
An institute, be it a laboratory or an
academy, has to be grown with
great care like a tree...

HEALTH Safety

Establishing fool-proof standards in Radiation Protections & Regulatory Aspects

स्वास्थ्य संरक्षा: विकिरण सुरक्षा एवं विनियामक पक्षों में प्रमाणित मानकों का निर्धारण

Hazard Categorisation for Nuclear and Radiological Facilities: Hazard categorisation of nuclear, radiological and chemical facilities is essential for regulatory clearance and civil structure design. It is based on the radioactive inventory and radiological consequences of an unmitigated release resulting from structural failure. It determines the building class from radiological and chemical safety perspectives and guides emergency response planning. Hazard categorisation of upcoming BARC facilities has been carried out.

Indigenous Radon Trend Analyser: BhaRaT-Rn (Bhabha Radon Technology - Radon Trend Analyser) is a low-cost, indigenous, continuous radon monitoring system developed in BARC as an import substitute. Its silicon photomultiplier (SiPM)-based design is compact, low-power and portable, eliminates the conventional high-voltage photomultiplier tube and enables unattended monitoring. Applications include occupational radon monitoring in NORM industries, uranium mines, phosphate industries and thorium processing plants, as well as monitoring in homes, workplaces, indoor and underground environments. It is also suitable for continuous soil-gas radon monitoring for earthquake precursory research. The technology is available for transfer from BARC.

Criticality Safety Evaluation: Criticality Safety Evaluation (CSE) demonstrates that facility designs and operating conditions maintain controlled parameters within the subcritical range. Evaluations cover normal operation, anticipated operational occurrences and design-basis accidents, establishing that fissionable material systems and processes remain subcritical under normal and credible abnormal conditions. CSEs of BARC facilities have been carried out as per the requirements.



Bhabha Radon Technology - Radon Trend Analyser.



Mobile Radiological Assessment Laboratory.

Radiological Impact Assessment: Radiological Impact Assessment (RIA) evaluates and predicts radiation doses to human health and the environment from routine operations and accidental releases at radioactive facilities. RIAs of selected BARC facilities were carried out during the reporting period, as required.

Implementation of the Indian Registry of Occupational Dose: The Indian Registry of Occupational Dose (IROD), an in-house web application for registering and managing occupational radiation dose records, has been successfully implemented. Hosted on ANUNET, it is accessible to all connected DAE sites. The system provides a secure, centrally monitored platform with advanced features, reduced hardware requirements and lower operational costs, while accommodating future expansion and increasing workloads in the nuclear sector.

Deployment of Mobile Radiological Assessment Laboratories: BARC developed vehicle-based Mobile Radiological Assessment Laboratories (MRALs) to strengthen DAE Radiation Emergency Response Centres. MRALs were handed over to NPCIL for deployment at nuclear power plant sites to support emergency response and routine radiological mapping, sampling and surveillance.



ERMSAT installed in Mizoram.

For CBRN preparedness during major public events, an MRAL was deployed at the Red Fort, New Delhi, for Independence Day celebrations and during the BRICS Summit in New Delhi from September 9-14, 2026.

MRAL development was recognised as an "Area of Good Performance by India" at the IAEA's 10th Review Meeting of the Contracting Parties to the Convention on Nuclear Safety, held in Vienna from April 13-24, 2026. The technology was also highlighted in India's National Report under the Convention for its role in supporting protective-action decisions during nuclear and radiological emergencies.

Computational Assessment of Ac-225 Production using a Medical Cyclotron: A computational study assessed the feasibility of producing ^{225}Ac through the ^{226}Ra(p,2n)^{225} Ac reaction using a sealed ^{226}Ra target in a medical cyclotron. FLUKA simulations evaluated target integrity, radiation safety and radiochemical feasibility before handling ^{226}Ra. Silver and barium were used as surrogate target materials before evaluating a ^{226}Ra-loaded target for production yield, isotopic purity and radiation fields.

For a 16.5 MeV proton beam at 35 μA, simulations indicated a favourable energy window for the desired reaction. A 1.5 μm ^{226}Ra layer with an initial activity of 38-39 MBq was estimated to yield approximately 1.98 MBq of ^{225}Ac at end of bombardment. The study provides a computational basis for optimising irradiation, shielding, handling and post-irradiation processing, supporting potential ^{225}Ac production using hospital-based medical cyclotrons.

LET-Dependent Response of Unlaminated Gafchromic EBT3 Film for Proton Dosimetry: A study characterised and corrected the linear energy transfer (LET)-dependent response of unlaminated Gafchromic EBT3 film for proton dosimetry. Unlike its near-water-equivalent response in photon beams, the film exhibits quenching in proton beams, causing dose under-response in high-LET regions. Pristine spot-scanning proton beams at 70.8, 100 and 150 MeV were used to derive an LET-quenching correction factor linear in dose-weighted LET (LETd).

Applying the LETd correction improved agreement between film-measured and treatment-planning system (TPS)-calculated doses. Before correction, dose differences ranged from -8.26% to 1.19%, with approximately 8.3% under-response at the distal edge. After correction, the range narrowed to -1.75% to 1.41%, demonstrating improved EBT3 film dosimetry accuracy in clinical proton beams.

Strengthening of IERMON Network: The Indian Environmental Radiation Monitoring Network (IERMON) was strengthened by installing Environmental Radiation Monitors with Satellite Communication (ERM-SAT) at additional locations, expanding coverage across states and Union Territories. IERMON currently operates more than 600 environmental radiation monitors across 170 cities to detect increases in background gamma radiation



Display of BARC Safety Council Publications Corner at Central Library.

caused by transboundary radioactive migration or radiological and nuclear emergencies.

BARC Membership of the Consultative Committee for Ionizing Radiation: BARC became a member of the Consultative Committee for Ionizing Radiation (CCRI) on March 30, 2026. As India's Designated Institution for ionizing radiation metrology, BARC qualified for full membership through its technical activities across CCRI's three sections viz., Radiation Dosimetry, Radionuclide Measurements and Neutron Measurements. The International Committee for Weights and Measures (CIPM) accepted its membership request.

The membership enables BARC to participate in CCRI activities, advise the CIPM on scientific matters pertaining to ionizing radiation metrology, contribute to work involving the Ionizing Radiation Department at the BIPM, and support globally recognised national measurement standards, methods and facilities.

Environmental Radiological Surveillance: Radiological surveillance activities continued at BARC facilities at Trombay and Visakhapatnam, and NPP sites in the interest of occupational workers, general public and the environment. Annual doses to general public were evaluated and found to be well below regulatory limits. Pre-operational environmental surveillance at upcoming NPP sites, including GHAVP, Mahi Banswara and Chutka, continued to establish baseline data.



Display of Posters at Central Complex Auditorium during National Safety Day 2026 event celebration.

Environmental thermoluminescent dosimeters (TLDs) were used across nuclear facilities nationwide to measure cumulative external gamma radiation. Nationwide soil measurements of naturally occurring radioactive materials (NORMs) were also conducted to estimate the terrestrial contribution to public radiation doses.

BARC Safety Council: The BARC Safety Council (BSC) continued its 26-year regulatory oversight of BARC facilities in Mumbai and elsewhere, strengthening safety culture and continuous improvement. During the reporting period, BSC issued 102 regulatory clearances covering siting, construction, equipment erection, commissioning and operation. It granted 20 authorisations and 14 special authorisations for radioactive waste transfer and disposal; approved the procurement or use of 248 radiation sources and three radiological laboratories; issued 37 radioactive material shipment approvals; and approved 76 Radiological Safety Officers for BARC and defence facilities.

BSC safety committees held 221 meetings, and regulatory inspections covered 96 facilities and projects. Observers participated in emergency exercises at 48 facilities to improve radiation and fire emergency preparedness. Industrial hygiene surveys, safety investigations and accident-prevention activities continued. An online colour-changing filter-paper swipe technique for beryllium detection was developed and successfully used during surveillance of beryllia reflector-block cutting.

BSC published two safety guides, *Safety in Laser Facilities* and *Cyber Security of I&C Systems and Physical Protection Systems,* and launched the biannual e-magazine 'Safety Sentinel' to enhance safety awareness.

Training programmes covered crane and forklift operation, safety and regulatory measures for BARC facilities, accelerator safety, laser safety and beryllium safety at various BARC locations. A safety training course was also conducted for Heavy Water Division staff at Rawatbhata. The programmes received wide participation and positive feedback.