CHAPTER-01

SAFETY SURVEILLANCE OF NUCLEAR & DAE INDUSTRIAL FACILITIES

SAFETY SURVEILLANCE OF NUCLEAR & DAE INDUSTRIAL FACILITIES

Nuclear and Industrial facilities in India are sited, designed, constructed, commissioned, operated and decommissioned in accordance with strict quality and safety standards. The primary responsibility for the safety of the facility lies with the licensee. All these facilities undergo an in-depth safety review during various stages as per AERB's established regulatory framework. The objective of safety review and assessment at various stages of a facility is illustrated below:

Siting

To ensure that the selected site is suitable for the proposed facility and meets criteria for site evaluation.

Construction

To ensure that the design of the proposed facility meets the regulatory requirements, the construction is as per the approved design and verify the construction methodology vis-à-vis design requirements.

Commissioning

To ensure that the commissioning programme meets the regulatory requirements; performance of the plant is as per design intent and results of commissioning tests confirm adequacy of the plant design.

Operation

To ensure that plant operates within approved limits & conditions, adequate level of safety is maintained through administrative control and adherence to procedures, availability of qualified manpower meets the licensing requirements as prescribed by AERB and management systems are established for safe operation.

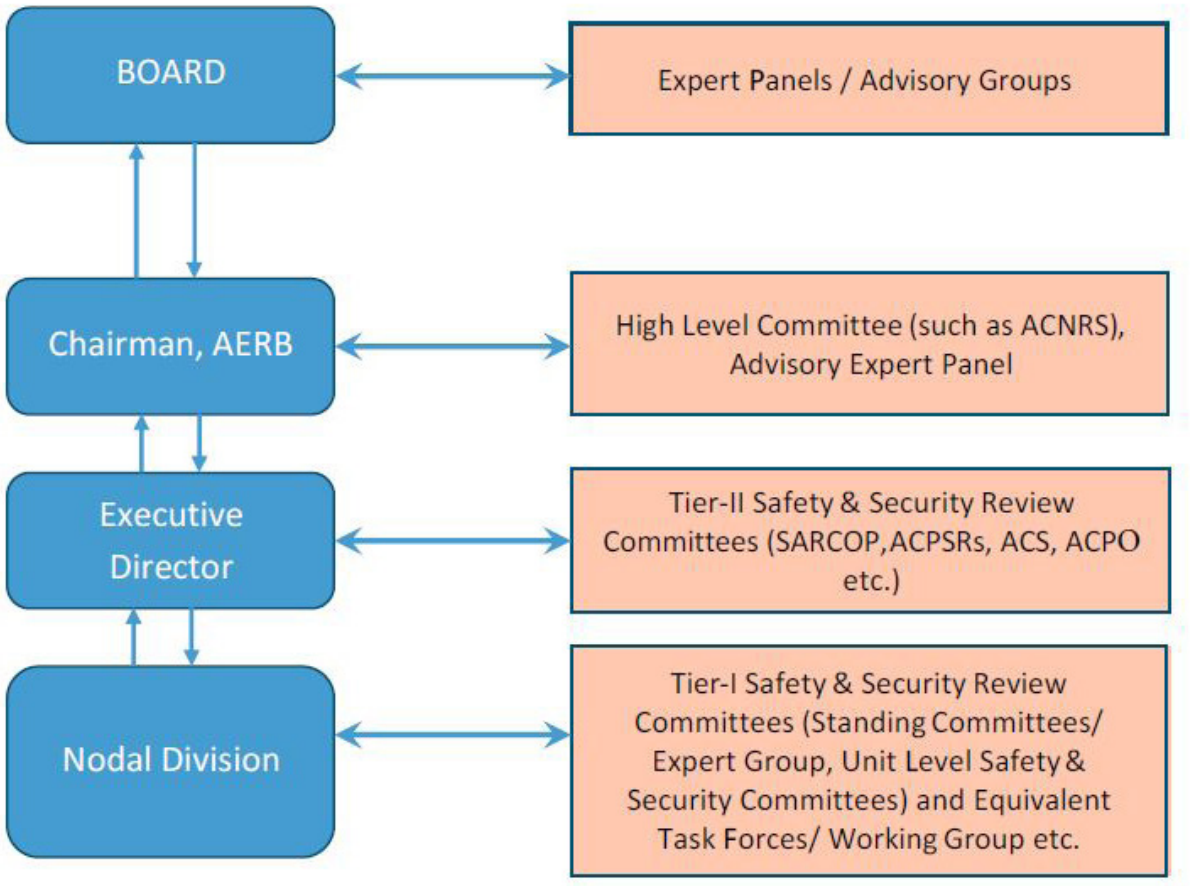
1.0 Safety Review Mechanism of Nuclear and Industrial Facilities

Review of Safety Aspects

AERB follows a multi-tier system of safety review. The scope and depth of safety review in AERB is based on graded approach. Issues of greater safety significance are given consideration at higher level for their satisfactory resolution.

AERB derives support from a number of safety committees for safety review and assessment activities. The safety committees include experts in relevant fields, including nuclear and radiation safety. Expertise of members from academia, national R&D institutes and government bodies are utilised in higher level committees. Recommendations of these committees concerning various safety issues and their consents are further considered in AERB for arriving at the regulatory decisions. This arrangement ensures comprehensiveness of the reviews and effective compliance with the specified requirements. AERB carries out periodic regulatory inspections to check conformance with regulatory requirements and consenting conditions.

The licence for operation of the facilities is issued after ensuring its satisfactory construction and commissioning as per the approved design and the specified safety/regulatory requirements. The



Multitier Safety Review System of AERB

licence for operation is issued with a specified validity period.

The operating facilities are subjected to a comprehensive Periodic Safety Review (PSR) every ten years. The PSR involves a thorough assessment of the safety of the plant in comparison with the current safety requirements and practices, covering a number of identified safety factors. This regulatory approach ensures that the safety levels of the plants are maintained and enhanced to remain comparable with the current safety standards /practices throughout the operating life of the plant.

Review of Security Aspects

AERB is also entrusted with the responsibility of review and assessment of nuclear security aspects (that have bearing on safety) for different types of nuclear and industrial facilities under its purview. AERB has issued various regulatory documents specifying nuclear security and cyber security requirements for nuclear and industrial facilities. Security aspects are reviewed against relevant regulatory requirements. Multi-tier approach is adopted for review of security aspects also.

1.1 Review Status of Nuclear Power Projects & Fuel Cycle Facilities

The status of various nuclear power projects under siting, construction and commissioning are presented in Table 1.1.

Table 1.1: Status of Nuclear Power Projects

Project Stage	Project	District/ State	Utility/ Licensee/ Applicant	Type	Review Status
Siting	Mahi Banswara Rajasthan Atomic Power Project -1-4	Banswara/ Rajasthan	NPCIL	700 MWe PHWRs	Initial Reviews Towards Admittance of Siting Application Completed
Construction	Kudankulam Nuclear Power Project -3&4	Tirunelveli/ Tamil Nadu	NPCIL	1000 MWe VVERs (LWRs)	Consent for Erection Of Major Equipment (MEE) Issued in April, 2022.
	Kudankulam Nuclear Power Project - 5&6	Tirunelveli/ Tamil Nadu	NPCIL	1000 MWe VVERs (LWRs)	Clearance for First Pour of Concrete issued on May 12, 2021
	Gorakhpur Haryana Anu Vidyut Pariyojana -1&2	Fatehabad/ Haryana	NPCIL	700 MWe PHWRs	Consent for FPC was issued in November, 2020. Permission for Commencement of Raft NB-01 issued in March, 2023.
	Rajasthan Atomic Power Project -7&8	Chittorgarh / Rajasthan	NPCIL	700 MWe PHWRs	Reviews related to Pre-commissioning Activities in Progress
	Kaiga Nuclear Power Project - 5&6	Karwar / Karnataka	NPCIL	700 MWe PHWRs	Excavation Consent was issued in March, 2022.
Commissioning	Prototype Fast Breeder Reactor, Kalpakkam	Kancheepuram/ Tamil Nadu	BHAVINI	500 MWe Prototype Fast Breeder Reactor	Reviews for Phase-A Commissioning Activities in Progress.

Project Stage	Project	District/ State	Utility/ Licensee/ Applicant	Type	Review Status
	Kakrapar Atomic Power Project - 3&4	Tapi, Gujarat	NPCIL	700 MWe PHWRs	For Unit -3, Permission for raising Reactor Power up to 100% FP was issued in August, 2023 For Unit-4, Permissions issued for Bulk Addition of Heavy Water to the Moderator System and First Approach to Criticality and Low Power Physics Experiments in December, 2023

1.2 Nuclear Power Projects: Review Status

Safety review activities related to the Nuclear Power Projects (refer Table 1.1) continued during the year 2023. The review status is as follows:

1.2.1 Light Water Reactor based Nuclear Power Projects

1.2.1.1 Kudankulam Nuclear Power Project (KKNPP) - 3&4

AERB had issued Consent for Erection of Major Equipment (MEE) in April, 2022. Currently civil construction and erection of equipment is in progress at KKNPP-3&4 site.

In KKNPP-3, welding of Main Coolant Pipelines (MCP) has been completed. AERB conducted a special regulatory inspection for witnessing the welding activities. Concreting of Inner Containment (IC) dome in Reactor Building of Unit-3 is completed.

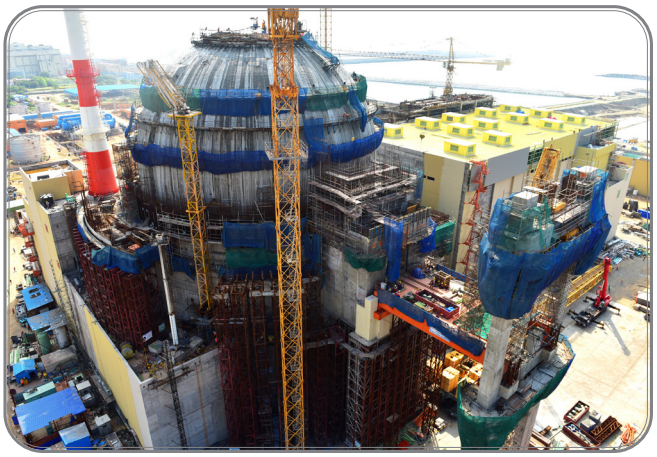
In KKNPP-4, Safety System pumps have been installed in all the safety trains.

View of Main Plant Buildings of KKNPP-3

1.2.1.2 Kudankulam Nuclear Power Project (KKNPP) - 5&6

AERB had issued Consent for First Pour of Concrete (FPC) in May, 2021.

Presently, civil construction work is in progress at KKNPP-5&6. Based on satisfactory safety review, permission for erection of Core Catcher Vessel was issued and the Vessel was installed in KKNPP Unit-5 in July, 2023.



View of Containment Dome of KKNPP-3

Overview of KKNPP-5 Reactor Building

View of Main Plant Buildings of KKNPP-4

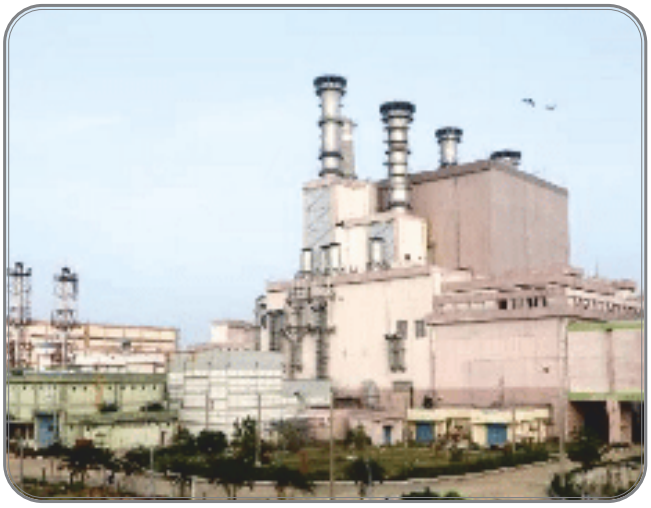
Overview of KKNPP-6 Reactor Building

Core Catcher Installation in KKNPP-5

1.2.2 Prototype Fast Breeder Reactor (PFBR)

Prototype Fast Breeder Reactor (PFBR) project is in commissioning stage. Safety review of Phase-A commissioning activities is in progress.

Based on review, permission for pre-heating of Main Vessel was issued in April, 2023. And subsequently, after satisfactory review, permission for sodium filling in Main Vessel and commissioning activities up to 200°C was issued in August, 2023. Later, on completion of sodium filling activity and review of its commissioning tests results, AERB issued permission for testing of fuel handling systems at 200°C in September, 2023.



Prototype Fast Breeder Reactor

BHAVINI also submitted an application for raising the temperature of primary sodium in Main Vessel, Secondary Sodium System and Safety Grade Decay Heat Removal (SGDHR) system up to 250°C and carry out the performance test of SGDHR loops. Based on the satisfactory review, permission was issued in November, 2023.

In December 2023, BHAVINI reported leaks in one of the air heat exchangers of SGDHR system. Investigations for the cause of leaks are in progress and methodology for corrective actions is under review in AERB.

AERB is closely monitoring and reviewing the commissioning activities and related issues. AERB has also conducted special regulatory inspection to witness the tests / activities being carried out during the commissioning phase.

Meeting of Project Design Safety Committee at Kakrapar Site

1.2.3 Pressurized Heavy Water Reactors (PHWR) based Nuclear Power Projects

1.2.3.1 Kakrapar Atomic Power Project (KAPP)-3&4

KAPP-3 attained first criticality in July 2020. As part of commissioning clearance, permission to raise the Reactor Power to 50% Full Power (FP) for power ascension tests was issued in November 2020. Subsequently, KAPP-3 was synchronized to the grid in January 2021.

NPCIL carried out modifications in the ventilation system and certain structures to address high temperatures in some areas of the Reactor Building (RB). After validation of these modifications, permission for resumption of Phase-C commissioning & reactor power operation of KAPP-3 up to 60% FP was issued in March, 2023. Subsequently, permissions for

Project Design Safety Committee Members with NPCIL Officials at KAPP-3&4

raising KAPP-3 reactor power to 70% FP, 80% FP, 90% FP and 100% FP were issued progressively and the commissioning results were reviewed by AERB. Permission for raising reactor power up to 100% FP was issued in August, 2023.

Similar to KAPP-3, modification works were carried out in KAPP-4 ventilation systems and certain structures in some of the reactor building areas. After safety review in AERB, permissions for KAPP-4 PHT system hot-conditioning & light water commissioning and initial Fuel Loading were issued in June and October, 2023 respectively. On completion of initial fuel loading and satisfactory safety review, permissions were issued for bulk addition of heavy water to the moderator system and first approach to criticality and low power physics experiments in December, 2023. KAPP-4 achieved its first criticality on December 17, 2023 and presently low power physics experiments are in progress.

Fuel Handling Control Panel of KAPP-3

View of Turbine Generator of KAPP-3

1.2.3.2 Rajasthan Atomic Power Project (RAPP) - 7&8

Based on the commissioning review experience of KAPP-3&4, modifications were carried out in some of the areas of the Reactor Building (RB) of RAPP-7. Also, necessary changes were incorporated in the commissioning procedures. Permission for RAPP-7 PHT system Hot Conditioning and light water commissioning was issued in November, 2023. After completion of hot conditioning, light water commissioning related tests are in progress in RAPP-7. At RAPP-8, construction/ pre-commissioning activities are in progress.

Rajasthan Atomic Power Project (RAPP)-7&8

1.2.3.3 Gorakhpur Haryana Anu Vidyut Pariyojana (GHAVP) -1&2

AERB issued permission for First Pour of Concrete for GHAVP-1&2 in November 2020. Subsequently, ground improvement works and construction of foundation piles in the Nuclear Building (NB) area were completed. In December 2022, NPCIL submitted request for resumption of further construction activities i.e. commencement of NB-1 raft construction. Considering the results of repeat NDT of foundation piles and revised analysis/ design of NB, permission for the commencement of raft construction of NB-1 at GHAVP-1&2 was issued on March 16, 2023.

AERB was subsequently notified of ground subsidence in some of the GI (Ground Improvement) area near Station Auxiliary building (SAB) of GHAVP-2. NPCIL is carrying out investigations to establish the cause and extent of the problem.

GHAVP Project Site

1.2.3.4 Kaiga Atomic Power Project (KAIGA)-5&6

Consent for siting and consent for excavation for KAIGA-5&6, was issued by AERB in November, 2020 and March, 2022 respectively. Excavation activities at Kaiga-5&6 Main Plant area are in progress.

NPCIL submitted an application for First Pour of Concrete (FPC) for Kaiga-5&6 in July 2022. The application was reviewed in AERB. NPCIL has been asked to revise the application and submit additional supporting documents for further review in AERB. The documents are being submitted progressively by NPCIL.

1.2.3.5 Mahi Banswara Rajasthan Atomic Power Project (MBRAPP)-1 to 4

Application for Siting Consent of Mahi Banswara Rajasthan Atomic Power Project Units 1 to 4 (MBRAPP 1 to 4) along with supporting documents was submitted. Adequacy review of the application and supporting documents has indicated that additional information is needed to admit the application for review.

1.3 Fuel Cycle Facility Projects

The status of various fuel cycle facility projects under siting, construction and commissioning are presented in Table 1.2.

Table 1.2: Status of Fuel Cycle Facilities under Siting, Construction and Commissioning

Project Stage	Project	Dist./ State	Utility/ Licensee/ Applicant	Review Status
Siting	Additional Away From Reactor Spent Fuel Storage Facility for RAPS	Chittorgarh / Rajasthan	NPCIL	Review of Siting application is in progress
Construction	Away From Reactor Spent Fuel Storage Facility for KKNPP-3&4	Tirunelveli/ Tamil Nadu	NPCIL	Construction Consent was issued in September, 2022.
	PHWR Fuel Fabrication Facility & Zircaloy Fabrication Facility, Rawatbhata.	Chittorgarh/ Rajasthan	Nuclear Fuel Complex, Kota	Construction Consent was issued in February 2018. Review of submissions related to Commissioning Consent is in progress.

1.4 Fuel Cycle Facility Projects: Review Status

Safety review activities related to the Fuel Cycle Facility Projects (refer Table 1.2) continued during the year 2023. The review status is as follows:

1.4.1 Additional Away From Reactor spent Fuel Storage Facility for RAPS (AAFR)

NPCIL submitted Application for Siting consent for the Additional Away From Reactor (AAFR) Spent Fuel Storage Facility at Rawatbhata Rajasthan site. Based on intial review, NPCIL was asked to submit additional information in support of the application.

1.4.2 KKNPP-3&4 Away From Reactor (AFR)

Based on review, Construction Consent for KKNPP-3&4 AFR was issued in September, 2022. First pour of concrete for the facility commenced in October, 2022 and raft concreting was completed in January, 2023. NPCIL submitted an application for construction of inner pool of AFR, which was one of the regulatory hold points of the Construction Consent. The application was reviewed in AERB and permission for construction of inner Pool of AFR was issued in October, 2023.

AFR of KKNPP-3&4

1.4.3 KKNPP-1&2 Away From Reactor (AFR)

AERB had issued Siting Consent in May, 2021 subject to compliance to certain stipulations. Application for Excavation Consent was treated as lapsed for want of submissions of required supporting documents.

1.4.4 Nuclear Fuel Complex, Kota (NFC-K)

500 Tons Per Annum (TPA) PHWR Fuel Fabrication Facility (PFFF) and 165 TPA Zircaloy Fabrication Facility (ZFF) are being setup at Nuclear Fuel Complex (NFC), Kota. In first phase, two modules of 250 TPA PFFF and 65 TPA ZFF are planned to be set up. Construction Consent to NFC-Kota was issued in February, 2018. The validity of construction consent of NFC-Kota was extended till December 31, 2024 based on review of NFC-Kota's request to complete ongoing civil works. Presently, installation of major equipment and cold commissioning of Zircaloy Fabrication Facility (ZFF) and PHWR Fuel Fabrication Facility (PFFF) are in progress.

NFC-Kota submitted proposals to conduct demonstration activities related to end cap welding and machining & end plate welding of the fuel bundles. These proposals were reviewed and permissions for one time-demonstration of these activities were issued in April and June, 2023 respectively. NFC-Kota successfully conducted these demonstration activities.

NFC Kota Project Site

The information on the meetings of the important safety review committees for facilities undergoing reviews related to siting / construction/ commissioning is given in Table 1.3.

Table 1.3: Safety Review Committee Meetings of the Nuclear Power Projects and Fuel Cycle Facilities under Construction

Project Safety Committee	Number of Meetings
Advisory Committee for Project Safety Review (ACPSR-NPPs) (for PHWRs, PFBR & LWRs)	07
Project Design Safety Committee – Fast Breeder Reactor (PDSC-FBR)	08
Project Design Safety Committee – Light Water Reactors (PDSC-LWR)	01
Project Design Safety Committee- Pressurized Heavy Water Reactors (PDSC-PHWR)	22
Civil Engineering Safety Committee (CESC)	02
Committee for Reviewing Security Aspects (CRSA)	02

1.5 Reportable Industrial Incidents at Construction Sites

1.5.1 KKNPP–3 to 6

In KKNPP 3&4, one reportable accident occurred in January 2023 which involved fall of a contract worker from a height of ~6 meters through an opening in a steel platform. The opening in the steel platform was provided to facilitate laying of temporary flexible duct for air conditioning and ventilation inside the reactor pressure vessel.

In KKNPP-5&6, one reportable accident occurred in February, 2023 which involved amputation of right hand fingers of a contract worker while fixing blade in band-saw machine.

1.5.2 RAPP-7&8

In December 2023, a fatal accident occurred at RAPP-7&8 involving a contract worker who fell from a scaffolding walkway at a height of approximately 13 meters. The worker was engaged in the task of removing shuttering material erected for constructing the fill structure of RAPP-8 Natural Draft Cooling Tower (NDCT). AERB identified the root cause of the accident as a failure to anticipate hazards related to material handling at height and the arrangement of scaffolding. AERB also acknowledged the corrective actions taken by the site to enhance the safety of the scaffolding in the NDCT area and improve work procedures. The recommendations made by AERB were implemented at the site, and an action taken report was submitted.

There were no reportable accidents at KAPP-3&4, KAIGA-5&6, GHAVP-1&2, NFC-Kota and PFBR during the period.

1.6 Operating Nuclear Power Plants, Research Reactors, Fuel Cycle Facilities and Industrial Facilities

AERB continued to carry out safety review & surveillance of operating Nuclear Power Plants, Research Reactors, Fuel Cycle Facilities and Industrial Facilities under its purview. Safety reviews of application for renewal of licence for operation, safety proposals submitted by these facilities and resolution of other safety issues that would emanate during plant operation is carried out. AERB renews Licence for operation of NPPs under the Atomic Energy Act, 1962 (and rules framed there under), the Factories Act, 1948 (and rules framed there under) and issues Authorization for safe disposal / transfer of radioactive waste under the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 (GSR-125) based on satisfactory safety review. Important licenses / authorizations / permissions / clearances issued during 2023 are as follows:

- Renewal of license for operation of KGS-3&4 up to April 30, 2028.
- Renewal of license for operation of NAPS-1&2 up to June 30, 2028.
- Renewal of license for operation of FBTR & IFSB up to June 30, 2028.
- Renewal of license for operation of CORAL, IGCAR up to August 31, 2028.
- Renewal of license for operation of RML, IGCAR, up to December, 2028.
- Renewal of license for operation of RCL, IGCAR up to December, 2028.
- Renewal of license for operation of Jaduguda mine up to January 31, 2028.
- Renewal of license for operation of Tummalapalle mine up to February 29, 2028.

- Renewal of license for operation of Narwapahar mine up to March 31, 2028.
- Renewal of license for operation of Bhatin mine up to April 30, 2028.
- Renewal of license for operation of Turamdih mine up to December 31, 2028.
- Renewal of license for operation of Rare Earths Division (RED), IREL (India) Ltd. Udyogamandal up to November 30, 2028
- Renewal of licence for operation of HWP-Hazira up to July 31, 2028.
- Extension of validity of the license for operation of HWP-Tuticorin up to July 31, 2025.
- Extension of validity of the siting & construction consent for Magnesium Recycling Technology Development & Demonstration Facility (MRTDDF) at Zirconium Complex up to March 31, 2026
- Consent for commissioning of Solvent Production Plant (SPP) at HWP-Tuticorin
- Consent for siting & construction of Versatile Deuterated compounds Production Plant (VDPP) at HWBF-Vadodara

1.7 Operating Nuclear Power Plants and Research Reactors

22 NPPs are under operation. The details are as follows.

Table 1.4: List of Operating NPPs

Operating NPPs	Site/district /State	Unit	Type	Gross Capacity (MWe)	Commencement of Commercial Operation	Validity of License
Nuclear Power Plants (NPPs						
Tarapur Atomic Power Station	Tarapur / Palghar / Maharashtra	TAPS-1#	BWR	160	October – 1969	March 2026
		TAPS-2#		160		
		TAPS-3	PHWR	540	August – 2006	August 2026
		TAPS-4		540	September-2005	
Rajasthan Atomic Power Station	Rawatbhata / Chittorgarh / Rajasthan	RAPS-1##	PHWR	100	December-1973	August 2024
		RAPS-2		200	April-1981	
		RAPS-3###		220	June-2000	October 2027
		RAPS-4		220	December-2000	
		RAPS-5		220	February-2010	March 2025
		RAPS-6		220	March-2010	
Kakrapar Atomic Power Station	Kakrapar / Tapi / Gujarat	KAPS-1	PHWR	220	May-1993	July 2024
		KAPS-2		220	September-1995	
Madras Atomic Power Station	Kalpakkam / Kancheepuram / Tamil Nadu	MAPS-1####	PHWR	220	January-1984	December 2025
		MAPS-2		220	March-1986	

Operating NPPs	Site/district /State	Unit	Type	Gross Capacity (MWe)	Commencement of Commercial Operation	Validity of License
Narora Atomic Power Station	Narora / Bulandshahar / Uttar Pradesh	NAPS-1	PHWR	220	January-1991	June 2028
		NAPS-2		220	July-1992	
Kaiga Atomic Power Station	Kaiga / Uttar Kannada / Karnataka	KGS-1	PHWR	220	November-2000	May 2027
		KGS-2		220	March-2000	
		KGS-3		220	May-2007	April 2028
		KGS-4		220	January-2011	
Kudankulam Nuclear Power Plant	Kudankulam / Tirunelveli / Tamil Nadu	KKNPP-1	PWR	1000	December-2014	July 2025
		KKNPP-2		1000	December-2017	

TAPS 1&2 Units are under shutdown since 2020 for Primary Coolant pipeline replacement
RAPS-1 Unit is under shutdown since 2004 and the reactor core is defueled
###RAPS-3 Unit is under shutdown since 2022 for EMCCR activities
####MAPS-1 Unit is under shutdown since 2018 due to leak from pressure tubes and calandria side tube sheet of North End Shield

Number of meetings of Safety Committees / Standing Committees / Expert Groups conducted during the year 2023 are given in table 1.5.

Table 1.5: Meetings of Safety Committees / Standing Committees / Expert Groups

Name of the Committee / Expert Group	No. of meetings
Safety Review Committee for Operating Plants (SARCOP)	12
LWR Safety Committee (TAPS-1&2 & KK-1&2)	12
PHWR Safety Committee -1 (RAPS-1&2, MAPS-1&2, NAPS & KAPS-1&2)	16
PHWR Safety Committee-2 (KGS-1&2, KGS-3&4, RAPS-3&4 & RAPS-5&6)	12
PHWR Safety Committee -3 (TAPS-3&4)	3
IGCAR Safety Committee (FBTR, CORAL, KAMINI, IFSB, RML & RCL)	8
Standing Committee on Control, Instrumentation & Computer Based Systems (SCCI & CS)	3
Expert Group on Coolant Channels (EGCC)	8
CRNRE for Review of INES Ratings of Events	4
Total	**78**


Glimpses of SARCOP Meeting at TAPS-1&2

1.7.1 Tarapur Atomic Power Station 1 to 4

TAPS-1 & TAPS-2 are under shutdown since January 08, 2020 and July 13, 2020 respectively for replacement of Class-I piping vulnerable to Inter-Granular Stress Corrosion Cracking (IGSCC). Both units of TAPS-3&4 were operational in the year 2023.

1.7.2 Rajasthan Atomic Power Station - 1 to 6

RAPS-2, RAPS-4, RAPS-5&6 were operational in the year 2023. RAPS-1 is under shut down since October 2004 and reactor core is defueled. RAPS-3 is under shutdown since October 27, 2022 for En-masse Coolant Channel Replacement (EMCCR) and En-masse Feeder Replacement (EMFR). In RAPS-3, installation and Pre-Service Inspections (PSI) of newly installed coolant channels has been completed.

1.7.3 Kakrapar Atomic Power Station – 1&2

KAPS-1&2 operated safely in the year 2023.

1.7.4 Madras Atomic Power Station -1&2

MAPS-1 is under shutdown since January 30, 2018 due to leak from pressure tubes O-09 & Q-09 and North End Shield. The Root Cause Analysis (RCA) reports for pressure tube and end shield leaks submitted by NPCIL are under review in AERB. MAPS-2 was operational in the year 2023.

1.7.5 Narora Atomic Power Station – 1&2

NAPS-1&2 operated safely in the year 2023.

NAPS-1&2 underwent Periodic Safety Review (PSR) as a pre-requisite for renewal of its operating licence beyond June 30, 2023 under 'The Atomic Energy Act, 1962' (and rules framed thereunder). Station had also submitted application for renewal of licence for operation under The Factories Act, 1948 (and rules framed thereunder) and authorization for radioactive waste disposal/ transfer under the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 (GSR-125).

These applications were reviewed by AERB following multi-tier review process. Review assessment indicated that the performance of NAPS-1&2 with respect to nuclear, radiological and industrial safety had been satisfactory. Radioactive effluent discharges were well below the limits specified in technical specifications for operation. Effective dose to a member of public residing at exclusion zone had been well within the limit prescribed by AERB. Station had implemented all short & medium-term

safety upgrades identified based on review of Fukushima NPP accident. Implementation of long term safety upgrades are in progress. Based on satisfactory review, AERB renewed the licenses for next 5 years i.e. up to June 30, 2028.

1.7.6 Kaiga Generating Station (KGS) - 1 to 4

KGS-1 to 4 operated safely in the year 2023.

KGS-3&4 underwent Limited Scope Safety Review (LSSR) as a pre-requisite for renewal of its operating licence beyond April 30, 2023 under 'The Atomic Energy Act, 1962 (and rules framed there under)'. Station had also submitted application for renewal of licence for operation under The Factories Act, 1948 (and rules framed there under) and authorization for radioactive waste disposal/transfer under the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 (GSR-125).

These applications were reviewed by AERB following multi-tier review process. Review assessment indicated that the performance of KGS-3&4 with respect to nuclear, radiological and industrial safety had been satisfactory. Radioactive effluent discharges were well below the limits specified in technical specifications for operation. Effective dose to a member of public residing at exclusion zone had been well within the limit prescribed by AERB. Station had implemented all short & medium-term safety upgrades identified based on review of Fukushima NPP accident. Implementation of long term safety upgrades are in progress. Based on satisfactory review, AERB renewed the licenses for next 5 years i.e. up to April 30, 2028.

1.7.7 Kudankulam Nuclear Power Plant -1&2

KKNPP-1&2 operated safely in the year 2023.

1.8 Status of Implementation of Safety Enhancements at Operating NPPs

The safety enhancements identified for Indian NPPs subsequent to the accident at Fukushima Daiichi NPPs were classified as short term, medium term and long term. Implementation of the short term and medium term safety enhancements have been completed. The long-term enhancements include enhancing severe accident management programme, strengthening hydrogen management provisions, provision of Containment Filtered Venting Systems (CFVS) and creation of On-Site Emergency Support Centre (OESC). The required R&D efforts, analyses, detailed engineering and testing/qualification, for these systems have been completed, and their on-site implementation is now in progress. The present status of long-term safety upgrades/ measures is as follows:

1.8.1 Accident Management Programme

The Accident Management Guidelines for different NPP designs (PHWR, BWR & PWR) were developed based on technical bases reviewed and accepted by AERB. These guidelines have been established at all the operating NPPs, including implementation of the necessary hardware enhancements, training of the operating personnel, mock-ups and periodic surveillance.

1.8.2 Strengthening Hydrogen Management Provisions

The hydrogen management provision in Indian PHWRs includes installation of Passive Catalytic Recombiner Devices (PCRDs) along with provisions for homogenizing the containment atmosphere and maintenance of the inert steam atmosphere. Installation of PCRDs have been completed at all stations. Remaining activities are in progress.

1.8.3 Provision of Containment Filtered Venting System (CFVS)

Technology development of CFVS has been completed and detailed engineering of the system has been finalized after analysis and testing. CFVS has been installed in TAPS-1&2 (BWR). Installation of CFVS at other operating NPPs where the requirement has been envisaged, is in progress.

1.8.4 On-Site Emergency Support Centre (OESC)

On-site Emergency Support Centre (OESC) is being set up at all the NPP sites. AERB has framed requirements and guidelines for establishing OESCs at all NPPs, which takes into account the NPPs at the given site and the accident scenarios. After AERB's review and permission, construction of OESC at TAPS, KAPS, MAPS, KGS and RAPS sites is in progress.

1.9 Fast Breeder Test Reactor (FBTR), IGCAR

FBTR underwent Periodic Safety Review (PSR) as a pre-requisite for renewal of its operating licence beyond June 30, 2023 under The Atomic Energy Act, 1962 (and rules framed there under). FBTR had also submitted application for renewal of authorization for radioactive waste disposal/ transfer under the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 (GSR-125). These applications were reviewed by AERB following multi-tier review process. Review assessment indicated that the performance of FBTR with respect to nuclear, radiological and industrial safety had been satisfactory. Radioactive effluent discharges remained well below the limits specified in technical specifications for operation. Effective dose to a member of public residing at exclusion zone had been well within the limit prescribed by AERB. FBTR has implemented all short & medium-term safety upgrades identified based on review of Fukushima NPP accident and actions are in progress for implementation of remaining upgrades. Based on the assessment of station applications, AERB renewed the licenses for next 5 years i.e. up to June 30, 2028.

Based on satisfactory review, AERB granted permission for commencement of 32nd irradiation campaign of FBTR with its design power level of 40 MWth. The irradiation campaign was completed in September, 2023.

1.10 KAMINI Reactor, IGCAR

During the year, KAMINI reactor was operated as per the user requirements.

1.11 Licensing of Operating Staff at NPPs and RRs

Operating personnel of NPPs namely Shift Charge Engineer (SCE), Assistant Shift Charge Engineer (ASCE) and Control Engineer (CE) are required to go through a rigorous licensing/relicensing process.

During the year 2023, total 26 meetings were held for licensing/re-licensing of operating personnel responsible for operations at various operating NPPs. A total of 187 candidates were licensed / relicensed. In addition to the above, 5 personnel for FBTR operation were also licensed / re-licensed. Details of manpower licensing of operating NPPs are given in Table 1.6.

Table 1.6: Licensing of Operating Staff

Plants	No. of Persons Licensed					Licensing Committee Meetings
	SCE	ASCE	ASCE (F)	CE	CE (F)	
TAPS-1&2	-	1	-	1	-	1
TAPS 3&4	7	9	1	8	3	3
RAPS-1&2	1	5	5	-	1	2
RAPS-3&4	6	6	2	9	-	3
RAPS-5&6	4	6	5	6	1	4
MAPS-1&2	8	4	2	7	-	2
NAPS-1&2	5	5	1	10	4	2
KAPS-1&2	2	2	2	6	4	2
KGS-1&2	1	4	3	-	-	2
KGS-3&4	2	4	-	2	1	2
KKNPP-1&2	5	4	-	12	-	3
Total	**41**	**50**	**21**	**61**	**14**	**26**

1.12 Nuclear Fuel Cycle Facilities and Industrial Facilities

The nuclear fuel cycle facilities and other related industrial facilities of DAE under the regulatory control of AERB are mines and ore processing plants of Uranium Corporation of India Ltd. (UCIL), mineral separation plants and chemical processing plants of Indian Rare Earths Limited (IREL), Nuclear Fuel Complex (NFC), Zirconium Complex (ZC), Heavy Water Board Facilities (HWBF) / Heavy Water Plants (HWP), Electronic Corporation of Indian Ltd. (ECIL) and some of the facilities of Indira Gandhi Centre for Atomic Research (IGCAR). In addition to this, Beach Sand Minerals (BSM) and other facilities handling Naturally Occurring Radioactive Materials (NORM) are also regulated by AERB with respect to radiological safety aspects. The list of fuel cycle facilities is given in Table 1.7.

Table 1.7: Status of Nuclear Fuel Cycle Facilities and other Industrial Facilities

Type of Facility	Name	Functional Status	District/ State	Scope of the Facility	Validity of Current License
Facilities Operated by UCIL					
Mines	Narwapahar Mine	In operation	Singhbhum (E) / Jharkhand	Underground Uranium Mine	March 31, 2028
	Turamdih Mine	In operation	Singhbhum (E) / Jharkhand	Underground Uranium Mine	December 31, 2028
	Bagjata Mine	In operation	Singhbhum (E) / Jharkhand	Underground Uranium Mine	June 30, 2025
	Mohuldih Mine	In operation	Singhbhum (E) / Jharkhand	Underground Uranium Mine	October 31, 2024
	Jaduguda Mine	Shutdown	Singhbhum (E) / Jharkhand	Underground Uranium Mine	January 31, 2028
	Bhatin Mine	Shutdown	Singhbhum (E) / Jharkhand	Underground Uranium Mine	April 30, 2028
	Banduhurang Mine	In operation	Singhbhum (E) / Jharkhand	Opencast Uranium Mine	June 30, 2026
	Tummalapalle Mine	In operation	Y.S.R. Kadapa (Dist) / Andhra Pradesh	Underground Uranium Mine	February 29, 2028
Mills	Jaduguda Mill	In operation	Singhbhum (E) / Jharkhand	Uranium Ore Processing	December 31, 2025
	Turamdih Mill	In operation	Singhbhum (E) / Jharkhand	Uranium Ore Processing	February 28, 2026
	Tummalapalle Mill	In operation	Y.S.R. Kadapa (Dist) / Andhra Pradesh	Uranium Ore Processing	June 30, 2027
Facilities Operated by IREL (India) Ltd.					
Mines	Chavara	In operation	Kollam (Dist) / Kerala	Mineral Separation	August 31, 2024

Type of Facility	Name	Functional Status	District/ State	Scope of the Facility	Validity of Current License
	Manavalakurichi	In operation	Kanyakumari (Dist) / Tamilnadu	Mineral Separation	August 31, 2024
	OSCOM Chatrapur	In operation	Ganjam (Dist) / Odisha	Mineral Separation	August 31, 2024
Ore Processing Facilities	OSCOM, Chatrapur	In operation	Ganjam (Dist) / Odisha	Monazite Processing	April 30, 2025
Others	Udyogamandal	In operation	Ernakulam (Dist) / Kerala	Rare Earths Compounds and Uranium Production	November 30, 2028
Facilities Operated by ECIL					
Electronics Manufacturing	Electronics Corporation of India Limited (ECIL), Hyderabad	In operation	Telangana	Electronics Manufacturing	June 30, 2025
	ECIL, Tirupathi	In operation	Andhra Pradesh	Electronics Manufacturing	October 31, 2026
Facilities Operated by NFC					
Nuclear Fuel Fabrication Facilities	NFC Hyderabad	In operation	Hyderabad / Telangana	Fuel Fabrication	August 31, 2027
	Zirconium Complex, Pazhayakayal	In operation	Tuticorin / Tamil Nadu	Reactor Grade Zirconium Sponge Production	June 30, 2026

Type of Facility	Name	Functional Status	District/ State	Scope of the Facility	Validity of Current License
Facilities Operated by HWB					
Heavy Water Plants	HWP-Kota, Rawatbhatha	In operation	Rawatbhata/ Chittorgarh Dist/ Rajasthan	Heavy Water Production	December 31, 2025
	HWP-Manuguru	In operation	Telangana State	Heavy Water Production Other diversified Activities viz. Production of Enriched Boric Acid, Elemental Boron, Boron Carbide Pellets and O-18 Enriched Water	June 30, 2025
	HWBF-Vadodara	Heavy Water Production Suspended Solvent & K & Na Metal Plant are in operation	Baroda / Gujarat	Tributyl Phosphate, Potassium & Sodium Metal Production	May 31, 2026
	HWP-Hazira	In operation	Hazira / Surat / Gujarat	Heavy Water Production	July 31, 2028
	HWP-Thal	In operation	Raigad / Maharashtra	Heavy Water Production	December 31, 2024
	HWP-Tuticorin	Heavy Water Production Suspended. Diversified Activities Like Solvent Production Plant in operation	Tuticorin / Tamil Nadu	Production of Solvents: TiAP, DHOA, D2EHPA-II	July 31, 2025

Type of Facility	Name	Functional Status	District/ State	Scope of the Facility	Validity of Current License
	HWBF-Talcher	Heavy Water Production Suspended. Diversified Activities Like Solvent Production Plant in operation	Talcher / Angul Dist. / Odisha	Production of Solvents: TBP, ^{10}B Enriched Boron, D2EHPA, TOPO, TAPO, DNPPA and other Products viz. ^{10}B Enriched Boron, Boric Acid	August 31, 2025
	HWBF-Mumbai (formally known as TDP-Chembur)	Main Plant Operation is Shut down (However, different Systems are being operated in Closed Loop for Developmental Activities)	Mumbai/ Maharashtra	Crude Sodium Di-Uranate Production	October 31, 2026

Number of meetings conducted by various safety committees for fuel cycle facilities and other industrial facilities during this period is given Table 1.8.

Table 1.8: Meeting of Safety Review Committee of Fuel Cycle Facilities

Name of the Committee	No. of meetings
NFSC-1 (UCIL-AMD Safety Committee and BSM-NORM Safety Committee)	6
NFSC-2 (NFC Safety Committee and ECIL Safety Committee)	4
NFSC-3 (HWP Safety Committee)	3
Industrial and Fire Safety Committee (I & FSC)	2
Occupational Health Safety Committee (OHSC)	1

1.12.1 Uranium Mines and Mills of UCIL

During the year, the licence for operation issued under 'The Atomic Energy Act, 1962 (and rules framed there under) & authorization for radioactive waste disposal / transfer under GSR-125 of Jaduguda mine, Tummalapalle mine, Narwapahar mine, Bhatin mine and Turamdih mine were due for renewal. The applications submitted by UCIL for renewal of the licenses / authorizations were reviewed in AERB following multi-tier review process. Safety assessment indicated that operational & radiological status of these mines was satisfactory. The average individual doses to the mine workers were well within the regulatory limit. Radioactive waste discharged/transferred from these mines remained within AERB authorized limits. The average radon concentration and gamma dose rate were within the permissible limit. Based on satisfactory review, AERB renewed the licence with respect to radiation safety for Narwapahar mine, Turamdih mine, Jaduguda mine, Bhatin mine and Tummalapalle mine for next five years.

1.12.2 Beach Sand Mines & Mills of IREL (India) Ltd.

Rare Earth Division (RED) of IREL (India) Ltd., Udyogamandal and Mineral Separation Plants (MSP) of IREL (India) Ltd at Chavara, Manavalakurichi and Chatrapur operated safely during the year. Monazite up-gradation plants at IREL (India) Ltd, Orissa Sand Complex (OSCOM), Manavalakurichi and Chavara were operational.

Application submitted by IREL for renewal of these license / authorization were reviewed in AERB following multi-tier review approach. Review indicated that during the license period, performance of the IREL facilities with respect to radiological and industrial safety had been satisfactory. Facility operated within the licensed capacity without any major operational problems. Radioactive effluent discharges from facilities were well within the technical specification / authorized limits. Environmental monitoring has not indicated any adverse impact of the facility operation on the environment. Based on satisfactory review, AERB renewed the license for operation & authorization for disposal / transfer of radioactive waste of IREL, Udyogamandal for next five years i.e. up to November 30, 2028.

1.12.3 Nuclear Fuel Complex (NFC) & Zirconium Complex (ZC)

All the plants of NFC, Hyderabad and ZC, Pazhayakayal operated safely during the year.
Consent for Siting & Construction of Magnesium Recycling Technology Development & Demonstration Facility (MRTDDF) at Zirconium Complex (ZC), Pazhayakayal was valid up to March 31, 2023. ZC submitted application for extension of validity of Consent for Siting & Construction of MRTDDF due to delay in tendering process. Based on satisfactory review, AERB extended the validity of consent for siting & construction of MRTDDF up to March 31, 2026.

1.12.4 Heavy Water Board Facilities (HWBF)

Heavy water plants at Kota, Manuguru, Thal and Hazira were operational. Heavy water production plant at Talcher was dismantled. Dismantling of heavy water production plant at Vadodara is under progress. Heavy water production facility at Tuticorin has been declared as 'CLOSED'. Diversifed activities at HWBF-Vadodara, HWBF-Talcher and HWP-Tuticorin were operational. Technology Demonstration Plant (TDP), Chembur is under shutdown due to non-availability of phosphoric acid from fertilizer plant. However, trial operation for developmental activities were

carried out as and when required. During the year following License applications were reviewed:

a) Renewal of Licence for Operation of HWP-Hazira

Application submitted for renewal of license for operation was reviewed in AERB following multi-tier review process. Safety review indicated that during the existing Licence period, the performance of the facility had been satisfactory. Based on the satisfactory review, AERB renewed the Licence for operation of HWP-Hazira for a period of five years i.e. up to July 31, 2028.

b) Extension of Validity of Existing License for Operation of HWP- Tuticorin

HWP-Tuticorin submitted application for extending validity of exisiting License for operation of HWP-Tuticorin (main plant & Versatile Solvent Synthesis Plant (VSSP)) for a period of two years i.e. up to July 31, 2025 in view of some more time required for revamping of the main plant. Based on satisfactory review, AERB extended the validity of existing license for operation of main plant and VSSP at HWP-Tuticorin for a period of two years i.e. up to July 31, 2025.

c) Consent for Commissioning of Solvent Production Plant (SPP) at HWP-Tuticorin

HWB is in process to set-up an industrial scale plant namely Solvent Production Plant (SPP) in the existing premises of HWP-Tuticorin for production of solvent viz. Tri Butyl Phosphate (TBP), Mono Ester of 2-Ethyl Hexyl Phosphoric Acid (D2EHPA-II), Tri Octyl Phosphine Oxide (TOPO), Tri iso Amyl Phosphate (TiAP) and Di Hexyl Octanamide (DHOA). After completion of construction & installation of all major equipment, HWP-Tuticorin has submitted application for commissioning of SPP. This application was reviewed in AERB following multi-tier review process. Based on review, AERB granted consent for commissioning of SPP for production of solvent TBP, D2EHPA-II & TOPO.

d) Consent for Siting & Construction Of Versatile Deuterated Compounds Production Plant at HWBF-Vadodra

HWBF-Vadodra submitted the application for siting & construction of Versatile Deuterated Compounds Production Plant. This application was reviewed in AERB following multi-tier review process. Based on the satisfactory review, AERB granted consent for siting & construction of Versatile Deuterated Compounds Production Plant.

1.12.5 Licensing of Operating Staff at Heavy Water Plants

During the year 2023, total 5 meetings were held for licensing/re-licensing of operating personnel

Table 1.9: Licensed Operating Staff of HWP

Plants	No. of Persons Licensed	Licensing Committee Meetings
HWP (Kota)	5	1
HWP (Manuguru)	10	2
HWP (Thal)	4	1
HWP (Hazira)	9	1

responsible for operations at various operating heavy water plants. A total of 28 candidates were licensed / relicensed. Details of manpower licensing of operating heavy water plants are given in Table 1.9.

1.12.6 Electronics Corporation of India Limited

ECIL facilities at Hyderabad and Tirupati operated safely during the year.

1.12.7 IGCAR Facilities

a) Demonstration Fast Reactor Fuel Reprocessing Plant (DFRP), IGCAR

AERB had earlier granted permission for cold commissioning with Uranium (U) for DFRP. After completion of cold commissioning, DFRP submitted application for carrying out limited hot runs with Plutonium (Pu) to AERB. The application was reviewed in AERB and DFRP was asked to submit additional supporting documents for further review. Currently these submissions are under review in AERB. Meanwhile, on request of IGCAR, AERB permitted DFRP to continue with Uranium run using Natural Uranium pins.

b) CORAL (Compact Reprocessing of Advanced Fuels in Lead cells), IGCAR

CORAL operated safely during the year as per the requirements.

CORAL submitted applications for renewal of license for operation and authorization for safe disposal / transfer of radioactive waste to AERB. These applications were reviewed in AERB following multi-tier review approach. Based on satisfactory review, AERB renewed the license for operation and authorization for safe disposal / transfer of radioactive waste of CORAL for five years i.e. up to August 31, 2028.

c) Radio Metallurgical Laboratory (RML), IGCAR

RML operated safely during the year as per the requirements

IGCAR applications for renewal of license for operation of Radio-Metallurgy Laboratory (RML) under 'The Atomic Energy Act, 1962 (and rules framed thereunder) and authorization for safe disposal / transfer of radioactive wastes under GSR 125 to AERB. The applications were reviewed in AERB following multitier review approach. Based on satisfactory review, AERB renewed the license for operation and authorization for safe disposal / transfer of radioactive wastes of RML, IGCAR for next five years i.e. up to December 31, 2028.

d) Radio Chemistry Laboratory (RCL), IGCAR

RCL operated safely during the year as per the requirements

IGCAR submitted applications for renewal of license for operation of Radio Chemistry Laboratory (RCL), under 'The Atomic Energy Act, 1962 (and rules framed thereunder) and authorization for safe disposal / transfer of radioactive wastes under GSR-125 to AERB. These applications were reviewed in AERB following multitier review approach. Based on satisfactory review, AERB renewed the license for operation and authorization for safe disposal / transfer of radioactive wastes of RCL, IGCAR for next five years i.e. up to December 31, 2028.

1.12.8 Private Beach Sand Minerals (BSM) & Naturally Occurring Radioactive Materials (NORM) Facilities

Presently, with the amendment of Atomic Minerals Concession Rules, 2016, only Central Government or its units are vested with the rights to mine beach sand minerals and the mining leases of all existing private companies have been prematurely terminated by Ministry of Mines. AERB has also not renewed the licence for operation of mineral separation plants by private entities under Atomic Energy (Radiation Protection) Rules, 2004. However, in view of stockpiled monazite enriched tailings in few of these facilities, AERB has been approving the designation of Radiological Safety Officer (RSO) in these facilities so as to ensure the radiation surveillance of the plant premises. Periodic radiological reports submitted by the Beach Sand Mines (BSM) facilities were reviewed and no abnormality was observed by AERB.

1.13 Significant Events

AERB requires NPPs to report certain events that occur in the plant which have or may have impact on operational safety. Under the reporting system established by AERB, the events reportable to AERB are divided into two categories, termed as,

(a) Events (b) Significant Events

This categorization of events is done based on their safety significance and importance to operational safety experience feedback. Based on established reporting criteria, Event Reports (ER) and Significant Event Reports (SER) are submitted to AERB. The SERs received from operating NPPs are rated on the International Nuclear and Radiological Event Scale (INES) of International Atomic Energy Agency (IAEA). The INES rates events at seven levels (1 to 7) depending on their safety significance as shown in figure-1.1 below.

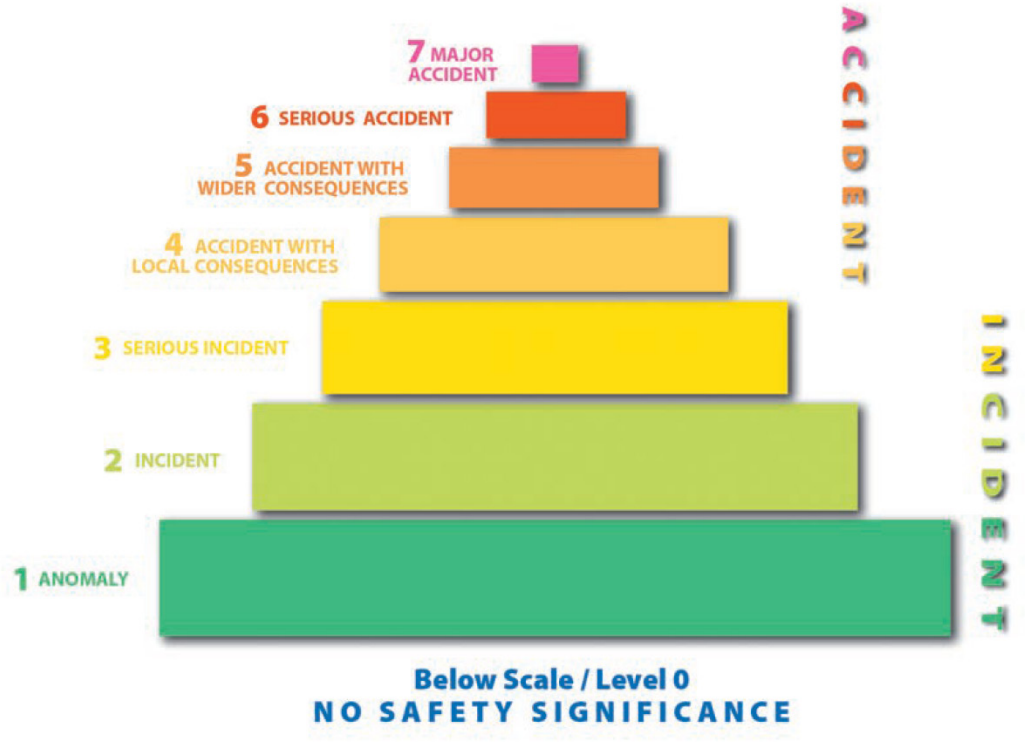


Figure-1.1: International Nuclear & Radiological Event Scale

Events rated at level 4 and above are termed as 'Accidents'. Events rated at levels 1, 2 and 3 are called 'Incidents'. The level 0 or below scale means events that have no nuclear and radiological safety significance.

1.13.1 Significant Events in NPPs under Commissioning

During the year 2023, one significant event was reported from KAPP-3 during Phase-C commissioning. While KAPP-3 reactor was in hot shutdown state, Secondary Shutdown Sytem (SDS-2) actuated due to control power supply disturbance. On investigation it was found that moisture ingress from the leaked steam led to failure of power supplies and resulted in SDS-2 actuation. On investigation steam leak was found from Steam Generator-4 main feed water line strainer due to improper venting of trapped air during system maintenance.

The event was reviewed in detail by AERB and plant was recommended to enhance the sensitization of O&M personnel towards procedure adherence to prevent reoccurrence of such event. The event was rated at 'Level 0' on INES.

1.13.2 Significant Events in NPPs under Operation

During the year 2023, a total of 21 significant events were reported from operating NPPs. Out of these 21 events one significant event at MAPS-1&2 was related to industrial safety and hence it was not rated on INES. Out of the remaining 20 events, 19 events were rated at 'Level 0' on INES, while one event at KKNPP-1 was assigned provisional rating of Level-1 on INES.

Leak from a QBIS Tank Vent Line Connection in KKNPP-1

On August 20, 2023, when KKNPP-1 was operating at full power, a disturbance in feed water flow occurred causing steam generator level low. Low levels in steam generator resulted in tripping of three primary circulating pumps as per logic. Reactor tripped on 'more than 2 primary circulating pumps unavailable' trip parameter. Subsequently, remaining fourth primary circulating pump also tripped on SG low level. Reactor was brought to hot shut down state. Core cooling was ensured through natural circulation. The cause of loss of feed water flow to SGs was attributed to a malfunction of controller of feed pump.

During hot leak search conducted after reactor trip, minor leak was observed from weld joint of liquid poison injection tank vent line connection to pressurizer spray header nozzle. A crack of 3 mm length was observed at 2-3 O'clock position. The crack had occurred in an area which was not protected by thermal shield. Other poison tank vent line connection to the nozzle on pressurizer spray header were found normal and no deterioration was observed. The root cause analysis of the cracking in nozzle based on metallographic analysis is under progress.

The number of SERs in operating NPPs along with their ratings on INES are given in Table-1.10.

Table 1.10: Number of Significant Events in Operating NPPs reported in Year 2023

Operating NPPs	INES Rating of Events	
	INES-0	INES-1
TAPS-1 & 2	0	0
TAPS-3 & 4	2	0
RAPS-1 & 2	3	0
RAPS-3 & 4	2	0

Operating NPPs	INES Rating of Events	
	INES-0	INES-1
RAPS-5 & 6	0	0
MAPS-1 & 2	2	0
NAPS-1 & 2*	3	0
KAPS-1 & 2	3	0
KGS-1 & 2	3	0
KGS- 3 & 4	0	0
KKNPP-1 & 2*	1	1
Total	19	1

* One event each at KKNPP-1 and NAPS-1 are assigned provisional INES rating of Level 1 and 0 respectively since these are under review.

For the purpose of analysis, the events reported in year 2023 were categorized as per the IAEA-IRS coding system. The classification of systems failed / affected during the significant events is given in Figure-1.2. The classification of direct causes and root causes of the significant events are given in Figure-1.3 & 1.4 respectively.

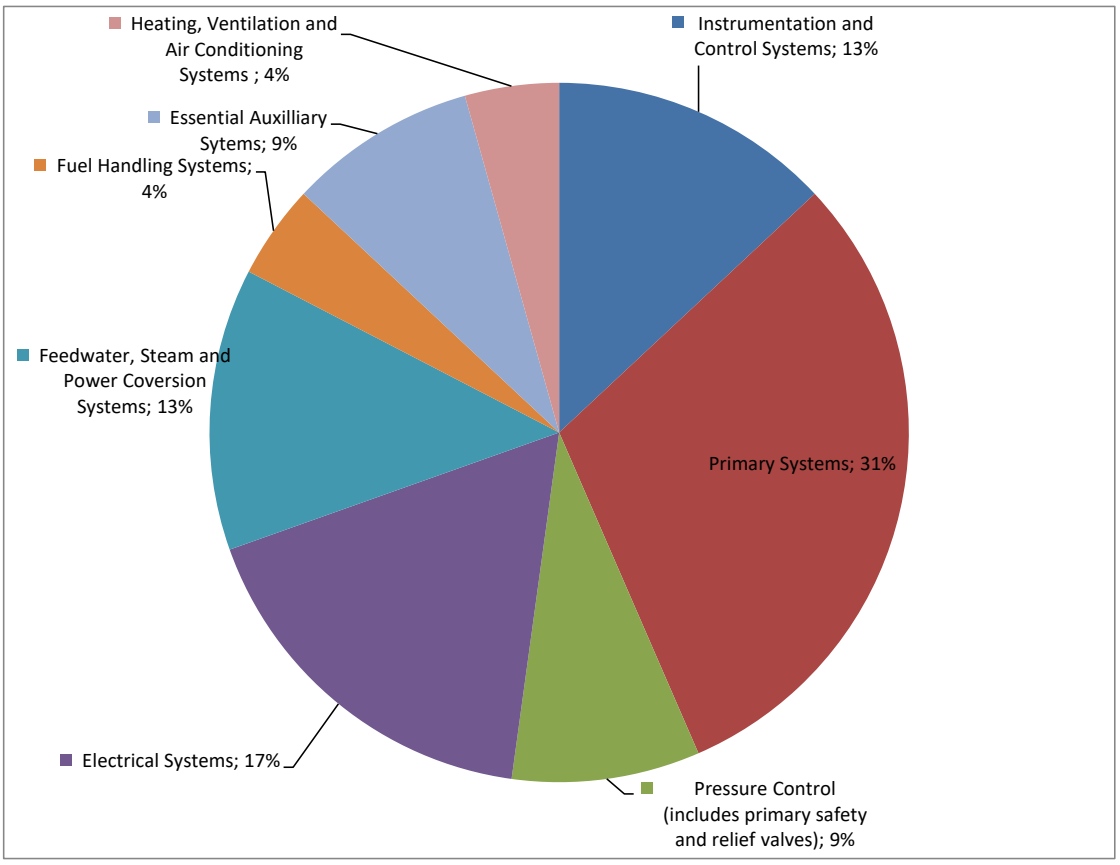


Figure-1.2: Classification of Failed/Affected System of SERs

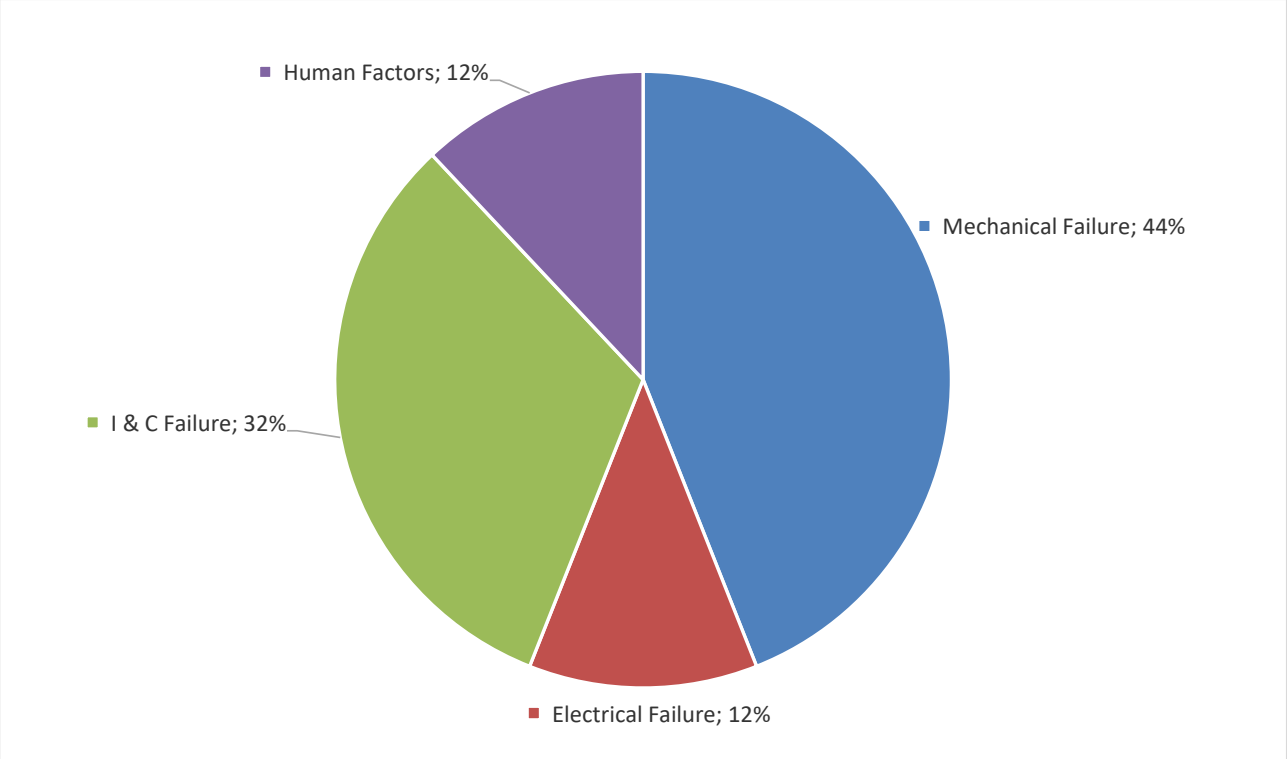


Figure-1.3: Classification of Direct Causes of SERs

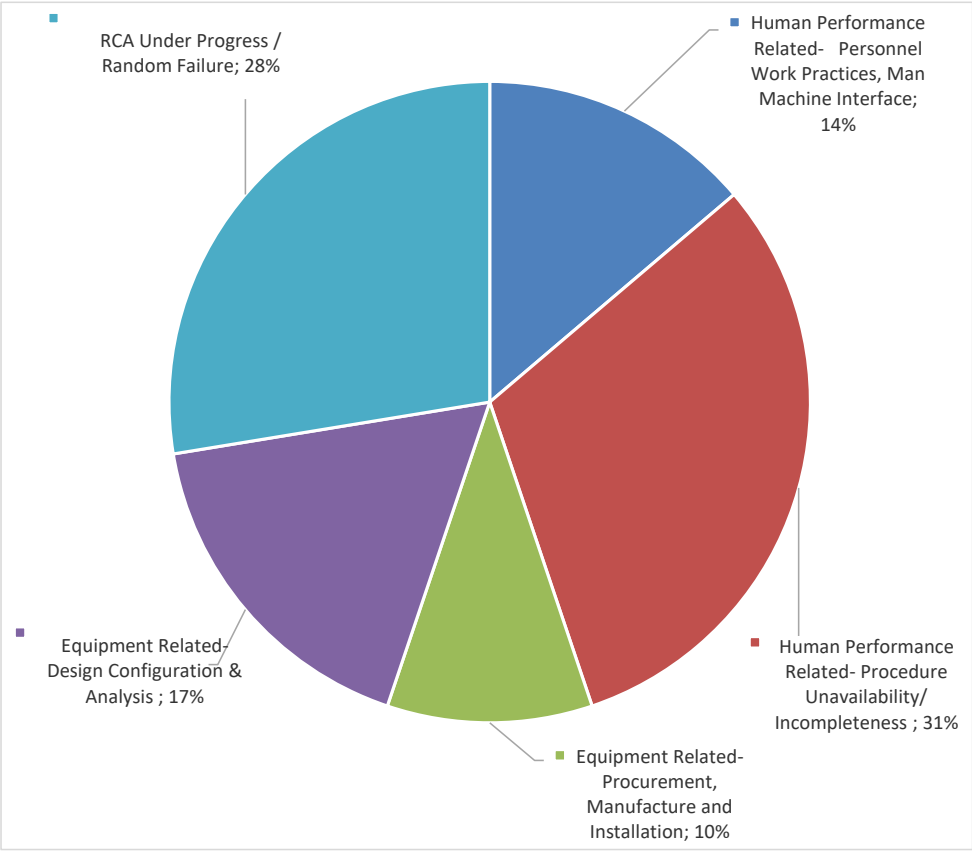


Figure-1.4: Classification of Root Causes of SERs

1.14 Occupational Injury Statistics of DAE Units

Occupational Injury Statistics for the year 2022 for DAE units (other than BARC facilities, AMD and mines of IREL & UCIL) was analysed. During the year 2022, there were 30 reportable injuries and 2 fatal injuries incurring a loss of 14,622 man-days. In Year 2022, Frequency Rate (FR), Severity Rate (SR), Injury Index (II) & Incidence Rate (IR) were 0.19, 94.67, 0.018 & 0.50 respectively. There was no notifiable disease reported during the period from any of the operating units of DAE.

Details are presented in table and Year-wise Frequency Rate (FR), Severity Rate (SR), Injury Index (II) and Incidence Rate (IR) in DAE Units are shown in Figure 1.5, 1.6, 1.7 and 1.8 respectively.

Table 1.11: Unit wise Comparison of Reportable Occupational Injuries in DAE Units for the Year 2022

Unit	C1 No. of Lost Time (Reportable) Injury	C2 No. of Man-days Lost	C3 No. of Fatal Injury	C4 No. of Employees	C5 No. of Man-hours Worked	C6 Frequency Rate $\frac{(C1 \times 10^6)}{C5}$	C7 Severity Rate $\frac{(C2 \times 10^6)}{C5}$	C8 Injury Index $\frac{(C6 \times C7)}{1000}$	C9 Incidence Rate $\frac{(C1 \times 10^3)}{C4}$
NP Plants	2	6015	1	15955	37285708	0.05	161.32	0.009	0.13
NP Projects	7	1382	0	19189	57897150	0.12	22.71	0.003	0.36
HWB	6	482	0	4208	10838867	0.55	44.47	0.025	1.43
IREL	0	0	0	563	1358340	0.00	0.00	0.000	0.00
NFC & ZC	5	521	0	6250	16983647	0.29	30.68	0.009	0.80
UCIL	6	6160	1	2831	5783032	1.04	1065.19	1.105	2.12
ECIL	1	35	0	4548	10808328	0.09	3.24	0.000	0.22
IGCAR	1	10	0	3369	6978714	0.14	1.43	0.000	0.30
BRIT	0	0	0	958	1024080	0.00	0.00	0.000	0.00
VECC	1	6	0	1047	2080000	0.48	2.88	0.001	0.95
RRCAT	1	11	0	1673	3408688	0.29	3.23	0.001	0.60

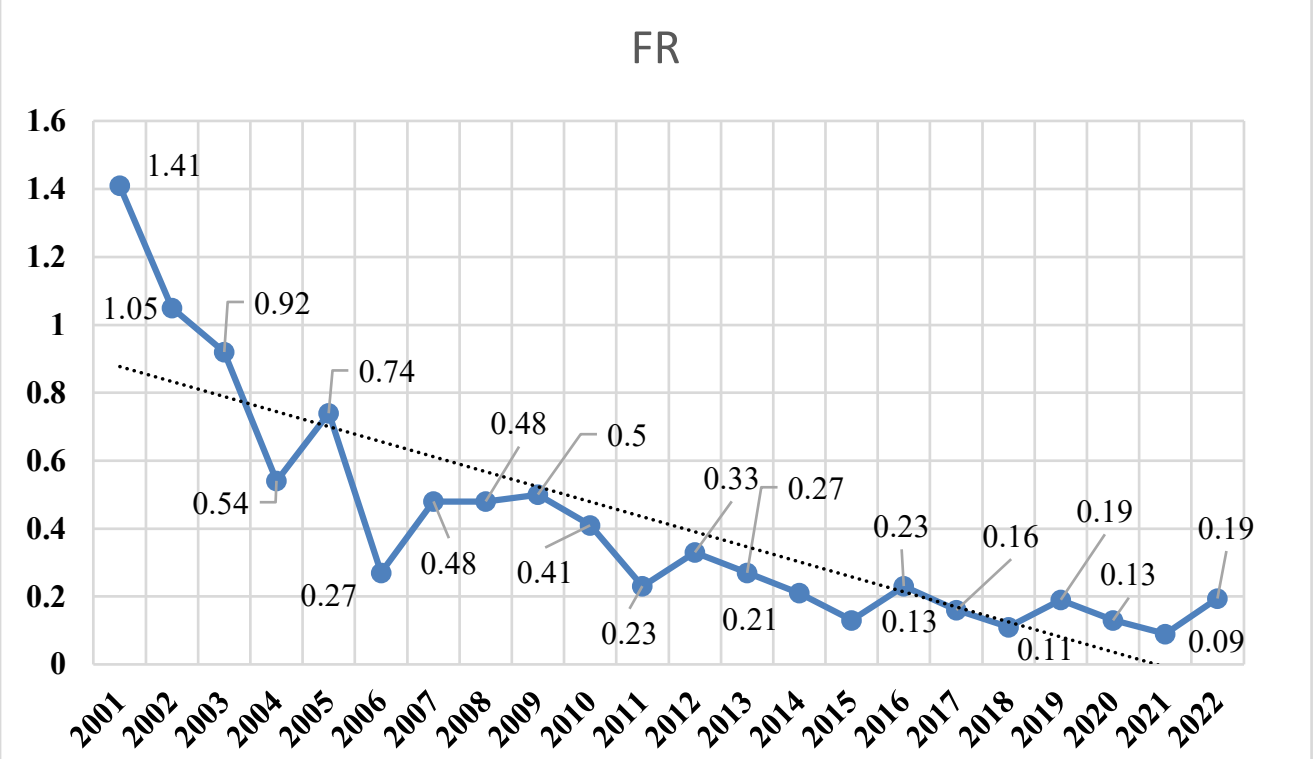


Figure 1.5: Year Wise Comparison of Frequency Rate along with its trend

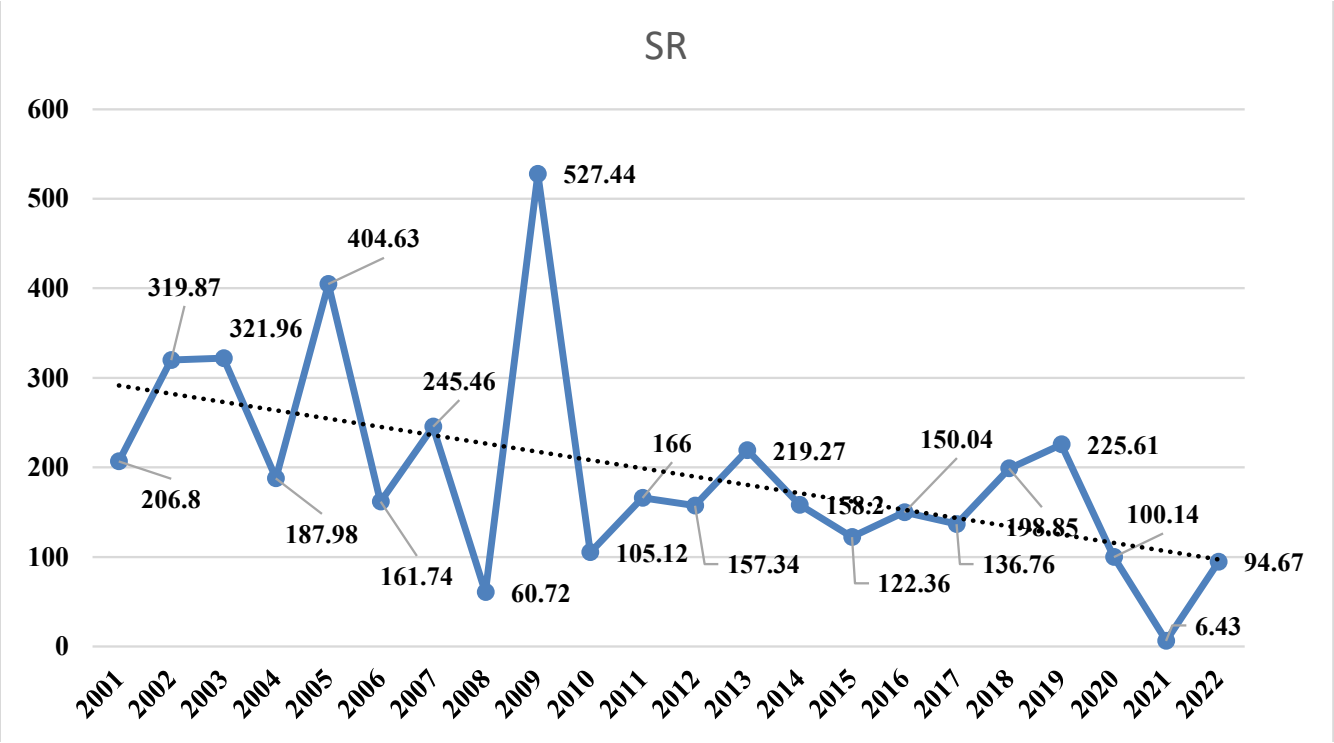


Figure 1.6: Year Wise Comparison of Severity Rate along with its trend

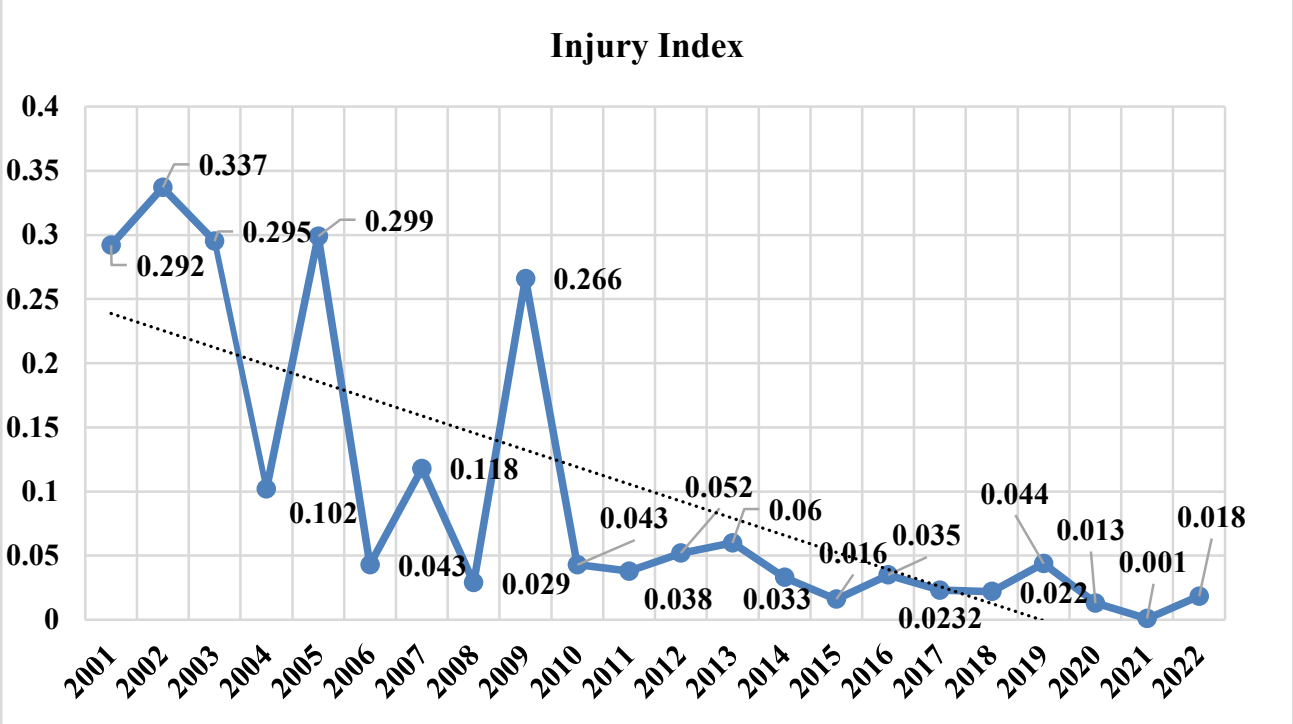


Figure 1.7: Year Wise Comparison of Injury Index along with its trend

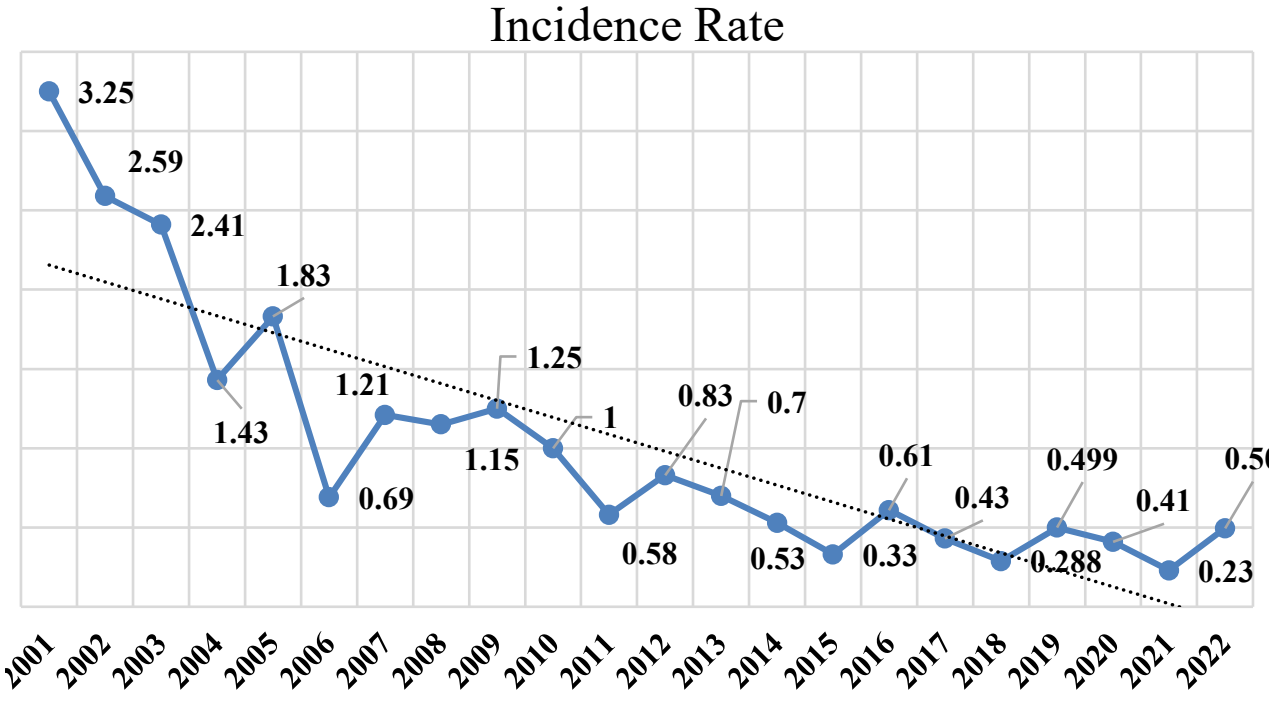


Figure 1.8: Year Wise Comparison of Incidence Rate along with its trend

1.15 Safety Performance Indicators of Operating Nuclear Power Plants (NPPs)

AERB monitors safety performance of operating NPPs on annual basis under five safety performance areas namely Nuclear Safety, Radiation Safety, Public & Environment Safety, Emergency Preparedness & Response and Regulatory Compliance. The performance is categorized as very good, good, satisfactory and scope of improvement based on assesment. The results of safety performance for the year 2023 are as follows:

Sr. no.	Safety Performance Area	PHWRs																BWRs		LWRs	
		RAPS-1&2		MAPS-1&2		KAPS-1&2		NAPS-1&2		KGS-1&2		RAPS-3&4		KGS-3&4		RAPS-5&6		TAPS-3&4		TAPS-1&2		KKNPP-1&2	
		U-1	U-2	U-1	U-2	U-1	U-2	U-1	U-2	U-1	U-2	U-3	U-4	U-3	U-4	U-5	U-6	U-3	U-4	U-1	U-2	U-1	U-2
1	Nuclear Safety	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Radiation Safety	●		●		●		●		●		●		●		●		●		●		●	
3	Public & Environment Safety	●		●		●		●		●		●		●		●		●		●		●	
4	Emergency Preparedness & Response	●		●		●		●		●		●		●		●		●		●		●	
5	Regulatory Compliance	●		●		●		●		●		●		●		●		●		●		●	

SPI Rating		Colour Code
Scope for Improvement	सुधार की गुंजाइश	
Satisfactory	संतोषजनक	
Good	अच्छा	
Very Good	बहुत अच्छा	

Safety Performance Assessment of Operating NPPs for the Year 2023