BANGLADESH NATIONAL REPORT

to the Seventh Review Meeting of the

CONVENTION ON NUCLEAR SAFETY

2017

Bangladesh Atomic Energy Regulatory Authority

FOREWORD

The government of the People's Republic of Bangladesh signed the Convention on Nuclear Safety (CNS) on 21 September 1995. Consequently it was formally accepted and entered into force on 24 October 1996. Pursuant to Article 5 of the CNS, this is the sixth National Report being submitted by Bangladesh for review by the Contracting Parties. The Report shows how Bangladesh has adhered to its obligations under Articles 6 through 19 of the Convention. This National Report has been prepared in accordance with the "Guidelines Regarding National Reports under the Convention on Nuclear Safety" issued as information circular INFCIRC/572/Rev.4.

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LIST OF ABBREVIATIONS

BAEC	Bangladesh Atomic Energy Commission
BAERA	Bangladesh Atomic Energy Regulatory Authority
BPDB	Bangladesh Power Development Board
CNS	Convention on Nuclear Safety
IAEA	International Atomic Energy Agency
INIR	Integrated Nuclear Infrastructure Review Mission of IAEA
MOST	Ministry of Science and Technology
NPCBL	Nuclear Power Company of Bangladesh Limited
NPP	Nuclear Power Plant
NPT	Non Proliferation Treaty
NSRC	Nuclear Safety and Radiation Control
PMU	Project Management Unit
RNPP	Rooppur Nuclear Power Plant

1. INTRODUCTION

On 21 September 1995, the People's Republic of Bangladesh signed the Convention on Nuclear Safety (CNS). Consequently it was formally accepted and entered into force on 24 October 1996. Each Contracting Party of the CNS is obliged to apply widely accepted principles and tools in order to maintain a high level of safety in its nuclear installation(s), and is also required to present a national report on implementation of these principles to the review meetings of the Contracting Parties as per the provisions of Article 5 of the CNS.

To date, apart from a research reactor, Bangladesh does not have any "nuclear installations" in operation, under construction or decommissioned as defined in the Convention. However, Bangladesh is going on with a nuclear power project named Rooppur Nuclear Power Plant (RNPP) project to construct two units of VVER-1200 (AES 2006) PWR in the north-western part of the country with the help of Russian Federation.

Therefore, this report has been prepared in accordance with the requirements of the Convention on Nuclear Safety and Guidelines regarding National Reports under the Convention on Nuclear Safety (INFCIRC/572/Rev.4) and reflects/covers the activities associated with the research reactor as well as the latest developments in the on-going nuclear power programme in Bangladesh and indicates how it meets the obligations of each of the articles of the Convention.

2. SUMMARY

The first initiative of installing a nuclear power plant in the territory of Bangladesh was taken in 1961. Afterwards, particularly in the post-independence period till present days, a good number of technical and economic feasibility studies of the proposed NPP have been conducted.

Bangladesh adopted a Nuclear Power Action Plan [1] in 2001 considering the role of nuclear power as vital for long-term energy security and sustainable development of the country. Later in 2007 government affirmed its plan to build a nuclear power plant in the Rooppur site of Pabna district (about 140 km W-NW of Dhaka, the capital city of Bangladesh) to meet the shortage of electricity as well as to diversify the sources of energy. For this, after considering various proposals from number of vendor countries, Bangladesh finally signed an

intergovernmental agreement with the Russian Federation in November 2011 on cooperation for construction of a nuclear power plant in the People's Republic of Bangladesh.

Nuclear Power and Energy Division (NPED) of Bangladesh Atomic Energy Commission (BAEC) was primarily responsible for carrying out all project related activities before formal creation of the project management unit (PMU) named First-phase of Rooppur Nuclear Power Project. In December 2015, BAEC signed the main contract of the construction with JSC Atomstroyexport (ASE).

Construction of the first unit of Rooppur NPP is anticipated to start from third-quarter of 2017, with commercial operation of the first unit to be started in 2023, and the second one will be a year afterwards. In this regard, Government of Bangladesh promulgated Nuclear Power Plant Act-2015 [2] that establishes a company named Nuclear Power Plant Company Bangladesh Limited (NPCBL) under the ownership of BAEC to run the Rooppur NPP.

According to the current legislation in Bangladesh, namely the Bangladesh Atomic Energy Regulatory (BAER) Act-2012 [3], the prime responsibility for the safety of a nuclear installation lies with the utility. A regulatory body, named Bangladesh Atomic Energy Regulatory Authority (BAERA), has been established in February 2013 to oversee all safety aspects and has been given appropriate authority/powers to develop safety regulations, codes & standards and has powers to inspect & enforce safety provisions in nuclear installations and related activities. On 21 June 2016, Bangladesh Atomic Energy Regulatory Authority (BAERA) issued "Siting Licence" to Bangladesh Atomic Energy Commission.

Bangladesh has taken all necessary steps required for developing national nuclear power infrastructure based on the widely used referring document, the "Millstones in the Development of a National Infrastructure for Nuclear Power" (IAEA Nuclear Energy Series No. NG-G-3.1). Accordingly, the whole nuclear infrastructure development activities have been divided into three progressive phases where underlying 19 infrastructure issues will be addressed in each phase.

To realize the establishment of national nuclear power infrastructure in an appropriate, phased, coordinated and comprehensive manner, high level Government Committees (National Committee, Technical Committee and Working Committee) have been formed that establishes overall administrative provision for coordinating the activities on 19 infrastructure issues, developing relevant policy and strategy on "Rooppur NPP" project development and implementation, monitoring the progress of the project activities and providing

recommendations and directives required for successful implementation of the project. The Hon'ble Prime Minister chairs the National Committee whose terms of reference include providing necessary directives and policy decisions on nuclear infrastructure program, deciding ownership pattern and project execution approach, selecting funding mechanism, strategic partnership and development of contract arrangements for "Rooppur NPP", capacity building and technical competency development, nuclear safety and regulatory infrastructure development, etc. Alongside the National Committee, a Technical Committee headed by the Minister, Ministry of Science and Technology (MOST) and a Working Group and eight Sub-Groups headed by Secretary, MOST have been formed to coordinate the overall work on 19 infrastructure issues of the concerned ministries/organizations and review the progress of "Rooppur NPP" project activities. The Technical Committee and the Working Group and Sub-Groups are coordinating all activities in relation to the infrastructure issues and monitoring regularly the progress of the project activities. Further to this, the Coordination Committee and various Sub-committees of BAEC are dealing with different technical aspects and providing support and cooperation to the project. Significant progress has been made in the development of national nuclear power infrastructure in the last four years following the Integrated Nuclear Infrastructure Review (INIR) mission to Bangladesh conducted by the IAEA in November 2011 to review the status of the National Nuclear Infrastructure as a newcomer country for NPP. The INIR mission had reviewed the 19 issues of Phase 1 and Phase 2. The mission after reviewing the activities provided 50 recommendations and 20 suggestions and concluded in general that the nuclear power infrastructure development of the country had progressed into Phase 2 by then.

In May 2016, IAEA conducted the INIR follow-up mission to Bangladesh; The INIR team concluded that Bangladesh has made manifested progress on the national infrastructure for nuclear power in general by initiating its actions responding to all recommendations and suggestions and in particular by completing implementation of 26 of the recommendations and 14 of the suggestions from the 2011 INIR mission, in the areas of Management, Funding and Financing, Legislative Framework, Safeguards, Regulatory Framework, Electrical Grid, Human Resource Development, Stakeholder Involvement, Site and Supporting Facility, Environmental Protection, Emergency Planning, Nuclear Fuel Cycle, Radioactive Waste, Industrial Involvement and Procurement. However, as per the mission’s report the other 24 recommendations and 6 suggestions require further work to complete.

3. ARTICLE 1 TO 5

These Articles cover the following:

- Article 1 – *Objectives*
- Article 2 – *Definitions*
- Article 3 – *Scope of Application*
- Article 4 – *Implementing Measures*
- Article 5 – *Reporting*

No report is required in respect of these Articles.

4. EXISTING NUCLEAR INSTALLATIONS (ARTICLE 6)

Until now, no nuclear power plant is under construction, in operation or decommissioning stage in the territory of Bangladesh. Following the framework agreement with the Russian Federation on peaceful uses of atomic energy in 2010, an intergovernmental agreement was signed between the two countries in November 2011 to construct two VVER type reactor power units at the Rooppur site (Figure 1).

Figure 1: Roopur NPP site

On 16 September 2015 government promulgated a law that established a company named Nuclear Power Plant Company Bangladesh Limited (NPCBL) to run the plant; the same recognized BAEC to be the owner of the plant.

The general contract for the construction of Rooppur Nuclear Power Plant (RNPP) between Bangladesh Atomic Energy Commission (BAEC) and JSC Atomstroyexport was signed on 25 December 2015 and it was finalized that the plant will be of type AES-2006 with V-392M reactors, where Novovoronezh II will serve as the reference plant for the RNPP project.

Bangladesh Atomic Energy Regulatory Authority (BAERA), the nuclear regulatory body of Bangladesh, granted "Siting Licence" to the BAEC on 21 June 2016 for building RNPP with 2 units of VVER-1200 PWR.

Currently, BAEC is in the process of fulfilling the conditions of the siting licence and applying for the Construction Licence of the RNPP project.

Although, at present Bangladesh has no nuclear installation/nuclear power plant as per the definition of the convention, Bangladesh Atomic Energy Commission, has the mandate for development and application of nuclear science and technology for peaceful uses of atomic energy in Bangladesh. The BAEC commissioned a cylindrical shaped pool type light water cooled and graphite-reflected 3 MWt TRIGA MARK II research reactor named BAEC TRIGA Research Reactor (BTRR) in 1987 for research as well as production of isotopes for industrial and medical uses.

Figure 2: Reactor hall of BAEC TRIGA Research Reactor (BTRR)

BTRR uses uranium-zirconium hydride fuel elements in a circular grid array. The array also contains graphite elements that serve to reflect neutrons back into the core. The core is situated near the bottom of a water filled tank and the tank is surrounded by a concrete bio-shield, which acts as radiation shield as well as provides structural support. Figure 2 shows the reactor hall and Figure 3 shows the old and new (digital) console of the BTRR. This research reactor is licensed by the Bangladesh Atomic Energy Regulatory Authority (BAERA) to operate at a maximum steady state power of 3 MW (thermal) and can also be

pulsed up to a peak power of about 852 MW with a maximum reactivity insertion of up to $2.00 having a half-maximum pulse width of nearly 18.6 milliseconds.

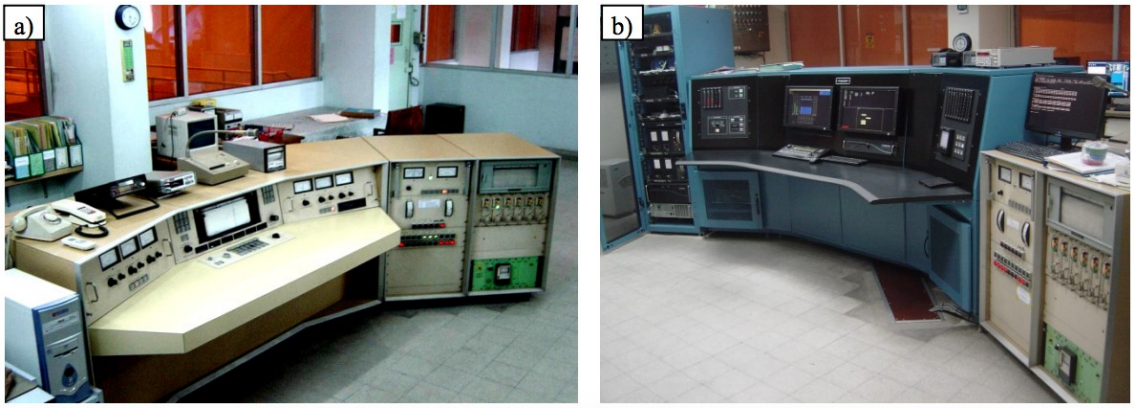

Figure 3: (a) Old and (b) new (digital) console of the BTRR

5. LEGISLATIVE AND REGULATORY FRAMEWORK (ARTICLE 7)

5.1 ESTABLISHING AND MAINTAINING A LEGISLATIVE AND REGULATORY FRAMEWORK

5.1.1 Regulatory Structure in Bangladesh

Legislative framework in Bangladesh consists of laws, rules, regulations, guides and codes and standards; this hierarchical pyramid forms the legal basis for control as given in Figure 4. This legislative and regulatory framework of Bangladesh ensures compliance with international conventions and treaties, and International Atomic Energy Agency (IAEA) safety requirements with almost all the aspects of nuclear safety and security.

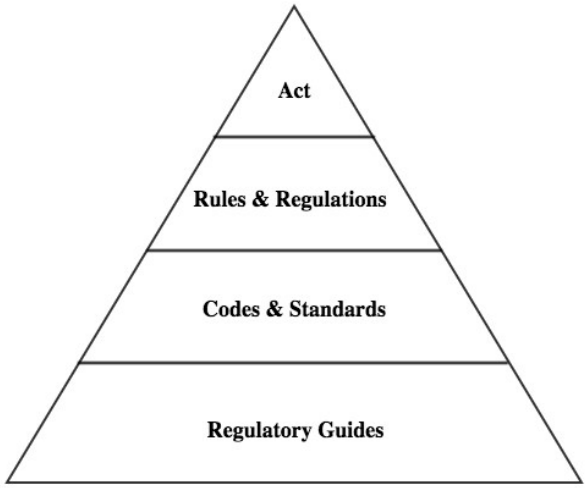

Figure 4: Hierarchy of regulatory instruments in Bangladesh

Current legislative and regulatory framework of Bangladesh guarantees proper consideration for health, safety, security and protection of the people and environment whilst utilizing nuclear materials and facilities as well as carrying out any nuclear and ionizing radiation related activities. Bangladesh, as a non-nuclear weapon state party to the Non Proliferation Treaty (NPT), has established a state system of accounting for and control of nuclear materials based on the agreement between Bangladesh and the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (Safeguards Agreement) and Protocol Additional to the Agreement between the People's Republic of Bangladesh and the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (Additional Protocol). Bangladesh is also a party to the Convention on the Physical Protection of Nuclear Materials.

Bangladesh Atomic Energy Commission (BAEC), which was established in 1973 by a Presidential Order [4] for the promotion of the peaceful uses of atomic energy through executing all possible activities, such as research work, generation of electricity via nuclear power plants, etc. was also assigned the role of the regulator through the promulgation of the Nuclear Safety and Radiation Control Act of 1993 [5]. A separate division was created under the umbrella of the BAEC, named Nuclear Safety and Radiation Control Division, to regulate all nuclear and radiation related activities in Bangladesh including that carrying out by the BAEC itself. To effectively control the activities under its jurisdiction, Nuclear Safety and Radiation Control Rules [6] was notified in 1997. Since then it was the only supervisory body

for all nuclear and radiological activities until 2012, when the government promulgated new act named Bangladesh Atomic Energy Regulatory Act, 2012 [3] to address the shortcomings in the repealed NSRC act-1993. This new act, which was developed, based on the IAEA Handbook on Nuclear Law, has established a regulatory body (BAERA) in Bangladesh to regulate the nuclear and radiation safety in a better way to fulfill requirements set by the IAEA as well as other international instruments. In addition to the BAER Act-2012 [3], owner/operator of any nuclear installations must abide by other relevant laws/acts in the country; for instance, Environmental Conservation Act-1995 [7] regulates environmental impact of these facilities, The Disaster Management Act-2012 [8] regulates the role of different organizations and management schemes in case of natural and manmade disasters that encompass nuclear and radiological incident/accidents, etc.

5.1.2 International Legal Instruments Related to Nuclear Safety

Bangladesh is a party to the following international legal instruments for safe, secure and peaceful uses of nuclear energy:

a) Convention on Early Notification of a Nuclear Accident (Entry into force 07 February 1988)

b) Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Entry into force 07 February 1988)

c) Convention on Nuclear Safety (Entry into force 24 October 1996)

d) Convention on Physical Protection of Nuclear Materials (Entry into force 10 June 2005)

e) Application of Safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (Entry into force 11 June 1982)

f) Protocol Additional to the Agreement between the People's Republic of Bangladesh and the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (Entry into force 30 March 2001)

g) Treaty on the Non-Proliferation of Nuclear Weapons (Accession on 27 September 1979).

5.2 PROVISIONS OF LEGISLATIVE AND REGULATORY FRAMEWORK

5.2.1 National Safety Requirements and Regulations

The National Legislative requirement on nuclear and radiological safety for all activities related to the peaceful use of atomic energy in Bangladesh stems primarily from the Section 18 of the BAER Act-2012 [3] that imposes restrictions on certain activities without having appropriate form of authorization by the authority (BAERA). BAERA, by exercising powers under section 11 of the Act, is the competent authority in Bangladesh to ensure the compliance of nuclear safety in any nuclear installation. Moreover, Section 30 of the BAER Act-2012 explicitly states that it is the sole responsibility of an authorization holder to ensure nuclear safety in his/her nuclear installation. The same Section has also given BAERA the power to make regulations on the requirements of nuclear safety. There is also a provision in the BAER Act-2012 that allows the NSRC rules (1997) made under the repealed NSRC Act 1993 continue to be in force as if made under the present Act until comprehensive and detailed regulations are in place under the BAER Act-2012. These rules (NSRC Rules 1997) also provide list of applicable standard, code and guides relevant to different stages of nuclear installations to ensure nuclear safety. Further to this, a number of regulations is in the final stage of the development process that is specifically identified to assist the authorization process and addresses the safety principles in details to ensure nuclear safety in light of the present knowledge base of post-Fukusima era.

5.2.2 System of Licensing

5.2.2.1 Requirements and Legal Provisions of Licensing under the BAER Act

Section 18 and 19 of the BAER Act-2012 [3] specifies the requirements and process for obtaining licence from the Authority (BAERA). This Act clearly states that no person, operator or overseas operator shall siting, design, construct, commission, operate, and decommission any nuclear installation and release the site from regulatory control without holding an authorization issued by the Authority. In addition, the Act restricts to procure, produce, own, import, export, possess, use, transport, process, reprocess, trade, transfer, displace, store, abandon or dispose any nuclear material, radioactive waste and spent fuel and carryout research on them without having appropriate form of consent of the BAERA.

BAERA issues the authorization (for instance, Siting Licence) to a nuclear installation and carries out safety monitoring, inspection and enforcement activities under the provisions of

BAER Act-2012. For instance, Section 21 of the Act prescribes the general procedure for issuing authorization. For different stages/types of authorization, BAERA follows specific standards, codes and guides that specify the minimum safety related requirements that must be fulfilled by a nuclear installation (NPPs) to get the regulatory approval at every stage leading to authorization for full operation (Operating Licence) as per NSRC Rules 1997 [6]. Presently, nuclear safety requirements are also further substantiated by requiring compliance with the vendor or designer country's regulations and the IAEA safety documents. To facilitate the licensing process the Applicant is required to submit to the BAERA a reference plant of the proposed design that is licensed in the vendor country.

These authorizations are issued by BAERA on the basis of its review and assessment process. Adherence to the regulatory requirements and licensing conditions is verified by conducting periodic onsite inspections. Section 51 and 52 of the Act specifies the requirement on regulatory inspection and enforcement to be carried out by the BAERA in NPPs. For NPPs, the authorizations are issued for the major stages like Siting, Construction, Commissioning, Operation and Decommissioning and these authorization types are known as licences. So far, apart from the experience in regulating the TRIGA MARK II Research Reactor, the newly established BAERA has recently issued the Siting License for the two units of VVER-1200 reactor at Rooppur NPP. The detailed licensing process in Bangladesh is described in section 15 of this report, which is in Article 17 of CNS (Siting).

5.2.3 System of Regulatory Inspection and Assessment

Regulatory Inspection is one of the main responsibilities and functions of the BAERA. The Regulatory inspection and assessment process as specified in Section 51 of the Act [3] guarantees compliance of the authorization holder/licensee with the safety provisions as prescribed in BAER Act-2012 and the rules/regulations and guidance documents made under it.

Both inspection and enforcement activities cover all areas throughout the lifetime of a nuclear installation. The scope and content of the inspection to be conducted, are not only limited to the authorized NPPs premises but also include its contractor and supplier chains. BAERA conducts inspections to make sure that the authorization holder is in compliance with the conditions set out in the authorization and all applicable regulations, codes and standards. BAERA may resort to enforcement actions as deemed necessary in the event of gross deviations from, or non-compliance with conditions and requirements. Regulatory inspection includes announced and unannounced inspections in the entire lifetime of a nuclear

installation including safety related activities on site and contractors/suppliers off site activities to ensure compliance with regulatory requirements.

BAERA can conduct inspection to:

- verify that the safety regulations formulated under the Act are being properly complied with;

- verify that the nuclear safety conditions, limits of radioactivity and doses of ionizing radiation are being complied with, collect related documents, equipment or materials or their samples for analysis, and demand necessary information from the person(s) concerned;

- examine designs, drawings, modification of layout & structure pertaining to nuclear safety and radiation protection, physical protection, records, memoranda, reports or documents pertaining to the use, operation, maintenance or storage of any radiation source or as the case may be, nuclear or radioactive material;

- direct the authorization holder(s) to take necessary measures in order to ensure the safety of the public health, property and environment as per provisions of the Act and regulations made there under;

- verify the compliance with security requirements and also cover the safeguards related activities under the Act.

5.2.4 Enforcement of Applicable Regulations and Terms of Licences

According to Section 11(3) of the BAER Act-2012 [3], BAERA may issue, amend, suspend or revoke authorizations such as license, permit etc. if it deems necessary for all the restricted activities as mentioned in the act. These include all the authorization steps associated with a nuclear installation.

To be specific, if any authorization holder -

- violates any provisions of the Act and rules or regulations made there under or the conditions of authorization applicable in case of action or services; and

- obtains authorization by providing incorrect or misinformation;

Then the authority shall issue a notice to that person to show cause within specific time limit as to why he/she shall not be punished and the authorization shall not be suspended or

cancelled. The notice shall have specific description of the nature of violations and amendment or remedial action; provided that the authorization holder shall be obliged to perform the above mentioned measures by his own responsibility within specified time up to the quality accepted by the Authority. If the authorization holder fails to comply with the notice, the Authority may lock and seal or cease the operation of any nuclear installation or radiation facility as applicable.

6. REGULATORY BODY (ARTICLE 8)

6.1 ESTABLISHMENT OF THE REGULATORY BODY

6.1.1 Legal foundations and mission of BAERA

The Government of the People's Republic of Bangladesh, exercising the powers conferred by Section 4 of the Bangladesh Atomic Energy Regulatory Authority Act-2012 [3], established a regulatory body named Bangladesh Atomic Energy Regulatory Authority (BAERA) on 12 February 2013, to carry out regulatory and safety functions with regard to nuclear power generation and use of ionizing radiations in the country.

BAERA's mission is to authorize and regulate the sources of ionising radiation and the use of nuclear energy in Bangladesh to ensure adequate protection of workers and public health and the environment. Therefore, BAERA is entrusted with the responsibility of regulating activities related to nuclear power generation, research and industrial and medical uses of radiation and radioactive sources.

6.1.2 Responsibilities and functions of BAERA

According to the relevant section of BAER Act-2012[3], the major responsibilities and functions of the Authority (BAERA) are as follows:

- Issuing Regulations, Guides, Codes, and Standards
- Notification, Review and Assessment, Authorization, Inspection, and Enforcement
- Inventory of radioactive and nuclear materials
- Ensure safe transport and storage of radioactive sources
- Environmental Radiation Monitoring
- Establish and maintain a state system of accounting for and control of nuclear materials (SSAC)

- Establish frameworks for physical protection and emergency preparedness and response for nuclear installations and activities
- Liaise and co-ordinate with other governmental or non-governmental bodies
- Liaise with regulatory bodies of other countries and with international organizations
- Approve an effective reporting procedures with respect to radiation incidents
- Establish regulatory measures for the security of nuclear and radioactive materials and their associated facilities
- Perform any other duties prescribed or assigned to the Authority by the Government from time to time as deemed necessary to meet its statutory obligations.

6.1.3 Structure of the BAERA

6.1.3.1 The Authority

According to the Section 6 of the BAER Act-2012 [3], the Authority (BAERA) consists of one Chairman and four Members. They are appointed by the Government for a fixed tenure of three years and are fulltime officials of the Authority. The Chairman is the Chief Executive of the Authority. The Chairman and the Members exercise powers and perform functions as prescribed or assigned to them under the BAER Act or the Rules or the Regulations made under the Act. In addition, government appoints a full time Financial Advisor and a Secretary to the Authority to cooperate and assist in the activities of the Authority. The present Authority comprises of one Chairman and two Members.

6.1.3.2 Advisory Council and Expert Committee

As per BAER Act 2012, the authority may form an Advisory Council consisting of reputed scientists, physicians and representative from different ministries to seek advice on the scientific and regulatory aspects of nuclear safety and radiation protection. Moreover, the Authority, if necessary, for assisting its functions, may form required number of expert committees comprising one or more members, or any of its employees, or one or more invited experts. The Authority may assign responsibilities to such expert committees and its terms and references. At present, BAERA has formed an advisory council with adequate experts from different disciplines and several expert committees to support the Authority to carry out its responsibilities properly.

6.1.3.3 Organization of BAERA

Bangladesh Atomic Energy Regulatory Authority has its office located in Dhaka, the Capital City of Bangladesh. To assist the Authority in its regulatory functions, presently BAERA comprises of four technical divisions. These are:

- Nuclear Safety & Security Division (NSSD)
  Main Responsibilities: Authorization of nuclear installations and associated activities (review and assessment of documentation important to nuclear safety), development of regulations and inspection of nuclear installations.
- Radiation Control Division (RCD)
  Main Responsibilities: Authorization of facilities/activities other than nuclear installation.
- Training & Documentation Division (TDD)
  Main Responsibilities: Public Information, Regulatory document development, In-house training of BAERA staff, Training of Radiation Control Officers (RCO) and users of radiation/radioactive sources.
- Planning & Development Division (PDD)
  Main Responsibilities: Planning and execution of the development activities.

Besides, there are three laboratories under BAEC namely, HPD, HPRWMU and RTML that provide technical supports to the regulatory services of BAERA.

The present organizational structure of BAERA is given in Figure 5.

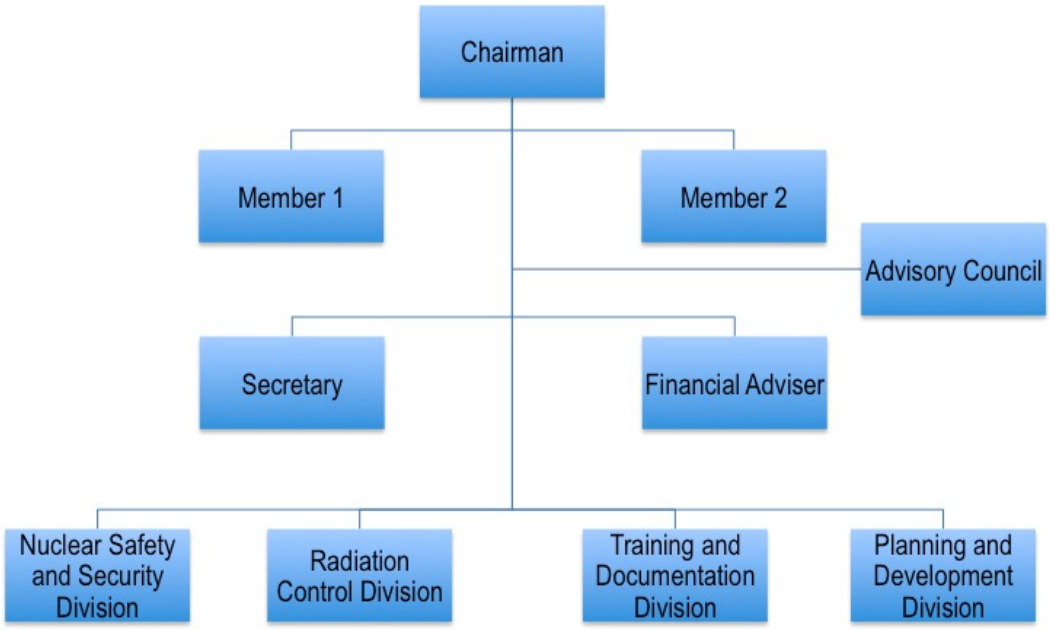

Figure 5: Present organizational structure of BAERA.

6.1.4 Human Resources

The technical and supporting staffs of the BAERA mainly consist of people with background on different aspects of nuclear and radiation technology for meeting the requirements of carrying out the regulatory functions. At present it has in total 65 staffs. Recently a proposal has been sent to the government for a new Organizational Structure as per IAEA INIR mission recommendation. The basic philosophy of the proposed Organizational Structure is consistent with IAEA-TECDOC-1513. Under the proposed organogram, a total of 360 personnel have been identified to perform different regulatory functions for the effective regulatory control of RNPP with 2 reactor units and non power installations.

For the current Rooppur NPP project, MoST is leading the development of a national HRD plan. Two committees had been established, one has identified the HR needs (demand side committee) and another has identified potential sources of HRD (supply side committee). From these a series of initiatives have been put in place. These include activities with IAEA, Japan, Korea, India, the Vendor (Russian Federation) as well as developments in the national education system and the development of a nuclear institute in BAEC. BAEC and BAERA will bring together all the above activities into a document, which will be submitted for approval as the National integrated HRD plan by 2016.

Currently BAERA has 30 technical staff, 35 supporting staff and 20 outsourced supporting staff (85 staff in total). BAERA prepared a phased recruitment plan to strengthen staffing and regulatory capabilities up to 360 staff by the end of 2025. BAERA submitted to the Ministry of Science and Technology a request for the initial increase of staff to meet the planned headcount of 164 by the end of 2016.

6.1.5 Financial Resources

Regular yearly funds of the BAERA accrued from the following sources as per Section 15 of the Act [3]:

(a) Funds granted by the Government annually;

(b) Fees and charges deposited under the Act;

However, the following sources can also be included if required:

- Grants received from National and International Agencies with prior approval of the Government; and

- Fund received from any other source with prior approval of the Government. BAERA has separate budget line in the Government budget through MOST. Therefore, the funding requirements for regulatory infrastructure development and maintenance have been well established and are funded directly by the government. In addition, state credit of 100 million USD over the next 10 years period to contract for technical support from the Russian regulatory TSO is in proposal. A draft DPP is under preparation with allocation of all necessary budgets for nuclear regulatory infrastructure development of BAERA.

6.1.6 External technical support

In 27 February 2012, MoST and ROSTECHNADZOR have gone into an inter-agency agreement (IAA) for cooperation in the field of safety regulation during siting, design, construction, commissioning of nuclear power plants in the following main areas:

- Development of legislative basis in the field of nuclear and radiation safety;
- Licensing of activities in the field of peaceful use of atomic energy;
- Training of nuclear regulatory body personnel.

Based on this agreement, a bilateral meeting was held between BAERA and ROSTECHNADZOR in March-April, 2015, where both parties agreed to finalize the draft assistance proposal for BAERA that encompasses the following areas:

- Review and assessment of licensing documents
- Joint inspection at the RNPP site
- Joint inspection at the manufacturing company
- Joint meeting/workshop on NPP safety related topics
- NPP licensing related regulatory documents and requirement
- NPP inspection and related procedure
- Development of NPP related regulation and guidance
- Human Resource Development

In this regard, a joint protocol was signed between BAERA and ROSTECHNADZOR in 14 October 2015.

6.2 STATUS OF THE REGULATORY BODY

6.2.1 Place of the BAERA in the governmental structure

Bangladesh is a parliamentary democracy where Prime Minister is the head of the government. The present BAER Act -2012 [3] is enacted by the Parliament in late 2012 and enforced by the Government in 2013 by establishing a regulatory body BAERA. Figure 6 shows the statute of the BAERA within the government structure.

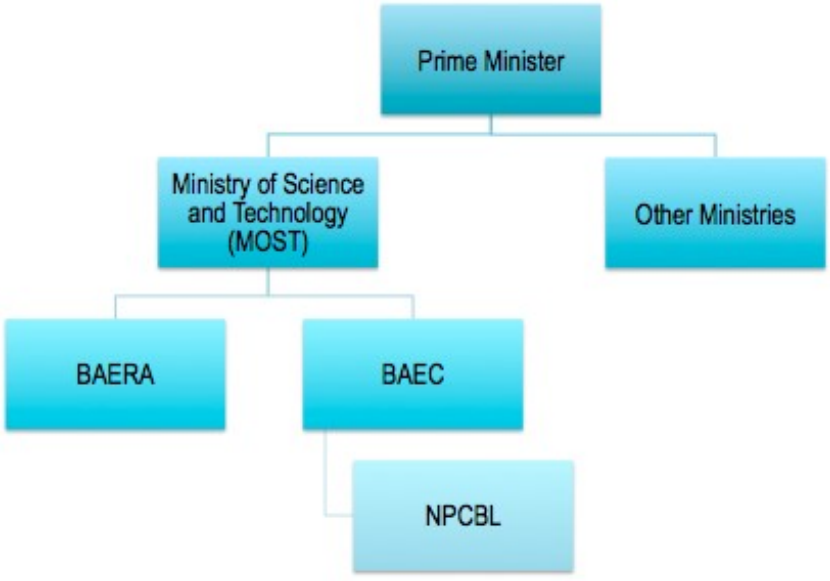

Figure 6: Statute of the BAERA within the government structure

6.2.2 Reporting obligations

BAERA is the competent authority in Bangladesh in regulating nuclear and radiation safety. It was formally separated in 2013 from the promoter of peaceful use of nuclear energy in the country, i.e. BAEC, which is the owner of NPCBL. Government provides budget for BAERA activities through MoST and therefore BAERA is functionally independent, as it only needs to present its Annual Report and Budget Proposals to the MoST once a year. BAERA's position in the government structure provides complete and effective separation in its regulatory work.

7. RESPONSIBILITY OF THE AUTHORIZATION HOLDER (ARTICLE 9)

As per the Section 23 of BAER Act-2012 [3], the authorization holder is solely responsible for ensuring the safety for all stages of lifecycle of a Nuclear Power Plant and needs to demonstrate to the BAERA's full satisfaction that the safety is ensured at all the times.

As per the Section 23 of the Act [3], the authorization holder is responsible to-

- Ensure nuclear safety, radiation protection, physical protection, emergency preparedness including verification thereof, during all the phases of nuclear installation or radiation facility from siting to decommissioning;
- Generate a decommissioning fund for nuclear installation;
- Establish preventive measures as well as measures to mitigate or eliminate consequences of incidents and accidents at nuclear installation during all the phases from siting to decommissioning or during the shipment of nuclear or radioactive material; make physical inventory and keep records of the nuclear material, radioactive material and of the radioactive waste and spent fuel; identify loss or theft of nuclear material or radioactive material or suspicious that or has the knowledge of a damage to nuclear material or radioactive material, of monitoring equipment or seals controlling the status and flows of nuclear material, and notify the Authority, without any delay;
- Ensure the safety measures to control or mitigate the environmental pollution caused by discharge or dispose of radioactive waste or material in the environment;

- Establish and maintain human resources development programme with adequate funding;
- Ensure the establishment and maintenance of safety culture in order to encourage a questioning and learning attitude for nuclear safety and radiation protection and to discourage complacency;
- Comply with additional duties as specified in the regulations made under the Act.

Further to the responsibilities assigned to the authorization holder of any type of facilities/activities by the Section 23 of the Act [3], Section 30 specifically addresses the requirement for nuclear safety of any nuclear installation and related activities. Section 30.2 states that the responsibility for nuclear safety shall lie with the authorization holder. The authorization holder shall be liable to provide for adequate funds and human resources to ensure nuclear safety, including the necessary engineering and technical support activities in all areas related to nuclear safety.

Section 30.3 through 30.7 details the requirements need to observe by the authorization holder to ensure nuclear safety throughout the lifetime of a nuclear installation. For instance, Section 30.3 affirms the liability of the authorization holder to perform regular, comprehensive and systematic assessments of nuclear safety taking into account the state of the art knowledge and understanding in the area of nuclear safety review, and to take measures to eliminate any deficiencies identified during the entire operating life and the decommissioning stage of a nuclear installation.

Section 30.8 allows BAERA to issue regulations on detail of requirements to further strengthen the nuclear safety aspects of a nuclear installation and authorization holder's responsibilities for different stages, such as siting, design, construction, commissioning, operation, decommissioning and closure of repository, as well as the criteria for the categorization of classified equipment into safety classes.

8. PRIORITY TO SAFETY (ARTICLE 10)

BAERA's mission is to ensure the safe and secure use of nuclear energy in Bangladesh so that undue risk to human health and the environment is practically eliminated. To realize this mission, BAER Act-2012 provides the main legal basis; on the other hand, national rules, regulations, guides and international instruments, codes, and standards are the primary documents detailing principal, requirements, practices and policies for enhancing safety. The

rules and regulations are chiefly based on IAEA safety requirements, standards and guides, giving top priority to the safety. BAERA uses IAEA safety requirements and vendor country regulations where the issues are not explicitly covered by the national regulations. Through a comprehensive authorization scheme, inspection and enforcement system, BAERA attains regulatory control of nuclear installation with proper consideration for the protection of workers, public and the environment and nuclear security.

9. FINANCIAL AND HUMAN RESOURCES (ARTICLE 11)

Inter-Government Agreement (IGA) signed between Bangladesh and the Russian Federation, on 2nd November 2011 covers technical and financial co-operation for Rooppur NPP. The Financing and Procurement Sub-group committee formed by the government provided a detailed report on the ownership options and financing strategy for Rooppur NPP Construction for the consideration of the National Committee; Based on its recommendations it was decided that the NPP will be solely Government owned and will be financed through a state credit agreement with the vendor country, and constructed on a turnkey basis.

The Executive Committee of National Economic Council (ECNEC) of the Government has been approved a Development Project Proposal (DPP) for the Preparatory Construction Phase activities of the Rooppur NPP project for the period of 2013 - 2016. A state credit of 500 million USD was agreed by the Bangladesh and Russian Governments for financing up to 90% of the preparatory phase activities.

A draft DPP has been prepared with allocation of all necessary budgets for the main stage of Rooppur NPP construction project. Prior to that, a detailed analysis of the financial risks regarding change of price, change of scope and delays in construction has been conducted as part of the feasibility evaluation of the contractor. Outcome of the analysis along with other relevant factors were reviewed by a number of committees and finally accepted by the National Committee. On 26th July 2016 Bangladesh and Russian governments formally signed the Intergovernmental State Credit Agreement (IGSCA) amounting to 11.38 billion USD for the construction of the two units of Rooppur NPPs against the total cost of 12.65 billion USD that fixed the level of state credit at 90%. The Bangladesh Government will generate funds for the rest of the 10% of the contract as well as necessary infrastructure costs for all future phases of RNPP project.

The funding requirements for regulatory infrastructure have been developed and will be funded directly by the government. A draft DPP for General Framework Contract (GFC) between BAERA and Rostechnadzor is under preparation with allocation of all necessary budgets for nuclear regulatory infrastructure development of BAERA. In addition, government is funding developments in national education related to the nuclear power programme.

Moreover, the government will also provide funds for the development of all other infrastructure areas (grid, roads, railway, water way transportation etc.) through separate projects managed by the respective government departments/organizations. For instance, the Asian Development Bank has already agreed funding for the required grid upgrades by 2020.

Most importantly, the Rooppur NPP project is one of the 10 fast track governmental projects under regular supervision of the Prime Minister's Office.

Bangladesh Power Development Board (BPDB), which is a government organization and is also the sole purchaser of electricity in Bangladesh, will sign a Power Purchase Agreement for the purchase of all the electricity produced by the NPP at a price based on the overall cost of production. Therefore, in reality operational costs, production and selling price risks lie entirely with the government of Bangladesh. Concerning the operational phase before the handover of the NPP, several other contracts covering services for operation and maintenance support, fuel supply, spent fuel and waste management are being finalized. The costs of these services/products, both before and after the handover of the NPP to BAEC/NPCBL, will be funded through the tariff structure of electricity sales to be agreed with BPDB. As per the Section 22 of BAER Act-2012, the Government of Bangladesh shall establish a decommissioning fund for all NPPs in its jurisdiction that shall be raised from the contributions mainly from NPP operator company (NPCBL).

As already mentioned earlier, a national human resource development (HRD) plan had been developed. Two committees had been established; one to identify the HR needs (demand side committee) and another to identify potential sources of HRD if any (supply side committee). Lot of efforts have been put in place to develop necessary human resources; these include cooperation activities in the field of nuclear energy with IAEA, Japan, Korea, and India, Russian Federation as well as developments of relevant sectors in the national education system and the development of a nuclear training institute in BAEC.

Concurrently initiatives have been taken for adequate education and training of operational and maintenance personnel of "Rooppur NPP" which will be executed by the vendor Russia under the General Contract for main stage of NPP construction. For the two units of the plant, a total of 1660 manpower has been identified that will be needed during the course of 60 years of plant operation of which technical workforce is 1048.

BAERA has also taken initiative to recruit and develop its manpower to cope with the challenge of licensing and inspection activities in different stages of the Rooppur NPP, although technical support will be sought from local and foreign organization, such as ROSTECHNADZOR, IAEA, India etc. to address the gaps in expertise if needed.

10. HUMAN FACTORS (ARTICLE 12)

In the interface/interaction between humans and technology in a NPP, which is important to nuclear safety, role of an individual becomes critical owing to the actual capabilities attainable as well as limitations of human performance. These human factors chiefly consist of two elements, namely internal factors such as aptitude, competence, professional abilities, motivation, endurance against stress, adaptability to changing situation, etc, and external factors, such as work environment process control, procedures, training and education, accessibility of components and automation, etc.

To avoid human errors, these factors will be considered in design, construction, and commissioning and operation stage of the envisaged NPPs to ensure that the capabilities and the limitations of human performance are taken into account. Existing NSRC Rules-1997 covers the requirement for qualification of operating personnel. Draft regulations concerning the authorization process of a nuclear installation and related activities further substantiate the requirement of overall criteria (both physical and mental) of key NPP personnel.

Further to these, Russian Regulations on Ensuring Safety of Nuclear Power Plants [9], which form the basis of the aforementioned draft regulations, require human factor to be considered throughout the lifetime of a NPP. According to [9]:

> -The design shall provide for the possibility to exclude personnel single errors and mitigate their consequences; in the design of NPP and reactor plant systems (elements) priority shall be given to systems (elements) design, which has been based on the

passive principle of action and inherent safety features (self- control, thermal inertia and other natural processes;

-In the design of the control room, problems of man-machine interface shall be solved. Parameters to be controlled shall be so selected and displayed as to provide personnel with unambiguous information indicating that NPP safe operating limits and conditions are met, and identification and diagnostics of automatic response and functioning of safety systems are possible;

-The operating organization of the NPP shall provide selection, training, and admission to independent work and maintain the operational personnel's qualification level. The system for selection and training of NPP operational personnel shall be aimed at achieving, control and maintaining level of qualification required for ensuring safe operation of the NPP in all regimes as well as performance of actions directed towards mitigating consequences of accidents occurred.

Moreover, it provides detail requirements of the selection and training of operating personnel.

11. QUALITY ASSURANCE (ARTICLE 13)

Section 32 of the BAER Act-2012 [3] states the requirements for establishment and implementation of quality assurance programme in each and every stage of a nuclear installation in order to ensure nuclear safety. The authorization holder is liable to establish the organizational structure, procedures and ensure availability of resources necessary to assure the quality for all activities of nuclear installation that is important for nuclear safety.

Moreover, it is the responsibility of the authorization holder to comply with the quality requirements for nuclear installation, classified equipment, their classification into the safety classes in the field of use of nuclear energy including equipment suppliers and provision of services as per the Act, the regulations made there under and applicable codes and standards.

For the requirements and guidelines on quality assurance, BAERA primarily envisaged to adopt/use the IAEA Safety Series (IAEA GSR Part 2 [10] , 50-C/SG-Q) and also the vendor country's relevant provisions if required, with necessary amendments for specific use in the context of Bangladesh.

12. ASSESSMENT AND VERIFICATION OF SAFETY (ARTICLE 14)

Section 30 of the BAER Act-2012 clearly addressed the requirement for Nuclear Safety of any nuclear installation and related activities. As per the Section 30.2, the responsibility to ensure the nuclear safety lies with the authorization holder of a nuclear installation. The authorization holder is liable for the provision of adequate funds and human resources as well as capable of carrying out necessary engineering and technical support activities to ensure nuclear safety in their nuclear installation.

As already mentioned earlier, section 30.3 through 30.7 detailed the requirements need to be fulfilled by the authorization holder to ensure nuclear safety throughout the lifetime of a nuclear installation. According to the Section 30.3, the authorization holder needs to perform regular, comprehensive and systematic assessments of nuclear safety taking into account the state of the art knowledge and understanding in the area as well as in the light of operating experiences of similar NPPs, and take all necessary measures to eliminate any deficiencies identified during the entire operating life and the decommissioning stage of a nuclear installation. The authorization holder also needs to keep records of safety assessment activities and about modifications of their nuclear installation if any. As per Section 11.7, BAERA carry out review and analysis of the safety assessments and invoke necessary action as required. Moreover, Section 51 of the BAER Act 2012 gives power to the Authority to conduct regulatory inspection in a nuclear installation to verify that the nuclear safety requirements of the Act and the relevant regulations formulated under the Act are being properly complied with.

13. RADIATION PROTECTION (ARTICLE 15)

According to the Section 11.4 of the BAER Act-2012 [3], BAERA is the competent body in Bangladesh to oversee that the provisions related to the radiation protection in its jurisdiction are properly complied with or not. According to Section 31 of BAER Act 2012, authorization holder is responsible to ensure radiation protection of nuclear installation. So far, Radiation Protection infrastructure and programme in all relevant activities/facilities, such as the research reactor (BTRR), Central Radioactive Waste Management Facility, numerous radiation facilities, etc., are comprehensive and satisfactory and is strengthened on continual basis based on experience and technology development. As a legacy from the former Nuclear Safety and Radiation Control Division of BAEC, safety surveillance/inspection and regulatory mechanism of BAERA in the area of radiation protection is also comprehensive,

continual and thorough. Therefore, there were no recommendations/suggestions in this area/issue in the 2011 INIR mission report.

Main regulatory document to prescribe the requirement for Radiation Protection is the Nuclear Safety and Radiation Control Rules 1997 [6], which was developed based on the BSS 115. It covers the requirements of radiation surveillance and its procedures, Radiation Protection Programme (RPP), dose limits for different target groups, limits of radioactivity in environments, the duties and responsibilities of Radiation Control Officers (RCO), etc.

Dose Limits for Occupational Workers

- an effective dose of 20 mSv/yr averaged over five consecutive years;

- an effective dose of 50 mSv in any single year;

- an equivalent dose to the lens of the eye of 150 mSv in a year;

- an equivalent dose to the extremities (hands and feet) of 500 mSv in a year and

- an equivalent dose to the skin of 500 mSv in a year.

Dose Limits for members of public

The estimated average dose to the members of the public shall not exceed an effective dose of 1 mSv in a year.

14. EMERGENCY PREPAREDNESS (ARTICLE 16)

As per the requirement of the BAER Act-2012, all future nuclear installation(s) in Bangladesh will be designed, constructed, commissioned and operated in conformity with relevant nuclear safety requirements as set out in regulations, codes & standards and guides. These requirements will guarantee sufficient margin of safety so that NPPs can be operated without unnecessary radiation exposure risks to the plant staffs and general public. Nevertheless, things can go out of control, therefore it is necessary to develop Emergency Preparedness and Response (EPR) plans. EPR plan is an essential requirement for operation of nuclear installation in Bangladesh.

According to the Section 40 of BAER Act-2012, "Authorization holder, operator or overseas operator shall have the ability to take measures for emergency preparedness, planning and preventive and remedial actions in order to effectively deal with potential nuclear or radiological accident or impact of such incident or damage to the public health, environment and properties". And the Act also distinguishes following emergency plans:

(a) preliminary on-site emergency plan, which contains scheduled measures to be taken on the site of a nuclear installation/radiological facility or several nuclear installations/ radiological facilities during its/their construction;

(b) on-site emergency plan, which contains scheduled measures to be taken on the site of a nuclear/radiological facility or several nuclear installations/radiological facilities, operated by a single authorization holder, and links to off-site emergency plan;

(c) off-site emergency plan, which contains measures 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 on-site emergency plan.

For prevention and mitigation of all types of disasters including Nuclear and Radiological Emergencies, Government of Bangladesh has enacted Disaster Management Act [8] in September 2012 and formed National Disaster Management Council (NDMC) headed by the honourable Prime Minister as the apex body for development of policy and planning and directing relevant activities regarding National Disaster Management. To implement the provisions of the Disaster Management Act-2012 and to support the NDMC, government also formed an office named Department of Disaster Management. According to BAER Act-2012, BAERA shall be the coordinator in formulating national nuclear and radiological emergency plan and for all activities concerning mitigation of emergency situation.

The National Nuclear or Radiological Emergency Response Plan (NNRERP), to be finally approved at a national level in 2016, includes, among other issues, roles and responsibilities for each organization involved and establishment of the chain of command for emergency response management. The NNRERP reflects inter-agency relationship and concept of operation, which is compatible with other emergency response, plans of different organization in Bangladesh. A draft Regulation on Emergency Preparedness and Response has been developed. According to the INIR mission's recommendation of 2011, the EPREV mission will be conducted during the Phase-3 of the nuclear power programme.

15. SITING (ARTICLE 17)

15.1 GENERAL

The siting process for a nuclear installation in general comprises of a thorough survey of one or several locations to select one or more candidate sites and finally identifying suitable site or sites. Authorization for siting (Siting Licence) involves review of the various site

characteristics as well as proposed plant specific safety aspects that ascertain suitability of the proposed nuclear installation in that site. The requirement for approval of Siting stems from the BAER Act-2012 and the NSRC Rules 1997. To facilitate the siting process for the first two-units of Rooppur NPP, BAERA developed a regulatory guide named "Regulatory Guidance on Site Evaluation for the Safety of Nuclear Power Plants" [11]. Only when all relevant issues have been adequately addressed, the site can be considered as suitable to build and operate the proposed nuclear installation; this ensures that the risk to the public and the environment from the radiation hazards stays within acceptable limits in the entire lifetime of the plant. Figure shows the location of the RNPP site for which a Siting Licence has been issued by the BAERA to BAEC on 21 June 2016.

Figure 7: RNPP Site Location

15.2 AUTHORIZATION OF SITES (SITING LICENCE)

Applicant/owner of a site notifies Bangladesh Atomic Energy Regulatory Authority (BAERA) before commencing any site investigations in writing of their intention; first regulatory intervention begins with the site inspection by the BAERA team. Application document for site licence includes relevant chapters of the Preliminary Safety Analysis Report

(PSAR), Environmental Impact Assessment (EIA), Feasibility Evaluation (FE) reports, General Quality Assurance Program, and Quality assurance program for project siting. In addition following elements are also considered:

- Information about the site evaluation with respect to natural phenomena such as earthquakes floods and storms.

- Information about the site evaluation with respect to man-made external events such as aircraft crashes, fires, explosions and failure of dams, etc.

- Information regarding the water availability for cooling purposes for the lifetime of the plant.

- Information regarding the national electrical grid connection and reliability of the off-site electrical power

- Preliminary studies on radiation exposure of the public due to liquid and gaseous radioactive effluents during normal operations, anticipated operational occurrences (AOOs) and accident conditions.

After submission of all required documents, BAERA conducted review and assessment by its own and external experts (FSUE VO “Safety” and SEC-NRS- TSOs of Rostechnadzor) and the whole process are coordinated by the Nuclear Safety and Security Division of BAERA. An illustration of the basic scheme for authorization process is given in Figure 8.

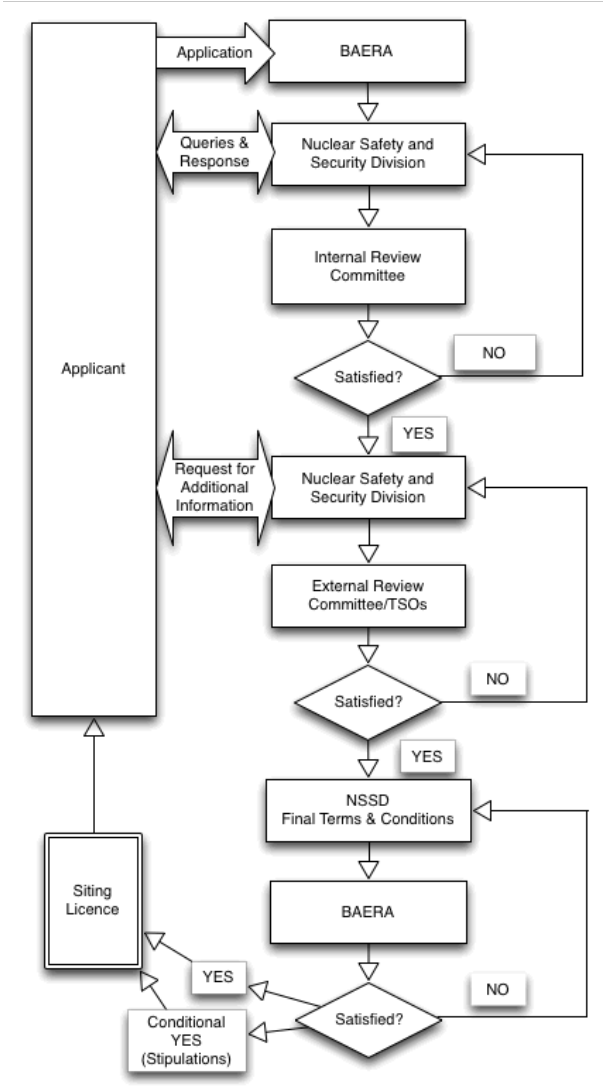

Figure 8: Siting Licence authorization scheme in Bangladesh

15.3 EVALUATION OF SITE RELATED FACTORS AFFECTING SAFETY

Prior to furnishing the application for the Siting Licence, the applicant has to stipulate all pertinent site-relevant external events that may affect the safety of the Rooppur NPP. These site-relevant external events are factors induced by human activities, such as aircraft crashes or chemical explosions, and events due to natural causes such as seismic phenomena, flood, tornados, high tides, etc.

Moreover, the reports specify brief design information and overview of the proposed NPP project, overall safety approach, dose limits, emergency preparedness aspects and offsite power supplies, etc.

BAERA carries out review and assessment of submitted documents in order to determine the potential consequences of interaction between the plant and the site and the suitability of the site for the envisaged plant from the point of view of nuclear safety.

15.4 ASSESSMENT OF IMPACT OF NPP ON PUBLIC AND THE ENVIRONMENT

BAERA issues "Siting Licence" by reviewing the documents as mentioned in section 15.2 of this report considering plant specific safety aspects of the site important to nuclear safety; This establishes suitability of the proposed nuclear installation in that site and ensure the nuclear safety as well as limits the risk to the public and the environment from the radiation hazards within acceptable limits for the entire lifetime of the plant. For all state of a NPP, namely normal operation, anticipated operational occurrences (AOO) and accident conditions, the effects on the general public and environment mainly arise from radioactive liquid and gaseous effluents and radiation exposure to the general public from these discharges. These effects, especially potential radiological impact on people and environment are assessed for the site for all operational states of the envisaged NPP, taking into account the atmospheric dispersion patterns, present and probable future population distribution in the area, etc. The acceptable doses to the public and environmental radioactivity limits are set as per the NSRC Rules-1997 [6].

15.5 RE-EVALUATION OF SITE RELATED FACTORS

As per the BAER Act-2012 [3] and the NSRC Rules-1997 [6], the Authorization Holder (Licensee) is required to perform regular safety assessments, the Periodic Safety Reviews (PSR). Terms and conditions in the licence (for instance, Siting Licence) state the type of these assessments and also indicate the maximum period between performing the assessments. In addition, these include surveillance and re-evaluation of the site to ensure continued acceptability of site conditions by taking into account site relevant factors. Regulatory Guidance on Site Evaluation for the Safety of Nuclear Power Plants [11] provides detail of the re-evaluation scheme.

15.6 CONSULTATION WITH OTHER CONTRACTING PARTIES

Legislative and regulatory framework of Bangladesh ensures the utilization of nuclear materials and facilities and carrying out related activities with due consideration to the health and safety of the people and the environment from the harmful effect of ionizing radiation.

All the obligations incurred from signing and/or approving related international agreements and conventions also support to achieve this objective. Bangladesh is party to the Convention on Early Notification of a Nuclear Accident (1988), and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1988) and fully complies with the obligations under these conventions.

16. DESIGN AND CONSTRUCTION (ARTICLE 18)

16.1 IMPLEMENTATION OF DEFENCE IN DEPTH

BAERA is currently drafting the regulations on "Safety of Nuclear Power Plant: Design and Construction" [12] on the basis of IAEA SSR-2/1 (Rev. 1) [13] and General Regulations on Ensuring Safety of Nuclear Power Plants [9] of Russian Federation. According to the IAEA SSR 2/1 (Rev. 1) "Safety of Nuclear Power Plants: Design", design of a NPP must be based on the defence-in-depth concept in order to achieve the general safety objectives. 'Defence-in-depth' safety philosophy consists of a set of diverse and overlapping strategies or measures, known commonly as 'levels of defence'. These levels of defence should be practically independent from one another to ensure that the failure of one system will not affect more than one level of defence at a time. This principle is defined and applied in various nuclear safety standards and documents, and also accepted as the fundamental concept of ensuring safety in design of a NPP in the aforementioned draft regulations in order to prevent any accidents as well as to mitigate their radiological consequences should they occur. According to the defence in-depth concept, as prescribed in the draft regulations, design of the NPP shall have adequate safety systems intended to fulfill the following main safety functions:

- Reactivity Control;
  -Prevention of uncontrolled reactor power increase
  -Ensuring fast safe shutdown of the reactor, if required
- Removal of decay heat to the ultimate heat sink;
  -Cooling of the shut-down reactor
  -Cooling of the spent fuel
- Confinement of radioactive materials;
  -Prevention of significant radioactive releases in the environment.

16.2 INCORPORATION OF PROVEN TECHNOLOGIES

As a newcomer country, Bangladesh's strategy is to use proven technology, equipment and systems as a whole for the installation of nuclear energy generating system, The regulations on "Safety of Nuclear Power Plant: Design and Construction" [12] will have the necessary provisions to use proven technologies in design that can be achieved by following the "Reference Plant" approach as stated in the IAEA INSAG-22 and INSAG-26 documents. Accordingly, BAEC selected the Novovoronezh-II NPP in Russian Federation as the reference plant of the Rooppur NPP.

16.3 DESIGN FOR RELIABLE, STABLE AND EASILY MANAGEABLE OPERATION

The selected design for Rooppur NPP will ensure reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface. During the review and assessment process of PSAR for issuing "Design and Construction Licence", all the design safety related aspects will be evaluated in compliance with BAERA's regulations as well as IAEA safety standards.

17. OPERATION (ARTICLE 19)

During the Commissioning and Operation phase of a NPP the following elements will be addressed:

- Accomplishment of an appropriate safety analysis and a commissioning programme prior to the issuance of the operating licence, demonstrating that the installation, as constructed, is consistent with design and safety requirements;
- Operational limits and conditions are in place, which are derived from the safety analysis; tests and operational experience are defined and revised as appropriate for identifying safe boundaries for operation;
- Approved procedures are in place for O&M, inspection and testing of a NPP;
- Establishment of procedures for responding to anticipated operational occurrences (AOOs) and to accidents;
- Availability of necessary engineering and technical support in all safety-related fields throughout the lifetime of a NPP;

- Reporting procedure of the licensee to the regulatory body of any incidents significant to safety.
- Establishment of operating experience feedback mechanism that allows sharing of important experience with international bodies and with other operating organizations and regulatory bodies.

The BAER Act-2012 [3] and NSRC Rules-1997 [6] have broadly addressed almost all the above mentioned requirements to ensure nuclear safety in the commissioning and operation stage of a NPP. Moreover, regulations will be developed on the Safety of Nuclear Power Plant (NPP) "Commissioning and Operation", based on the IAEA SSR-2/2 (Rev.1) [14] which will address the post-Fukushima knowledge base and will facilitate the commissioning and operation of the Rooppur NPP as well as any other future NPPs ensuring all nuclear safety aspects.

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