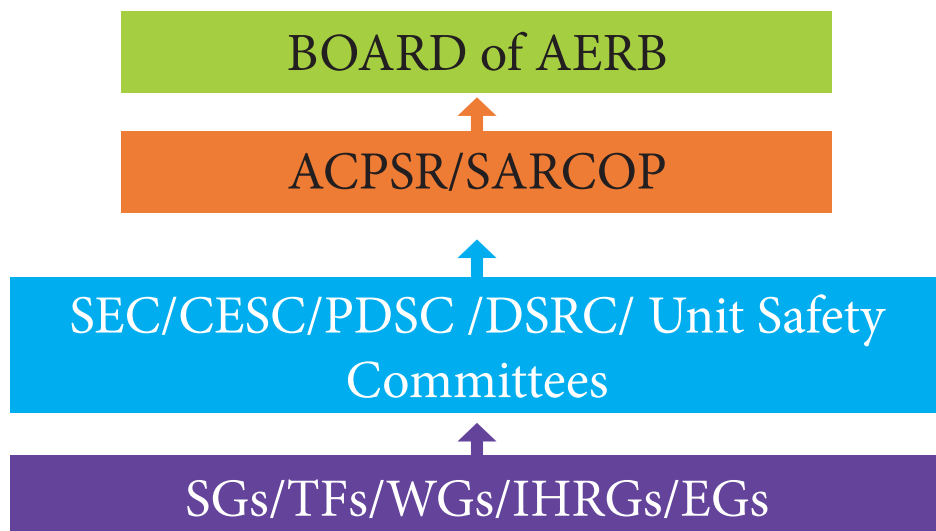
Safety reviews related to the consenting decisions and safety monitoring during various stages are carried out through multi-tier safety committees. It follows the principle of “management by exception”, following graded approach and is based on principles, requirements and criteria specified by AERB in its regulatory documents.



The Multi-tiered System of Safety Reviews

In this approach, the safety issues are first reviewed and assessed through In-House safety Review Groups (IHRG) within respective Directorates/Divisions of AERB. The issues of greater significance are given consideration at higher level committees for their satisfactory resolution. Recommendations of these committees concerning the various safety issues and consents are further considered by AERB for arriving at regulatory decisions. This arrangement is well defined in the AERB's Integrated Management System (IMS) to ensure comprehensiveness of the reviews and effective compliance with the specified requirements.

The committees include experts in relevant fields, including process design, control and instrumentation, thermal hydraulics, structural analysis, reactor physics, seismology etc., relevant to nuclear and radiation safety. The higher level Committees include experts from academia, national R&D institutes and government bodies.



AERB	: Atomic Energy Regulatory Board
ACPSR	: Advisory Committee for Project Safety Review
PDSC	: Project Design Safety TF Committee
SEC	: Site Evaluation Committee
CESE	: Civil Engineering Safety Committee

DSRC	: Design Safety Review Committee
SG	: Specialist Groups
WG	: Working Group
TF	: Task Force
EG	: Expert Group
IHRG	: In-House Review Groups

Nuclear Power Projects- Siting

The Indian government is committed to grow its nuclear power capacity as part of its massive infrastructure development programme. In May 2017, Government of India approved ten new Pressurized Heavy Water Reactors (PHWR) of 700 MWe capacity, in fleet mode.

Nuclear Power Corporation of India Ltd. (NPCIL) has proposed to install progressively 6 units of European Pressurized Reactors (EPR), 1650 MWe PWR (light water reactor) each, of French design at Jaitapur site on the western coast of Maharashtra and 2 units of 700 MWe Pressurized Heavy Water Reactors (PHWRs) each, of indigenous design at Kaiga, Karnataka.

AERB continued the exhaustive process of site evaluation for proposed sites wherein the impact of site on the plant including extreme earthquake, flood and meteorological conditions, the impact of plant on the site under normal and accidental conditions and feasibility of implementation of emergency

plans are assessed. At this stage, AERB also assesses the compliance of the site selection and rejection criteria specified by AERB in its Safety Code on Site evaluation.

NPCIL, submitted application for Siting Consent for two units of 700 MWe PHWRs at Kaiga (Kaiga Units - 5&6) along with Site Evaluation Report (SER) in December 2018. During the year, detailed review was carried out by Site Evaluation Committee (SEC) followed by site visit to obtain first-hand knowledge of site characteristics.

Review w.r.t. Excavation Consent for Kaiga-5&6 is under progress.



Visit of AERB Site Evaluation Committee to
KAIGA- 5&6 Site



KAIGA-5&6 Site

Nuclear Power Projects-Construction

Light Water Reactors (LWR)

AERB had earlier issued the Siting Consent for 4 more Russian design VVERs (KKNPP 3-6) each of 1000 MWe at Kudankulam site in February, 2011. The reactors are of similar design as KKNPP-1&2. Subsequently, AERB had granted clearance for First Pour of Concrete (FPC) to KKNPP-3&4 on June 23, 2017 with certain stipulations. Presently, civil construction work is in progress at KKNPP-3&4.

KKNPP-3&4

During the year 2019, AERB review of revised Preliminary Safety Analysis Report (PSAR) w.r.t. Reactor Coolant System, Engineered Safety Features, I&C, Electrical Systems, Radioactive Waste Management System and Radiation Protection & salient changes is in progress.

Design Basis Report (DBR) on system for retention and cooling of molten core (core catcher) was also reviewed along with erection of core catcher of KKNPP-3&4. AERB also carried out review of design adequacy checks for critical locations and concrete mix designs for normal and heavy concrete.



Core Catcher erection in KKNPP-3

KKNPP-5&6

AERB granted Clearance for Site Excavation to KKNPP-5&6 in November 2018. KKNPP-5&6

application for FPC along with relevant PSAR Chapters is under review with major focus on design differences w.r.t. KKNPP-3&4.



Liner Erection Works in Reactor Building of KKNPP-4

Nuclear Power Projects-Construction

Pressurized Heavy Water Reactor (PHWR)

Twin units of indigenously designed 700 MWe PHWRs are being set up each at Kakrapar (KAPP-3&4), Rawatbhata (RAPP-7&8) and Gorakhpur (GHAVP-1&2) respectively. These reactors are similar in design except for site specific changes. Safety review of progressive submissions are in progress.

Civil construction and erection of equipment/components are under progress at KAPP-4 and RAPP-7&8. Following activities completed during the year;

- **KAPP-4:** Pre-stressing activity of Inner Containment was completed.



RAPP-7&8 Main Plant Area



Preparation for vertical testing in progress

- **RAPP-7:** Inner Containment Dome Concreting and Pre-stressing activities have been completed.
- **RAPP-8:** North & South SG vault and IC wall construction including ring beam has been completed.

GHAVP-1&2

AERB issued Siting consent for 4 units of 700 MWe PHWRs at Gorakhpur, Haryana site (GHAVP-1 to 4) in 2015. Subsequent to grant of excavation consent in January 2018, the excavation activities being commenced for main plant buildings of GHAVP-1&2.

PSARs of GHAVP-1&2 as required for FPC, have been reviewed with a focus on design/layout differences in GHAVP w.r.t. KAPP-3&4 and site-specific features.



Head preparation for anchor piles in progress



AERB Team along with Plant Personnel during Commissioning of KAPP-3

Nuclear Power Projects- Pre-Commissioning



View of KAPP-3&4 Project Site



Erection of Dome Structure of Inner Containment at KAPP-3



700 MWe End Shield received at KAPP-3, 4 Site

Different Phases of Construction in KAPP-3

Kakrapar Atomic Power Project-3&4 (KAPP-3&4) is the first twin unit project in a series of 700 MWe PHWR Units. This is an evolved design from 540 MWe PHWR (TAPS-3&4, Tarapur). A number of First-Of-A-Kind (FOAK) systems/ features have been introduced in 700 MWe PHWR design viz. steel lined containment, containment spray system, passive decay heat removal system, partial boiling at the outlet of coolant channels, mobile fuel transfer machine, forced evaporation of tritiated liquid waste for discharging to air route through stack, use of super heavy concrete for construction of shielding structure of Fuel Transfer Room etc. Pre-commissioning activities were in progress at KAPP-3. AERB progressively reviewed relevant submissions w.r.t. Safety analyses, Stress analysis reports, Commissioning Procedures & reports, and Technical Specifications for Operation.

Application for authorization of Primary Heat Transport (PHT) System, Hot Conditioning and Light Water Commissioning (LWC) of KAPP-3 was reviewed and clearance for hot-conditioning and associated hot tests was granted on August 07, 2019. Subsequently, clearance for balance LWC tests was granted on November 01, 2019.

Based on AERB review observations, some of the commissioning tests were repeated. After completion of PHT related commissioning tests, permission for draining of Light Water from PHT system was granted on December 16, 2019.

Stage-wise regulatory clearances granted by AERB to KAPP -3

- Consent for Siting of Twin Units (KAPP-3&4) issued on May 25, 2009.
- Clearance for Site Excavation granted on January 15, 2010.
- Clearance for First Pour of Concrete (FPC) was granted on November 20, 2010.
- Permission to proceed with construction activities beyond 91.7 m EL in November 2011.
- Erection of Major Equipment (last sub stage of construction consent) granted on May 26, 2014.
- Permission for Grouting End-Shields granted on September 29, 2014.
- Clearance for hot-conditioning and associated hot tests granted on August 07, 2019.
- Clearance for balance Light Water Commissioning tests granted on November 01, 2019.
- Permission for draining of Light Water from PHT system granted on December 16, 2019.



Electrical Installation work in progress at KAPP-3&4



Installation of Pre-Fabricated Ring Liner at KAPP-3

Nuclear Power Projects - Commissioning

Prototype Fast Breeder Reactor (PFBR)



Commissioning activities are in progress at 500 MWe Prototype Fast Breeder Reactor (PFBR). Clearance for receipt, handling and storage of 42 numbers of fresh fuel sub-assemblies (FSA) at Fuel Building (FB) was issued on June 28, 2019 after detailed safety review and assessment of the application along with the supporting documents.

Decoupling and recoupling of Large Rotatable Plug (LRP) bearing is planned for investigation of high torque observed during trial rotation of LRP. AERB Site Observers Team (SOT) deputed at Kalpakkam Site has been independently observing ongoing commissioning activities at PFBR with respect to regulatory safety aspects.



Safety Surveillance of Operating NPPs & Research Reactors

Currently there are 22 operating NPPs in the country. During the year 21 NPPs operated safely, one unit (RAPS-1) under defueled condition.

- Radiological doses to all occupational workers were within the limit
- The releases from all the plants continued to remain only a small fraction of the allowable discharge limits
- The effective dose to public due to the radioactive discharges were estimated to be far less than the annual limit of 1mSv prescribed by AERB

SARCOP Members' Visit to RAPS-1&2



Operational Status of NPPs and Research Reactors

AERB continued its regulatory supervision of Nuclear Power Plants as well as two research reactors, (FBTR and KAMINI) which are under the purview of AERB.



TAPS-1&2, 160 MWe twin units are located at Tarapur, Maharashtra. They are the only BWR units in India & are first nuclear power plants in India. These units became operational in 1969. The licence for operation of TAPS-1&2 is valid upto March 2021.

TAPS-3&4, 540 MWe twin units are located at Tarapur, Maharashtra. They are PHWR type reactors, became operational in 2005-2006. The Licence for operation valid upto August 2021.



RAPS-1&2, 100 & 200 MWe twin units are located at Rawatbhata, Rajasthan. They are the first PHWR type reactors in India, became operational in 1973 & 1981 respectively. Licensed upto August 2024.
RAPS-1 unit is under shutdown since 2004 and the reactor core is defueled.

RAPS-3&4 and 5&6, 220 MWe units are located at Rawatbhata, Rajasthan. They are PHWR type reactors became operational in 2000 and 2010 respectively. Licensed upto October 2022 and March 2020 respectively.



KAPS-1&2, 220 MWe twin units are located at Kakrapar, Gujarat. They are PHWR type reactors, became operational in 1993 and 1995 respectively. The Licence for operation of KAPS-1&2 is valid upto July 2024.

- BWR : Boiling Water Reactor
- PHWR : Pressurized Heavy Water Reactors
- PWR : Pressurized Water Reactor



MAPS-1&2, 220 MWe twin units are located at Kalpakkam, Tamil Nadu. They are PHWR type reactors, became operational in 1984 & 1986 respectively. Licensed upto December 2020.

NAPS-1&2, 220 MWe twin units are located at Narora, Uttar Pradesh. They are PHWR type reactors, became operational in 1991 & 1992 respectively. Licensed upto June 2023.



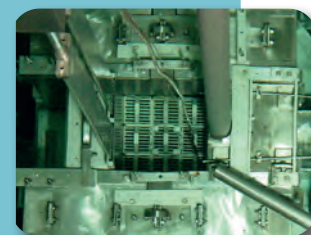
KGS-1&2 and KGS-3&4, 220 MWe units are located at Kaiga, Karnataka. They are PHWR type reactors. KGS-1&2 became operational in 2000 and licence for operation is valid upto May 2022. KGS-3 & 4 became operational in 2007 and 2011 respectively, and licence for operation is valid upto April 2023.

KKNPP-1&2, 1000 MWe twin units are located at Kudankulam, Tamil Nadu. They are PWR type reactors, became operational in 2014 and 2017 respectively. Licensed upto July 2020.



FBTR is India's first and only fast breeder test reactor located at Kalpakkam. This test reactor has been operational since 1985. The current output is 18 MW. The licence for operation of FBTR is valid upto June 2023.

KAMINI (Kalpakkam Mini) reactor at IGCAR is India's first U-233 fuelled research reactor, located at Kalpakkam. It produces 30 kW at full power. It achieved criticality in 1996 & is under regular safety surveillance of AERB. This reactor functions as a neutron source for neutron radiography, activation analysis and radiation physics experiments.



Licensing of Plant and Personnels

Operating plants undergo continuous safety review through periodic reports and regulatory inspections supplemented by exhaustive five yearly reviews which takes place prior to renewal of licence. It involves detailed safety review of safe operation of NPP as per its design intent, safety systems performances, improvements in safety etc.

In addition to this, a periodic safety review (PSR) is carried out once in ten years,

which is a much more comprehensive safety review and includes additional factors like advancement in technology, feedback of operating experience from within India as well as from other countries, comparison of safety standards, cumulative effects of plant ageing, probabilistic safety assessments etc.

Based on these reviews, licence for operation of NPPs were either renewed or extended.

Unit	Renewal of Licence /Authorization under following Acts & Rules	Validity
RAPS-1&2	✓ Atomic Energy Act, 1962 (and rules framed thereunder)	August 31, 2024
KAPS-1&2	✓ Factories Act, 1948 ✓ Authorization for Radioactive Waste Disposal/Transfer under GSR-125	July 31, 2024
KKNPP-1&2	✓ Factories Act, 1948	July 31, 2020

Licensing /Re-Licensing of Operating Personnel

181 Operating personnel of NPPs in various positions (Shift Charge Engineer (SCE), Assistant Shift Charge Engineer (ASCE) and Control Engineer (CE)) were licensed in different NPPs, research reactor and associated facilities

Re-Start of KAPS-1

KAPS-1&2 units had experienced the events of failure/leak from the coolant channel in March 2016 and July 2015 respectively. Subsequent to these events, En-Masse Coolant Channel Replacement (EMCCR) was taken up in KAPS-1&2. Based on

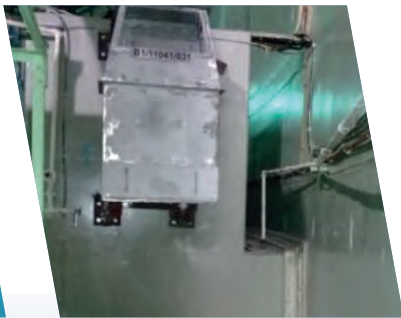
satisfactory review of submission, AERB granted the permission for fuel reloading and re-start of KAPS-1 which was synchronized to grid on May 24, 2019 after completion of EMCCR activities. KAPS-2 is already in operation since September 2018.

Safety Upgrades at NPPs Post-Fukushima

Safety assessment of NPPs carried out post Fukushima accident, has provided assurance on availability of adequate safety margins and inherent strength in dealing with external hazards. However, certain safety enhancements were identified for further strengthening the defences against rare external events exceeding the design bases and enhancing severe accident mitigation capabilities. These actions were classified as short, medium and long term measures/safety upgrades. Implementations of short and medium term safety measures/upgrades have been already completed.

AERB is closely monitoring the status of implementation of long term measures and the progress is as follows:

- ❖ Activities related to indigenous development, testing and qualification of Passive Catalytic Recombiner Devices (PCRD) addressing the post-accident hydrogen management needs for the Indian PHWR containments have been completed. PCRDs are being progressively installed in NPPs.
- ❖ Technology development of Containment Filtered Venting System (CFVS) has been completed. CFVS has been installed in TAPS-1&2 (BWR), whereas installation is in progress in PHWR based NPPs, where the requirement has been envisaged.
- ❖ On-site Emergency Support Centres (OESC) are being constructed in phased manner at all the NPP sites.



Passive Catalytic
Recombiner Devices



CFVS at TAPS-1&2



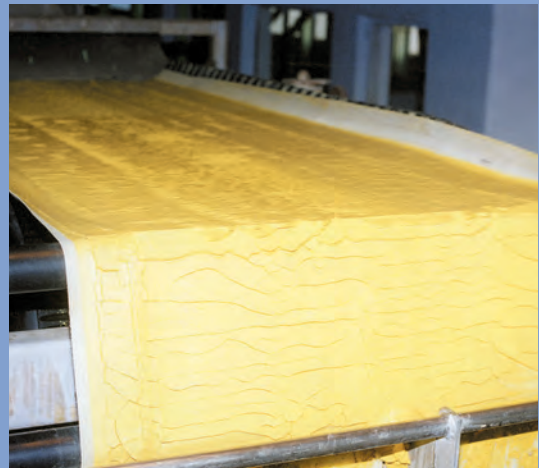
Experimental Facility
for CFVS at TAPS-3&4

Nitrogen Inerting System at TAPS-1&2





Fuel Cycle Facilities





SARCOP Visit to IREL OSCOM

The nuclear fuel cycle facilities and other related industrial facilities under the regulatory control of AERB are mines and ore processing plants of Uranium Corporation of India Ltd. (UCIL), mineral separation plants and chemical processing plants of Indian Rare Earths Limited (IREL), Nuclear Fuel Complex (NFC), Zirconium Complex (ZC), Heavy Water Plants (HWP) and some of the facilities of Indira Gandhi Centre for Atomic Research (IGCAR).

In addition to this, Beach Sand Minerals (BSM) and other facilities handling Naturally Occurring Radioactive Materials (NORM) are also regulated by AERB with respect to radiological safety aspects.

Important proposals reviewed:

- Renewal of Licence for Operation of Mohuldih Mine, HWP-Hazira and HWP-Thal
- Permission for Ore Production in Jaduguda and Bhatin Mine after being shutdown for prolonged period
- Extension of Trial Operation of Tummalapalle Mill
- Authorization for Operation of Sodium Facility for Component Testing, IGCAR
- Amendment of Licence for operation of HWP-Tuticorin
- Licences for operation of Beach Sand Minerals (BSM) Facilities of IREL
- Renewal of License of State Government PSU (KMML) of Kerala engaged in beach sands mining
- Enhancement of licensed production capacity of Zirconium Complex (ZC), Pazhayakayal

Authorization of operating personnel

63 personnel in HWP

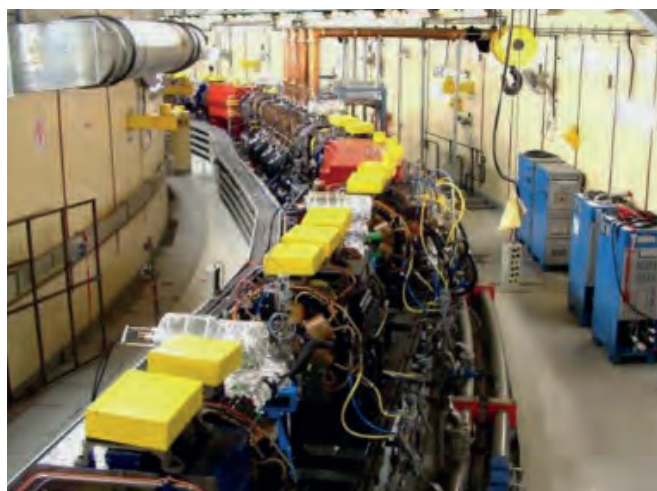
24 personnel in NFC

Safety Surveillance of R&D Centres and Industrial Plants

Safety review of Variable Energy Cyclotron Centre (VECC), Raja Ramanna Centre for Advanced Technology (RRCAT), Indira Gandhi Centre for Atomic Research (IGCAR) and Electronics Corporation of India Limited (ECIL) was done by AERB apart from the Fuel Cycle Facilities.

Raja Ramanna Centre for Advanced Technology (RRCAT)

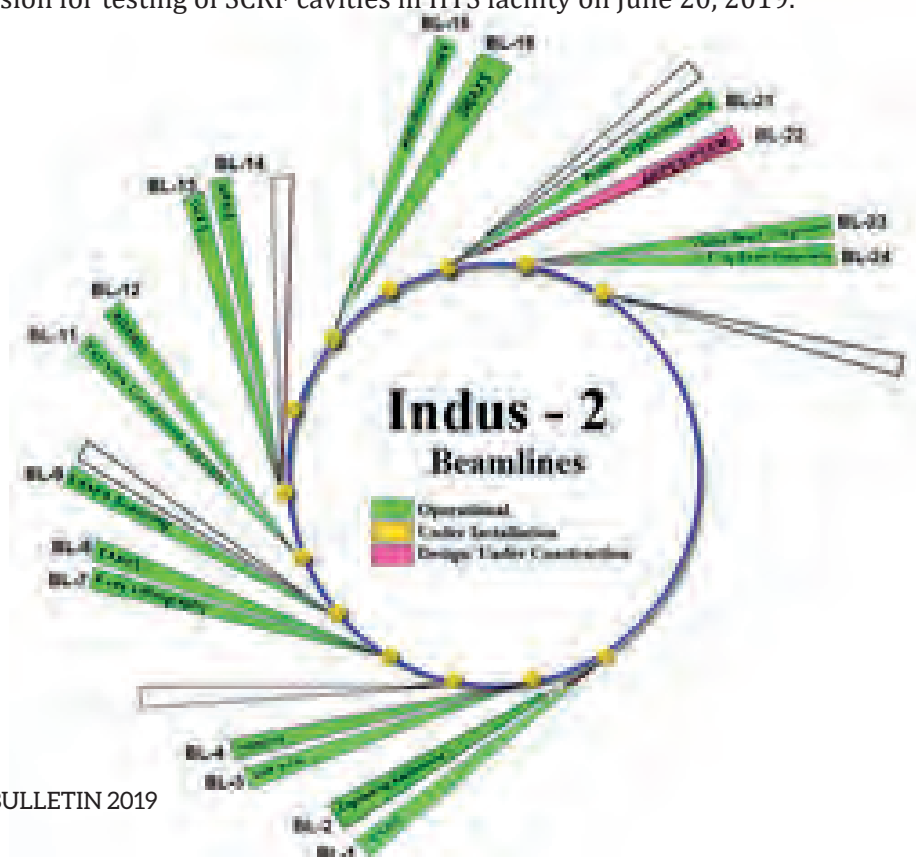
RRCAT had licence for operation of Agricultural Radiation Processing Facility (ARPF) with TWINDUS LINAC-1, which is a technological demonstration facility for food irradiation.



Facility	Status	Scope of the Facility
INDUS-1	In operation	450 MeV, 100 mA electron Storage ring
INDUS-2	In operation	2.5 GeV, 200 mA Synchrotron Radiation sources
TWINDUS LINAC -1	In operation	10 MeV, 5 kW LINAC for Technology Demonstration for Food Irradiation
TWINDUS LINAC-2	Trial Run Operation	10 MeV, 5 kW Electron Accelerator
TWINDUS LINAC-3	Under Commissioning	10 MeV, 5 kW Electron Accelerator
Accelerator	In operation	10 MeV, 10 kW Electron Accelerator
LASER	In Operation	150 TW Ti: Sapphire Laser System
LASER	Under Construction	1 PW Laser System
Superconducting RF Cavity	Commissioning and operation	Superconducting RF cavity at 650 MHz

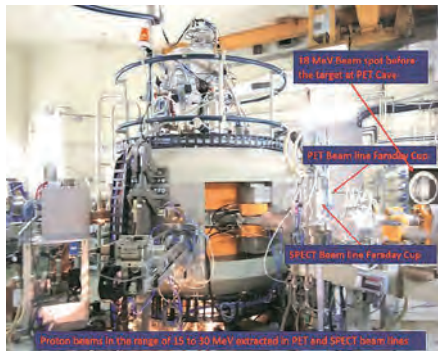
During the year, AERB reviewed following proposals and granted permissions:

- ✓ **TWINDUS LINAC-2:** Permission for trial run operation granted on January 25, 2019.
- ✓ **TWINDUS LINAC-3:** Permission for installation, testing and commissioning granted on June 4, 2019.
- ✓ **Superconducting RF (SCRF):** Consent for commissioning and operation of Horizontal Test Stand (HTS) and permission for testing of SCRF cavities in HTS facility on June 20, 2019.



Variable Energy Cyclotron Centre (VECC)

The Room Temperature Cyclotron (K-130) was under operation, delivering alpha and proton beams of various energies and intensities. Commissioning of Super-conducting cyclotron and Radioactive Ion Beam facility were in progress.



During the year, AERB reviewed, application for Stage-1 Commissioning of Medical Cyclotron and its associated beamlines and the consent

was granted on July 30, 2019. Medical Cyclotron will be used for commercial production of isotopes for Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) as well as high end technological research.

Electronics Corporation of India Limited (ECIL)

ECIL facilities are involved in production of nuclear industrial instrumentation systems, control & communication systems and other electronic components. ECIL facilities at Hyderabad and Tirupati operated safely during the year.



Indira Gandhi Centre for Atomic Research (IGCAR)

Two accelerator facilities viz. 1.7 MV Tandatron and 150 kV Accelerator were safely operated at IGCAR during the year.



Board of Radiation & Isotope Technology (BRIT)

BRIT facilities at Vashi, Navi Mumbai and its Regional Centres at several locations in the country are involved in production of radio-isotopes used in radiation facilities as well as radio-pharmaceutical used mainly in nuclear medicine applications.

During the year, following applications pertaining to BRIT facilities were reviewed and based on the outcome of the safety review, respective licences were extended as detailed below;



Unit	Renewal of Licence /Authorization under following Acts & Rules	Validity
BRIT, Navi Mumbai	✓ Atomic Energy Act, 1962 (and rules framed thereunder)	January 31, 2024
BRIT-RAPPCOF, Kota	✓ Factories Act, 1948, and ✓ Authorization for Radioactive Waste Disposal/Transfer under GSR-125	
Regional Centre BRIT, Hyderabad	✓ Atomic Energy Act, 1962 (and rules framed thereunder) ✓ Factories Act, 1948	

Safety Surveillance of Back-end Fuel Cycle Facilities

Compact Reprocessing of Advanced Fuels in Lead Cell (CORAL)

The reprocessing of Fast Breeder Test Reactor (FBTR) spent fuel is being carried out at CORAL facility of IGCAR. AERB had extended the licence for operation of CORAL under the Atomic Energy Act, 1962 up to March 2018 subject to keeping the facility in safe shutdown condition and not carrying out reprocessing operation during this period, for completion of activities related to ageing management, residual life assessment of major component & dose reduction. CORAL facility is re-licensed up to August 30, 2023.



Demonstration Fast Reactor Fuel Reprocessing Plant (DFRP)

DFRP is being set up at Kalpakkam for reprocessing of the spent fuel from Fast Breeder Test Reactor (FBTR) and demonstration of reprocessing process of the PFBR spent fuel. It is divided into 2 concrete cell facilities called Head End Facility (HEF) and Process Plant Facility (PPF). During the year, AERB completed safety review and assessment of the application for commencing acid-Tri-Butyl Phosphate (TBP) run (initial inactive commissioning) and issued clearance in March 2019.

Fast Reactor Fuel Cycle Facility (FRFCF)

FRFCF is an integrated facility being set up at Kalpakkam, which will be used for recycling the spent fuel from PFBR, including fuel fabrication & assembly, reprocessing and waste management. Presently, civil construction activities of Waste Management Plant, Core Subassembly Plant, Fuel Fabrication Plant (FFP) and Reprocessed Uranium Plant (RUP) are in progress. AERB is following up the safety aspects related to construction.



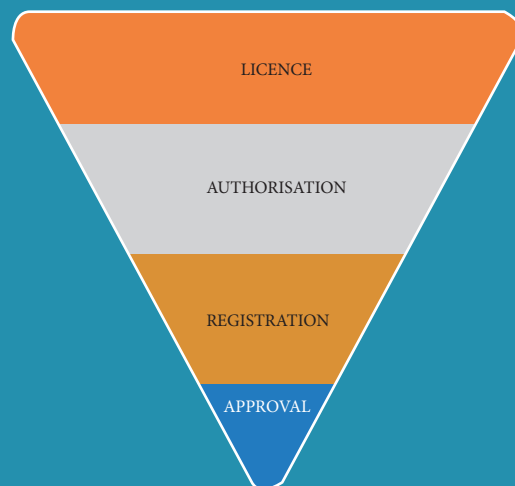
Safety Surveillance of Radiation Facilities

Radiation Applications in Medical, Industry and Research

Radiation sources such as radioisotopes (^{192}Ir , ^{60}Co , ^{137}Cs , ^{170}Tm , ^{75}Se , ^{241}Am , $^{99\text{m}}\text{Tc}$) and radiation generating equipment (X-ray machines, accelerators) are being used in multifarious and ingenious ways to achieve overall societal health and prosperity. The radiation sources have a wide range of applications in the industry, medicine, agriculture and research institutions and AERB regulates these facilities/institutions. These sources possess radiation hazard potential ranging from very low to high. Proper design, handling and disposal methodologies are required for ensuring safe and intended use of radiation sources. Regulation of these sources is in accordance with the radiation hazard potential involved and the extent of use in the public domain.

As per the Atomic Energy (Radiation Protection) Rules, 2004 promulgated under the Atomic Energy Act, 1962, the radiation sources are classified as LICENCE, AUTHORISATION, REGISTRATION and CONSENT/APPROVAL categories, based on their hazard potential. Accordingly, the statutory requirements are graded and may require multiple stages of approval to address the hazard, before final issuance of consent to operate the facility/ equipment.

The Graded approach in AERB Consenting Process based on Radiation Hazard Potential



Medical Applications of Radiation Sources

Radiotherapy



Teletherapy

Teletherapy is a branch of radiotherapy in which tumour is treated by using ionising radiation keeping radiation source(s) at certain distance. The radioisotope like ^{60}Co and radiation generators such as Linear Accelerators are used.



Proton Beam Therapy

It is a type of radiation therapy that uses a beam of protons having energies 70 to 230 MeV. Proton beam is specifically beneficial in treating paediatric cancers and deep-seated tumours more effectively than the conventional Gamma/ X-ray radiation therapy. First-of-a-kind Proton Beam Therapy facility in the country was licensed in December 2018.

Sources and devices used in teletherapy are of high radiation hazard potential.



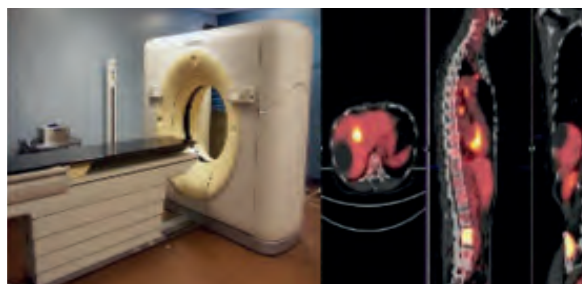


Brachytherapy

In brachytherapy, source is kept very near to the lesion. The radioisotopes used are ^{192}Ir , ^{137}Cs , ^{90}Sr , ^{106}Ru , ^{125}I and ^{60}Co with activity range from few MBq to GBq. They are of moderate radiation hazard potential as compared to teletherapy.

Nuclear Medicine

Nuclear medicine facility uses very small amount of radioactive material in the form of radio-pharmaceuticals (eg. $^{99\text{m}}\text{Tc}$, ^{131}I , ^{201}Tl and ^{18}F) for diagnosis and treatment. Imaging equipment such as PET-CT and Single Photon Emission Computed Tomography (SPECT) are used in these practices. The facilities using radio-pharmaceuticals are of moderate-to-low radiation hazard.



Diagnostic Radiology (X-ray)

X-rays are used in medical facilities as an important diagnostic tool. Following practices use X-ray for various diagnostic examinations.



Interventional Radiology equipment (Cath-Lab)

These equipment are used in operation theatres for various interventional procedures and pose moderate radiation hazard to patients and medical professionals involved in operation of the equipment.

There are 1,944 Cath Lab. equipment.



Computed Tomography (CT)

CT is a non-invasive medical examination that uses X-ray equipment to produce cross-sectional images of the body. CT equipment pose moderate radiation hazard potential to both worker and patient.

There are 4,824 CT equipment.



Radiography and Fluoroscopy

Radiography, Fluoroscopy, Dental X-ray, Mammography, Bone Mineral Densitometer equipment are used for diagnostic purpose. These constitute around 70-80% of all X-ray equipment that are used, and are of low-to-very low radiation hazard potential, to both worker and patients.

There are about 70,578 such medical diagnostic X-ray equipment.

Following table provides the details of consents issued for Medical Radiation Facilities during the year.

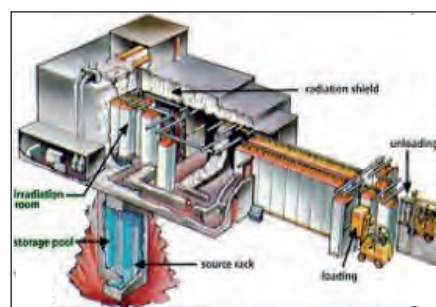
Type of Consent ↓ No. of Facilities (Equipment) →	Radiotherapy	Nuclear Medicine	X-ray
	503 (735 Teletherapy +316 Brachytherapy)	350	56,660 (77,346)
Licence*	206	170	19,747
Permission for Import/Procurement of Equipment	152	64	10,458
Permission for Procurement of Radioactive Sources	419	2314	---
Type Approval/Renewal (Equipment)	19	---	169
Layout Approval	325	160	---

*Licence includes Licence / Authorisation / Registration for various radiation facilities

Industrial Applications of Radiation Sources

Radiation Processing Facilities (RPF)

RPF includes Gamma Radiation Processing Facility (GRAPF)/ Gamma Irradiators and Electron Beam Accelerators are used mainly for radiation processing of food (i.e. inhibiting sprouting, delay in ripening, microbial decontamination, insect disinfestation, shelf-life extension etc.), sterilisation of healthcare products and crosslinking of polymers in cable industries. The activity range is about few PBq (eg. 10^{15} Bq) of ^{60}Co .



Industrial Accelerators Radiation Processing Facility (IARPF) operated in electron mode of energy range from 1.5 to 3 MeV and are mainly used for cross linking of polymers. One of the benefits of accelerators is that, unlike radioactive sources, it produces radiation only when they are energized.

The RPFs are of high radiation hazard potential.

Research Accelerators

Research Accelerators or Particle Accelerator Research Facilities (PARF) are generally installed in academic & research institutions and catering to the research needs of various fields of high energy physics, material science, radiation studies etc. Accelerators installed in our country operated in the energy range from a few hundreds of keV to GeV. The hazard associated with the facilities also diverse in nature and ranges from very high-to-moderate hazard potential. The radiation hazard potential of an accelerator mainly depends on the type of ion(s) accelerated, type of accelerator and beam parameters (e.g. energy & current, target system). Besides radiation hazard, other industrial hazards such as electrical, mechanical, RF, magnetic, cryogenic etc. are also present in an accelerator facility.





Gamma Irradiation Chamber (GIC)

Gamma Irradiation Chamber is basically used for research and development in research and academic institutions and also in blood banks for irradiation of blood and blood components. Radioisotopes like ^{60}Co and ^{137}Cs are used in these applications. The activity ranges from few tens of TBq to few hundreds of TBq. They are of high to moderate radiation hazard potential.

Now a days, Irradiator based on X-ray generator are also used in blood banks and research application. X-ray energy range is from 160 to 300 keV.

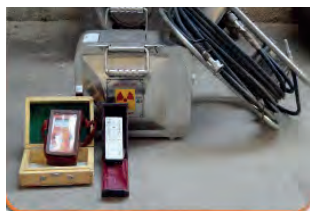
Medical Cyclotron

Short-lived radioisotopes that are used in nuclear medicine Positron Emission Tomography (PET) scans are generally produced in medical cyclotron facilities. In India, cyclotrons are primarily utilised for the production of ^{18}F labelled radio-pharmaceuticals. The medical cyclotron facilities are of high-to-moderate radiation hazard potential.



Industrial Radiography (IR)

Radiography using Industrial Radiography Exposure Device (IRED), is one of the important non-destructive (NDT) methods used for study / evaluation of weld joints, castings etc. Radioisotopes like ^{192}Ir , ^{60}Co , ^{75}Se and different energies of X-rays are used in the field of industrial radiography. The activity range is from few hundreds of GBq to few TBq. The X-ray energy range is from few hundreds of keV to few MeV. They are of high-to-moderate radiation hazard potential.



Nucleonic Gauges (NG)



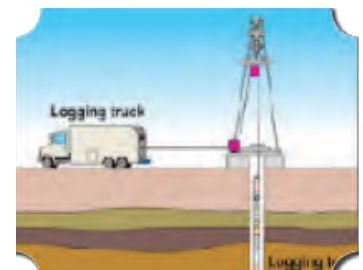
Nucleonic Gauges also known as Ionising Radiation Gauging Devices (IRGD) are used for online measurement/monitoring of quality control parameters such as thickness, level, density, coating thickness, composition of material, elemental analysis etc. Sources used for nucleonic gauges comprise of gamma sources (e.g. ^{60}Co , ^{137}Cs , ^{241}Am), beta sources (e.g. ^{85}Kr , ^{90}Sr , ^{147}Pm , ^{204}Tl) and neutron sources ($^{241}\text{Am-Be}$ and ^{252}Cf). The activity range is from MBq to GBq. They are of moderate-to-low radiation hazard potential.



Well Logging (WL)

Radioactive sources are used in well logging application for exploration of oil, coal and geophysical logging etc. The sources used are mainly ^{137}Cs for density measurement, $^{241}\text{Am-Be}$ and neutron generators (Deuterium-Tritium generators) for exploration of hydrocarbon. The activity range is from kBq to GBq. They are of moderate-to-low radiation hazard potential.

Some calibration sources such as ^{60}Co , ^{226}Ra , ^{232}Th of MBq activity are also used in well logging.



Following table provides the details of consents issued for Industrial Radiation Facilities during the year.

Type of Consent	RPF	Research Accelerators	Medical Cyclotron	GIC	IR	NG ^s	WL
No. of Facilities and Equipment/ Devices	23 (Gamma) & 16 (IARPF)	10	21	124	612	1097	51
	21 (Accelerators)	10	21	128	2970	7212	1690 (Sources)
Licence*	11	1	4	24	243	99	09
Type Approval/Renewal (Equipment)	---	---	---	4	3	61	---
Sources				---	---	08	06
Permission for Import/Procurement of Equipment	04	---	---	---	325	400	---
Permission for Procurement of Radioactive Sources	15	---	---	---	1839	418	107
Approval (Layout/ Commissioning/ Source Storage Facility)	---	---	---	---	392	---	15

*Licence includes Licence / Authorisation / Registration for various radiation facilities.

^sNucleonic gauge institute registration and migration of equipment were in progress in e-LORA.

Consumer Products and Research Applications

Consumer Goods Manufacturing Facilities

Consumer products such as smoke detectors, thorium gas mantles and starters, gaseous tritium luminescence devices use exempt quantity of radioactive sources. They are of very low hazard potential. However, regulatory control exists on the manufacturing facilities of these devices. The products containing radioactivity above the exempt limits have to be assessed for safety and are required to be type approved by AERB.



X-ray Baggage Scanner

Scanning facilities are used for detection of contrabands and explosives. Scanning facilities are mainly X-ray based equipment. These have extremely low radiation hazard potential. Design (Type) approval is carried out by AERB. Only the manufacturers /suppliers of equipment are regulated.

Container Scanner Facility

Container scanners are used at various ports (land/sea) for inspection of material inside cargo/ container without opening them. These scanners are either accelerators or ⁶⁰Co based. They are high-to-moderate radiation hazard potential.



Facilities using Sealed and Unsealed Sources

Though sealed radioactive sources are used in various industrial and medical applications, but here sealed source means those used in education, research and calibration purposes. Unsealed sources are also used in various research and academic institutions such as agriculture research, veterinary science, tracer studies. The activity range is from kBq to GBq. They are of low-to-moderate radiation hazard potential.



Following table provides the details of consents issued for Consumer Products and Research Applications Facilities during the year.

Type of Consent	Consumer Goods Manufacturing Facilities	Container / Baggage Scanner	Research Facilities (Sealed and Unsealed Sources)
No. of Facilities/ (Equipment)	25	22 (26)	262 and 186
Licence*	01	05	---
Permission for Procurement of Radioactive Sources	---	---	357
Type Approval (Equipment)	---	72	---

*Licence includes Licence / Authorisation / Registration for various radiation facilities.

BRIT has indigenously developed Ru-106 eye plaque for brachytherapy treatment of eye cancers. Based on review AERB issued approval of Classification Designation to Ru-106 eye plaque.

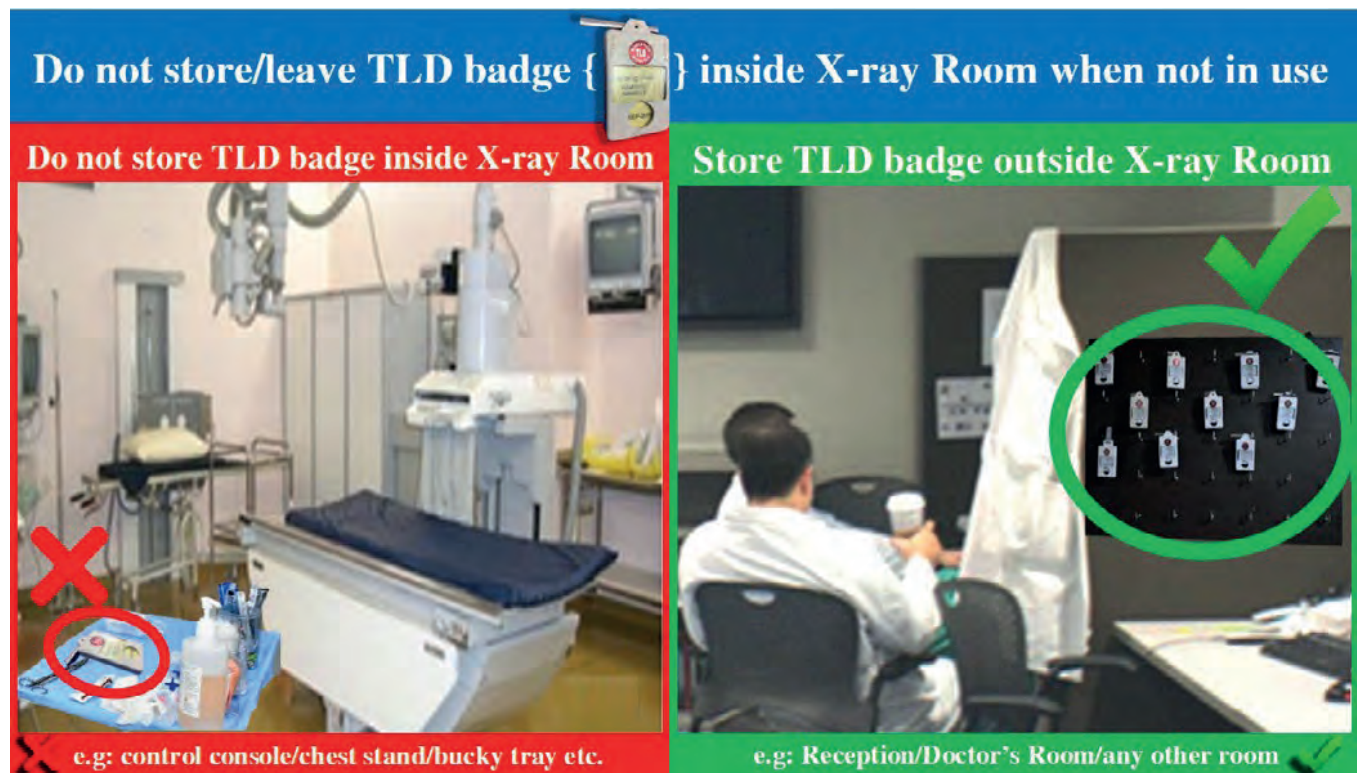


Assessment of Excessive Exposure Cases for Radiation Facilities

Radiation dose to worker in excess of regulatory constraint of 10 mSv in a monitoring period is communicated to respective user institution for investigation. Such investigation reports are reviewed by AERB through multi-tier review, for not only assigning the dose to the worker but also to initiate regulatory actions to prevent such recurrences.

In the recent past, a large number of excessive exposure cases got accumulated for final resolution due to various reasons. Several steps were initiated by AERB, such as constitution of an In-House Review Group (IHRG) for resolution of excessive exposure cases, revision of procedure of assessment of excessive exposure cases, spreading awareness to the workers about proper use of TLD and safe work practice. With this multipronged approach not only the number of reported cases were reduced but also the reported cases were expeditiously resolved to avoid further accumulation in future.

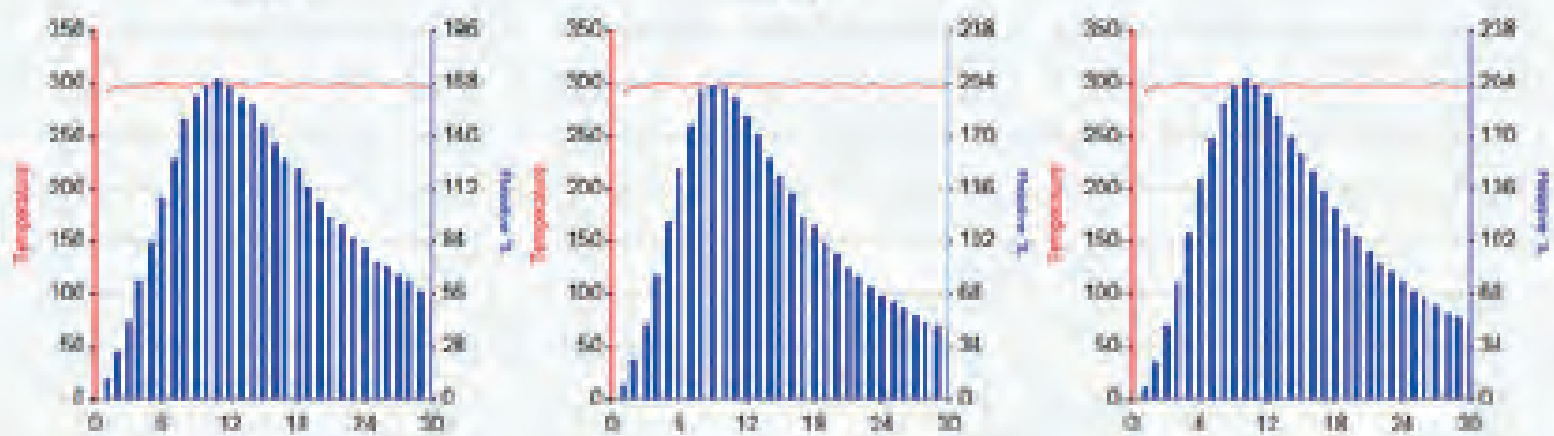
Analysis shows that around 90% of the reported cases are from medical X-ray practice and out of which 95% cases are found to be non-genuine, where the persons were not actually exposed to the reported radiation dose.



Awareness Posters on Proper Storage of TLD

Disc 1

Disc 2



Simplification of Regulatory Requirements

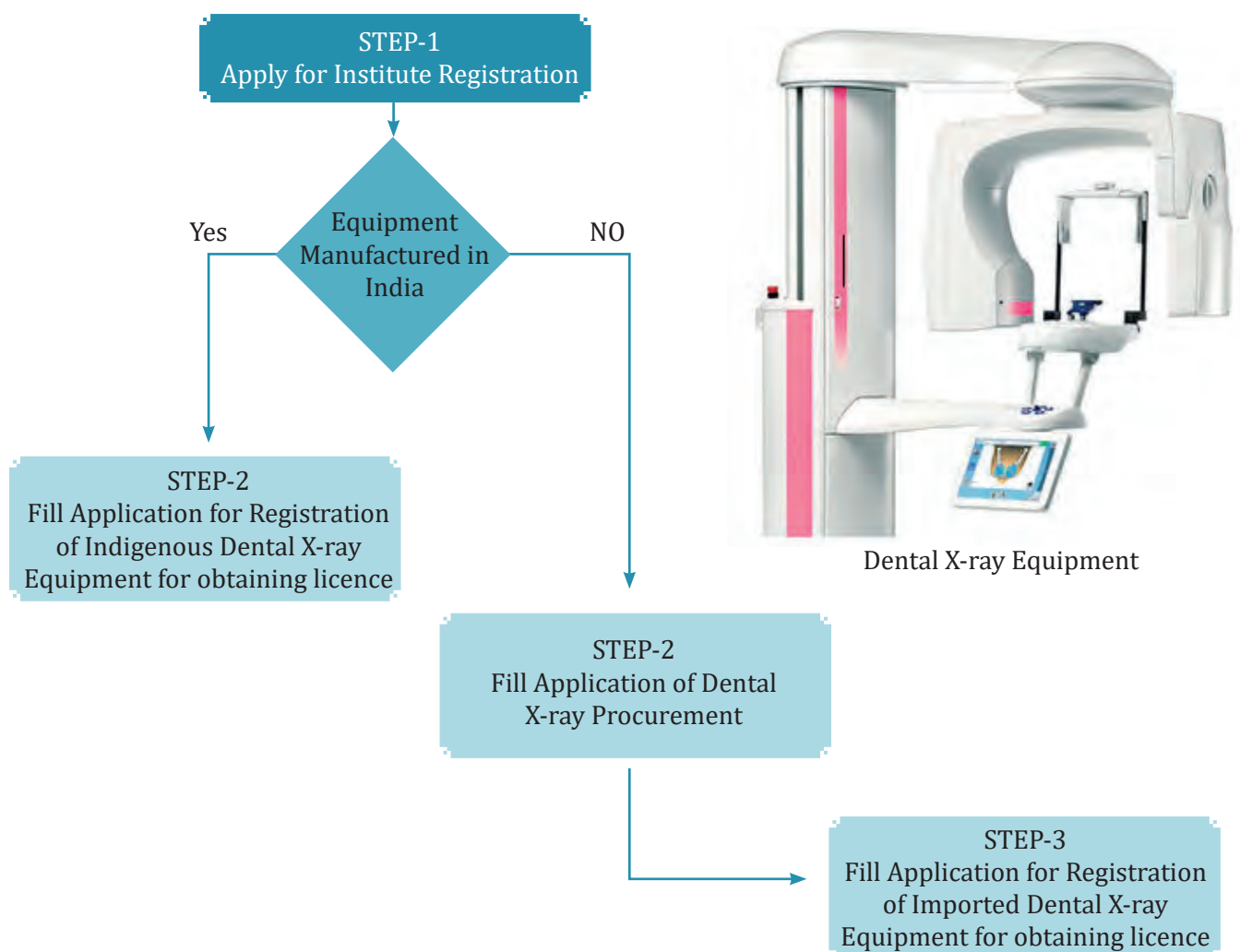
- **Amendment of Safety Code on Industrial Radiography**

The Safety Code on Industrial Radiography [AERB/RF-IR/SC-1 (Rev.1) 2015], was amended with an aim to improve the availability of qualified industrial radiographers and also accommodating the fresher's entering in this field without compromising on radiation safety. Now, a candidate with minimum one year course from Industrial Training Institute (ITI) and with one year working experience is also eligible to undergo Training Course on 'Radiological Safety for Industrial Radiographer' at par with candidate possessing 10+2 or equivalent examination with science subjects.

- **Simplification in Registration of Dental X-ray Equipment**

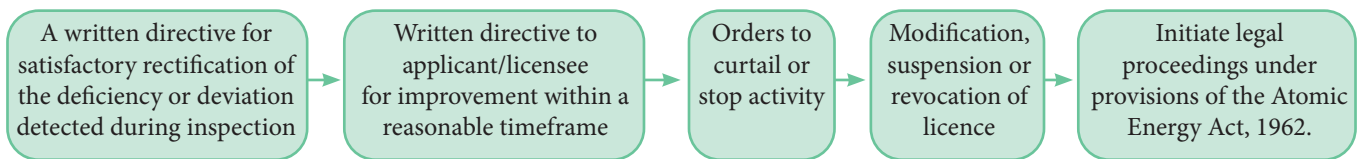
The module for processing applications for Licence (in the form of Registration) for operation of Dental X-ray equipment has been simplified and made functional in AERB's e-LORA system. Now, the Registration for operation of indigenously manufactured dental X-ray equipment be obtained in two steps, where as it is three step process for imported equipment.

Steps to be followed for obtaining Licence for operation of Dental X-ray Equipment



Safety Surveillance Enforcement Actions

AERB may initiate enforcement actions, if in its opinion the licensee has violated the conditions of the licence, after specifying the reasons for such actions. The enforcement actions may include one or more of the following:

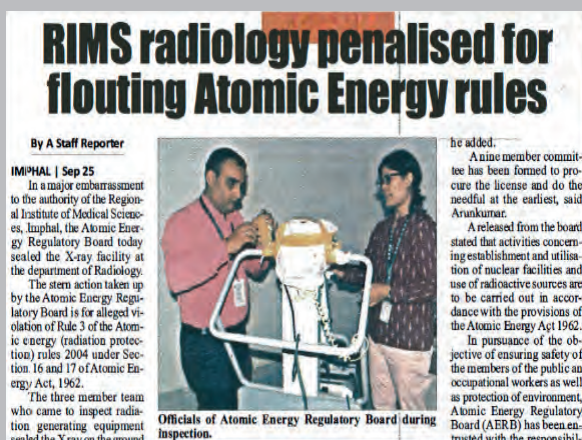


Enforcement in Diagnostic Radiology (X-ray) Facilities

As part of the nation-wide campaign to ensure increased compliance and regulatory coverage of medical diagnostic X-ray equipment, AERB continued the unannounced inspections programme and carried out inspections of facilities in four states in North-Eastern region viz. Manipur, Assam, Meghalaya and Nagaland during September 2019. Total 11 equipment were 'Sealed' and issued 'Warning for Seal' to 91 X-ray for violation of major safety & regulatory requirements.



Information on such inspections is shared with local print media and television media to spread awareness among the users on radiation safety



Imphal
Bishnupur
Shillong
Guwahati
Tinsukia
Dibrugarh
Digboi
Dimapur
Kohima



Enforcement in Radiation Facilities

Warning Letter was issued to licensee of well logging institution due to loss of source during transport.

Show-cause notice was issued to two nucleonic gauge institutions on regulatory violations committed by the institution resulted in loss of radioactive sources.

Suspended operation of two industrial radiography devices at Agra and Rajkot site for a period of three months, for storage/use of radiography devices at unapproved/unauthorised sites.

Enforcement in NPP

Stopped all construction activities at KKNPP-3 to 6 following an accident of serious nature occurred at Fabrication Shop of KKNPP-3&4 where left hand of the victim (an operator with the contractor) got entangled in a drilling machine while cleaning the drilling chips.

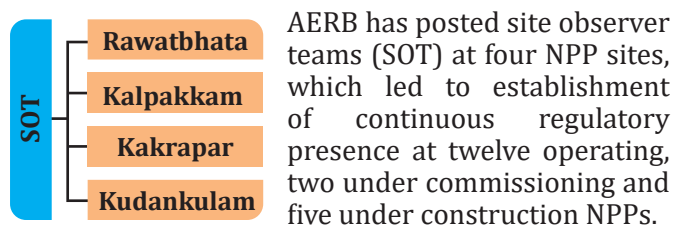


Safety Surveillance

Regulatory Inspection

Regulatory inspections are carried out to ensure compliance with AERB regulatory requirements and consenting conditions.

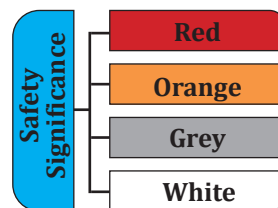
Inspections are carried out periodically as well as in special circumstances. AERB also conducts unannounced inspections, to observe the actual state of the facility and the way in which it is being operated and maintained.



Regulatory Inspections of Nuclear and Radiation Facilities	
Type of Facility	No. of Inspections Conducted
Nuclear Power Projects and Fuel Cycle Facilities under Construction & Commissioning	27
Operating NPPs and Research Reactors	64
Fuel Cycle Facilities, R&D Units and Industrial Plants of DAE	37
Radiation Facilities	1038



AERB follows a graded approach during regulatory inspections. The reported deviations observed during RI are categorised in the increasing order of safety significance. White indicates deviations of very low safety significance, whereas Red indicates high safety significance.





Special Inspections

- KKNPP-1&2 site inspected in view of media reports on cyberattack on computer systems.
- Unannounced inspections of NPPs viz. TAPS-1&2, NAPS-1&2 and KGS-1&2 to cover operation and surveillance activities.
- GHAVP and KGS-1&2 to assess the nature of safety measures after fatal accident.
- KGS-1 & 2 and NAPS-1 during Biennial Shutdown to cover radiological safety aspects.
- KGS-1 & TAPS-3 to cover the Integrated Leak Rate Test (ILRT) of Reactor building containment.
- As a vendor inspection programme, carried out special RI of NFC, Hyderabad and NPC Regional QA office at Hyderabad.
- Inspected UCIL mines viz. Jaduguda and Bhatin to cover radiological safety aspects.



Post-RI meeting between AERB and NPCIL Officials

Inspection of NPCIL Headquarter

AERB carried out NPCIL HQ inspection in 2017, the follow-up inspection was carried out by AERB to verify the 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 applicable to the activities of NPCIL HQ was also verified during this inspection.

AERB officers carried out hand-holding inspections-cum-training along with staff of Directorate of Radiation Safety, Andhra Pradesh and familiarized them with the RI process and inspection methodology.



Radioactive Waste Management and Environmental Safety



The disposal of radioactive wastes is governed by the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 promulgated under the Atomic Energy Act, 1962.

The rules require that for disposal of any radioactive waste, an authorization has to be obtained from AERB. The radioactive wastes can be disposed/transferred only in accordance with the terms and conditions specified in this authorization.

Further regulations for safe management of radioactive wastes are laid down in the Safety Code on Management of Radioactive Waste. AERB has prepared various Guides on radioactive waste management which provide guidance on implementation of the regulatory requirements of the Safety Code.

DAE Facilities Authorized for Disposal/Transfer of Radioactive Waste

Name of DAE Organisation	No. of Facilities
Uranium Corporation of India Limited	11
Indian Rare Earth Limited	1
Nuclear Fuel Complex	6
NPCIL	14
IGCAR + SRI(AERB)	5
Board of Radiation & Isotope Technology	4*
Technology Demonstration Plant	1

*LBL, JONAKI, BRIT is exempted from waste authorisation

Validity of Authorisation for Safe Disposal / Transfer of Radioactive Wastes for DAE Facilities has been changed from fixed term of 5 years and is linked with validity of operating licence.

Accordingly, Authorisation for waste disposal was issued to NPPs viz. RAPS-1&2, KAPS-1&2; Mohuldih Mine & Tummalapalle Mill of UCIL and RAPPCOF, BRIT during the year.



Disposal of Wastes from Operating NPPs

Wastes generated from nuclear facilities are in the form of gaseous, liquid and solid. The public dose limit of 1mSv is apportioned among the various facilities located at a given site in a conservative manner. This apportioned dose is further subdivided among atmospheric, aquatic and terrestrial pathways and also among radionuclides which are specific to the installation.

Solid wastes generated from nuclear power plants are generally low level waste which are decontaminated, compacted and disposed of in engineered near surface disposal facilities

Disposal of Disused Radioactive Sources

Spent radioactive sources from radiation facilities must be safely disposed of once they reach the end of their useful life. These sources are disposed of at authorised waste management facility in the country. In India two sites are authorised, one is at Bhabha Atomic Research Centre (BARC), Mumbai and another is at Central Waste Management Facility (CWMF), Kalpakkam. The imported sources are sent to the original supplier abroad.

During the year, 63 approvals were issued for disposal of radioactive sources at authorized waste management facilities within the country and 348 approvals for exporting back to supplier in the country of origin



Emergency Preparedness

For Nuclear Power Plants it is mandatory to develop Emergency Preparedness and Response (EPR) plans as a measure of abundant caution. These plans are prepared in accordance with the national laws and regulations and deal with the effective management of any eventuality with a potential to pose an undue radiological risk to plant personnel and public.

Similarly, EPR plans are ensured for nuclear facilities (under the purview of AERB) and handling hazardous chemicals namely ammonia and hydrogen sulphide based Heavy Water Plants (HWP) and some of the heavy water plants catering to the production of solvents.

The establishment and submission of EPR plan is one of the pre-requisites for licensing of radiation facilities (RF) also.

Guidelines for EPR Plan

AERB lays down the requirements and provides guidance for preparation of EPR plans. AERB reviews and approves the EPR plans of the licensee. In accordance with the severity of the potential consequences, emergency situations are graded as Plant Emergency, Site emergency and Off-site emergency as defined below along with frequency to conduct these exercises at NPP.

Declared emergency conditions in which the radiological/other consequences, confined to the plant or a section of the plant, requiring immediate operator action.

Plant Emergency

Accidental condition/ emergency situation in the plant involving radioactivity transgressing the plant boundary but confined to the site, or involving release of hazardous chemicals or explosion, whose effects are confined to the site, with off-site consequences being negligible.

Site Emergency

Accident condition/ emergency situation involving excessive release of radioactive materials/hazardous chemicals from the plant to the public domain calling for intervention.

Off-Site Emergency

Plant
Emergency
Exercise

Once in a Quarter

Site
Emergency
Exercise

Once in a Year

Off-Site
Emergency
Exercise

Once in Two Years

During 2019, seven Site Emergency Exercises (SEE) and one Off-Site Emergency Exercise (OSEE) were conducted at various NPP sites.

Plant Advisory Group at Plant Emergency Control Centre (PECC)



Strengthening the Emergency Preparedness

New procedure for conducting off-site emergency exercises is being introduced by AERB as part of its ongoing revision of regulatory requirements for conduct of exercises. Different type of exercises viz. Table top exercise, Integrated Command Control and Response (ICCR) exercise and Field exercise were conceptualized and conducted, focusing on different aspects of emergency management. So far, three trial table-top exercises and 2 ICCR exercises were conducted at various NPP sites.



On-site Emergency Support Centre (OESC)

In the light of the accident at Fukushima NPPs, AERB has framed requirements and guidelines for establishing OESCs at all NPPs. OESC has capability to withstand earthquake and flood of magnitudes larger than their respective design basis for the NPP. Construction of the OESCs at two sites (Tarapur and Kakrapar) is in progress.



Nuclear and Radiological Emergency Monitoring Cell (NREMC)

In order to strengthen the monitoring of progress of response actions during nuclear and radiological emergencies and the review of these actions, NREMC was established at AERB with capabilities of emergency analysis, assessment of emergency response actions & protective actions and communication with all stakeholders including public and government on the safety significance of events and actions being taken.

Integrated Command Control and Response (ICCR) Exercise

ICCR is conducted to test the command control functions, response timeline, initial field response, communication & co-ordination among various response agencies. During the year, off-site emergency exercise was conducted at Kalpakkam site in September 2019. It was designed to challenge all organisations having a role in responding to a nuclear emergency. The various DAE and other Government organisations actively participated in the exercise. Strengths and gap areas were identified for corrective action by relevant organizations. The feedback obtained would be used to finalize revised AERB policy on conduct of off-site emergency exercises.

District Authorities at the District Emergency Operation Centre (EOC)



Safety In Transport of Radioactive Material



The widespread use of ionizing radiation has brought in the necessity of voluminous transport of the radioactive material from one place to another, many a times through public domain.

The transportation of radioactive material (including that of nuclear material from nuclear facilities), is governed by regulations specified by AERB in Safety Code on 'Safe Transport of Radioactive Material' and is in line with the International requirements specified by IAEA for safe transport of radioactive material.

All transport consignments require Approval from AERB under Atomic Energy (Radiation Protection) Rules 2004. These consignments are required to be accompanied by a TREM card which contains emergency phone numbers to be contacted during accidental conditions. The design of the radioactive package

should be such that during the entire process of transport, it is ensured that the radioactive material remains contained and shielded to avoid unacceptable radiation exposure to cargo handlers and public.

As the activity and nature of radioactive material to be transported varies over a wide range i.e. from few kBq (few μCi) to few PBq (thousands of Ci), a graded approach is used in selection of the packaging.



"Type A packages", are used for transport of radioactive material of activity not exceeding the specified limits and need to be registered with AERB.



"Type B packages" are subjected to a stringent approval procedure and are required to fulfil the safety standards.



I-White



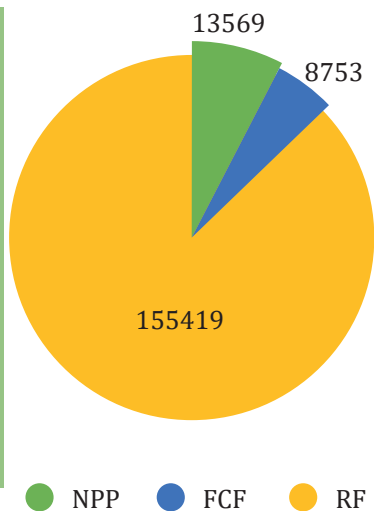
II-Yellow



III-Yellow

During the year, 2 Type A packages were registered and approval issued to 4 Type B(U)/B(M) Packages

Safety Statistics



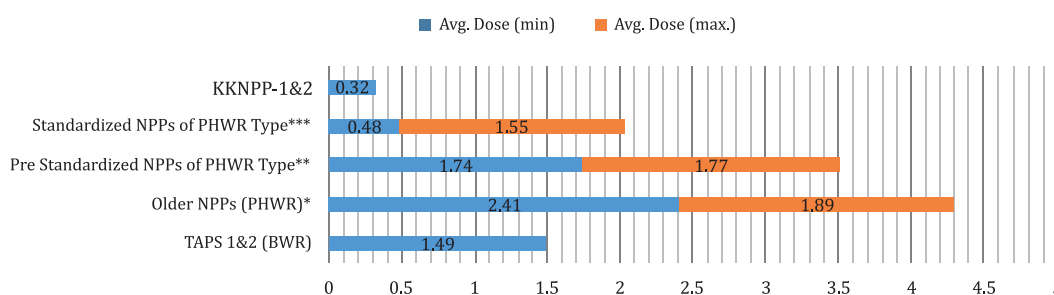
No. of Monitored Persons

Occupational Exposures

No worker received dose greater than the annual investigation level of 20 mSv in NPPs & Fuel Cycle Facilities (FCFs).

In case of Radiation Facilities (RFs), one radiation worker in diagnostic radiology facility received radiation dose above 30 mSv due to non-standard operating practice. AERB has issued notices to concerned institution to prevent recurrence of such incidents.

Average Doses (mSv) in Operating NPPs (2019)



"AERB has prescribed a dose limit of **30 mSv** in a year for occupational radiation exposure, with the condition that it should not exceed 100 mSv in a span of 5 years.

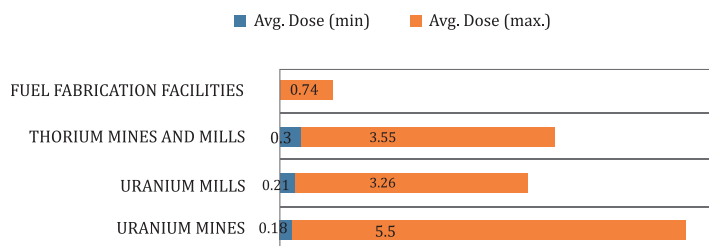
This limit is more stringent than the ICRP recommended limit followed around the world.

*Older plants consist of RAPS-1&2 and MAPS-1&2

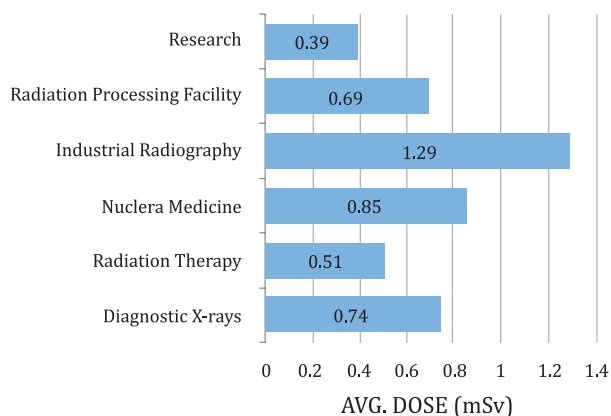
** Pre-Standardized NPPs consist of NAPS-1&2 and KAPS-1&2

*** Standardised NPPs consist of KGS-1&4, RAPS-3 to 6, TAPS-3&4

Average Doses (mSv) in Fuel Cycle Facilities (2019)



Average Doses in Radiation Facilities (2019)



Safety Statistics

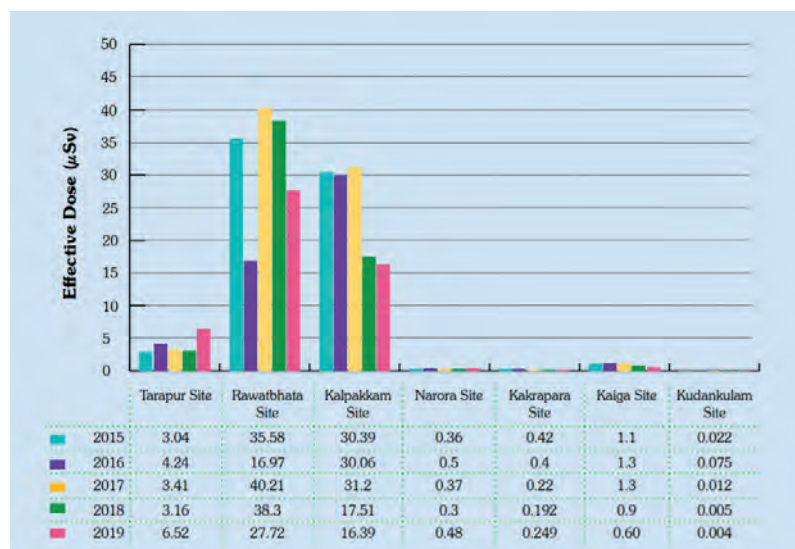
Public Exposure

AERB imposes limits on radioactive liquid and gaseous discharges from operating nuclear and radiation facilities. These limits are decided by experts and very conservative such that there is no adverse effect on the health of public or environment.

Apart from prescribing limits AERB verifies conformance to these limits. Radiation dose to the members of the public near the operating plants is estimated based on gaseous release and measurements of radionuclide concentration in items of diet, i.e. vegetables, cereals, milk, meat, fish etc., and through intake of air and water.

During 2019, the liquid and gaseous radioactive wastes discharged to the environment from the operating units were only a small fraction of the prescribed technical specification limits. The effective dose to public due to the radioactive discharges were estimated to be far less than the annual limit of 1 mSv (1000 micro-Sievert) prescribed by AERB.

AERB has prescribed a public dose limit of 1 mSv (1000 micro-Sieverts) per year. All operating NPPs maintained an exclusive zone boundary at 1.6 km radius within which no habitation is allowed.



Public Dose at 1.6 km Distance (Exclusion Boundary) for NPPs

Note: Public dose at Rawatbhata and Kalpakkam sites are relatively higher as compared to other reactor sites, due to release of Ar-41 from RAPS-2 and MAPS.

Perspective of Doses

Threshold for Mortality
20,00,000

Radiation Sickness Appears
10,00,000

First Signs of Radiation Effects
500,000

Emergency Worker Dose Limit/yr
250,000

Risk of Health Effects insignificant
100,000

Thyroid Scan
43,000

Thallium Cardiac Stress Test
36,000

Occupational Dose Limit/yr
30,000

One Chest CT Scan
7,000

Natural Background/yr
2,400

Public Dose Limit/yr
1,000

One Chest X-ray
100

One 10 hr. Air flight
50

Actual Annual Radiation Dose
from Operation of NPPs
at Exclusion Boundary
< 15

All Values in Micro-Sievert

Safety Statistics

Significant Events

AERB requires NPPs to report certain events that occur in the plant which have or may have impact on operational safety. The reporting criteria is provided in the Technical Specification for operations. These reports are reviewed and categorized based on International Nuclear & Radiological Event Scale (INES).

INES Rating

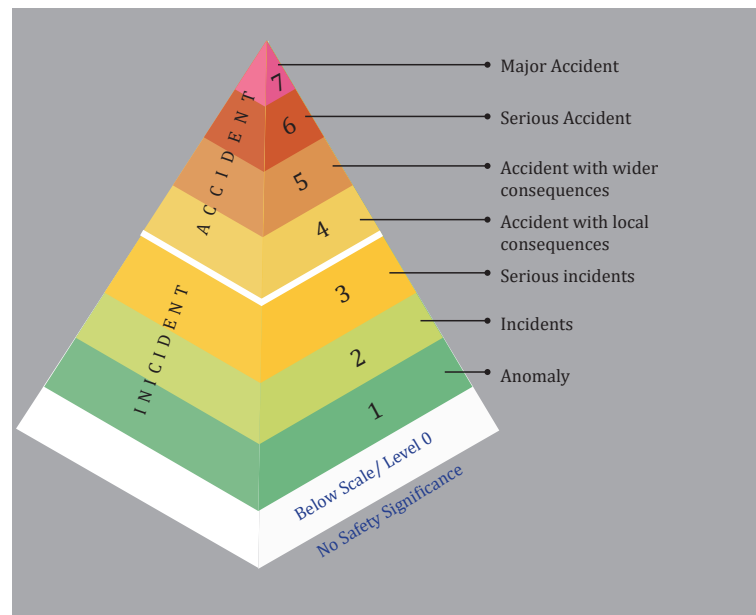
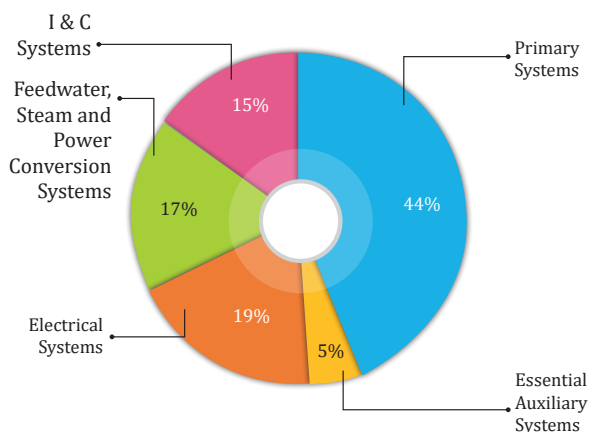
The INES system of the International Atomic Energy Agency (IAEA) rates events at seven levels (1 to 7) depending on their safety significance.

The accidents at Chernobyl NPP in former USSR (now in Ukraine) in April 1986 and Fukushima NPPs in Japan in March 2011 were rated at level 7 on INES. These accidents involved core meltdown with the consequences of off-site radioactivity release to environment.

- No significant event was reported in NPP under construction.
- A total of 45 significant events were reported from the operating NPPs in 2019. Of these, one significant event at RAPS-2 was rated at level-1 on INES, while 40 significant events were rated at level-0 on INES.
- One event at TAPS-3&4 is currently under review for finalising the INES rating.
- Three industrial safety events, one each at RAPS-5&6, KGS-1 and KKNPP-1&2 were not rated on INES (as they are amenable for rating in INES).

All these significant events were reviewed in detail to identify and implement corrective actions as required.

The events reported were categorized as per the IAEA-IRS coding system. The classification of systems failed / affected in the significant events is as shown.



NPPs	INES Rating of Events	
	INES-0	INES-1
TAPS-1 & 2	2	0
TAPS-3 & 4	3	0
RAPS-1 & 2	7	1
RAPS-3 & 4	3	0
RAPS-5 & 6	6	0
MAPS-1& 2	3	0
NAPS-1 & 2	1	0
KAPS-1 & 2	2	0
KGS-1 & 2	8	0
KGS- 3 & 4	1	0
KKNPP-1&2	4	0
Total	40	1

RAPS-2 Event

RAPS-2 was shut down due to water leakage from secondary side of multiple boiler hairpins. The investigation revealed that leakage was due to generic phenomenon (i.e. under deposit corrosion) which had led to wall thinning and pinholes in the boiler hairpins, near the weld joint between tube-sheet and boiler hairpin shell.

Safety Statistics

Industrial Safety Reportable Injuries

There were 31 reportable injuries including 5 fatalities with a loss of 30,994 man-days.

Frequency Rate

No. of reportable injuries divided by million man-hrs worked

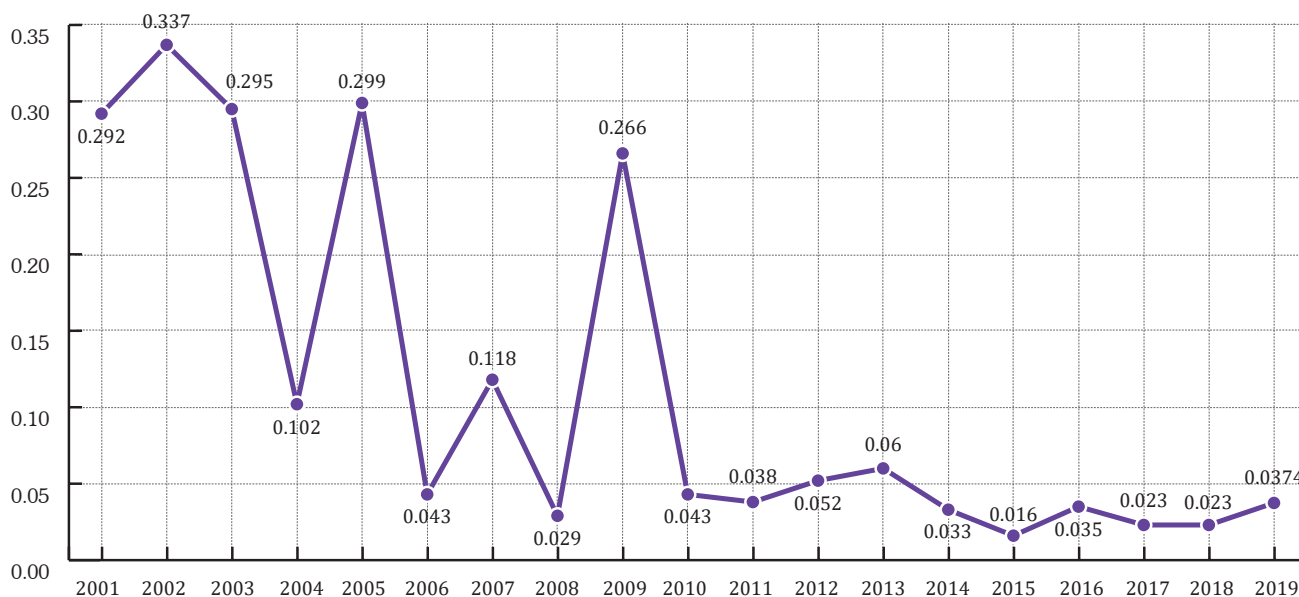
The Frequency Rate has increased to 0.19 in the year 2019 as compared to 0.11 in the year 2018.

Severity Rate

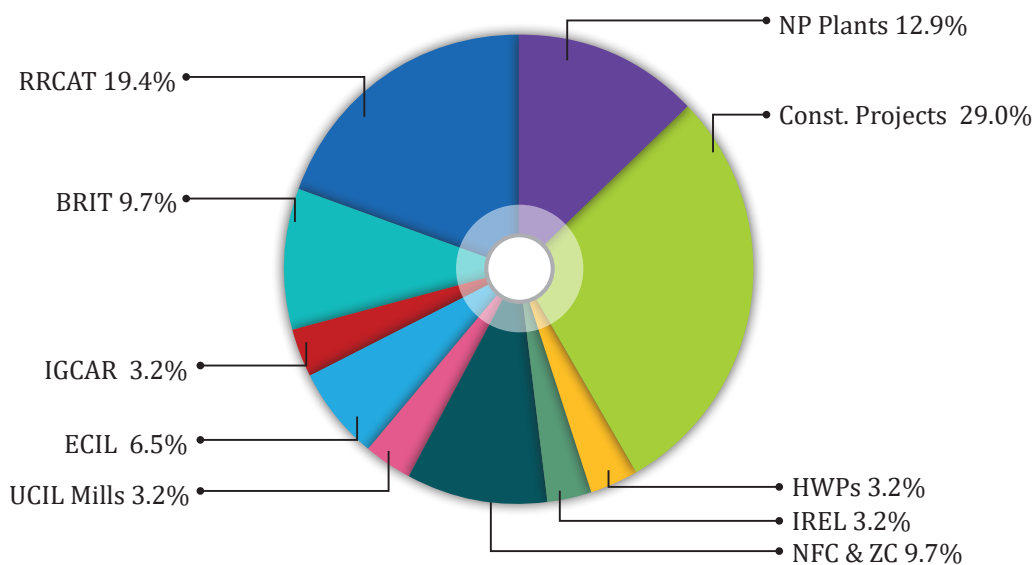
No. of man-days lost divided by million man-hrs worked

The Severity Rate was 193 in 2019 as compared to 204.61 in 2018.

Injury Index is product of Frequency rate and Severity rate



Trend of Injury Index in DAE Units



Distribution of Reportable Injuries (%) in DAE Units in 2019

Occupational Health

There was no notifiable disease reported during the period from any of the operating units of DAE under the purview of AERB.

Significant Events related to Industrial Safety in Nuclear Facilities

During the year 5 significant events related to industrial safety were reported in nuclear facilities. Brief description of the events is given below:

- A fatal accident took place at the temporary dyke area of KKNPP-3 to 6. The victim while doing the repair work on an excavator fell down from a height of around 2.5 m.
- A fatal accident occurred at RAPP-7&8, while shifting of a girder, it slipped from pipes & toppled, the victim caught in between the girder and floor.
- A fatal accident occurred at GHAVP-1&2 main plant area, where a dumper en-route hit the victim.
- A fatal accident occurred at KGS-1 where a crane operator was found lying unconscious on the crane access walkway platform.
- A fatal accident occurred at IREL, OSCOM, where a contract worker fell from top of tanker (3.3 m height) which resulted in serious injuries on his skull and face.

These accidents were investigated by AERB and recommendations were made to prevent such recurrences. The analysis and recommendations of these accidents were forwarded to all DAE units for information and lessons to be learnt.

Unusual Occurrences in Radiation Facilities

Few unusual occurrences were reported from radiation facilities involving loss or theft of sources. The incidents were reviewed by safety review committees in AERB and appropriate enforcement actions were taken against the respective institutions. Finding of incidents indicated the inadequate security arrangements for storage of disused sources and delay in disposal.

Loss of Radioactive Source from Storage

- Two incidents of loss of nucleonic gauges containing ^{60}Co and ^{137}Cs sources (Activity range ~20 to 2300 MBq (0.56 to 6.2 mCi). The containers housing source were reported missing from the storage room. After a search operation, one container was recovered, whereas four sources could not be recovered.

Loss of Radioactive Source during transport

- An oil-well logging container housing ^{137}Cs source (A~80 GBq/2 Ci) got lost during transport. After search operation, source container was recovered from a scrap dealer in intact condition. Incident has been reported in IAEA INES and Incident and Trafficking Database (ITDB).
- A car carrying industrial radiography device (^{192}Ir , 1.53 TBq (41.4 Ci) met with an accident near Pune. Later on, the radiography device was recovered from a scrap dealer in intact condition.



Regulatory Activities Safety Studies and Research Activities

Safety Studies and R&D Activities at SRI, Kalpakkam and Mumbai Headquarters

AERB recognises the importance of Safety Analysis & Research in support of its regulatory function. Safety analysis and research activities are carried out by AERB as a part of its regulatory activities. Several

important developmental studies were taken up by AERB and completed during this year. Various studies were undertaken during 2019 in following areas:

THERMAL HYDRAULICS SAFETY STUDY

In support of regulatory review, number of studies on thermal hydraulics of nuclear and radiation facilities were undertaken.

- A detailed 3-D transient heat transfer analysis was carried out using COMSOL for proposed FBTR fast flux experimental facility (FFEF) for irradiation of radioactive samples.
- Thermal transient analysis of CORAL high-level waste raffinate for estimating the maximum temperature of raffinate waste solution during unavailability of primary cooling water.
- Analyses related to 700 MWe PHWR to evaluate the effect of inadvertent opening of the Passive Decay Heat Removal System valve during normal operation.
- 3-D model of concrete shield was developed in multi-physics software COMSOL for Assessment of the cooling coil capability in ISOMED.

SEVERE ACCIDENT STUDIES

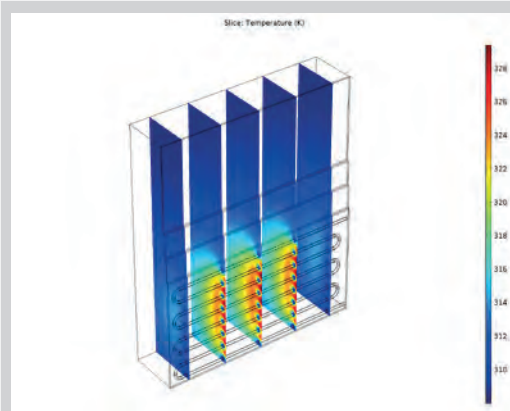
A number of studies on severe accident assessment of nuclear and radiation facilities were undertaken.

- Calculation of Radiation view Factor of 37 Pin Fuel Bundle for estimation of radiation view factors between pins of bundle and pin to PT (pressure tube).
- Developed AERB Source Term Estimation Tool for KKNPP and MAPS reactors and integrated with the in-house developed AERB tool.

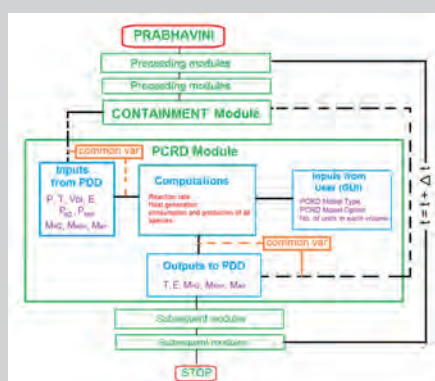
PROBABILISTIC SAFETY STUDIES

A probabilistic safety assessment (PSA) of a nuclear and radiation facility provides a comprehensive and structured approach for identifying failure scenarios and deriving numerical estimates of the risks to workers and members of the public.

The review of Shutdown and Low Power PSA report of MAPS-1&2 has been completed.



Temperature Field Slices with Modified Coil & Water Cooling

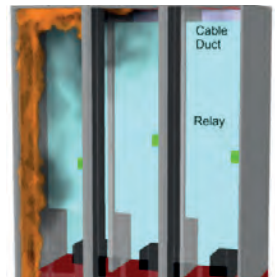


AERB continued to contribute in development of PRABHAVINI, DAE computer code to address Design Basis Accidents (DBA) and Design Extension Conditions (DEC) in the Indian nuclear reactors.

Experimental Studies at AERB-SRI, Kalpakkam

AERB is also involved in experimental studies relevant to safety of nuclear and radiation facilities for independent verification, development of correlations, validation of computer codes or models etc. The following Experimental studies were performed.

- Cable fires studies in Compartment Fire Test Facility (CFTF).
- Studies on fires in electrical cabinets containing components critical to reactor safety.
- Studies on passive hydrogen removal at HYdrogen MIItigation Facility (HYMIF).
- Condensation Induced Water Hammer (CIWH) experiments in Water and Steam Interaction Facility (WASIF).
- Conducted experiments on AGMS and Coolant Channel Heat-up Facility.
- Conducted experiments in Core Melt Retention Facility.



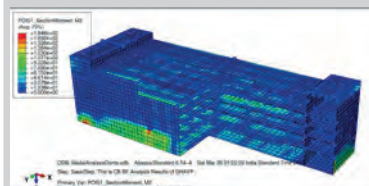
REACTOR PHYSICS STUDIES

The following reactor physics related studies were carried out.

- Calculations to study FAC of KAPP-3 using independent core neutronics code system.
- Lattice physics analysis of TAPS BWR core using in-house code VISWAM for the reload pattern 2 fuel.
- Developed computer code for analysing flow and power transients in Sodium Cooled Fast Reactor.
- Stability analysis of the total power control loop of 700 MWe PHWR.
- Suitability of $^6\text{LiF:Mg,Ti}$ and $^7\text{LiF:Mg,Ti}$ TL detectors was studied for thermal neutron dose mapping.

SAFETY STUDIES TO SUPPORT REVIEW AND ASSESSMENT

Dynamic soil structure interaction (SSI) analysis of control building of GHAVP-1&2 using SASSI in frequency domain and includes analytical half-space model for layered soil which captures soil wave propagation effects in all frequency ranges.



RADIOLOGICAL ASSESSMENT & ENVIRONMENTAL SAFETY STUDIES

- Numerical Simulation of Atmospheric Flow Field over a Complex Terrain NPP Site.
- Synthesis, Characterization and Evaluation of Novel Extractants for the separation of Lanthanides and Actinides.
- Synthesis and Thermal Characterization of Cerium loaded Strontium Borophosphate Glasses.
- Spatio-temporal Surveillance on Urbanization in the No Growth Zone of MAPS.

Safety Studies with National and International Collaboration

AERB participated in several national and international collaborative problem exercises

- As part of OECD/NEA carried out Computational Fluid Dynamics simulations to study the onset of recombination of Hydrogen using FLUENT.
- As a part of OECDNEA-CSNI THAI-3 project, analysis of the database from a number of hydrogen deflagration experiments performed in the THAI facility.
- Participated in the OECD/NEA benchmark to enable a comparison of XFEM capability of different codes used in the nuclear industry.
- Analysis of reactivity initiated transients in a VVER-1000 reactor using TRIKIN as part of

Indo-Russian RPWG bilateral benchmark.

- Experiments were conducted at IIT Bombay in collaboration with BARC and NPCIL to study the effect of Molten Corium Concrete Interaction on Indian specific concrete used in NPPs.

Safety Studies Funded by AERB

AERB continued to promote safety research and funds projects proposal to academic and research institutions for research in radiation safety and industrial safety. During the year four new projects were sanctioned and approved the renewal of ten ongoing projects.

Document Development

Development of Regulatory Safety Documents

AERB develops and lays down safety requirements and guidance for utilities and users in the form of Regulatory Safety Documents (REGDOCs). These REGDOCs are issued under provisions of Atomic Energy (Radiation Protection) Rules, 2004. The REGDOCs are developed with a view to cover the entire spectrum of regulated Nuclear and Radiation

facilities and activities, as applicable, with graded approach.

AERB has established a process for Revision/ Development of REGDOCs for use in regulation of Nuclear, Fuel Cycle and Radiation Facilities. REGDOC undergoes multi-tier review during its preparation. Experts, utility and stakeholders are involved in the development of the regulations and guides by direct involvement as well as through comments and feedback throughout the development process.



"A total of 165 Regulatory Safety Documents have been published by AERB"



Experts in AERB reviewed 32 Draft Safety Standards and Document Preparation Profiles of IAEA and offered valuable suggestions to IAEA.

New Safety Documents Published



Safety Guide on "Remediation of Areas Affected by Radioactive Contamination" [AERB/NRF/SG/RW-9, 2019]

provides guidance for planning and implementing remediation of areas affected by radioactive contamination, protective and remedial actions that are intended to reduce the existing exposure and to avert potential for the likelihood of such exposure from the related contamination.

Safety Guide on "Monitoring and Assessment of Occupational Exposure due to Intake of Radionuclides" [AERB/NRF/SG/RP-1, 2019]

provides guidance for the dose assessment of radiation workers due to internal uptake of radionuclides. This guide is applicable for the internal dosimetry of personnel working in nuclear fuel cycle facilities and radiation facilities having potential for internal exposure.





Caution Symbol for
Radioactive Source



Government of India

Atomic Energy Regulatory Board

Attention Owners and Users of Ionising Radiation Sources



Caution Symbol for
X-rays

Concerned about radiation safety?? Ask for AERB compliance !!!

Obtaining Licence from AERB for safe handling of radiation sources is a statutory requirement under Atomic Energy (Radiation Protection) Rules, 2004.

Societal Benefits Accrued from Radiation Sources include

Radioactive Sources used in:

- Research, Academic Institutions and Universities
- Nucleonic Gauge and Well Logging
- Industrial Radiography using gamma rays
- Gamma Chamber
- Gamma Radiation Processing Plants
- Nuclear Medicine
- Tele-cobalt and Brachytherapy units of Radiotherapy

Radiation Generating Equipment used in:

- Research, Academic Institutions and Universities
- Industrial Radiography using X-rays
- Accelerators based Radiation Processing Plants
- Medical Accelerators for Radiotherapy
- Medical Cyclotron
- Industrial & Research Accelerator
- Diagnostic Radiology -
CT/ Cath Lab / X-ray Machines
- X-ray Baggage Scanner, etc.

Obtaining Licence from AERB is easy through AERB's web based system e-LORA (e-Licensing of Radiation Applications).
No fee is charged for AERB Licence.

For detailed information and accessing e-LORA system, visit AERB website
www.aerb.gov.in

Radiation Sources found to be in possession and / or in operation without a valid Licence from AERB can be SEIZED or SEALED without further notice and owner is liable for legal prosecution.



Issued by:

**Directorate of Regulatory Affairs and Communications
Atomic Energy Regulatory Board
(Government of India)**

Niyamak Bhavan, Anushaktinagar, Mumbai - 400094

AERB Advertisement on Regulatory Requirements for Users of Ionising Radiation
Sources/Equipment

International Cooperation



"AERB accords top priority in the area of International Co-operation by maintaining regular technical interactions with regulatory bodies of other countries for the exchange of information in the field of regulation of nuclear activities for peaceful purposes.



India is signatory to several international conventions related to nuclear safety and security such as Convention on Nuclear Safety (CNS), Convention on Physical Protection of Nuclear Material and its 2005 Amendment, Convention on Assistance in the case of Nuclear Damage and Radiological Emergency, Convention on early notification of nuclear accident etc. India is also committed to implement the provisions of Code of Conduct on safety of research reactors and code on safety and security of radioactive sources. AERB is obliged to fulfill the responsibilities assigned to it under these instruments. AERB actively participates and contributes in several multi-lateral international platforms working for promotion of nuclear and radiological safety. AERB also has bilateral cooperation arrangement with the regulatory bodies of other countries for information exchange and experience sharing related to regulation of nuclear and radiation safety. AERB has bilateral arrangements with the nuclear regulatory authorities of France, Russia, Romania, Ukraine, the United States of America, Finland, Canada, Bangladesh and the United Kingdom. AERB also has an agreement with IRSN, which is a Technical Support Organization in France. Some important activities undertaken during the year are listed here.

Participation in IAEA General Conference

Participation in IAEA Conference on Effective Nuclear and Radiation Regulatory Systems

Participation in Technical Meeting of CANDU Probabilistic Safety Assessment (PSA) Working Group

Contribution in Research Coordination Meeting under the IAEA Coordinated Research Project (CRP) on Multi-unit PSA

Availed Membership of Atomic Energy Research (AER), Hungary

CNS activities and Participation in IAEA-CNS officers' turnover meeting

IRRS Follow-up Mission Preparatory activities

NEA/MDEP activities

Bilateral Meetings

Public Outreach Transparency and Openness





AERB continued to conduct its outreach activities by participating in public & scientific events/exhibitions/public awareness programmes/ broadcasting advertisements, publishing safety articles in public magazines, etc. This year AERB participated in one of its kind journalist workshop at Rawatbhata site and interacted with media personnel

Public Outreach



Indian Institute of Packaging (IIP)

package design approval for transport of radioactive material



Ministry of Road Transport & Highways

national regulations for transport of radioactive material by road



Directorate General of Health Services

-regulation of medical devices emitting ionizing radiation



Department of Atomic Energy

-regulation of prescribed substances, disposal of disused sealed radioactive sources

Interaction with various ministries for resolution of generic issues related to radiation safety due to handling of radiation sources for various applications

Stakeholder Engagement & Consultation



AERB hosted 3rd National Conference on Regulatory Interface (NCRI-2019) on December 24, 2019 at Mumbai to take open feedback on all regulatory processes of AERB from its Licensees of Accelerator Facilities and DAE units involved in activities associated with transport of Radioactive Material



Nation Human Rights Commission

NHRC sought response from AERB with regard to a complaint unregulated medical X-ray equipment, operating in the State to which AERB provided detailed clarifications. The Commission disposed of the petition subsequently based on response from AERB



AERB provided all necessary information to its stakeholders through website updates, annual reports, newsletters, press releases/briefings and media interviews

Safety Promotional Activities



AERB continued organizing and/or participating in theme meetings, workshops, awareness programmes, etc. as part of its efforts towards inculcating safety consciousness amongst its licensees and stakeholders, on nuclear and radiation safety aspects, regulatory regime, basis of regulatory decisions, etc.

Theme Meetings /Workshops for Nuclear Facilities

DAE Safety and Occupational Health Professionals' Meet

Regulatory Inspection Process

Measurement of Carbon-14 Activity in Effluent release and Environment Samples

Environmental Remediation Strategies for Radioactive Contamination

Nuclear Security Regulation

Safety Perspectives in Reactor Containment & Systems Design, Assessment and Quality Assurance

Exchange of Experience on Radiological Safety among the Licensee & Regulator

Transportation and Management of Trauma Victims

Special Meets /Awareness Programmes for Radiation Facilities

Awareness Programme on Safety and Security of Well-logging Sources

Special Meet for Calibration and Testing Radiological Laboratories

Awareness programme on Safety and Regulatory Requirements for Diagnostic Radiology (DR) Facilities

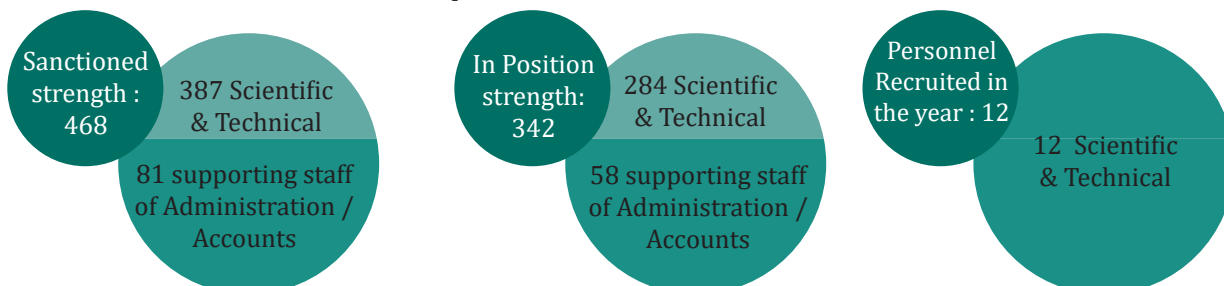


Strengthening In-house Competence

Human Resource Development

AERB's manpower is being augmented at various levels in view of the expanding nuclear power programme and increasing number of radiation facilities in the country. This is being done through fresh recruitments, transfer of experienced

personnel from operating plants and R&D institutes like BARC and IGCAR and induction of postgraduates through AERB Graduate Fellowship Scheme (AGFS) in IIT Bombay and IIT Madras. The manpower status is as follows:



During the year, eight personnel retired on superannuation and one person resigned.

Technical Talk / Colloquium

AERB conducts technical talks/colloquia at regular intervals for its staff for knowledge upgradation. The topics are chosen in line with the mandate and functioning of AERB, covering latest scientific and technical development worldwide in the field of nuclear and radiation industries, regulatory

practices, legal aspects and aspects enhancing personal and interpersonal effectiveness etc.

During the period, 18 colloquia on various topic were organised, apart from a technical talk on "How Safe is 'Safe Dose'? Low Level Radiation Effects: Some Recent Studies".



Dr. K. L. Ramakumar, Dr. A. R. Sundararajan and Shri Avinash Gaikwad delivering talks in AERB colloquia





Participants of Management Development Programme at YASHADA, Pune

Promotion of Excellence in Human Resources

- Five days residential training programme was conducted in (4 batches) during February to December 2019 for middle level officers [SO/E&D) and personnel from Administration on 'Management Development Programme (MDP) at YASHAD, Pune. Total 105 officers participated in the programme.
- The advance course on 'Human Factors' was organised in May 2019. Twenty-seven officers from various technical divisions of AERB benefited by the course.
- A course on mechanical vibrations was conducted.
- AERB officers provided internship training to students from different academic institutes. Also summer interns from two institution underwent training on projects related to Computer Code Development and Thermal Hydraulic Analysis.



Promotion of Excellence in Human Resources

During the year, 45 employees were promoted under the Merit Promotion Scheme of the Department. Three officers were awarded with Ph.D. during the year.



Shri Santosh Kumar Pradhan, SO/G, NSAD has been awarded Doctor of Philosophy (Ph. D.) degree from Indian Institute of Technology (IIT) Bombay, Mumbai for his thesis titled 'Coupled Neutronics Thermal-Hydraulics Safety Analysis of Large Nuclear Power Reactors' in the 57th Convocation ceremony held on August 10, 2019.



Shri Raj B. Solanki, SO(G), R&DD has been awarded Ph. D degree from Indian Institute of Technology Bombay, Mumbai for his thesis titled 'Reliability Assessment of Passive Safety Systems in Nuclear Power Plants' in the 57th Convocation ceremony held on August 10, 2019.



Shri Bibekananda Mishra, SO(E), RSD, AERB has been awarded Ph.D. degree from Tata Memorial Centre under Homi Bhabha National Institute (HBNI), Mumbai for his thesis titled 'Study of Dosimetric Characteristics of a Flattening Filter Free Medical Accelerator for its Clinical Use' on September 5, 2019.



Rewards for Meritorious Performance

AERB has its award scheme to promote excellence among its staff and to recognise outstanding achievements of those engaged in regulatory and associated R&D activities. AERB award scheme comprises of individual awards as well as group achievement awards.

AERB Formation Day was celebrated on November 22, 2019. Padmashri Dr. Anil Kakodkar, Former Chairman, AEC and Secretary, DAE graced the occasion as Chief Guest and presented AERB awards (2018) to employees.



Dr. Anil Kakodkar, Former Chairman, AEC addressing the gathering during AERB Day Celebration

Young Scientific Officer Award



Shri Prashant Sharma, receiving the 'Young Scientific Officer Award'



Smt. Purva Awasthi, receiving the 'Young Scientific Officer Award'



Shri Ritu Raj receiving the 'Young Scientific Officer Award'



Shri Rajendra R. Shete, receiving the 'Young Scientific Officer Award'

Outstanding Performance Award



Shri Utkarsh S. Chikkanagoudar receiving the 'Outstanding Performance Award'



Shri Devendra V. Pimpale receiving the 'Special Contribution Award'



Shri Bibekananda Mishra receiving the 'Special Contribution Award'
Shri R. R. Koli receiving 'Meritorious Service Award'



Group Achievement Award



Emergency Preparedness and Response



Regulatory Review of activities related to EMCCR and subsequent commissioning and Restart of KAPS-2



Making the Quality Assurance Protocols and Procedures in Nuclear Medicine



Strengthening Regulatory Control, Radiation Safety and Simplification of Regulatory Processes in Diagnostic Radiology Practice



Special Regulatory Inspection of Diagnostic X-ray Facilities and Radiation Safety Jaagrukta Seva Campaign

Farewell



Knowledge Management

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

- ✓ Induction training was given to newly recruited officials.
- ✓ Ten officers underwent Orientation Course on Nuclear Law.
- ✓ Officers participated in various workshops/training such as workshop related to 'Computational Fluid Dynamics' and training program on 'Coastal and Ocean Vulnerability Assessment using Geospatial Technologies'



AERB Library



10603 : Collection of Publications

42 : Publications uploaded in KMS

17 : Journals Subscribed

Publications



**Conferences
Journal Articles
Proceedings**

Journals-05

International
Conference-10

National
Conferences/
Seminars-18

Infrastructure Development

AERB HQ and AERB Regional Regulatory Centres

With a view to decentralise its regulatory activities, AERB has established Regional Regulatory Centres (RRC) at Chennai, Kolkata and New Delhi.

Southern Regional Regulatory Centre (SRRC) has been functioning at new building since November 2018. Building construction is in advance stage of completion for Eastern Regional Regulatory

Centre (ERRC), Kolkata. Actions are initiated for construction of NRRC at New Delhi.

AERB had proposed construction of new building in addition to existing two wings (Niyamak Bhavan - A&B) at its HQ. Bhoomi Poojan ceremony of construction of new building (NB-C) was held on September 11, 2019.



Shri G Nageswara Rao, Chairman, AERB and Shri Dinesh Kumar Shukla, Executive Director, AERB performing the Bhoomi Poojan



SRRC, Chennai



View of Construction Activities of NB-C, Mumbai



Construction of ERRC, Kolkata

Information Technology

The effectiveness of the organisation in modern times essentially depends on the smooth functioning of the IT infrastructure and services. Towards maintaining information technology resources in normal operating state and upgrading the same periodically to deploy latest available technologies, AERB has taken several steps. These include the following:



VC System

AERB has installed video conferencing system. The system is used more frequently to interact with its satellite office at SRI and other DAE units such as IGCAR, VECC, HWB, IREL and NPP sites.



AERB Website

AERB website (www.aerb.gov.in) is a user-friendly platform for dissemination of people centric information towards meeting its objectives of enhancing transparency and public outreach. The website is regularly updated with latest information.



Safety Awareness

In order to enhance radiation safety awareness, AERB developed and uploaded video on 'Personnel Working in Diagnostic Radiology' and 'Radiation Safety in Fluoroscopy'. Similarly, a video on 'Construction Safety - Hazards and Safety Barriers' was developed and uploaded.



eOffice

The e-office has been implemented in AERB with the help of National Informatics Centre (NIC). Various modules of File Management, Knowledge Management system and Leave Management System have been made operational and put in regular use in e-Office.



eLORA

The number of users and institutes accessing e-Licensing Radiation Application (e-LORA) portal are growing fast, to ensure system availability even during the failure of one of the leased lines and improve the system performance, the Link Load Balancing (LLB) devices have been implemented.



Software Development

Developed in-house software applications for online management of 'Nomination and Deputation including Training' and 'Regulatory and Safety Documents', status review system for 'Safety Research Projects' etc.

WELFARE AND AWARENESS ACTIVITIES FOR EMPLOYEES

International Women's Day



International Women's Day was celebrated at AERB on March 8, 2019. On this occasion a talk on 'Health Concerns for today's Working Women' was delivered by Dr. N. Mishra, Head Dept. of Obstetrics & Gynaecology, BARC. A cultural programme was organized, which included dances, songs and quiz competition etc.

International Yoga Day



The 5th International Yoga day was celebrated on June 21, 2019 with large participation from AERB employees. A talk on 'YOGA and Health' was delivered by Yoga Guru, Shri Jateen Dave followed by a Yoga session for benefit of AERB staff.

Vigilance Awareness Week



Participants of Poster Drawing Competition



Dr. L.R. Bishnoi, Director, NSARG and Vigilance Officer, AERB delivering the talk

The 'Vigilance Awareness Week-2019' was observed in AERB with a theme "Integrity - A Way of Life" during October 28 to November 2, 2019. A quiz competition on related topics (eg. CCS (Conduct) Rules, 1964 and CCS (CCA) Rules 1965) was organised. The Cartoon / Poster drawing competition was also organised.

Swachh Bharat Mission



As part of 'Swachh Bharat Mission' launched by the Govt. of India, AERB celebrated 'Swachhata Pakhwada' during February 16-28, 2019. Various activities such as cleaning of work place, office premises and canteen; weeding out of old/obsolete records, slogans writing and poster competitions were organised during the period.



Chairman, AERB and staff members participated in 'Shramdaan' during Swachhata mission



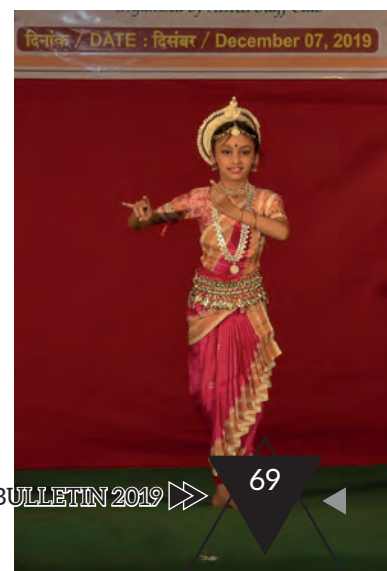
'Swachhata Hi Seva - 2019'

AERB staff performed 'Shramdaan' on September 27, 2019 at its premises and in the vicinity of AERB complex.

PHOTO GALLERY: AERB ANNUAL DAY 2019 CELEBRATION



Performances at the AERB Annual Day Celebration by Staff and their Children



Promotion of Official Language

AERB is committed to implementation of Official Language policy of the Government of India. It has an established programme for the implementation of official language, Hindi in various official works, to create favourable environment for the use of Hindi and to motivate and encourage staff members to do their work in Hindi.

Publications in Hindi

Translation of AERB documents in Hindi is an ongoing activity. Under this activity, AERB Annual Report, Bulletin and Quarterly e-Newsletter has been translated in Hindi. Regulatory Licence and inspection reports were issued in Hindi. Total 15,607 letters were sent in bilingual (English and Hindi).

Promotional Activities for Hindi Implementation

In addition to the regular official works and various translations into Hindi, AERB proactively initiates a series of activities for the propagation and implementation of the official language which includes training programmes, workshops, talks, annual competitions and divisional inspections. Some of the activities are as given below:

- Four Hindi workshops were conducted on behalf of the Joint Official Language Coordination Committee (JOLCC).
- A special workshop on Parliamentary Questionnaire was organised for enabling the officers concerned to be armed with tips and techniques to fill up the said questionnaire.

Celebration of World Hindi Day

World Hindi Day was celebrated on January 10, 2019. Dr. Girish Patel, a renowned Psychologist, writer and international Trainer, was invited as the Guest Speaker. He delivered a talk on 'Stress Free Life'.

Celebration of Hindi Day

Hindi Day was celebrated on September 18, 2019. Making the Hindi Day celebrations, a series of Hindi competitions were held on behalf of JOLCC. On this occasion, six AERB personnel were awarded for their excellent performance in various competitions. AERB Quiz Team secured first rank among all the participating teams.



AERB employees receiving the Prizes in Hindi Competitions



To celebrate world environment day, AERB organized a Hindi Scientific Seminar focused on the theme 'Atomic Energy and Environment' on June 6, 2019 at Mumbai. Total 140 employees from different DAE units including AERB, participated in the seminar. Technical talks were delivered highlighting the safety aspects of Atomic Energy and Protection of Environment.



To mark the occasion, plantation of trees was carried out in the campus.



Plantation of saplings in AERB premises by Chairman, Executive Director and AERB Staff

Rajbhasha Awards - A Recognition of Work in Hindi

With a view to encourage the implementation of official language in AERB and honouring the personnel working in Hindi, AERB has initiated 'Rajbhasha Rolling

Shield' and 'Rajbhasha Group Achievement Awards'. Staff of Administration received Official Language Rolling Shield and the Group Achievement Award.



Recipients of Rajbhasha 'Group Achievement Award' and 'Rolling Shield' for Official Language

To promote use of official language in day-to-day work, Hindi competitions were held in AERB in December 2019, which included various competitions such

as Essay writing, Noting & Drafting, Dictation, Hindi Slogan, Hindi Typing, Scientific and Technical Translation etc. Winners were awarded with prizes.



Under Hindi Teaching Scheme of Rajabhasha Vibhag, training of 'Parangat' (a course prescribed for the employees possessing working knowledge of Hindi) was imparted to Scientific and Administrative staff. During the year, total 28 employees have been declared successful in Parangat examination.

Public Accountability

Grievance Redressal

AERB receives grievances through Centralised Public Grievance Redress and Monitoring System (CPGRAMS) portal which includes Department of Atomic Energy (DAE) and Prime Minister's Office (PMO). All grievances pertaining to AERB were duly responded to in time during the year.



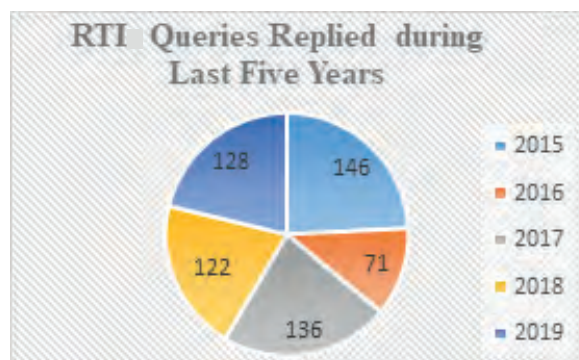
Right To Information Act 2005



Requisite measures were taken on the implementation of 'Right to Information Act' (RTI) and the required information have been put on AERB website. During the year, 128 RTIs related to AERB activities were received

and replied.

In addition to above, the frequently asked questions under RTI were updated/compiled and uploaded on AERB website for reference of the public.



Parliamentary Questions

Parliamentary questions and sub-questions related to regulation of nuclear and radiation facilities were received and replied.

During the period, AERB responded to 33 parliamentary questions. The questions answered with implications to radiation safety were broadly on the issues as shown

- Regulation of handling radioactive material in India
- Radioactive waste disposal and discharges
- Safety of Nuclear Power Plants and clearances for new NPPs
- Guidance for Physical Protection of Nuclear Facilities
- Use of radiation technology and radiopharmaceuticals
- Treatment of people affected by Nuclear Disaster
- Administrative issues such as backlog vacancy etc.

Annual Budget of AERB

AERB receives funds from Government of India (GoI) for meeting its expenditure. AERB has full powers to operate its budget, which it prepares and submits for approval. Annual expenditure during the period was Rs. 99.61 crores.



Fund utilised for Regulatory Activities

Expenditure included budget utilisation for R&D experiments and activities, upgradation of IT systems, procurement of softwares, grant-in-aid towards financial assistance for projects of AERB interest to academic institutes and financial support for seminars/ conferences etc. Refurbishing and upgradation of existing office, construction of Niyamak Bhavan-C at HQ and establishment of Regional Regulatory Centres (RRC).

Fund utilised for Public Outreach Programmes

In order to inform the public on various safety related issues, to address their concern and to sensitise the users on regulatory requirements, awareness programmes were conducted for stakeholders and public. Some of these are listed below:

- 'Radiation Safety in the use of Radiation Source



for Societal Benefits' at Madurai.

- Awareness programme on 'Safety in Diagnostic Radiology' at Kolkata.
- 'Responsibilities of Suppliers in Nucleonic Gauges' and 'Well Logging Facilities' at Mumbai.
- A short Audio Video film on safety aspects in Diagnostic Fluoroscopy.
- Displayed exhibits in journalists' workshop organised by DAE, to spread awareness on societal applications of radiation.

Awareness Programme in RF

Diagnostic Radiology

Nucleonic Gauges' Suppliers

Well Logging

Display of Exhibits

Journalist Conference

Safety Professionals' Meet

National Technology Day



Published an article and advertisement in Scientific Journals/ Technical magazines & Newsletters (e.g. RADBUZZ and ALARA magazine).

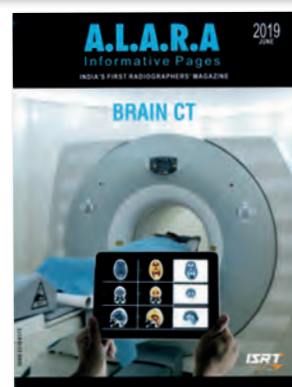


Photo Gallery





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