

Virtual Event: Regional Workshop on Managing the Interface Between Safety and Security for Research Reactors, from 06 – 10 June 2022

**Title: Status of Nuclear Safety and Security Management of the BAEC
TRIGA Research Reactor**



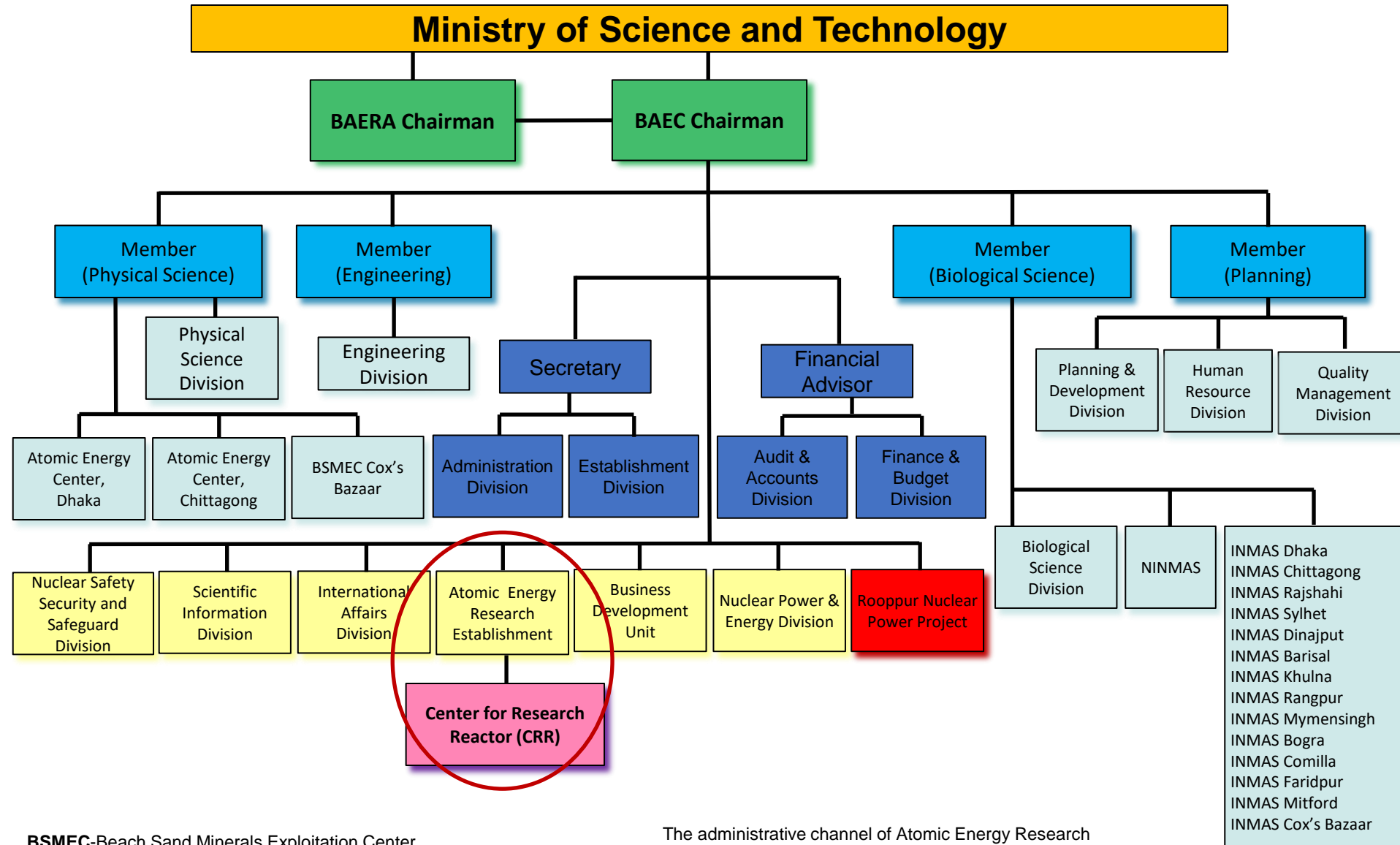
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- Brief Description of BAEC TRIGA Research Reactor (BTRR)
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Organization: BAEC

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: BAEC

Major Infrastructures of BAEC:

1. 3 MW TRIGA Mark-II Research Reactor,
2. Radioisotope Production Laboratory,
3. 3 MeV Van De Graff Accelerator Facility,
4. 3 MeV TANDEM Accelerator Facility,
5. 350 kCi & 50 kCi Co-60 Gamma Irradiators,
6. Reactor Physics and Engineering Laboratory,
7. Analytical laboratories including Isotope Hydrology laboratory
8. Radioactive Waste Management Facility,
9. SSDL Facility, NDT Laboratory, NAA & NS Laboratories,
10. Neutron Powder Diffractometer and
11. Several Nuclear Medical Centers,
12. Medical Physics Institute, etc.

Organization: BAEC

- **Rooppur Nuclear Power Plant (RNPP)** is the first nuclear power plant of Bangladesh, currently under construction;
- The RNPP has two units (1200MWe each) and first unit is expected to commence operation in 2023;
- Govt. is also considering another NPP in the southern part in the country.



*NPP-Nuclear Power Plant

Brief Description of BTRR



TRIGA

Ttraining

Rresearch

Iisotope production

General **A**tomics

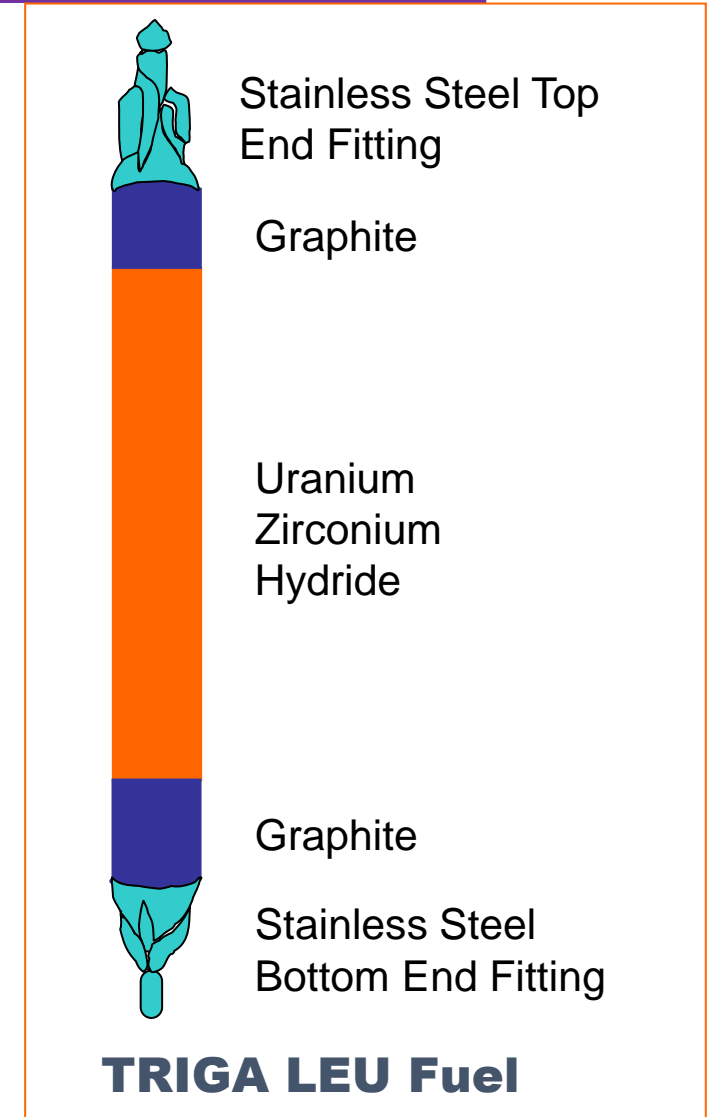
Brief Description of BTRR

Brief History:

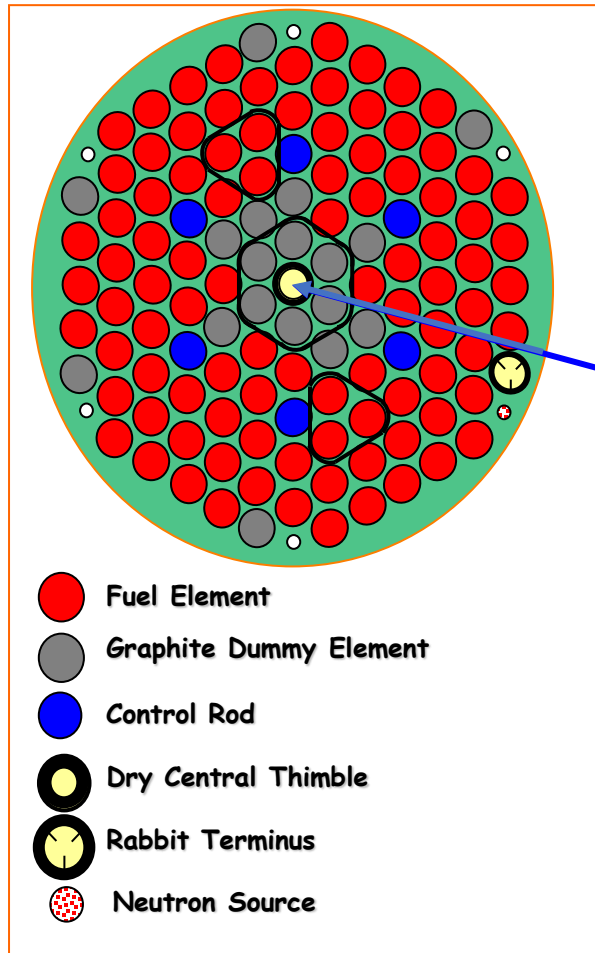
- Reactor Type: TRIGA Mark-II (Tank type RR)
- Construction Started: May 1981
- Criticality: Sept 1986
- Commissioning of the renovated cooling system: Aug 2001
- Updated the Safety Analysis Report (SAR) as per IAEA Guide (SG-35-G1): April 2006
- Installation of HRPD at RBP-2: February 2010
- Commissioning of digital console system: June 2012
- Updated SAR : 2021
- Upgrading cooling and I & C systems: on going

Brief Description of BTRR

Reactor Power (Thermal)	: 3 MW
Reactor Type	: Mark-II
Fuel	: Uranium 20% (wt) 19. 7% U-235
Moderator Material	: Zr-H, Water
Cladding Material	: SS 304
Control Rod	: B ₄ C
Coolant (primary)	: Demineralized Water
Reflector	: Graphite
Neutron Flux (Thermal)	: $7.46 \times 10^{13} \text{ (n.cm}^{-2}.\text{s}^{-1})$
Prompt –ve Temp Coefficient of Reactivity	: $1.07 \times 10^{-4} \Delta k/k/^{\circ}\text{C}$



Brief Description of BTRR



Reactor core configuration

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

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

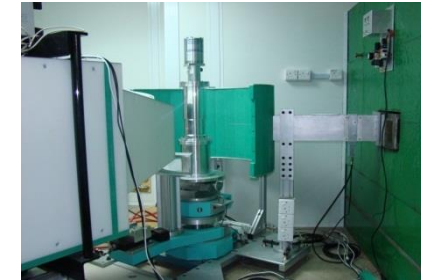
Utilization of BTRR

Areas of Utilization

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



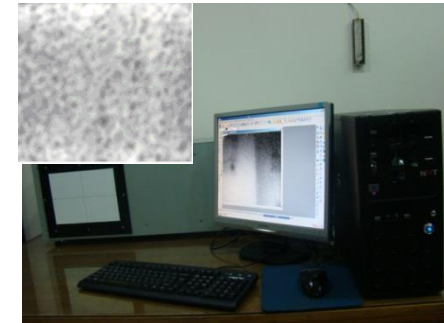
NAA Facility



NS Facility (NPD)



I-131 Production Facility



NR Facility

Utilization of BTRR

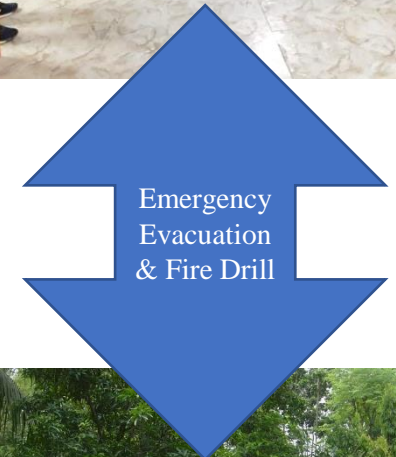
In-house Training and Qualification Programs

Different training programs are conducted at the reactor facility:

- RO & SRO training and re-qualification programs;
- Industrial attachment training program for university students
- Training programs for technical supporting personnel on the following fields,
 - Radiation protection
 - Reactor I&C system
 - Operation and maintenance of reactor associated systems
 - **Improvement of safety culture and security culture**
 - **Nuclear Safeguards activities**
 - **Emergency evacuation and fire drill**
 - **Safety training & drill**
 - Calibration of reactor safety related equipment;

Utilization of BTRR

In-house Training Programs

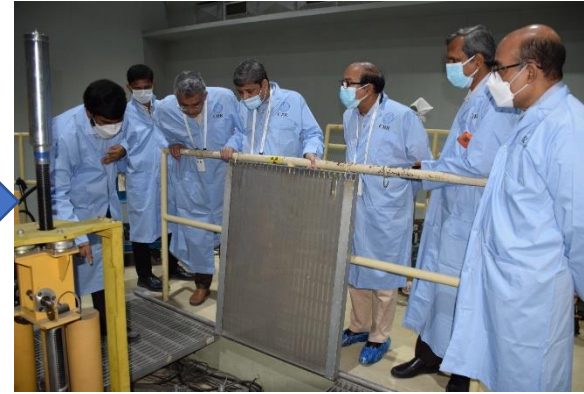


Utilization of BTRR

Manpower Training at CRR



High Officials
Visit



Around 1000 visitors from different sectors visit BTRR every year.



FTC
Participants

Students
visit



Utilization of BTRR

Manpower Training at CRR

More than 200 students of different Universities receive training using BTRR per year.



Nuclear Engineering Students
Dhaka University

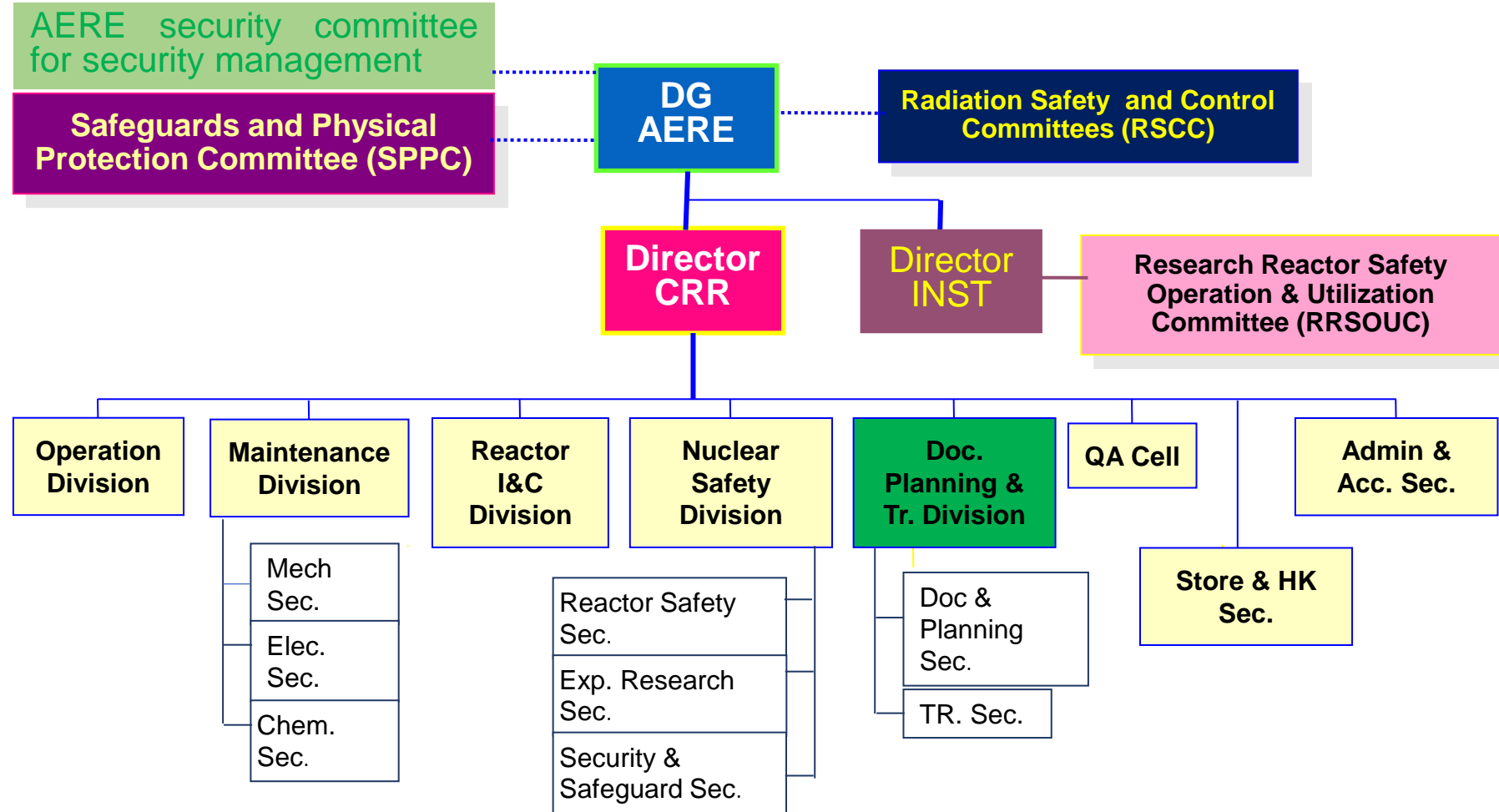


IUT Students



Management System of BTRR

Organization Structure of CRR (Changed on 12 January, 2015)



AERE : Atomic Energy Research Establishment
CRR : Center for Research Reactor
INST : Institute of Nuclear Science & Technology

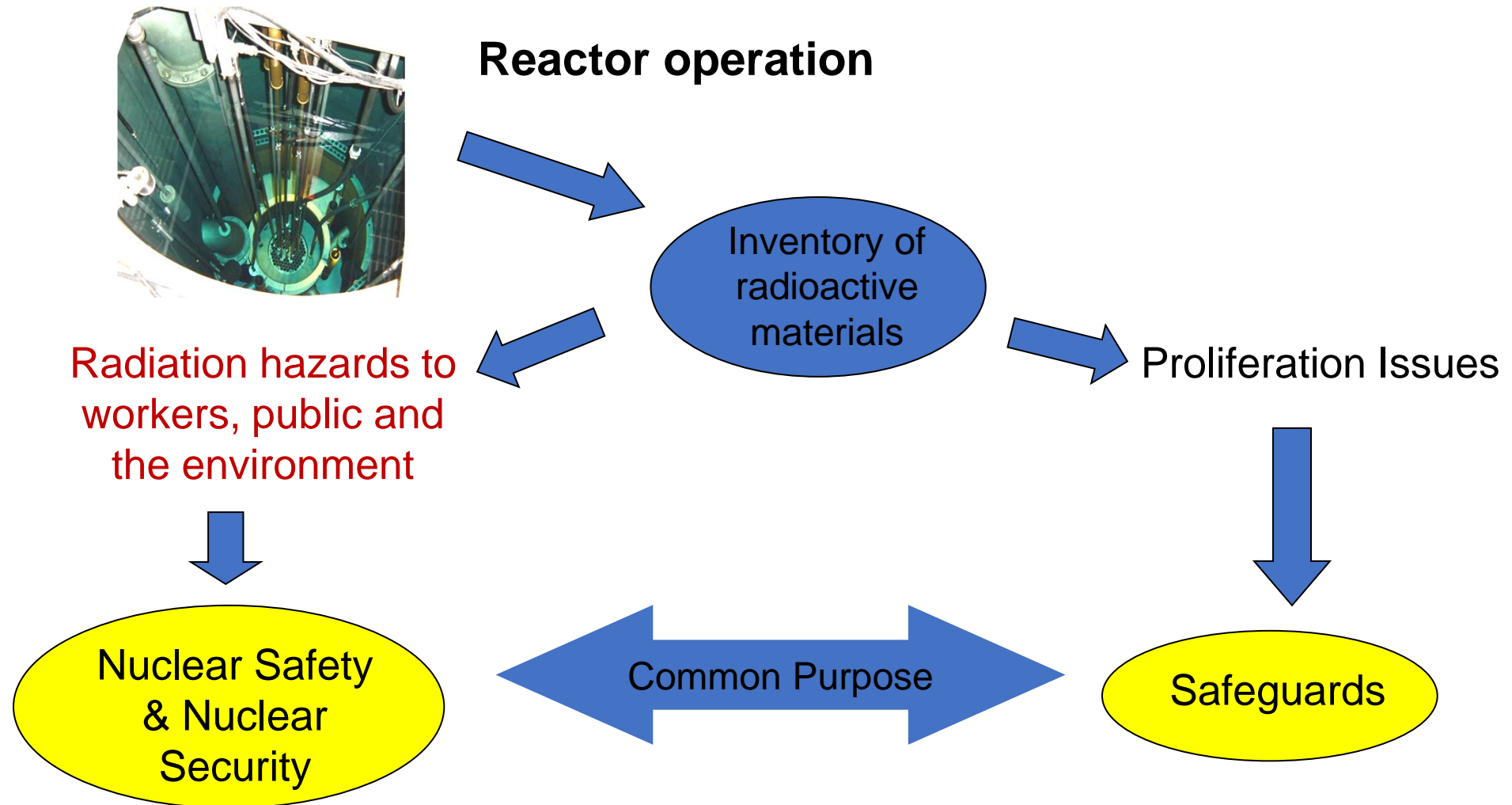
Management System of BTRR

Legal and Safety Documents for BTRR

- NSRC Rules-1997
- BAER Act 2012
- BAEC Law 2017
- AERE Security Policy
- Safety Analysis Report (SAR)
- Charters: SPPC, RRSOUC, RSCC
- Radiation Protection Program
- Operating Operation and Maintenance Procedures (29 Nos.)
- Training Manuals
- Technical Specifications
- Facility License
- Console Logbook

Interface in Nuclear Safety-Security

Specificity of Nuclear Reactor



Interface in Nuclear Safety-Security

- **Government of Bangladesh** has set up an appropriate legislative and regulatory framework to ensure control of nuclear power plants and thus require safety and security provisions.
- **Bangladesh Atomic Energy Regulatory Authority (BAERA)** has been designated in both the safety and security fields and is provided with the authority, competence and the financial and human resources.

Interface in Nuclear Safety-Security

Detection Element at the BTRR facility

- PIR detector;
- Surveillance cameras (CCTV)
- Micro switches and Balance Magnetic Switches (BMS) on access doors;
- Vibration detectors on the walls;
- Lighting system around the reactor facility;
- Hand held metal detector;
- Personal ID system



Access Control

Alarm Control Panel

PIR Motion Sensor

Camera

Interface in Nuclear Safety-Security

Detection Element at the BTRR facility

- Hardened wall with hardened door;
- Security fencing around the reactor facility;
- High security hasps and locks;
- Heavy duty steel plate in the primary return trench;
- Steel doors & collapsible gates;
- Fireproof security safe and key pad-entry type key box;



New Hardened Door



Safety Lock



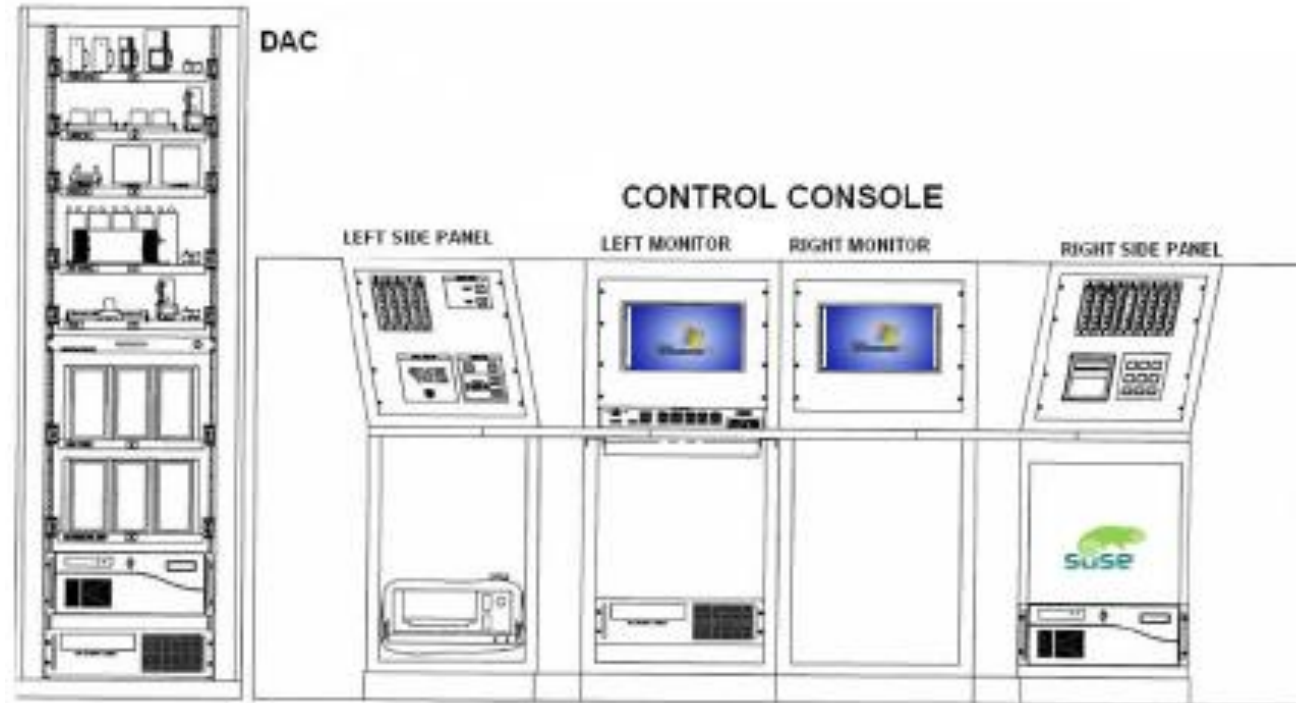
Steel Plate in Primary Trench



Security Lock

Interface in Nuclear Safety-Security

Computer Security



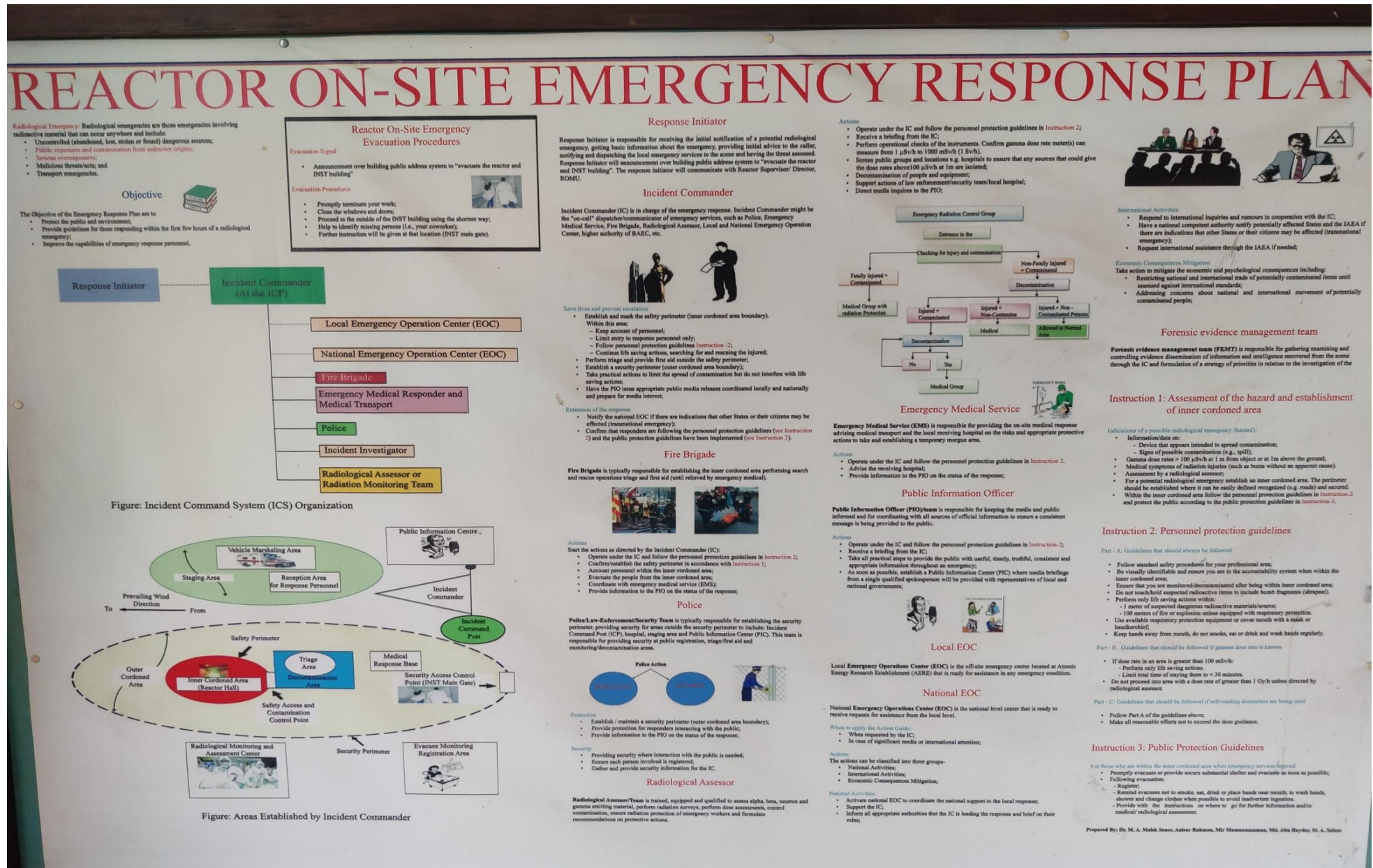
- All the Console Control System (CCS), Data Acquisition system (DAC) and User Interface Terminal (UIT) CPUs are locked at the front side. Without the key no one can access the front side of the CPUs.

Interface in Nuclear Safety-Security

Computer Security

- BTRR digital console computers have both hard and soft security
- CPUs are locked at the front side
- The software of the digital console system asks for operator login first to perform any action
- Sole network computer system which is not connected to any other computer network or internet
- It is strictly prohibited to connect any memory stick to any CPU of the digital console system

On site Emergency Response



On site Emergency Response

Response Forces

- BAEC Security Guards;



- Ansar;



- Police Forces;



- Fire Fighters;



Strengthening Nuclear Safety and Security

- Two sets of seismic switches were installed in the reactor facility which will turn off the UPS of the new digital console when seismic condition will trigger the set point
- Reactor building was designed considering a seismic ground acceleration of 0.1g.
- A 5kVA petrol generator is installed additional to 250 and 650kVA generator to provide power to the digital console.
- New fire detection & alarm system and fire hydrant system is installed.
- All the electrical wiring has been replaced by a new one.
- Old substation near reactor building has been removed.
- New substation has been setup far from reactor building.

Strengthening Nuclear Safety and Security

CRR has taken an ADP Project (Annual Development Program) with a view to strengthen reactors operational safety, security 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;
- Replace old heat exchanger by a new one;
- Modification of reactor hall ventilation and emergency purging system;
- Upgrade Digital Control Console and collection of spare parts of the Digital Console;
- Strengthen physical protection system installing IP based camera, remote monitoring system of the facility.

BAEC has Plan to establish a high power multipurpose (15-20 MW_{th}) Research Reactor at AERE, Savar.

Conclusion

- ❑ BAEC TRIGA Research Reactor has been in operation successfully for more than 36 years
- ❑ Presently the reactor is used for different R&D activities, education and training programs
- ❑ **BTRR** is playing an important role for human resources and infrastructure development for nuclear science and nuclear power programs in Bangladesh.
- ❑ BTRR personnel is always involved in strengthening of nuclear safety and security of the reactor facility.
- ❑ An ADP Project is going on for ageing management and strengthening nuclear safety and security of BTRR facility.
- ❑ **Interfacing between nuclear safety and security is one of the prime factors for maintaining peaceful use of nuclear energy.**

Thank you very much
for your attention!