

Geological Background of Rooppur Nuclear Power Plant Bangladesh

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Agenda

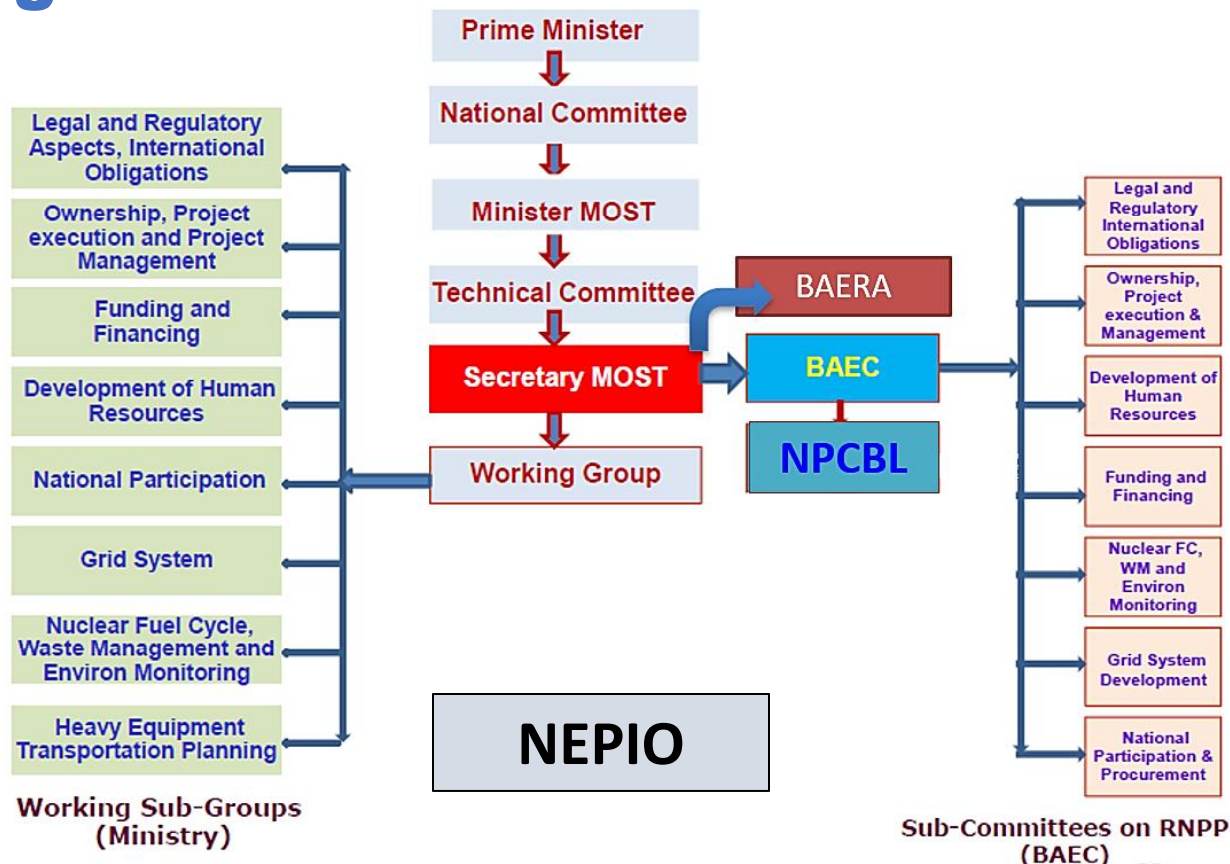
- Existing Nuclear and Radiological Facilities
- Nuclear Energy Program Implementing Organization
- Brief Description of Geology of Bangladesh
- Site Characteristic
- Soil Stabilization for Rooppur NPP



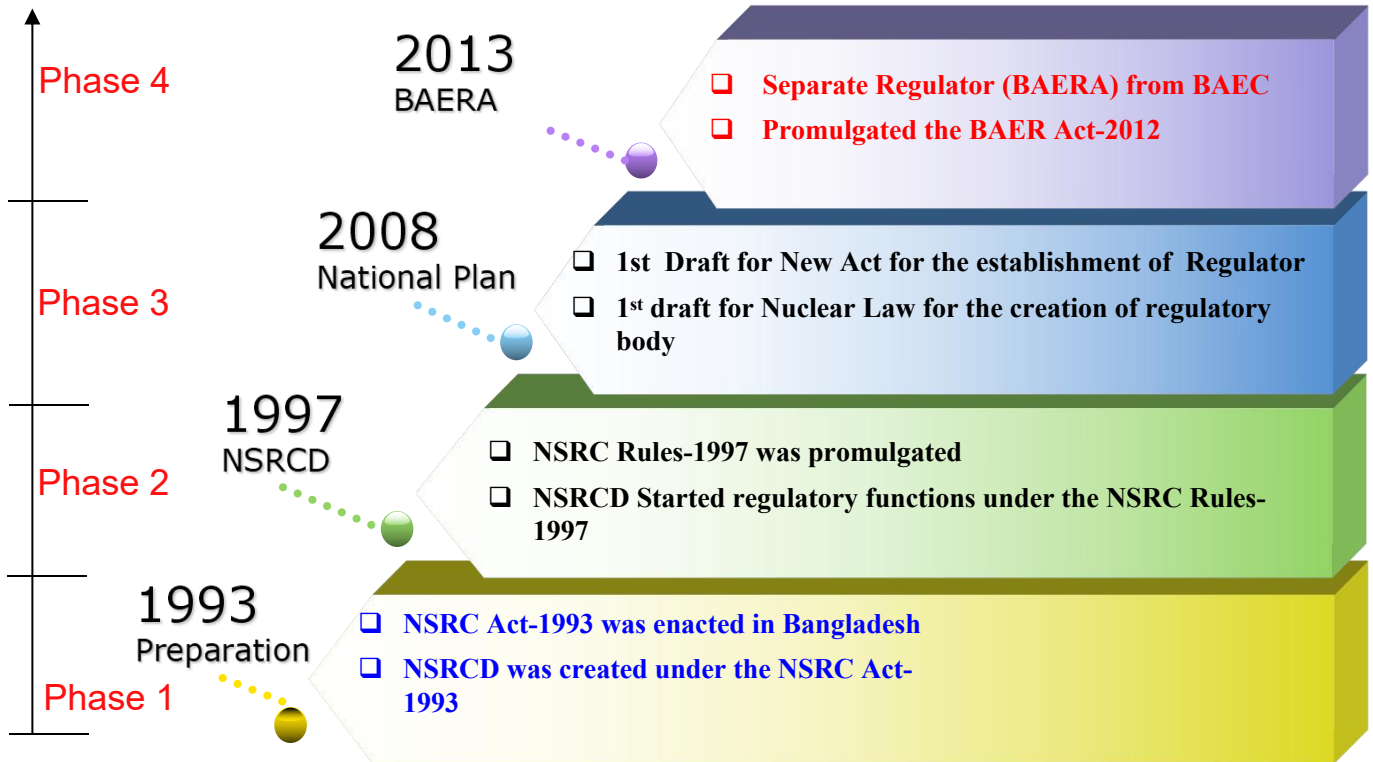
Existing Nuclear and Radiological Facilities

- Bangladesh is **embanking** on for Nuclear power programme.
- An IGA was signed between **Russian Federation** and Bangladesh in **November 2011** to construct nuclear power plant at Rooppur site. The Rooppur NPP will be equipped with two Russian VVER reactors, each with a capacity of 1,200 MW. The referential project for Rooppur NPP is Novovoronezh II NPP in Russia, which is a unique new Generation 3+ power unit with a VVER-1200 reactor (Water-cooled Water-moderated Power Reactor).
- Construction of the first unit began in November 2017 and it is scheduled to be **commissioned in 2024**. Construction of the second unit began in July 2017.
- General contract for the construction of Rooppur NPP was signed in in December 2015 between Bangladesh Atomic Energy Commission(BAEC) and JSC ASE
- A 3MW TRIGA MARK-II Research Reactor is in operation

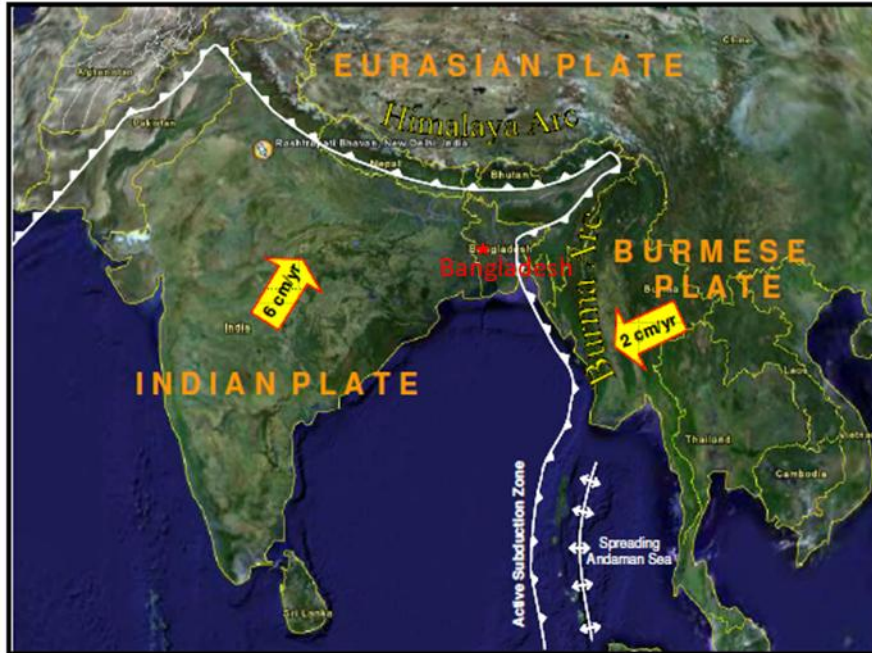
Nuclear Energy Program Implementing Organization



Chronological Development of BAERA



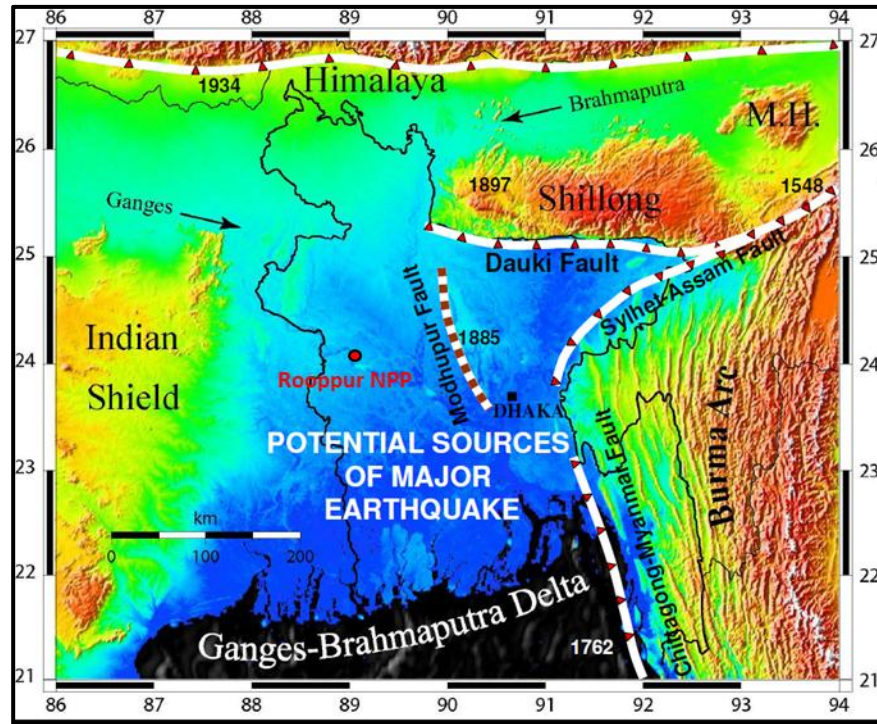
Geology of Bangladesh



Tectonically, Bangladesh lies in the northeastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates – the Indian plate, the Eurasian plate and the Burmese microplate.

Geology of Bangladesh

The present-day tectonics of this region is complicated because of the interaction between the active north-south convergence along the Himalayas, and the east-west convergence and folding within the Indo-Burma ranges



Geology of Bangladesh

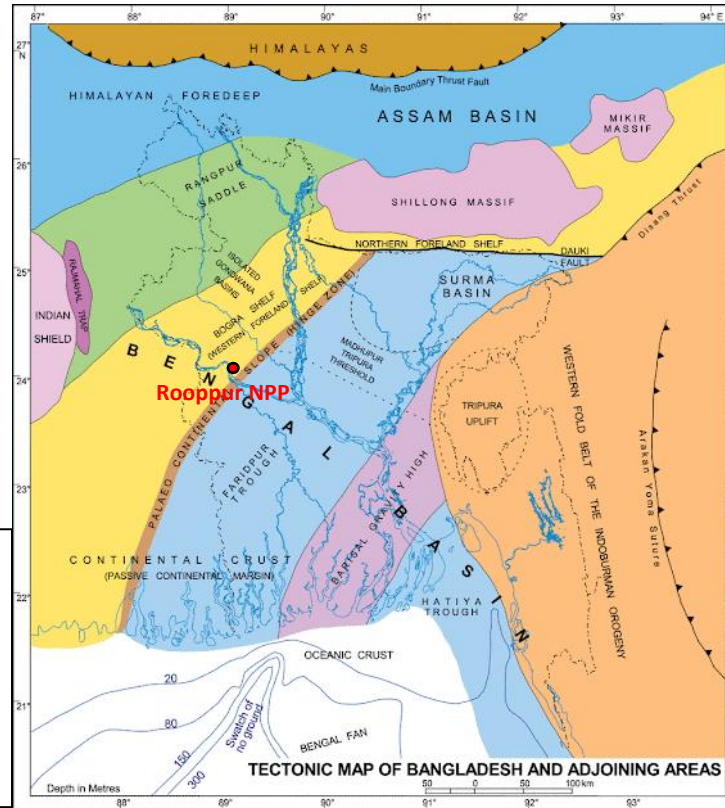
Tectonically, Bangladesh as is divided into two major divisions

(a) the Precambrian Rangpur Platform and

(b) the Bengal Foredeep

In addition, there is a ~25 km wide SW-NE trending hinge zone separating the Bengal Foredeep from the Stable Shelf.

Rooppur NPP site lies within the northwestern part of Bangladesh and falls in the Precambrian Rangpur Platform west to the hinge zone of the Bengal Basin.

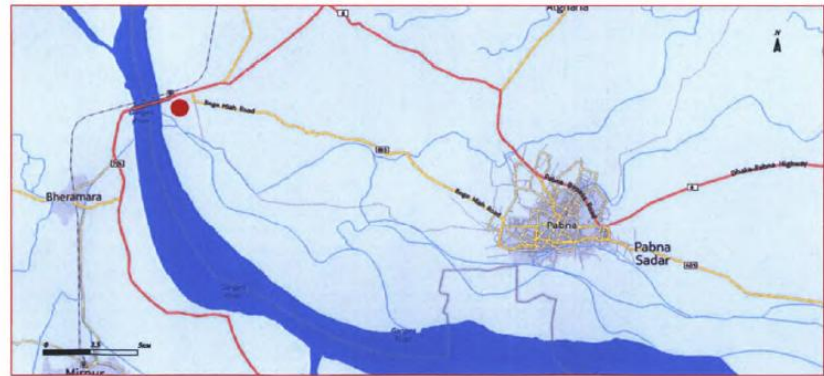


Source: Guha (1978), GSB (1990), Reumann (1993)

Location of Rooppur NPP



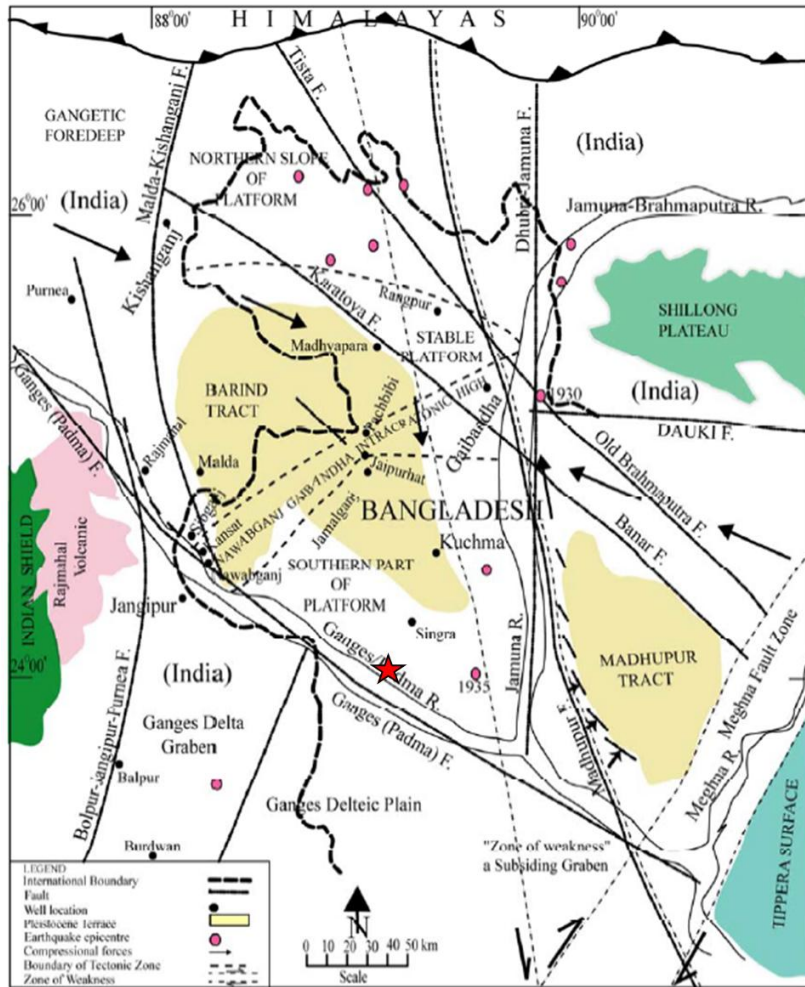
● - Rooppur NPP Area
/площадка размещения АЭС "Руппур"



Rooppur NPP Site is located in **Pabna district**, Ishwardi sub-district on the **Eastern bank of Padma River**. The NPP site territory is of irregular polygon shape of 750m length along the river and about 1200m from the bank. The area of the site is 105 hectares.

Location of Rooppur NPP

Although the RNPP site is located more than 300 km away either from the Indo-Burma subduction zone to the east or from the Himalayan collision zone to the north, these global-scale structures govern to a great extent the seismicity and seismic hazard in the site vicinities.



Geological Condition of RNPP site

The Rooppur NPP site has adverse soil and hydrogeological conditions because of the following reasons-

- the site is located under a **flooding zone** caused by groundwater since the **groundwater table** is directly linked to the waters of the Padma River (subject to seasonal variations of the Padma River);
- water-bearing soils have high permeability (permeability coefficient is 7 m/day, specific water inflow up to 0.57 l/s*m);
- the upper part (up to the depth of 20.0 m) of the geological section is comprised of **alluvial** loams and sandy loams with **low load-bearing capacity** and can settle under loads;
- **fine and silty sands** lie under the foundations of main buildings. These medium-density sands are micaceous, loose and contain silty-clayey material, and are dynamically unstable.

Site Characteristics (Hydrology)

On the basis of comprehensive hydrological, hydraulic and morphological studies of the site, the scenario of the **maximum probable flood (MPF)** formation has been determined. In prediction of the MPF scenario, the combination of all **possible hydrological events** were taken into consideration with probability of 0.01% (with frequency once per 10,000 years):

- (1) simultaneous flood peak occurrence **including precipitation** on all major river basins,
- (2) **Bay of Bengal water fluctuation (tidal) impact**,
- (3) further precipitation and sea level rise due to **global climate change** (global warming scenario) and
- (4) a **failure** of the **Farakka dam** located upstream the river Padma.

Based on the analyses, the design values of the **MPF** level is found **17.981m** elevation mark in the MSL (Mean Sea Level) system.

Site Characteristics (Hydrology)

According to relevant international guidelines, the general layouts of buildings and structures shall be at least 0.5 m higher than the design MPF level.

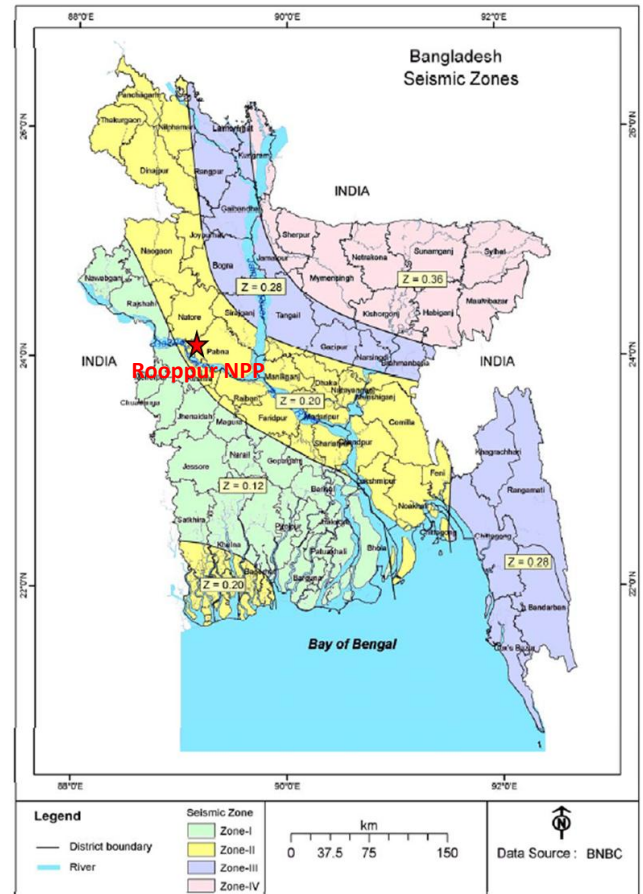
For Rooppur NPP, a **19.00 MSL** site level, **more than 1m** above the design MPF level, was considered to ensure site protection against flooding.

Moreover, through analyzing the site under-flooding due to ground waters, it was ensured that the **extreme level of ground waters** would reach at elevation **15.50 m MSL**.

To protect all buildings and structures of the 1st category against the ground waters, the Rooppur NPP design has provided reliable waterproofing of the underground parts of the buildings and structures up to the grade.

Site Characteristics (Seismic)

- Site-specific seismic hazard assessment in terms of intensity is equal to **7** on **MSK 64** scale at **Design Basis Earthquake (DBE)** impact and **8 (8.03)** on MSK 64 scale at Average **Safe shutdown earthquake** (SSE).
- In accordance with map of general zoning of Bangladesh (BNBC 2020) the site of Rooppur NPP located in zone with typical peak acceleration equal to **0.20g** with corresponds to degree of Intensity 7 in accordance with MSK 64 scale
- According to Terms of Reference the design level of seismic action was taken into account at Intensity of the **1.4 MDE (0.466g)**.



Site Characteristics

Tornado

Intensity class F 3,6



Hurricane

Design wind velocity id 120 m/s



Air shock wave with a front pressure of 30 kPa



Seismic inputs

SL2 - 8 points on the MSK-64 scale

SL1 - 7 points on the MSK-64 scale

Aircraft crash

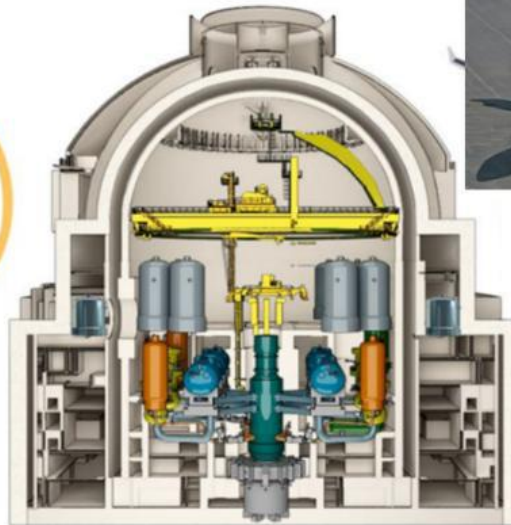
Lear Jet type - weight 5,7 t, velocity 100 m/s

Cessna type - weight 1,4 t, velocity 100 m/s



Flooding

With a level corresponding to an occurrence rate of > 0.01%



Design parameters of Rooppur NPP for Natural and Man-made Impacts

Design Requirements for Improved soil

Since the **in situ** properties of soils do not comply with the **design requirements** for buildings and structures of NPP Rooppur without additional measures, it was required to modify the natural properties of soils.

In situ Soil Characteristics at Rooppur NPP	Required Soil Characteristics for Rooppur NPP
Young's modulus at the depth 0 - 5m $E=5 - 9 \text{ Mpa}$ 5 -25 m $E=15 - 25 \text{ Mpa}$ 25 -40m $E=25 - 37 \text{ Mpa}$ deeper than 45m $E=37 - 142 \text{ Mpa}$	Young's modulus for long term $E \geq 100 \text{ Mpa}$
Angle of internal friction at the depth 0 - 5m $\phi= 17^\circ -29^\circ$ 5 -25 m $\phi=29^\circ -30^\circ$ 25 -40m $\phi=33^\circ -36^\circ$ deeper than 45m $\phi=36^\circ -39^\circ$	Angle of internal friction at the depth $\phi=35^\circ$ Unconfined compressive strength $R \geq 2\text{Mpa}$

Experiences of Stabilization

- In Rooppur, all the piles under one structure are overcut (270mm) with each other to make a solid ground for further foundation work. Special Drilling Rigs were used to make each pile (bore up to **20m** depth with a diameter of 2 meters).
- CEM-III type cement has been used for **Deep Soil Mixing** in the RNPP site.
- The total number of facilities is 163, whose substructures are treated with soil stabilization technology. A total of **43,43,666 m³** of soil was stabilized in the Rooppur NPP site with the total weight of consumed cement being 13,03,100 tonnes



THANK YOU

Any Question

Do you have any questions or comments for me before we conclude?

Back Up

Key Milestones of RNPP

BAERA NPP licensing steps are also consistent with INSAG-26:

