Country Nuclear Power Profiles
2022 Edition

BANGLADESH

(Updated 2022)

PREAMBLE AND SUMMARY

Bangladesh is a newcomer to nuclear power, with two power reactors under construction. The construction of country's first nuclear power plant (NPP) in the Rooppur, Pabna district started with the first concrete pouring (FCP) of the two reactor units on 30 November 2017 and 14 July 2018 respectively. The two units are WWER-1200 reactors and are expected to come into operation by 2024. Bangladesh has a long-term target to increase the share of nuclear power in the electricity generation-capacity mix to 12% by the year 2041.

This report provides information on the status and development of nuclear power programs in Bangladesh, including factors related to the effective planning, decision-making and implementation of the nuclear power program that together leads to safe and economical operation of nuclear power plants.

The CNPP summarizes organizational and industrial aspects of nuclear power programs and provides information about the relevant legislative, regulatory and international framework in Bangladesh.

1. COUNTRY ENERGY OVERVIEW

1.1. ENERGY INFORMATION

1.1.1. Energy policy

The government's policies in the energy sector will remain critical to the country's national security, economic development, and environmental sustainability. Energy demand in Bangladesh has been burgeoning and the country has become increasingly dependent on imported oil, and recently gas and coal, to sustain its economic growth.

Although gas will remain the main source of power generation, a more diversified mix is developing and sources also include coal, nuclear energy and renewable energy. Foreign financing of more than $20 billion from the China, India, Japan and the Russian Federation are expanding electricity capacity while the World Bank and the Asian Development Bank (ADB) have been supporting gas-to-power, transmission and distribution, and solar projects.

The 2016 Power System Master Plan (PSMP), sponsored by Japan International Cooperation Agency (JICA), is aimed at formulating an extensive energy and power development plan up to year 2041 and covers energy balance, power balance, and tariff strategies. The plan projects that electricity demands will be more than double during the period up to 2041, rising to 236 terawatt-hours (TWh) from the 2018 level of 79 TWh and driven by the expectation of a large increase in industrial electricity consumption.

Bangladesh faces a number of significant energy sector challenges including the following:

1. Meeting growing energy demand and moving to a cleaner energy mix. Bangladesh should continue to diversify its electricity mix, but it needs to reorient its strategy away from oil and coal by focusing on gas and renewable energy and by increasing energy efficiency. Given the growing demand for gas and the potential for declines in major gas fields, high priority should be given to increasing onshore and offshore gas exploration and development. Bangladesh should also reexamine its grid-based renewable energy targets, given new solar park models.

2. Collaborating with neighbors on regional electricity and gas networks. Bangladesh should continue to diversify its electricity imports while avoiding overdependence on coal-based energy from India. It should prioritize expanding gas and liquefied natural gas (LNG) trade links.

3. Improving sector governance and the regulatory environment. The government of Bangladesh needs to introduce more competition in the energy market, reduce subsidies, improve efficiencies in state companies, strengthen the role and competence of energy regulators, and develop a more attractive environment for private investment, particularly in domestic gas development and renewable energy.

4. Achieving financial viability in the power sector. Inadequate revenue generation by the distribution companies has created pressure on the Bangladesh Power Development Board (BPDB)—the power market's single buyer—and the government, which has had to cover the losses to maintain payments to the private generators. Bangladesh needs to increase revenues while ensuring energy remains affordable for people who have low incomes. This is a huge challenge but will have to be met if the distribution system is to meet growing demand.

The strategic priorities in the energy sector may be summarized as:

1. Diversify fuels. Given Bangladesh's heavy dependence on limited domestic gas supplies, the majority of new power supplies coming online include imported LNG, coal, nuclear energy, and regional electricity imports.

2. Attract financing and private sector participation. Bangladesh is looking at a wide range of investment options to meet future requirements, including green bonds and capital from insurers, pension funds, and sovereign wealth funds. In parallel, the government has put in place several incentives to enhance independent power producer (IPP) investment and is advancing the liberalization of private involvement in gas production.

3. Modernize grid infrastructure. Inadequate transmission and distribution systems, particularly in the southern and western regions of the country, create bottlenecks. There are plans to build 8,000 km of new transmission lines and 120,000 km of new distribution lines by 2021. Very high population densities are a challenge to these new developments, especially in Dhaka.

4. Harness renewable energy resources. Due to seasonal water flows and the limited land area, renewable energy sources are not seen as a primary contributor to the energy mix, although developments such as rooftop photovoltaic (PV) energy have potential.

5. Enhance energy efficiency. In a situation where demand exceeds available power at prevailing prices, energy efficiency improvements across the supply and demand chain can help to close the gap. The government's Energy Efficiency Master Plan prepared by SREDA aims to reduce primary energy consumption per unit of GDP by 15% by 2021, with a target of 20% by 2030.

6. Rationalize tariffs. The government has recognized the need to increase gas prices, which are heavily subsidized, that the power sector pays. In July 2019 the regulator raised average consumer prices by 33%, with the power sector receiving a 40% increase.

7. Expand regional cooperation for cross-border power trade. Bangladesh intends to import power from Bhutan, India, Nepal, and Thailand (via Myanmar). Bangladesh is doubling the capacity of its interconnection with India to 1 GW, and the government and its neighbors have begun exploring potential co-investments in hydropower plants.

1.1.2. Estimated available energy

Known commercial energy resources in Bangladesh include indigenous natural gas, coal and hydro-electricity. Biomass accounts for about 27% of the primary energy and the rest 73% is being met by commercial energy. Natural gas accounts for about 62% of the commercial energy (with 8% imported LNG). Imported oil accounts for the majority of the rest. In this year, Bangladesh imports about 8.5 million metric tons of crude and refined petroleum products. Apart from natural gas and crude oil, coal is mainly used as fuel in the brick-fields and thermal power plants. Moreover, power is also generated by using the solar home system (SHS) in on-grid and off grid areas [2].

The use of renewable energy has become popular worldwide in view of the depleting reserves of non-renewable fossil fuels. Renewable energy is environmentally friendly. Renewable energy resources used in Bangladesh may be classified into three major types- (i) traditional biomass fuels, (ii) conventional hydropower, (iii) new-renewable resources (e.g., solar PV, wind, biogas etc.) of energy.

The amount of solar energy available in Bangladesh is increased about 4 to 7 kWh/m^2 perday. There is a fast-growing acceptance of people in rural areas to solar photovoltaic (PV) systems to provide electricity to households and small businesses in off grid areas. Also, Bangladesh is exploring the potential of wind power. In the coastal area of Bangladesh, windmills with a capacity of 2.9 MW are in operation.

Average increase of energy consumption is about 6% per annum. Per capita consumption of energy in Bangladesh is on an average 334 kgoe (Kilogram Oil Equivalent) and per capita generation of electricity is 512 kWh with an access to electricity at 97 %, which is lower than those of South Asian neighboring countries.

TABLE 1. ESTIMATED AVAILABLE ENERGY SOURCES (2019-20)

	Petroleum	Natural Gas	Coal	Hydro	Uranium
Total	0.03billion barrels	10000 BCF	2083million tons	1.5TWh per year	—
Total in exajoules (EJ)	0.18	10.55	61.05	0.0054	—

—: data not available.

Source: The Global economy, Bangladesh oil reservehttps://www.theglobaleconomy.com/Bangladesh/oil_reserves/ [3]https://www.tbsnews.net/bangladesh/energy/we-have-gas-reserve-10-years-only-then-what-405470[4],https://en.banglapedia.org/index.php/Coal[5],

https://www.andritz.com/hydro-en/hydronews/hydro-news-asia/bangladesh[6]

1.1.3. Energy Consumption Statistics

TABLE 2. ENERGY CONSUMPTION

Final Energy consumption [PJ]	2000	2005	2010	2015	2020	Compound annual growth rate 2000–2020 (%)
Total	634	766	954	1 183	1 490	4.37
Coal, Lignate and Peat	14	18	23	83	229	15.07
Oil	113	132	135	163	193	2.70
Natural gas	149	195	310	368	458	5.77
Bioenergy and Waste	313	340	361	383	321	0.13
Electricity	45	80	124	186	290	9.78

-: data not available.

Source: United Nations Statistical Division, OECD/IEA and IAEA RDS-1 [7],

IEA World Energy Balances https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances [8]

1.2. THE ELECTRICITY SYSTEM

1.2.1. Electricity system and decision making process

The Bangladesh Power Development Board (BPDB) was created in 1972 and is a public sector organization. The Rural Electrification Board (REB) was established in 1978 as a semi-autonomous government agency.

As Dhaka grew in population and became a metropolitan city, the need for its own electricity grid led to the creation of the Dhaka Electric Supply Authority (DESA) in 1991. It was created to operate and develop the distribution system, bring improvements in customer service and revenue collection and lessen the administrative burden of BPDB. The Dhaka Power Distribution Company Ltd. (DPDCL) took over DESA activities in 2008 as part of an overall power sector reform to unite the energy system and produce a more competitive, reliable and efficient system. The Power Grid Company of Bangladesh (PGCB) was created in 1996 to own, operate and expand the national power grid. In 2003, PGCB completed the takeover and began the operation of all the transmission assets of BPDB and DESA. The PGCB is a public limited company and is 75% owned by BPDB; the remaining 25% is owned by institutional investors, the general public and foreign investors.

The creation of the Dhaka Electric Supply Company (DESCO) was also part of the reforms. It is a public sector company, and a subsidiary of DESA. However, in the future, its shares will be offered to other power sector entities and the general public.

The REB has 80 operating rural electric cooperatives called PalliBidyuitSamity (PBS). In 2021, BREB completed 100% electrification of all 462 Upazilas (461 Gris and one off-grid) of Bangladesh. About 13 crore population mostly in rural areas are the beneficiaries of REB. It has total 3.20 crore consumers and 5,38,000 km of distribution lines.

The oil and natural gas market is primarily operated by the Bangladesh Oil, Gas and Mineral Corporation, which holds the shares of all state-owned companies involved in oil and gas production and exploration, and the Bangladesh Petroleum Corporation (BPC) is responsible for the refining, distribution and import of crude oil and petroleum products.

The electricity sector of Bangladesh has undergone reform since the mid-1990s, including unbundling of the state-owned energy supplier, the BPDB, into separate companies responsible for power generation, transmission and distribution. At present BPDB is functioning as a single buyer, except for some direct power purchases from small IPPs. Multi buyer/competitive pools may be adopted when the market becomes mature and stable.

Since 1996, responsibility for the operation and expansion of the entire electricity transmission grid has lain with the PGCB, a subsidiary of the BPDP. Since the start of the power reform process in 1996, the DPDCL (formally the DESA) has shared electricity distribution operations in the capital with the DESCO. In addition, another power distribution company, the West Zone Power Distribution Company (WZPDC), was established in 2003 as a BPDB subsidiary and is responsible for the southwestern area of the country.

Although generation, transmission and distribution have been opened to foreign and private sector involvement, these sectors remain dominated by state-owned entities. BPDB accounts for over 70% of the electricity generated in Bangladesh. This share also includes the first BPDB-founded subsidiaries, such as the Ashuganj Power Company (APS), which originated with the transformation of the state-owned Ashuganj Power Station into a joint stock company in 2002. IPPs have been allowed to enter the market since 1996. Between 1998 and 2005, seven power plants belonging to IPPs started operation, providing an installed capacity of more than 1,290 MW and mainly fired by natural gas. These plants represent a 26% share in the country’s total electrical generating capacity. Actual planning envisages the construction of further power plants by non-state-run producers, or joint state and private providers, for a total output exceeding 1,590 MW. Self-generators account for 1.1 GW of installed capacity in Bangladesh.

Perspective Energy Plan of Present Government

The Perspective Plan of the Planning Commission of the government of Bangladesh for the period 2021–2041 has recommended an energy mix to achieve the generation of 56,734 MW by 2041. Targets of electricity production by 2025, 2030 and 2035 are 24,495 MW, 31,120 MW and 40,858 MW respectively. According to the Perspective Plan, the energy mix for power generation in Table 3, TABLE T1.

ENERGY MIX OF THE PERSPECTIVE PLAN 2021 – 2041 FOR POWER GENERATION

Energy Sources	Target Period	**2005**	**2010**	**2015**	**2020**	**Compound annual growth rate 2000-2020 (%)**
	2020	2021	2025	2030	2035	2041
Gas/LNG	47%	45%	35%	28%	36%	35%
Coal	28%	27%	29%	30%	29%	35%
Oil	18%	17%	16%	14%	6%	1%
Hydro	1%	1%	1%	1%	1%	1%
Nuclear	0%	0%	9%	11%	11%	12%
Cross Border	6%	9%	10%	17%	17%	16%

Source: The Perspective Plan for Bangladesh 2021-2041 [9]

ROLE OF INDIGENOUS FUEL IN POWER GENERATION

Energy Mix

Due to the low current state of primary energy resources, demand is not being met. In this context, the Government is formulating the Five-Fuel Strategy , of which the priorities are given below.

1. Undertake immediate exploration of hydrocarbon reserves and identify additional reserves that can meet the growing demand of gas by all consumer sectors.

1. Develop alternative commercial energy supplies suitable for power generation, especially coal, to ease the burden of fast-growing electricity demand on gas resources. Thus, a two-fuel (gas and coal) strategy is required for both resource diversification and energy security.

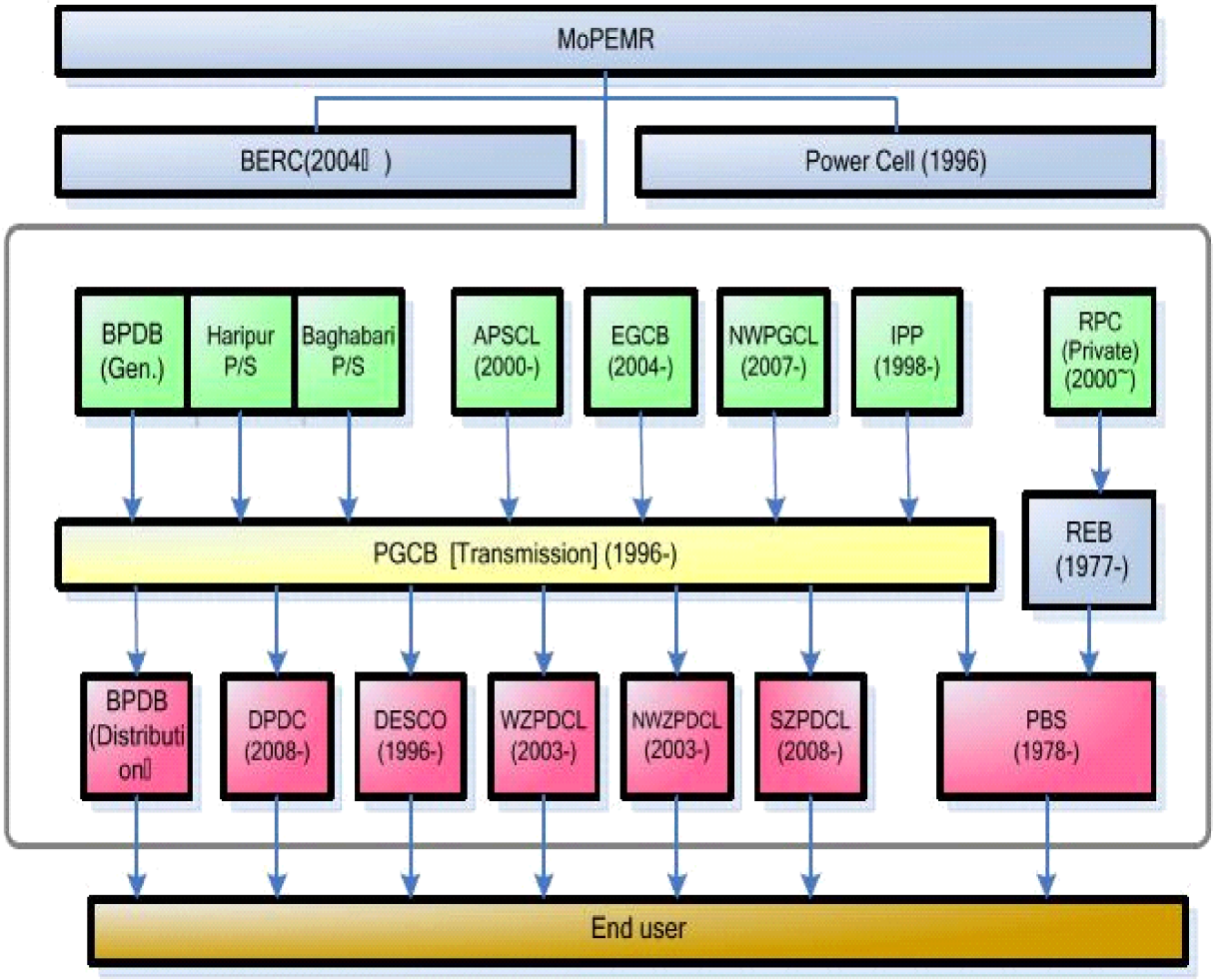
1. Ensure efficient use of energy by using energy–saving appliances, plants and equipment in order to effectively increase the stock of available energy supplies.

1. The resource potential of renewable energy is significantly larger than its present consumption and is a promising source of clean, convenient energy supply, especially in rural areas.

1. Considering the limitation of fossil fuel supplies, nuclear fuel could be a potential energy option for the country, as it is a proven technology for economic, reliable and sustainable electricity generation.

1.2.2. Structure of the electric power sector

In Bangladesh, MoPEMR Power Division manages the electricity business. Under its control, power is generated by the BPDB, power plants that are departments and subsidiaries of BPDB, IPPs, and private power generation companies (TABLE T2). Power is supplied through PBCB’s power transmission facilities to customers in local cities by BPDB, in the metropolitan area by DPDC and DESCO, and in rural areas by PBS. Note that distribution departments in local cities are being separated one by one. Fig. 1 shows the structure of the electric power sector in the country.



Note: ⟶ Power flow、

Abbreviation	List
MoPEMR	Ministry of Power, Energy & Mineral Resource
BERC	Bangladesh Energy Regulatory Commission
BPDB	Bangladesh Power Development Board
APSCL	Ashuganj Power Station Company Ltd.
EGCB	Electricity Generation Company of Bangladesh
NWPGCL	North-West Power Generation Company Ltd.
IPP	Independent Power Producer
RPC	Rural Power Company Ltd.
PGCB	Power Grid Company of Bangladesh
DPDC	Dhaka Power Distribution Company Ltd.
DESCO	Dhaka Electric supply Company Ltd.
WZPDCL	West Zone Power Distribution Company Ltd.
NWZPDCL	North-West Zone Power Generation Company Ltd.
SZPDCL	South Done Power Distribution Company Ltd.
REB	Rural Electrification Board
PBS	Palli Biddyut Samities

Source: "Electric Energy Situations in Foreign Countries" Vol.2 (2010) JEPIC BPDP Annual Report

Structure of electric power sector of Bangladesh

BANGLADESH ELECTRICITY GENERATION CAPACITY SCENARIO AS OF 2022

Ownership of Power Plants	Number of Power Plant	Installed Capacity (MW)
Government of Bangladesh	57	9996
Joint Venture	1	1244
Private Sector Organizations	94	9984
Import from neighbor country	-	1160
Total	**152**	**22348**

GENERATION

In order to mitigate the demand-supply gap, an aggressive plan has been prepared by the Government for new generation addition. As part of the plan, 35 power generation projects of 13387 MW capacity are now under construction.

TRANSMISSION AND DISTRIBUTION

Total lengths of 132 kV, 230 kV and 400 kV transmission lines are 8228 c-km, 3658 c-km and 950 c-km respectively. The total capacities of substations as of 2021 are as follows: 132/33 KV sub-stations, 29204 MVA; 230/22 KV sub-stations, 910 MVA; 230/132 KV sub-stations, 15175 MVA; 400/132 KV sub-stations, 1300 MVA; and 400/230 kV sub-stations, 3770 MVA. Total length of distribution line is 6,22,000 km and has 42,200,000 customers, (approximately) which covers the 100% of the electrification of the country.

1.2.3. Main indicators

TABLE 3. ELECTRICITY PRODUCTION

Electricity production (GWh)	2000	2005	2010	2015	2020	Compound annual growth rate 2000-2020 (%)
Total	15 771	26 447	40 832	59 103	85 613	8.83
Coal, Lignate and Peat	0	163	772	997	2 622	0.00
Oil	1 020	1 526	1 477	9 666	7 665	10.61
Natural gas	13 984	23 991	37 811	47 624	73 864	8.68
Bioenergy and Waste	0	0	0	0	0	0.00
Hydro	767	767	772	600	875	0.66
Nuclear	0	0	0	0	0	0.00
Wind	0	0	0	6	0	0.00
Solar	0	0	0	210	587	0.00

*Latest available data, please note that compound annual growth rate may not be representative of actual average growth.

**Electricity transmission losses are not deducted.

—: data not available.

Source: United Nations Statistical Division, OECD/IEA and IAEA RDS-1

—: data not available.

Source: United Nations Statistical Division, OECD/IEA and IAEA RDS-1 [10]

TABLE 4. ENERGY RELATED RATIOS

	2015	2016	2017	2018	2019	2020	2021
Nuclear/Total Electricity (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2. NUCLEAR POWER SITUATION

2.1. HISTORICAL DEVELOPMENT AND CURRENT ORGANIZATIONAL STRUCTURE

2.1.1. Overview

Peaceful uses of nuclear technology were initiated in Bangladesh in early 1960's under the framework of the then Pakistan Atomic Energy Commission (PAEC). After independence, Bangladesh became a Member State of the International Atomic Energy Agency (IAEA) in 1972. The Bangladesh Atomic Energy Commission (BAEC) was formed in 1973 with the goal of using of nuclear science and technology for national development.

The proposal for building a nuclear power plant (NPP) in the western zone of the country was first suggested in 1961. Since then, a number of feasibility reports establishes that the plant was technically and economically feasible. The Rooppur site was selected for the first NPP in Bangladesh. Due to limited resources and competencies, Bangladesh considered building the Rooppur NPP through an Inter-Governmental Arrangement (IGA). On 2 November 2011, Bangladesh signed an IGA with the Russian Federation for cooperation on construction of a NPP with two units, as well as in the establishment of necessary infrastructure to ensure the proper operation. BAEC is appointed as the customer for IGA on behalf of Bangladesh government. To implement the provisions of the IGA, a General Contract for construction of Rooppur NPP was signed between BAEC as the customer and Joint Stock Company Atomstroyexport (JSC ASE, an Engineering Company of ROSATOM) as the general contractor (see Fig. 2). The general contractor has taken the responsibility for design and working documentation, site preparation, supply of equipment, construction, commissioning and hand over to the owner after demonstration of its operation at rated capacity.

Some of the key milestones of Bangladesh National Nuclear Power Program:

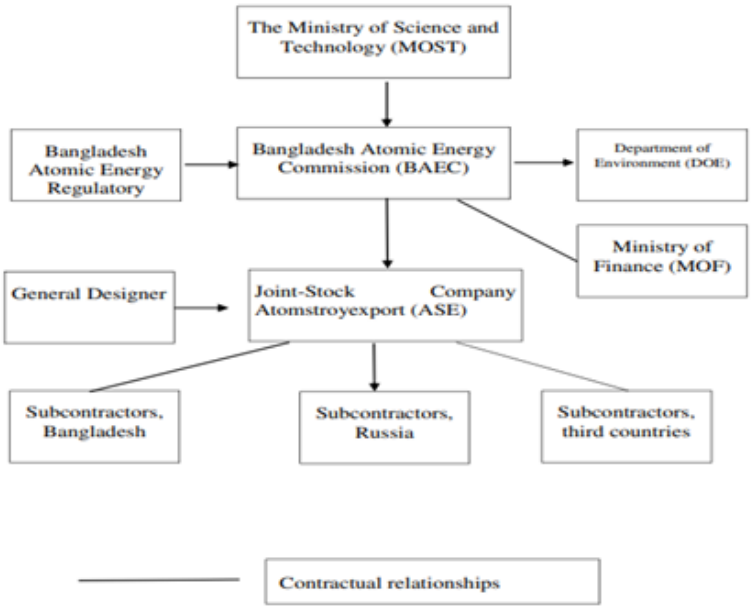
1963:	Rooppur site selected for the NPP.
1971–78:	Feasibility studies for site and first NPP conducted.
1987–88:	Further feasibility studies for site and first NPP conducted.
1996:	National Energy Policy identifies nuclear power as an option.
2000:	Bangladesh Nuclear Power Action Plan (BANPAP) was approved by the government.
2010:	National Parliament approves first NPP project and new structure for nuclear power program development (equivalent Nuclear Energy Programme Implementing Organization, NEPIO) were formed (National Committees, Technical Committee, Working Group).
2011:	IGA with the Russian Federation signed for the first NPP with two WWER-1000 units
2012:	Bangladesh Atomic Energy Regulatory Act 2012 was passed in the National Parliament on 19 June 2012.
2013:	Bangladesh Atomic Energy Regulatory Authority (BAERA) was formed as a separate entity on 12 February 2013.
2015:	A company named Nuclear Power Plant Company Bangladesh Limited (NPCBL) was formed on 18 August 2015. General Contract was signed with the Russian Federation for main stage construction of Rooppur NPP on 25 December 2015.
2016:	Inter-Governmental State Credit Agreement for financing the main stage construction of Rooppur NPP. ECNEC (Executive Committee of the National Economic Council) approved Construction of Rooppur NPP Project.
2017:	Agreement between the Government of the Russian Federation and the Government of the People's Republic of Bangladesh on Cooperation Concerning Return of Spent Nuclear Fuel from Rooppur Nuclear Power Plant to Russian Federation was signed on 30 August 2017. Design and Construction License for the Unit 1 of Rooppur NPP was issued by BAERA on 04 November 2017. Construction of the first unit of Rooppur NPP was started on 30 Nov 2017.
2018:	Design and Construction License for the Unit 2 of Rooppur NPP was issued by BAERA on 08 July 2018. Construction of the second unit of Rooppur NPP was started on 14 July 2018. Installation of core catcher of Unit 1 of Rooppur NPP on 18 August 2018.
2019:	Installation of core catcher of Unit 2 of Rooppur NPP on 03 May 2019. General Framework Agreement on Nuclear Fuel Supply for Rooppur NPP was signed on 06 August 2019 between BAEC and TVEL, JSC Russian Federation.
2020:	An amended protocol to the IGA was signed between the governments of Bangladesh and the Russian Federation which provides an opportunity to receive technical assistance from the Russian Federation for the commissioning, operation and maintenance of the Rooppur NPP. Reactor pressure vessel for Unit I arrived at Project Site on 10 Nov 2020.
2021:	A modern training center was launched at Rooppur NPP on 01 June 2021. Two complex polar crane beams installation on the rail track of Unit 1 was completed on 03 March 2021. Pressurizer of Unit 1 was installed on 6 June 2021. Four reactor circulation pumps of Unit 1 were installed on 20 June 2021. Reactor pressure vessel of Unit 1 was placed at the designed position on 10 October 2021. Four steam generators were installed in Unit 1 on 12 November 2021.
2022:	Turbo-generator stator was installed on 05 April 2022.

Source: RPV Installation Publication [11]

2.1.2. Current organizational structure

The following are the key organizations for the nuclear power sector in Bangladesh:

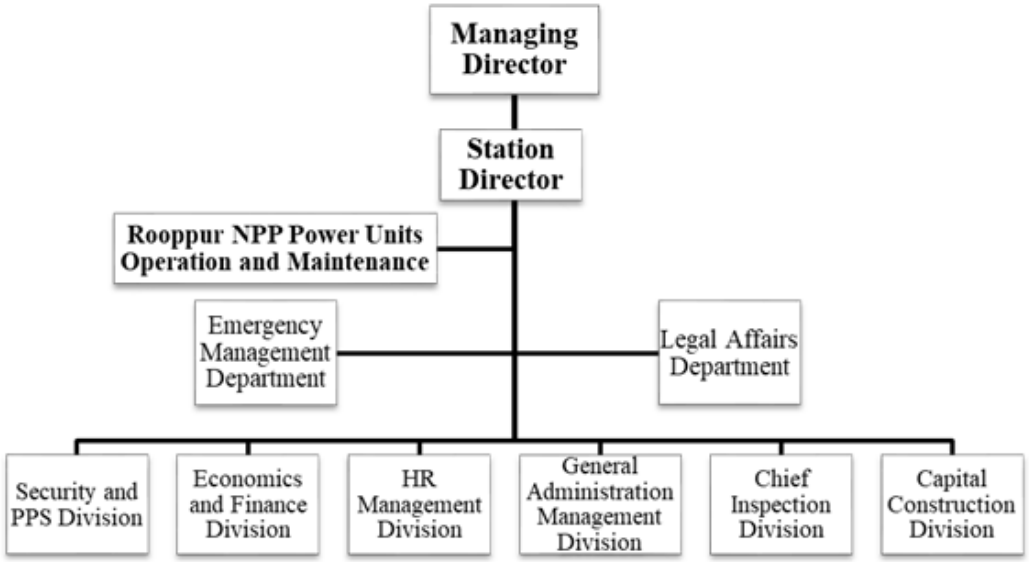
1. NEPIO-High Level Committee Headed by Hon'ble Prime Minister;
2. NPP Owner Organization (Licensee)-Bangladesh Atomic Energy Commission (BAEC);
3. Project Management Organization-Project Management Unit (PMU), BAEC;
4. Nuclear Regulatory Authority-Bangladesh Atomic Energy Regulatory Authority (BAERA);
5. Environmental Regulator-Department of Environment (DoE), Bangladesh;
6. NPP Operating Organization-Nuclear Power Plant Company Bangladesh Limited (NPCBL) (see Fig 3).



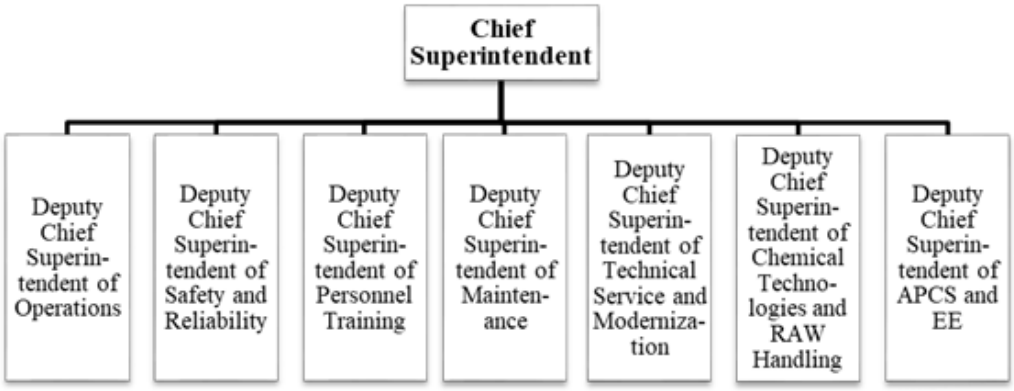
External interaction of organizations to Rooppur NPP constructions

Organizational structure of NPCBL

During operation phase, Rooppur NPP will be operated by NPCBL. Management and organizational structures of Rooppur NPP are shown in Figs 4–5:



Organizational structure for management of Rooppur NPP



Organizational structure for operation and maintenance of Rooppur NPP

2.2. NUCLEAR POWER PLANTS: OVERVIEW

2.2.1. Status and performance of nuclear power plants

TABLE 5: STATUS AND PERFORMANCE OF NUCLEAR POWER PLANTS

Reactor Unit	Type	Net Capacity [MW(e)]	Status	Operator	Reactor Supplier	Construction Date	First Criticality Date	First Grid Date	Commercial Date	Shutdown Date	UCF for 2021
ROOPPUR-1	PWR	1080	Under Construction	NPCBL	AEM	2017-11-30					0
ROOPPUR-2	PWR	1080	Under Construction	NPCBL	AEM	2018-07-14					0

2.2.2. Plant upgrading, plant life management and licence renewals

BAERA and NPCBL are in charge of plant upgrading, plant life management and license renewals.

2.2.3. Permanent shutdown and decommissioning process

Not Applicable.

2.3 FUTURE DEVELOPMENT OF NUCLEAR POWER SECTOR

2.3.1. Nuclear power development strategy

Bangladesh has already considered nuclear power being one of the options for meeting the country's expanding energy demands. For Bangladesh's nuclear power infrastructure development, the IAEA milestone approach may be the ideal technique and guiding instrument. International collaboration is also necessary.

Bangladesh government approved the National Nuclear Action Plan (BNPAP) in 2000 to accomplish the goals outlined below for the early implementation of the nuclear power project in the country. The primary goal of this document is to determine:

- Various actions required for the implementation of the nuclear power program;
- The organizations in charge of each of these activities;
- Measures, such as finance, that are needed to carry out the activities.

Bangladesh is currently amending and upgrading the BANPAP in light of national and international nuclear power program developments.

During April 2017, a MoU was signed between Bangladesh and the Russian Federation on Mutual Assistance in Returning Spent Fuel of Rooppur Nuclear Power Plant to Russia. A cooperation agreement was signed with Bangladesh and the Russian Federation on 30 August 2017 to return the spent fuel of Rooppur nuclear power plant to the Russian Federation.

The Design and Construction License of Rooppur Nuclear Power Plant was given in favor of Bangladesh Atomic Energy Commission by the Bangladesh Atomic Energy Regulatory Authority through a ceremony on 4 November 2017.

Honorable Prime Minister of Bangladesh inaugurated the first concrete pouring of Unit 1 of Rooppur Nuclear Power Plant on 30 November 2017. As a result, Bangladesh has initiated the construction of a nuclear power plant and the country has entered the “nuclear power club”. It is expected that the Rooppur Nuclear Power Plant will supply power to the national grid starting in 2023. Also, the first concrete pouring of Unit 2 was also inaugurated by Honorable Prime Minister of Bangladesh on 14 July 2018. [14]

To support the working group which will determine and compete the necessary work procedures for the Implementation of Rooppur Nuclear Power Plant Project, Government of the Peoples’ Republic of Bangladesh has made eight working subgroups [15]:

- International Obligations, Legal and Regulatory Aspects and Nuclear Safety and Security
- Ownership/Institutional Framework
- Nuclear Fuel Cycle and Management of Radioactive Waste and Decommissioning
- Development of Human Resources
- National Participation
- Financing and Procurement
- Grid System Development
- Heavy Equipment transportation Planning.

2.3.2. Project management

The Nuclear Power Plant Act of 2015 and the Bangladesh Atomic Energy Regulatory Act of 2012 have been used to establish a plan for implementing management systems within the Operator, the Regulator, and TSOs. BAEC understands the importance of management system adoption and has a clear policy statement. The task has been delegated to a distinct division, the quality management division (QMD). Project Management Unit (PMU) management systems are based on the Bangladesh government's Annual Development Program (ADP) project and encompass execution, monitoring, reporting, control, and risk management, as well as communication.

Rooppur NPP Project Management includes :

- Project Steering Committee (PSC) and Project Implementation Committee (PIC) for project implementation;
- National Committee, Technical Committee, Working Group, Sub-group, fast track monitoring committee, fast track task force etc. for project monitoring;
- Project Management Unit of Rooppur NPP for project execution (Figure 6);

Bangladesh Atomic Energy Commission (BAEC) has been appointed as the owner organization of NPP by:

- the Presidential Order 15, 1973;
- Bangladesh Nuclear Power Action Plan, 2000;

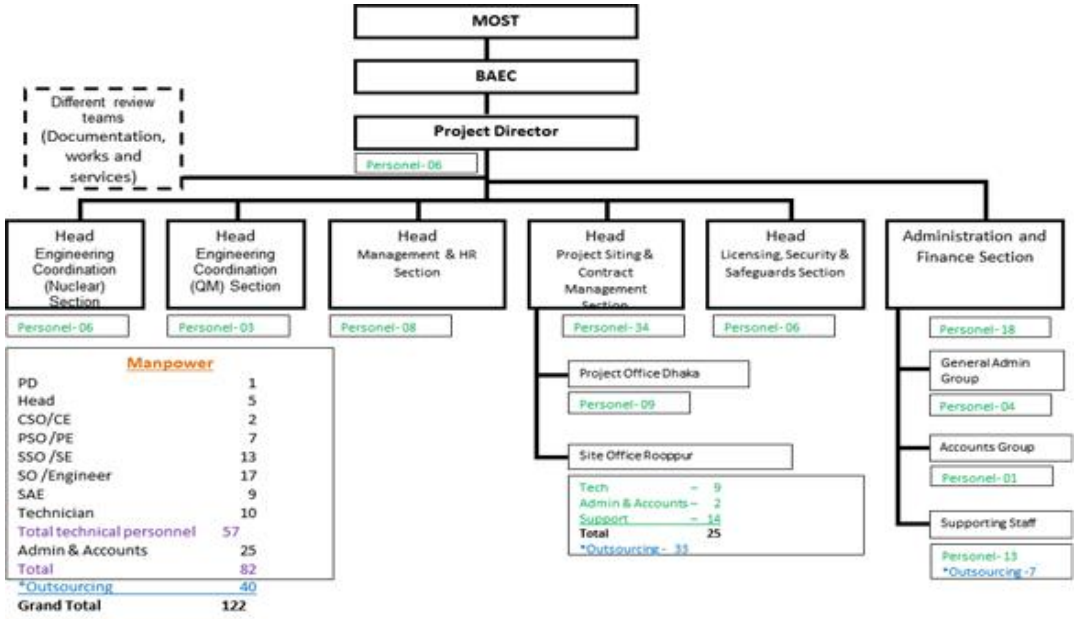
- IGA between the Russian Federation and Bangladesh, 2011;
- Nuclear Power Plant Act, 2015;

Operating Organization:

- Nuclear Power Company of Bangladesh Limited (NPCBL) is the operating organization by the Nuclear Power Plant Act, 2015

Description of Project Management System:

- Service Regulation: Implementing organization of Rooppur NPP Project is BAEC;
- Project Document: Development Project Proposal (DPP) for the construction of Rooppur NPP (First Phase) has already been implemented and DPP for the main stage of Rooppur NPP Construction is being implemented.



Current project management structure for Rooppur NPP construction

THE PROJECT MANAGEMENT COMMITTEE

Sl. No.	Designation of person	Role
	State Minister, Ministry of Science and Information & Communication Technology	Advisor
	Secretary, Ministry of Science and Technology	Convener
	Secretary, Economic Relations Division/Nominated Joint Secretary	Member
	Secretary, Legislative and Parliamentary Affairs Division/Nominated Joint Secretary	Member
	Secretary, Power Division/Nominated Joint Secretary	Member
	Additional Secretary, Finance Division, Ministry of Finance (Treasury and Debt Management)	Member
	Chairman, Bangladesh Atomic Energy Commission (BAEC)	Member
	Joint-Chief, PAMSTEC Wing, Planning Commission	Member
	Member, Planning and Development, BAEC	Member
	Member, Engineering, BAEC	Member
	Dr. Mohammad Shawkat Akbar, Director, Nuclear Power and Energy Division, BAEC	Member
	Joint-Secretary, Ministry of Science and Technology	Member-Secretary

2.3.3 Project funding

It was necessary to prepare a financing plan, which includes necessary infrastructure, all site studies and the construction of the plant, in the light of the signed agreement with the Russian Federation, in order to estimate the actual cost of the implementation of Rooppur NPP Project On 2 November 2011, the Government of the Russian Federation and the Government of the People's Republic of Bangladesh signed Agreement on cooperation for the construction of a NPP on the territory of the People's Republic of Bangladesh. An agreement was signed on 15 January 2013 between the Government of the People's Republic of Bangladesh and the Government of the Russian Federation on the extension of a state export credit to the Government of the People's Republic of Bangladesh for financing of the preparatory stage for construction of a NPP in the People's Republic of Bangladesh. The credit is now used by Bangladesh during 2013 – 2016.

Bangladesh has a plan for a two-stage construction approach. The stages are as follows:

- Siting assessment to first concrete;
- Construction and commissioning.

The siting assessment to first concrete pouring for Unit 1 was finished at the end of 2016 and was done under a turn-key package. The first stage has four sub-phases:

- Feasibility Evaluation, Environmental Impact Assessment and site engineering survey;
- Permit of the site license and the detailed project report;
- Design and documentation (e.g. preparations of PSA, and PSAR);
- Excavation, priority civil construction and erection.

Recently the General Contract for main stage construction and commissioning of Rooppur NPP was signed between Bangladesh and the Russian Federation. The contract price is US$12.65 billion, 90% of which is supposed to be sanctioned by the Russian Federation through a state credit agreement, is also going to be signed very soon.

The Russian Federation and Bangladesh signed an US$11.38 billion credit agreement during July 2016, initiating the Rooppur Nuclear Power Project's major construction work. The Russian loan covers 90% of the project costs and has a LIBOR plus 1.75 percent interest rate. The interest rate will not be higher than 4%. The payback duration is 30 years, including a 10-year grace period. In 2017, disbursement was commenced. [14] [16]

THE MEMBERS OF THE WORKING FINANCING AND PROCUREMENT SUB-GROUP

Sl. No.	Designation of person	Role
	Secretary, Ministry of Science and Technology	Convener
	Prime Minister’s Office (one representative)	Member
	Ministry of Foreign Affairs (one representative	Member
	Legislative and Parliamentary Affairs Division (one representative)	Member
	Finance Division (one representative)	Member
	Economic Relations Division (one representative)	Member
	Ministry of Industries (one representative)	Member
	Ministry of Commerce (one representative)	Member
	CPTU, IMED (one representative)	Member
	Deputy Technological Adviser, Ministry of Science and Technology (one representative)	Member
	Bangladesh Atomic Energy Commission (two representatives)	Member
	Bangladesh Atomic Energy Regulatory Authority (one representative)	Member
	Project Director, Construction of Rooppur Nuclear Power Plant Project, Bangladesh Atomic Energy Comission	Member-Secretary

Source: Bangladesh Government Gazette No. 04.00.0000.611.06.002.19.150, Web link: http://www.dpp.gov.bd/upload_file/gazettes/32159_27702.pdf[15]

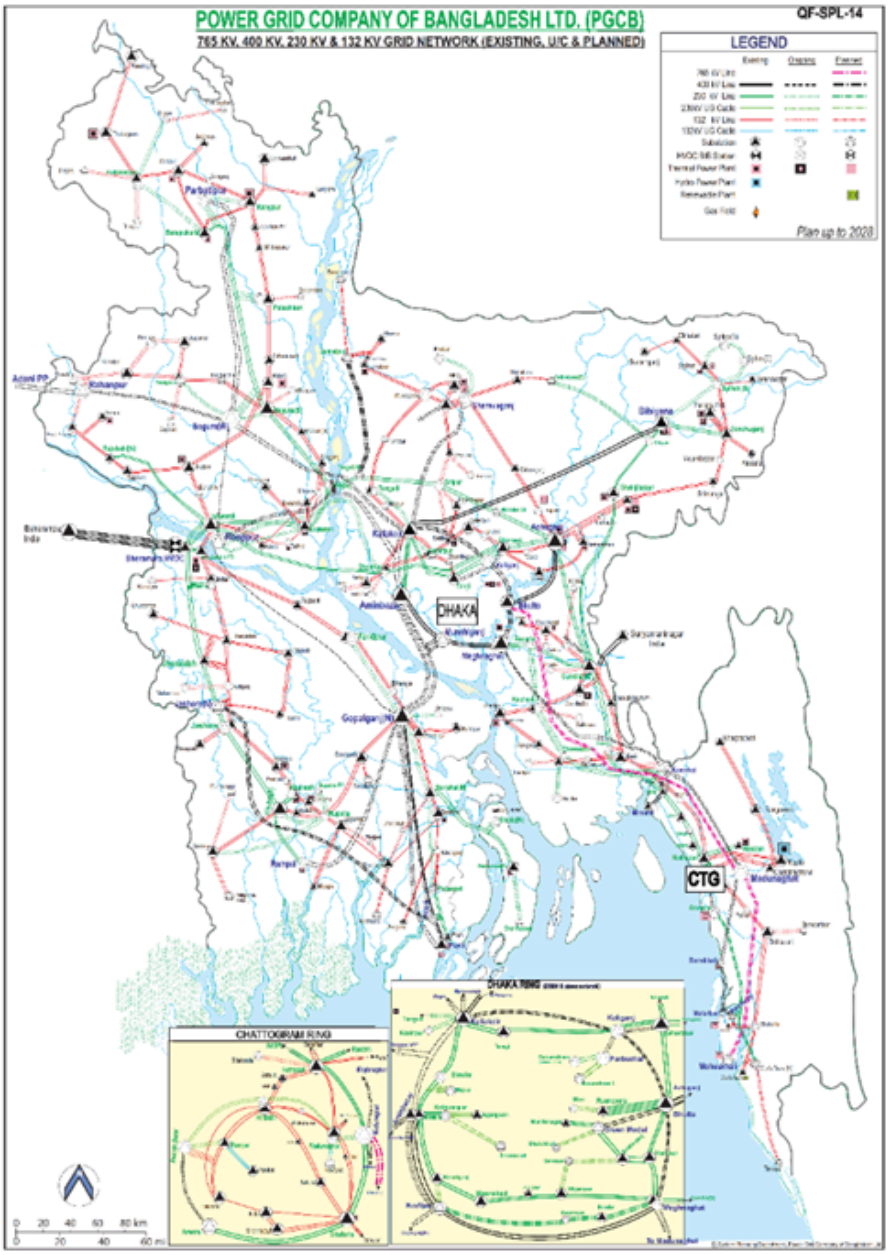
2.1.4. Electric grid development

The entire power grid of Bangladesh is monitored and controlled by Power Grid Company of Bangladesh Ltd. (PGCB). The power grid of the entire country is controlled from National Load Dispatching Centre (NLDC) located in Aftabnagar, Rampura, Dhaka. PGCB has a grid development project currently ongoing for the preparation of the grid tie of the two units of Rooppur NPP named Infrastructure development for Accommodating Rooppur NPP (IDRNPP). The objective of this project is to ensure power evacuation from Rooppur Nuclear Power Plant (RNPP) and the qualitative upgrade of the Bangladesh power system for the integration and safe operation of Rooppur Nuclear Power Station. The scope of work under this project are

- 400 kV Transmission Lines: 464 km (13 km river crossing),
- 230 kV Transmission Lines: 205 km (7 km river crossing),
- 400 kV Bay Extensions: 4 nos,
- 230 kV Bay Extensions: 5 nos

to implement the frequency control and frequency drop protection, protection system, emergency control system and other associated tasks for the qualitative upgrade of Bangladesh Power System.

The estimated project duration is from April 2018 to December 2023. Currently the construction of one of the 230 kV back feed line is almost ready to be completed. [18]



Bangladesh electricity grid map (As of January 2022 and the plan up to 2028) [17]

2.3.5. Sites

SITE SAFETY REPORT OF THE UNDER CONSTRUCTION ROOPPUR NUCLEAR POWER PROJECT

Bangladesh prepared a draft site safety report on Rooppur NPP in 2000. BAEC conducted the following site specific studies of the Rooppur NPP while it is under construction to estimate the specific safety parameters required for designing and constructing the NPP.

Site specific geological, geophysical and geotechnical study of the Rooppur Nuclear Power Project

1. Review of geology and fault information; Compilation of earthquake database; Analysis of seismic source and seismicity characteristics; Probabilistic seismic hazard assessment (200, 475, 975, 2475 years);

2. 1D Site response analysis (Site specific) study; Development of site-specific response spectrum;

3. Determination of liquefaction resistance by cyclic triaxial test;

4. Assessment of liquefaction potential of the site;

5. Supervision of Geophysical Investigation by P-S logging;

6. Analyses of Soil Stabilization and Slope Stability.

BAEC had made agreements with the Bureau of Research, Testing and Consultation (BRTC), Bangladesh University of Engineering and Technology (BUET), Ground Water Hydrology Division (GWH), and Bangladesh Water Development Board (BWDB) to perform services in respect of above-mentioned study.

Summary of the Study:

- Tectonically Bangladesh is divided broadly into three (3) divisions:

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 - Stable Shelf (in the northwest),
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 - Bengal Foredeep (in the center),
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 - Chittagong-Tripura Belt (in the east).
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- In addition, there is a southwest-northeast trending Hinge Zone that is 25 km wide separating the Bengal Foredeep from the Stable Shelf. The NPP site at Rooppur is located near this Hinge Zone in the Stable Shelf part.

- During the last decade, the occurrence and damage caused by a number of earthquakes (magnitudes between 4 and 6) inside the country or near the country's border, has raised the awareness among the general population and the government. These earthquakes are located far away from the Rooppur site.

- There is no indication of surface faulting around the site;

Study on site related hydrological and morphological characteristics of the Ganges River in the vicinity of the site and the flooding effect due to global climate change impact and major human interventions

BAEC prepared a report on hydrological and morphological characteristics of the site area in collaboration with the Institute of Water Modelling IWM) whose summary is given below.

- Global climatic change has significant impact at the project area from hydrological and hydraulic points of view (depth and extent of flood). There is no impact of a tsunami at the power plant site.

- Due to construction of the proposed Ganges Barrage, the water level will be up to 17 m PWD. The crest level of existing embankment and pakshey bridge guide bund is 16.5 m PWD and 16.7 m PWD respectively.

- There is no hydraulic impact at the Rooppur NPP site due to the Gorai River Restoration Project.

- Using a certain global warming scenario, it was computed that the water level would be over 18 m PWD in the vicinity of Rooppur NPP site, while the existing embankment height is 16.5 m PWD.

- Possibility of left bank erosion of Ganges River at Rooppur NPP site is insignificant.

- The recommended location for the intake point is 401177.95 m east and 659569.00 m north.

- The recommended location for the outfall point is 403952.90 m east and 659543.00 m north.

Construction of first NPP is under development in Rooppur which is in the northern region of Bangladesh. Site selection for the second NPP is going on in the southern region [19, 20]. Seismological, hydrological, hydrogeological and meteorological surveys on the identified sites including land size, land type and composition, use and sustainability, population, human settlements, industrial plants, toxic chemicals have been conducted. Storage, government, autonomous and military installations, airport location, communication system, transportation system, environmental regulations, load center, electric transmission, distribution and power grid location have been explored. After completion of data collection and analysis of parameters including rainfall, temperature, humidity, wind speed, cyclone, flood and quality information in surface water, five sites in Patuakhali and Barguna have been short-listed at the latest stage.
These potential sites are
(i) Nishanbari (East) of Borbogi union, Taltoli, Borguna;
(ii) Nishanbari (West) of Borbogi union, Taltoli, Borguna;
(iii) Kumirmara, BorgunaSadar;
(iv) Moudubi, Rangabali, Patuakhali;
(v) Char Montaz, Rangabali, Patuakhali.

The issue of safety and security of the site

The issue of safety and security in siting, designing, construction and operation phases of NPP has to be given top priority. Safety from radiological hazard is also crucially important for Bangladesh. According to National Nuclear and Radiological Emergency Preparedness and Response Plan (NNRERP)" the Rooppur NPP is divided into three (3) zones.

On-Site/Exclusion/Sanitary Protection Zone: In the Rooppur NPP of Bangladesh, based on design and technology of the third generation plus nuclear reactor, the On-Site/Exclusion Zone/ Sanitary Protection Zone is considered to have a 300 m radius.

Off-Site Emergency Planning Zones: Off-site zones are categorized into following zones:

Sterilized Zone/ Restricted Zone/ Precautionary Action Zone (3 km radius)

Emergency Planning Zone / Protective Measures Planning Zone/Urgent Protective Action Planning Zone (25 Km radius)

Surveillance Area (SA), for protecting the food chain and water supply as well as for protecting the public from the ingestion of contaminated food, milk and drinking water etc. (12.5 km radius).

On-Site at an NPP, the Automated Radiation Monitoring System (ARMS) will give the radiation safety assurance of the NPP through radiation situation monitoring during all operating modes of the NPP, including design and beyond design basis accidents. ARMS also will be linked-up with the off-site monitoring. In the off-site zone and within the surveillance/observation zones (12.5 km) the radiation monitoring values will be obtained from 23 Automated Environment Radiation Monitoring System (AERMS) posts.

2.3.6. Public awareness

To increase the public awareness, following tools are used

- Seminars and lectures,

- Fairs,

- Quizzes and Competitions,

- Information materials,

- Audio and video documentaries,

- Print media,

- Websites,

- Social media,

- Nuclear bus tours,

- Information centers.

- Note that planning for nuclear power at the Rooppur site has been ongoing for nearly 50 years with no public opposition and with support of the local community. A previous newspaper poll showed 65% of the public are in favour, and a poll of students in Dhaka and around the site showed 60% are in favour. The BAEC website has information on the Rooppur NPP project, including the national justification. BAEC's scientific information office responds to questions and inquiries regarding the Rooppur NPP.

2.4. ORGANIZATIONS INVOLVED IN CONSTRUCTION OF NPPs

BAEC is the owner organization of Rooppur NPP. NPED of BAEC is implementing the project. Employees of NPCBL are also a part of the project. Employees of project perform supervisory work from customer side. BAERA is the regulatory authority. JSC Atomstroyexport is the general contractor of Rooppur NPP. Major equipment manufacturers of RNPP are LLC Atommash (reactor and steam-generator), JSC Power Machines (turbine, turbo-generator, condenser, deaerator) and JSC Tyazhmash (core-catcher). A bunch of sub-contractors are involved in construction, installation and commissioning work (i.e. LLC TREST ROSSEM, JSC NIKIMT-Atomstroy, LLC ESKM AK CORPORATION, LLC SMU, LLC ESM, LLC VdMU, JSC Atomtechenergo).

2.5. ORGANIZATIONS INVOLVED IN OPERATION OF NPPs

Bangladesh Atomic Energy Commission is the owner of the Rooppur NPP. The Nuclear Power Plant Company of Bangladesh (NPCBL) has been formed to perform as the operator of Rooppur NPP along with other future NPPs setup in the territory of Bangladesh. An amended protocol to the IGA provides an opportunity to receive technical assistance from the Russian Federation for the commissioning, operation and maintenance of the Rooppur NPP.

2.6. ORGANIZATIONS INVOLVED IN DECOMMISSIONING OF NPPs

According to Nuclear Power Plant Act, 2015 (No 19 of 2015), NPCBL will be responsible for decommissioning of Rooppur NPP and all the NPPs that will be constructed in future. IGA between Bangladesh and Russian Federation paves the way for mutual co-operation in the field of decommissioning of NPP.

2.5. FUEL CYCLE INCLUDING WASTE MANAGEMENT

Bangladesh is not operating any NPP. Currently the construction of Rooppur NPP is going on. Radioactive wastes are being generated through the operation and maintenance of a 3MW_t TRIGA MARK-II research reactor, radioisotope production labs, 14MeV neutron generator, research and commercial irradiators, different industries, research labs (such as INST, AECD, IFRB, ICDDRB, etc.), universities, agricultural applications, etc. In addition, several isotope production and usage facilities in medicine produce various sorts of LLW. The waste management program is focused on the research reactor and industrial uses of radiation/nuclear sources.

BAEC has established the Central Radioactive Waste Processing and Storage Facility (CWPSF) in the campus of Atomic Energy Research Establishment (AERE; Savar) under the Government Annual Development Project and the IAEA Technical Co-operation Project (BGD/4/022, 2001-2004).

The functions of this facility are collection, segregation, packaging, conditioning, treatment, and storage of low and intermediate level radioactive wastes from different nuclear facilities.

The design of the facility was based on the IAEA generic reference design.

Approximately 7m^3 of LILW have been collected and safely stored at CWPSF. CWPSF is expected to serve the waste management needs in the country, and it may be turned into an international level training centre in the field of radioactive waste management. The facility is expected to be helpful in piloting waste management tasks in large scale and in the near future. This facility has license from regulatory authority (BAERA).

For Rooppur NPP, a strategy for fuel cycle has been established through the IGA between the Russian Federation and Bangladesh. Under the IGA, the Russian Federation will cooperate with Bangladesh on the long-term supply of nuclear fuel and repossession of spent fuel. Furthermore, the Russian Federation will cooperate in the management of radioactive waste and decommissioning of NPP units.

Uranium enrichment of fuel not greater than 5% will be used in RNPP. Maximum in house storage life of spent fuel is 10 years. The refueling period for RNPP will be 12 or 18 months depending on the supplied fuel.

During NPP operation, a certain amount of radioactive waste (approximately 95m^3) will be generated per one power unit per one year. Several treatment methods will be taken to reduce the final volume of rad waste. The treatment facility and the interim storage (00UKS) of solid and solidified rad waste is provided at the NPP Site. High level RAW will be stored in the RW storage facility for the entire NPP service life.

2.7. RESEARCH AND DEVELOPMENT

2.7.1. R&D organizations

BAEC has been engaged in R&D in various fields of peaceful applications of nuclear techniques since the early 1960s. Introduction of nuclear power in the country has always been a priority area. Development of human resources for the programme was initiated in the 1960s with the assistance of the IAEA, which is still on going. Activities now encompass the following areas:

1. Medicine: One institute and nine nuclear medicine centres have been established in different parts of the country.
2. Agriculture
3. Food and medical products
4. Industry
5. Radio-tracer techniques
6. Radiation processing technology
7. Vulcanization of rubber latex
8. Radioisotope production
9. Development of nuclear analytical science
10. Research reactor: A 3 MW research reactor has been installed for conducting research, training of personnel and production of short-lived radioisotopes for medical uses. It may be mentioned that in spite of its being the first major nuclear facility in the country, the local participation in its implementation was significant. Appropriate research laboratories based on the reactor facilities, such as radioisotope production, neutron activation analysis, neutron radiography, neutron spectrometry for elemental and structural analysis of materials are being developed.
11. Exploration of nuclear and other related minerals: Prospecting of nuclear and related minerals is included in the overall programme of the BAEC. Surveys were conducted in the past in various regions of the country to ascertain the possibilities of finding uranium and thorium. This survey helped identify some areas where such materials are available at various levels of concentration. Extensive surveys, including drilling, are needed to ascertain the extent of reserves and the prospects of their mining on a commercial scale.
12. Tissue banking and bio-materials
13. Isotope hydrology
14. Element analysis by Van de Graaff and tandem accelerator facilities

BAEC's overall R&D programs are formulated in two distinct tracks, namely (a) solutions addressing the needs of national development and (b) basic R&D. Of these tracks, the first track is now being given higher priority. This will also be evident from the direct link between BAEC and the Ministry and the Planning Commission, which ensures that national goals and development targets are featured in its programs and projects.

Over the years, the IAEA has been a partner-in-development in most of the leading BAEC institutes. This has meant a continuing relationship between the IAEA and various institutes at Savar and at AECD. Broadly speaking, the program at Savar covers research reactor commissioning and its utilization for isotope production, 1.85 PBq Co-60 irradiation, neutron activation analysis and neutron radiography. Nuclear analytical facilities and laboratories for repair and maintenance of nuclear instruments have been established both at Savar and at AEC, Dhaka. Utilization of Van de Graaff accelerator at AECD was also supported by the IAEA. The NDT program at AECD; the isotope hydrology at Savar; and the food preservation, pest control, radiation sterilization of pharmaceuticals, tissue banking and agrochemical residue analysis programs at the Institute of Food and Radiation Biology have also been well supported.

2.7.2. Development of advanced nuclear power technologies

The plasma physics division is the newest division of the Atomic Energy Center (Dhaka), which began in January 2016 for promoting fundamental, advanced and applied research works in the related areas of plasma physics. Hence, the major objective of the plasma physics division is to build up capacity in plasma research and plasma-based technology development.

The division is actively engaged in theoretical, computational and experimental aspects of research including, fundamental plasma physics, dusty plasmas, quantum plasmas, industrial plasmas, dense plasma focus device and controlled thermonuclear fusion.

2.6.3. International cooperation and initiatives

- Membership in international organizations: Bangladesh became a Member State of the IAEA in 1972. It also became the 40th Member of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) in 2014.
- International agreements: Bangladesh demonstrated the commitments to the international nuclear non-proliferation and verification regime, such as NPT, Bilateral Safeguard Agreement with the IAEA, the Protocol Additional to Safeguards Agreement, and the Comprehensive Test Ban Treaty (CTBT). Please see Appendix 1.
- Past technical co-operation with IAEA: Under MOST, BAEC is the national focal point for the IAEA including its Technical Cooperation (TC) program, which so far has covered almost the entire range of BAEC activities, especially those which have direct relevance to the national development agenda. The total assistance provided during years 1991–2000 amounted to approximately US$6.885 million. More than half of this assistance (53.87%) was devoted to the human resources development and the reminder was provided in the form of equipment and subcontracts. In regard to the area-of-activity, 88% of the assistance was provided in five areas, namely: agriculture (24.2%), application of isotopes and radiation in medicine (21.2%), nuclear engineering and technology (20.3%), nuclear safety (13.1%), and industry and hydrology.
- Ongoing technical co-operation with IAEA:

T5 12. 2012–14

Sl No	Project Code	Project Title
1	BGD/5028	Assessing crop mutant varieties in saline and drought prone areas using nuclear techniques
2	BGD/8/018	Strengthening oncology department of Bangabandhu Sheikh Mujib Medical University

T6. 2012-2013

Sl No	Project Code	Project Title
3	BDG/1012	Implementing an Ageing Management Programme for the TRIGA Research Reactor of Bangladesh
4	BGD/6022	Production of Therapeutic Radiopharmaceuticals
5	BGD/9012	Strengthening Occupational Radiation Protection
6	BGD/2012	Establishing Nuclear Power

T7. 2014-2016

Sl No	Project Code	Project Title
7	BDG/2014	Infrastructure Development for the First Nuclear Power Plant in Bangladesh: Preparatory Stage Construction and Erection Phase
8	BGD 2016	Developing Infrastructure and Support Systems for a Nuclear Power Plant During the Various Stages of Construction

T8. 2020-2023

Sl No	Project Code	Project Title
9	BDG 2018	Developing Infrastructure and Support Systems for a Nuclear Power Plant During the Various Stages of Construction-Phase II
10	BGD 2020	Infrastructure Development for the First Nuclear Power Plant in Bangladesh: Commissioning and Start-Up

- Intergovernmental agreement with India: In April 2017 BAERA signed an agreement with India's Atomic Energy Regulation Board (AERB) on the exchange of technical information and cooperation in the regulation of nuclear safety and radiation protection. Three nuclear energy agreements between Bangladesh and India were signed in April 2017. These comprise a nuclear cooperation agreement between Bangladesh's Ministry of Science and Technology and India's Department of Atomic Energy (DAE), a regulatory cooperation agreement between BAERA and India's AERB, and an agreement between BAEC and DAE's GCNEP on "cooperation regarding nuclear power projects in Bangladesh" [21]

- Bangladesh signs a Country Programme Framework (CPF) for 2018–2023: A CPF is the frame of reference for the medium-term planning of technical cooperation between a Member State and the IAEA and identifies priority areas where the transfer of nuclear technology and technical cooperation resources will be directed to support national development goals. [22]

2.8. HUMAN RESOURCES DEVELOPMENT

The development of required human resources for the nuclear power program is considered in the following ways:

- Educational institutions in Bangladesh (public universities, private universities, Bangladesh Technical Education Board etc.);
- Educational institutions in Foreign Countries (Bangladesh providing scholarships to its students for higher education abroad);
- Training under the IGA with the Russian Federation;
- BAEC TRIGA Research Reactor;
- Professional certification program administered by national and international institutions;
- Rooppur NPP training center;

LIST OF BANGLADESHI UNIVERSITIES SUPPORTING NUCLEAR EDUCATION PROGRAM

Name	Degrees*	Field	Established
University of Dhaka (DU)	B.Sc., M.Sc. & PhD	Nuclear Engineering	2012
Military Institute of Science and Technology (MIST)	B.Sc.,M.Sc., M.Engg & PhD	Nuclear Science and Engineering	2014
Bangladesh University of Engineering & Technology (BUET)	M.Sc., M.Engg.	Nuclear Power Engineering	2015
Chittagong University of Engineering & Technology (CUET)	B.Sc., M.Sc.	Nuclear Engineering	2019

Jahangirnagar University, University of Rajshahi, University of Chittagong, Shahjalal University of Science and Technology, and Bangladesh University of Engineering and Technology offer several courses in nuclear physics and reactor physics.

Institute of Nuclear Power Engineering (INPE) at Bangladesh University of Engineering and Technology (BUET), one of the leading universities in Bangladesh and established in September 2015, is currently offering post-graduate programs, short-term training, workshops and technical seminars in nuclear engineering.

In the scope of special grants, there is provision for attaining advanced studies in nuclear engineering at MEPhI University in the design and security of nuclear power plants. One hundred and two students have been sent to MEPhI University for advanced education.

According to the Feasibility Evaluation of Rooppur NPP, about 2100 personnel shall be required for managing, operating and maintaining the NPP in different phases. Among them, 1750 personnel are technical and 350-personnel are non-technical [24].

Considering the complexity and sensitiveness, the General Contracts dated 25 December 2015 considered advanced training in the Russian Federation. During 2023, 851 technical personnel will be trained in the Russian Federation. The rest of the personnel shall be trained in the Rooppur NPP Training Centre, which is already constructed. In the meantime, 460 personnel have already completed their training and 163 personnel are currently undergoing training in the Russian Federation. During 2022, 238 personnel will be sent to the Russian Federation. The rest of the personnel training will be carried out in 2023.

Please see details in followings link:

https://inis.iaea.org/collection/NCLCollectionStore/_Public/50/083/50083112.pdf?r=1

https://www-pub.iaea.org/iaeameetings/cn215p/Tuesday/IAPs/Morning/Hossain.pdf

1. STAKEHOLDER INVOLVEMENT

Bangladesh developed a joint action plan and signed a Strategy for Promoting Communication in Bangladesh Nuclear Power with the Russian Federation for 2015–2021.

Media personnel, professionals, government senior officials, national and local political leaders, IAEA experts, university students and other stakeholders are being informed about Rooppur NPP technology by visiting a reference plant in the Russia Federation as well as the RNPP construction site. During any notable stage (e.g. unveiling or closing program of construction), representatives of the stakeholders are given the utmost priority to participate. Even the representatives from the local community participated in the ceremony for the IGA signing.

At the local site, BAEC maintains an office. The local residents were resettled long ago from the land, which has been preserved for the Rooppur NPP use. IAEA and FNCA training has been given to the BAEC and Ministry technical officials.

2.9. EMERGENCY PREPAREDNESS

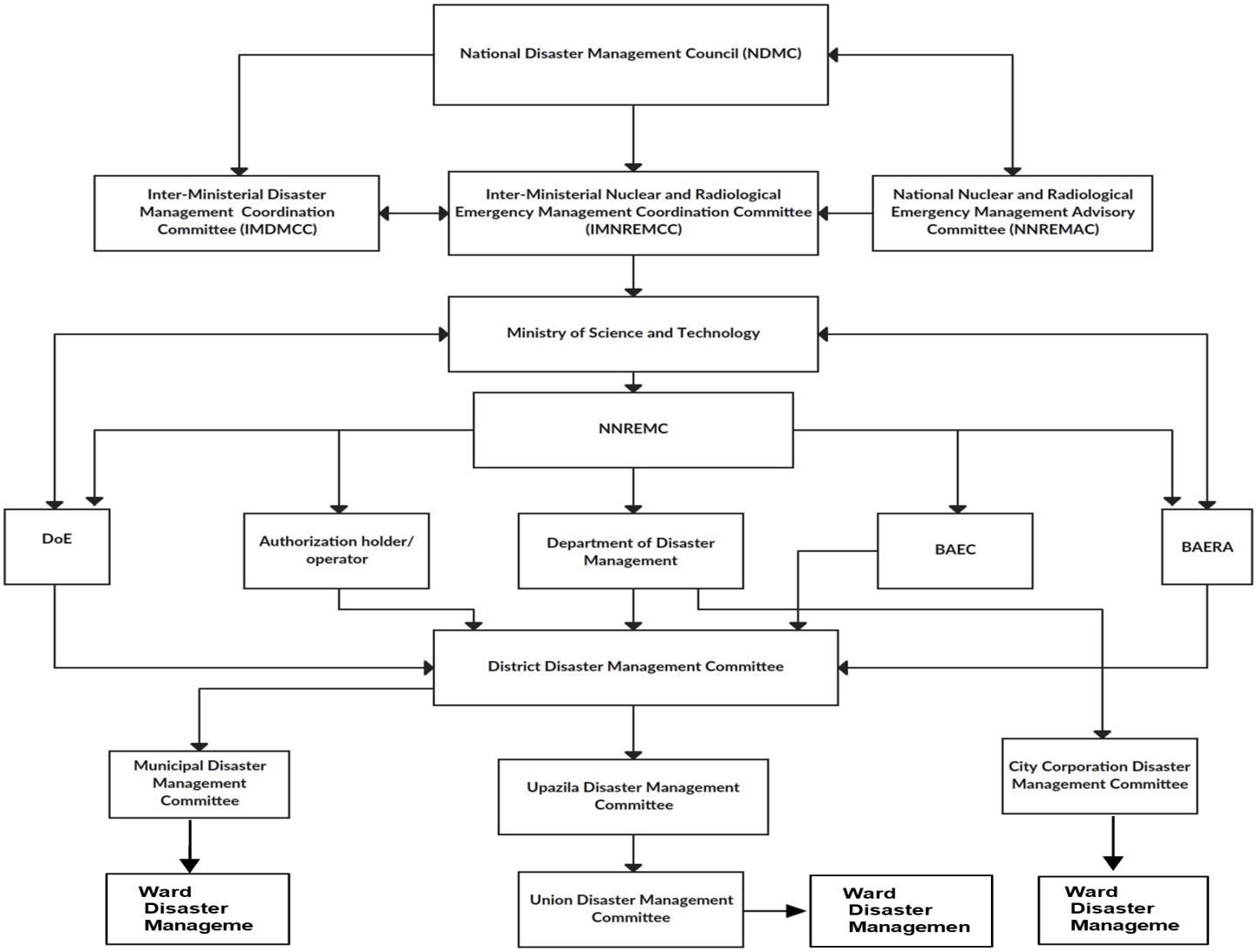
Nuclear emergency preparedness in Bangladesh comprises of on-site and off-site planning. An on-site emergency plan contains scheduled measurement to be taken within the site of a nuclear/radiological facility operated by a single authorized organization and links to off-site emergency plan. An off-site emergency plan contains measurements to be taken for the protection of the population within the emergency planning zone during the release of radioactive substances into the environment, as well as links to the on-site emergency plan. The off-site emergency response plan should be in line with the national disaster management plan and should have approval of the concerned authorities.

National Disaster Management Council (NDMC) is responsible for providing policy guidance towards all kinds of disasters and emergencies at all levels including large scale nuclear and radiological emergencies in Bangladesh [26]. A National Nuclear and Radiological Emergency Management Centre (NNREMC) will work under MoST as an emergency management center.

NNREMAC will advise the government in management of radiological and nuclear emergencies. Inter-Ministerial Nuclear and Radiological Emergency Management Coordination Committee (IMNREMCC) will assist in emergency preparedness. BAERA will coordinate all the activities in this regard.

The National Nuclear and Radiological Emergency Preparedness and Response (NNREPR) Plan, 2020 was issued by MoST and ascribed responsibilities to specific agencies for coordinating the activities of other agencies involved in a preparedness and response program for any nuclear and radiological emergency (see FIG) [27]. Thirty service groups are designated in the NNREPR plan that will develop their own capacity to actively participate in the event of a nuclear and radiological emergency and will also involve their relevant organizations/divisions/departments, when necessary. The roles of ministries, institutions and service groups are elaborated in Annex 2 of NNREPR plan. NNREPR plan will be implemented under the guidance of the NDMC.

In addition, Bangladesh has promulgated Nuclear Safety and Radiation Control (NSRC), Act 1993 (Act No. XXI of 1993) which is the basic Nuclear Legislation and provides for framing of rules for ensuring safety in the use of ionizing radiation in Bangladesh. Pursuant to Section 16(1) of the NSRC Act-93, the NSRC Rules were notified in the Bangladesh Gazette on 18 September 1997 to ensure nuclear safety and radiation control in the country. Also, The Bangladesh Atomic Energy Regulatory Act 2012 provide some directions for nuclear and radiological emergency management in Bangladesh [28].



Flow chart/block diagram of the national level response organization.

Source: NATIONAL NUCLEAR AND RADIOLOGICAL EMERGENCY PREPAREDNESS AND RESPONSE PLAN (NNREPRP), November 2020.

3. NATIONAL LAWS AND REGULATIONS

3.1. REGULATORY FRAMEWORK

3.1.1. Regulatory authority(s)

Presently, the BAERA Act 2012 was passed in the National Parliament on 19 June 2012 to develop the capacity of the nuclear regulatory body. The Bangladesh Atomic Energy Regulatory Authority was formed as a separate entity on 12 February 2013. This authority is responsible for regulating the use of atomic energy, radiological practices and relevant activities under the provision of the Nuclear Safety and Radiation Control (NSRC) Act (No. 21 of 1993) and the NSRC Regulations 1997.

3.1.2. Licensing process

Based on INIR recommendations, initiatives for an appropriate nuclear infrastructure have been taken, including, among others, the establishment of a competent and effectively independent regulatory authority with adequate legal provisions on nuclear safety, radiation protection, authorization, transportation and waste safety, nuclear security, handling and safeguarding of nuclear material and nuclear liabilities for transporting of nuclear material. The issuance of licenses for the different phases of NPP activities and the regulatory supervision of the NPPs will be the most critical factor. BAER Authority is preparing safety regulations and guides for issuance of individual permits or licenses for site, construction and operation of NPP, as well as import, transport, storage, export goods and services.

In order to obtain other nuclear related licenses, an entity, shall apply for a license to the Regulatory Authority in the prescribed form applicable for the specific class and practice, furnishing all pertinent information required by the applicable standard and guide.

3.2. NATIONAL LAWS AND REGULATIONS IN NUCLEAR POWER

The Nuclear Safety and Radiation Control Act, 1993 was passed by the National Assembly of Bangladesh during July 1993 and has been in force since then. According to this law, BAEC was empowered to work as the nuclear regulatory body. The Nuclear Safety and Radiation Control Rules were formulated for that purpose in 1997. Presently, the Regulatory Body has been separated from BAEC. Bangladesh Atomic Energy Regulatory Act 2012 was passed in the National Parliament on 19 June 2012 [27].

Nuclear Power Plant Act 2015 (Act No. 19 of 2015) was adopted on 16 September 2015. This Nuclear Power Plant Act 2015, consisting of 35 sections, establishes the composition, duties and responsibilities of the company responsible for managing the Rooppur NPP and other nuclear power plants as well as the management of the concerned structure, dealing also with Managing Director and other directive functions. In addition, it establishes conditions under which land acquisition is allowed [28].

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APPENDIX 1: INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

AGREEMENTS WITH THE IAEA	Degrees*	Field
NPT related safeguard agreement INFCIRC/301	Entry into force:	11 June 1982
Additional Protocol	Entry into force:	30 March 2001
Improved procedures for designation of safeguards inspectors	Accepted on:	25 April 1995
Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	31 December 1979
RCA	Entry into force:	24 August 1987
Agreement on privileges and immunities	Non-Party	
OTHER RELEVANT INTERNATIONAL TREATIES etc.		
NPT		31 August 1979
Convention on physical protection of nuclear material	Non-Party Entry	
Convention on early notification of a nuclear accident	Into force:	7 February 1988
Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	7 February 1988
Convention on civil liability for nuclear damage	Non-Party	
Joint protocol	Non-Party	
Protocol to amend the Vienna convention on civil liability for nuclear damage	Non-Party	
Convention on supplementary compensation for nuclear damage	Non-Party	
Convention on nuclear safety	Entry into force	24 October 1996
Joint convention on the safety of spent fuel management and Non-Party on the safety of radioactive waste management	Non-Party	
ZANGGER Committee	Non-Member	
Acceptance of NUSS Codes	No reply	
Nuclear Suppliers Group	Non-Member	

BILETERAL COOPERATION AGREEMENT

Bangladesh has bilateral agreements on nuclear cooperation with the governments of China, France and the United States of America. Recently, Bangladesh made a bilateral Cooperation Agreement with the Russian Federation and India on Peaceful Uses of Nuclear Energy.

REGIONAL AGREEMENT

Forum for Nuclear Cooperation in Asia (FNCA) on 15 November 2006.

APPENDIX 2: MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

Name of the Owner Organization:	Bangladesh Atomic Energy Commission (BAEC)
Address: Telephone number: Facsimile number: *Web site address:*	E-12/A, Agargaon, Sher-E-Bangla Nagar, Dhaka-1207 880-2-8141843 880-2-8130102 www.baec.gov.bd

Name of the Operator Organization:	Nuclear Power Plant Company Bangladesh Limited (NPCBL)

Address: Telephone number: Facsimile number: *Web site address:*	Rooppur NPP Bhaban, 4 KaziNazrul Islam Avenue, Karwan Bazar, Dhaka-1000 880-2-9664572 880-2-58611081 http://www.rooppurnpp.gov.bd
Name of the Regulatory Organization:	Bangladesh Atomic Energy Regulatory Authority (BAERA)
Address: Telephone number: Website Address: *Web site address:*	Bangladesh Atomic Energy Regulatory Authority (BAERA) E-12 / A ParamanuBhaban, ShahidShahabuddinShorok, Agargaon, Dhaka 1207 880-2-9124846 http://www.baera.gov.bd

Coordinator information

Name of the report coordinator:	*Dr. Md. Shawkat Akbar, Project Director,* Construction of Rooppur Nuclear Power Plant
Institution:	Nuclear Power & Energy Division (NPED), BAEC
Contacts:	Phone (Office): 880-2-8120343 Personal phone: 880-01715012416 Residence phone: 880-2-8124398 E-mail address: shawkat_nped@yahoo.com
Name of the associate to the coordinator:	Mahmud Hossain, Director
Institution:	Nuclear Power & Energy Division (NPED), BAEC
Contacts:	Phone (Office): 880-2-8120343 Personal phone: 880-01818425219, 01966610803 Residence phone: 880-2-7211530 E-mail address: jamibashabo@yahoo.com
Name of the associate to the associate-coordinator:	A.K.M. Nazmul Hasan, Manager
Institution:	Nuclear Power Plant Company Bangladesh Limited.
Contacts:	Personal phone: +8801721550171 Personal E-mail address: rakib.064@gmail.com Official E-mail address: Nazmul.hasan539@rooppurnpp.gov.bd
Name of the associate to the associate-coordinator:	Jubair Sieed
Institution:	Senior Engineer, Nuclear Power and Energy Division (NPED), BAEC
Contacts:	Personal E-mail address: jubair@ymail.com Official E-mail address: jubair@rooppurnpp.gov.bd