

# IAEA-KINS Basic Professional Training Course on Nuclear Safety

19-30 September, 2022  
Daejeon, Korea

## Country Presentation-Bangladesh

***Abdullah Al Mahmud***

***Scientific Officer & Reactor Operator***

***Nuclear Safety Division, Center for Research Reactor***

***Bangladesh Atomic Energy Commission***

***Bangladesh***



# Contents

- ❑ **Overview of the Nuclear Safety Infrastructure**
  - ❑ **Legal and Regulatory Framework**
  - ❑ **Technical Support Organizations**
- ❑ **BAEC TRIGA Research Reactor (BTRR)**
- ❑ **Safety Review of BTRR**
- ❑ **Refurbishment and Modernization Activities**
- ❑ **Introduction to Nuclear Power**
- ❑ **Future Plan**
- ❑ **Conclusions**

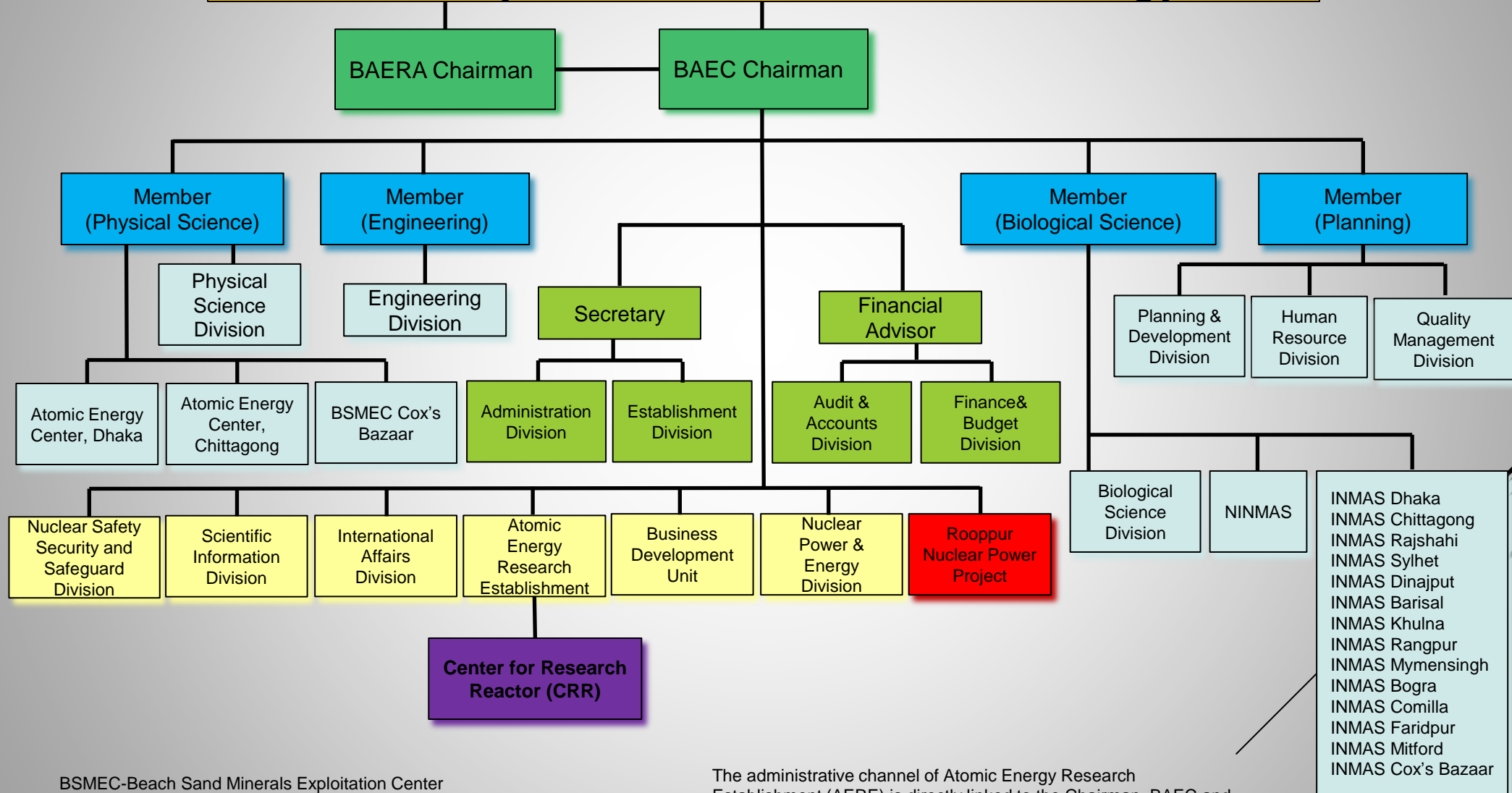
# Location



Name: Bangladesh  
Location: South Asia  
Area: 57,320 sq mi  
Population: Over 165 million  
Language: Bengali

# BAEC Organogram

## Ministry of Science and Technology



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



# Overview Of The Nuclear Safety Infrastructure



## Status of Legislative Framework

In 19 June 2012, the Government enacted an Act entitled “Bangladesh Atomic Energy Regulatory Act” (in short, BAERA 2012) for establishing an effective **Independent Regulatory Body** as well as for introducing Nuclear Law in the country.

# Overview Of The Nuclear Safety Infrastructure

## Status of Legislative Framework

- ❑ The BAER Act-2012 has been formulated based on IAEA Handbook of Nuclear Law and existing NSRC Act-1993.
- ❑ Inputs from several IAEA experts have also been taken while formulating the draft of the Act.

# Overview Of The Nuclear Safety Infrastructure

## Status of Legislative Framework

Provisions of the BAER Act-2012 covers **Nuclear Safety**, **Security** and **Safeguards** of Nuclear as well as Radioactive materials and also ensure **Civil liability for Nuclear Damage** in the event of an accident.

An Independent Regulatory Body has been establishment on **12<sup>th</sup> February 2013**

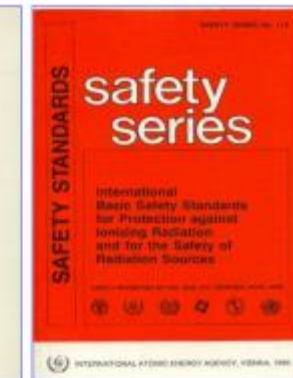
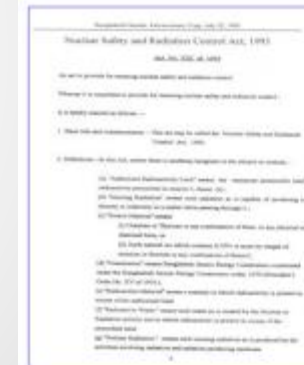
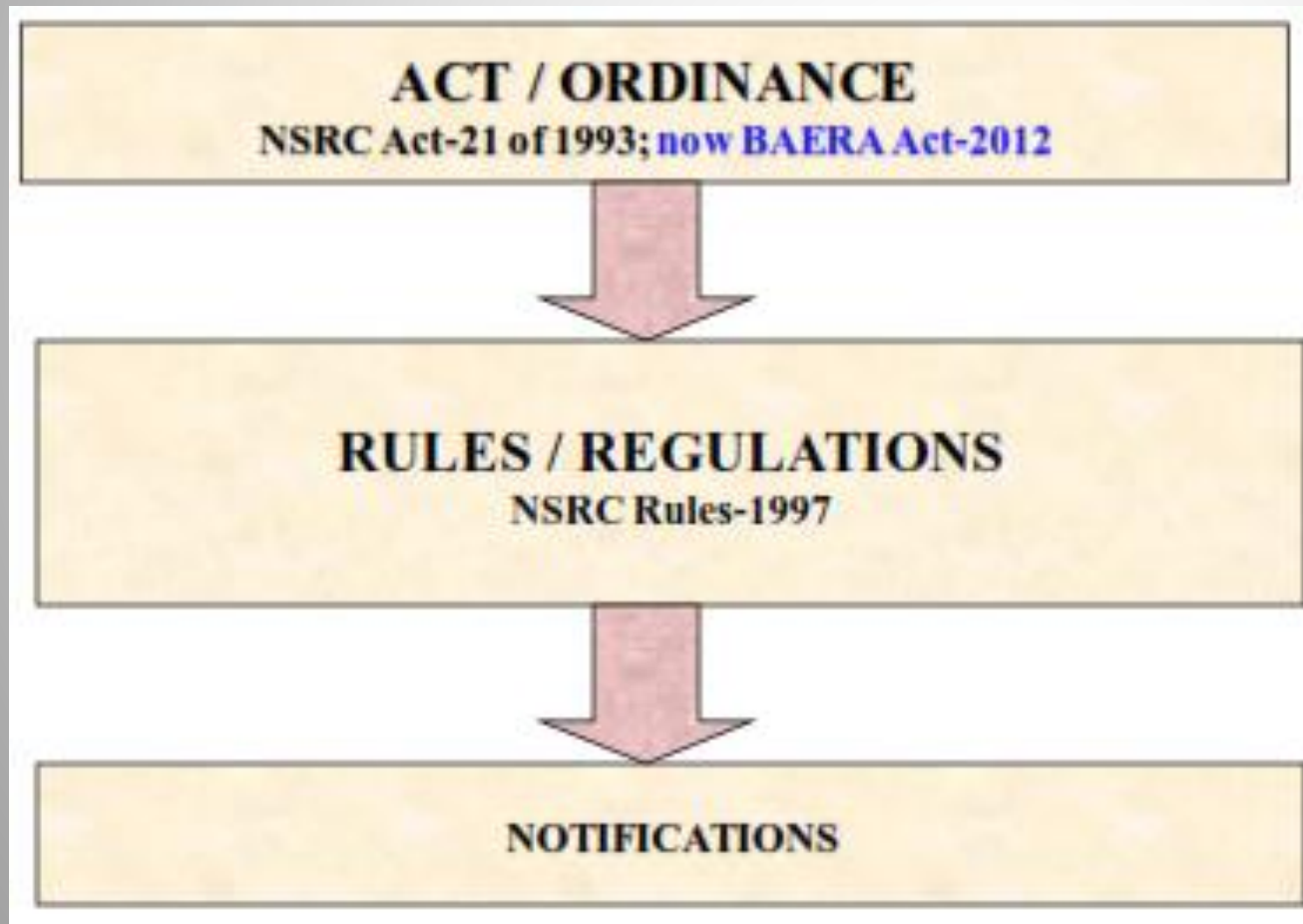


BAERA Building

# Overview Of The Nuclear Safety Infrastructure

## Status of Legislative Framework

Legal Basis For Control: Laws have Hierarchy as



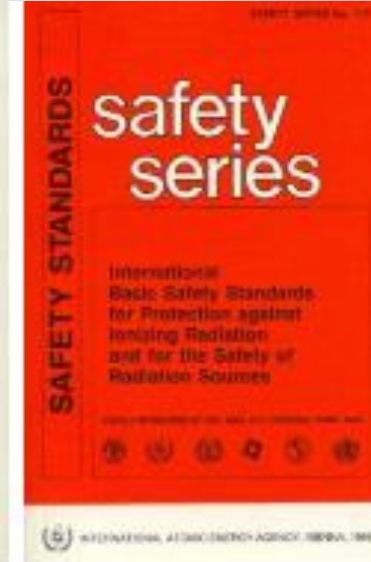


# Overview Of The Nuclear Safety Infrastructure

## Status of Legislative Framework

### NSRC RULES-1997

- \* The NSRC Rules were notified and put to force on September 18, 1997.
- \* The Rules incorporate the principal requirements of the Basic Safety Standards -115, 1996 (IAEA).



### Key Features:

- **The Rules have 13 chapters and 18 schedules.**
- **Rules 10-16: the manner of obtaining license for nuclear and ionizing radiation practices in Bangladesh.**
- **Chapter X: Transport of Radioactive Material**

# Overview Of The Nuclear Safety Infrastructure

## Status of Legislative Framework

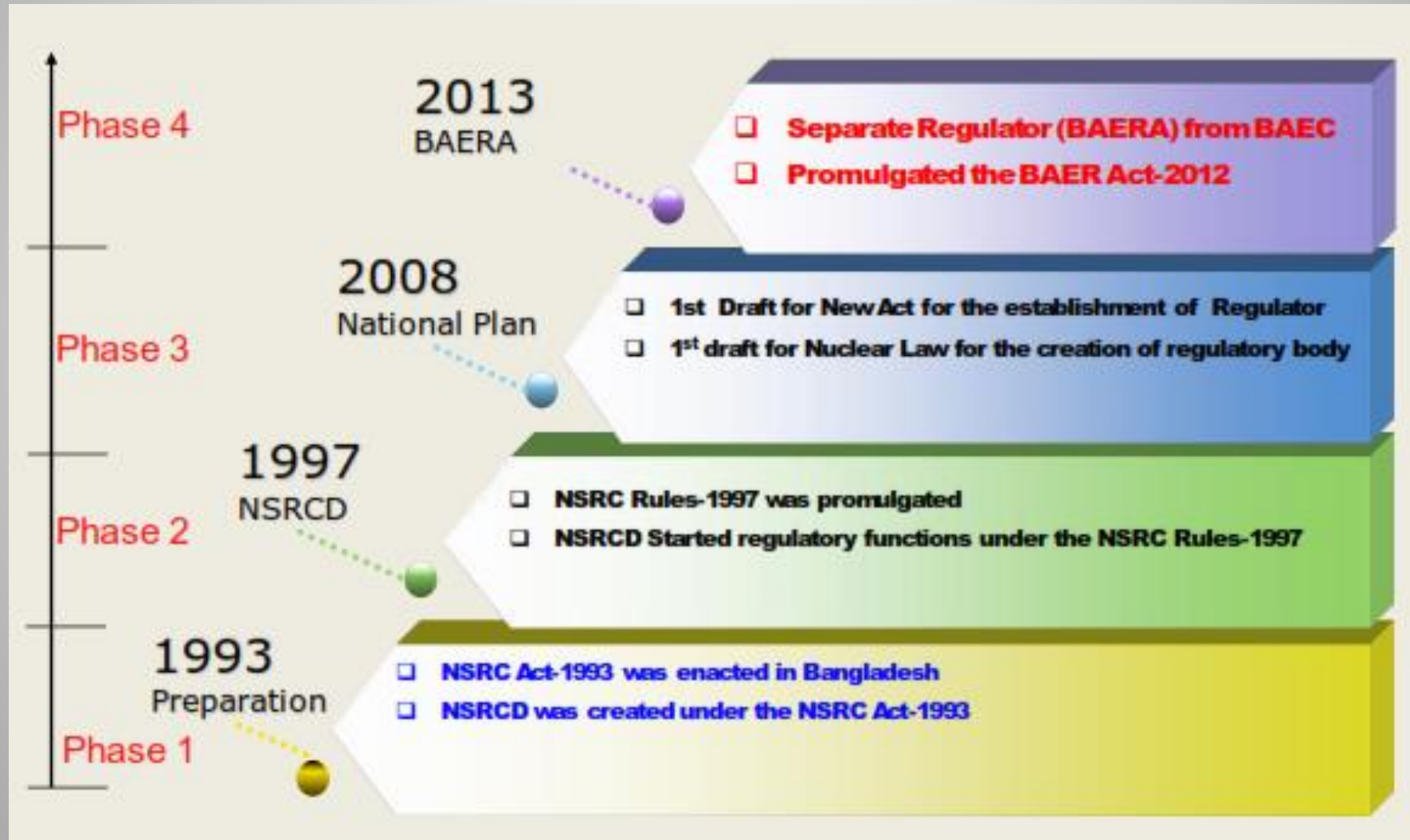
### Some important sections of existing regulation:

- |                  |   |  |
|------------------|---|--|
| * Rule 10.13 (a) | > | Quality Assurance Program                |
| * Rule 10.13 (b) | > | Emergency Response Plan                  |
| * <b>Rule 15</b> | > | <b>Codes and Standards [schedule IX]</b> |
| * Rule 17.2      | > | Security of the Sources                  |
| * Rule 19.2      | > | Safety Culture                           |
| * Rule 19.3      | > | Human Factor; and                        |
| * Rule 54        | > | Radiation Control Officer                |
| * Chapter 4      | > | Safety, Technical and Management         |
| * Chapter 9      | > | Operational Exposure Control             |



# Overview Of The Nuclear Safety Infrastructure

## Chronological Development of BAERA





# Overview Of The Nuclear Safety Infrastructure

## Technical Support Organizations



Bangladesh Atomic Energy Commission



# Overview Of The Nuclear Safety Infrastructure

## Technical Support Organizations

**Vendor Regulatory Resources:** Assistance in the Regulatory review process of NPP licensing and Regulatory Human Resource Development (RHRD):

ROSTECHNADZOR → VO “Safety”, SEC NRS

**National Stakeholders:** BUET, BCSIR, DU, SOB, GSB, BMD, DOE, IWM, CDMP, etc.

**AERB, India** active negotiation is under process.

# Facility Description



# Reactor Safety Committees

- ❑ Three Research Reactor Safety committees are in place
  - Research Reactor Safety, Operation & Utilization Committee
  - AERE Radiation Safety and Control Committee
  - Safeguards and Physical Protection Committee of AERE
- ❑ Safety Committees meet regularly
- ❑ Utilization program exist
- ❑ Emergency Planning and Preparedness for Accident Situations are being reviewed



# BAEC TRIGA Research Reactor (BTRR)



**BTRR**

**TRIGA**

**T** raining

**R** esearch

**I** sotope production

**G** eneral **A** tomics



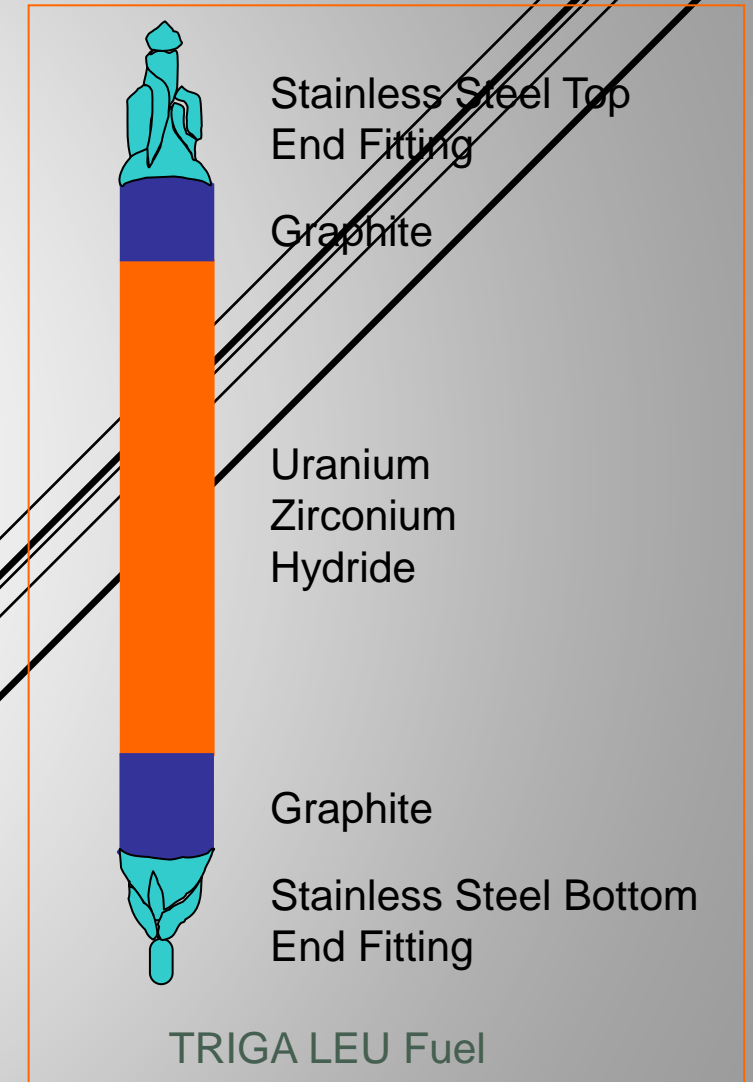
# Main features of BTRR

## 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 : April 2006
- Installation of High Resolution Powder Diffractometer at RBP-2: February 2010
- Commissioning of digital console system: June 2012
- Updated SAR : 2021

# Main features of BTRR

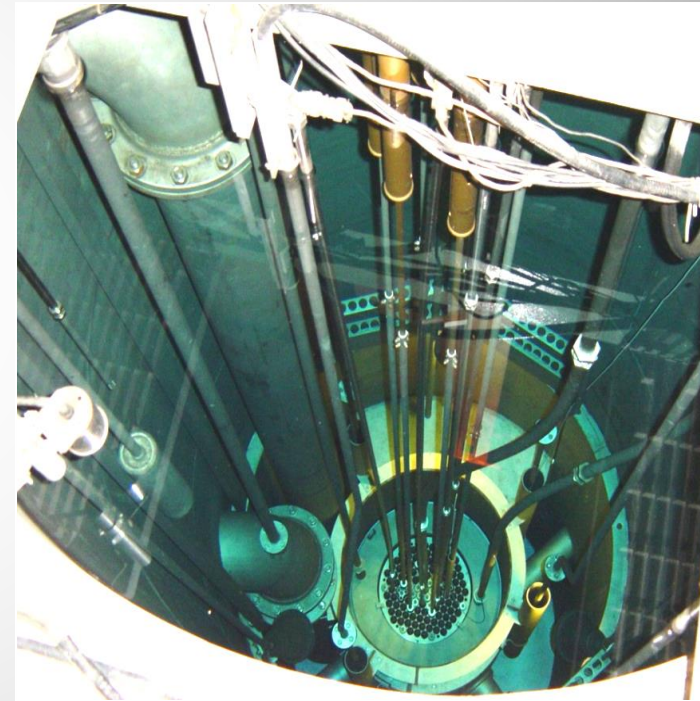
Thermal power output	: 3 MW
Fuel element cooling	: Natural convection ( $\leq 500$ kW) Forced convection (up to 3000 kW)
Fuel-moderator material	: Uranium = 20.0 wt% (19.7% U-235) Er-167 = 0.47 wt% ZrH <sub>1.6</sub>
Prompt -ve temp. coefficient	: $1.07 \times 10^{-4} \Delta k/k/^{\circ}\text{C}$
Total No. of FE in core	: 100 (93 STD+2 IFE+5 FFCR)
Total No. of Control Rods	: 6 (5 FFCR+1 AFTR)
Control Rod Material	: Boron Carbide (B <sub>4</sub> C)
Coolant	: Demineralized Water
Reflector	: Graphite
Thermal Neutron Flux (Max)	: $7.46 \times 10^{13} \text{ (n.cm}^{-2}\text{.s}^{-1}\text{)}$



# Utilization of the BTRR

## Areas of Utilization

- ✓ Neutron activation analysis (NAA),
- ✓ Neutron radiography,
- ✓ Neutron scattering experiments,
- ✓ Production of radioisotopes,
- ✓ Training of manpower,
- ✓ Experimental research on reactor safety parameters
- ✓ Education, etc.



## INSARR Mission

- ❑ An Integrated Nuclear Safety Assessment of Research Reactor (INSARR) mission: **January, 1995** with a number of significant recommendations.
- ❑ A Post-INSARR mission: **8-11 May, 2001** to review the progresses of 1995 INSARR mission recommendations.
- ❑ The subsequent INSARR mission reviewed the Revised Safety Analysis Report and Operational Safety of BTRR from **21-27 June 2002**.
- ❑ The Follow-up INSARR Mission: **26 July to 28 July 2004**.



## Safety Management System (SMS) Review

- Forum for Nuclear Cooperation in Asia (FNCA) SMS Workshop & Peer review of BTRR: 19-23 May 2014

## BTRR SMS Peer Review Results (1/2)

- The review team Identified the good practices and weaknesses of safety management systems of reactor facilities and made recommendation/suggestions for the improvement.
- Peer review team identified 11 “Good Practices, 21 “Comments and 14 “Recommendations. Out of these most of the items have no comments.

### Some of the good practices are:

- There was good evidence of an open and honest culture within BAEC
- The leadership commitment to safety was also evident as demonstrated by the support provided to the peer review by the highest levels of BAEC management.

# Safety Review of BTRR

## OMARR (Operational and Maintenance Assessment of Research Reactor) Mission

- ❑ Pre-OMARR: conducted from 21 to 23 March 2018.
- ❑ Main OMARR: conducted from 19 to 23 November 2018 with recommendations and suggestions in the area of Fuel cycle & Core Management, Computerized Operation & Maintenance Management System, Systematic Ageing Management and Integrated Management System.
- ❑ Post OMARR mission will be conducted soon.

# Safety Review of BTRR

## ISSAS (IAEA Safeguards and SSAC Advisory Service) Mission

❑ ISSAS mission: conducted from 20 to 28 March 2022.

### Good practice for BTRR:

The Nuclear Materials Accounting & Control (NMAC) handbook of AERE on safeguards responsibilities for safeguards staff is a good practice for capacity building and to improve the effectiveness and efficiency of safeguards implementation.



## Safety Review After FD NPP Accident (1/2)

- ❑ Two sets of seismic switches were installed in the reactor facility which will turn off the UPS power 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. Reassessment of the integrity of reactor building is required considering largest possible earthquake at the nearest fault.

## Safety Review After FD NPP Accident (2/2)

- ❑ BAEC research reactor facility has 250 kVA and 650 kVA diesel generators (DG). A portable 5 kVA petrol generator was also installed after FD NPP accident to provide power to the digital console.

# Refurbishment and Modernization Activities

## Annual Development Project (ADP):

An ADP funded by Bangladesh Government has been approved for BMRE of safety system of the BTRR. The project has been started from October 2018 and will be finished by June 2021. The main objectives of this project are:

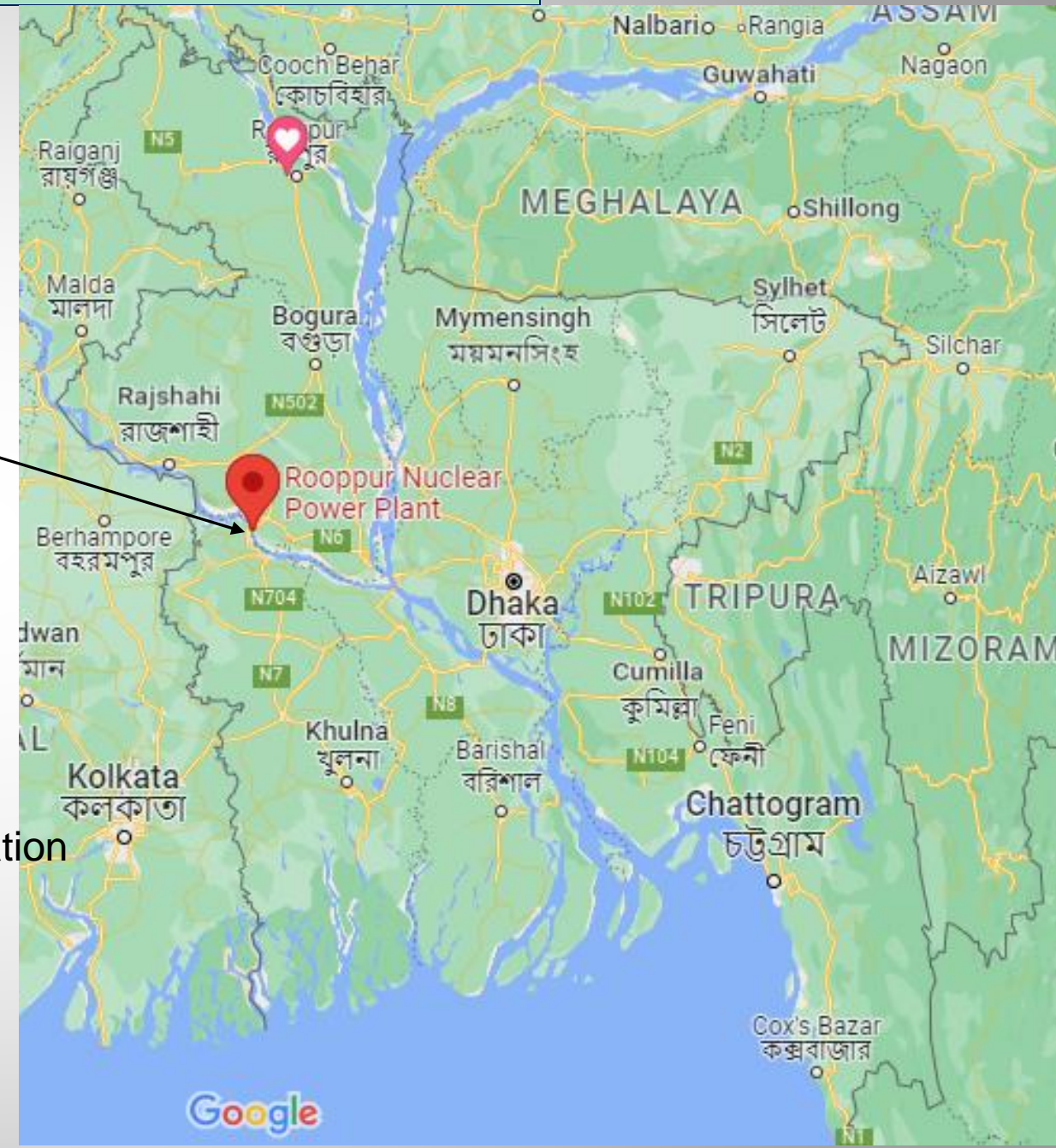
- To increase the operating life of the BTRR for about 15 to 20 years by implementing ageing management of different systems/components of the reactor facility;
- Construction of spent fuel storage facility to accommodate about 200 TRIGA spent fuels;
- Procurement of spare parts and upgradation of Digital Control Console;
- Upgradation of physical protection system like new entry control system and vehicle portal system, reactor building perimeter fencing, additional CCTV cameras etc.
- Strengthening of nuclear safety as well security with installation of new area radiation monitoring, new CAM and stack monitor, new fire suppression & protection system etc.



# Introduction to Nuclear Power



- Ishwardi, Pabna, on the bank of the river Padma
- Capacity: 2.4 GWe
- Construction Start: 2016
- Built by: Russian Rosatom State Atomic Energy Corporation





# Introduction to Nuclear Power

- ❑ Government of Bangladesh is constructing two units of nuclear Power plant (Total 2400MW) in Rooppur, Pabna, Bangladesh.
- ❑ VVER-1200 is one of the latest Generation III+ nuclear reactor. Design feature of the nuclear reactor is layered safety barriers preventing escape of radioactive material.
- ❑ Unit 1 of Rooppur Nuclear Power Plant (RNPP): planned to be commissioned in 2023.
- ❑ Unit 2 of Rooppur Nuclear Power Plant (RNPP): planned to be commissioned in 2024.
- ❑ 15% of total electricity of the country.

## Future Plan

- Feasibility Study Project completed for a new high power research reactor.
- Site selection and feasibility study going on for another NPP in the southern part of the country.

## Conclusion

- Regulatory supervision is an important consideration of Bangladesh Atomic Energy Regulatory Authority (BAERA).
- With the Independent Regulatory Body and recruitment of additional manpower, regulatory supervision is expected to be improved.
- Bangladesh emphasizes on Safety and security culture and good practices for ensuring safe operation of the research reactor as well as NPP.
- Bangladesh is very much thankful to the IAEA and other international stakeholders for their continued supports for strengthening the nuclear safety regime of the country.



# Welcome to Bangladesh

**Largest mangrove forest Sundarban**



**Longest Natural Sea Beach, Cox's Bazar**



**Sajek Valley and many more**





# Thank You

