

# Vol. 1: Draft Summary Environmental and Social Impact Assessment

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Project Number: 50253-001  
March 2017

## BAN: Reliance Bangladesh LNG and Power Project

Prepared by Environmental Resources Management (ERM)

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**Draft SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT**

**LIQUEFIED NATURAL GAS FLOATING STORAGE & RE-GASSIFICATION AT  
KUTUBDIA ISLAND, MOHESHKHALLI AND 750MW NATURAL GAS BASED  
POWER PLANT AT MEGHNAGHAT, SONARGAON, NARYANGANJ  
BANGLADESH**

**March 2017**

## ABBREVIATIONS

ADB	Asian Development Bank
CCPP	Combined Cycle Power Plant
CO	Carbon Monoxide
DMP	Disaster Management Plan
DOE	Department of Environment
ECA	The Environment Conservation Act, 1997
ECC	Environment Clearance Certificate
ECR	Environment Conservation Rules
EHS	Environment, Health and Safety
EIA	Environment Impact Assessment
ERM	Environment Resource Management
ESIA	Environment and Social Impact Assessment
ESMP	Environment and Social Management Plan
FGD	Focussed Group Discussion
FSRU	Floating Storage and Regasification Unit
FSU	Floating Storage Unit
GIS	Geographic Information System
GoB	Government of Bangladesh
GRM	Grievance Redressal Mechanism
GTCL	Gas Transmission Company Limited
HC	Hydrocarbons
IFC	International Finance Corporation
IMO	International Maritime Organisation
LILO	LInux LOader (power distribution system)
LNG	Liquefied Natural Gas
LNGC	LNG Carrier
MARPOL	Marine Pollution
IPP	Independent Power Producer
IRLNGS	Independent Regassified LNG Supplier
MMSCFD	Million Standard Cubic Feet Per Day
MMTPA	Million Tonnes Per Annum
MW	Mega Watt
NGO	Non-Governmental Organisation
NO <sub>x</sub>	Oxides of Nitrogen
ORF	Onshore Regassification Facility
PM	Particulate Matter
RBLTL	Reliance Bangladesh LNG Terminal Limited
RBLPL	Reliance Bangladesh LNG & Power Limited
RLNG	Regasified LNG
RPL	Reliance Power Limited
SO <sub>2</sub>	Sulphur di oxide
STP	Sewage Treatment Plant
TOR	Terms of Reference

## Weights and Measures

°C	Degree Celcius
dB(A)	Decibel on A weightage
kg	kilogram
knots	Nautical mile per hour (1.852 km per hour)
m <sup>3</sup>	Cubic meter
mm	Millimeter
µg	Microgram
S	Second

## Note

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## I) INTRODUCTION

1. Reliance Power Limited (Reliance Power) through its subsidiaries in Bangladesh – Reliance Bangladesh LNG Terminal Limited (RBLTL) for development of LNG facility and Reliance Bangladesh LNG and Power Limited (RBLPL) for development of gas based power plant, has strategic plans to establish the subsidiaries as Independent Regassified LNG Supplier (IRLNGS) and Independent Power Producer (IPP) respectively. Accordingly, RBLTL proposes to set up LNG facility of up to 5.0 million tonnes per annum (MMTPA) and RBLPL proposes to set up a natural gas/RLNG based combined cycle power plant (CCPP) initially of 750 Megawatt (MW) in Bangladesh (hereinafter the proposed LNG facility and 750 MW CCPP are referred to as the Combined Project) to meet the existing power shortage and the demand-growth in future years. In Bangladesh, the demand for natural gas is rapidly rising due to its diversified use in industrial and electric power sector and fast depletion of existing reserves. As a result many of the gas fired power plants are experiencing gas shortages in Bangladesh and running below their rated capacity.
2. The LNG storage and re-gasification facility is proposed as an offshore Floating Storage unit (FSU) with land based regasification facility. The FSU will have storage in the range of 3.5 MMTPA to 5 MMTPA [about 750 million standard cubic feet per day (MMSCFD) peak load] with a storage capacity of 145,000 m<sup>3</sup> to 216,000 m<sup>3</sup> and land based regasification facility located offshore of Kutubdia Island in Cox's Bazar region of Bangladesh (hereinafter referred to as the LNG Project).
3. The gas based 750 MW Combined Cycle Power Plant (hereinafter referred to as the Power Plant) is proposed to be located on land allotted by Bangladesh Power Development Board (BPDB), Government of Bangladesh at Meghnaghat, Sonargaon, district Narayanganj under the land lease agreement.
4. The LNG Project and the Power Plant are classified as the Red Category projects and thus requiring EIA studies to be conducted for obtaining the Environmental Clearance Certificates (ECCs) under the Environment Conservation Act (ECA) 1995 and the Environment Conservation Rules (ECR), 1997 from the Department of Environment (DoE) under Ministry of Environment and Forest (MoEF), Government of Bangladesh (GoB).
5. Reliance Power (through RBLTL and RBLPL) is seeking finance from multi-lateral financial institutions such as the ADB and the EPFIs for setting up of the LNG Project and the Power Plant. This support from the multi-lateral financial institutions/ export credit agencies requires adherence of international best practices and environmental and social safeguard requirements of the lenders. The LNG Project and the Power Plants are classified by ADB as Environmental Category “A” and Social Category “A” projects which means the Combined Project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented without appropriate mitigating measures in place. These impacts may affect an area larger than the sites or facilities subject to physical works thus requiring ESIA studies. The Combined Project will also conform to the requirements under SPS, 2009 in respect of consultation, disclosure requirements and safeguard documentation to meet safeguard principles and requirements of ADB.
6. RBLTL and RBLPL have therefore initiated an environmental and social impact assessment (ESIA) studies for the LNG Project and the Power Plant respectively to comply with the requirements of environmental impact assessment (“EIA”) guidelines of the Government of Bangladesh (“GoB”) to obtain necessary Environmental Clearance Certificates for the LNG Project and the Power Plant as well as to meet the ADB’s Safeguard Policy Statement, 2009. The IFC Environmental, Health, and Safety (EHS) General Guidelines (April 30, 2007) will be applicable for the Combined Project. In addition to that, IFC’s Sector specific EHS Guidelines for LNG Facilities (April 30, 2007) and for Thermal Power Plant (December 19, 2008) will apply. The LNG Project will also conform to international maritime conventions, protocols and agreements as relevant to the project such as MARPOL.

## II) PROJECT DESCRIPTION

### LNG Project Site Location

7. The site for LNG Project is proposed in north-western part of the Kutubdia Island in Dakshin Dhurung and Kaiyabil Unions of the Kutubdia Upazila. The marine facilities are planned to be set up in the Bay of Bengal, 2.4 km from the sea front. The landfall point is south of the existing Light House on the island. Approximately 2.4 km of cryogenic pipeline on trestle is planned to connect the FSU to onshore gas receiving facility (ORF). Another onshore spur pipeline of ~17 km will be laid to transport regassified LNG gas from the gas receiving facility on Kutubdia Island to GTCL grid pipeline on the mainland.
8. The Kutubdia Channel is directly connected with Bay of Bengal at both ends. The Chittagong Port is located on north of the Kutubdia Island and ~50 km from the LNG Project site. An anchor point of the Chittagong Port is located in the Kutubdia offshore region along with an existing navigational channel, which is located ~3 km off the north western shore of the island.
9. The Kutubdia Island is isolated from main shore of Bangladesh with no direct road access. For an access to the LNG site, one has to cross the Kutubdia Channel to reach the island. At present, the channel is ~4 km wide between Boroghob (Kutubdia) – Magnama Ferry Ghat. Aerial distance from the nearest town at Cox's Bazar is ~50 km and by road ~85 km including the channel crossing. The nearest national highway is Chittagong-Cox's Bazar National Highway (NH-1).

### Power Plant Site Location

10. The site for the Power Plant is located at Meghnaghat, Sonargaon, district Narayanganj, Bangladesh. The site of the Power Plant is located ~200 km from Kutubdia, the LNG Project site. The Power Plant site is situated to the west of a box-shaped island formed due to meandering of Meghna River from its main course. It is situated ~36 km southeast of Dhaka, near Meghna Road Bridge on Dhaka-Chittagong Highway and is ~2km west from Dhaka-Chittagong Highway, at the bank of the Meghna River. The site is surrounded by Meghna River along west and south directions.
11. There are three major power plants situated in the east of the Power Plant site. Meghnaghat Power Limited, with capacity of 450 MW CCPP and Summit Meghnaghat Power Company Limited with capacity of 350 MW are situated at the eastern part of the Power Plant site and Orion Power Meghnaghat Power Plant with capacity of 100 MW on norther part of the Power Plant Site. Char Balaki Village is located in the south-west direction and Hossaindi Union of Gazaria Upazila is located in the south of the Power Plant.
12. Access to the Power Plant site may be made from Dhaka through Dhaka-Chittagong Highway followed by raised access road of ~1 km. The inland waterway accessibility via Meghna River is also considered to be feasible for the Power Plant.

### LNG Project Components

13. The LNG Project will comprise of the following components:
  - (i) Floating Storage Unit (FSU) with a storage capacity 145,000 m<sup>3</sup> to 216,000 m<sup>3</sup>
  - (ii) Twin Jetty with topside facility
  - (iii) Cryogenic Pipeline of ~ 30 inches of 2.4 km on motorable trestle to connect the FSU to the onshore terminal;
  - (iv) Onshore regasification facility of 750 MMSCFD capacity with an option of building a 185,000 m<sup>3</sup> (gross capacity) LNG tank later
  - (v) Onshore receiving facility including Custody Transfer Metering system (CTMS)

- (vi) Spur pipeline up to 36 inches (High pressure i.e. 70 bar (g) to 100 bar (g)) to transport gas from the onshore regasification facility to Valve station 2 (at Napura) of Moheskhali- Anwara grid pipeline of Gas Transmission Company Limited (GTCL).
  - (vii) Onshore gas based captive power plant of 20 MW (2 x 10 MW)
14. The Island Jetty consisting of two parallel berthing facilities with offshore steel/concrete structures and mooring facilities on either side so as to manage simultaneous berthing of a Floating Storage Unit (FSU) and LNG carriers (LNGCs) for unloading of LNG (adjacent / side-by-side) berthing and mooring on either side of the jetty with fenders. The Jetty and associated facilities will be built to operate in a draft of more than 12 m. The design of Jetty and necessary facilities would be such that it puts no restriction for the movement of FSU / LNG carrier ships (entry channel, turning circle, berthing / mooring pockets) to and from the proposed jetty with required navigational aids.
15. LNG will be brought by LNG carriers of sizes ranging from 125,000 m<sup>3</sup> to 263,000 m<sup>3</sup> capacity. LNG carriers will unload LNG to the FSU (moored to Jetty) with hard arms / soft arms wherein they are stored in membrane tanks.
16. The FSU will be provided with a main power generation system designed for power supply. The actual power requirement at FSU is expected to be less than 5 MW. Because of the necessity to handle the boil off gas that naturally boils from cargo tanks, almost all LNG carriers/FSU are designed to use the vaporized LNG as fuel for power production and propulsion. The boil off gas is collected in the vapour header and compressed by the low duty compressors into the fuel gas main that feed the captive power plant and/or boilers. If the natural boil off is not sufficient, forced vaporizers will be used for vaporizing part of the cargo and feed the fuel gas main.

### **Power Plant Components:**

17. The Power Plant of 750 MW will comprise of the following components:
- (i) Tapping of natural gas of 130 million standard cubic feet per day (MMSCFD) (at 100% load) from GTCL national gas pipeline coming from Kutumbpur, Comilla. RBLTL will be supplying regasified LNG to GTCL national gas pipeline at Kutubdia to Pekua which will be supplied to RBLPL through a new pipeline to be built by GTCL from Kutumbpur, Comilla to the Power Plant site;
  - (ii) Construction of temporary RO-RO jetty (along southern bank of Meghna River) to ensure convenient and efficient transportation of construction material. The RO-RO jetty will be demolished upon completion of the construction of the Power Plant;
  - (iii) State-of-the art heavy duty industrial type gas turbines suitable for base load and cyclic load operation in both open cycle and combined cycle modes<sup>(1)</sup>. The combined-cycle will consist of four main components: control, auxiliary components, gas turbine, and generator. There will be two gas turbine generators (2 x 255 MW) fitted with two heat recovery steam generators (HRSG) and one steam turbine generator (1 x 240 MW) with “Multishaft” arrangement;
  - (iv) A vertical module forced circulation triple pressure reheat type heat recovery boiler with water tube construction without supplementary firing;
  - (v) Raw Water treatment Plant for treatment of 1,096 m<sup>3</sup>/hour of water from Meghna River;
  - (vi) Circulating cooling water system; and
  - (vii) Power evacuation through 400 kV two double circuit transmission lines connecting Aminbazar using a LILO (Linux LOader) as temporary measure. The temporary facility for LILO attachment will be built within the existing government land.

(1) A gas turbine in simple (open) cycle discharge exhaust gases at high temperature directly into the atmosphere through stack while in combined cycle exhaust gases are recovered in boiler to generate steam which in turn enter steam turbine for electricity generation thus to achieve high efficiency of ~ 50%.

**Manpower Deployment:**

18. During construction phase, the LNG Project would deploy ~1,000 persons, mostly unskilled workers, during peak construction period while the Power Plant would deploy ~1,800 persons, mostly unskilled workers. Construction of LNG Project will be completed in 30 months and the Power Plant in 36 months working three shifts a day. Construction manpower will be temporarily employed from within the local regions to the extent possible both for the LNG Project and the Power Plant.
19. During operation phase, LNG Project would employ 120 full time employees while Power Plant would require 160 full time employees working in three shifts daily.

**Water Requirement:**

20. During construction phase, the LNG Project would require domestic water of ~20 m<sup>3</sup>/day (normal) to 40 m<sup>3</sup>/day (peak construction) while the Power Plant would require domestic water ~50 m<sup>3</sup>/day (normal) to 90 m<sup>3</sup>/day (peak construction). Drinking water will be provided onsite after desired treatment. During operation phase, the LNG Project would require ~20 m<sup>3</sup>/day of domestic water (to be sourced through barges from the Chittagong Port) for personnel working on-board the FSU and at the ORF. The Power Plant operations would require 26,300 m<sup>3</sup>/day of water to be sourced from Meghna River. No ground water will be extracted for either of the projects.

**Land Requirement:**

21. For the LNG Project, RBLTL will require 37.91 acres (15.34 hectares) of land for ORF and it will be a mix of both government land and private land. The onshore pipeline of 17 km length will be laid from ORF to Banskhal. The gas pipeline will pass through Uttar Dhurung, Chhanua and Puichhari Union Parishads of Kutubdia and Banskhal Upazila respectively. The width of land to be acquired for laying of pipeline is proposed to be 8 m along the pipeline corridor while an additional 15 m will be required during the pipeline laying phase for staging of materials used in construction. Land area up to 1.85 acres will be acquired for the terminal station (Valve 2) at Napura adjacent to existing MLV station along the GTCL pipeline.
22. For the Power Plant, RBLPL will require 35 acres (14.2 hectares) of total land of BPDB located to the west of Summit Meghnaghat CCPP.

**Power Requirement:**

23. During construction phase, the LNG Project and the Power Plant would require individually a maximum of 2 MW power through diesel generators. Availability of construction power from local electricity supplying agency will also be sourced to the extent possible.
24. During operations phase, the LNG Project would meet the power requirement through 20 MW (RLNG based) captive power plant to be installed at the ORF. The operation phase power requirement of the Power Plant would be met through onsite power generation.

**Pollution Sources and Characterisation****Air Emissions:**

25. During construction phase, the air emissions will mainly related to onsite power generation through small diesel generators and fugitive dust emissions from construction activities both at the LNG Project and the Power Plant sites.
26. During operation phase, the gaseous pollutants emission from the LNG Project and the Power Plant would be due to combustion of natural gas for onsite power generation. The emissions would be compliant of prescribed standards of Bangladesh and IFC/WB. The required emission control techniques would be incorporated where appropriate to emit the pollutants below the applicable standards.



27. The LNG Project operation of FSU and ORF will involve emissions from the following sources:
- Methane gas combustion emissions of pollutants NO<sub>x</sub> and CO through stack of 43 m attached to 20 MW captive power plant to meet power requirement of FSU and ORF operations;
  - Marine gas oil combustion emission of NO<sub>x</sub> and CO in engines of LNG carriers and Tugs (for maneuvering and LNG discharge to the FSU);
  - Methane gas combustion emission NO<sub>x</sub>, CO and HC during emergency flaring (no cold venting will be resorted);
  - Potential fugitive emissions of vapourised methane gas from compressors, joints and valves FSU, ORF and send-out pipeline;
  - Combustion emission of pollutants SO<sub>2</sub> and NO<sub>x</sub> from diesel engines to be operated in the event of back-up power requirement.
28. The Power Plant operations will involve natural gas combustion emission of pollutants NO<sub>x</sub> and CO through three stacks each of 70 m height two attached to 2 x 255 MW gas turbines fitted with 2 HRSG and one attached to 240 MW steam turbine.

**Liquid Discharges:**

29. During construction phase, the LNG Project will generate domestic wastewater of ~16 m<sup>3</sup>/day during normal to 32 m<sup>3</sup>/day during peak construction period while the Power Plant will generate 40 m<sup>3</sup>/day during normal to 72 m<sup>3</sup>/day during peak construction time. The domestic wastewater generated during construction phase both at the LNG facility and the Power Plant will be treated in septic tanks followed by discharge into the adjoining leach fields.
30. During operation phase, FSU deployed will have a sewage treatment system onboard to treat and discharge offshore and meet the MARPOL standards. Similarly, treatment facilities for bilge water will be provided onboard the FSU. During operation phase, the LNG Project will have sewage treatment plants (STPs) of capacity 20 m<sup>3</sup>/day for treatment of sewage generated at the ORF site. No cold water discharges are anticipated from the LNG Project as the facility is planned using air based re-gasification systems. No other wastewater generation is envisaged from ORF.
31. During operation phase, the Power Plant would generate domestic wastewater of ~20m<sup>3</sup>/day which will be treated in an onsite sewage treatment plant. The Power Plant would generate cooling tower blow down (209 m<sup>3</sup>/hour) and 5 m<sup>3</sup>/hour reject from demineralization (DM) Plant (2 m<sup>3</sup>/hour as backwash and 3 m<sup>3</sup>/hour as acid-alkali neutralization reject). A stream of 20m<sup>3</sup>/hour from cooling tower blowdown will be diverted for use in floor washing. The wash wastewater will be physico-chemically treated in effluent treatment plant of 20 m<sup>3</sup>/hour capacity. All the wastewater from cooling tower blow down, treated wash wastewater and neutralized DM Plant will be equalized in Central Monitoring Basin (CMB). From CMB a stream of 6 m<sup>3</sup>/hour will be diverted for use in horticulture and remaining 206 m<sup>3</sup>/hour will discharged into natural water drain conforming to applicable discharge standards as per the approval of Department of Environment, Bangladesh.

**Solid Waste:**

32. During construction phase, the LNG Project would generate domestic solid waste of ~150 kg/day while the Power Plant would generate it of 250 kg/day. About 60% of the domestic waste to be generated is expected to be biodegradable. Both biodegradable and non-biodegradable waste will be disposed of in separate bins at the nearby municipal disposal site. Other waste during construction phase would be construction civil waste of ~50 tonnes per annum each (from LNG ORF and the Power Plant). All the construction civil waste will be used in raising the ground levels within the LNG ORF and the Power Plant sites.
33. During operation phase, the LNG Project would generate solid wastes onboard from FSU and LNG Carrier will be segregated and will be either safely incinerated onboard or brought onshore at onshore

waste disposal facilities available with the Chittagong Port / Cox's Bazar Town. Food wastes of ~10 kg/day to be generated on board the FSU will be ground to a particle size capable of passing through a screen with openings of 25 mm and then discharged into the sea. While plastic and non-incinerable waste (~5 kg/day) will be collected and disposed of along with solid wastes (~15 kg/day) from ORF to be disposed of at an approved waste handling facility.

34. The FSU related waste will be handled by a MARPOL compliant Ship-Board incinerator capable of handling burning of allowed waste (sludge oil and solid) generated on-board. Un-allowed items as per MARPOL will be collected in separate bins and brought onshore for disposal.
35. During operation phase, the Power Plant is expected to generate ~25 kg/day which includes 15 kg/day of food waste. Daily solid waste will be collected and disposed of at an approved waste handling facility.

**Hazardous Wastes:**

36. Both during construction and operation phases, the LNG Project and the Power Plant would generate hazardous waste comprising of used oil; empty containers of paints, varnishes, thinners and lubricating oil; rags containing oil and grease, filter materials and packages containing hazardous wastes. Dedicated areas will be earmarked for temporary storage of hazardous wastes on impervious surface at both project sites. All construction and operation phase hazardous wastes will be brought to on-shore dedicated area for recycling and/or final disposal at approved hazardous waste handling facilities near to the project sites.

**Noise Emissions:**

37. During construction phase, the primary sources of noise generation will be due to use of heavy earth moving barges and construction activities onsite. The expected equivalent day time noise levels will range from 75 dB(A) to 95 dB(A).
38. During operation phase, the main noise emission sources in LNG facilities include pumps, compressors, generators and their drivers, air dryers, air coolers at liquefaction facilities, vaporizers used during regasification, and general loading /unloading operations of LNG carriers /vessels. Sound pressure levels (at 1 m from the source) of each equipment have been considered to be within 75 dB(A) to 95 dB(A). With reference to the ORF, in normal operating conditions noise emissions mainly refer to regasification, captive power generation system and gas compression skid with sound pressure levels (at 1 m from the source) have been considered to be within 80 dB(A) to 90 dB(A).
39. From the Power Plant, the gas turbine and the steam turbine will have internal noise level of ~85dB(A) at 1 m from source which will be minimized by sophisticated acoustic power house building design so as to minimize the noise up to standard. The heat recovery steam generator stack will emit a noise level of 85dBA after providing the silencer.

### III) DESCRIPTION OF THE ENVIRONMENT

#### A) Physical Environment

##### LNG Project

40. **Study Area (Area of Influence):** An area within 10 km radial zone around the FSU site was considered as the study area (area of influence) due to the construction and operation phase activities of the LNG Project. Additionally, an area of 500 m either sides of the pipeline corridor from the ORF to Napura Valve Station was considered as the area of influence.
41. **Physiography:** The Kutubdia Island is a young active coastal plain. Geologically major portion of the study area dominantly consists of tidal deposits, i.e. inter tidal and supratidal deposits composed of silty clay with organic clay mix and little sand. The elevation of the island varies between 0 to 7.6 m (25 feet) above mean sea level. The northern part of the island is having comparatively higher elevation and the slope of the island is from north to south. An earthen embankment is present along the entire stretch of the island. The average height of this coastal wall is 6 m.
42. **The oceanographic conditions** in terms of bathymetry describes a steep sea floor with 10 m contour reaching within 1 km from the Kutubdia Island on the west and with more than 13m water depth near the proposed FSU location. Predominant wave direction is from south west. Maximum wave height recorded near the Project areas during 2005-2009 was found to be 2.25 m. Strong longshore currents occur in the monsoon season near Kutubdia Island. Direction of current is predominantly north during peak flood tide and south during ebb tide and NE monsoon.
43. **Landuse:** As assessed through high resolution satellite imagery (of May 2015), the predominant land use of the on-shore portion of the study area around ORF includes agricultural land (5.56%), salt pans (9.06%), and settlement (4.16%) and remaining forms sea front.
44. **Shoreline Erosion and Accretion:** About 9 km<sup>2</sup> area of Kutubdia was eroded whereas 0.35 km<sup>2</sup> of land accretion occurred on the Kutubdia Island in a period between 1972 and 2013<sup>1</sup>. Major erosion occurred on the southern part of the island. The western side of the island, i.e. towards the Bay of Bengal side was less prone to erosion compared to the southern section. The ORF has been proposed on the north-western side of the island, south of the existing light house and appears to have less erosion potential in comparison to the southern part of the Kutubdia Island.
45. **Drainage:** A natural drainage channel Pilat Kata Khal flows along the mid of the island and discharges into the Kutubdia Channel. This channel is influenced by tidal effects. Several minor channels are also connected with the Pilat Kata Khal. Also, several salt pans and some fresh water ponds are located within the study area.
46. **Water Quality: Marine water** samples were collected from six locations in the Bay of Bengal and Kutubdia Channel for analysis of water quality. The pH values of the marine water samples were found to be neutral to slightly alkaline with salinity levels varying from 10.4 parts per thousand (ppt) to 17.7 ppt. Concentration of most of the heavy metals analysed were found to be below their corresponding detection limits.

<sup>1</sup> Munshi Khaledur Rahman. 2015. Environmental and Social Vulnerabilities and Livelihoods of Fishing Communities of Kutubdia Island, Bangladesh by (A dissertation submitted to Kent State University).

47. **Inland Surface Water** sample was collected from Pilat Kata Khal for analysis of inland surface water quality. The water quality analysed for Pilat Kata Khal was found to be in compliance with the use of water for fisheries as per the ECR, 1997.
48. **Groundwater** samples were collected from four locations within Kutubdia Island for analysis of water quality. The groundwater analysis reveal that almost all the parameters were within the standard values of the ECR, 97 (excepting TDS) and the ground water quality was satisfactory for potable uses within the Kutubdia Island.
49. **Soil Quality:** Soil samples were collected from two locations within Kutubdia Island for analysis of soil quality. Soil of the Project area mainly formed from recent alluvial sediments. Soils are clay loam and acidic in nature and non-saline to slightly saline. In general the soils were found to be of low nutrient content to very low nutrient content (except for potassium).
50. **Sediment Quality:** Marine sediment samples were collected from four locations in the Bay of Bengal and Kutubdia Channel for analysis of sediment quality. Sediment texture was found to be varying between sandy-loam to silty-loam in nature with neutral pH. Organic carbon contents of the sediment samples were found to be low. Heavy metal concentrations of the sediment samples were also found to be negligible.
51. **Climate & Meteorology:** The LNG Project site falls in the Southeastern zone of Bangladesh where the climate is tropical monsoon with three distinct seasons *viz.* cool dry season (November-February), pre-monsoon hot season (March – May) and the rainy monsoon season (June –September) are recorded in Kutubdia Island. Average minimum temperature in Kutubdia region generally varied from 6.2°C to 13.4°C; while the maximum temperature of 39.5°C was observed in May. The maximum annual rainfall recorded during the last decade (2000-2010), was about 3,171 mm with about 80% of the total rainfall occurring during the monsoon season. Wind direction generally prevails from south-southeast during June-September with maximum wind speed of 1.68m/s.
52. **Ambient Air Quality:** Ambient air quality was measured during post monsoon season of 2016 at six locations within the Kutubdia Island. The concentrations of PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub> and CO were found to be in compliance with the national standards, presented under the ECR, 1997 (as amended), while PM<sub>10</sub> and PM<sub>2.5</sub> exceeded the corresponding WHO guideline limits of 50 µg/m<sup>3</sup> and 15 µg/m<sup>3</sup> respectively throughout the monitoring period.
53. **Ambient Noise Quality:** Ambient noise quality was monitored at six locations within the Kutubdia Island. Daytime and night time equivalent noise levels at residential and commercial areas were found to be in compliance with the Noise Pollution (Control) Rules, 2006. The equivalent noise levels at the Kutubdia Upazila Health Complex were found to be exceeding the respective noise standards of *Silent Zone*.
54. **Natural Hazards:** The LNG Project site is located in Earthquake Zone -II, where building design of moderate levels will be necessary. Kutubdia region is affected by cyclone and storm surge almost every year. Kutubdia Island is falling in a high risk area where surge heights are above 1 m. The southern part of the island (Borohop and Ali Akbar Deil Unions) are most affected by inundation (3m to 4m), whereas the northern Unions are relatively at lesser risk, except for the coastal stretches. The Cox's Bazar coast falls within Tsunamigenic Zone-I, which is reportedly most vulnerable.

## Power Plant

55. **Study Area (Area of Influence):** An area within 5 km radius from the CCPP site was considered as the study area (area of influence) due to both construction and operation phase activities of the Power Plant.
56. **Physiography:** The Power Plant site falls in the Old Meghna Estuarine Floodplain which occupies abandoned channel of the Brahmaputra River on the border between Bandar and Narayanganj Upazila. This region includes islands-former Brahmaputra chars within the Meghna River as well as adjoining parts of the mainland. Meghna River is running adjacent to the site.
57. **Drainage & Hydrology:** The drainage from the site flows to the south into the Meghna River. The flow of Meghna River at Sonargaon is less affected by tides. Based on historical information, the maximum discharge of 16,558m<sup>3</sup>/sec was measured on 9<sup>th</sup> September 2002; while the minimum discharge of 2,050 m<sup>3</sup>/sec was recorded on 10<sup>th</sup> June, 1998.
58. **Water Quality:** Inland surface water samples were collected from three locations from Meghna River i.e. upstream, downstream and near the project site. The quality of parameters investigated were within the Bangladesh DoE standards. The pH of surface water samples ranged from 7.11 to 7.26 i.e. slightly alkaline.
59. **Groundwater** table in major portion of Bangladesh exists at a shallow to moderate (Generally below 3.0 m) depth with confined, semi-confined and unconfined aquifers which is being recharged by major river systems and by infiltration of rain water. The ground water table fluctuates with seasons approaching near ground surface (within 1 m) over most of the country during wet seasons (July-September). Groundwater samples were collected from three locations surrounding the power plant site for analysis of water quality. The groundwater analysis reveal that most of the parameters (excepting Nitrate in one of the samples) were within the standard values of DoE - the ECR, 97
60. **Soil Quality:** Soil samples were collected from four locations within the Meghnaghat area for analysis of soil quality. Soils of the study area are sandy silt with low clay content in soil from the Project site (2%). Soil are neutral to slightly basic in nature. The heavy metals were found to be untraceable to low concentrations with relatively high concentrations of barium (ranging from 1,145 mg/kg to 1,875 mg/kg) and low concentrations of arsenic (0.29 mg/kg to 2.56 mg/kg).
61. **Climate & Meteorology** The Power Plant site falls in the Northern part of north zone of Bangladesh where the climate is tropical monsoon characterized by four seasons: pre-monsoon (March to May), monsoon (June to September), post-monsoon (October to November) and dry season (December to February). High air temperature is observed all throughout the year; daily air temperature variations are insignificant; air humidity is high with abounding rains. Temperature of the region varied from 5.3°C in January 2013 to 40.2°C in May 2014. The annual rainfall recorded during the last decade varied from 1,329 mm to 2,774 mm with almost 90% of rainfall occurred from April to October. At normal times, the maximum and minimum wind speeds at Dhaka (no meteorological station in Narayanganj) are 1.65 m/s (3.2 knots) and 1.08 m/s (2.1 knots) respectively in 2013. Wind direction generally prevails from south-southeast during April to September with maximum wind speed of 2.2 m/s (4.3 knots).
62. **Ambient Air Quality:** Ambient air quality was measured during post monsoon season of 2016 at six locations within Meghnaghat region. The concentrations of PM<sub>10</sub>, PM<sub>2.5</sub>, SPM, SO<sub>2</sub>, NO<sub>x</sub> and CO were found mostly in compliance with national standards, presented under the ECR, 1997 (as amended), while PM<sub>10</sub> and PM<sub>2.5</sub> exceeded the corresponding WHO guideline limits of 50 µg/m<sup>3</sup> and 15 µg/m<sup>3</sup> respectively throughout the monitoring period.

63. **Ambient Noise Quality:** Ambient noise quality was monitored at six locations within the Meghnaghat region. Baseline noise levels measured near the plant site were found in the range of 54.6 to 74.8 dB(A). The noise levels were found to be exceeding at four of the six locations as prescribed in the Noise Pollution (Control) Rules, 2006.
64. **Natural Hazards:** The Power Plant site is located in Earthquake Zone -II, where building design of moderate levels will be necessary. Meghnaghat region being far away from the coastal area, no cyclone has been recorded in the past. The area faces thunderstorms once in a while but those storms are not as destructive as a cyclone by any means.

## B) Biological Environment

### LNG Project

65. **Terrestrial ecosystem:** Total 87 terrestrial floral species were recorded from the terrestrial ecosystem of the study area which included 48 trees, 16 shrubs and 23 herbs and climbers. No protected floral species were recorded.
66. A total of 17 species of terrestrial herpetofauna are reported from the study area which included Green Frog (*Euphlyctis hexadactylus*) (Endangered as per IUCN Red List) and Spotted Pond Turtle (*Geoclemys hamiltonii*) (Vulnerable as per IUCN Red List). A total of 91 Avifaunal species were observed in the study area. Black-headed Ibis (*Threskiornis melanocephalus*) is reported Vulnerable while Eurasian Curlew (*Numenius arquata*) is reported as Near Threatened as per IUCN Red List. A total of 11 species of mammals were reported within the study area. Large Indian Civet (*Viverra zibetha*) and Common otter (*Lutra lutra*) are listed as Near Threatened as per IUCN Red list.
67. **Aquatic Ecosystem:** Planktonic survey was conducted at six locations in the Bay of Bengal and Kutubdia Channel. Phytoplankton community was represented by 17 genera with *Nitzschia sp.* as the most dominant followed by *Navicula sp.* and *Synedra sp.* Zooplankton community was represented by 23 genera with *Crab Zoea* as the most dominant followed by *Copepod nauplii* and *Penaus sp.* Sediment samples collected reveal poor density of benthic communities. Among the benthic organisms higher concentration was recorded for Nematodes and Bivalves.
68. A 5-days survey was undertaken by 2 local fishery experts in Kutubdia Island. Fishery survey indicated that around 400 numbers of ponds were present in Kutubdia Island and among them 20 ponds were used for commercial aquaculture. Major inland fish species cultured were Pangas (*Pangasius pangasius*), Tilapia and Rui (*Labeo rohita*).
69. There were two different kinds of fishing activities on Kutubdia Island, (i) deep sea fishing; (ii) Estuarine and near shore fishing. It was revealed through consultation with fishermen that about 57 fish species were caught during deep sea fishing and about 32 species of fishes were caught from nearshore and channels of Kutubdia. Two species of fishes were threatened and these were Korat mach (*Anoxypristis cuspidate*; endangered as per IUCN Red List) and Koiputi (*Anodontostoma chacunda*) is now a rare locally.
70. During the local consultation with local fishermen and Department of Fisheries it was revealed that Hilsha migrate from deep sea to north of 150-200 km offshore of Kutubdia and then the Hilsha school crosses eastern Nearshore of Kutubdia and aggregate near Bashkhali at Gandamara point where they breed and then the school begin its journey to enter into Meghna River system.
71. Isolated Olive Ridley turtle nesting is reported by the villagers all along the west coast of Kutubdia Island (Olive Ridley's Turtle (*Lepidochelys olivacea*) IUCN listed Vulnerable 2016.3). However, sighting of Olive Ridley turtle nesting was not observed during survey.

72. Four marine Dolphin species were reported by the local fishermen (both near Shore and Deep Sea) to be present within 5 km area of Kutubdia Island. There are no protected areas like National Park, Wildlife Sanctuary or Ecologically Critical Areas (ECAs) etc. within the study area.

### **Power Plant**

73. **Terrestrial Ecology:** A total of 192 vascular plant species belonging to 161 genera under 78 families have been recorded from the Power Plant where the maximum 153 (80%) plant species belonged to the dicotyledonous group, followed by 32 (17%) and 7 (3%) plant species belonged to the monocotyledonous and pteridophytes (ferns) groups, respectively. *Aponogeton appendiculatus* of the family Aponogetonaceae was found conservation dependent, *Christella dentata* of the family Thelypteridaceae was found near threatened and *Chromolaena odorata* of the family Asteraceae was found vulnerable categories.
74. Among fauna, 15 species recorded, 8 species were dragonflies of families Libellulidae, and Gomphidae; 7 species of damselflies of families Coenagrionidae, and Platycnemididae. A total of 24 species of butterflies were recorded during the survey.

### **C) Socioeconomic Environment**

#### **LNG Project**

75. The Project footprint for ORF is located on two Unions i.e. Dakshin Dhurung and Kaiyabil Union of Kutubdia Upazila and proposed Right of Way (ROW) of onshore pipeline is located in four Union i.e. Dakshin Dhurung and Uttar Dhurung Unions in Kutubdia Upazila of Cox's Bazar District and Chhanua and Puichhari Union in Banskhali Upazila of Chittagong District.
76. Among these five unions Puichhari Union (38,224) has the highest population while the lowest populations were recorded in Kaiyabil Union (12,945). Average literacy rate of these 5 Unions observed as 29.34% and highest and lowest literacy is recorded in Puichhari Union and Kaiyabil Union respectively. Employed population in Kutubdia Upazila and Banskhali Upazila are 70% and 72% respectively of the total working age population. Workforce participation rate recorded in the Dakshin Dhurung, Kaiyabil, Uttar Dhurung, Chhanua and Puichhari Unions are 78%, 78.25%, 79.51%, 76.35% and 77.27% respectively.
77. It has been observed during site visits that agriculture, salt cultivation and fishing are three major livelihood earning activities observed in Kutubdia Island. Community consultation also revealed that most of the community people are engaged in this activity and all other livelihood activity like small business, boat making and maintenance, salt and dry fish marketing are all directly and indirectly dependent on these three activities.
78. The main profession of the habitants of Kutubdia Upazila is agriculture. 56% of the total population is dependent on agriculture. Agriculture has traditionally been the primary source of income for the inhabitants of this island Upazila, but over the years due to frequent cyclonic events and sea water surge, the cultivable land on the island is increasingly being rendered infertile due to increased salinity. More and more agricultural lands are now being converted to salt fields.
79. Cox's Bazar is the only region in Bangladesh where salt harvesting is done. In Kutubdia Upazila, salt harvesting is one of the primary livelihood options of the island population and also practiced as a secondary seasonal source of income. It is mainly carried out at the central part of the island on both sides of the Pilat Kata Khal.
80. Fishing is also a key livelihood earner for the residents of Kutubdia. It was informed by the District Fisheries Officer (DFO), Cox's Bazar that number of registered fishermen with the Department of

Fisheries as on 30<sup>th</sup> June, 2016 is 7,116 in the Kutubdia Upazila (it was also understood that there may be additional 20% more fishermen in the island those who have not been registered due to various reasons). Overall an estimated population of 8,500 fishermen, are mostly living in 14 fisherman settlement in Kutubdia. Predominance of fishermen communities are more in Uttar Dhurung, Ali Akbar Deil and Boroghob Unions followed by Dakshin Dhurung. In Lemshikhali and Kaiyabil Unions there is no fishermen settlement in particular and fishermen are scattered all over the union.

81. Focus Group Discussions (FGDs) and interviews with the key informants revealed that in Kutubdia, traditionally fishing was practiced by the minority fishing community – *jeles (Hindu community)*, who had been residing in this island for almost four generations (~ 200 years). The Muslim population of the island adopted fishing as occupation in the last 20-25 years.
82. Types of fishing practiced by the fishermen in Kutubdia region can be classified into three category i.e. deep-sea fishing, daily fishing, foot fishing. The hydrological conditions of the Bay of Bengal make it favorable for a variety of shrimps and fishes. Although fishes remain scattered in the Bay of Bengal in some places they get concentrated and constitute important fishing grounds. Four fishing grounds have been identified in the exclusive economic zones – *South Patches, South of South Patches, Middle Ground and Swatch of No Ground*. Discussions with the fishermen brought out the fact that in winter season income from fish sale is higher than in summer and monsoon. In monsoon the income majorly depends and varies on the Hilsa catch.
83. No known remarkable archaeological or historically important structure or sites are reported in the study area. However, from the point of local cultural importance, the Kutubdia Island is famous for birthplace of *Saint Hazrat Abdul Malek* and for certain cultural and religious sites including *Ek Hatia Fakirer Masjid, Kalarma Masjid, Maharaja Kazir Masjid, Tomb of Qutb Auliya*. The island is also famous for its Lighthouse that was built during the British period in 1896 and much later eroded by the sea.

### **Power Plant**

84. The Power Plant area is an industrial site beside and adjacent to the Dhaka-Chittagong Highway and is surrounded by Meghna River in the north, west and south direction. Economically the area is very active. The Meghna River is the main navigation route near the Power Plant site which connects Dhaka with north eastern region of the country via Sonargaon River ports. Different types of commodities including quarry, cement and paddy etc. are transported through the river route. So cargo vessels are seen frequently in the river. Narayanganj and especially Sonargaon is an industrial zone comprising of three power plants adjacent to the Power Plant area namely Meghnaghat Power Limited, Summit Meghnaghat Power Company Limited (SMPCL) and Orion Power Meghnaghat Power Plant (OPML). Within 3 km, there are shipyards, 3 cement plants, a print and packaging industry, many chatal (rice husking mills) are located along Power Plant side of Meghna River bank. Many local workers are getting employment in the chatal for husking rice. And most of them are female workers. Across the river from the Power Plant site, there are many more industries, e.g. shipbuilding industry, chemical factory, refinery etc. making the area around the Power Plant industrially significant at a highest level.
85. Occupation pattern in Sonargaon shows farming is decreasing as occupation. At present farming as occupation is 25.95% at Sonargaon of total households. Pirojpur Union have urban characteristic but some part is predominantly rural. Agriculture activities and business are the main occupation of the area. Meghna River is enriched with different kinds of fishes and many people around the area depend on fishing across Meghna River for their livelihood. Production of cultured fish is 250 kg/acre and open water fish production is 500 kg/acre. Major fish varieties are Ruhi, Katla, Taki, Kai, Magur, Singhi and Boal etc. Kai and Singhi are nearly extinct varieties. In the area, there is some professional fishing community or fisherman across the river of the Power Plant site. According to discussion with fishermen, around 40-50 fishermen families live in Charbalaki and nearly 150 fishermen fish around the area. During monsoon season, some people catch fishes in the Upper Meghna River Fish is an important resource of the area.



86. Main crops grown in the study area include Aus, Aman and Boro. The paddy is grown three seasons of the year. Besides these, potatoes, sweet potatoes, oil seeds, vegetables, arum, til (sesame), wheat, sugarcane, mustard, bottle gourd etc. are cultivated in the study area. Fruits like, jackfruit, lemon, watermelon are also produced.
87. There are no professional cow farms owners in the area but people keep a few numbers of cows in their home as a part time income source. Most of the cow owners work in various industries near the project site and keep cows as a source of additional income. Around 25-30 cows graze near the project site.
88. No known remarkable archaeological or historically important structure or sites are reported in the survey area. However, the historical Panam City is situated six to seven kilometer distance from the project site. Other historically significant places situated in the Sonargaon Upazila include Single domed mosque built by Jalaluddin Fathah Shah, Tomb of Sultan Ghiyasuddin Azam Shah, single domed mosque built by Alauddin Hussain Shah, Tomb of Shah Langar, Panch Pir Dargah, Khasnagardighi, Company Kuthi, Yusufganj mosque, Goaldi mosque and Langalb and (holy bathing spot). None of these places are close enough to be adversely affected by the Project.

#### IV) ALTERNATIVES

##### **LNG Project:**

89. **Site Location Alternatives:** Five locations on the west coast of Bangladesh have been studied as potential locations for the LNG terminal viz. Parki, Kutubdia, Matarbari, Maheshkhali / Sonadia and Elephant Point. Among the five sites Kutubdia was selected as it was technically feasible; cost effective, least ecologically sensitive among the other sites.
90. **Technology Alternatives- FSU/FRSU:** - The onshore regasification unit will protect the LNG facility from extreme weather conditions as the offshore facility would be more vulnerable to waves, currents and natural calamities (cyclones etc.). The operation cost of the offshore gasification would be higher due to high lease rate of FRSU. Moreover, with the FSRU solution, gas send out will be interrupted when the FSRU is required to disconnect. In view of this the FSU option is preferred over the FRSU option.
91. **FSU Berthing Options (Dual or Single Berthing):** The LNG Project has opted for double (dual) berthing which is more reliable than single berthing, hence the option of double berthing is preferred option.
92. **Offshore Pipeline - Submerged/ Pipeline on Trestle:** As subsea cryogenic pipeline is not a field proven technology, construction of trestle mounted cryogenic pipeline is considered to be more feasible option.
93. **Pipeline Route Alternatives:** Four pipeline alignment options from Kutubdia ORF to Napura valve Station were studied to identify the alignment with least environmental and social sensitivity. Channel and road crossing is more for Alignment A and Alignment B compared to the other alignments. Among the 4 alignments considered Alignment A and B will pass through mangrove vegetation and the other two alignments would not. Minimum physical resettlement would take place for Alignment D. In view of this Alignment D is preferred over the other options.

### **Power Plant:**

94. The 'No Build' alternative in the present case would mean continued power deficiency, in the face increasing demand for industrial and economic growth which leads to poverty reduction. So, the 'No build' alternative is unacceptable, and the potential socio-economic benefits of implementation of such a project far outweigh the adverse impacts, all of which can be controlled and minimized to an acceptable level.
95. The project site is Bangladesh Power Development board's property which will be leased to Reliance Bangladesh LNG & Power Limited, which was vacant and therefore involved no resettlement issues. After analysis of various possible alternatives, this ESIA finds the plant's environmental impacts at the selected site are acceptable if the management procedures delineated are properly implemented. Therefore, the site has been considered suitable for the plant.

## **V) ANTICIPATED IMPACTS AND MITIGATING MEASURES**

### **LNG Project**

96. The impacts have been identified based on the information presently available from the project proponent on the Project configuration through stakeholder consultations with government officials, community members along with fishermen community, site visits and broadly assessment of the high resolution satellite imagery. The potential environmental and social impacts have been assessed for each phase of the Project – construction (including pre-construction and operational).

#### **Potential Impacts on Aesthetics and Visual Quality**

97. **Construction Stage:** The construction activity will be a short term activity. The sources of aesthetic and visual impacts can result from raising of land designated for the ORF; storage of construction materials; storage and disposal of waste, physical presence of labour camps; earth work along the pipeline route; disposal of HDD cut material generated from pipeline laying etc. Kutubdia region has a typical rural setting with flat terrain (agricultural land and salt pans) with small villages with homestead plantation. The above mentioned activities are expected to create measurable changes of the environmental setting. The aesthetics and visual impact is assessed to be moderate.
98. During the period of the construction, the Project will ensure that the entire ORF facility will be fenced with bamboo mat or tin sheet. All construction activities including material and waste stockpiling will be restricted between the boundaries of the proposed site. All temporary structures, surplus materials and wastes will be completely removed from site and disposed at only designated areas.
99. **Operation Stage:** The physical presence of the ORF, cryogenic pipeline on trestle, FSU during the operational phase can be visible from a distance of 2-3 km. All the Project facilities will have bright illumination arrangements. The study area typically represents a rural setting with no industrial presence – more so the settlements close to the site like Ali Akbar Deil, Bindapara have no power supply. The impact of aesthetics and visual quality is assessed to be **moderate**. So in view of this the Project will consider appropriate shading of lights to prevent scattering.

#### **Potential Impact on Land Use**

100. **Pre-Construction and Construction Stage:** The Project will result in permanent change in land use of the Project site due to the planned sub components in the area (like onshore gas pipeline, valve station, etc.) from agricultural and salt pan to industrial.
101. Land requirement for the ORF facility is 37.91 acres including agricultural land, salt pans, sea beach land and possibly homestead land which will be permanently converted into industrial land. The impacts are expected in form of reduction in land area available for agriculture and resultant livelihood impacts

on land owners and share croppers and also reduction in area of land for salt cultivation. It is anticipated that there will be potential displacement of people living in those land parcels.

102. The total land required for the pipeline is estimated to be 34 acres which includes agricultural land, salt pan land and Govt. land/ private land. Laying of the pipeline will not significantly impact in the change of land use along the corridor. It is reported that once the construction is complete, Reliance Power might return the land back to the land losers for redevelopment including growing crops, grazing, salt cultivation, etc. However, no structural development would be permitted which may lead to loss of value for land. The impact of land use changes is assessed to be **minor**.

#### **Potential Impact on Soil Quality**

103. **Construction Stage:** Before construction activity, the top soil of the agricultural land if not properly stripped and stored for future use, the entire volume of top soil will be permanently lost or fertility/soil characteristics will be changed. Contamination of soil can happen only due to accidental spillage of fuel, lubricants and paints from storage areas and during the transfer of fuels and chemicals. The above mentioned soil quality impacts will be localised within the project site or immediate vicinity. The potential impact on soil quality is assessed to be **minor**.
104. Proper stripping of top soil, its conservation for future use in greenbelt or for reclaiming agricultural land along the pipeline shall be ensured. The drainage system at site will be designed with sedimentation tank and Oily-water Separator to prevent contaminants from entering soils.
105. **Operation Stage:** During operation phase, contamination of soil can happen only due to accidental spillage of fuel, lubricants and chemicals from storage areas and during the transfer of fuels and chemicals. Sludge generated from the STP and during cleaning of LNG storage tank will be stored in pits with impervious liners and same will be periodically transferred to the disposal facility of the Chittagong port. Improper handling and mixing with surface runoff water can lead to contamination of soil in nearby area. Contamination of soil can happen only during accidental cases or in case of improper management. The potential impact on soil quality is thus assessed to be **minor**.
106. The Project will ensure proper spill control and management at site along with conduct of regular monitoring to detect any contamination on soil & ground water. It shall also be ensured that the waste from the Project is disposed only in designated storage and disposal area.

#### **Potential Impact on Physiography & Drainage**

107. **Construction Stage:** Construction of the ORF site will entail the raising of the existing ground level by 8.0 m from the existing ground level. This will result in considerable change in the existing local physiography, given the fact that the area being considered for the project is flat agricultural land with a gradual slope towards the west. The excess runoff water from the agricultural fields drains through lower surfaces along the embankment and finally discharges into the Pilat Kata Khal through micro-drainage channels. The raising of land for ORF may disturb the low lying areas and its drainage slope towards west. After completion of pipeline laying, if the earth materials are not properly cleared, micro-drainage of the area may be disturbed. The impact on topography and drainage assessed to be moderate.
108. The ORF will be designed with an adequate drainage system to prevent any impedance to local micro drainage. It will be ensured that the cross drainage structures along the pipeline route are properly maintained during the process of pipeline laying and also that the sites are reclaimed immediately on completion of pipeline laying.
109. **Operation Stage:** Impact to local drainage during operational phase will occur only in proximity to the ORF site. The impact would be primarily due to raising the land of the ORF for 8 m from existing levels. The nature and scale of impact to local drainage would be similar in nature as explained for construction phase. Internal drainage system within ORF and the peripheral drains will be periodically

maintained to prevent any impedance / disturbance to the drainage pattern in the area during the operation stage.

#### **Potential Impact on Air Quality**

110. **Construction Stage:** During construction phase, the sources of emission are fugitive emission from construction material handling, earth work, and emission from machinery and vehicles. The pollutant especially particulate matter will be settled in areas surrounding proposed project site, however this activity will be continuing during the construction phase only. The impact is assessed to be of **minor** significance.
111. **Operation Stage:** During the operation phase, the main source of air pollution from proposed project will be from the 20 MW natural gas based power generation facility at the ORF. The emissions from the captive power plant will primarily be NO<sub>x</sub>, PM, CO. Impacts due to the operation of onshore facility of the project were assessed by modelling projected emission through ISC-AERMOD View 9.2.0 model. The results from the modelling exercise revealed that the resultant concentrations of the pollutants are expected well within the applicable standard and the impact magnitude is assessed to be **negligible**.

#### **Potential Impact on Noise Quality**

112. **Construction Stage:** Construction activities such as transportation of materials, operation of heavy equipment and construction machinery are likely to cause increase in the ambient noise levels in and around the project site. The noise generated from the aforementioned activities may cause discomfort to the construction workers onsite and also to the nearby villagers. The potential impact on noise quality during construction stage is assessed to be **minor**.
113. **Operation Stage:** Noise during operations will be primarily generated from captive power generation and from use of pumps and compressors. The environmental noise prediction model SoundPLAN 7.2 was used for modelling noise emissions from key noise generating equipment within the onshore LNG facility. The noise modelling results indicate predicted noise levels at all receptors considered for the study to be within the applicable noise standard for day and night time. Furthermore there will be no change in the resultant noise levels at each receptor due to the Project. Therefore, the impact magnitude is considered to be **negligible**.

#### **Potential Impact on Surface Water Quality**

114. **Construction Stage:** Surface run offs from construction material storage area, construction waste storage areas, hazardous waste (waste oil, used oil etc.) and chemical storage areas may lead to pollution of receiving natural drainage channels etc. It is also proposed to lay 17 km of onshore pipeline; during this process earth work (excavation and stacking of soil) will be required; the surface runoff from disturbed site may lead to pollution of the receiving water bodies. The surface run offs may contain high sediment load, oil residues, organic wastes, etc. This can cause adverse impact on water quality, which ultimately leads to impacts on aquatic ecology.
115. The excavation activities and pilling work in the seabed for construction of the island jetty and the trestle for the cryogenic pipeline will generate fine sediments and will also result in resuspension of sediments in water. This expected to increase the turbidity of water and this have an adverse impact on surface water quality. The turbid waters impact on aquatic ecology thus affecting primary productivity. The leakage and spillage of oil and lubricants from machineries and equipment can cause adverse impact on surface water quality.
116. During the pipeline laying, hydro-testing will be required. Hydro-testing water if directly discharged into the Kutubdia Channel or nearshore will affect the water quality. Hydro-testing water is generally characterized by high pH, turbidity, metals, oxygen scavengers (like ammonium or sodium bisulphite etc.), biocide residues, etc. and can adversely affect aquatic ecology as well as benthic ecosystem. The potential impact on surface water quality due to construction activities is assessed to be **moderate**.

117. The Project shall try and restrict earth work activities during monsoon season and shall also install proper storm water drainage system with adequate size double chambered sedimentation tank. The Project shall also ensure that the hydro-testing water is treated before discharge into sea/channel
118. **Operation Stage:** Surface run off during the operation phase from oil storage, waste handling unit may lead to the pollution of receiving water bodies. However, taking into account the provision of onsite drainage system with sedimentation tank, oil separators, etc., the pollution load is not expected to be significant. The grey water, black water, ballast water and bilge water from the FSU, LNG carriers, etc. will be discharged into the Chittagong Port facility or as per the requirement of MARPOL. No direct discharge is expected into the sea. The impact on surface water quality is assessed to be **minor**.

#### **Potential Impact on Ground Water Quality**

119. **Construction Stage:** Spillage and seepage of chemical, oil and lubricants from storage area, waste handling area and generation of domestic waste/wastewater from construction labour camp area may adversely affect ground water quality in the area.
120. The existing groundwater quality analysis does not reveal any contamination or pollution of groundwater. The geographical extent of potential impact due to above activity is anticipated to be local and impact duration is expected to be short term. The sensitivity is high, as the water is unpolluted and provides services as drinking water, domestic uses for the region. The impact on ground water quality assessed to be **moderate**.
121. **Operation Stage:** Ground water may be contaminated from the operational area due to spillage of oil & lubricant or hazardous waste. The impact will be same as construction phase.

#### **Potential Impact on Terrestrial Habitat (Flora & Fauna)**

122. **Construction Stage:** During the construction phase, vegetation removal at the ORF and along the pipeline route will cause loss of vegetation cover, habitat loss to the faunal species living within the project area and habitat disturbances to the faunal species in the nearby areas. The species of concern amongst mammals are Indian Grey Mongoose, Large Indian Civet both listed 'Near Threatened as per IUCN Red List'. Among avifauna Red-breasted Parakeet (listed Near Threatened as per IUCN Red List) and among herpetofauna Spotted Pond Turtle (Vulnerable as per IUCN Red List) and Indian Black Turtle (Near Threatened as per IUCN Red List) are reported from the area. No floral species was identified to be under the threatened category. The impact of the vegetation clearance is assessed as minor.
123. Plantation of local species will be carried out for stabilization of the filled in material within the ORF and also in surrounding areas. Additional plantation is also proposed at other identified areas such as in available areas along the inland pipeline line corridor
124. **Operation Stage:** Operation phase impacts on terrestrial flora and fauna would be primarily from emission, noise and illumination from the ORF. A Green Belt Management Plan will be developed and its strict implementation will be ensured within the project site and immediate surrounding areas.

#### **Potential Impact on Aquatic Habitat**

125. **Construction Stage:** There is likelihood of turtle and dolphin mortality/injury during the construction period due to boat and vessel movement in sea and channel area. Turtle nest can be poached by the working labour force. Impact on aquatic habitat flora and fauna is assessed as moderate.
126. A pre survey of turtle nesting habitats at the ORF location and also pipeline route will be conducted prior to start of construction works. Adequate safeguard will be built in the contract of the EPC Contractor to prevent any poaching of turtle eggs by the construction workforce as well as to prevent any disturbance to aquatic habitats from construction activities.

127. **Operation Stage:** During the operation phase, impacts may arise from spillage and leakage of fuel and lubricant, mortality caused due to movement of ships and vessels and from illumination. The Project will have in place specific procedures and necessary preparedness to contain any accidental spill at source and also prevent their spread in the surrounding environment. The Project will also plan vessel movement and design the site illumination in a manner to limit impacts on aquatic habitats.
128. The Project will also support the Local Forest Department and Local NGOs in their initiatives to study and protect turtle nesting activities on the island and also support government initiatives in terms of research and monitoring for dolphin studies in the region.

#### **Potential Impact due to Land Acquisition**

129. **Pre-Construction and Construction Stage - Land Loss:** Based on the present information available from the Reliance Power the following land requirement is anticipated that will be acquired through land acquisition – 37.91 acres, both government and private land for Land Based facility, 34 acres of land for proposed onshore pipeline and an area up to 1.85 acres land for Terminal Station at Valve 2.
130. It is anticipated that during the construction phase the land owners will lose land due to land acquisition. Based on satellite imagery interpretation it also appears that few residential plots might be acquired for the project activity. It will be determined and accordingly APs will be identified once the project foot print is finalised through subsequent field surveys. Impact due to land loss is assessed to be **minor**.
131. **Change in Landuse:** The establishment of the Project will result in permanent change in land use of the Project site for the sub components areas (like land based facility and Terminal Station at Valve 2 from agricultural and salt pan to industrial. It is envisaged that the laying of the pipeline will not significantly impact in the change of land use along the corridor as it will be returned after construction for growing crops, grazing and salt cultivation, however no structural development will be permitted. Impact due to land use change for agriculture and salt cultivation in Dakshin Dhurung and Kaiyarbil Union is assessed to be **minor**.
132. **Fragmentation of Land Holdings:** Parcels of land along the proposed RoW for gas pipeline may get temporarily fragmented due to the linear acquisition associated with the route of the gas pipeline.
133. This may either lead to partial loss of cultivable land and salt pans (primarily during the construction phase. In operation phase land will be restored and returned to the owners who may resume previous livelihood, such that no real loss is expected. There may be creation of orphan lands<sup>1</sup> which may be rendered too small or unviable for cultivation both for agriculture or salt. Valuation of the land prices may decrease.
134. As a mitigation measure it should be carefully assessed during socio-economic survey and the project proponent should try to avoid creation of such orphan land parcels. If creation of orphan land parcels could not be avoided, the land owners will be appropriately compensated as detailed out in Entitlement Matrix in the Resettlement Framework (to be compensated if remaining land is no longer viable) with special focus on vulnerable households. Impact assessed to be **negligible**.

#### **Potential Livelihood Impacts**

135. **Construction Stage:** The land parcels that will potentially go for land acquisition are agricultural lands and salt cultivation fields as assessed from satellite imagery and from the Reconnaissance Survey

<sup>1</sup> Orphan land parcel is that land located outside of the normal compensation area but is made uneconomic by occupation or acquisition part of the plot. It is eligible for compensation. Compensation may be determined based on reviewing of the land parcel by Revenue Department or any Valuation Committee on cases to case basis if any land owner lodges a request.

Report for the LNG Terminal and associated pipeline. The impacts on different stakeholder groups are as follows:

136. **Livelihood of Land Owners:** Land Based Facility & Terminal Station Valve 2 – Owners and families deriving income from the agricultural lands and salt pans from the proposed ORF plot will be impacted due land loss.
137. **Onshore pipeline:** Significant impact from loss of land for the RoW for the gas pipeline is not envisaged because of the temporary nature of acquisition. Once the construction is complete, Reliance Power might return the land back to the land losers for redevelopment including growing crops, grazing, salt cultivation, etc. Impact assessed to be **minor**.
138. **Sharecroppers, Lessee Farmers & Land Depended Groups Salt Pan Workers:** Sharecroppers (if any) and salt harvesting workers cultivating within the project area would have to discontinue their practice in the project area once the construction activities start.
139. Restriction on use of land in project area may lead to impacting their livelihood and income. This impact may be temporary i.e. loss of income during the transition phase and could be mitigated once the sharecropper and the salt harvesting workers finds a new site for cultivation and renews his sharecropping or salt harvesting practice. However, the impacts could also be long term and in some instances lead to change in occupational pattern (like cultivator to agricultural wage labour, contract worker etc.) if any sharecropping family or land depended workers is unable to find alternate land/ salt pan.
140. The land owners will receive cash compensation, transition allowance and they will also be allowed to take away the crops, also the affected employees and wage earners will receive cash grants as defined in the Entitlement Matrix in the Resettlement Framework. Impact assessed to be **moderate**.

#### **Potential Impact on Fishing Activities**

141. **Construction Stage:** Fishing is one of the primary livelihood options of the inhabitants of Kutubdia Island. As per the Fisheries Department records there are 168 registered fishermen in Ali Fakir Deil and 23 fishermen<sup>1</sup> in Bindapara villages in Dakshin Dhurung and Kaiyarbil Unions respectively. The fishermen practice deep-sea fishing, daily fishing, foot fishing/ shoreline fishing throughout the year as their livelihood means. The sand beach portion is used for anchoring of boats, fishing net drying and repairing, boat repairing, etc. Impact on fishing activities is anticipated both during construction phase and will continue through operation phase.
142. **Land Based Facility:** Shoreline fishing done by the fishermen of these two villages – Ali Fakir Deil and Bindapara, using the push nets and small setback nets (choto behundi jal) will be impacted during the construction and operational phase of the LNG Terminal. The fishermen will be prevented from fishing in this region and it may impact the family income partially. With steep sea floor with 10 m contour reaching within 1 km from west of Kutubdia Island may prevent the fishermen to go little deep and at other locations for foot and shoreline fishing. It is envisaged that impact will be localized and permanent in nature.
143. **Cryogenic Pipeline on Trestle:** It is proposed that a 2.4 km motorable trestle will be constructed from the LNG receiving facility off shore to land based onshore facility to hoist the gas pipeline. There will be an exclusion zone of about 100m on either side of the trestle for safety and security reasons to avoid potential accidents – this will potentially impact some of the deep-sea fishing routes. It will be a localised impact and especially for the fishermen of Ali Fakir Deil and Bindapara villages.

<sup>1</sup> Ward wise list of registered fishermen as on 30<sup>th</sup> June, 2016, data received from District Fisheries Office

144. **Twin Berthing for FSU and LNG Carrier:** The Floating Storage Unit (FSU) will be located in the Bay of Bengal, approximately 2.4 km from the north western shoreline off Kutubdia Island; it will have an exclusion zone of about 500 m around the FSU for security and safety reasons. This may not directly impact fishing activities but they may have to sail further west or south-west for daily fishing. There could therefore be some disruption in existing fishing boat movements.
145. **Onshore Gas Pipeline:** The onshore gas pipeline will cross the Kutubdia Channel from the north-east part of the island. This may not directly impact the fishing activity, however it will impact the navigation of the trawlers and fishing boats that sail out through Kutubdia channel from north of the island upazila to Bay of Bengal.
146. A monitoring study may be undertaken by the project proponent that will help in identifying actual fishing routes, fishing zones and fish catch that may potentially get impacted. Fishermen families whose family income may be partially impacted will be compensated as detailed out in the Resettlement Framework and CSR programs may be undertaken by the project proponent for betterment of the fishing community.
147. **Operation Stage: Impacts related to livelihood during Operation Phase:** Fishing, agricultural activities and salt cultivation would continue to be the same as in construction phase to operation phase. However, positive impact on local enterprise and economy will improve from construction phase to operation phase in the immediate vicinity of the project area that will see a spurt of entrepreneurial activity in the form of locals opening up food joist, tea stalls, spare-parts and repair outlets and general provisions.
148. As mitigation measure financial compensation for loss of income incurred as a result of the Project until fishing or alternative income is secured may be provided as detailed out in Entitlement Matrix in the RF.

#### **Potential Impact on Community Health & Safety**

149. **Construction Stage:** Construction materials and heavy equipment used during the construction phase will be brought into the site by barges using the water ways. Though it will not cause any traffic congestions on roads and possible disruption to the community usage of roads – it will increase the inconvenience to community in terms of air and noise pollution caused by unloading of materials and construction.
150. Impacts, risks associated with access to waterways are comparatively lesser and the only identified impact is with respect to spillage and seepage in the sea due to increased material movement, handling and unloading. Additionally it may be a potential risk to the fishing boats and the fishermen involved in shoreline fishing. Impacts are assessed to be **moderate**. Adequate mitigation measures as outlined in the ESMP will be implemented to prevent and minimise impacts on community health and safety.
151. **Operation Stage:** During the operation phase of the Project, the regular traffic and transportation will be limited to the movement of plant personnel and contracted workers during their working shifts. Considering these factors, the impact due to traffic movement during operation phase will be **minor**.
152. In addition to implementing the measures as outlined in the ESMP, awareness campaign focusing on traffic safety will be regularly organised for the community residing adjacent to the road. Specific efforts will be made towards maintaining a healthy relationship with community through CSR activity.

#### **Potential Impact on Occupational Health & Safety**

153. **Construction Stage:** The sources of occupational health and safety impacts to Project's construction workforce include accidents and injuries associated with the operation of heavy machinery and other



construction activities; health impacts associated with changes in environmental quality, arising from emissions to air, water, land and noise emissions from construction activities as well as from storage and handling of waste, particularly hazardous waste. The occupational health and safety impacts to construction workforce are assessed to be moderate. Adequate mitigation measures as listed out in the ESMP will be implemented to prevent and minimise impacts on occupational health and safety.

154. **Operation Stage:** The health and safety risks during LNG terminal operations include potential for respiratory diseases, burns, allergies and industrial accidents among the employees and the workers of other sub-contractors would be exposed to such risks. Impact on workers' health and safety is assessed to be **moderate**. Adequate mitigation measures as listed out in the ESMP will be implemented to prevent and minimise impacts on occupational health and safety.

## **Power Plant**

155. Identification of potential impacts due to the plant location, construction and operation of the Power Plant has been done using a checklist. The significant impacts identified during construction phase (from construction of temporary jetty, labour camp, access road and the plant) include air quality, water quality, noise quality, solid waste management and occupational health & safety. Since the Power Plant would be implemented on the preoccupied and developed land of BPDB, the resettlement will not be an issue in this case. The EPC contractor and RBLPL authority will ensure the necessary implementation and monitoring of EMP to comply with the requirement of national and IFC/WB guideline during the construction period. The operation phase significant impacts include (i) air emissions especially NO<sub>2</sub> (ii) noise emission, (iii) water pollution, and (iv) occupational health hazards.

156. **Air Emissions:** As the proposed power plant will utilize natural gas as fuel, the only pollutant of potential concern is Oxides of Nitrogen (NO<sub>x</sub>) during the operation period of the project. This pollutant has been examined to ensure the Bangladesh emission limit standard as well as IFC/WB, where appropriate, the required emission control techniques would be incorporated into the mitigation measures. The ground concentration of NO<sub>x</sub> emission have been determined by air emission dispersion modelling by using USEPA approved AERMOD 8.9.9 model) has been done and the result shows that all the criteria pollutants will be within the Bangladesh NAAQS and Bank group's (i.e. IFC) standard.

157. **Noise Emissions:** The gas turbine and the steam turbine will have internal noise level of around 85dBA which will be minimized by sophisticated acoustic power house building design so as to minimize the noise up to standard. The heat recovery steam generator stack will emit a noise level of 85dBA after providing the silencer. To reduce the effect, most costlier and effective Critical Type Silencer will be used in the stack. In particular, significant noisy components such as the gas turbine sets are enclosed in buildings acoustically designed, providing Styrofoam filler of 50 mm width in between 300 mm thick brick walls around the power house building. Moreover, thick doors are provided and holes which may create sound pollution are sealed with sound proof materials. Vibration pad will also be used at the bed of all power generation units to prevent the vibration. The stack noise emission dispersion has been predicted by means of noise impact modeling. It is observed from the noise emission modelling that the max noise level within the 50m radius is 32.16dBA. The resultant noise calculation with the ambient noise level shows that the noise level after 300m from the power plant will not affect the ambient noise level of the area, so, there would not create any noise problem due to the power plant to the nearest settlement.

158. **Liquid Discharge:** The estimated water consumption is 1096 m<sup>3</sup>/hr and discharge will be 196 m<sup>3</sup>/hour from the 750 MW CCPP Meghnaghat Power Plant. The low amount of water discharge is due to the use of "Closed Circuit Cooling System". Owing to the low amount of discharge and use of closed circuit cooling, rise in river temperature will have no impact on river water temperature considering the amount of discharge from the other power plants near the project premise. The domestic liquid wastes would be disposed through a septic tank system. It has been planned that the surface drainage network would be connected with an interceptor prior to discharge to surface drainage system. All other surface water

coming from cooling tower blow down, DM plant rejects and service water will be taken to wastewater treatment plant prior to discharge to natural water.

## **VI) INFORMATION DISCLOSURE, CONSULTATION & PARTICIPATION**

159. The ESIA reports will be uploaded in the Company's website and a copy of ESIA is kept at the plant for public review. The executive summary will be translated into Bangla and will also be made available to the public.

### **LNG Project**

160. Series of consultations were held during the ESIA process with stakeholders to have an insight of the baseline situation of the site and regulatory and administrative setups in the proposed LNG Terminal site. This in turn helped in developing an understanding of the perceptions of stakeholders with regards to the project and also allowed for a means of recording their feedback. The stakeholder views expressed were incorporated in the ESIA and the planning and development of the project.

161. **A Grievance Redressal Mechanism (GRM)** will be in place to handle and resolve the conflicts and aggrieved situations. It is understood that Reliance Power already has GRM in place. There will be a specific GRM that will be put in place by RBLPL for this project. This project specific GRM will be formulated in keeping with the process and procedure of the existing GRM and will be integrated into the same. The GRM will aim to provide a time bound and transparent mechanism for expressing and resolving social and environmental concerns linked to the project.

162. **Environmental and Social Management Plan:** Project specific Environment and Social Management Plans (ESMP) have been developed with an aim to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts/risks and to propose enhancement measures. The plan covers;

- mitigation of potentially adverse impacts;
- monitoring of impacts and mitigation measures during project implementation and operation;
- institutional capacity building and training;
- compliance to statutory requirements; and
- integration of the ESMP with project planning, design, construction and operation.

163. **Resettlement Plan:** As a part of the ESMP, a Resettlement Framework has been prepared. Based on further detailing of project plans and firming of the project footprint and subsequent land requirements, a Resettlement Plan (RP) will be prepared that will delineate the exact magnitude of impact, number of DPs and APs and their compensation entitlement along with cost for implementing the RP. Impacts related to land acquisition, involuntary resettlement and livelihood restoration of the affected persons (APs) - title holders, non-titleholders, land users groups, encroachers will be covered in the resettlement plan based on the final project footprint.

164. **Institutional Setting and Implementation Arrangements:** The ESMP (mitigation plan) will be included in the construction contract and the contractor will be responsible for implementation of the measures associated with design and construction. The Project Developer's staff, specifically the EHS Officer and Site Engineer, will monitor the implementation of these mitigation measures by the contractors at the site. These two officers will be responsible for the field level monitoring of the Project.

165. **Environmental Monitoring:** The environmental monitoring programme has been devised with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;

- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project area.

166. **Reporting Mechanism for Environmental and Social Monitoring Program:** A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will ensure regular flows of information from the Project site to the Project headquarters and, as necessary, to regulatory authorities and funding agencies. The reporting system will provide a mechanism for ensuring that the measures proposed in the Project's ESMP are implemented. The quarterly reports of the management measures will form an integral part of the Quarterly Progress Reports that can be submitted to the lenders. Additional compliance reports to the Regional Office and Head Office of the Department of Environment (DOE) required as a part of environmental clearance process shall also be prepared and submitted based on the necessary monitoring and reporting formats.

### **Power Plant**

167. A formal stakeholder consultation meeting hasn't been held yet but informal discussion sessions with the government representatives have taken place. The formal public consultation will be held in a later date and included in the final draft ESIA as per ADB's SPS requirement. Before the formal public consultation, a verbal notice and a notice in newspaper will be given beforehand so that people can take part in it. Informal meeting and fishermen FGD were held multiple times and the local dwellers and fishermen were briefed about the project. Their concerns and expectations were also taken into consideration. The stakeholders' consultation process will be continued in the operation phase of the plant as well, so that issues of public concern can be addressed.

168. **A Grievance Redressal Mechanism:** The Project Management has established a procedure to answer to the Power Plant related queries and address complaints and grievances about any irregularities in application of the guidelines adopted for assessment and mitigation of environmental safeguards impacts. The complaints related to the Power Plant operation that may create inconveniences to agency/individual should be addressed based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to acceptance or rejection of the particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authority known to be working with urban development issues. However, it should be noted that the GRC process will not preempt and aggrieved person's right to seek redress in the courts of law.

169. **Environment and Social Management Plan:** Project specific Environment and Social Management Plans (ESMP) have been developed with an aim to identify monitoring requirements and monitoring indicators; mitigation measures to reduce or eliminate negative impacts; and enhancement measures to maximize positive impacts.

170. Monitoring of the performance of a plant is to be done for the environmental parameters related to plant operation, thereby neglecting the environment. For surveillance of the environmental performance of an industry, and monitoring of the quality of the local environment, environment in the work-zone and the general impact zone have to be performed on a regular basis. A management set up has to be created for the environmental monitoring program which can ensure compliance with national environmental standards. To this end a committee (Environmental Management and Safety Committee) will be created with plant manager as head and with 2-4 other members. The committee must meet at least once in a quarter and discuss about the environmental status of the plant. The main emission from the plants (i.e., air emissions, noise and any other) are to be analyzed as per monitoring plan. The "the quarterly and

annual environmental monitoring reports will be submitted to DOE, ADB and will also be placed on the company website for public scrutiny.

171. The cost of the Environmental Management Plan (EMP) is divided into several parts to reflect the different phases of the project and the requirements of each phase. The cost of EMP must include the costs of the capacity building, public consultation and the quality control requirements for a period of 5 years of operation. An allocation will be made for EMP every year in budget estimated for the project.
172. **Emergency Response and Occupational Health & Safety:** Under the supervision of the 'Environment Management and Safety Committee', all plant personnel will have responsibilities assigned to them during emergency. The documented responsibility will be included in a program manual which can constitute a part of the plants operation manual. Compliance with the responsibilities should be monitored and if these are not carried out for any reason, corrective measures should be taken. The plant management will prepare an occupational health safety policy manual which should be updated from time to time. The policy should be signed and dated by the Chief Safety Officer who may be the Plant Manager. The policy should be discussed with all the plant personnel. The Chief Safety Officer should periodically review the policy and re-issue the policy.

## VII) CONCLUSION AND RECOMMENDATIONS

### LNG Project

173. This environmental and social impact assessment of the Kutubdia LNG Project ('Project') has been prepared based on review of draft technical specifications of the Project as provided by Reliance Power and through analysis of primary and secondary information of the site and surroundings as collated by ERM. Through this process, an assessment has been undertaken of the potential environmental and social risks and impacts that may be attributed by the development of the project in its pre-construction, construction and operation phases.
174. The Project will have both positive and adverse impacts on social environment. The positive impacts will include temporary employment opportunity for the unskilled labourers during the construction period and business opportunities for the local people. Based on the present level of information available from the Project Developer it is anticipated that the Project is likely to have adverse social impacts pertaining to land loss, land fragmentation, potential physical displacement, loss of income (that may include agricultural labourers, sharecroppers, workers/labourers of salt pans), loss of productive land, potential income loss for fishermen and preventing to fishing related activities and fishing routes. The impacts may be localised and some are permanent in nature that can be mitigated with appropriate measures; it is anticipated that vulnerable groups (women headed households, to be identified during Census survey and social impact assessment) may also experience impacts due to the project implementation.
175. The construction phase of the Project will have an important role in the socio-economic development of the area, whereas the operation phase of the Project will play an important role by supplying gas in the region. A reliable and expanded gas supply will support future economic development of dependant sectors like industry and manufacturing enabling them to operate and compete.
176. During the operation phase of the Project, the two key impacts will be some incremental in the existing noise and ambient air quality, however, the resultant noise and ambient air quality will remain within the applicable limits of Government of Bangladesh as well as those prescribed in IFC EHS guidelines.

177. Based on the analysis conducted in this environmental and social assessment, it is concluded that overall the Project will result in moderate to major positive socio-economic benefits and the potential negative environmental and social impacts that have been identified as mostly short-term and localised in nature, and can be minimized adequately through good design, appropriate application of mitigation measures and regular supervision of implementation.

### **Power Plant**

178. The present ESIA report finds that though there are certain adverse environmental impacts associated with the industrial unit under consideration, these are manageable. The project is indispensable in view of the current energy shortage scenario in Bangladesh. The impact on the social environment is positive given the job and business opportunities created for local residents from the project. The project will help in the industrialization, accelerating socioeconomic growth, and improving quality of life. One of the most critical issues for the project is safety. This has been adequately addressed through compliance with national building code (BNBC) in the construction to ensure safety during natural disasters like earthquake and cyclone.

179. The project has been designed to comply with the country's environmental laws and regulations, especially on air emissions, ambient air quality, wastewater effluent, and noise. The project management has taken steps to ensure that the plant meets the DOE/World Bank/ADB's environmental standards. Given the management measures and monitoring commitments by the RPL for the project, environmental impact of the project will be manageable.

180. Given the proponent's commitments, actions undertaken for further measures to be adopted in due course of time as required, the 750 MW Power Plant is going to be a nationally important and environmentally sustainable industrial venture.