India's Nuclear Regulatory Framework

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Contents of the lecture

- Regulatory requirements in setting up the nuclear fuel cycle facility
- Regulatory consenting process
- Relevant stages requiring consent
- Nature of submissions at each stage
- Extent of safety review by AERB
- Methods of review and assessment adopted by AERB
CATEGORISATION OF NUCLEAR FUEL CYCLE ACILITIES

• Uranium/Thorium mining and processing including uranium enrichment
• Heavy minerals mining and processing
• Uranium/Thorium fuel fabrication
• Heavy water production
• Nuclear Power Plant/Research Reactors
• Spent fuel reprocessing
• Plutonium recycling/fuel fabrication
• Zirconium, Beryllium extraction and processing
• Nuclear/chemical waste management
• Isotope handling/processing
Radiation in Medicine, Industry and Research

Regulation of Facilities in the Application of Radiation in Medicine, Industry and Research. AERB is mandated to cover following radiation facilities:

- Diagnostic Medical X-ray installations
- Radiation Therapy installations
- Nuclear Medicine Laboratories
- Research
- Industrial Radiography Installations
- Gamma Irradiation Plants (15)
- Nucleonic Gauges
- Consumer Products
REGULATORY CONSENTING PROCESS

Consents in the form of Authorisation or Licence at various major stages of establishment of the facility

- Siting
- Construction
- Commissioning
- Operation
- Decommissioning

Consents subject to the facility’s location, design and operation fulfilling the safety objectives and requirements as specified in the relevant Rules, Codes and Guides and stipulated by AERB
Statutory Provisions for Regulatory Consents

- Statutory bases for issuing consents are enabling provisions in the Atomic Energy Act 1962 & various Rules issued there under
- Radiation Protection Rules 2004 provide for the issuance of a licence by AERB for handling of radioactive substances
- Atomic Energy (Safe Disposal of Radioactive Wastes) Rules 1987 provide for disposal of radioactive wastes or transfer of radioactive wastes to an approved waste management agency
- Atomic Energy (Factories) Rules 1996, issued for administering the provisions of the Factories Act 1948 in the nuclear facilities
- Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules 1984 to prescribe procedures for maintenance of radiation exposures and medical records of the workers and to approve emergency plans & industrial safety aspects
- Consents from other statutory agencies such as MOEF and, the Central and State Pollution Control Boards may also be required
Consent for Siting

Consent at the siting stage, involves review of the safety aspects based on the conceptual design (or actual design, if available) of the facility and the site characteristics that have to be considered for the location of the facility at the specified site.

Applicant to submit a Site Evaluation Report (SER) that should include:

- Salient features of the proposed site
- Site Characteristics affecting safety
- Impact of the facility with its environment
Siting Considerations

In evaluating the suitability of a site for locating a nuclear power plant, the following major aspects are considered:

• Effect of external events (nature and man induced) on the plant
• Effect of plant on environment and population and
• Implementation of emergency procedures in the public domain
CONTENTS OF SITE EVALUATION REPORT (SER)

Site Evaluation Report should cover all items under the following broad categories:

• Salient features of the proposed site
• Site characteristics affecting safety
• General description of plant covering basic design features
• Nuclear security- Impact of site and surroundings on nuclear security to be brought out.
• Interactions of the facility with its environment
Topics to be covered in SER

Geography, Demography and Topography

• Site and its location with the aid of maps
• Land use: Data on food/milk production
• Dietary habits in the area
• Existing/future industrial & public facilities in the neighbourhood
• Roads, railways, waterways, transport of dangerous goods, chemical plants, military installations, gas pipelines, airports, archaeological monuments and places of pilgrimage
• Current and forecast of permanent population in the surrounding area should be tabulated as a function of distance and direction
• Transient and seasonal population
• Access to the site, ease of evacuation of personnel or members of the public
Topics to be covered in SER

Meteorology

• Meteorological conditions having an influence on the consequences of normal and accidental releases of radioactive/hazardous materials should be discussed.

• Frequency of occurrence and possible consequences of extreme meteorological conditions such as cyclones and heavy precipitation should be discussed.

• Information should include:
  — distribution of wind velocity and direction
  — atmospheric stability conditions
  — Annual/monthly average data on
    ✓ temperature
    ✓ humidity
    ✓ rainfall
Topics to be covered in SER

Hydrology

• Information on quantity and quality, about the water at and around the site
• Sources of cooling water and their availability
• Potable and service water supplies
• Ground water movement
• River or lake current, dispersion conditions
• Natural phenomena such as tidal effects, floods coastal cyclones and tsunami
• Contamination potential in normal operation and accident conditions
Topics to be covered in SER

Geology

• Information should be provided on the geological formation of the site and its surrounding area and the effect it may have on the design of the foundations and structures.

• This information should include investigation of surface faulting, stability of sub-surface materials, and stability slopes and embankments. Such features as geological anomalies and underground workings should be identified.
Topics to be covered in SER

Seismicity

• Information concerning the seismicity of the site and its surrounding area and the method followed for establishing the design basis vibratory ground motions should be discussed and the data given

• This information should include a description of the behaviour of the ground during tremors in the past, a seismic history of the area, an indication and evaluation of the active faults within a significant radius, and data on the seismotectonics of the site
Topics to be covered in SER

Radiological and Chemical Impact

All necessary ecological data from the site and its surrounding area that are important for assessment of the radiological/environmental impact of the nuclear facility, such as biological systems and critical pathways.

In case such data still needs to be generated, program for the generation of the same may be given. In the mean time, conservative assumptions/approaches could be used with respect to the radiological impact.

A description should be given of the organisation and conduct of an environmental monitoring program to establish base line data on radioactivity levels.
Consent for Construction

• Consent at construction stage involves review of the safety aspects as presented in the Safety Analysis Report (SAR) for the facility submitted by the applicant. Typical format and content of Safety Analysis Report for reprocessing and waste management plants are given in AERB guides.

• Applicant should also submit Job Hazard Analysis Report identifying the jobs for which job hazard analysis has been done during construction.

• Emergency Preparedness
FORMAT AND CONTENT OF SAFETY ANALYSIS REPORT

FOR ANY FUEL CYCLE FACILITY

- Introduction and General Description of the Plant
- Summary of Safety Analysis
- Site Characteristics
- Principal Design Criteria
- Facility Design
- Reactor System
- Safety Protection Systems
- Classification of Structures, Components and Systems
- Waste Management
- Radiation Protection
- Decommissioning
INDUSTRIAL AND FIRE SAFETY

SAFETY ANALYSIS

– Impact from Normal Operations
– Impact from Abnormal Events
– Accidents
– Risk assessment

CONDUCT OF OPERATIONS

• QUALITY ASSURANCE
Consent for Commissioning

Consent at commissioning stage may be issued in several interim stages for major facilities like NPPs or FRPs.

AERB Safety Guide SG/0-4 covers all aspects of commissioning procedures for PHWR s. Following are the interim stages at which regulatory reviews are required.

- Hot conditioning of the primary heat transport system
- Fuel loading of the reactor core
- Heavy water addition to moderator system
- First approach to criticality and low power physics experiments
- Initial power raising and synchronization with grid up to 50% of full power (F.P)
- Power operation typically at 50%, 75%, 90% and 100% F.P. or at power levels stipulated by AERB based on review of performance.
Consent for Commissioning

Technical Specifications for Operation

• Operational limits and conditions for safe operation of the facility
• Prevention of situations which might lead to an accident condition
• Should an accident situation occur, mitigation of consequences
• Operational limits & conditions should comprise of the following:
  ✓ Safety limits
  ✓ Safety system settings
  ✓ Limiting conditions for operation and
  ✓ Surveillance requirements, in-service inspection, maintenance and periodic testing
• Governing bases for each of the technical specification
• Minimum trained operational staff requirements
• Procedures to report of tech-specs violation and safety related unusual occurrences to AERB
Consent for Operation

• Consent for operation may initially be restricted to operation of the facility to process only a limited quantity of the feed material and / or for a limited period in order to gain operating experience or for test production of the end product to verify the quality and grade.

This permits the plant to

• rectify the deficiencies
• repair equipment
• eliminate leakages from systems

Limited Consent with pending implementation of Recommendations; no compromise on the safety of the plant, its personnel and the environment.
Consent for Operation

On establishing satisfactory and safe operation of the entire plant as per design intent, the plant will be issued with consent for regular operation and production at rated capacity.

For this plant should submit

• Detailed reports on the commissioning tests
• Final Safety Analysis Report (FSAR) reflecting the as-built design approved by AERB
Consent for Operation

Authorization for operation of a plant is issued by AERB for a specified period. During this period, the operational nuclear power plant is continuously under regulatory review in which the following elements are covered:

1. Review of periodic reports submitted by the plant as per reporting criteria specified in the authorization for operation.
2. Review of off-normal occurrences of safety significance.
3. Radiological safety status.
4. Periodic regulatory inspections.
5. Review of proposals for modification in hardware, control logics, plant configuration & procedures related to safety and safety related system.
6. Reports of special Investigation Committees and/or special regulatory inspections following an event of major safety significance.
Three Tier Safety Review System in AERB

SEC : Site Evaluation Committee
PDSC : Project Design Safety Committee
PSRC : Project Safety Review Committee
USC  : Unit Safety Review Committee
ACPSR : Advisory Committee for Project Safety Review
SARCOP : Safety review Committee for Operating Plants
AERB Review Process

• For relatively less hazardous facility two tier review may be adopted
• USC gets inputs also from PORC
• SARCOP gets inputs also from Regulatory Inspection Reports
• All the committees may appoint WGs for special topics / tasks
• ACPSRs are composed of experts not only from DAE and AERB but also from other governmental agencies and reputed academic institutions
AERB has published number of safety documents like codes, guides, standards and manuals that provide regulatory guidance to the plant authorities.
AERB SAFETY GUIDE

AERB/NF/SG/G-2

CONSENTING PROCESS FOR NUCLEAR FUEL CYCLE FACILITIES AND RELATED INDUSTRIAL FACILITIES OTHER THAN NUCLEAR POWER PLANTS AND RESEARCH REACTORS

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ATOMIC ENERGY REGULATORY BOARD
Some of the Challenges to the Regulator

- Ageing management and safety upgradations of old NPPs to meet current safety standards have engaged the attention of AERB in recent past.

- Consequent actions have resulted in incorporation of major safety upgrades and design retrofits in some of the old plants. For the other old plants, required actions have been identified and are being implemented as per an agreed time schedule between AERB and NPCIL.

- Review of different designs: BWR, PHWR of different designs, Fast Reactors, AHWRs, VVER, French EPR, US-LWRs
AERB : Interaction with R&D institutions and international co-operation

- In order to ensure that best technical inputs are available for its safety review functions, AERB maintains close interactions with R&D institutions like BARC, IGCAR, IITs, National Laboratories and extensively utilizes the high level of expertise available in these premier institutions of the country.

- AERB also has strong participation in NPP related international co-operative activities like the Incident Reporting System, INES-Based Reporting and CANDU Senior Regulators’ Meetings of the International Atomic Energy Agency. Co-operative agreements between AERB and the regulatory bodies of France, Russia and USA.
New Regulatory Authority

For some time there has been criticism that AERB does not have the kind of independent status that exists in the advanced countries like USA, U.K. etc. The demand for an independent regulator became louder after the accident at Fukushima. Government introduced recently a Bill in the parliament seeking an autonomous status for the nuclear regulatory function. The Bill seeks to dissolve the AERB and replace it with the Nuclear Safety Regulatory Authority (NSRA). The NSRA shall regulate nuclear safety and activities related to nuclear material and facilities. The government can exempt facilities from NSRA’s jurisdiction if they relate to national defence and security.
New Regulatory Authority

The Bill also establishes the Council of Nuclear Safety to review policies on nuclear safety. The Council shall consist of the Prime Minister as its Chairperson and six Cabinet Ministers, Cabinet Secretary, Chairman of the Atomic Energy Commission, and eminent experts nominated by the central government. It will oversee NSRA’s policies on nuclear safety.
New Regulatory Authority

- The Chairperson and members to the NSRA would be selected by the Search committees constituted by the Council. The Search Committees would consist of eminent persons in the field of science, engineering and technology as its Chairperson and members.

- The NSRA shall consist of a Chairperson, two whole-time members and a maximum of four part-time members. Appointment to the position of a Chairperson requires a minimum experience of 25 years, and a member requires a minimum experience of 20 years in the government, or national laboratories in the field of nuclear science, safety radiation therapy and medicine, environmental science or engineering.

- The Chairperson and members of the NSRA shall hold office for a term of three years and shall be eligible for appointment for another term.
New Regulatory Authority

- The NSRA is empowered to take measures to ensure that the use of nuclear energy is safe for workers, public and the environment. It may undertake to devise and implement policies for nuclear safety advise the central government on nuclear safety and preparedness in emergencies.

- The written consent of the NSRA is required for carrying out activities such as production, storage, disposal, transport, export, import etc of nuclear material or equipment for production or use of nuclear material.

- The Bill penalises all violations with imprisonment for up to five years.
Thank you