EFFORTS TO IMPLEMENT INTEGRATED MANAGEMENT SYSTEMS FOR SAFE AND EFFECTIVE USE OF BAEC TRIGA RESEARCH REACTOR

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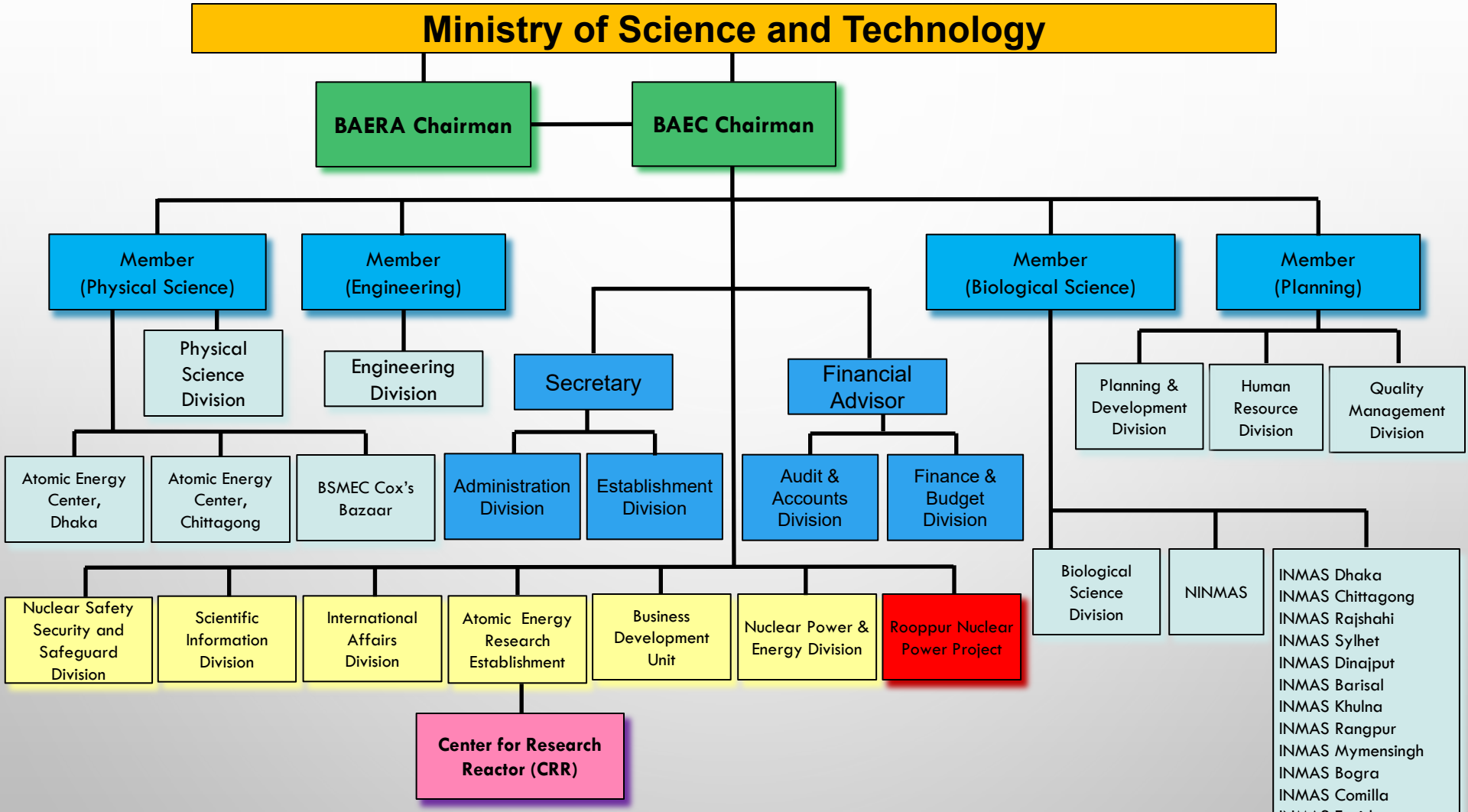
PRESENTATION OUTLINE

- BAEC ORGANIZATION
- OVERVIEW OF BTRR
- MANAGEMENT SYSTEM OF BTRR
  - *SAFETY MANAGEMENT
  - *RESOURCE MANAGEMENT
  - *EMERGENCY MANAGEMENT
  - *AGEING MANAGEMENT
- MANAGEMENT SYSTEM REVIEW
- GOOD PRACTICES
- REGULATORY SUPERVISION
- ASSESSMENT OF IMPROVEMENT
- FUTURE PLAN FOR IMS
- CONCLUSIONS

ORGANIZATION: BAEC

ORGANOGRAM

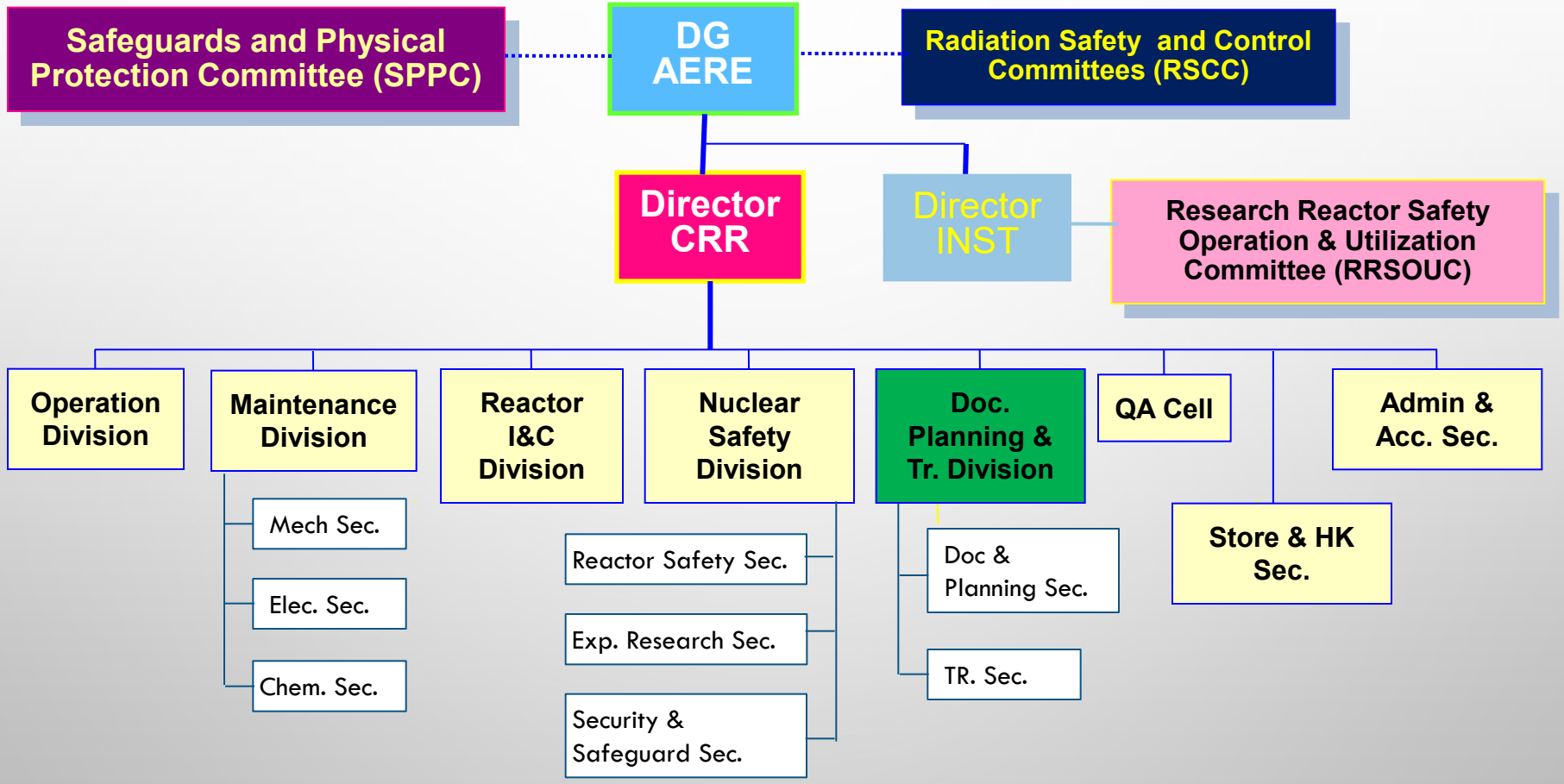


BSMEC-Beach Sand Minerals Exploitation Center
NINMAS-National Institute of Nuclear Medicine and Allied Sciences
INAMS-Institute of Nuclear Medicine and Allied Sciences

The administrative channel of Atomic Energy Research Establishment (AERE) is directly linked to the Chairman, BAEC and the channels for R&D activities of AERE are linked to the respective Member of BAEC.

ORGANIZATION STRUCTURE OF CENTER FOR RESEARCH REACTOR (CRR)

Organization Structure Changed on 12 January, 2015



AERE : Atomic Energy Research Establishment
INST : Institute of Nuclear Science & Technology

Overview of BTRR

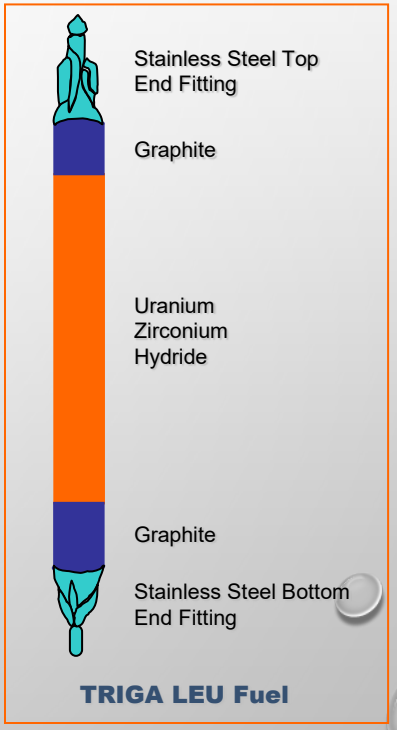
- REACTOR TYPE: TRIGA MARK-II
- THERMAL POWER: 3 MW
- THERMAL FLUX: 7.46×10^{13} N/CM^{2}S
- FIRST CRITICALITY: 14 SEPT 1986
- UPGRADING OF THE COOLING SYSTEMS: 2001 & 2023
- UPDATING OF SAR AS PER IAEA GUIDE (SG-35-G1): 2021
- COMMISSIONING OF THE DIGITAL CONTROL SYSTEM: 2024

Overview of BTRR

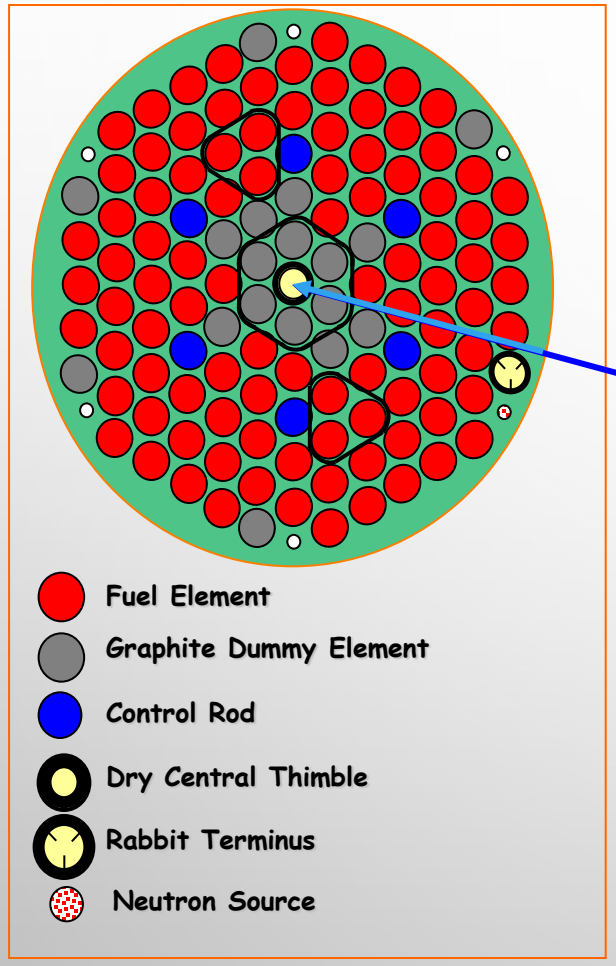
Fuel element cooling : **Natural convection (≤ 500 kW)**
Forced convection (> up to 3000 kW)

Fuel-moderator Material : **Uranium = 20.00 wt%**
ZrH1.6 = 79.53 wt%
Er-167 = 00.47 wt%

Prompt -ve temp. coefficient : **1.07×10^{-4} $\Delta k/k/^0C$**



Overview of BTRR



Reactor core configuration

- **Fuel Elements** : 100 Nos. (**93 STD +2 IFE+ 5 FFCR**)*
- Graphite Element : 18 Nos.
- Dry central Thimble: 1 No.
- Rabbit Terminus : 1 No.
- Neutron Source : 1 No.
- Control Rod : 6 Nos.
- Fission Chamber : 3 Nos.
- Gamma Chamber : 1 No.

*** STD: Standard; IFE : Instrumented Fuel Element; FFCR: Fuel Follower Control Rod**

Overview of BTRR

Old Console

New Digital Console

Overview of BTRR

Safety Systems in BTRR:

BAEC TRIGA reactor is equipped with a number of passive as well as engineered safety systems.

Passive safety systems

1. **PROMPT NEGATIVE TEMPERATURE COEFFICIENT OF REACTIVITY OF THE FUEL ELEMENT.**
2. **HIGH FISSION PRODUCT RETENTION IN THE FUEL MATRIX.**
3. **NO METAL-WATER REACTION.**
4. **HIGH FUEL CLAD STRENGTH.**
5. **HIGH TEMP. (~1150 °C) WITHSTANDING CAPABILITY OF FUEL ELEMENT.**
6. **ANTI-SIPHON LINE IN THE COOLING PIPE.**

Overview of BTRR

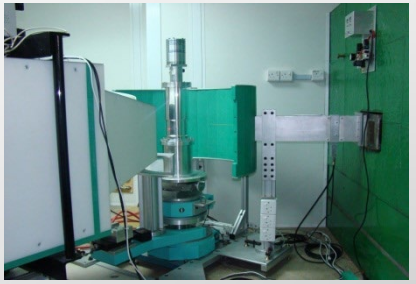
Engineered safety systems

- **AUTOMATIC REACTOR SCRAM SYSTEM** WHICH PROVIDES SHUTDOWN OF THE REACTOR UNDER VARIOUS ABNORMAL CONDITIONS.
- **EMERGENCY CORE COOLING SYSTEM (ECCS)** WHICH LIMITS FUEL MELTING IN THE EVENT OF LOSS OF COOLANT ACCIDENT (LOCA).
- **EMERGENCY PURGING SYSTEM** WHICH REMOVES POST ACCIDENT RADIOACTIVITY FROM THE REACTOR HALL.

Areas of Utilization

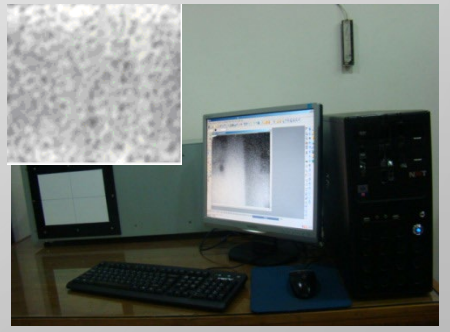
- Experimental Reactor Safety Analysis
- Neutron Activation Analysis (NAA)
- Neutron Scattering (NS)
- Neutron Radiography (NR)
- Radioisotope Production
- Training
- Education

NAA Facility



NS Facility (NPD)

I-131 Production Facility



NR Facility

From Quality Control to IMS

Quality control

QC is the set of operational techniques and activities that are used to fulfill the requirements of quality.

Product oriented : Expected results

Quality assurance

QA is the set of the planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

(quality control, appropriate equipment, trained and skilled staff, documented and validated procedures, non-conformance management, internal audits, statistical analysis, ….)

Process oriented : Quality Assurance makes sure you are doing the right things, the right way

Quality Management System (QMS)

1) Management policies, strategies and responsibilities should be clearly defined for development, implementation and monitoring of a QA programme.

2) The quality assurance programme should provide an **interdisciplinary approach** involving all of the organizational components (organizational structure, functional responsibility levels of authority and interfaces)

3) **Improvement**

Integrated Management System (IMS) :

An Integrated Management System is a **QMS including also other aspects (environment, health, safety).**

For a **Nuclear Facility** this typically means incorporate **all the safety requirements** in a whole Management System **(i.e. safely operation of the reactor ; reactor maintenance; safety aspects of the experiments)**

MANAGEMENT SYSTEM OF BTRR

MANAGEMENT LEVELS OF CRR

- LEVEL 1: DIRECTOR, CRR (REACTOR MANAGER)
- LEVEL 2: REACTOR SHIFT SUPERVISORS (RSS)
- LEVEL 3: H.O.D. OF DIVISIONS/SECTIONS AND OPERATING PERSONNEL

The facility is under the control of the director, or in his absence, reactor shift supervisor (RSS).

Safety Management System of BTRR

The committee responsible for safety management:

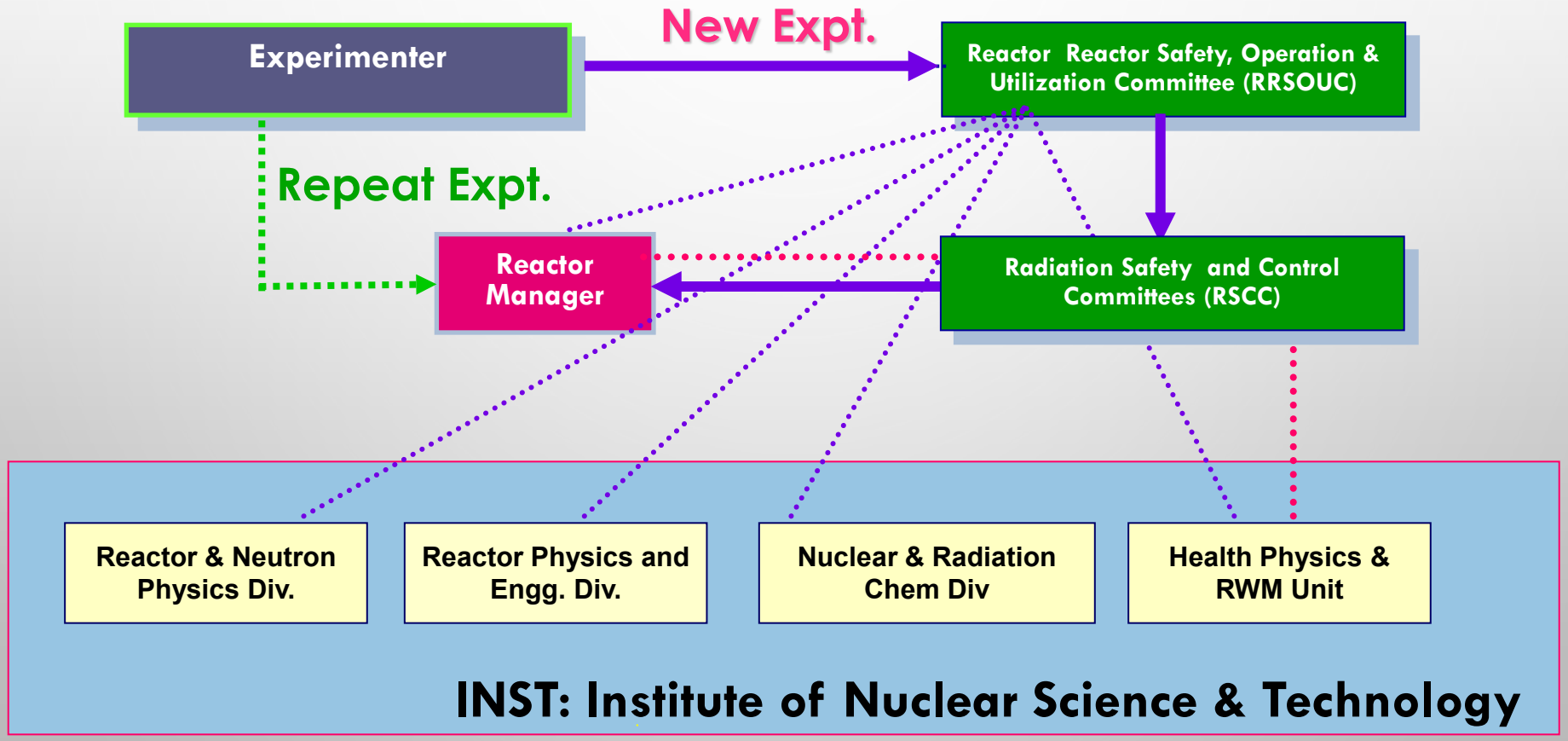
- Research Reactor Safety, Operation and Utilization Committee (RRSOUC)
- Safeguards and Physical Protection Committee of AERE (SPPC-AERE)
- AERE Radiation Safety & Control Committee (AERE-RSCC)

Previously, RROUC used to look into the safety issues related to operation and utilization of RR and RSCC used to look into the radiation control related issues of RR as well as other Radiation Facilities.

- Now there is one exclusive safety committee for RR to review and recommend on all the issues of RR.
- The committee is now independent of Reactor Manager.
- Experts from various fields have been included in the committee.

SAFETY MANAGEMENT SYSTEM OF BTRR

Experiment approval process:



Management Systems of BTRR

RESOURCES MANAGEMENT (HUMAN RESOURCES)

Total manpower of CRR

Engineers and Scientists Technologists (RSS, SRO, RO, TRO)	9
Technical and Scientific staff	13
Administration and others	6

Total:28

The same personnel are responsible for operation as well as the maintenance activities of the reactor facility.

Management Systems of BTRR

RESOURCES MANAGEMENT (HUMAN RESOURCES)

Training of Reactor Operating Personnel

- The training program for reactor operating personnel is administered and coordinated by the Reactor Manager.
- The program open to those personnel who are:
  - Engineers/scientists of at least B.Sc. Engineering/M.Sc. Level.
  - B.Sc./Diploma Engineers with a minimum of 5 years of working experience at the reactor facility.
- Duration of the training program for new reactor operators is 9 months.

Management Systems of BTRR

RESOURCES MANAGEMENT (HUMAN RESOURCES)

RO/SRO License Examination:

The trainee RO/SRO need to appear three levels of examinations-

- Written examination
- Console practical and oral
- Walk through reactor facility

The final examination conducted by the Regulatory Authority.

Management Systems of BTRR

RESOURCES MANAGEMENT (INFRASTRUCTURE)

- The CRR, BAEC and the relevant ministry determine, provide and maintain the necessary infrastructure of the reactor facility;
- Different modification and modernization activities were performed under several annual development project (ADP) funded by Bangladesh government;
- The government has strong commitment for providing the necessary fund for reactor facility, associated programs and regulatory infrastructure development.

Management Systems of BTRR

RESOURCES MANAGEMENT (INFRASTRUCTURE)

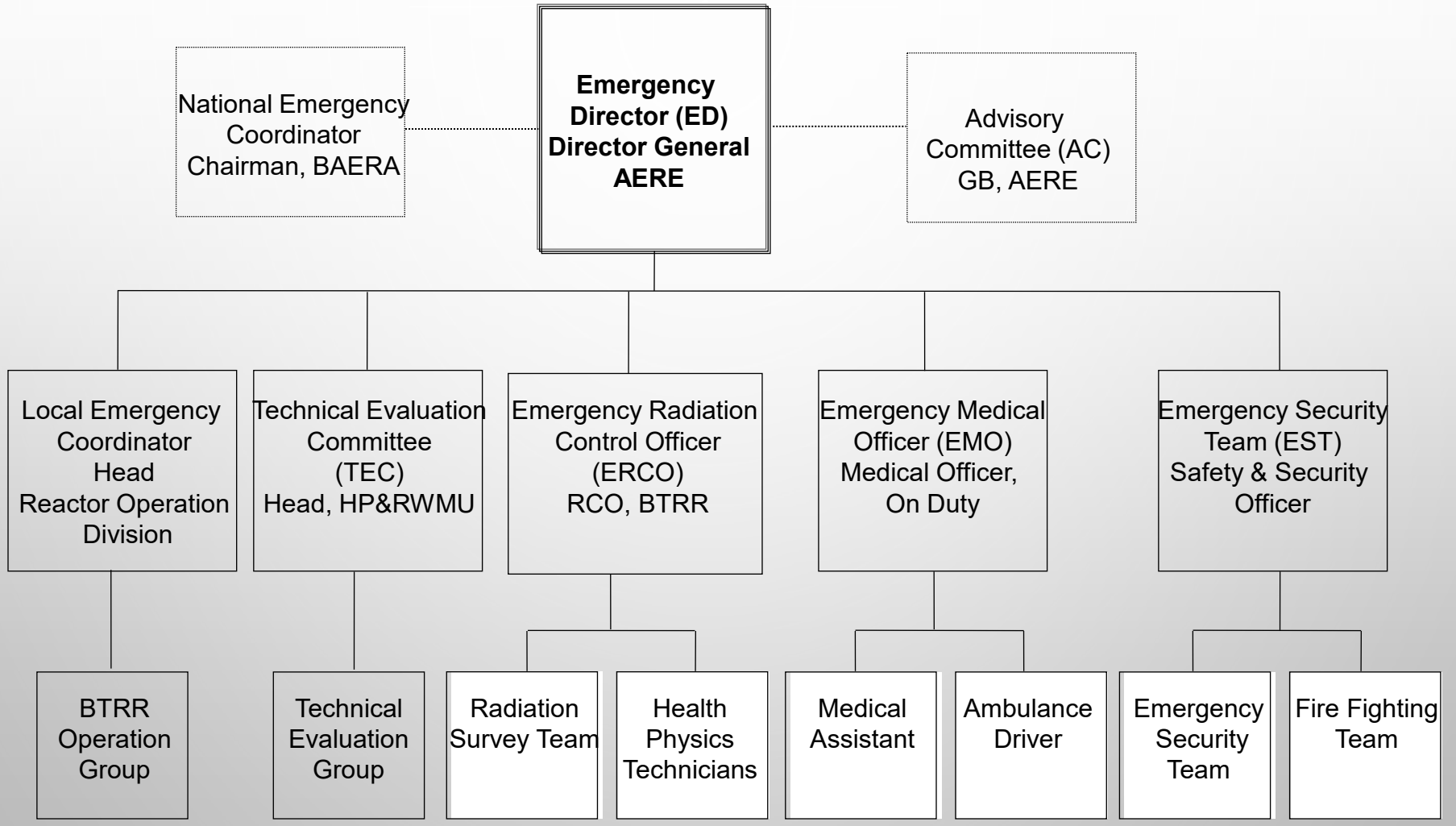
CRR takes an ADP project (annual development program) with a view to strengthen reactors operational safety and utilization. The following systems will be upgraded/install under the ADP at the reactor facility.

- To increase operating life of the BTRR for about 15 to 20 years by implementing ageing management of different systems/components of the reactor facility;
- Design and development of spent fuel transfer cask;
- Build a new spent fuel storage facility;

EMERGENCY PLAN AND RESPONSE PROGRAM

- The BAEC TRIGA research reactor facility of AERE has an emergency plan and response program as per section 10.13(B) of the nuclear safety and radiation protection rule (NSRCD rule-1997) of Bangladesh government;
- The objectives of this emergency plan are to identify types of emergencies, establish guidelines and designate areas of responsibility for the emergency management team should an accident or incident occurs at the BTRR.

EMERGENCY PLAN AND RESPONSE PROGRAM



AGEING MANAGEMENT PROGRAMS OF BTRR

- Ageing is an important issue for the BTRR as it has been in operation for last 38 years;
- As a result of ageing, some of the reactor tank internals such as, the radial beam tube, rotary specimen rack (Lazy Susan) loading tube etc. are encountering corrosion damage;
- The issues mentioned above have potential safety concern, and if are not handled properly they might even limit the operational life of the research reactor.
- Basis on these understanding an IAEA TC Project (BGD1012) titled “Implementing an Ageing Management Program for RR” was undertaken. Under this project an effective ageing management program has commenced on January, 2013.

Ageing Management Activities

Major Refurbishment and Modernization Work Carried Out:

- Refurbishment of Primary Cooling System of the RR.
- Improvement of ECCS
- Improvement of shielding of the delay tank room
- Improvement of the shielding of the Radial Beam Port
- Repair of Leaking Beam Tube (RBP-1)
- Installation of digital neutron radiography system
- Installation of High Performance Powder Defractrometer
- Installation of Digital Control Console System

MANAGEMENT SYSTEMS REVIEW

The FNCA SMS workshop & peer review of BTRR was conducted 19-23 may 2014, Dhaka, Bangladesh

Systems reviewed by the peer review team:

- Management system
- Management responsibility
- Resource management
- Operation maintenance
- Safety documents control
- Safety culture
- Performance of specific process

GOOD PRACTICES

- Clear and open communication through all levels of the organization;
- The establishment of an independent regulatory body
- BAEC TRIGA research reactor are committed to no blame culture;
- Following manufacturer's instructions as part of routine operation and maintenance of equipment;
- There is a very open culture within the reactor organization, the research institute and the regulatory authority.

REGULATORY SUPERVISION OF BTRR

LEGAL BASES FOR REGULATORY CONTROL OF BTRR

1. BANGLADESH ATOMIC ENERGY REGULATORY AUTHORITY (BAERA) ACT – 2012 AND

(BAERA- AN INDEPENDENT AUTHORITY)

2. NUCLEAR SAFETY AND RADIATION CONTROL RULES – 1997 (SRO NO.205 – LAW/97)

REGULATORY SUPERVISION OF BTRR

Regulatory Supervision:

Documents reviewed by the regulatory body:

(1) Safety Analysis Report of the Reactor Facility

(2) All operational records of the RR, such as –

- Console log book,
- Instrument log sheets,
- Startup and shutdown checklists,
- Various reports in connection with the evaluation of safety of in-core experiments,
- Miscellaneous incident reports, ISI data, etc.

Assessment and Improvement

Following changes have been made over the past decade:

- An independent regulatory body named Bangladesh Atomic Energy Regulatory Authority (BAERA) is formed in place of Nuclear Safety and Radiation Control Division (NSRCD) of BAEC.
- Quality Management Division (QMD), Nuclear Safety, Security and Safeguards Division (NSSSD) and Human Resource Division (HRD) have been formed under BAEC.
- Management Information System (MIS) is also introduced.
- Up gradation of BAEC organogram
- Up gradation of CRR organogram

FUTURE PLAN FOR IMPROVEMENT OF IMS

Further improvement is necessary:

- Need to develop an fully integrated management system
- Need to increase aging management activities.

– Emergency planning and response preparedness program of the facility needs to be strengthened;

– QA related documents needs to be strengthened;

– Strengthening the ISI activities

CONCLUSIONS

- A management structure with clear definition of roles, responsibilities and lines of communication is in place;
- BAEC is fully committed for ensuring quality at all levels of the organization,
- A management policy that makes safety is the highest priority;
- Need to development of integrated management system under a quality management framework;
- Aging Management Project are now being implemented for the BTRR with a view to extend the operating life and strengthen its operational safety;
- The government has strong commitment for the reactor facility, associated programs and regulatory infrastructure development.


CRR
Thank you very much!!