

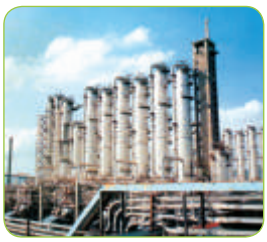

2013-14

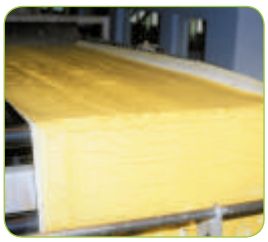





*Our mission is to ensure that the use of ionizing radiation and nuclear energy in India does not cause undue risk to the health of people and the environment.*








## Atomic Energy Regulatory Board

# AERB BULLETIN

सत्यमेव जयते

**Government of India**

# Functions of AERB

***AERB enforces the following Rules issued under the Atomic Energy Act, 1962:***

Atomic Energy (Radiation Protection) Rules, 2004

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

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

Atomic Energy (Factories) Rules, 1996

- Develop safety policies in both radiation and industrial safety areas.
- Develop Safety Codes, Guides and Standards for siting, design, construction, commissioning, operation and decommissioning of different types of nuclear and radiation facilities.
- Grant consents for siting, construction, commissioning, operation and decommissioning, after an appropriate safety review and assessment, for establishment 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 the 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.
- Promote research and development efforts in the areas of safety.
- Maintain liaison with statutory bodies in the country as well as abroad regarding safety matters.
- Review the nuclear safety aspects in Nuclear Facilities under its purview.
- Review the safety related nuclear security aspects in Nuclear Facilities under its purview.

AERB Board meeting in progress

# About AERB

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 regulatory requirements are brought out in a set of Codes and Guides; more than 140 such documents have been developed over the years. Nuclear and radiation facilities and activities require consents from AERB for various stages during the lifetime of the facillity viz., siting, construction, commissioning, operation and decommissioning. These consents are granted after ensuring that the regulatory requirements are met. At each stage a comprehensive review in a multi-tier structure of safety committees is carried out.

The Board consists of a Chairman, five Members and a Secretary. AERB Secretariat currently has a staff strength of more than 300 personnel organized in nine Divisions and AERB Safety Research Institute (SRI) at Kalpakkam. AERB is supported by the Safety Review Committee for Operating Plants (SARCOP), Safety Review Committee for Applications of Radiation (SARCAR) and Advisory Committees for Project Safety Review (ACPSRs). ACPSR recommends to AERB issuance of consents at different stages of plants till it's operationalisation, after reviewing the submissions made by the plant authorities, based on the recommendations of the associated Design Safety Committees. The SARCOP carries out safety surveillance and enforces safety stipulations in the operating facilities. The SARCAR recommends measures to enforce radiation safety in medical, industrial and research institutions, which use radiation and radioactive sources. AERB also receives advice on codes and guides and on generic issues from the Advisory Committees. The administrative and regulatory mechanisms which are in place ensure multi-tier review by experts in the relevant fields available nation wide. These experts come from reputed academic institutions and governmental agencies.

# Preface

Owing to the encouraging response to previous years' AERB Bulletin, an initiative by Atomic Energy Regulatory Board to enhance its transparency and public outreach, this year too AERB brings out the third issue of its Bulletin. It attempts to present information contained in the Annual Report 2013-2014 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.

One of the major highlights of this year was safety review and assessment of commissioning activities of unit-1 of Kudankulam Nuclear Power Plant. The safety review for this plant was challenged in several litigations and the courts eventually gave their verdict in favour of AERB. AERB continued to oversee safe operation of 20 operating power reactor units and construction/commissioning of seven units.

AERB has launched a vigorous campaign to strengthen the regulatory coverage and control of the large number of medical diagnostic X-ray units spread across the length and breadth of the country. AERB has introduced a restructured regulatory process with enhanced focus on ensuring safety built into the design of the equipment. In parallel, AERB continued the ambitious plan of implementation of state-of art E-Licensing of radiation Applications (ELORA), a web-based ICT (Information and Communication Technology) application for the automation and real time management of "Consenting Process". The eLORA system has already been made operational for Radiotherapy and diagnostic X-ray module and steps for extending the system to other practices is in progress.

In view of the requirement of notification of "Nuclear Incident" under the Civil Liability for Nuclear Damage Act, 2010, AERB has issued an Order as well as a Safety Directive on reporting and notifying criteria for such an event respectively. AERB has also issued a consolidated Policy document governing Nuclear & Radiation Safety in the country. This bulletin features special articles on both of these topics.

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 2013-14. 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.

# Contents.....

Board of AERB visits construction site of Kakarapar Atomic Power Project 3 &4

# Safety Surveillance of Nuclear power projects

## SITING stage

Nuclear Power Corporation of India Ltd. (NPCIL) has proposed to install progressively 6 units of European Pressurised Reactors (EPR), each of 1650 MWe PWR at Jaitapur site on the western coast of Maharashtra and 4 units of 700 MWe Pressurised Heavy Water Reactors (PHWRs) at Gorakhpur in Haryana.

Gorakhour Site, Haryana

Jaitapur Site, Maharashtra

**Site Evaluation of Jaitapur Nuclear Power Project (6 x 1650 MWe EPRs) and Gorakhpur Haryana Anu Vidyut Pariyojna (4 x 700MWe PHWRs) is under progress.**

AERB continued the exhaustive process of site evaluation for both these sites wherein the impact of site on the plant including extreme earthquake, flood and meteorological conditions and also the impact of plant on the site under normal and accidental conditions 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.

Four more Russian design VVERs (KKNPP 3-6) of 1000 MWe each is proposed at Kudankulam site. Siting clearance for Units 3 to 6 was granted by AERB in February 2011. Infrastructure development for KKNPP 3&4 is in progress. Safety review by AERB of site specific data, lay out, geotechnical data, design basis ground motion, tsunami hazard assessment etc is in progress.

**Review for site excavation of 2 x 1000 MWe Kudankulam Nuclear Power Project 3-4 is in progress.**

US designed Advanced Pressurised Water Reactors (AP-1000) planned to be set up in India, the general technical information on overall design and operational safety requirements is under review.

## CONSTRUCTION stage

Twin units of indigenously designed 700 MWe PHWRs are being set up at Kakrapar (KAPP 3&4) and Rawatbhata (RAPP 7&8) respectively. These reactors are similar in design except for site specific changes.

KAPP 3&4

RAPP 7&8

AERB granted clearance for "First Pour of Concrete" for KAPP 3&4 in November 2010 and for RAPP 7&8 in July 2011. AERB is continually reviewing the progress of the construction activities and have issued various permissions for intermediary stages.

Civil construction activities related to safety and non-safety buildings are in progress at both of these sites. Implementation of recommendations made by the committee for review of design in the light of Fukushima event is in progress. Compliance to the recommendations was periodically followed up by AERB. Various experimental studies related to decay heat removal, containment spray system were performed and results were reviewed. Additional experiments are being conducted at Indian Institute of Technology, Bombay with regard to iodine removal by containment spray system and pressure reduction in containment building.

## PRE-COMMISSIONING stage

AERB continued its regulatory supervision on 1000 MWe unit-2 of Kudankulam Nuclear Power Project and 500 MWe PFBR, both of which are under pre-commissioning stage.

KKNPP 2

PFBR

Pre commissioning activities at Kudankulam Nuclear Power Project- Unit 2 are under progress. After obtaining concurrence from AERB, structural integrity test and Integrity Leak Rate Test (ILRT) for containment was carried out. AERB observers were posted at the site to witness these tests.

In the upcoming Proto Type Fast Breeder reactor at Kalpakkam, majority of the equipment below roof slab and inside Main Vessel have been erected and the reactor top is closed. Control and Safety Rod Drive Mechanisms & Diverse Safety Rod Drive Mechanisms have been installed. Reactor vault biological shield cooling system testing was completed. All the Intermediate Heat Exchangers have been erected. Works related to the primary and secondary sodium circuits and fuel handling systems are nearing completion. Both the primary sodium pumps have been erected inside Main Vessel.

# COMMISSIONING stage

KKNPP Unit-1 achieved first criticality on July 13, 2013 at 2305 hrs. Subsequently, various low power physics tests were conducted to establish nuclear characteristics, efficiency of reactor control & protection and associated safety systems. Based on satisfactory review of the test results, Clearance was granted by AERB to raise reactor power up to 50% Full Power (FP) & to synchronize the unit with grid on August 14, 2013.

The reactor power was raised gradually in steps and unit was synchronized successfully with grid on October 22, 2013 at ~150 MWe. Based on satisfactory review of plant performance data and various test results by AERB, concurrence was given to raise power in steps. Tests namely power failure, turbine trip tests, natural circulation test and reactor physics related tests etc were conducted and results were found satisfactory.

***AERB Observer Teams (AOTs) were deputed regularly to KKNPP Site for physical verification of various compliances and witness the various tests. The reports sent by AOT were reviewed in-house as well as in various safety committee for necessary follow up.***

Visit of Chairman, AERB during commissioning of KKNPP unit-1

## Step wise regulatory clearances granted by AERB for KKNPP-1

Clearance for First Approach to Criticality (FAC) was granted on July 4, 2013.

Final permission for FAC based on satisfactory compliance checking of various stipulations was granted on July 11, 2013.

Concurrence for Phase-B Low Power Physics Experiments was granted on July, 14, 2013.

Clearance for Raising Reactor Power up to 50% FP & Synchronization of Generator was granted on August 14, 2013.

Concurrence for Reactor Power Raise from 40 to 50 % FP was granted on November 23, 2013.

Clearance to raise Reactor Power up to 75% FP was granted on January 24, 2014.

Clearance for Raising Reactor Power upto 90 % FP and upto 100% FP for limited period to conduct specified Tests (Phase-C3) was granted on May 01, 2014.

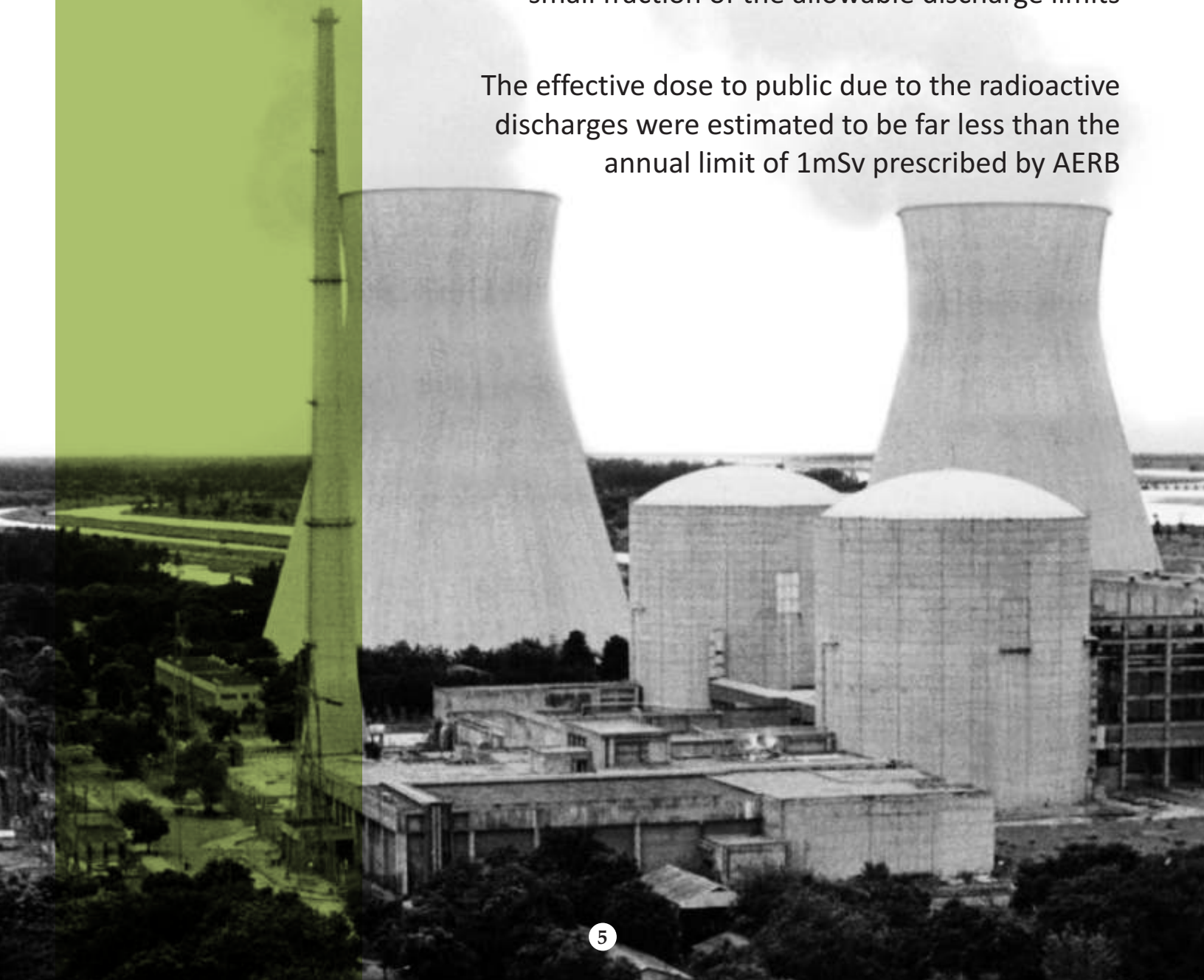
## All 20 NPPs operated* safely during the year

* RAPS-1 is under defuelled 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



# Safety Surveillance of operating Nuclear power plants & Research Reactors

Unlike many other countries, in India, AERB does not grant an operational license for design life of a plant but grants it for a limited period for not more than 5 years. Over a period, this practice has become one of the cornerstones in the regulation of operating nuclear power plants in India and has proved to be a very powerful tool in assessing and enhancing safety of NPPS.

Operating plants undergo continuous safety review through periodic reports and regulatory inspections supplemented by exhaustive five yearly reviews which takes place during review of application for renewal of license. This review 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, license for operation of NPPs were either renewed or extended.

## Licenses issued/renewed/ extended in 2013-14

Renewal of License for operation of TAPS-3&4

Renewal of License for operation of RAPS-3&4

Renewal of License for operation of NAPS

Renewal of License for operation of KGS-3&4

Extension of License for operation of TAPS-1&2

License for operation of FBTR (research reactor)

Permission for regular operation of resin fixation facility at TAPS-1&2

In addition to granting license for operation, AERB also participates in licensing of operators at operating NPPs. **162** operators in various positions were licensed in different Nuclear Power Plants and associated facilities

# Operational Status of Nuclear

**TAPS 1&2**

TAPS 1&2, 160 MWe are twin units 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 license for operation of TAPS-1&2 is valid upto December 31, 2014.

**TAPS 3&4**

TAPS 3&4, 540 MWe are twin units located at Tarapur, Maharashtra. They are pressurized heavy water reactors. These units became Operational in 2005-2006. The license for operation of TAPS-3&4 is valid upto August 31, 2016.

**KGS 1&2**

KGS 1&2, 220 MWe are twin units located at Kaiga, Karnataka. They are pressurized heavy water reactors. These units became Operational in 2000. The license for operation of KGS-1&2 is valid upto May 31, 2017.

**KAPS 1&2**

KAPS 1&2, 220 MWe are twin units located at Kakrapara, Gujarat. They are pressurized heavy water reactors. These units became Operational in 1993-1995. The license for operation of KAPS-1&2 is valid upto June 30, 2019.

**RAPS 3&4**

RAPS 3&4, 220 MWe are twin units located at Rawatbhatta, Rajasthan. They are pressurized heavy water reactors. These units became Operational in 2000. The license for operation of RAPS-3&4 is valid upto October 31, 2017.

**RAPS 5&6**

RAPS 5&6, 220 MWe are twin units located at Rawatbhatta, Rajasthan. They are pressurized heavy water reactors. These units became Operational in 2010. The license for operation of RAPS-5&6 is valid upto May 31, 2015.

# Power Plants & Research Reactors

## MAPS 1&2

MAPS 1&2, 220 MWe are twin units located at Kalapakkam, Tamil Nadu. They are pressurized heavy water reactors. These units became Operational in 1984-1986. The license for operation of MAPS-1&2 is valid upto December 31, 2015.

## NAPS 1&2

NAPS 1&2, 220 MWe are twin units located at Narora, Uttar Pradesh. They are pressurized heavy water reactors. These units became Operational in 1991-1992. The license for operation of NAPS-1&2 is valid upto June 30, 2018.

## KGS 3&4

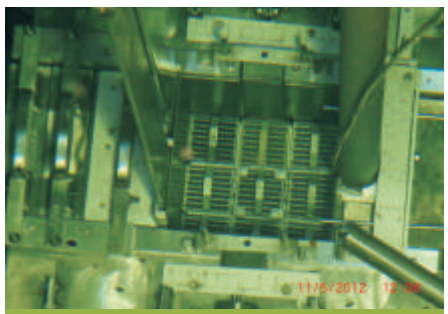
KGS 3&4, 220 MWe are twin units located at Kaiga, Karnataka. They are pressurized heavy water reactors. These units became Operational in 2007-2011. The license for operation of KGS-3&4 is valid upto April 30, 2018.

## RAPS 1&2

RAPS 1&2, 100 & 200 MWe are twin units located at Rawatbhatta, Rajasthan. They are the first pressurized heavy water reactors in India. These units became Operational in 1973 & 1981. RAPS-1 remained in the state of passivation with continuous radiological surveillance. The license for operation of RAPS-1&2 is valid upto November 30, 2014.

## FBTR, IGCAR

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 $MW_{th}$. The license for operation of FBTR is valid upto June 30, 2018.



## KAMINI, IGCAR

Kalpakkam Mini (KAMINI) reactor is India's first U-233 fuelled research reactor, located at Kalpakkam. It produces 30 $KW_{th}$ at full power. It achieved criticality in 1996 & is under regular safety surveillance of AERB.

**SARCOP (apex safety review committee of AERB) visits Fuel Fabrication plants at Hyderabad**

# Safety Surveillance of front-end Fuel Cycle facilities

## Uranium exploration, mining and milling

AERB continued its safety surveillance on the exploration sites of Atomic Minerals Directorate for Exploration and Research (AMD) located at southern, northern, western, eastern, central and south-central regions of India.

All the six operating uranium mines (Jaduguda, Bhatin, Narwapahar, Turamdih, Banduhurang and Bagjata) and two operating mills (Jaduguda and Turamdih) of Uranium Corporation of India Ltd. (UCIL) in the Singhbhum belt of Jharkhand and the new operating mine at Tummalapalle in Karnataka operated safely.

Safety review of the other mines under development at Mohuldih, Jharkhand and Gogi, Karnataka continued. Regulatory review and assessment for the capacity expansion of Turamdih mill was in progress with special focus on adequacy of the effluent treatment plant and existing tailings dam due to the enhanced capacity.

## Thorium mining and milling

All the three operating thorium mining and mineral separation plants at Chavara, Manavalakurichi and Chatrapur and the two chemical processing plants at Udyogamandal and Chatrapur of Indian Rare Earths Ltd. (IREL) operated safely. There was no radiological impact due to the severe cyclone 'Phailin' at Chatrapur site.

Review of the commissioning of upcoming 10,000 tons per annum Monazite Processing Plant (MoPP) at Chatrapur, continued. AERB permitted to upgrade the mineral separation plants of IREL to produce 96% monazite which will provide raw feed for the upcoming MoPP at Chatrapur.

IREL Udyogamandal, apart from processing of secondary sources of uranium, has also been permitted to produce high purity rare earths using some of the existing facilities.

## Fuel fabrication facilities

All the fuel fabrication plants at Nuclear Fuel Complex (NFC), Hyderabad and Zirconium Complex, Pazhayakayal operated safely.

Proposal for renewal of license for operation of 18 plants within NFC, Hyderabad together with the capacity enhancement of 10 plants was reviewed by AERB. It was noted that enhanced capacity would be achieved because of higher recovery and productivity without any additional burden on ventilation system, industrial safety aspects and effluent generation. After ensuring compliance of the earlier pending recommendations, the license was renewed upto August 2017.

The proposal for setting up of 500 tons per annum PHWR fuel fabrication facility and 65 tons per annum zircaloy fabrication facility at Rawatbhata, Kota is under review by AERB. A task force was constituted to look into detail the siting related aspects including the possible impact of hydrogen sulphide release from the heavy water plant located in the nearby vicinity.

## Heavy water plants

Heavy Water is currently being produced in four Heavy Water Plants (HWP) at Kota, Manuguru, Hazira and Thal. All these plants operated safely during the year. HWP-Kota completed in-depth inspections of equipment/piping during its major turn-around of eight months. License for operation of HWP - Hazira was extended for a period of two years based on review of structural integrity aspects and safety assessment.

Heavy Water Plants at Baroda, Tuticorin and Talcher, where heavy water is no longer produced, are now being used for production of various other diversified products such as elemental boron, tri-butyl phosphate solvent and other organic solvents. Safety review of these ongoing diversified projects continued. Regulatory consent were issued for commissioning and operation of 2000 Amp Sodium cell test facility at HWP-Baroda. And for siting and construction of O-18 plant at HWP-Manuguru. The license for operation of Boron enrichment plant at HWP-Manuguru was also renewed.

**38** operators of Heavy Water Plants were licensed / relicensed this year

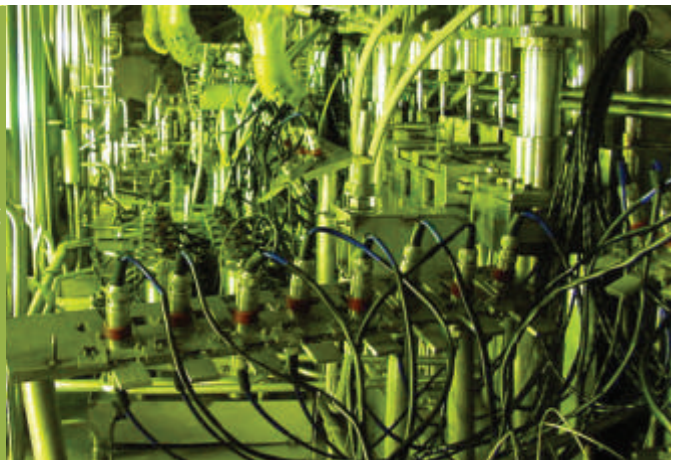
## NORM Industries

AERB continued its radiological safety surveillance on the industries handling Natural Occurring Radioactive Materials (NORMs), namely

- Facilities processing **beach sand minerals** to recover heavy minerals other than monazite
- Facilities processing **columbite-tantalite** ore
- Facilities processing **rock-phosphate fertilisers** to obtain phosphoric acid and resulting in generation of **phosphogypsum.**

This year ten License applications from existing BSM facilities were renewed & fresh licenses were issued to two new BSM facilities. With this, total number of licensed non-DAE BSM facilities by AERB in the country stands twenty-five.

# Safety Surveillance of back-end Fuel Cycle facilities



CORAL (Compact Reprocessing of Advanced fuels in Lead Cells)

This facility was constructed to develop technology for reprocessing of fast reactor fuel. Earlier AERB permitted operation of CORAL on campaign basis. Earlier the application for regular operation of the facility was reviewed. Pending completion of the detailed safety evaluation, AERB had granted permission for reprocessing of limited number of FBTR spent fuel assemblies till December 2013.

Subsequently several modifications / replacements had been carried out in order to improve performance & enhance safety. In-service inspection indicated that the health of important systems and components is satisfactory. The radioactive effluent releases and dose to public were well within prescribed dose limit. Assessment carried out post Fukushima accident indicated that the facility is safe against envisaged flood at site due to tsunami, cyclone or heavy precipitation. The assessment and implementation of seismic strengthening measures are in progress and expected to be completed by March 2015. Based on satisfactory review and action plan for addressing the identified issues, AERB granted license for operation to CORAL facility valid up to December 31, 2014.

## Demonstration Fast Reactor Fuel Reprocessing Plant (DFRP)

DFRP is a fore-runner of the reprocessing facility FRFCF (Fast Reactor Fuel Cycle Facility) to close fuel cycle of PFBR, being setup by IGCAR at Kalpakkam. It is divided into 2 concrete cell facilities called Head End Facility (HEF) and Process Plant Facility (PPF). Construction and equipment installation in PPF has been completed. Construction of HEF is nearing completion. Safety review of pre-commissioning activities is in progress.

## Fast Reactor Fuel Cycle Facility (FRFCF)

Fast Reactor Fuel Cycle Facility is an integrated fuel cycle plant being set up at Kalpakkam to facilitate closure of fast reactor fuel cycle. There are five dedicated plants with common services and utilities. Based on the satisfactory review of the design specification and design methodology of safety related structures, construction clearance was granted in September 2013.

Chairman, AERB inaugurates the Fire Safety Wing at VECC, Kolkata in presence of Director, VECC

# Safety Surveillance of R&D centres and Industrial plants

Accelerator Beamlines

AERB regulates the particle accelerators used for R&D purposes at Indira Gandhi Centre for Atomic Research, Kalpakkam, Variable Energy Cyclotron Centre (VECC), Kolkata and Raja Ramanna Centre for Advanced Technology (RRCAT), Indore. The safety surveillance of research reactors and fuel cycle facilities at Indira Gandhi Centre for Atomic Research (IGCAR) Kalpakkam, have already been dealt with in previous sections.

AERB also regulates the Industrial Plants of Department of Atomic Energy such as Electronics Corporation of India Limited, Hyderabad and plants of Board of Radio Isotope Technology (BRIT).

## IGCAR, Kalpakkam

**Operating accelerators:** 1.7 MV Tandetron accelerator, 400 kV Heavy Ion accelerator, 150 kV Accelerator and a 30 kV accelerator.

**Projects:** Neutron generator based on the Radio Frequency Quadrupole (RFQ) - linear accelerator (LINAC)

## VECC, Kolkata

**Operating accelerators:** Room temperature (k-130) cyclotron

**Projects:** Super conducting (k-500) cyclotron, Radioactive Ion Beam facility, Medical cyclotron at Chakgaria with 3 radiopharmaceuticals & 2 R&D beamlines

## RRCAT, Indore

**Operating accelerators:** INDUS-1 (storage ring) 450 MeV at 100mA electron beam, 10MeV & 10 kW Electron LINAC

**Projects:** INDUS-2 (synchrotron cum storage ring) 2.5 GeV and 300mA, 10 MeV, 5 kW Electron LINAC, 2.5 MeV DC Accelerator, 20 MeV Electron Microtron, 10MeV FEL-LINAC, Infra red FEL-LINAC, Agricultural Radiation Processing Facility at Choithram Mandi, laser projects.

## Consents Issued

Renewal of License for INDUS-1 at RRCAT, Indore

Approval for construction of power electronics laboratory at ECIL, Hyderabad

# Radiation Applications in Medicine, Industry and Research

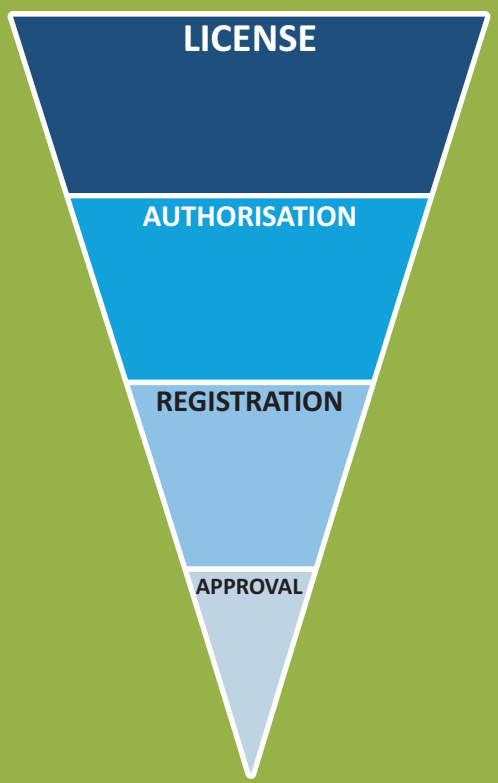
# Safety Surveillance of Radiation Applications in medicine, industry and research

In the modern age, radiation sources (i.e. radioactive isotopes and radiation generating equipment) are being used in multifarious and ingenious ways to achieve over all societal health and prosperity. Hence, it is not an overstatement to say that the use of radiation sources is concomitant with the country's progress and development.

Even so, there is an inherent hazard involved in handling of these sources. Proper design, handling and disposal methodologies offset these hazards and ensure safe and intended use of these radiation sources. The Atomic Energy Regulatory Board regulates the use of these radiation sources so that they do not cause any undue harm to the radiation workers, general public, patients and the environment.

As per the Radiation Protection Rules, 2004 promulgated under the Atomic Energy Act, 1962, the radiation sources are classified as **LICENSE, AUTHORISATION and REGISTRATION** 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**



# Radiation Applications in Medicine

## License Category - High Radiation Hazard Potential

### Radiotherapy

Radiation therapy uses very high-energy radiation to kill cancer cells. The radiation produced either from the radioactive material or X-ray based Linear accelerators can be hazardous to the staff and general public in hospitals.

| Consents Issued at various stages |
|---|
| 44 Licenses/Renewal for operation |
| 14 Type approvals |
| 08 Permissions for source replenishment and<br>30 Permissions for source procurement |
| 06 Permissions for decommissioning |
| 76 Layout plan approvals |

### Medical Cyclotron

The medical cyclotron which produces radioactive isotopes and are further used for patient imaging procedures in Positron Emission Tomography or PET. This poses radiation hazard to the workers and public near the equipment.

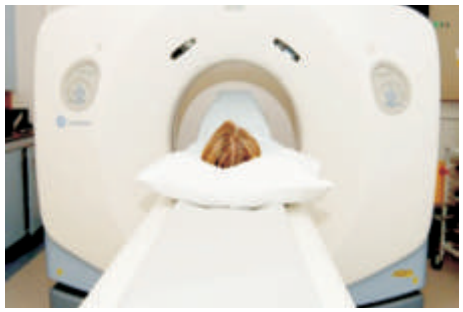
| Consents Issued at various stages |
|---|
| 05 Licenses/Renewal for operation |
| 02 Site approvals |
| 03 Design & Construction approvals |
| 02 Commissioning approvals |

### Interventional Radiology

As Interventional radiology utilizes X-rays to diagnose diseases and can pose radiation hazard to cardiologist, neurologist, etc; As the interventional procedures are long and complicated, and in close proximity, the surgeons and the allied medical professionals are likely to receive higher doses.

| Consents Issued at various stages |
|---|
| 50 Licenes/Renewal for operation |
| 03 Type Approvals |
| 40 Layout plan approvals |

### Computed Tomography & PET-CT/SPECT CT



Computed Tomography (CT), is a noninvasive medical examination that uses X-ray equipment to produce cross-sectional images of the body. PET CT is a combination of PET technology and CT for precise imaging, early and accurate detection of cancer and detecting certain diseases of the heart and brain. CT equipment emit moderately high radiation field. The workers are safe if they follow the basic safety protocols. However, CT procedures should be used with discretion especially to children.

| Consents Issued at various stages |
|---|
| 121 Licenses/Renewal for operation |
| 09 Type approvals |
| 25 Licenses/Renewal for PET CT/SPECT CT |

# Radiation Applications in Medicine

## Authorisation Category - Medium Radiation Hazard Potential

### Gamma Irradiation Chambers/Blood Irradiators

Gamma Irradiation Chambers are used extensively in academic institutions for research. They are used in hospitals as Blood Irradiators. The built-in design safety to a great extent ensures safety.

| Consents Issued at various stages |
|---|
| 38 Authorisations/ 07 layout approvals |
| 02 Permission for procurement of radioactive source |

### Branchy Therapy

Brachytherapy is radiation therapy applied over a short distance with low or high dose. Source getting stuck can pose a safety issue while operating this equipment.

| Consents Issued at various stages |
|---|
| 09 Authorisations/ Renewal for operation |
| 82 Permissions for source procurement |
| 04 Commissioning of HDR equipment |

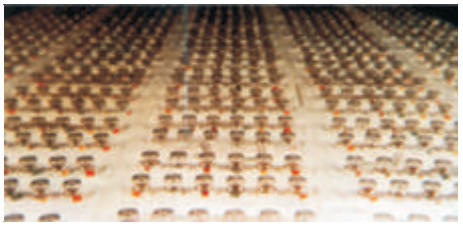
### Nuclear Medicine Laboratories

Nuclear medicine facilities use very small amounts of radio-pharmaceuticals to diagnose and treat disease. Spillage/ loss/ theft of radioactive material could pose a radiological safety issue.

| Consents Issued at various stages |
|---|
| 48 Layout plan approvals |
| 619 Permissions for source procurement |

## Registration Category - Low Radiation Hazard Potential

### Radio Immuno Assay Kits



Radioimmunoassay (RIA) kits containing small quantity of radio isotopes is used for various diagnostic purposes.

| Consents Issued at various stages |
|---|
| 36 Source procurement permissions |

### Medical Diagnostic X-Ray Equipment

Radiography, fluoroscopy, Mammography, Dental equipment are used for medical diagnosis. These equipment are regulated to ensure patient and operator safety. AERB approves the design of equipment by issuance of Type approval.

| Consents Issued at various stages |
|---|
| 1558 Registrations for operation |
| 54 Type approvals |

# Radiation Applications in Industry

## License Category - High Radiation Hazard Potential

### Radiation Processing Facilities

Radiation processing facilities use either X-rays or Gamma rays. The radiation produced during operation and the radioactive waste created from operation pose worker safety issues. One of the benefits of radiation processing facilities which use X-rays is that, unlike radioactive sources, they only produce radiation when they are operated.

| Consents Issued at various stages |
|---|
| 02 Licenses/Renewal for operation |
| 02 Site approvals |
| 01 NOC issued for procurement of equipment |
| 02 Design & Construction approvals |
| 157 Permissions for source replenishment |

### Industrial Radiography

Manufacturers use Industrial radiography for Non-destructive testing. Industrial radiography uses either x-rays or gamma rays. X-ray radiography is used in a fixed location. Radiation is present only when these machines are turned on. Portable industrial radiography devices are smaller, and use radioactive source as a “sealed source” to provide gamma rays. There is an inbuilt shielding to protect workers from the radiation. Potential for exposure from the radiation sources exists when the equipment is mishandled, source is removed by unauthorized persons or theft.

| Consents Issued at various stages |
|---|
| 57 Licenses for operations |
| 127 Commissioning approvals at facilities |
| 78 NOC issued for procurement of equipment |
| 04 Design approvals |
| 440 Permission for source movement |

## Authorisation & Registration Category - Medium & Low Radiation Hazard Potential

### Nucleonic Guages

Most Nucleonic Gauges use small amounts of radioactive material. Nucleonic Gauges used for Well logging operations are of higher hazard and come under the Authorization Category.

These gauges are used extensively in the industry. Loss / Theft of sources is a safety issue.

| Consents Issued at various stages |
|---|
| 71 Registrations for operation |
| 12 Type Approvals |

# Radiation Applications in Research & Consumer goods

## Registrarion Category - Low Radiation Hazard Potential

### Radioactive Traces In Research

Small amount of radio active sources are used in research applications. Handling and disposal of small radioactive sources are regulated.

**Consents Issued at various stages**

26 Registrations for operation

233 Permissions for source procurement

### X-ray baggage scanners

Extremely low radiation hazard potential. Design (Type) approval is carried out by AERB. Only the manufacturers / suppliers of equipment are regulated.

### Thorium Gas Mantles

Extremely low radiation hazard potential. Only the manufacturers / suppliers of thorium gas mantles are regulated.

**Consents Issued at various stages**

08 Type Approvals

> AERB approves qualified and experienced personnel as Radiation Safety Officers (RSOs) in various practices to ensure continued radiation safety.

| Practice | RSO's approved this year |
|---|---|
| Medicine | 621 |
| Industry | 414 |
| Research | 26 |

**AERB is entrusted to administer the provisions of the Factories Act, 1948 in the units of Department of Atomic Energy (other than BARC & BARC facilities) under its purview.**

# Industrial Safety in DAE units

## License under the Factories Act, 1948

| Unit | License Validity |
|---|---|
| Narora Atomic Power Station 1 & 2 | Renewed for five years |
| Heavy Water Plant - Hazira | Renewed for two years |
| Indian Rare Earths Limited, Udyogamandal (for high purity rare earth production) | Issued for five Years |
| Indian Rare Earths Limited, Udyogamandal (for uranium recovery from secondary sources) | Renewed for five years |
| Nuclear Fuel Complex | Renewed for four years |

## Designation of Competent Persons

Competent Persons are designated for the purpose of carrying out tests, examinations and inspections of lifting machineries, tackles, lifts and hoists, ventilation system, civil construction and structural works, operation of dangerous machines, pressure plants, for supervision of handling of hazardous substances and dangerous fumes.

"54 persons were designated as **Competent Persons** in different DAE units this year

## Appointment of Certifying Surgeons

Certifying Surgeons are appointed for carrying out duties and responsibilities related to occupational health safety of workers such as pre medical examination of workers and periodical examinations of workers as per specified frequency.

A workshop cum training programme on "Basic & Advanced Life Support", "Audiometry" and "Emerging concepts in medico-legal cases in clinical practice" for Certifying Surgeon & Para - Medical staff of DAE units was jointly organized by Heavy Water Plant, Hazira & Advisory Committee on Occupational Health (ACOH) of AERB on August 24, 2013 at HWP (Hazira).

## Important Safety enhancements based on AERB's review & assessment

Following the fire incident in 2009 at ECIL, Hyderabad AERB had recommended for setting up a full fledged fire fighting system. Independent fire station has now been established.

Improvement in safety management system with respect to responsibility of line management at construction sites of Nuclear power projects.

Preventive maintenance and surveillance plans for electrical equipment has been developed by ECIL and RRCAT.

Code of Practice for In-service Inspection for NFC facilities has been developed.

Enhanced In-service Inspection for critical equipment implemented at HWPs in accordance with the revised Code of Practice

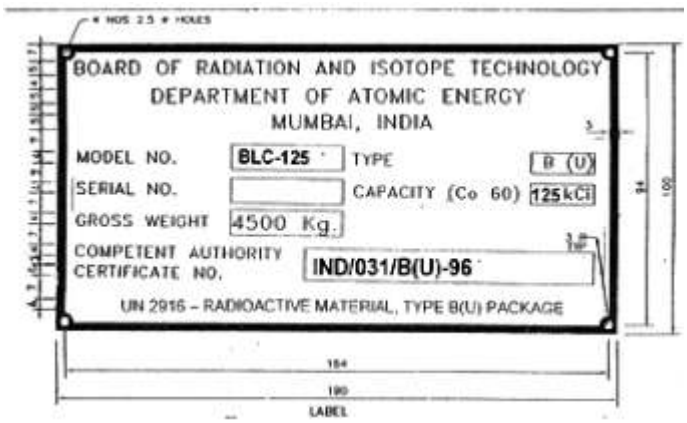
## Industrial Safety Inspections

| Units | Inspection Frequency |
|---|---|
| Nuclear Fuel Cycle Facilities (other than mines) under operation | Twice in a year |
| Nuclear Power Plants under operation | Once in a year |
| Nuclear Power Projects under construction | Once in a month |
| Fuel Cycle and R&D Projects under construction | Once in a quarter |


***135*** *regulatory inspections were carried out, which include* ***43*** *special monthly inspections at construction sites of nuclear power projects and* ***4*** *quarterly inspections of construction sites of fuel cycle facilities.*

# Safety in Transport of Radioactive materials


Handling of flask containing cobalt-60 for transportation




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 for the transport of radioactive materials and is line with the International requirements specified by IAEA for safe transport of radioactive material.

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 of transport 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 fulfill the safety standards.

During 2013-14, **32** five Type B(U)/(M) packages and **23** Type A packages were approved for transportation.

# 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.

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.

## Gaseous Emissions from Nuclear Power Plants

Tritium:
Within 6 % of the Technical Specifications limit

Argon-41:
Within 5% of the Technical Specifications limit except in older generation plants such as RAPS 1&2 and MAPS which is upto 25% (due to use of air instead of $CO_2$ as annular gas)

Fission Product Noble Gasses
Within 11 % of the Technical Specifications limit

Iodine-131
Mostly within 1% of the Technical Specifications limit except for Boiling Water based Reactor TAPS-1&2 which is within 5%

## Liquid effluent from Nuclear Power Plants

Tritium:
Within 23% of the Technical Specifications limit

Gross beta:
Mostly within 10 % of the Technical Specifications limit except in MAPS (around 40%) due to increased activities during long shutdown

## Solid Wastes from operating NPPs Nuclear Power Plants

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

## Disposal of spent radioactive sources

All the radioactive sources must be safely disposed off once they reach the end of their useful life. These sources are disposed off at different disposal sites such as Board of Radiation and Isotope Technology (BRIT), Bhabha Atomic Research Centre (BARC), Central Waste Management Facility (CWMF), Kalpakkam, Electronics Corporation of India (ECIL), Hyderabad and Narora Atomic Power Station (NAPS). The sources are also exported back to the original supplier abroad, in case of imported sources.

*During 2013-14, approvals were issued for disposal of 210 radioactive sources in facilities within the country and 403 sources for exporting back to the original supplier.*

# Emergency Preparedness in Nuclear and Radiation Facilities

Nuclear Power Plants (NPPs) are designed with defence-in-depth philosophy which includes various safety barriers and systems to guard against any possible nuclear accident. In spite of all these, if any emergency situation arises due to an accident, well defined plans are laid down as required by AERB to tackle such situations.

AERB requires Nuclear Power Plants to conduct Site emergency exercise once in a year & off-site emergency exercise once in 2 years. During 2013-2014, seven site emergency exercises and six off site emergency exercises were conducted.

Site emergency exercise (once in six months) and Off-site emergency exercises (once in a year) were also carried out at hydrogen sulphide based Heavy Water Plants at Manuguru and Kota.

Emergency training are also imparted to radiation facilities with emphasis on loss or theft of source.

## Types of emergency situations

| | |
|---|---|
| **Emergency standby** | Abnormal plant conditions with potential to develop into accident situations, if timely preventive actions are not taken. |
| **Personnel emergency** | Emergency involving serious injury and/or excessive contamination of personnel involving radioactive/toxic chemicals or exposures to radiation and toxic chemicals |
| **Plant emergency** | Accident situations due to release of hazardous chemicals/radioactive materials, fire/ explosion in the plant but with consequences confined within the plant boundary |
| **Site emergency** | Accident situations in the plant involving radioactivity transgressing the plant boundary but confined to the site, or involving release of hazardous chemicals/ explosion/fire, whose effects are confined to the site, with off-site consequences expected to be negligible. |
| **Off-site emergency** | Accident situations with excessive release of radioactivity or release of large amounts of hazardous chemicals/ explosion/ fire, with consequences likely to extend and transgress public domain, calling for intervention. |

# Review of Preparedness for Offsite Emergencies at NPP sites

AERB officials carried out special regulatory inspections on emergency preparedness aspects and participated in off site emergency exercise as observers. The findings of observer teams were reviewed by higher level Committee in AERB. It was observed that the coordination among plant personnel, district officials and public was good with timely response and actions. Plant Management were asked to address the minor deficiencies identified during these exercises.

# Guidelines on Emergency Preparedness Plans

AERB in co-operation with National Disaster Management Authority (NDMA) assessed the existing guidelines for emergency preparedness in view of the lessons learnt from Fukushima nuclear accident. Based on these assessments together with the recent publication of IAEA on criteria for use in preparedness and response for a nuclear or radiological emergency, AERB has revised its safety guide on 'Intervention Levels and Derived Intervention Levels for Off-Site Emergency". A one day theme meeting was conduced by ERB to obtain feedback from various stakeholders on the revised intervention levels. AERB has also undertaken revision of its safety guide on 'preparation of Off-Site Emergency Preparedness Plan'.

# Strengthening of provisions for managing nuclear emergencies

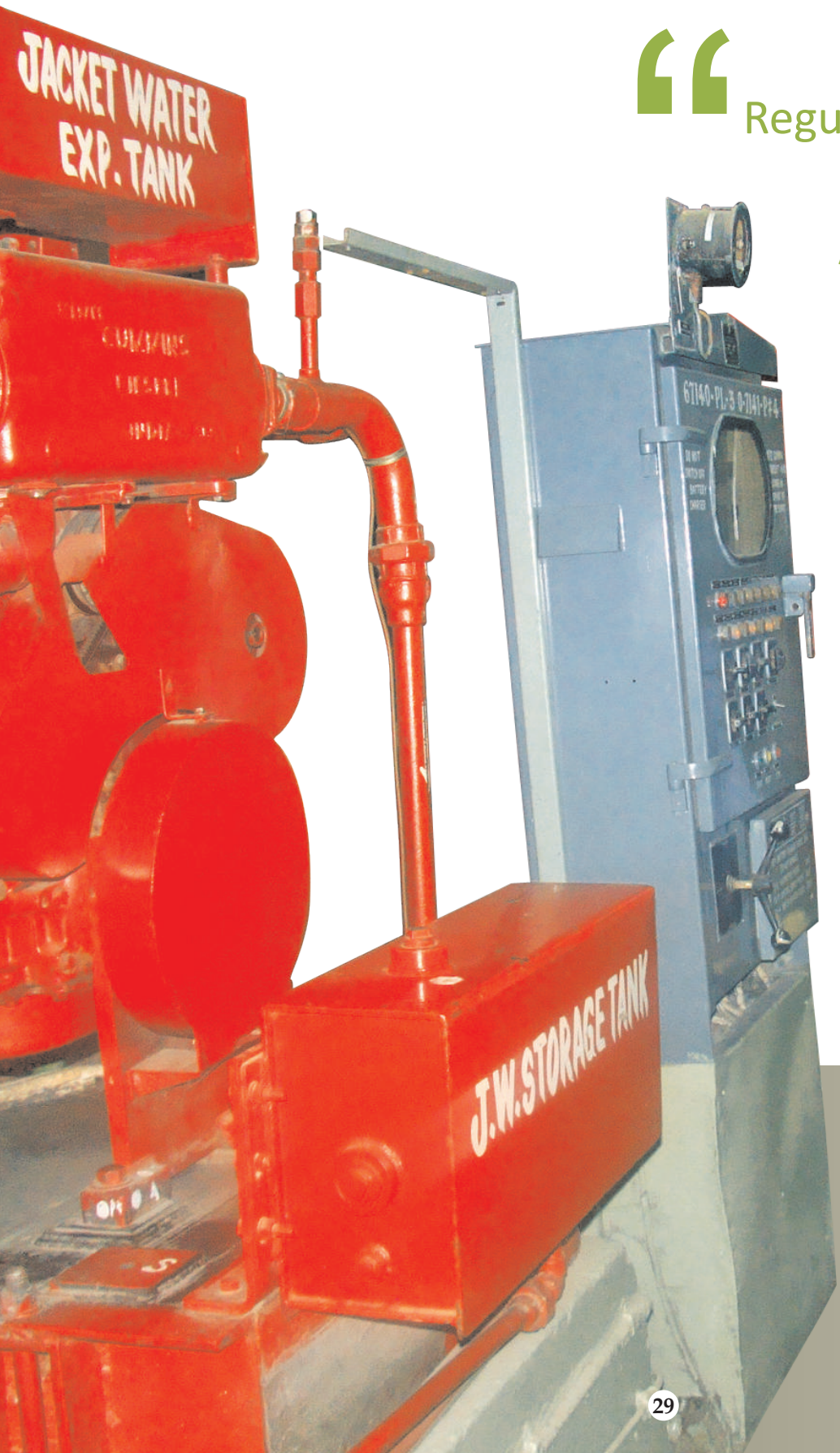
### Onsite emergency support centres at NPPs

Post Fukushima safety assessments recognized that a beyond design basis external event may disable the facilities available at the NPP site for monitoring and control of important reactor parameters. It may also result in physical isolation of the site such that it may not be possible to receive outside help for a considerable period of time. In view of this, the provision of an On-Site Emergency Support Centre is being considered for all NPP sites from where the actions required for managing the accident will be coordinated.

AERB has constituted an Advisory Committee to develop the guidelines for creation of such a facility at all NPP sites. AERB has asked the NPP sites to submit design basis report for the site specific Off Site Emergency Support Centre in accordance with these guidelines.

### AERB's nuclear and radiological emergency monitoring cell

The actions to be taken during a nuclear or radiological emergency calls for co-ordination between regulatory body and various other agencies. In order to strengthen the provisions for monitoring of progress of emergencies and review of actions taken by the involved agencies, a Nuclear and Radiological Emergency Monitoring Cell (NREMC) has been established at AERB. The cell consists of experts equipped with communication facilities and protocols to obtain information during emergency condition from the concerned agencies.




## Regulatory Inspections

are carried out to ensure compliance with the AERB safety requirements and stipulations

# Regulatory Inspections

## Routine Inspections

| Facilities Inspected | No. of inspections during the year |
|---|---|
| Operating Nuclear Power Plants and associated facilities | 26 |
| Nuclear Power Projects and associated facilities | 23 |
| Nuclear Fuel Cycle Facilities, R&D units and industrial plants of DAE | 34 |
| Radiation Facilities | 1080 (1649 equipment) |

About 75-90% of major observations of last year's inspections have been complied in nuclear facilities. Remaining are in progress as per schedule.

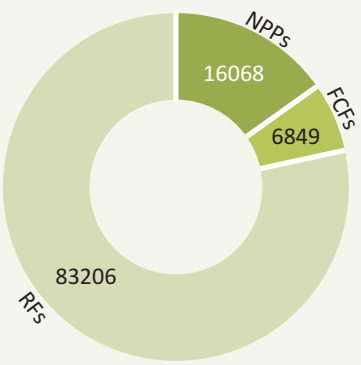
## Special Inspections

| Facilities Inspected | No. of inspections during the year |
|---|---|
| Nuclear Power Plants and associated facilities | 8 |
| Monthly industrial safety inspections of Nuclear Power Projects under construction | 43 |
| Quarterly industrial safety inspections of Fuel Cycle Projects under construction | 4 |
| Fuel Cycle Facilities | 4 |
| Radiation Facilities | 11 |

## Security Inspections

| Facilities Inspected | No. of inspections during the year |
|---|---|
| Operating Nuclear Power Plants | 7 |
| Nuclear Power Projects | 11 |
| Fuel Cycle Facilities | 2 |

# Safety Statistics

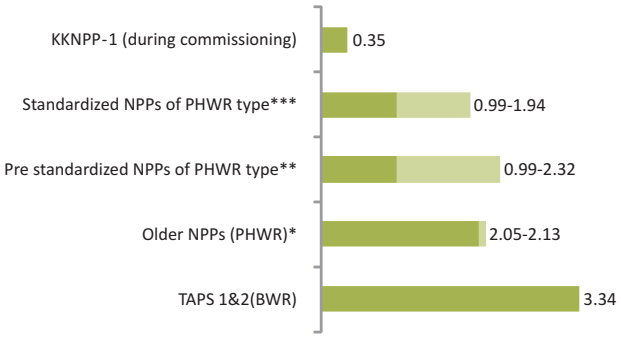



No. of Monitored Workers - 2013

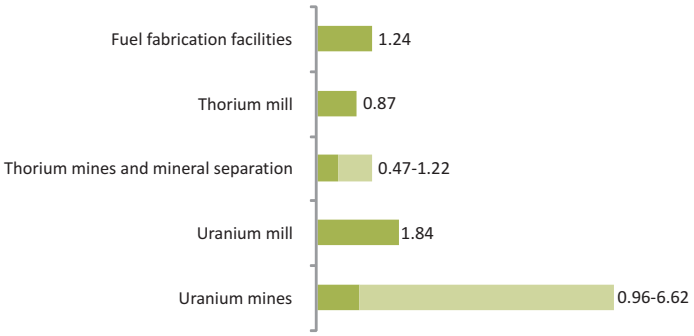
## Occupational Exposure

No worker received dose greater than the annual investigation level of 20mSv in Nuclear Power Plants (NPPs) & Fuel Cycle Facilities (FCFs). With respect to Radiation Facilities (RFs), nine radiation workers in diagnostic radiology and one radiation worker in industrial radiography received radiation dose greater than 50mSv due to non standard operating practice. AERB has issued notices to concerned institutions to prevent recurrence of such incidents.

Average Doses (mSv) in operating NPPs - 2013

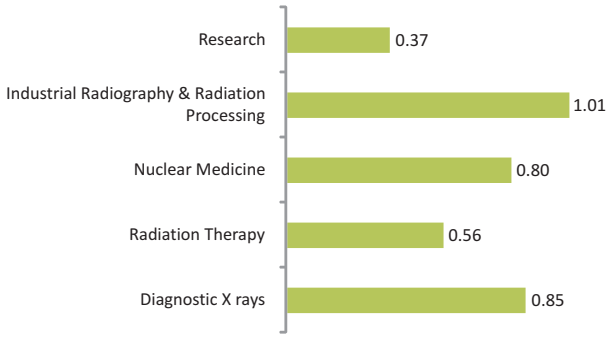



Average Doses (mSv) in Fuel Cycle Facilities - 2013




* Older plants consist of RAPS 1&2 and MAPS 1&2
** Pre-standardized NPPs consist of NAPS 1&2 and KAPS 1&2
*** Standardized NPPs consist of KGS 1-4, RAPS 3-6, TAPS 3&4

Average Doses (mSv) in Radiation Facilities - 2013




AERB has prescribed a dose limit of **30 mSv** in 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

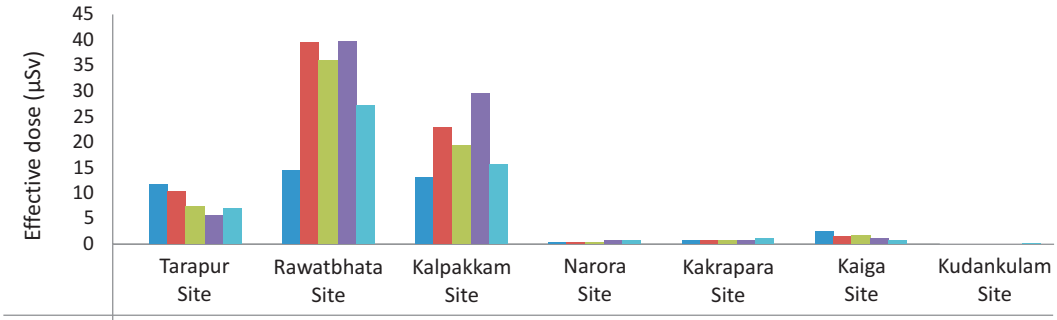
# Safety Statistics

## Public Exposure

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

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

During 2013, the liquid and gaseous waste discharge from the operating NPPs 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 is far less than the annual limit of 1 mSv (1000 micro-Sievert) prescribed by AERB.




| | Tarapur Site | Rawatbhata Site | Kalpakkam Site | Narora Site | Kakrapara Site | Kaiga Site | Kudankulam Site |
|---|---|---|---|---|---|---|---|
| 2009 | 11.82 | 14.60 | 13.20 | 0.30 | 0.60 | 2.48 | |
| 2010 | 10.15 | 39.60 | 22.93 | 0.42 | 0.75 | 1.47 | |
| 2011 | 7.42 | 36.30 | 19.50 | 0.48 | 0.88 | 1.90 | |
| 2012 | 5.52 | 39.88 | 29.88 | 0.56 | 0.78 | 1.24 | |
| 2013 | 6.94 | 27.40 | 15.52 | 0.56 | 0.92 | 0.80 | 0.0007 |

Estimated Public dose at Exclusion Zone Boundary of NPP sites

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

> Public dose estimated from NPP is found to be only a fraction of public dose limit (1000 micro-sieverts) prescribed by AERB

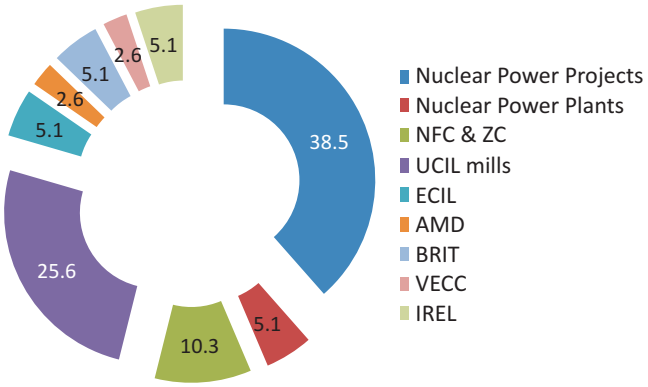
*Perspective of Doses*

| |
|---|
| Threshold for Mortality 2,000,000 |
| Radiation Sickness Appears 1,000,000 |
| 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

## Industrial Safety




Reportable Injuries (%) in DAE units in - 2013

There were 39 reportable injuries i.e. injuries resulting in absenteeism for 48 hours in 2013 including 5 fatalities in the calendar year. In 2013, 312 Near-Miss Accidents were reported from different units of DAE. About 18 % of the reported near miss accidents were due to "Fall of Objects" from height and about 12 % were due to "fall of persons from height"

No occupational diseases were reported from any of the DAE units during 2012-13.

### Frequency Rate

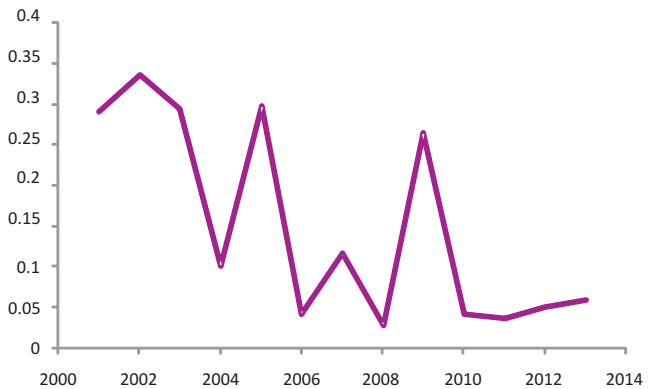
**No. of reportable injuries divided by million man-hrs worked**

The frequency rate has decreased to 0.27 in the year 2012 after being almost constant at 0.50 since 2007.

### Severity Rate

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

The Severity Rate (SR) for 2013 was 219 in 2013.




Injury Index: Product of Frequency Rate and Severity Rate

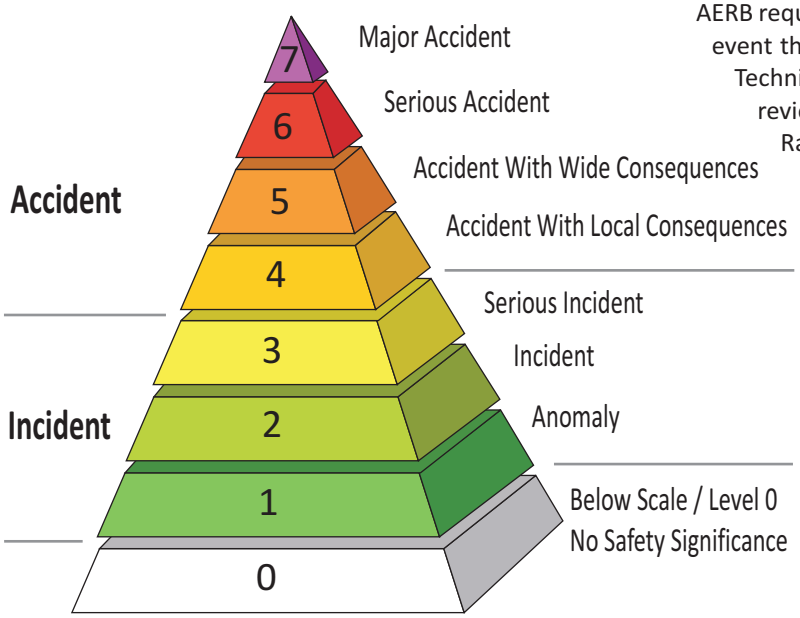
| Industry Type | Incidence Rate | |
|---|---|---|
| | Fatal | Non-Fatal |
| Heavy Water Plants (2012) | 0 | 0.58 |
| Manufacture of Chemicals & Chemical products (2007) | 0.09 | 1.25 |
| Nuclear Fuel Complex (2012) | 0 | 2.01 |
| Manufacture of Fabricated Metal Products except Machinery and Equipment (2007) | 0.04 | 2.34 |
| Nuclear Power Plants (2012) | 0 | 0.37 |
| Electricity, Gas, Steam and Hot water supply (2007) | 0.05 | 0.46 |

Comparison of Incidence Rates of DAE Units (2013) with Equivalent Non-DAE Industries (2010)
(Data Source- Statistics of Factories -2010 published in April 2013 by Ministry of Labour & Employmment

"Industrial Safety Standard in DAE units fare better than corresponding Non-DAE industries

# Safety Statistics

## Significant Events




AERB requires NPPs to submit detailed report for every significant event that takes place. The reporting criteria is provided in the Technical specification for operations. These reports are reviewed and categorized based on International Nuclear & Radiological Event Scale. 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.

Out of 33 significant events in 2013, 32 significant events were rated at level 0 on INES while one significant event of contamination of storm water drain at NAPS was rated at level 1 on INES respectively.

At NAPS, the tritiated water leaked out from the dyke floor area of downgraded heavy water storage tanks, and found way to a nearby storm drain. The tritium activity was conservatively estimated as 10 Ci, which was much below the authorized daily limit for discharge. The event was reviewed in detail in AERB.

After this event, necessary measures were taken by the station to ensure appropriate configuration / condition of the isolation provisions in dyke floor drain.

| INES levels | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|
| 0 | 23 | 33 | 36 | 30 | 32 |
| 1 | 0 | 1 | 1 | 2 | 1 |
| 2 | 0 | 0 | 1 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 |
| >3 | 0 | 0 | 0 | 0 | 0 |
| Total | 23 | 34 | 38 | 32 | 33 |

INES Rating of Significant Events in NPPs during the last five years

“ There has been no ‘Accident’ as per INES in Nuclear Power Plants in India

# Enforcement actions by AERB

Enforcement actions by AERB arise from review of documents submitted by the consentee, findings of regulatory inspections conducted by AERB or based on information it receives from overseas agencies like International Atomic Energy Agency (IAEA) and other regulatory bodies.

Several graded enforcement options are available to AERB to ensure that the Licensee takes timely corrective actions whenever needed. The actions taken by AERB are based on aspects such as safety significance of the deficiency, seriousness of violations, the repetitive nature and/or deliberate nature of the violations.

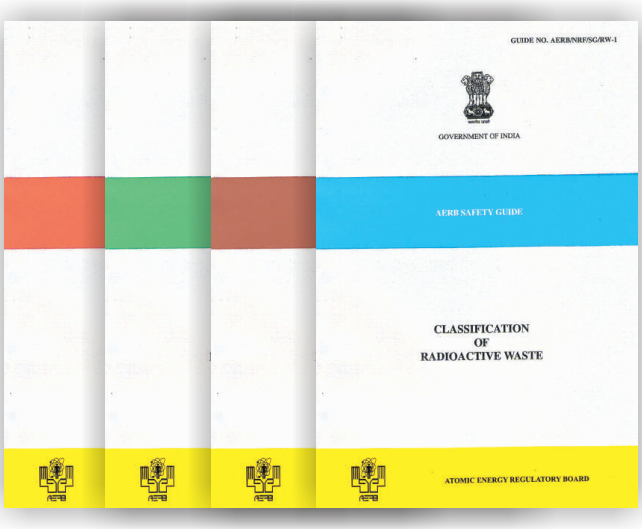
AERB asks utility to take corrective actions like increasing the surveillance, replacement of equipment, revision of procedures, training etc. Actions may also include requiring the plant to incorporate additional features in design or operation, calling for additional test/mockups or analysis etc.

In the past, AERB has enforced regulatory actions against nuclear power reactors by restricting power levels, directing design modifications, calling for additional tests or studies or in extreme situations, AERB has even ordered shutdown of plants, or suspension of activities in projects.

Enforcement actions may include one or more of the following:

- A written directive for satisfactory rectification of the deficiency or deviation detected during inspection;
- Written directive to consentee for improvement within a reasonable time frame;
- Orders to curtail or stop activity;
- Modification, suspension or revocation of operating consents; and
- Penalties

# Development of Regulatory Safety Documents




AERB develops safety documents, which form the basis for regulation of nuclear and radiation facilities and related activities in the country. It includes Safety Codes (SC), Safety Standards (SS), Safety Guides (SG), Safety Manuals (SM) and Technical Documents (TD).

*A total of **144** safety documents have been published by AERB*

## New Safety Documents Published

**AERB Safety Guidelines 'Siting, Design, Construction, Commissioning, Operation and closure of Tailing management Facilities for Uranium Ore Processing' (AERB/FE-FCF/SG-4)**

provides requirements and guidance on siting, design, construction, commissioning, operation, maintenance, closure and monitoring of the tailings management systems for uranium ore processing.

**AERB Safety Guidelines 'Radiological Safety in Handling Beach Sand Minerals and Other naturally Occuring Radioactive Materials' [AERB/FE-FCF/SG-5]**

provides regulatory requirements and guidance with respect to radiological safety, waste management and transportation aspects relevant to facilities processing beach sand minerals, columbite tantalite ore, rock phosphate and phosphogypsum.

**AERB Revised Safety Guide 'Development of Regulatory Safety Documents for Nuclear and Radiation Facilities' [AERB/NRF/SG/G-6]**

provides guidance for the process of proposal, development and publication of regulatory safety documents in order to ensure that quality is achieved and maintained.

Seventeen Regulatory Safety Documents were translated in Hindi

Experts in AERB reviewed 6 Draft Documents and 12 Document Preparation Profiles of IAEA and offered valuable suggestions to IAEA.

# Safety Studies and

Chairman, AERB inaugurating the 'Severe Accident Analysis and Management Symposium' at IIT, Kanpur

## Safety studies and R&D activities at SRI, Kalpakkam and Mumbai Headquarters

Several important developmental studies in the areas of severe accident analysis, hydrogen distribution & mitigation, probabilistic safety assessment, reactor physics, radiochemistry, thermal hydraulics, fire safety, seismic safety, geo-technical, structural safety assessment etc were taken up and completed during the year.

## Safety studies with National & International Collaboration

AERB has been participating in several national and international collaborative problem exercises in severe accident analysis, thermal hydraulics, hazard assessment, structural integrity assessment etc. This year the IAEA International Collaborative Standard Problem on Heavy Water Reactor Moderator Sub-Cooling requirement to demonstrate backup heat sink

# Research activities

capabilities of moderator during accidents and International round robin analysis program organized by BARC to assess ultimate load capacity (ULC) of containment test model were taken up.

AERB recognizes the importance of safety research in support of its regulatory work as it helps in obtaining deeper insights into the issues concerning nuclear and radiation safety to arrive at scientifically sound regulatory decisions. Safety analysis activities to support the regulatory decisions are being carried out at AERB headquarters in Mumbai as well as in Safety Research Institute, Kalpakkam which was primarily set up in 1999 to carry out safety research studies of regulatory interests.

## Safety studies Funded by AERB

AERB continued to fund project proposals from academic and research institutions for research in nuclear and radiological safety. The following 5 new research projects were sanctioned during the year 2013-2014:

Radiation Doses and its Impact from Radiological and Cardiological interventions, Christian Medical College, Vellore

Development of Novel Polymeric Detectors for Selective Dosimeters for Selective Dosimetric Analysis, Goa University, Goa

Development of a Standardized Thermal Infrared Imaging Technique for Monitoring Temperature Distribution at Power Plant Outfall Sites, Anna University, Tamil Nadu

Synthesis and Characterization of $Al_2O_3$ for Ion Beam Dosimetry, PESIT, Bangalore

Study on Levels and Effects of Natural Radiation in the Environment of Different Regions of Manipur, Churachandapur Govt. College, Manipur

AERB's Committee on Safety Research Projects visits the ongoing project facility at IIT, Madras

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.

*AERB continued its cooperation activities with international organizations such as International Atomic Energy Agency (IAEA), Nuclear Energy Agency (NEA), regulatory fora such as CANDU Senior regulators forum and VVER regulators forum and with regulatory bodies of France (ASN), Russian Federation (Rostechnadzor), United States of America (USNRC), Ukraine (SNRIU) and Romania (CNCAN).*

# International Co-operation

## Cooperation with IAEA

The staff of AERB participates in various Technical and Consultants meetings organized by IAEA. AERB staff have been participating in IAEA Coordinated Research Programme (IAEA-CRP) on various topics as well as in development of IAEA's safety documents. AERB is the national coordinator for IAEA - International Nuclear Event Scale (INES) based reporting of events and IAEA/NEA - Incident Reporting System (IRS) and Fuel Incident Notification and Analysis System (FINAS).

### Convention on Nuclear Safety of IAEA

A fourteen member delegation led by Chairman, AERB presented the national report during the sixth review meeting of the CNS held in March 2014. The Indian National Report was well received, in particular, the post-Fukushima measures taken for enhancing the nuclear safety in Indian NPPs was appreciated. Highlights of IAEA OSART mission and follow-up mission for RAPS-3&4 was considered to be noteworthy safety achievements along with other major activities such as: (i) completion of periodic safety reviews for four twin-unit NPPs during last three years (ii) development/revision of regulatory documents based on the lesson learnt from Fukushima accident, (iii) development of generic Severe Accident Management Guidelines document, (iv) completion of previous planned measures and challenges (i.e. addressing public concern, development of competent human resources, establishment of EQ program) in all respect.

### IAEA Workshop on IRS, RCA AND CA

A five-day IAEA workshop was organized by AERB during November 4-8, 2013 at Mumbai. Participants were introduced to the concepts and methodologies associated with International Reporting System (IRS) for operating experience, Root Cause Analysis (RCA) and Corrective Actions (CA) techniques. IRS Coordinator from IAEA made presentations on background and history, safety principles, requirement for operating experience analysis and use, role and responsibilities of national coordinator of IRS and those of NEA and IAEA. The presentations were followed by tutorial exercises for ensuring greater clarity on the associated concepts.

Indian delegates during CNS meeting

Participants at IAEA workshop

### Conventions on Early Notification of Nuclear Accidents & Assistance in case of Nuclear Accident/Radiological Emergency

Under these conventions India has agreed to provide notification of any nuclear accident that occur within its jurisdiction that could affect other countries and any assistance that can be provided in the case of a nuclear accident if it occurs in another state which has ratified the convention. Periodic exercises are conducted by IAEA for training and preparedness of the involved agencies. AERB participates in these exercises through Crisis Management Group of Department of Atomic Energy (CMG-DAE).

## Cooperation with NEA

India has started participating in Nuclear Energy Agency's Committee on Nuclear Regulatory Activities (NEA/CNRA) for regulatory activities and Nuclear Energy Agency's Committee on Safety of Nuclear Installations (NEA/CSNI) for safety research activities. AERB is actively participating in the activities of CNRA along with its working groups. AERB is also being represented in senior task group of CNRA for preparation of NEA booklet on long term operation and Safety of Research Reactors.

The objective of CNRA Working Group on Public Communication of Nuclear Regulatory Organizations (WGPC) is to provide support to improve public communication of Nuclear Regulatory Organizations through exchange of information and experience and to maintain a network among working group members. Officials from AERB attended various meetings of this working group.

Indian representative with other Members of CNRA's Working Group on Public Communication

## Multinational Design Evaluation Programme (MDEP)

AERB is a full member of MDEP of NEA, which is a multinational initiative to develop innovative approaches to leverage the resources and knowledge of national regulatory authorities who are, or will shortly be, undertaking the review of new reactor designs. As a full member, AERB is contributing to the Programme's strategic decisions in the MDEP Policy Group and the MDEP Steering Technical Committee. Besides, AERB is actively participating in design specific working groups such as on EPR and issue specific working groups such as Codes and Standards Working Group (CSWG), Digital Instrumentation and Control Working Group (DICWG) and Vendor Inspection Co-operation Working Group (VICWG)

National & International Delegates at VVER Regulators Forum Meeting, Kanyakumari

## VVER Regulators Forum

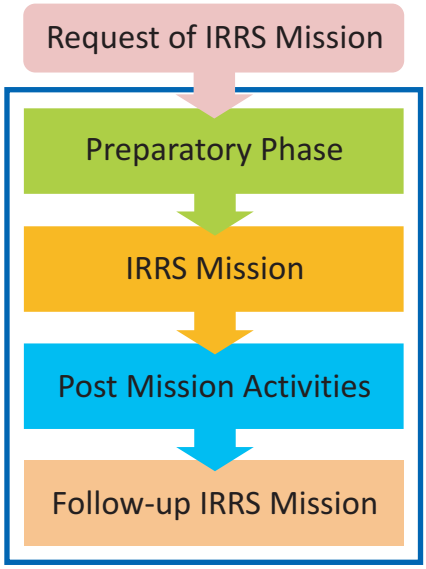
The 20th annual meeting of the VVER Regulators Forum was hosted by AERB during December 11 - 13, 2013, at Kanyakumari near Kudankulam Nuclear Power Plant, Tamil Nadu. Founded in the year 1993, this Forum consists of the nuclear regulators of countries around the globe with operating reactors of Russian VVER design. The Forum comprises nuclear regulatory organizations from Armenia, Bulgaria, China, Czech Republic, Finland, Hungary, Republic of Iran, Russian Federation, Slovakia, Ukraine and India. This Forum mainly aims at sharing the experiences of global nuclear regulators and harmonizing the regulatory practices.

The country representatives participated and presented their country's reports. The reports dealt with comprehensive information about latest update and recent developments in legislations, nuclear safety, regulatory activities, operational aspects of special interest, probabilistic safety assessment (PSA), etc. The incidents in the VVERs of member countries were also shared as a part of operational experience feedback. Apart from this, the Forum also deliberated over adequacy of measures taken after the Fukushima accident. The delegates visited Kudankulam Nuclear Power Plant (KKNPP), wherein the VVER design reactors are under construction and commissioning.

## New bilateral arrangements with regulatory bodies

AERB signed a bilateral arrangement with the United State Nuclear Regulatory Commission (USNRC) on October 9, 2013 for the exchange of technical information and cooperation in nuclear safety matters. The scope of the arrangement provides for the technical information exchange, co-operation in safety research, training and assignments and administration of the dissemination of proprietary information. This arrangement has already entered into force and shall remain in force for a period of five years.

# IAEA's Integrated Regulatory Review Service (IRRS) Mission




The International Atomic Energy Agency (IAEA) conducts an Integrated Regulatory Review Service (IRRS) in countries with Nuclear Power Plants and radiation facilities to review the common aspects of the State's national, legal and governmental framework and regulatory infrastructure for nuclear and radiation safety against IAEA Standards and Guidance. It is a peer review and is conducted at the request of a country, which is a member of IAEA. An expert peer review of the current extent of compliance with IAEA Standards and Guidance provides a good indicator of the effectiveness of the regulatory oversight for various facilities /activities in the country.

India has decided to host the IRRS Mission and has already submitted a formal invitation to IAEA to review the activities of AERB in respect of the regulatory system and activities related to safety of Nuclear Power Plants in India.

Efforts had already been initiated in previous years to assess the readiness of AERB for IRRS mission. These efforts were further intensified this year which included preparation of position papers on identified issues, formation of teams for preparation of response to Self Assessment of Regulatory Infrastructure for Safety (SARIS) questionnaire which is a pre-requisite for inviting the IRRS peer review mission.

AERB organized a 'National Self-Assessment Seminar' during March 4-6, 2014 in order to communicate greater understanding of the Mission's expectations. Three IAEA officials elaborated the process and procedures of the IRRS Mission, requirements and stipulations made in IAEA standards, the mission's expectations and explained the use of SARIS (Self Assessment of Regulatory Infrastructure for Safety), a software-tool, developed by IAEA for carrying out the Self-Assessment process which is an integral part of IRRS mission. The officials from various governmental agencies involved in the regulation of NPPs, participated in the seminar. After the seminar, a meeting was held between the IAEA officials and the senior management of AERB to discuss the scope and schedule of IRRS Mission in India and the preparations required to host the same.

IAEA officials conducting National Self-Assessment Seminar for AERB staff

# Safety Promotional activities

## AERB Safety Awards

AERB has annual safety award schemes to promote industrial safety, fire safety and environment protection in DAE units

### Safety Award Winners for 2013

Industrial Safety Award:

TAPS 1&2 and 3&4 (production group)

HWP-Talcher (research and other low risk units group)

Fire Safety Award:

HWP, Kota and RAPS 3&4 (high risk group)

HWP - Baroda (low risk group)

Environment Protection Award:

HWP-Kota (operating units and mines group)

ECIL (R &D units group)

BHAVINI (projects & under development mines group)

## DAE Safety & Occupational Health Professionals Meet

AERB organizes DAE Safety and Occupational Health Professionals Meet every year which provides a platform to the safety professionals of DAE for sharing of experiences on safety related matters. Last year the Meet was jointly organized by Atomic Energy Regulatory Board, Mumbai and Uranium Corporation of India Limited at Narwapahar, Jharkhand during December 18-20, 2013. The themes for the meet were “Safety in uranium and thorium mining and milling and chronic respiratory diseases”.

## Demonstration on Rescue and Fire Fighting Operation

In view of the observance of Fire Service Week during April 14-20, 2013, Fire Services Section of BARC in coordination with AERB organized a demonstration programme with special emphasis on “Office Fire Safety”. High elevation rescue operation and use of first-aid and firefighting equipment were demonstrated.

In addition, AERB organised various awareness programmes on radiation safety aspects

# Public Communication and Outreach activities

## Traditional Approaches

### Website

AERB has been maintaining a website with all relevant and updated information. This year, AERB revamped its website. The revamped website apart from having an elegant professional look, is also associated with various useful features for public like advanced search mechanism, availability of feedback form for suggestions, links to external agencies and details about various functions carried out by AERB.


Chairman, AERB launches the revamped website of AERB


### Annual Report/Newsletters

AERB publishes Annual Reports and Newsletters once in every six months. These contain information on various activities carried out by AERB as well as the nuclear and radiological safety status of regulated plants and activities.

### Press releases/Parliament queries/RTI queries

**Five** press releases were issued providing information on important events and activities of AERB

**Fifty nine** parliament questions were responded

**One hundred twelve** queries under Right To Information Act were replied

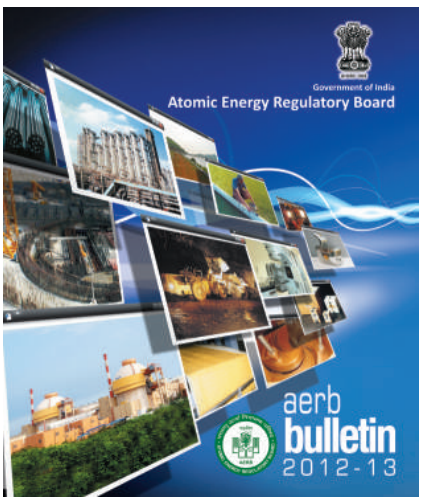
## Participation in Science and Technology Fairs

AERB continued to participate in science and technology fairs: an initiative which started two years back with an aim to expand the public outreach activity. This year, AERB displayed its exhibits during the Chennai Science Fair held at Chennai and also during the DAE Safety and Occupational Health Professionals Meet held at Narwapahar, Jharkhand in December 2013.


Chairman, AERB & Secretary AERB visits AERB's Exhibition Stall

## Press Conference

At the conclusion of the 20th annual meeting of VVER Regulators Forum at Kanyakumari, which is near to KKNPP site, a press briefing was arranged on December 13, 2013 which was addressed by Shri S.S. Bajaj, Chairman AERB in presence of senior officials of AERB. Various aspects related to regulatory review of the commissioning of unit-1 and AERB's regulatory process were addressed.




## AERB Bulletin

AERB continued its initiative to publish annual bulletin which is an attempt to summarise the information contained in the Annual Report in an attractive format. It has also been translated to Hindi, Marathi and Tamil.

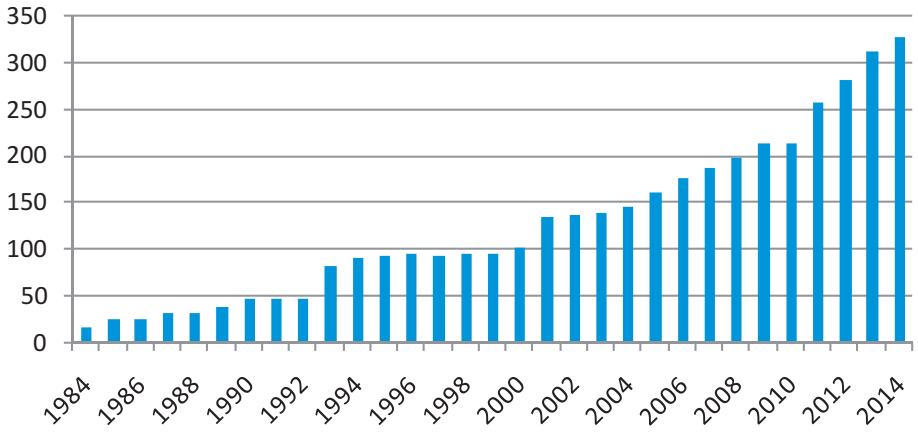

## Public Information brochure

This year AERB prepared an informative public information brochure which in a nutshell provides an overview of AERB and its activities.

# Strengthening Inhouse Competence

## Human Resource Development

To meet the regulatory challenges arising out of expansion of nuclear and radiation facilities, AERB has augmented the technical manpower substantially by direct recruitment, inducting postgraduates through AERB Graduate Fellowship Scheme (AGFS) at IIT-Bombay & IIT-Madras, and through training schools of BARC, IGCAR, NPCIL and NFC. Total sanctioned strength in AERB as on March 31, 2014 is 344, comprising of 274 scientific & technical and 70 supporting staff.




Year wise Manpower Augmentation in AERB

## Knowledge management

As a part of competence development, AERB continued to train its staff by organizing various training programmes, workshops, on the job training at nuclear facilities, refresher courses, technical talks, colloquia etc. AERB Orientation Course for Regulatory Processes (OCRP-2013) was conducted at AERB, Mumbai during March to May 2014. Thirty Four participants from various technical divisions of AERB were benefitted by the course. Apart from this, an Orientation Course on Environmental Impact Assessment (EIA) of nuclear fuel cycle facilities was conducted in July 2013 at SRI, Kalpakkam. AERB has also initiated steps for competency mapping of its staff.

AERB Staff Attending Technical Talk

Publications/Paper presentations

Journals: 15 | International Conferences: 51 | National Conferences: 28

## Workshops/Discussion Meets

During the process of regulatory review, several important topics emerge out which require consultation with the experts. In order to have a better understanding of the subject and to resolve issues on the topic, AERB organizes theme specific discussion meets and workshops wherein experts, representatives from utilities and concerned officials from AERB participate. The important discussion meets/workshops organized this year are as follows:

- Revised criteria for emergency preparedness & response
- Experience on equipment qualification
- Challenges in design of foundations for NPP structures in alluvial sites
- Safety assessment against aircraft impact and blast loading
- PHWR safety R&D with focus on severe accidents
- New horizons in nuclear reactor thermal hydraulics and safety

## Formal Arrangements with other institutes/State Governments

.....With Anna University

To promote and develop cooperation and synergy in mutually beneficial areas of research related to regulatory aspects of nuclear facilities and to enhance collaborative research with academic institutions, Atomic Energy Regulatory Board (AERB) signed a Memorandum of Understanding (MoU) with Anna University (AU), Chennai.

.....With NISST

Memorandum of Understanding (MoU) has been signed between AERB and NISST. Under this MoU, it is envisaged to increase awareness of various stakeholders of re-cycling steel industry to avoid radioactive contamination in steel.

.....with Govt. of Arunachal Pradesh

In view of tremendous increase in medical diagnostic installations using medical x-rays in the country, a decision was taken to decentralize the regulation of these units by setting up a Directorate of Radiation Safety (DRS) in States by signing MoU with State Governments and Union Territories. AERB has signed 11 such MoUs with various State Governments. DRS is functional in Mizoram and Kerala.

## FICCI

AERB has welcomed the proposal of Federation of Indian Chambers of Commerce and Industry (FICCI) for joint workshops to create awareness towards application submissions for import authorizations, acceptance testing protocols and similar subjects on medical applications of radiation.

AERB accredited laboratories for carrying out measurement of radionuclide content in commodities and/or environs. Presently there are fifteen such laboratories accredited by AERB.

## Technical support to national agencies

### Bureau of Indian Standards (BIS)

BIS is the National Standards Body involved in Standards Formulation apart from other activities. Secretary, AERB is a member of Occupational Safety & Health and Chemical Hazards Sectional Committee of BIS as well as convener of its Sub-Committee and is involved in review and revision of BIS documents.

### Ministry of Environment and Forests (MOEF)

Secretary, AERB is a member of environment appraisal committees of Ministry of Environment and Forests for both, Civilian Nuclear Facilities as well as Strategic Nuclear Facilities and contributes in finalization of terms of references for EIA as well as in review of EIA reports.

### National Disaster Management Authority (NDMA)

Secretary, AERB is a member of a Technical Committee constituted by NDMA. As part of the responsibility in the committee, AERB conducted dispersion analysis (atmospheric dispersion and in-room distribution) of hazardous chemicals using heavy gas dispersion models and CFD tools. This analysis was vital in determining the protection requirements against the analyzed scenarios

## Guidance to Engineering Interns

Technical divisions in AERB and SRI have been providing guidance to undergraduate engineering students as well as M.Tech students in the fields of Quantitative Risk Assessment, Hazard Assessment and Operability (HAZOP) studies, Fire Hazard Analysis/Modeling, Probabilistic Safety Analysis, Core Dynamic Studies, Plant Dynamics, etc.

## Quality Management System

AERB has obtained certification under ISO 9001 standard by Bureau of Indian Standards (BIS) for its consenting activities, regulatory inspection and preparation of regulatory documents in November 15, 2006 and was recertified as per new ISO 9001:2008 standard in November 2009. During the year internal audits were conducted. BIS team carried out surveillance audit of Quality Management System of AERB in December 2013 and no Non-Conformance was observed. To enhance awareness level on QMS requirements and improve competence of AERB personnel in performing QMS functions, a workshop on 'Promotion of Awareness on ISO 9001:2008 QMS was organized in April 2013. Similarly, training on QMS by BIS was organized for 25 new internal auditors in October 2013.

Training of AERB staff on QMS by BIS staff

# Special Feature - I

## Notification of Nuclear Incidents under Civil Liability for Nuclear Damage Act, 2010

The Civil liability for Nuclear Damage Act, 2010 promulgated by the Government of India came into force on November 11, 2011. The Act was framed to provide civil liability for nuclear damage and prompt compensation to the victims of a nuclear incident. The Atomic Energy Regulatory Board (AERB) was given the additional responsibility under this Act to notify the nuclear incidents within 15 days of its occurrence and cause wide publicity of the incident.

In order to enable AERB to promptly notify a nuclear incident, the Civil Liability for Nuclear Damage Rules, 2011 required the operator of a nuclear installation to report immediately the occurrence of nuclear incident in his nuclear installation or during transportation of nuclear material to AERB, where such nuclear installation is under its jurisdiction, in the manner as the Board may, by order, specify.

The practice of reporting of safety related events or that exceeding the regulatory limits to AERB is already in place. However, the various regulatory limits prescribed by AERB are not appropriate for direct application in the reporting of an event for the purpose of the said rules as they were arrived at with other purposes in mind, and those limits have been set at a level which is conservatively arrived at by incorporating a significant safety factor. Thus, a discharge or dispersal of radioactivity or exposure to ionizing radiation which exceeds the regulatory limits prescribed by AERB, although possible cause for concern, is not one which would be expected to cause substantial injury or damage unless it exceeds by some significant multiple the appropriate regulatory limit.

Hence AERB, as mandated under the Civil Liability for Nuclear Damage Rules, 2011 have categorically specified through a gazetted order the requirement of reporting of 'extraordinary nuclear events'. The reporting of extraordinary nuclear events under this Order shall be in addition to, and in no way in derogation of the existing regulatory mechanism of reporting of events to the AERB. The order also sets forth the responsibilities of Radiological Safety Officers and Environmental Survey Laboratories of nuclear installations with respect to assessment of off-site and on-site radiological conditions respectively and promptly reporting of any abnormal radiological conditions to AERB.

The set of extraordinary nuclear events specified by AERB are as follows:

i) Any single event (including that caused by natural disaster) resulting in stack release of radiologically equivalent I-131 corresponding to a quantity of radioactivity 500 times or more of I-131 annual release limit prescribed in technical specifications for operation of the plant, or

ii) Any single event (including that caused by natural disaster) where in one or more person offsite were, could have been, or might be exposed to radiation or to radioactive material, resulting in a dose or in a projected dose of 1 mSv, or

i) Any event (including that caused by natural disaster) leading to injury or death of a person off site due to exposure to ionizing radiation emanating from a nuclear installation, or

ii) Any event (including that caused by natural disaster) requiring evacuation as a part of counter measure following an off-site emergency, or

iii) Any event (including that caused by natural disaster) leading to a surface contamination of at least a total of any 100 square meters of offsite property due to release of radioactive material from nuclear installation of 1000 Bq/sq.m or more from alpha emitting radionuclides, or leading to radiation level of 10 µGy/h (1 mR/h) at 1m or more above natural background from beta or gamma emitting radionuclides.

iv) Any event (including that caused by natural disaster) in the course of transportation by road, air or water ways leading to release of nuclear material or injury or death of a person due to exposure to ionizing radiation emanating from the release of nuclear material

# Special Feature - I

Once the reports of extraordinary nuclear events are received in AERB, these will be further reviewed to assess whether they qualify for being notified as 'nuclear incidents'. For this purpose, AERB has issued a safety directive on “Criteria and Assessment Procedures for Notification of Nuclear Incident under the Civil Liability for Nuclear Damage Act, 2010”. As per this Directive, an Expert Review Committee consisting of relevant experts in the field will be constituted to review the extraordinary nuclear events. Necessary guidance for this purpose has been provided in the Directive. Those extraordinary nuclear events, which satisfy the following criteria will be notified as 'nuclear incident' after obtaining approval from the Board of AERB:

i) Any single event (including that caused by natural disaster) resulting in stack release corresponding to a quantity of radioactivity radiologically equivalent to a release of 1000 TBq of I-131 or more

ii) Any single event (including that caused by natural disaster) where in one or more person offsite were, could have been, or might be exposed to radiation or to radioactive material, resulting in a dose or in a projected dose of 100 mSv, or

iii) Any event (including that caused by natural disaster) leading to injury or death of a person offsite due to exposure to ionizing radiation emanating from a nuclear installation or during transportation of nuclear material

iv) Any event (including that caused by natural disaster) requiring evacuation and having potential economic loss as a part of countermeasure following an off-site emergency at an nuclear installation, or

v) Any single event (including that caused by natural disaster) leading to a surface contamination of at least a total of any 100 square meters of offsite property due to release of radioactive material from nuclear installation of 10000 Bq/sq.m or more from alpha emitting radionuclides, or leading to radiation level of 100 µGy/h (10mR/h) at 1 m or more above the natural background from beta or gamma emitting radionuclides, or

vi) Any event (including that caused by natural disaster) in the course of transportation leading to release of nuclear material resulting in a surface contamination of off-site property of 10,000 Bq/sq.m or more from alpha emitting radionuclides, or leading to radiation level of 100 µGy/h (10mR/h) at 1 m or more above the natural background from beta or gamma emitting radionuclides, or

Any event, other than those mentioned above, and in the opinion of the Event Review Committee is of sufficient safety significance to cause damage to personnel or property, can be recommended to the Board of AERB for notification. In addition, on receipt of any information from any source on suspected occurrence of any extraordinary nuclear event, AERB may initiate suo-moto action to determine whether or not there has been any such event and determine whether such an event qualifies for notification under the Act.

The details of the order & the safety directive are available on AERB’s website: www.aerb.gov.in

# Special Feature - II

## Policies Governing Nuclear and Radiation Safety in India

AERB has published a policy document which consolidates the safety policy objectives that are stated in the Atomic Energy Act, 1962, the Rules and the Codes and Standards of AERB, which form the framework for regulation of safety, into a single document. Such a policy document as a single reference is intended to enhance openness in the conduct of regulatory activities and to reduce communication gaps while interacting with its stakeholders as well as outside agencies. These polices are:

1) Fundamental objective of AERB is 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. Towards this, the activities related to nuclear and radiation facilities shall be regulated through a system of regulatory consents that allows activities with stipulated conditions.

2) AERB shall be responsible for ensuring through safety reviews and inspections that the consented activities of the nuclear and/or radiation facility comply with the safety requirements and conditions of consent. This however does not diminish the responsibility of the consentee for safety, who shall be solely responsible for ensuring safety of the nuclear and/or radiation facility / activity and shall demonstrate that safety is ensured at all times.

3) The regulatory processes for nuclear and radiation facilities shall have the objectives to ensure that:
Only such practices are permitted which are justified in terms of their societal and/or individual benefits,
Radiation protection is duly optimised in all nuclear/radiation facilities,
Radiation doses to the personnel in these facilities, and to the members of the public in their vicinity, do not exceed the prescribed limits, and the potential for accidental exposures from the facilities remains acceptably low.

4) Decisions related to regulatory consent for the facilities / activities shall be based on review and assessment by the Regulatory Body of the demonstration of compliance to the regulatory requirements by the applicant for consent. The consent issued by the regulatory body shall have a validity period. The regulatory process shall have provision for periodic renewal of consent, for which the review and assessment should ensure that safety of the facility / activity is judged after comparison with the current safety standards and practices.

5) The regulatory process shall provide for review and assessment, including conduct of inspections, of the consented facilities and activities on a continuing basis to ensure that the facility / activity is being done with due regard to safety and in compliance to the regulatory requirements and the conditions laid down in the consent.

6) The regulatory control over the nuclear and radiation facilities shall follow a graded approach, based on the radiological hazard potential.

7) All activities pertaining to nuclear and radiation facilities shall be in accordance with requisite Quality Assurance Programmes, establishing the goals, strategies, plans and objectives as well as identifying the organisational and individual responsibilities towards safety. The overall responsibility for establishment, implementation, assessment and continual improvement of the programme shall be with the consentee.

8) All nuclear and radiation facilities shall implement appropriate radiation protection programmes, to ensure safety of occupational personnel, the public and the environment. The programmes should provide for monitoring of radiation exposures as well as for environmental surveillance, as necessary.

9) The radioactive waste generated during operation, maintenance and decommissioning of nuclear and radiation facilities shall be managed in a safe manner to ensure protection of human health and the environment from the undue effects of ionising radiation in the present and in the future, without imposing undue burden on future generations.

# Special Feature - II

10) All nuclear and radiation facilities / activities shall have arrangements for development of adequate plans and preparedness for responding to emergency situations, for protection of the occupational personnel, the public and the environment, in accordance with the hazard potential of the facility / activity.

11) When a nuclear / radiation facility or radiation generating equipment ceases to be in use, it shall be ensured that it undergoes safe decommissioning. Remediation of a contaminated site shall be carried out if the radionuclide concentration exceeds the reference levels specified by the Regulatory Body.

12) The Regulatory Body may resort to enforcement actions on the consentee for securing timely compliance to the regulatory requirements and conditions of consent or corrective actions, based on review and assessments of the submissions from the consentee and/or findings during review or inspection. The enforcement options should follow graded approach, taking account of aspects such as safety significance of the deficiency, seriousness of violations, the repetitive nature and/or deliberate nature of the violations. The enforcement actions may include initiation of penal provisions as provided under section 17 of the Atomic Energy Act, 1962.

13) Radiation exposures resulting from naturally occurring radionuclides present in the human body, cosmic radiation at the earth surface, unmodified concentrations of radionuclides in raw materials, except the radioactive materials / waste generated from operation of uranium and thorium mining and milling facilities, are excluded from regulatory control. The regulatory body may 'exempt' certain sources or practices involving artificial radionuclides from regulatory control, the radiation exposure from which is too small to warrant such control. Also certain radioactive materials or radioactive objects arising from / within the consented practices may be considered for clearance from any further regulatory control, provided that the continued regulatory control of which would yield no net benefit in terms of reduction of individual doses or of health risks. The decisions with respect to exemption and clearance shall be based on the prescribed criteria.

14) On the issues of Safety, Health and Environment at work place, in relation to the factories owned by the Central Government and engaged in carrying out the purposes of the Atomic Energy Act, 1962, the objectives of the "National Policy on safety, health and environment at work place" issued by the Ministry of Labour and Employment, Government of India and the provisions of the Atomic Energy (Factories) Rules, 1996 shall prevail.

15) The Regulatory Body shall take steps as necessary, to keep the public informed on safety issues of radiological safety significance. It shall also be responsible for notifying to the public, the 'extraordinary nuclear events', occurring in the nuclear facilities in India, as mandated by the Civil Liability for Nuclear Damage Act, 2010.

16) In the conduct of regulatory activities, the Regulatory Body shall be governed by the provisions of the 'Right to Information Act, 2005, as applicable to the 'public authority'.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**Printed at Printania Offset Pvt. Ltd., Matunga, Mumbai-400 019**

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