

SUMMIT NARAYANGANJ POWER UNIT II LIMITED

Environmental and Social Impact Assessment (ESIA) Report



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List of Acronyms

ADB	:	Asian Development Bank
AQM	:	Air Quality Monitoring
BBS	:	Bangladesh Bureau of Statistics.
BCAS	:	Bangladesh Centre for Advanced Studies
BPDB	:	Bangladesh Power Development Board
DoE	:	Department of Environment
DTW	:	Deep Tube Well
EE	:	Energy Efficiency
EGCB	:	Electric Generation Company of Bangladesh
EMP	:	Environmental Management Plan
GHG	:	Greenhouse Gas
GNI	:	Gross National Income
GoB	:	Government of Bangladesh
HFO	:	High Furnace Oil
IEE	:	Initial Environmental Examination
IFC	:	International Finance Corporation
IFS	:	Income and Expenditure Survey
IPP	:	Independent Power Producer
km	:	Kilometre
MOF	:	Ministry of Finance
MPEMR	:	Ministry of Power Energy & Mineral Resources.
MW	:	Mega Watt
NEMAP	:	National Environment Management Action Plan
NEP	:	National Energy Policy
NGO	:	Non-Government Organization.
NOX	:	Oxides of Nitrogen
NO ₂	:	Nitrogen Dioxide
OHSP	:	Occupational Health and Safety Programme
PAH	:	Project Affected Household
PAP	:	Project Affected People
PDB	:	Power Development Board
PM _{2.5}	:	Particulate Matter < 2.5µm
PM ₁₀	:	Particulate Matter < 10µm
PPA	:	Power Purchase Agreement
QRA	:	Quantified Risk Analysis
RAP	:	Resettlement Action Plan
REB	:	Rural Electrification Board.
ROW	:	Right of Way
RP	:	Resettlement Plan
SNPL UNIT II	:	Summit Narayangonj Power Company Limited
ESIA	:	Environmental and Social Impact Assessment
SHM	:	Safety Health Manager
SPM	:	Suspended Particulate Matter

EXECUTIVE SUMMARY

Power generation and supply is one of the vital issues in Bangladesh to enhance its ongoing development efforts. Having 149.8 million people, electricity demand is increasing day by day but the generation of electricity is not increasing as expected. The industrial production which is the driven force of economy is being hampered due to inadequate power supply. Thus foreign and local investment are being discouraged and impeded. The Sixth Five Year Plan contains information on demand-supply gap for electricity, source of electricity supply, use of different types of energy, electricity generation program and strategy for power generation.

Narayanganj Power (Unit-2) Limited based on HFO and it is situated at Modongan, Bondor, Narayanganj with 55 MW capacity with a 15 years Power Purchase Agreement with the BPDB. In the same premises a 102 MW power plant is fully operational since 2011.

As per Environment conservation Rules '1997 (amended 2002) this type of industry has been categorized as Red category. An Initial Environmental Examination (IEE) was carried out for this power plant as per regulation of Department of Environment under Ministry of Environment and Forest for getting site clearance. And the Site Clearance is issued on 06/08/2015. An Environmental Impact Assessment (ESIA) is a formal requirement for the power plant according to the Bangladesh Environment Conservation Act '1995 (Amended 2010) and the Environment conservation Rules '1997 (Amended 2002).

The ESIA has been undertaken to meet the Terms of Reference provided by the DOE and IDCOL.

The ESIA primarily comprises of a detailed baseline analysis through measurements of different environmental parameters like air quality, noise level and the quality of ground and surface water in the vicinity of the project site. Based on the baseline data the impact the project's impact has been analysed through predictive models. Identification of the potential impacts has been made and the mitigation measures have been suggested which if undertaken will meet the regulatory standards of the DOE as per Environmental Conservation Rules of 1997 and later amendments. The anticipated impacts has been analysed for the construction phase, operation phase and decommissioning phase. The assessment has taken into consideration the cumulative impact of the existing operational 102 MW HFO power plant and the 55MW proposed power plant. The baseline air quality and noise data can be considered as cumulative as during carrying out the baseline study the 102 MW was fully operational.

Of the impacts noise pollution was of concern particularly the nearest settlements in the North East corner which is located 40m from the power plant just outside the northern boundary wall. Several modeling exercises were undertaken and it was found that the noise level at these nearest households exceeded the standards set by the DOE. Mitigation measures were suggested like building of a 7.5m high specifically designed acoustic wall along the Northern boundary and sound proofing the engine hall by using sound absorbing material and fitting of silencer pipes in the stack and in ventilation exhaust system. These mitigation measures will reduce the noise level at the nearest receptor in the North East corner of the power plant to within acceptable limits set by DOE for mixed zones. The site clearance and the Environmental Clearance Certificate was given to SNPL UNIT II Unit II being located in the mixed zone.

The impact on air quality of the area needed careful consideration because of the cumulative

impact of two power plans operating from the same compound and adjacent to each other. The baseline data taken was inclusive of the 102MW power plant which was in operation at the time baseline air quality measurements. To make a conservative estimative of the cummalative impact the Sulphur concentrarion in the HFO eas assumed at 3.5% which is the permissible limit allowed by international standards. The recent version of USEPA approved aAir Dispersion model AERMOD was used to prdict the stack emission from the propsed 55 MW power plant. The results of the model calculation indicate that the concentrations of NO2, SO2 and PM10 remains within the limits set by the DOE.

SNPL UNIT II Unit II will use radiative cooling system and hence there will be no withdrawl of water from the River Sitalakha. The water requirement for the power plant during operation will be 40 cubic meter per hour and mainly used as make up water for the radiators, waste heat boiler and general washing and drinliking purposes. However, there will be generation of oily water from the fuel treatment plant and other leakages. The oily water is treated in an ETP which will remove the oil from water through the principle of multiple phase emulsion breaking. Emulsifying agents will be added to the oily water which will then be passed through multiple filtrers for the separation to be completed. The separated oil sludge will be stored and disposed through DOE approved contractors. The separated water will remain within the limits set for different parameters.

Several plans and procedures have been suggested in the assessment including Environmental and Social Management and Monitoring Plan, Emergency Resposponse Plan and a Hazard Identification Risk Assessment and Control has been included for both construction phase and operation phase. This will assist the SNPL UNIT II Unit II to prepare the EHS and OHS manuals and training modules for workers and management. A Grievance Redress Mechanism and its modalities has been included in the assessment.

An extensive stakeholder's consultation process was undertaken through FGDs, KIIs and one large general consultation meeting. In most cases the major concern was the potential noise generation due to addition of another power plant in the same area. The consultants and technical management of SNPL UNIT II Unit II explained the mitigation measures that are being taken to mitigate the problem. There was demand of building acoustic walls on four boundaries of the power plants. SNPL UNIT II Unit II assured that they are considering it and will implement this as early as possible.

The propsed project falls under the Red category as per Environmental Conservation 1995 and Environmental Conservation Rules 1997 and subsequent ammendments. The proposed project's potential adverse impacts are site specific and most cases mitigation measures can be designed more readily than for Category A projects. Therefore an ESIA along with EMP is requited and fall under Category B.

There was no resettlement or livelihood resoration requirents as the land for the purchased from willing sellers. There were no agricultural workers or sharecroppers in the land purchased by SNPL UNIT II Unit II. Since there was no involuntary resettlement issue, in the light of ADB SPS the proposed project falls under Category C and therefore no further action is necessary.

CHAPTER I

INTRODUCTION

1.1 Background of the project

Power generation and supply is one of the vital issues in Bangladesh to enhance its ongoing development efforts. Having 149.8 million people, electricity demand is increasing day by day but the generation of electricity is not increasing as expected. The industrial production which is the driving force of the economy is being hampered due to inadequate power supply. Thus foreign and local investment are being discouraged and impeded. The Sixth Five Year Plan contains information on demand-supply gap for electricity, source of electricity supply, use of different types of energy, electricity generation program and strategy for power generation. The current access to electricity is 59.6% of the population (data.worldbank.org). The demand is growing at a rate of 10% to 15% per year. Power got the highest priority in 6th Five Year Plan of the country and the government has given highest priority to this sector even in the budget of current financial year as the GoB has committed to making electricity available to all citizens by 2021. The government fully recognizes the fact that public sector investment alone is not sufficient to achieve its target and has aimed at mobilizing resources from the private sector investments. Accordingly, GoB has approved a number of rental and IPP project to be established and will operate by private entrepreneurs under (Special act) Law 2010 for implementation of the plan adopted by Power Division, Ministry of Power, Energy and Mineral Resources (MPEMR), Government of Bangladesh. Like other parts of the country, **Narayanganj** area is under power crisis.

Considering the immense opportunities, the company is striving to establish **Summit Narayanganj Power (Unit-2) Limited** based on HFO at Modonganj, Bondor, Narayanganj with 55 MW capacity with a 15 years facility to the BPDB. In the same premises a 102 MW power plant has been in operation since 2011.

As per Environment conservation Rules '1997 (amended 2002) this type of industry is fallen into Red category. An Initial Environmental Examination (IEE) was carried out for this power plant as per regulation of Department of Environment under Ministry of Environment and Forest for getting site clearance. And the Site Clearance is issued on 06/08/2015. An Environmental Impact Assessment (ESIA) is a formal requirement for the power plant according to the Bangladesh Environment Conservation Act'1995 (Amended 2010) and the Environment conservation Rules '1997 (Amended 2002).

The Project will construct, operate and maintain a 55 MW HFO based power plant at Modonganj, Narayanganj on Build, Own and Operate (BOO) basis. Bangladesh Power Development Board (BPDB) will purchase the electricity generated from the Project under a 15-year Power Purchase Agreement (PPA). The Project is expected to go into commercial operation within 15 months from the date of signing of PPA with BPDB.

For establishing the Project SNPL UNIT II has purchased an area of about 3.0 acres of land at Modonganj Mouza under the jurisdiction of Narayanganj City Corporation, Narayanganj district. During site visit, the site was found to have a satisfactory ambient condition for a power plant project of this size. The site is about 3.5 kilometers from the centre of Narayanganj City and within 12 kilometer of the Dhaka-Chittagong highway. In West of the proposed plant there are residential area, DPDC sub- station in the West side, residential area in the North side and East side, and on the South East side there is a cement factory of Bashundhara group

Project Implementation Agreement

The Implementation Agreement (IA) of the project was executed on 2013. Parties to the IA had been (i) the Project Company(s), i.e. the SNPL UNIT II Unit II in relation to the 55 MW Power plant project (ii) the Government of Bangladesh (GoB); and (iii) the Bangladesh Power Development Board (BPDB). The IA became effective from the date of signing and will continue in full force and effect until the last day of the Power Purchase Agreement unless extended or terminated earlier as per the provisions of IA.

Power Purchase Agreement

The Power Purchase Agreements (PPAs) for 55 MW SNPL UNIT II power plants was signed on August 28, 2014, between BPDB and SNPL UNIT II Unit II. Under the terms of the PPAs, SNPL UNIT II Unit II agreed to maintain the power plants and deliver electric energy produced at the power plants exclusively to BPDB. In turn, BPDB agrees to purchase from SNPL UNIT II Unit II the Net Energy Output.

In the contract the Environmental Guidelines and Occupation Health and Safety standards of the DOE and the World Bank will be applicable.

The contract stipulates that the fuel supplier means Bangladesh petroleum Corporation (BPC) provided that, in the event BPC is unable and expresses unwillingness to supply the required fuel then the the Company or any other entity organization appointed by the Company from time to time procure fuel in accordance with Fuel Supply Agreement.

The People's Republic of Bangladesh represented by the Power Division, Ministry of Power, Energy and Mineral Resources (MPEMR) accords its approval on the Levelized Tariff Charge (LTC) and grants its permission to SNPL UNIT II to design, finance, insurance, construct, own, Commission, operate and maintain (the "Project") a 55 MW (at Reference Site Condition), power generating facility at Modongonj hereinafter referred to as the "Facility".

The contract stipulates that the fuel supplier means Bangladesh petroleum Corporation (BPC) provided that , in the event BPC is unable and expresses unwillingness to supply the required fuel then the the Company or any other entity organization appointed by the Company from time to time procure fuel in accordance with Fuel Supply Agreement.

In the contract the Environmental Guidelines and Occupation Health and Safety standards of the DOE and the World Bank will be applicable.

Land purchase

The Land purchase activities of SNPL UNIT II were started from October 30, 2013 and about 3.00 acres of land bought at Modongonj Mouza under 19 Number Ward of Narayanganj City Corporation. Detailed of the Land purchase documents is provided as Annexure 4 in the ESIA report.

Extent of the Study

Bangladesh Environmental Conservation Rules (ECR, 1997) and ADB Safeguard Policy require that the environmental and social impacts of development projects are identified and assessed as

part of the planning and design process. Based on the magnitude of potential adverse impacts, mitigation measures are to be planned before starting the implementation of the project.

Bangladesh Centre for Advanced Studies (BCAS) has been carrying the detailed Environmental Impact Assessment (ESIA) to comply with DoE, IDCOL, IFC Guidelines as well as the ADB Safeguard policy 2009 for the proposed IPP 55 MW Power Plant project since October 2015 by that time 60% of the construction phase was completed.

Project Area

It is already mentioned that the project site is located at Modongonj, Narayangang, Mouza-Modongonj, J.L No. 103, Sheet No. 1, and District- Narayangang, Bangladesh

1.2 Scope of the ESIA Study

The area falling within 5 km distance from the proposed site has been considered as the study area for conducting detailed studies. The scope of the Environmental and Social Impact Assessment (ESIA) as the following:

- a brief description of the project;
- a detailed characterization of the existing environment within the area of 1 km radius from the project site for environmental components viz. air, noise, water, land, soil, biological and socio-economic aspects;
- prediction and evaluation of positive and negative impacts that may result from the proposed power plant project;
- consideration of alternatives;
- undertaking public consultation and disclosure of project-related information;
- grievance redress mechanism;
- formulation of an environmental management plan (EMP) to eliminate or minimize the adverse impacts of the project on the surrounding environment and affected communities;
- preparing occupational health and safety as well as Disaster Management Plan (DMP) to minimize any accident or emergency situation; and
- to propose plans for post project monitoring, ongoing consultation and disclosure, EMP implementation, and institutional arrangement/organizational arrangement.
- Obtaining approval of the lending financial institutions, viz., the Asian Development Bank, IDCOL;
- Obtaining Environmental Clearance Certificate

1.3 Study Methodology in detail

Based on the above Scope of Work, the study built upon the baseline survey carried out by BCAS as Environment and Social Consultant for the Environmental and Social Impact Assessment (ESIA) during October 2015 to December 2015.

Primary and Secondary data were obtained from the project location and various sources. Several field visits had been undertaken to the project location with a view to updating the findings of the baseline study carried out by BCAS. During the study period the following steps were followed:

1. Confirmation of survey/monitoring data in the baseline study and ESIA carried out by BCAS during generating primary data;
2. Understanding the technical aspects of the proposed power plants through secondary literature and consultations
3. Identification of potential environmental impacts and evaluating the consequences through using a checklist method;
4. Identification of impacts was undertaken using Checklist Matrix and Issues forecasting tabular methods;
5. Review of the adequacy and efficiency of proposed mitigation measures for the proposed power plant project through public consultations where the main topic of discussion was the impact of sound. BCAS explained in details the mitigation measures SNPL UNIT II Unit II is taking to minimize the impact;
6. Development of an Environmental Management Plan (EMP) for possible mitigation/enhancing measures, respectively, for negative and beneficial impacts;
7. Suggestion of mitigation measures for residual impacts;
8. Completion of a comprehensive social impact assessment through primary data collection;
9. Primary data collection from 30% of the total households within 1 km radius of the project area included in the baseline study carried out by BCAS. The criteria for choosing 30% of households within 1 km radius of the project site is judgmental based on the expected picture required for the specific study. Additionally, since the area is in a mixed commercial cum rural zone the number of household are and business institutions are numerous in numbers. However, in choosing the households a mix of rural and commercial households were chosen. A number of Focus Group Discussions (FGDs) with the different categories of stakeholders were held including women;
10. Detailed social survey work was undertaken throughout the high impact zone (0.6km radius), and high impact zone (0.6km radius) of the project air-shed to inform the preparation of the land use map. The technical basis is that the since plant capacity is relatively small the social impact will not extend beyond 1km as far as social impacts are concerned. For environmental impacts for air and biodiversity a 5km radius was considered especially air dispersion modeling was carried out to assess the concentrations of air pollutants over 5km radius of the plant. During the mapping exercise, in-depth consultations with local stakeholders were carried out to aide accurate identification of suitable plots. Use of maps and also utilization of the historic maps was undertaken for identifying the plots and ground level. Field verification was undertaken by the team leader after the field data collection. Updated GIS version was applied to finalize the land use map; and

The following primary data was obtained during the ESIA processes:

- Socio-Economic survey data;
- Baseline air quality data;
- Baseline noise data (day and night time);
- Groundwater data from deep and shallow tube wells;
- Road Traffic data were collected from the plant site
- Surface Water data

This ESIA report has been prepared with the following documents:

- Asian Development Bank (ADB), *Safeguard Policy Statement*, June 2009;

- Department of Environment (DoE), Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, *ESIA Guidelines for Mix zone Industrial and residential*, June 1997.
- EHS guidelines for thermal power plants IFC 2008.

1.4 Limitation of the Study

The data collected for inclusion in the ESIA study has been conducted within a limited time and it was not possible to carry out a Social Impact Analysis based on which a Livelihood Restoration Framework.

1.5 The ESIA Team-the qualification and competencies of team member

The ESIA Team comprises of the following:

1. Dr. Moinul Islam Sharif, Modeling and ESIA Expert	Team Leader
2. Mr. Osman Goni Shawkat, Sociologist	Project Coordinator
3. Mr. Shaker Ali, Modeling Expert	Member
4. Mr. Ikbāl Hossain, EIA Expert	Member
5. Ms. Ismot Ara, GIS and Landuse Expert	Member
6. Mr. Sadman K. Monsur. Socio-economist	member
7. Mr. Moniruzzaman, Field Surveyor	Member
8. Mr. ZH Khan, Field Surveyor	Member
9. Mr. Kawser Ahmed, Field surveyor	Member
10. Mr. Imam Hossain, Field team surveyor	Member
11. Mr. Sohel, Data Analyst and SPSS expert	Member
12. Ms. Dil Meher Banu, DTP Incharge	
13. Dr. Monirul Islam, Biodiversity Expert	Member

1.6 Acknowledgement

In preparing the ESIA, various stakeholders were consulted. It comprises a number of government agencies, Narayangang City Corporation, NGOs, Dhaka Power Distribution Company (DPDC), Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI), Bangladesh Bureau of Statistics (BBS), Bangladesh Water Development Board (BWDB), Department of Environment (DOE), Fire Service and Civil Defense Office, Narayangang, Bangladesh Inland Water Transport authority and Modongonj Ward Commissioner. The ESIA team is grateful to these stakeholders for their contribution to enrich the ESIA report and present the accurate the data in the concern section of the report.

CHAPTER 2

LEGISLATIVE, REGULATION AND POLICY CONSIDERATION

2.1 General

The following is the review of the relevant national legislation, regulatory and policy instrument and some international ones. The proponent of the project will conduct its infrastructural and operational activities in compliance with applicable Bangladeshi and international legislation and agreements.

A comprehensive review of the legal and institutional frameworks within which the environmental and social assessment is to be carried out

National Environmental Policy, 1992

The Bangladesh National Environmental Policy, approved in May 1992, sets out the basic framework for environmental action together with a set of broad sectoral action guidelines. Key elements of the Policy are:

- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment;
- Protecting the country from natural disasters;
- Identifying and regulating all activities that pollute and destroy the environment;
- Ensuring environment-friendly development in all sectors;
- Ensuring sustainable and environmentally sound management of the natural resources;
- Maintaining active association, as far as possible, with all international initiatives related to environment.

The Policy, *inter alia*, seeks to ensure that transport systems, including roads and inland waterways, do not pollute the environment or degrade resources. The Policy states that an Environmental Impact Assessment (ESIA) should be conducted before projects commence.

Environment Conservation Rules, 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, *inter alia*, the following:

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and ESIA as well as formulating EMP according to categories of industries/development projects/activities; and
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon location, size and severity of pollution loads, projects/activities have been classified in the Environmental Conservation Rules (ECRs) into four categories:

1. Green,
2. Orange A
3. Orange B
4. Red

The corresponding category related to power plants and associated infrastructure (e.g. the construction of a natural gas pipeline from the nearest distribution point to the power plant) is included under:

Schedule-1, Red Category:

- Item 6: power plants; and
- Item 64: includes construction/SNPL UNIT II Unit II.

The Rules also incorporate “inclusion lists” of projects requiring varying degrees of environmental investigation e.g. all new projects under the ‘red’ category generally will require a two-step assessment procedure. Firstly, an Initial Environmental Examination (IEE) will be required for site clearance, and secondly, if warranted, a full Environmental Impact Assessment (ESIA) for technical clearance. This IEE has been carried out following the previous IEE of the project and also on the basis of the Terms of Reference (ToR) for the ESIA (in Annex 9), which were approved by DoE, in accordance with the requirements of the ECRs, toward obtaining an ‘Environmental Clearance Certificate’ for the proposed project.

Environmental Court Act '2000

By the act government shall establish one or more environment court in each division. Each court will be constituted with one judge and in consultation with Supreme Court. The Govt. shall appoint an officer of judicial service of the rank of joint district judge.

- The environmental court will be competent to impose penalty for offences under section 5A of this Act and under any other environmental law
- To confiscate an equipment or part, a transport used in the commission of such offence or article or other thing involved with the offence
- To pass order or decree for compensation in appropriate cases.
- Environmental Court Act (amendment) '2010.
- To establish Environmental Court in every district
- Aggrieved People may appear to Environmental court for justice directly.

2.2 Asian Development Bank Safeguard Policy Statement (SPS)

The ADB Safeguard Policy Statement (‘the SPS’) 2009 sets out the requirements for ADB’s operations to undertake an environmental assessment for projects funded by the bank. The goal of the SPS is to promote the sustainability of project outcomes through protecting the environment and people from potential adverse impacts. The overall objectives of the SPS are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is impossible; and
- help borrowers/clients strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The SPS sets out the ADB policy objectives, scope and triggers, and principles for following three key safeguard areas:

- Environmental Safeguards;
- Involuntary Resettlement Safeguards along with those vis-à-vis Land Acquisition; and
- Indigenous Peoples Safeguards.

ADB implements the SPS through the safeguard review procedures outlined in Section F1/O Profits Operation Manual (OM) and the documents cited there in. However, the third area of the above three areas is beyond the scope of EIA consideration for the Proposed Development as the AoI does not involve any *indigenous peoples*².

According to ADB Operation Manual activated since 2010, a proposed project is assigned to one of the following categories depending on the significance of the potential environmental impacts and risks :

Category A—a proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An EIA, including an EMP, is required.

Category B – a proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of Category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. An IEE, including an EMP, is required.

Category C – a proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.

Category FI—a proposed project is classified as Category FI if it involves the investment of ADB funds. The proposed Power Plant falls under Category B according to ADB environmental categorization of projects, as the potential exists for significant adverse environmental impacts. An ESIA including an EMP is therefore, an essential element of this project.

The EIA must include an EMP that outlines specific mitigation measures, environmental monitoring requirements, and related institutional arrangements, including budget requirements. Loan agreements include specific environmental covenants that describe environmental requirements, including the EMP. The provisions for the EMP must also be fully reflected in the project administration memorandums. To ensure proper and timely implementation of the EMP and adherence to the agreed environmental covenants, ADB requires borrowers or executing agencies to submit semi-annual reports on implementation of EMP, and that this requirement is reflected in the loan agreements.

With regards socio-economic impacts, ADB screens all projects to determine whether or not they involve Involuntary Resettlement or have potential impacts on Indigenous Peoples. A project's involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The Involuntary Resettlement Impacts of an ADB-supported project are considered significant if “...200 or more persons experience major impacts, which are defined as (i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating).”

2.3 Performance Standards of the World Bank Group

In accordance with OP 4.03, the World Bank has adopted the eight IFC Performance Standards as ‘WB Performance Standards’. These standards are to be used in lieu of the World Bank Safeguard Policies. The eight IFC Performance Standards are outlined in the following section.

2.3.1 International Finance Corporation Performance Standards and Environmental, Health and Safety Guidelines

The IFC has set out eight Performance Standards, as listed below, in respect of various parameters pertaining to a proposed project.

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labor and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety, and Security;
- Performance Standard 5: Land Acquisition and Involuntary resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

Of the above eight Performance Standards set by IFC, Performance Standard 1 envisages establishing the importance of:

- (i) integrated assessment to identify the social and environmental impacts, risks and opportunities;
- (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and
- (iii) the client's management of social and environmental impacts throughout the life of the project.

The remaining seven Performance Standards, i.e., Performance Standards 2 to 8 seek to ascertain establish requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

In addition to the eight Performance Standards, the IFC General Environmental, Health and Safety (EHS) Guidelines are considered pertinent to the Project. The EHS Guidelines comprise technical reference documents with general industry-specific examples of Good International Industry Practice. The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide guidance to users on EHS issues in specific industry sectors. During preparation of this EIA for the SNPL UNIT II Power Plant project, the General EHS Guidelines were applied and relevant guidance in the Industry Sector Guidelines for Thermal Power Plants(dated December19,2008) and Gas Distribution Systems (April 30, 2007) was followed (where applicable).

The IFC *Policy on Disclosure of Information*, The Access to Information Policy is effective as of January, 2012 supersedes the IFC Disclosure of Information Policy of April 2006.The policy seeks to provide accurate and timely information regarding its activities to clients, partners and stakeholders including the Affected Communities and other interested parties.

For each proposed Category A and B project, IFC disclose as summaryof its review findings and recommendations, the Environmental and Social Review Summary (ESRS).The ESRS includes:

- i) reference to the Performance Standards and any applicable grievance mechanisms, including the CAO;
- ii) the rationale for IFC's categorization of a project;
- iii) a description of the main environmental and social risks and impacts of the project;

- iv) key measures identified to mitigate those risks and impacts, specifying any supplemental actions that will need to be implemented to undertake the project in a manner consistent with the Performance Standards, or where required by IFC, the Environmental and Social Action Plan (ESAP);
- v) where greater than 25,000 MT CO₂ equivalent, the expected GHG emissions of the project;
- vi) electronic copies or web links, where available, to any relevant EIA documents prepared by or on behalf of the client; and
- vii) for those projects where the verification of the Free, Prior, and Informed Consent (FPIC) of indigenous peoples is required, a description of the status of that consent process;

2.4 Safeguard Requirements of Equator Principle Financial Institutions

The ten requirements of the Equator Principle Financial Institutions (EPFIs) correspond to the following parameters:

- *Principle 1 (Review and Categorization)*: When a project is proposed for financing, the EPFI will, as part of its internal environmental and social review and due diligence, categorize it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorization process of the IFC. Projects are classified, relating to social or environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts).
- *Principle 2 (Environmental and Social Assessment)*: For all Category A and Category B Projects, the EPFI will require the client to conduct an assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed project (which may include the illustrative list of issues found in Exhibit II to the EPs). The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.
- *Principle 3 (Applicable Environmental and Social Standards)*: The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. The EPFI will require that the assessment process evaluates compliance with the applicable standards as follows:

For projects located in Non-Designated Countries, the assessment process evaluates compliance with the then applicable IFC Performance Standards and the World Bank Group EHS Guidelines; and

- *Principle 4 (Environmental and Social Management System and Equator Principles Action Plan)*: For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards;
- *Principle 5 (Stakeholder Engagement)*: For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to the risks and impacts of the project, the project's phase of development; the language preferences of the Affected Communities, their

decision-making processes and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation.

To facilitate Stakeholder engagement, the client will, commensurate to the project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner.

The client will take account of and document, the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts, disclosure should occur early in the assessment process, in any event before the project construction commences, and on an ongoing basis.

EPFIs recognize that indigenous peoples may represent vulnerable segments of project affected communities. Projects affecting indigenous peoples will be subject to a process of informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in IFC Performance Standard 7 (when relevant as defined in Principle 3), projects with adverse impacts on indigenous people will require their Free, Prior and informed Consent (FPIC) 3.

- *Principle 6 (Grievance Mechanism)*: For all Category A and, as appropriate, Category B projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.

The grievance mechanism is required to be scaled to the risks and impacts of the project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.

- *Principle 7 (Independent Review)*: For all Category A and, as appropriate, Category B projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance. The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible.

- *Principle 8 (Covenants)*: For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Further more for all Category A and Category B Projects, the client will covenant the financial documentation:

- to comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and
- to provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws,

regulations and permits; and

- to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan

Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

- *Principle 9 (Independent Monitoring and Reporting):* To assess project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI.

- *Principle 10 (Reporting and Transparency):* For all Category A and, as appropriate, Category B Projects:

- The client will ensure that, at a minimum, a summary of the EIA is accessible and available online; and
- The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO₂ equivalent annually.

2.5 International Conventions

Quite a significant number of international conventions have relevance to activities related to power plant project and associated facilities. Bangladesh is a party to almost all of such conventions. Such conventions include those on biological diversities, endangered species, desertification, climate change, hazardous wastes, persistent organic pollutants, wetlands, ozone layer depleting substances, nuclear test ban, etc.

Among the above, the following have a greater degree of relevance to the Proposed Development, and include policies that have been acknowledged as well as accepted throughout the world as applicable to projects including those related to power generation of the types similar to the proposed one at the Project Site.

a) *Basel Convention:* Signed and ratified by 170 Parties, the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention aims to protect human health and the environment against the adverse impacts of generation, management, trans-boundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992.

Although policies and rules are yet to be adopted, in Bangladesh the Department of Environment pursues the spirit of Basel Convention and undertakes, more than often, actions toward indiscriminate use and disposal of such wastes and substances throughout the country. The Proposed Development forms part of an overall development of power station, transmission lines, HFO transportation and related infrastructure c) *Stockholm Convention on Persistent Organic Pollutants:* The Governing Council of the United Nations Environment Program (UNEP), in 1995, had made a call for global action on the Persistent Organic Pollutants (POPs), which it defined as “chemical substances that persist in the environment, bio-accumulate through the food web, and

pose a risk of causing adverse effects to human health and the environment”.

This was followed by assessment of the 12 worst offenders, known as the *dirty dozen*, made by the Intergovernmental Forum on Chemical Safety (IFCS) and the International Program on Chemical Safety (IPCS). The negotiations for the Convention were completed on 23 May 2001 in Stockholm. The convention entered into force on 17 May 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agree to outlaw nine of the *dirty dozen* chemicals, limit the use of DDT to malaria control, and curtail in advertent production of dioxins and furans.

Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans-boundary threat. The first set of new chemicals to be added to the Convention was agreed at a conference in Geneva on May 8, 2009.

Whilst the use of electrical transformers containing Polychlorinated biphenyls (PCBs) – a chemical substance belonging to the above dirty dozen that have been banned under the Stockholm convention – is an issue at some power generating facilities, it has been confirmed by the equipment supplier that PCB containing oils and equipment will not be used at the proposed Power Plant.

(b) *Stockholm Convention on Persistent Organic Pollutants*: The Governing Council of the United Nations Environment Program (UNEP), in 1995, had made a call for global action on the Persistent Organic Pollutants (POPs), which it defined as “*chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment*”.

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CHAPTER 3

DESCRIPTION OF PROJECT

3.1 Background and Rationale of the project

Summit Narayanganj Power (Unit-2) Limited project is a proposed HFO based 55 MW power plant is being located at Modanganj, Narayanganj District.

Rationale for the proposed project

The supply of electricity has a great impact on the national economy of any country. Presently in Bangladesh, 59.6% of the total population has access to electricity and per capita generation is only 236 KWh (inclusive of captive), which is very low compared to other developing countries. The GOB has given highest priority to power sector development in the country and has committed to making electricity available to all citizens by 2021. With this in mind, the government has initiated the implementation of reform measures in the power sector, including significant development programs of which this Project constitutes an important part.

Basic information of proposed project

Summit Narayanganj Power (Unit-2) Limited project is a proposed HFO based power plant is being located at Modanganj, Bondor, Narayanganj district to contribute in meeting demand of electricity.

Basic information of proposed power plant project is represented below:

1. Name of Project	: Summit Narayanganj Power (Unit-2) Limited
2. Project Proponent	: Mr. Wadud, Managing Director
3. Project Location	: Modonganj, Bondor, Narayanganj.
4. Head Office Address	: Summit Centre, 18 Kawran Bazar, Dhaka-1215.Dhaka.
6. Final Product	: Electricity
7. By-product if any	: N/A
8. Plant Capacity	: 55 MW
9. Type of fuel	: HFO
10. Source of Raw Material	: Imported
11. Required HFO Quantity	: 111600 MT/year
12. Water requirements	: 40 cum/hr
13. Source of Water	: Deep Tube Well
14. No of Employees	: 70 (Proposed)
15. Total Area of Land	: 2.22 acres
16. Covered Area of Land	: 70%
17. Project Cost	: BDT 350 Corers.

The project area consists of the following primary components:

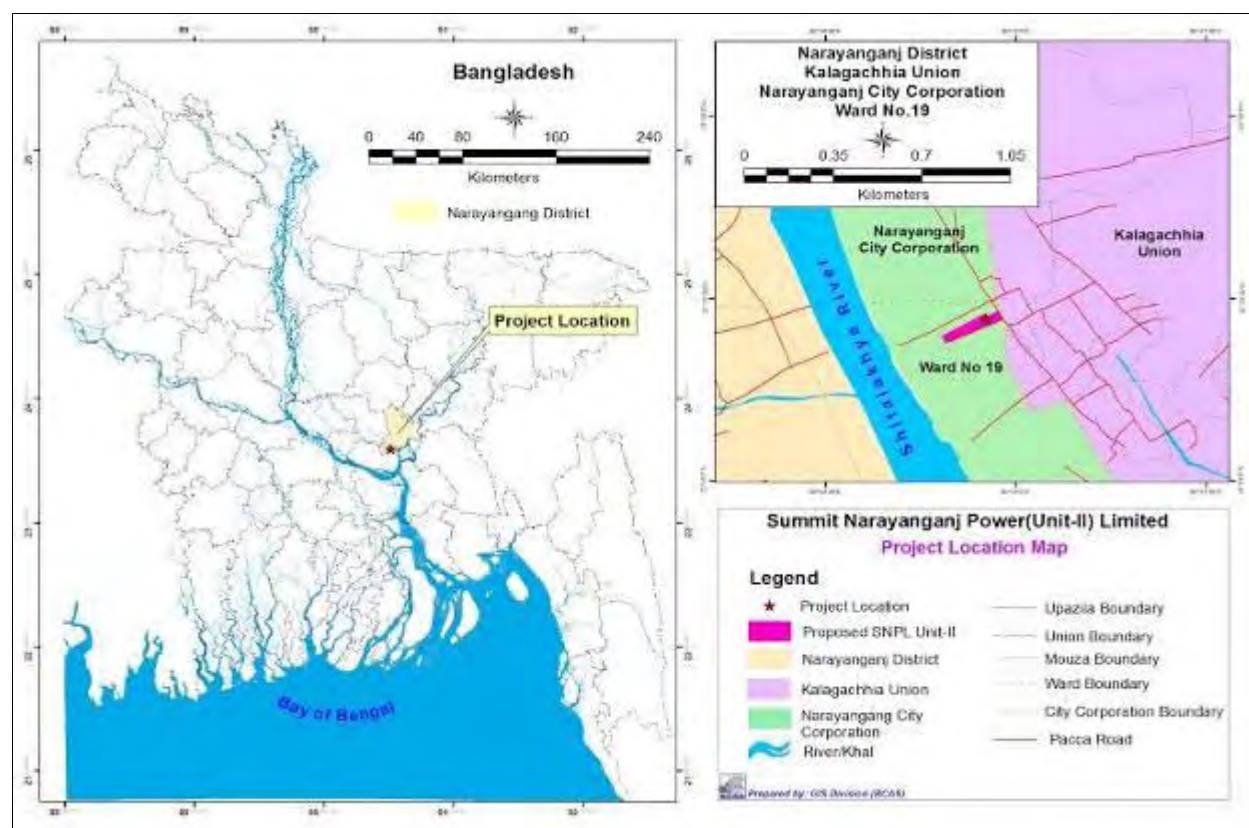
- i. Development of the site for the SNPL UNIT II Unit II 55 MW Power Plant at Modonganj project;
- ii. Development of 350m HFO collection pipeline from the Sitalakha oil terminal to power plant.
- iii. Development of 350m power transmission line from plant site to DPDC substation

The proposed site to the 55 MW Summit Narayanganj Power Unit II Limited occupies an area of approximately 3 acres which includes a construction ‘lay-down’ area in the northern section of the site. An aerial photograph of the proposed project site is included in Map 4.1, 4.2 and the layout of the site is presented in Annex 2 and the Satellite image of the proposed project 1 km radius and 5km radius is given in Map4.1 and 4.2 in Chapter 4. Modonganj, Narayanganj is bordered by Munshigonj, Comilla and Narshindi Districts to the South, East and North.

3.2 Project Site and Location

The proposed power plant is located at Modonganj, Bondor, Narayanganj in Bangladesh. The project location in geological map, soil map, agricultural map, agro-ecological map and surrounding pictures are given in Map 3.3

The site is situated in the north-eastern side of Dhaka-Chittagong Highway and at a distance of 11 kilometer. The present location is at a distance of 1.5 kilometer from the Bondor Upazilla, Narayanganj, which is north-east to the proposed site. The place is known as Modonganj. The site is adjacent to existing pucca road of 12 feet, which connects this side of Modonganj village, Bondor Upazilla, Narayanganj. The site is also adjacent to **Sitalakha River**. The location of the site is presented in district, location of project site in detailed map, location in district map, aerial view and mouza map in Map3.1, 3.2, and figure 3.1 and 3.2 respectively.



Map 3.1: Project Location Map



Figure 3.1: Aerial view of the project location

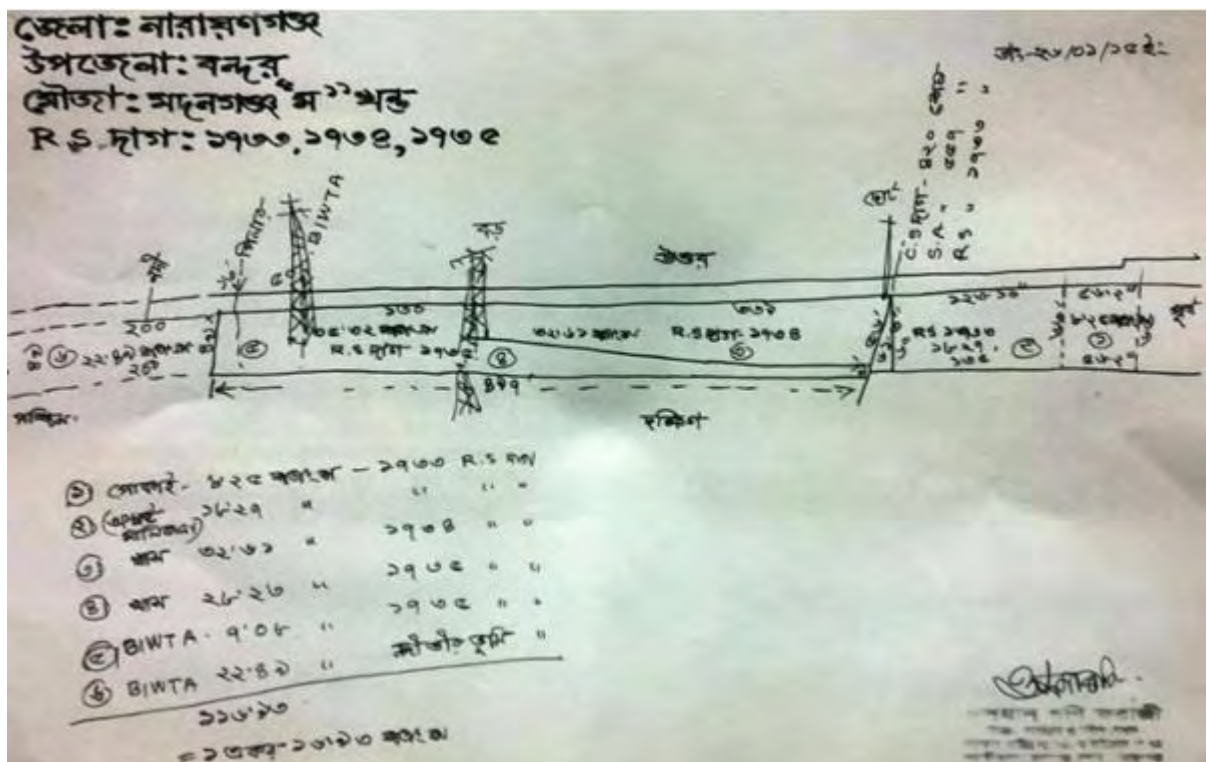
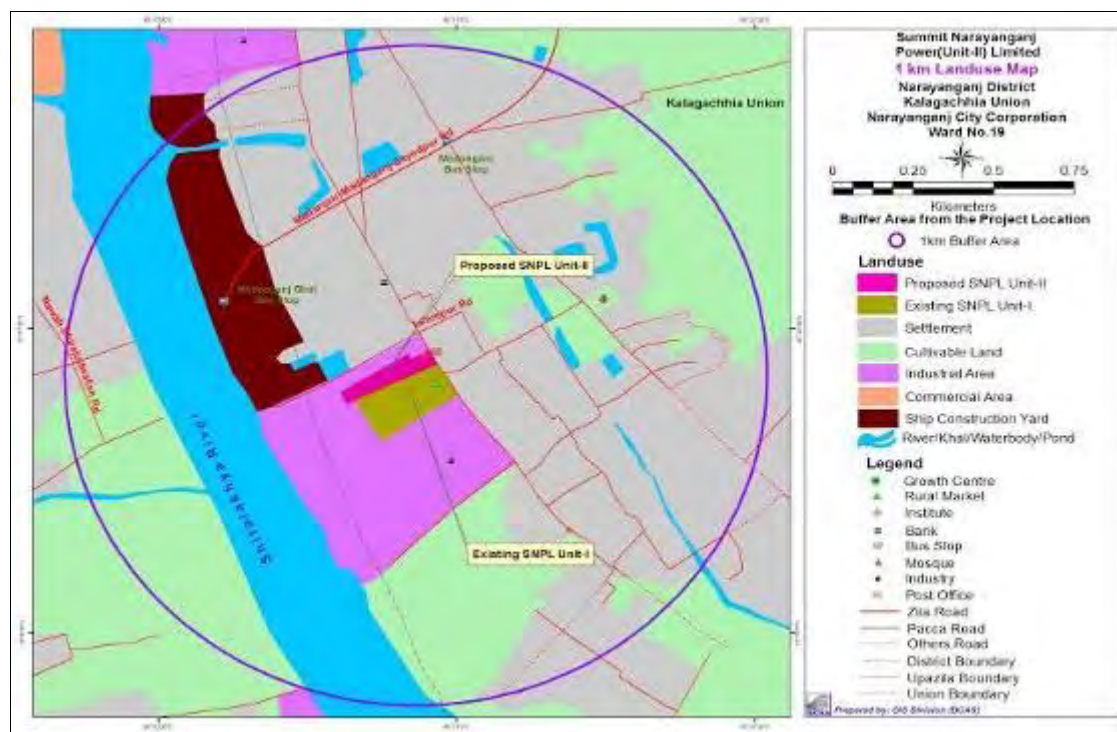


Figure 3.2: Mouza Map of project location

3.3 Project Site and Surroundings

The site has already occupied 2.22 acres of land in 70 percent will be covered by establishment and paved surface. There will be about 30% open surface of land and tree will be planted in this open space. Map 3.3 presents the project land details. This has been confirmed with SNPL UNIT II Unit II that trees will be planted in open spaces within the plant area and the boundary wall of the plant which will account for 30% open space.



Map 3.2: 1km land use map in the vicinity of the project site

The proposed project site is easily accessible by road as it is situated nearby to Dhaka-Narayanganj Bondor Highway.

The project site surrounding feature with distance presented below:

Table 3.1: Project site surrounding feature

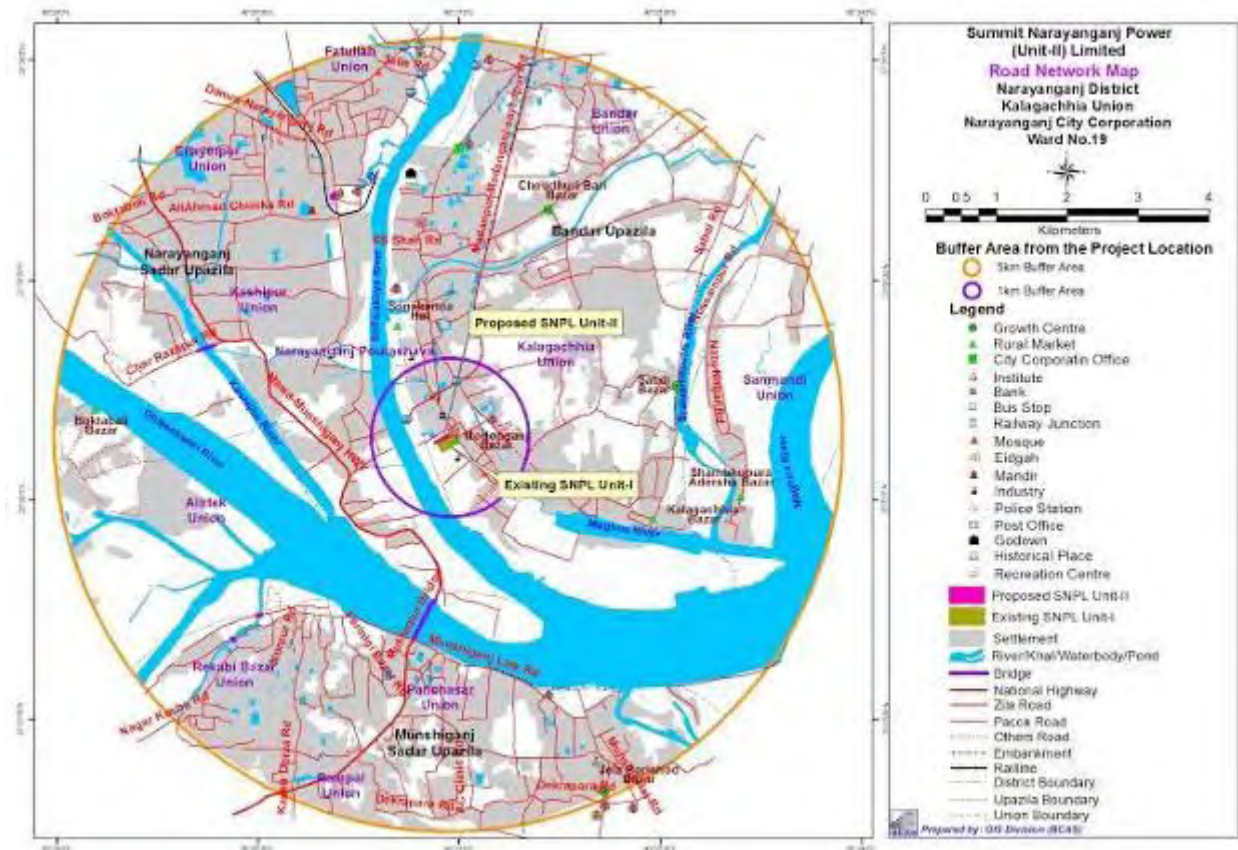
Location	Land type	Coordinate point	Coordinate
North	Settlement and open space	NE Corner	23° 59' 01.37" N 90° 51' 36.47" E
South	Basundhara Cement	SW Corner	23° 59' 09.54" N 90° 51' 53.99" E
East	Road and market	SE Corner	23° 59' 07.34" N 90° 51' 60.95" E
West	Sitalakha River	NW Corner	23° 58' 97.99" N 90° 51' 38.46" E

Major Land use and main occupations:

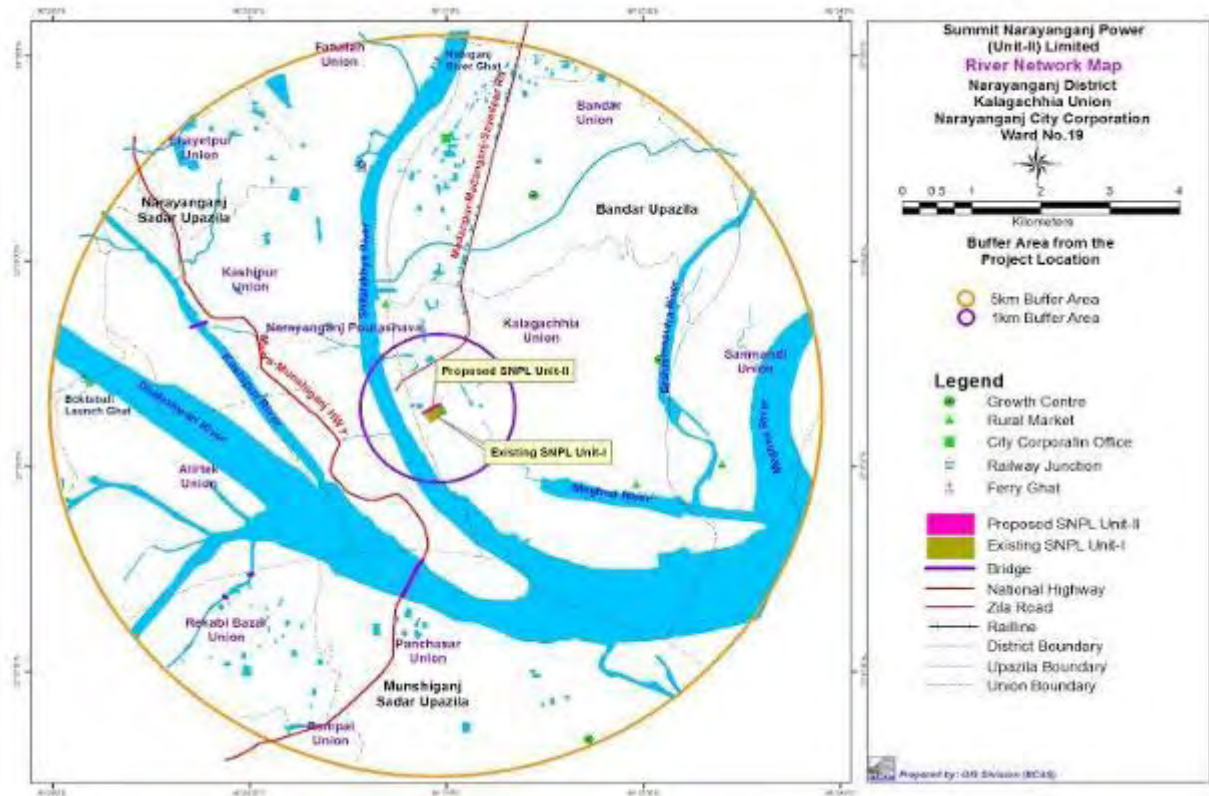
As per BBS the main occupations within the Narayanganj City Corporation are as follows: Agriculture 15.28%, Commerce 30.6%, Service 25.78%, Transport 8.36%, Agricultural labourer 15.89%, Wage labourer 2.46%, Construction 1.03%, Others; 1%. (Source: BBS 2011).

3.4 Transportation of Road and River Network

Narayanganj has both land and river network between Dhaka-South Bengal river Routes and Narayanganj to Dhaka, Chittagong and Sylhet routes. Narayanganj is known as the hub of river Communication connecting the Southern part of Bangladesh with Dhaka which is only 40km away. The transportation time is relatively slower than road or rail but it is the cheapest way to transport goods and passengers. The following Maps 3.4 and 3.5 shows the river and road network with plant site



Map-3.3: Road Network



Map 3.4: River network with project site

3.5 The Air Shed of the project area

The air shed for the project has been considered a radius of 5 kilometers. The impacts on environment and social issues this air shed has been considered. An air shed area of 1 km and 5km radius of the project is showing in the above Map 3.5. The major findings from the airshed of the project is that within 1km radius of the plant there are large industries for example Boshundhara Cement Plant and very densely populated settlements and river ports along river Sitalakshya. For socio-economic studies the 1km radius was considered and for environmental assessments 5km airshed was covered.

Accessibility to the project Site

Accessibility is an important parameter for a power plant project. A power plant project usually involves movement of heavy vehicles for various purposes. The SNPL UNIT II Unit II site has been found to have a satisfactory accessibility. Access to the site is by the Dhaka to Modongonj through Chittagong Highway directly.

3.6 Project Facilities and Design

Environmental considerations: All power plant design, regardless of the type of power plant, must be in accordance with the rules and regulations which have been established by the relevant national authority. SNPL UNIT II Unit II is committed to comply with all applicable national and international standards. Moreover, the ambient condition of the site is suitable for the proposed power plant project. This has been discussed in the site alternative section.

Water supply: Water supply should be adequate to meet present and future plant requirements. The supply may be available from a underground or it may be necessary to utilize surface and

sub-surface sources. To meet the required water demand, SNPL UNIT II has planned to set up two deep tube-wells with a capacity of 2 cusec each. The cooling is radiator type design with closed cooling water circuit.

Wastewater Disposal System: On-site effluent disposal system will be installed to effectively treat and dispose of project effluents. Ultimately all effluents will be passed through the ETP before discharge.

Transmission and interconnection: The generated electricity of the SNPL UNIT II plant will be transmitted through the nearby Dhaka Power Distribution Company (DPDC) sub-station. The interconnection line will be handed over to DPDC after commissioning and subsequently, DPDC will operate and maintain the equipment of the bay. SNPL UNIT II will install, operate and maintain separate 230 kV synchronizing breaker at the high voltage side of the step-up transformer and also construct the connecting lines for connection as mentioned above. The 600 meter underground interconnection transmission line has been taken from the plant to DPDC substation along the road for which permission from the City Corporation was obtained by SNPL UNIT II Unit II.

Fuel supply arrangements: SNPL UNIT II Unit II has signed an Agreement with Bangladesh Petroleum Corporation (BPC) for supply of Heavy Furnace Oil (HFO). The HFO will be supplied to the Plant Site by inland tankers. The constraint on sulphur content for Wartsila, the engine manufacturer, is that the concentration cannot exceed 4.5%. as shown in Annex 20. If the concentration is above that then the guaranteed figure of SO₂ emission by Wartsila cannot be met.

3.7 Technology and Major Components of the Project

Process Flow Diagram

The proposed fuel power plant will use HFO as fuel. The Project comprises four (4) numbers of Wartsila made of which 3 x 18V46 GD engines and 1 x 12V46 GD engine, each coupled with ABB made AMG 1121 0M (or equivalent) of 17.076 MVA (21345 KVA) Generators. Electrical power is generated from 3 engines is 64035 MW and 14230 MW from the other. The engine is the four strokes, lean burn, prechamber, spark ignited, port injected, trunk piston, turbocharged and intercooled design. The engine has a fully microprocessor based control system.

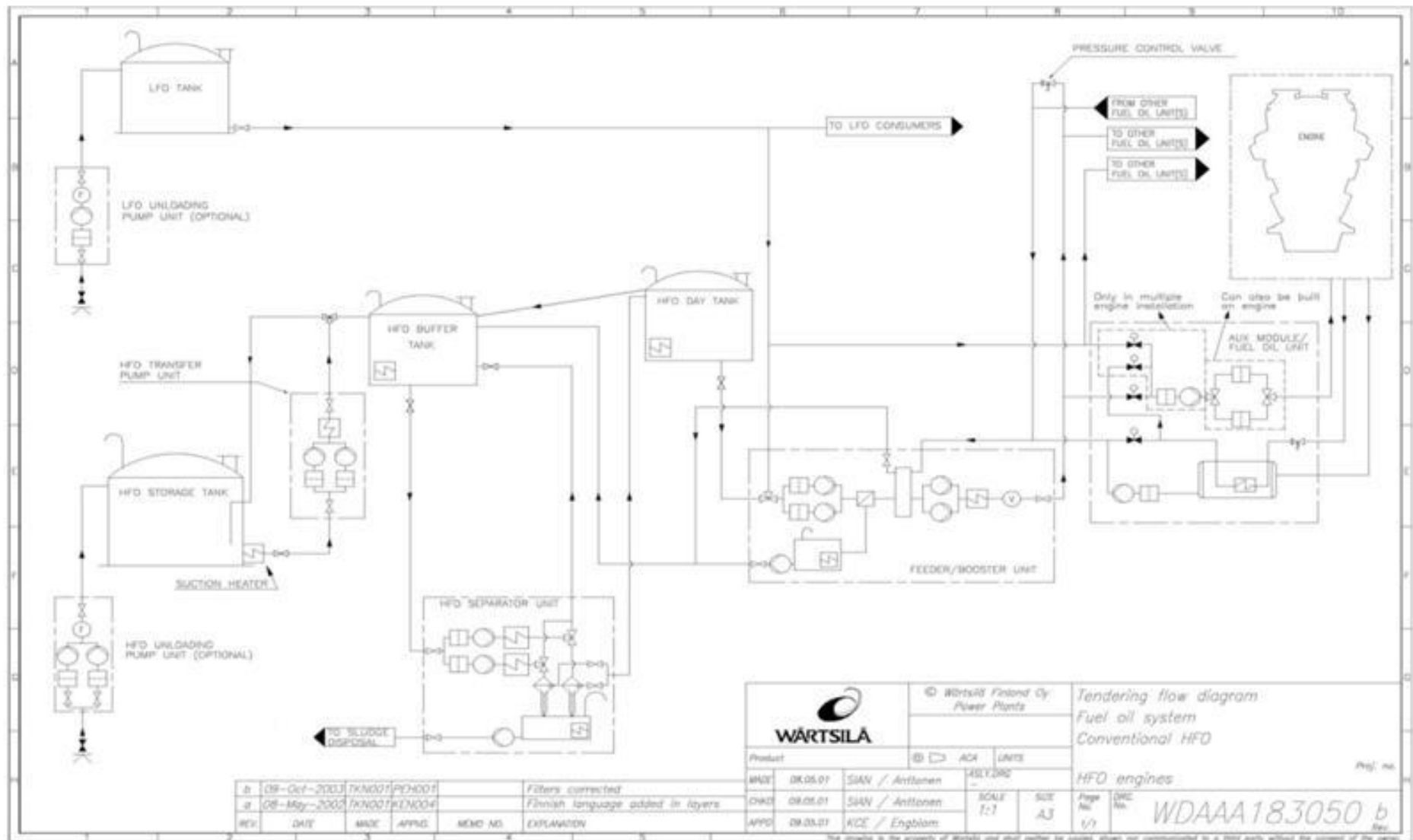


Figure 3.3: Process flow diagram of the SNPL UNIT II Unit II

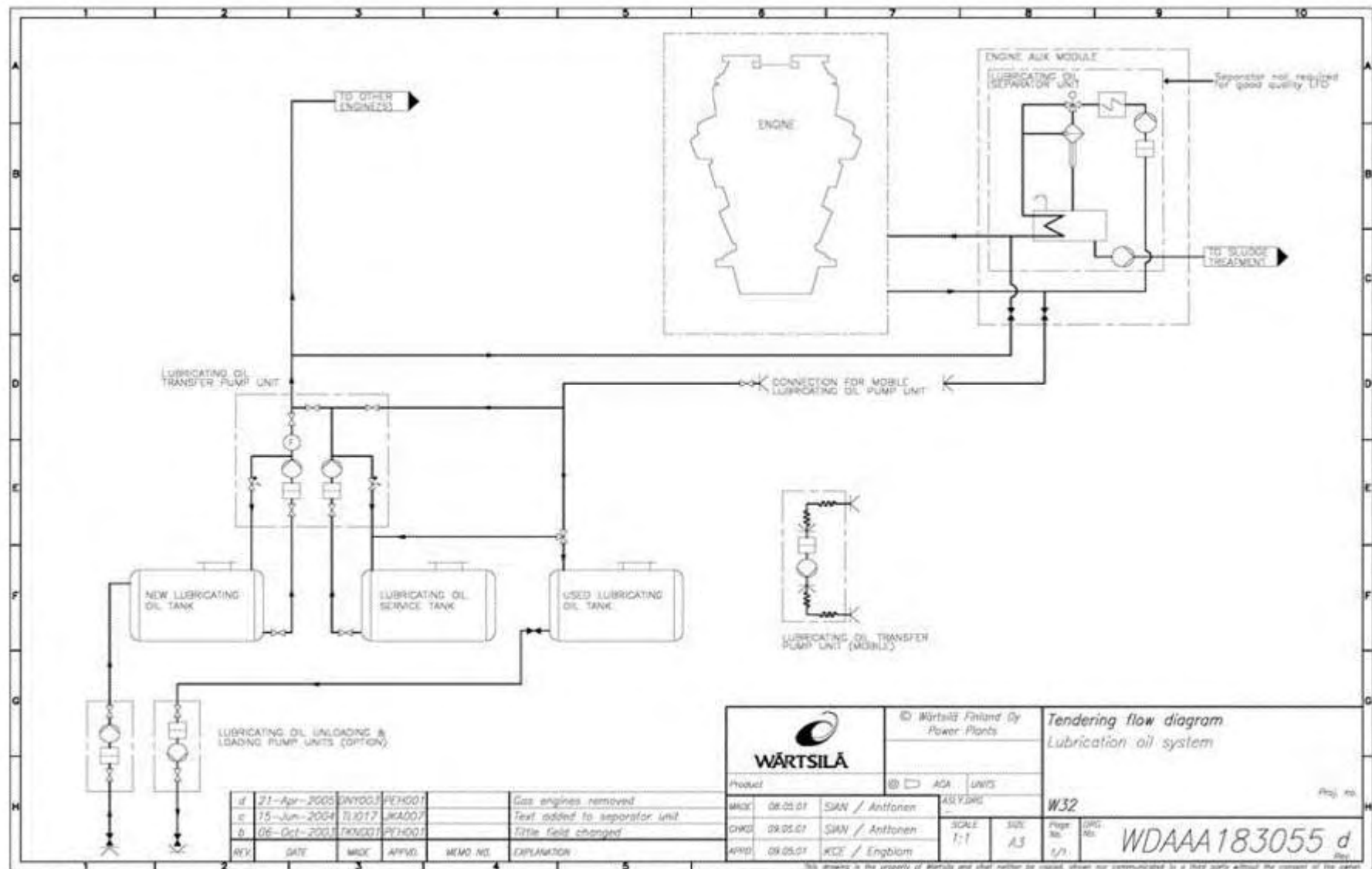


Figure 3.4: Process flow diagram of the SNPL UNIT II Unit II

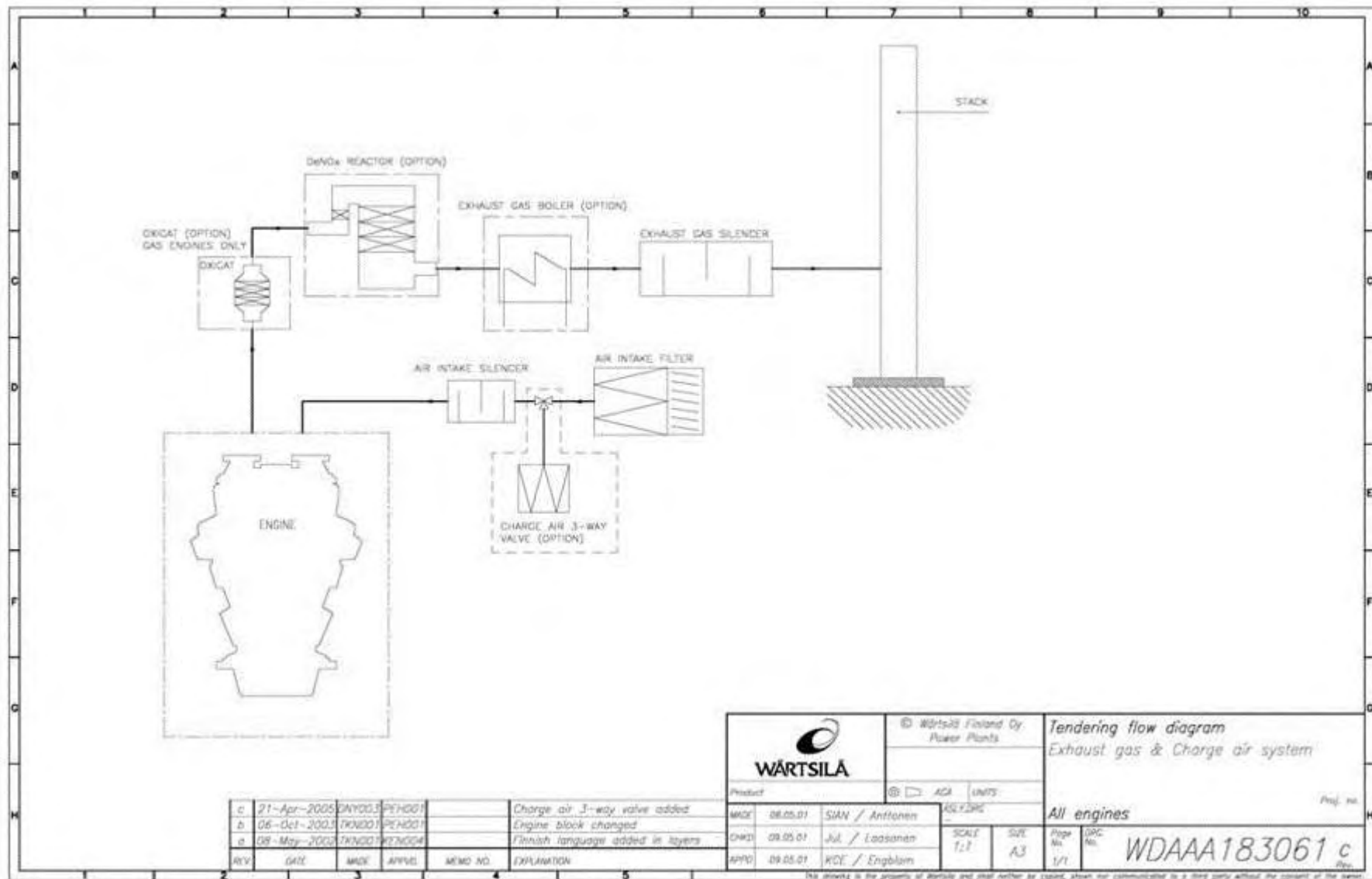


Figure 3.5: Process flow diagram of the SNPL UNIT II Unit II

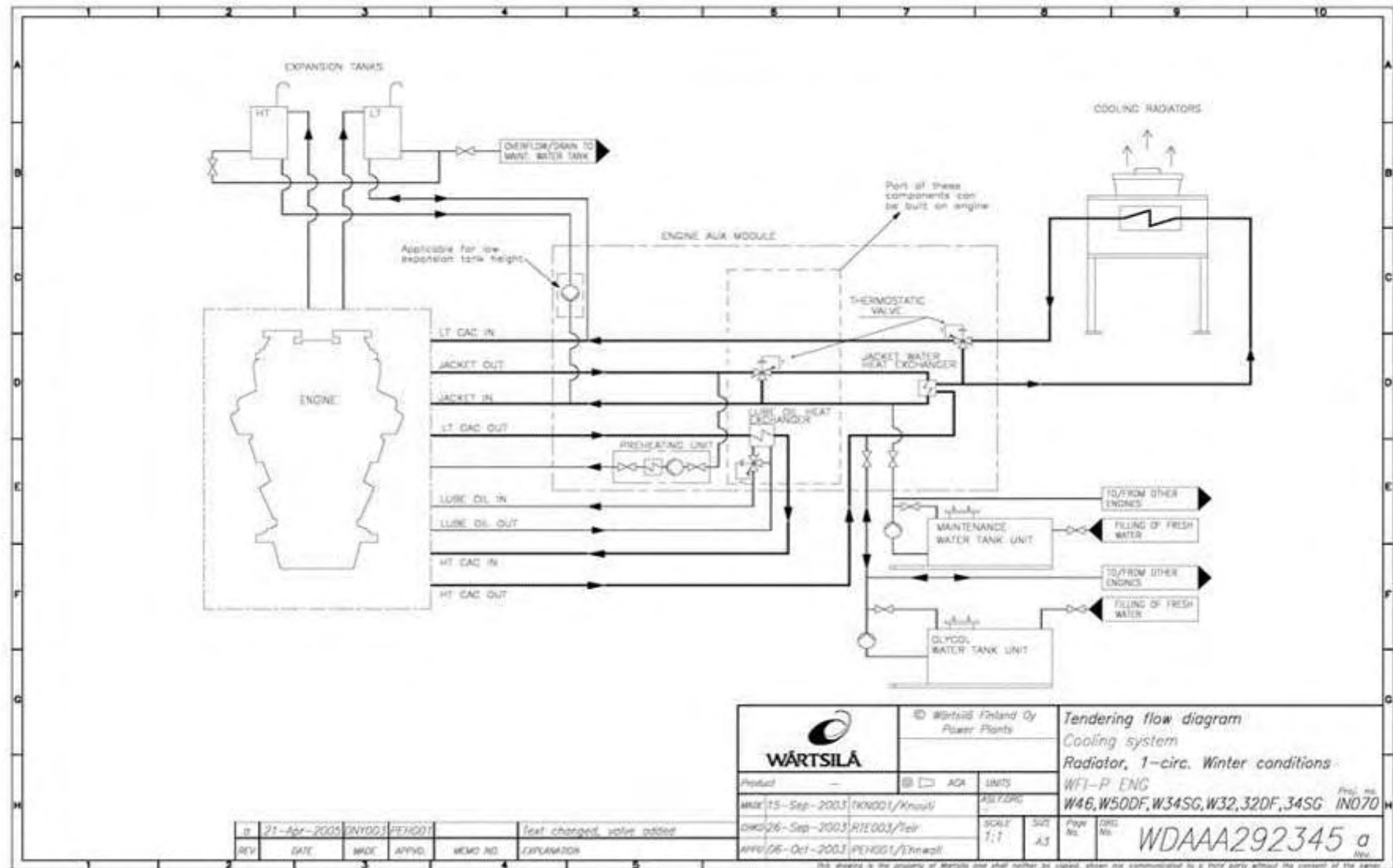


Figure 3.6: Process flow diagram of the SNPL UNIT II Unit II

Radiative cooling or dry cooling systems are used for generators having medium to low generation capacities. It consists of cooling fans without the physics of evaporation as is the case for wet cooling systems to bring down the temperature of the flue gases sufficiently to operate the waste heat boiler efficiently. It basically consists of high forced draft through a finned assembly. Cooling process using water is normally used for larger plants.

The stack height will be determined through air dispersion modeling recommended by USEPA. Detailed Environment Impact Assessment (ESIA) of the project have been carried out after obtaining the site clearance certificate from the Department of Environment. Table 3.3 shows the specifications of the machineries and equipment and the detailed technical specifications of the machinery and equipment list is shown in Annex 1

Table 3.2: List of Machineries & their key details for 55 MW Power Plant at Modongonj, Narayangang

SN.	Component	Manufacturer/ Country	Model / type
1	Reciprocating Engine	WARTSILA / FINLAND	14G46
2	Generator	ABB / GERMANY (or equivalent)	AMG 1121 M
3	Control system	WARTSILA / FINLAND	WOIS

3.8 Description of all project components

1. Stack Height : 45 meter
2. Effective Stack Height : 45 meter
3. Design Stack diameter : 1.1m
4. HFO Operation: Flue gas
5. Exit velocity of 27m/s at a Temperature of 240 ± 15 °C in 2 engines' chimneys with Waste Heat Recovery Boilers and it is 32m/s at a temperature of 335 ± 15 °C in other 4 engines' chimneys.
6. Fuel consumption per unit power production: 8850.58 BTU/KWH
7. Mass of pollutant emission per unit power production: g/kWh: 47.37g/KWH
8. Mass of pollutant emission per unit time g/sec:
(NO_x: 260grams/second, SO_x: 401.92 grams/second and, CO: 18.40 grams/second)
9. Emission control system used if any: Low emission in built in generator set

3.9 Fuel Treatment Plant

Fuel treatment System consists of 2 Nos. of centrifuge type separators with capacity 15,400 Litres/hr each designed for treatment of Heavy Fuel Oil with Viscosity 180 cSt (at 50°C), Max. Density 1010 kg/m³ (at 15°C) and heavier solids content than oil up to max. 4% (V/V). Fuel Separation Temperature is 98°C and the discharge pressure is 1.5 kg/cm². Free Water Removal capability: Up to 2000 (0.2%) ppm from initial of around 15000 ppm (1.5%) in single pass. Particle removal capability: Up to ISO Class 18/15 of 4406 or heavier metallic solids than oil of size up to 5 micron will be removed. It may be mentioned that Fuel Treatment process for HFO based power plants is generic.

Fuel Storage

Fuel storage tanks are atmospheric tanks designed according to API 650; the Standard for Welded Steel Tanks for Oil Storage. As specified there, sufficiently sized vents, filling & draining provisions, access ladders & manholes provisions are included. In addition, both

mechanical & electronic level indicators/switches, temperature gauges, thermostats & heaters and valves are provided. Tanks are painted with epoxy primer & 3 layers of polyurethane paints against weathering and they are electrically grounded to avoid electrical/lightening hazards.

All the tanks are surrounded by a sufficiently sized containment tank to avoid undesired spread of oil which could be happened due to an accidental oil spillage.

Below is the list of fuel storage tanks along with their capacities.

- Diesel Storage Tank – 100m³
- HFO Storage Tanks – 2 x 2500m³
- HFO Buffer Tank – 55m³,
- HFO Day Tank – 100m³

3.10 Raw Materials and Final Product

Raw Material

HFO will be used as fuel by **Summit Narayanganj Power (Unit-2) Limited** for the production of electricity based on twenty-four hours per day and 365 working days in the year. The annual requirements of raw material are as under:

Item	Unit	Quantity	
		Per day	Yearly
HFO	ton	307	111600 MT

Final Product

Final product is electricity with a yearly production of 337260 MWh.

Utility Demand

Water, fuel oil and electricity are necessary for this project both at construction and operational phase. The utility requirements are given below-

Construction Phase		Operational Phase		
Utilities	Quantity	Utilities	Quantity	Source
Water	120 cum/day	Water	Water 40 cum/hr	Deep Tubewell
Fuel oil	30-60 l/day	Fuel oil	111600 MT/year	Imported
Electricity	1.08 MWh/day	Electricity	337260 MW	Gen-sets.

3.11 Project Schedule

The project construction is almost 75% complete when BCAS started the assignment. The project has gone into commercial production in March 2016. The project schedule is shown in Annex 12 and 17

3.12 Civil Construction

3.12.1 Site Preparation

Site preparation would comprise the land filling of 1.5 meters and compaction of 2.22 acres of land. Prior to construction, a 300mm thick carpet of crushed stone should be spread in the lay-down areas and on the working surface.

3.12.2 Piling

The proposed power plant is being founded on piles. The piles could be bored, augured or driven and the type will depend upon the geotechnical data available. However given the close location of existing generating plant it is anticipated that the piles will be of a type which could be installed with the minimum of disturbance to existing equipment. This would imply bored or augured piles rather than driven types. Design load tests should be made on test piles for design purposes (design piles). Design piles are normally loaded until the failure of the bearing soil as an aid to the pile design in similar conditions.

3.12.3 Foundations

Foundations should be designed to British Standard Code of Practice BS 8004 or equivalent Bangladesh National Building Code 2006. The design of foundations for all structures and equipment are to be such that differential and total settlements or other movements should not exceed acceptable limits and ensure safe and maintenance free operation of the plant. Detail design parameters for the civil works was provided by the relevant consultant. The nature of the filling material and the construction techniques used should be such that the less heavily loaded equipment and the buildings may be founded on rafts or spread footings. The following shows the number pilings required for the construction of different facilities at SNPL UNIT II Unit II:

Based on the soil report and load calculations for each structure the following table shows the details of the piling done for foundation:

Serial Nos.	Structures	Number of Piles	Depth of the piles in meters
1	Engine Hall	155	23.5
2	Stack	33	23.5
3	Heat Recovery System	6	23.5
4	Duct Support	4	23.5
5	FTP	15	23.5
6	Day HFO Tank	9	23.5
7	Boundary Wall	144	14.0
8	Guard Dormitory	39	14.5
9	Grid End Substation	4	19.0
10	Substation	32	14.5
11	Blast Wall	4	19.0
12	Lube Oil Storage tank	5	23.5
13	700 MT HFO Storage Tank	150	28.7

3.12.4 Proposed storm water drainage system

It is recommended that the storm water and sewage system should be separate and should be designed in accordance with BS EN 752 Parts 1 to 4" Drain and sewer systems outside buildings". Manhole and chamber covers should be heavy duty throughout.

The capacity of the surface water drainage system should be sufficient to deal with a storm return period of 1 in 5 years. The surface water drainage should include all necessary gutters, down pipes, gullies, traps, catch pits, manholes etc. The quality of the discharge shall be in compliant with the required statutory limits and standards of Bangladesh.

3.12.5 Power Station Buildings

The dimension of all the buildings should be such as to provide generous space for the safe installation and proper operation and maintenance of the plant and its equipment. In particular generous space should be provided immediately in front of, behind and beside all items of the

plant. It is recommend that the floors should be constructed in reinforced concrete and designed to accommodate all foreseeable static and dynamic loads. They should be provided with surface finish appropriate for their intended usage and properly drained bounded areas should be provided wherever necessary to contain accidental spillage of oil or other harmful liquids. The design of all buildings must ensure that noise, vibration and temperature levels are within permissible limit.

3.13.6 Sub-station

The DPDC substation is located about 350m from the power plant. The power generated from the proposed plant will be transmitted underground cables to the DPDC.

3.13.7 Site Fencing

A security fence has been built which is 5m high around the permanent boundary of the site. In order to reduce noise level especially at the North and North Eastern side of the power plant an acoustic wall of 7m high has been built. The entrance gates have securely built with steel gates.

CHAPTER 4

BASELINE ENVIRONMENTAL CONDITION

4.1 General Consideration

Base line information of existing environment is essential to take decision regarding lay out, mitigation measures and plant operation process. Information was gathered on the existing physical environment including meteorology, geology, topography, soils, hydrology and drainage, surface water quality, air quality and noise levels. In the following sections,

4.2 Geographical Location of the Project Area

Bangladesh is divided into seven administrative divisions within these administrative divisions are administrative districts (similar to counties), upazila/thanas (Police jurisdiction), unions (cluster of villages) and villages. Summit Narayanganj Power Limited project will be located at Modonganj, Bondor, Narayanganj in Bangladesh. A political map is shown in Figure 4.1. The location of the proposed project site confined geographically, between 23°35'26.7"N and 90°30'54.4"E, 23°35'23" N and 90°30'55.2"E, 23° 35' 26.8" N and 90° 30' 57.4" E, 23°35'19.85" N and 90°30'37.07" E. The site is adjacent to Shitalakha River.

4.3 Landscape and Topography

The site is situated in the north-eastern side of Dhaka-Narayanganj Bondor Highway and at a distance of 11 kilometer. The present location is at a distance of 1.5 kilometer from the Bondor Upazilla, Narayanganj, which is north-east to the proposed site. The place is known as Modonganj. The site is adjacent to existing pucca road of 12 feet, which connects this side of Modonganj village, Bondor Upazilla, Narayanganj.

Topography is a configuration of a land surface including its relief and contours, the distribution of mountains and valleys, the patterns of rivers, and all other natural features that produce the landscape. Although Bangladesh is a small country, it has considerable topographic diversity.

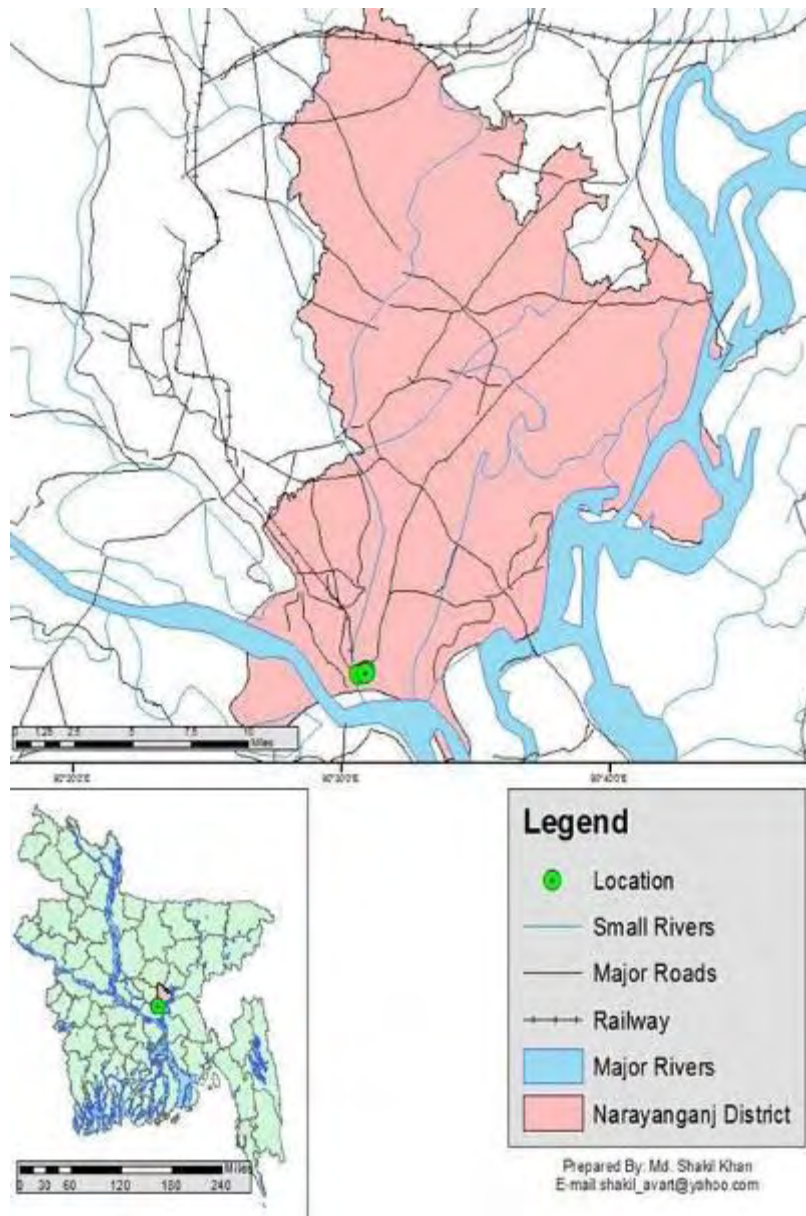
There are three distinctive natural features in Bangladesh:

- a broad alluvial plain subject to frequent flooding;
- a slightly elevated relatively older plain;
- a small hill region drained by fast flowing rivers.

The land within the 5 km project command area radius is part of the Meghna floodplain with almost no annual deposition of new sediment and is composed of older and more developed soil. The landscape is gently undulating and nearly flat. The physiography of Bangladesh indicating the Project Site is shown in Map 4.2. The main soils consist of grey silty to loamy top soils along with black structured grey-silty to clayey sub-soils. The project command area comprises agricultural land, homestead land. The topographic map is shown in the fig. 4.1 and Map 4.1 below:



Figure 4.1: Elevation map of the project site



Map 4.1 : Elevation Map of Narayanganj District

The topography of the plant area shows that the elevation of the project site above se level is between 9-12 feet. The land was filled further by 5 feet making it 17 feet above sea level which is above the maximum flooding level in the area

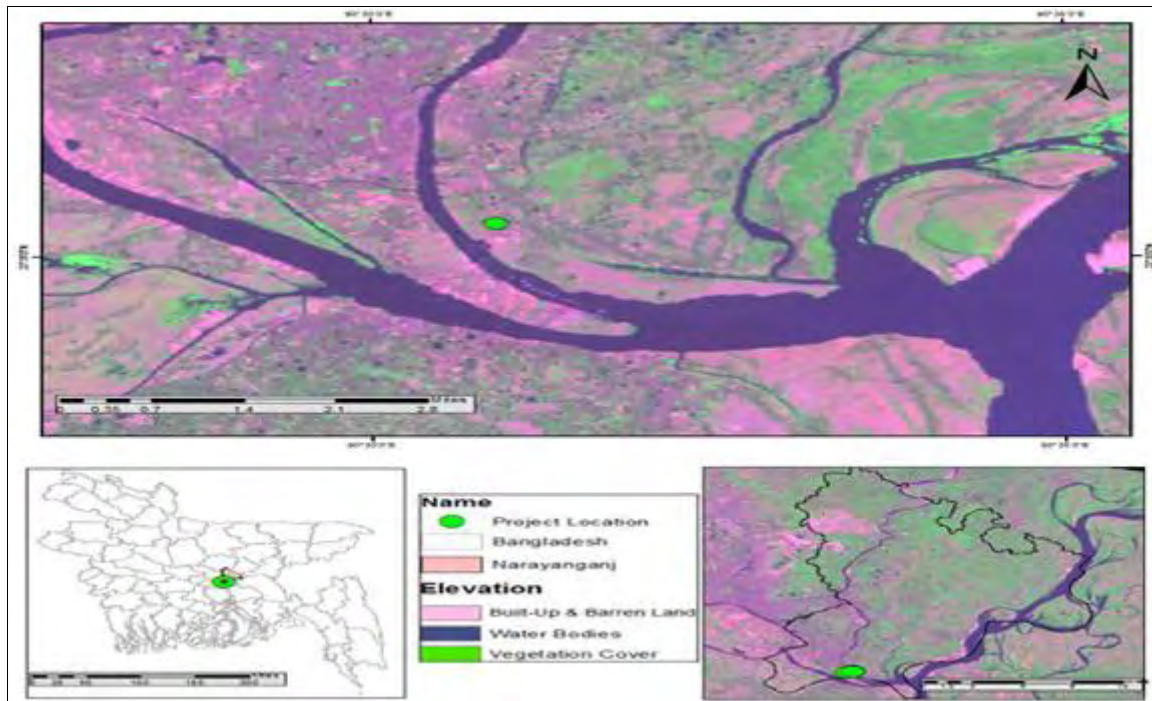


Figure 4.2: Land Cover Map Using Satellite Imagery of the Project area

4.4 Physiography

The landforms of Bangladesh can be divided into three major classes:

- (i) The northern and eastern hills,
- (ii) The Pleistocene terraces, and
- (iii) The Holocene floodplains.

Sedimentary deposits of Bangladesh mainly consist of those laid down by the Ganges, Brahmaputra and Meghna (GBM) river systems. Holocene floodplain deposits cover most of the surface area of present-day Bangladesh. According to geographic and geomorphic distribution, the Holocene floodplains are divided in four classes:

- a. Piedmont plains, (b) meander floodplains, (c) tidal floodplains, and (d) estuarine floodplains.

Physiographical features are shown in the following figure 4.3 and in the Map 4.2

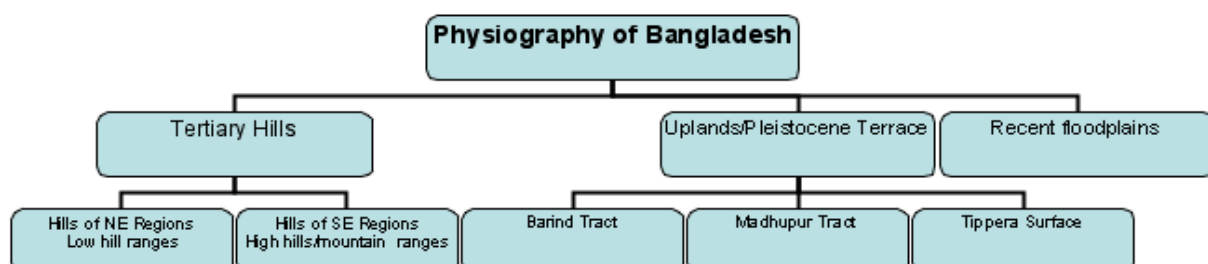
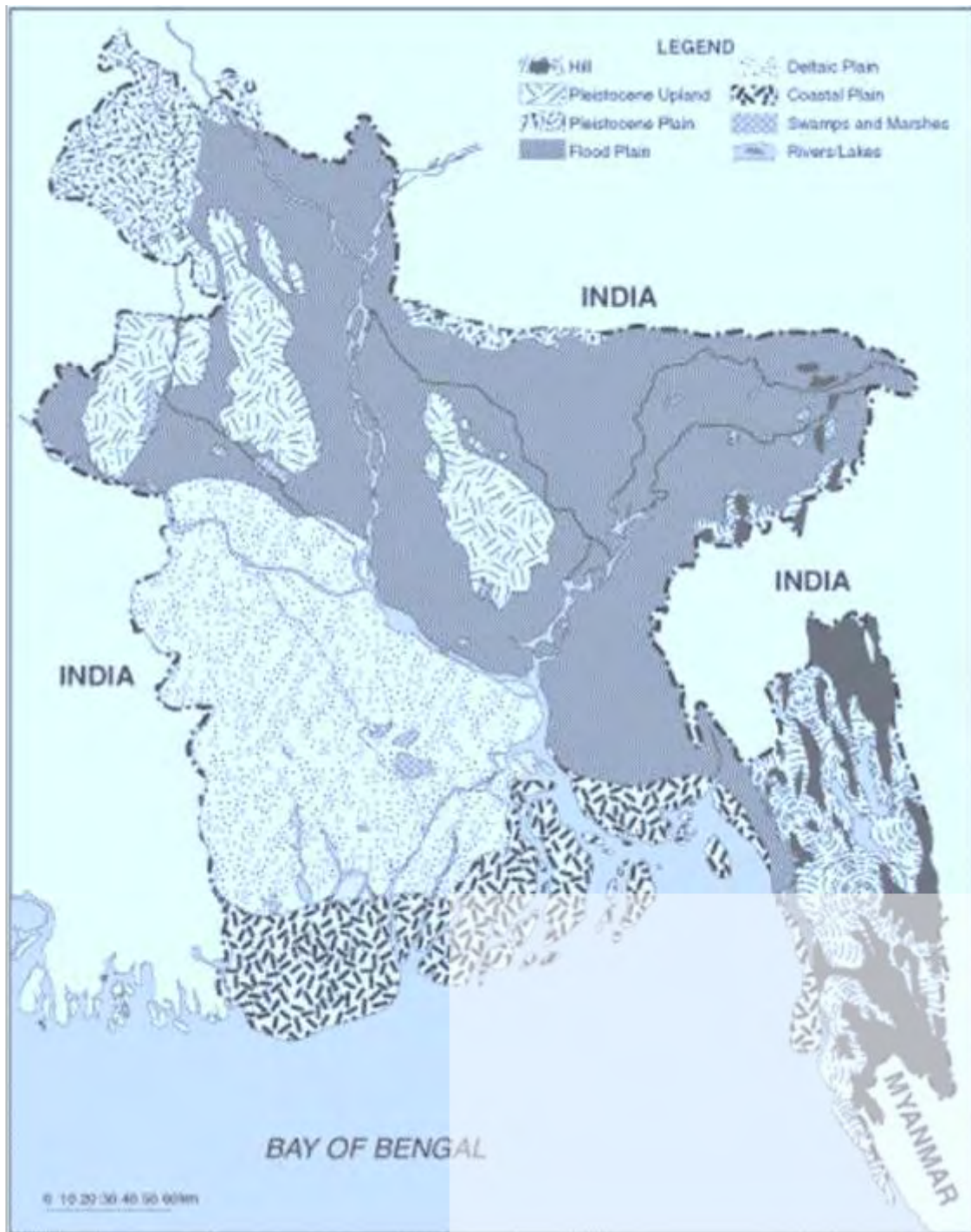


Figure 4.3: Physiographical feature of Bangladesh



Map 4.2: Physiographical Map of Bangladesh

4.4.1 Geology and Soils

Physiographically the project area occupied within Shitalakshya tidal floodplain and the East-Southern part of Dhaka of Bengal Fore deep. Soils are described in terms of general soil type. A general soil type is a group of soil, which is broadly similar in appearance and characteristics because they have been developed in response to similar environmental factors such as climate, physiography and drainage. In the study region the soil is general type 5b Non-calcareous Floodplain unit (seasonally saline). These are seasonal flooded soils, which have either dominantly dark grey pressure faces and calcareous within 125 cm from surface.

The soil of study area in many cases is moderately acidic to neutral with some areas with moderately alkaline. . The soil category are shown in the following figure 4.4

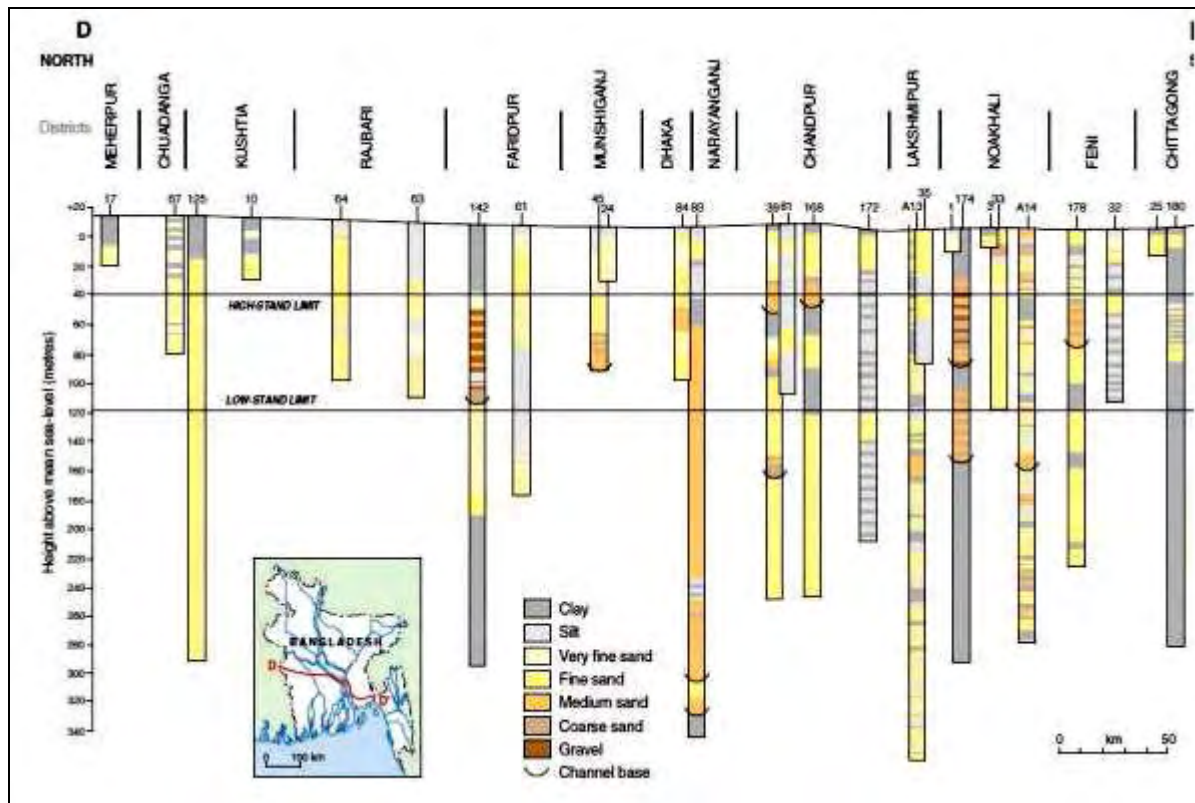


Figure 4.4: Geological Cross-section

Figure 4.4 shows the geological cross section from the extreme North i.e. Meherpur to extreme south Chittagong of the country. For Naryangang. The top layer is clay followed by fine sand. This is followed subsequently by medium sand and a layer of clay. This is followed by a layers of fine sand and clay. The last layer is fine sand. This information is useful for the civil construction of the plant as it will involve insitu piling.

4.4.2 Major Land Use Categories

Major land use categories as identified during the survey are depicted in the table below (Table 4.16):

Table 4.1: Present Land use Pattern in the project site

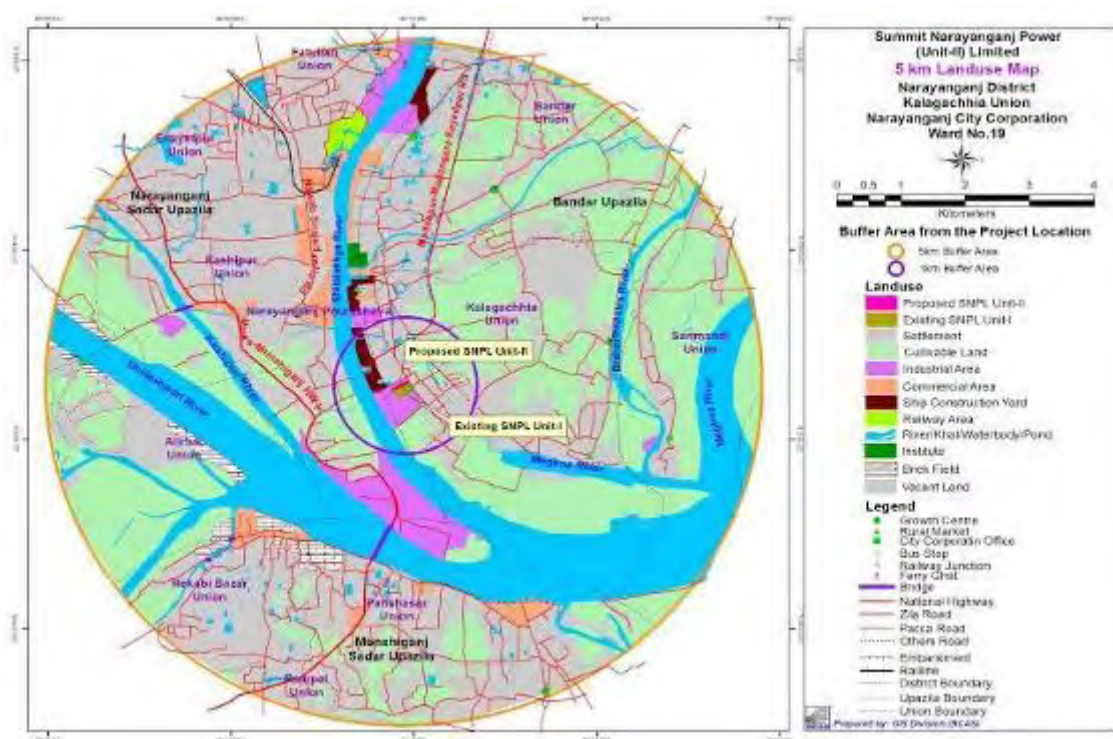
Landuse Pattern	Number	% of Total
Agricultural lands	-	24.25
Settlement area and commercial Area	-	34.35
River Sitalakha, khal and water bodies	-	15.11
Others	-	26.4

4.4.3 Agricultural Lands

The project area has agricultural cultivable land (24.25%, Table 4.1). The largest percentage of land use within 1km of the radius of the power plant is for settlements. There are two main crops grown in a year depending on the water availability. Irrigation water is taken from the Sitalakha River, surface water and nearby water bodies. Paddy (aus, aman and boro rice), potato and vegetables are the main crops. A small amount belongs to fallow land in the surveyed area which is left unutilized. There is no mineral or forest coverage reserve in the close vicinity of plant site.

4.4.4 Settlement Area

Within 1 km radius from the plant Katpatti and Islampur cluster of settlements is in the North side. On the east side PM Road and Pikker More, Naya Para and on the south side MM Ghoshal Road Lakkar Char are located. For socio-economic baseline study the household surveys were carried out in these areas. Detail landuse types are showing in the following Map 4.3



Map 4.3: Land use map of SNPL UNIT II Unit II

4.5 Biological Environment

4.5.1 Introduction

Narayanganj is a city in central Bangladesh situated near the capital city Dhaka. The city mainly covers with home state forest areas, marshy lands, agricultural crop lands and vegetation. Wetland includes ponds, ditches, and small canal connect to the Shitalakkha River. The areas support a diverse animal group and hold a balanced ecosystem.

The Summit Narayanganj Power Ltd.(SNPL UNIT II) project is a power plant at Madanganj, Narayanganj near Shitalakkha and Dhaleswary River established for partial fulfilment of the power crisis in Bangladesh. While establishing this project a lot of interventions were carried out there. These might have impacted on the terrestrial and aquatic biodiversity within the impact zone of SNPL UNIT II project. In view of this, this study assesses the terrestrial and aquatic flora and fauna within the impact zone of SNPL UNIT II project. The section below outlines the scope of work or core components of this study.

4.5.2 Scope of work

The scope of work of this study includes:

- a) Identify the terrestrial plants within 5km radius of the project the impact zone of SNPL UNIT II project.
- b) Identify the terrestrial fauna (vertebrate) within the impact zone of SNPL UNIT II project.
- c) Identify the aquatic macro fauna/fish species within the impact zone of SNPL UNIT II project.

4.5.3 Methodology

To identify the biodiversity, data were collected from the impact zone of SNPL UNIT II project during March 2016 as outlined below through physical observation and and crying out FGD and KIIs with the loca; people:

4.6 Collection of Terrestrial Plants Data

Plant species were recorded surrounding 5 km of power plant area. At first, the areas were visited to monitor and plant species were recorded. Then one focus group discussion (FGD) and two key informant interviews were carried out with the local people to prepare a checklist of the plantspecies available in that area. The participants were also asked to express their observations about changes of plant diversity in last one year by showing the images of plant found nearby power plant area. Sample specimens that remained unidentified from those locations were collected and later identified in the laboratory of the Department of Botany, University of Dhakausing the book Ahmed et al. (2007).

4.7 Collection of Terrestrial Fauna Data

Four vertebrate classes (mammals, birds, reptiles and amphibians) were surveyed as this group of animals presumably important and indicator species of a balanced ecosystem. To conduct the biodiversity survey, the researcher team carried out an ecological survey in the core and surrounding areas (upto 5 km) of the power plant site. The sampling was made in a realistic manner to achieve the objectives of this study. Within the impact zone a broad range of terrestrial habitats were identified where wildlife species distributed in a dynamic way with having diversity, abundance and the status of animal species/animal groups supported by those micro and macro-habitats.

Survey of amphibians, reptiles, mammals and birds in the SNPL UNIT II areas and adjacent areas carried out through conducting field survey by employing different survey methods such as transact line sampling, point sampling, time sampling methods, opportunistic survey

and zigzag survey, and oneFGD. Data were collected based on the direct observation in the field. However, where the animal were not immediately available or difficult to locate or trace, observations were made on foot print, pug marks, trailing, tracks, burrows, nests, animal holes, caves on the trees or fruits made by animal, etc. Besides, local people were discussed (during FGD) to ascertain the existence and to assess the status/abundance of amphibians, snakes, monitor lizards, mongooses, jackals, foxes, bats, dolphins, birds etc.

Standard taxonomy books, field notebooks, field manuals and taxonomic sheets used for identification of species. The species, which were not possible to identify in the field, brought to laboratory of the Department of Zoology, University of Dhaka for proper labelling for its subsequent identification.

4.8 Collection of fish data

Fish species was identified and changes in their biodiversity were investigated using key 2informant interviews and 1FGD. Key informant interviews were conducted with respondents from both aquatic habitat dependent people and outside people who have good knowledge about the biodiversity in those habitats. FGD (4-8 people) was conducted with the habitat depended people to discuss any disputed issue that might have arisen from interviews as well as to triangulate the findings. The fish species were identified using the book of Rahman (2005) and the latest scientific names were updated according to ITIS (2016). Only the species caught from the impact zone of SNPL UNIT II were taken into account.

4.9 Results

4.9.1 Terrestrial Flora

The plant species recorded from the impact zone (5 km radius) of the SNPL UNIT II along with their IUCN status are given in Table 4.2.

Table 4.2: List of plant species recorded from the impact zone of the SNPL UNIT II, Narayanganj.

No.	Common Name	Bangla Name	Scientific Name	Type	IUCN Status*
1	Jack Fruit	Katal	<i>Artocarpus heterophyllus</i>	Tree	LC
2	Laddies Finger/Okra	Verendi/Dheros	<i>Abelmoschus esculentus</i>	Shrub	LC
3	Silk Trees	Koroi	<i>Albizia richardiana</i>	Tree	LC
4	Wood Apple	Bhel	<i>Aegle marmelos</i>	Tree	LC
5	Bailly Great Weed	Ochunti	<i>Ageratum conyzoides</i>	Herb	LC
6	Gaint Taro	Makachu	<i>Alocasia macrorrhizos</i>	Herb	LC
7	Custard Apple	Sharifa	<i>Annona squamosa</i>	Tree	LC
8	Red Amaranth	Lal Shak	<i>Amaranthus gengeticus</i>	Herb	LC
9	Green Amaranth	Data Shak	<i>Amaranthus viridis</i>	Herb	LC
10	Penut	Badam	<i>Arachis hypogaea</i>	Herb	LC
11	Betel Palm	Supari	<i>Areca catechu</i>	Tree	LC
12	Monkey Fruit	Deaua	<i>Artocarpus lacucha</i>	Tree	LC
13	Star fruit	Kamranga	<i>Averrhoa carambola</i>	Tree	LC
14	Margosa/Neem Tree	Neem Tree	<i>Azadirachta indica</i>	Tree	LC
15	Indian Timber Bamboo	Bash	<i>Bambusa tulda</i>	Shrub	LC
16	Spinach	Pui Shak	<i>Basella alba</i>	Herb	LC
17	Ash Gourd/White Gourd/Winter Gourd	Chal Kumra	<i>Benincasa hispida</i>	Herb	LC
18	Sugar Palm	Tal	<i>Borassus flabellifer</i>	Tree	LC
19	Paper Flower	Kagoj Phool	<i>Bougainvillea peruviana</i>	Shrub	LC

No.	Common Name	Bangla Name	Scientific Name	Type	IUCN Status*
20	Soap Bush	Ghash	<i>Calibanus hookeri</i>	Herb	LC
21	Chili Peppers	Morich	<i>Capsicum annum</i>	Shrub	LC
22	Pepper	Morich	<i>Capsicum frutescens</i>	Shrub	LC
23	Papaya	Pepe	<i>Carica papaya</i>	Tree	LC
24	Lemon	Lebu	<i>Citrus aurantifolia</i>	Shrub	LC
25	Pomelo	Jambura	<i>Citrus grandis</i>	Tree	LC
26	Coconut Tree	Narikel	<i>Cocos nucifera</i>	Tree	LC
27	Garden Croton	Pata Bahar	<i>Codiaeum variegatum</i>	Shrub	LC
28	Common Coleus	Pata Bahar	<i>Coleus Scutellarioides</i>	Herb	LC
29	Taro	Kochu	<i>Colocasia esculenta</i> White	Herb	LC
30	Jute	Deshi Pat	<i>Corchorus capsularis</i>	Shrub	LC
31	Coriander	Dhonia	<i>Coriandrum sativum</i>	Herb	LC
32	Pumpkin	Misti Kumra	<i>Cucurbita maxima</i>	Herb	LC
33	Nabhali	Ghash	<i>Cyanotis cristata</i>	Herb	LC
34	Bermuda Grass	Dürvā Grass	<i>Cynodon dactylon</i>	Herb	LC
35	Flat-Sedge	Chanch	<i>Cyperus compressus</i>	Herb	LC
36	Elephant Apple	Chalta	<i>Dellenia indica</i>	Tree	LC
37	Royal Poinciana/Flamboyant	Krisnochura	<i>Delonix regia</i>	Tree	LC
38	Malabar Ebony/Pale Moon Ebony	Gaub	<i>Diospyros perigrina</i>	Tree	LC
39	Edible Fern	Dhekia Shak	<i>Diplazium esculentum</i>	Herb	LC
40	Water Hyacinth	Kochuripana	<i>Eichhornia crassipes</i>	Herb	LC
41	Cylon Olive/Indian Olive	Jalpai	<i>Elaeocarpus robustus</i>	Tree	LC
42	Chinese Water Chestnut	Pānaphala	<i>Eleocharis dulcis</i>	Herb	LC
43	Gum Trees	Eucalyptus	<i>Eucalyptus camaldulensis</i>	Tree	NE
44	Bean	Sheem	<i>Lablab purpureus</i>	Herb	LC
45	Bottle Gurd	Lau	<i>Lagenaria siceraria</i>	Herb	LC
46	Wood Apple/Elephant Apple	Bael	<i>Limonia acidissima</i>	Tree	LC
47	Tomato	Tomato	<i>Lycopersicon esculentum</i>	Herb	LC
48	Indian Banyan	Baut	<i>Ficus bengalensis</i>	Tree	LC
49	Hairy Fig/Devil Fig	Kakdumur/Dumur	<i>Ficus hispida</i>	Tree	LC
50	Pipal/Bo-Tree/Peepul Tree	Ashwath/Pipul	<i>Ficus religiosa</i>	Tree	LC
51	Jasmine	Gandharaj	<i>Gardenia jasminoides</i>	Shrub	LC
52	Indian Heliotrope	Hatisur	<i>Heliotropium indicum</i>	Herb	LC
53	China Rose	Joba	<i>Hibiscus rosa-sinensis</i>	Shrub	LC
54	False Rubber Tree	Kurchi	<i>Holarrhena floribunda</i>	Tree	LC
55	Water Spinach	Kolmishak	<i>Ipomoea aquatica</i>	Herb	LC
56	Sweet Potato	Misti Alu	<i>Ipomoea batatas</i>	Herb	LC
57	Pink Morning Glory	Dhol Kolmi	<i>Ipomoea fistulosa</i>	Herb	LC
58	West Indian Jasmine	Rangan	<i>Ixora chinensis</i>	Shrub	CD
59	Arabian Jasmine	Beli	<i>Jasminum duplex</i>	Shrub	LC
60	Green Kayllinga	Ghash	<i>Kayllinga brevifolia</i>	Herb	LC
61	Henna Tree	Mehedi	<i>Lawsonia inermis</i>	Shrub	LC
62	Honeyweed/Siberian Motherwort	Roktodron	<i>Leonurus sibiricus</i>	Herb	LC
63	Litchi/Liechee	Litchu	<i>Litchi chinensis</i>	Tree	LC
64	Mango Tree	Aam	<i>Mangifera indica</i>	Tree	LC
65	Sapodilla/Chiku	Sofeda	<i>Manilkara achras</i>	Tree	LC

No.	Common Name	Bangla Name	Scientific Name	Type	IUCN Status*
66	Lacy Fern	Fita Dhekia	<i>Microlepia spelunce</i>	Herb	LC
67	Spanish Cherry/ Medlar/ Bullet Wood	Bokul	<i>Mimusops elengi</i>	Tree	LC
68	Bitter Melon/Bitter Gourd/ Bitter Squash	Karolla/Uchhe Usta	<i>Momordica charantia,</i>	Herb	LC
69	Flowering Banana/Ornamental Banana	Kala	<i>Musa ornata</i>	Tree	LC
70	Banana Plan	Kancha Kala	<i>Musa paradisiaca</i>	Tree	LC
71	Banana Plant	Kala	<i>Musa sepientum</i>	Tree	LC
72	Holy Basil	Tulshi	<i>Ocimum sanctum</i>	Shrub	LC
73	Paddy	Dhan	<i>Oryza sativa</i>	Herb	LC
74	Creeping Woodsorrel/ Sleeping Beauty	Amrul	<i>Oxalis corniculata</i>	Herb	LC
75	Skunkvine/Chinese Fever Vine	Gandhabhaduli/Ga ndhal	<i>Paederia foetida</i>	Herb	LC
76	Pepperwort	Panimarich	<i>Persicaria hydropiper</i>	Herb	LC
77	Silver Date Palm/Sugar Date Palm	Khajur/Khejur	<i>Phoenix sylvestris</i>	Tree	LC
78	Betel	Pan	<i>Piper betle</i>	Herb	LC
79	Knotweed/Tearthumb/Sma rtweed	Biskatali/Panimari ch	<i>Ploygonum tomentosum</i>	Herb	LC
80	Reed	Nol-khagra	<i>Phragmites australis</i>	Herb	LC
81	Guava/Lemon Guava	Payra	<i>Psidium guajava</i>	Tree	LC
82	Chinese Brake/Chinese Ladder Brake	Dhekia Shak	<i>Pteris vittata</i>	Herb	LC
83	Low Flat-Sedge	Ghash	<i>Pycnus pumilus</i>	Herb	LC
84	Cursed Buttercup/Celery-Leaved Buttercup	Palik/Podika/ Kandir	<i>Ranunculus scleratus</i>	Herb	LC
85	Rose	Golap	<i>Rosa centrifolia</i>	Shrub	LC
86	Rain Tree	Rain Tree	<i>Samanea saman</i>	Tree	LC
87	Sugarcane	Aakh	<i>Saccharaum officinarum</i>	Herb	CD
88	Bur Tree/Canary Wood	Kodom	<i>Sarcocephalus cordatus</i>	Tree	LC
89	Eggplant	Begun	<i>Solanum menlongena</i>	Shrub	LC
90	Potato	Alu	<i>Solanum tuberosum</i>	Herb	LC
91	West Indian Mahogany	Mahogany	<i>Swietenia mahagoni</i>	Tree	LC
92	Chivit/Civit	Civit	<i>Swintonia floribunda</i>	Tree	LC
93	Black Plum	Jam	<i>Syzygium cumini</i>	Tree	LC
94	Java Apple/Wax Jambu	Jamrul	<i>Syzygium samarangense</i>	Tree	NE
95	Peacock Feathers	Thuja	<i>Thuja orientalis</i>	Shrub	LC
96	Bengal Arum	Ghet Kachu	<i>Typhonium trilobatum</i>	Herb	LC
97	Madagascar Periwinkle/ Rosy Periwinkle	Noyon Tara	<i>Vinca rosea</i>	Shrub	LC
98	Rough Cocklebur/ Common Cocklebur	Ghagra/Lehra/Bich aphal	<i>Xanthium indicum</i>	Shrub	LC
99	Corn	Bhutta	<i>Zea mays</i>	Herb	CD
100	Chinese Date/ Chineese Apple/Indian Jujube	Boroi/Kul	<i>Zizyphus mauritiana</i>	Tree	LC

*LC = Least Concern, NE= Not Evaluated, CD= Conservation Dependent according to IUCN Bangladesh (2000).

4.9.2 Terrestrial Fauna

There are 42 species of amphibian species, 157 reptilian species, 124 species of mammals and 718 birds species reported from Bangladesh (Khan 2010, Sarker and Sarker 1988). However, in the current study, a total of 9 Amphibians, 17 reptiles, 12 mammals and 43 birds were identified in the impact or project areas.

A total of 9 amphibian species were identified in the present project area (Table 4.2). On the basis of frequency of occurrence or relative abundance Common Toad, Skipper Frog and Indian Bull Frog were commonly (44.45%) found. Furthermore, Green Frog, Pierries Cricket Frog and Ornate Narrow-mouthed Frog were less common (33.33%). On the other hand, Common Tree Frog was rare (22.22%) anuran species in the study area. Species found on the impact areas were Least Concern (LC) on the basis of IUCN-Bangladesh (2000) threatened category. Although Cricket frogs have not been evaluated yet but the species of cricket frog found in the impact areas were not subject to any threats.

Table 4.3: List of Amphibian species identified in the impact zone of the SNPL UNIT II, Narayanganj.

No	Order	Family	Species	English Name	Local Name	IUCN Status*
1	Anura	Bufonidae	<i>Duttaphrynus melanostictus</i>	Common Toad	Kuno Bang	LC
2		Dicroglossidae	<i>Euphlyctis cyanophylctis</i>	Skipper Frog	Kotkoti Bang	LC
3			<i>Euphlyctis hexadactylus</i>	Green Frog	Sabuj Bang	EN
4			<i>Fejervarya syhadrensis</i>	Syhadris Cricket Frog	Syhadrir Jhijhi Bang	LC
5			<i>Fejervarya teraiensis</i>	Terrei Cricket Frog	Terrei Jhijhi Bang	NE
6			<i>Fejervarya pierrei</i>	Pierries Cricket Frog	Pierrei's Jhijhi Bang	NE
7			<i>Hoplobatrachus tigerinus</i>	Indian Bull Frog	Sona Bang	NE
8		Microhylidae	<i>Microhyla ornata</i>	Ornate Narrow-mouthed Frog	China Bang	LC
9		Rhacophoridae	<i>Polypedates leucomystax</i>	Asian Brown Tree Frog	Gecho Bang	LC

*LC = Least Concern, NE= Not Evaluated, CD= Conservation Dependent according to IUCN Bangladesh (2000).

A total of 17 reptiles species were identified in the present study area (Table 4.4). On the basis of frequency of occurrence or relative abundance Common Garden Lizard, Common skink, Common House Lizard, Yellow-bellied House Gecko and Checkered Keelback water snake were found as common(29.41%). Indian Roofed Turtle, Common House Lizard, Common Smooth Water Snake, Common Wolf Snake, Indian Rat Snake/Western Rat Snake and Spectacled Cobra were less common (35.29%) in this area. Rare species (35.29%) were Tokay Gecko, Oriental Leaf- Toed Gecko, Vine Snake, Monocellate Cobra, Striped Keelback and Common Indian Krait. On the other hand according to IUCN-Bangladesh (2000) Red list of Threatened category Monocellate Cobra, Common Indian Krait species were Vulnerable and Common Smooth Water Snake was endangered.

Table 4.4. List of Reptilian species identified in the impact zone of the SNPL UNIT II, Narayanganj.

No	Order	Family	Species	English Name	Local Name	IUCN Status*
1	Testudines (Chelonia)	Bataguridae/ Geoemydidae	<i>Pangshura tecta</i>	Indian Roofed Turtle	Kori Kaitta	LC
2	Squamata	Agamidae	<i>Calotes versicolor</i>	Common Garden Lizard	Roktochusha	LC
3		Scincidae	<i>Mabuya carinata</i>	Common skink	Anjon/Anchil	LC
4		Gekkonidae	<i>Gekko gekko</i>	Tokay Gecko	Takkok	VU
5			<i>Hemidactylus brookii</i>	Oriental Leaf- Toed Gecko	Choto Tiktiki	LC
6			<i>Hemidactylus flaviviridis</i>	Yellow-bellied House Gecko	Goda Tiktiki	LC
7			<i>Hemidactylus frenatus</i>	Common House Lizard	Dakchara Tiktiki	LC
8		Varanidae	<i>Varanus bengalensis</i>	Bengal Monitor	Painna Shap	LC
9		Colubridae	<i>Ahaetulla nasuta</i>	Vine Snake	Sutanoli Shap	LC
10			<i>Amphiesma stolatum</i>	Striped Keelback	Dora-shap	LC
11			<i>Enhydryis enhydryis</i>	Common Smooth Water Snake	Paina-shap	EN
12			<i>Lycodon aulicus</i>	Common Wolf Snake	Shadaraon Gharginni Shap	VU
13			<i>Xenocrohis piscator</i>	Checkered Keelback Water Snake	Dhora Shap	LC
14			<i>Ptyas mucosus</i>	Indian Rat Snake/ Western Rat Snake	Daraj Shap	VU
15		Elapidae	<i>Naja kaouthia</i>	Monoclate Cobra	Gokhra Shap	VU
16			<i>Naja naja</i>	Spectacled Cobra	Khoia Gokhra Shap	VU
17			<i>Bungarus caeruleus</i>	Common Indian Krait	Kalkeotey	VU

*LC = Least Concern, NE= Not Evaluated, CD= Conservation Dependent according to IUCN Bangladesh (2000).

A total of 12 mammalian species were identified in the impact area (Table 4.5). On the basis of frequency of occurrence or relative abundance Indian Grey Mongoose and House Rat were commonly (16.67%) found in the study area. Golden Jackal, Bengal Fox, Jungle cat, Mole Rat, Greater Bandicoot Rat, Indian Flying Fox, Asian House Shrew and Ganges River Dolphin were less common (6.66%) in the study area. Five-Stripped Palm Squirrel and Rhesus Monkey were found as rare species (16.67%). On the other hand according to IUCN-Bangladesh (2000) Red list of Threatened category Jungle Cat categorized as endangered. According to the local people the Ganges River Dolphin is fairly common in the Shitalakkha River. The Rhesus Monkey is also a resident non-human primate of this area.

Table 4.5. List of Mammals identified in the impact zone of the SNPL UNIT II, Narayanganj

No	Order	Family	Species	English Name	Local Name	IUCN Status*
1	Carnivora	Canidae	<i>Canis aureus</i>	Golden Jackal	Pati Shial/Shial	VU
2			<i>Vulpes bengalensis</i>	Bengal Fox	Khek Shial	VU
3		Felidae	<i>Felis chaus</i>	Jungle cat	Ban Biral	EN

No	Order	Family	Species	English Name	Local Name	IUCN Status*
4		Herpestidae	<i>Herpestes edwardsi</i>	Indian Grey Mongoose	Beji	VU
5	Rodentia	Muridae	<i>Bendicota bengalensis</i>	Mole Rat	Indur	LC
6			<i>Bendicota indica</i>	Greater Bandicoot Rat	Dhari indur	LC
7			<i>Rattus rattus</i>	House Rat	Indur	LC
8		Sciuridae	<i>Funambulus pennanti</i>	Five-Stripped Palm Squirrel	Katbiral	LC
9	Chiroptera	Pteropodidae	<i>Pteropus giganteus</i>	Indian Flying Fox	Bara badur	LC
10	Soricomorpha	Soricidae	<i>Suncus murinus</i>	Asian House Shrew	Chika	LC
11	Primates	Cercopithecidae	<i>Macaca mulata</i>	Rhesus Monkey	Bandor	EN
12	Scandentia	Platanistidae	<i>Platanista gangetica</i>	Ganges River Dolphin	Shishu/ Shushuk	EN

*LC = Least Concern, NE= Not Evaluated, CD= Conservation Dependent according to IUCN Bangladesh (2000).

A total of 42 birds species were found in the project area (Table 4.6). On the basis of frequency of occurrence or relative abundance commonly (54.76%) found species were Red Junglefowl, Spotbill Duck, Burmes Hoopoe, Common Kingfisher, Asian Cuckoo, House swift, Rock Pigeon, Spotted Dove, Little Cormorant, Indian Pond Heron, House Crow, Grey Drongo, White-rumped Shama, Oriental Magpie, Asian Pied Starling/Myna, Jungle Myna, Bank Myna, Common Myna, Red-vented Bulbul, House sparrow etc. Bar-headed Duck, Greylag Goose, Black-rumped Flameback, Barn Owl, Crested Goshawk, Brahminy Kite, Great Cormorant, Little egret, Black-hooded Oriole and Purple-rumped Sunbird were less common species (26.19%) in the study area. Red headed Bay Woodpecker, Streak-throated Woodpecker, Blue-throated Barbet, Rose-ringed Parakeet, Common Buzzard, Hill Myna, Asian paradise flycatcher and Forest wagtail were found as rare species (19.05%). On the other hand according to IUCN-Bangladesh (2000) Red list of Threatened category most of the species found in the impact area were categorized as Least Concern.

Table 4.6. List of Birds identified in the impact zone of the SNPL UNIT II, Narayanganj.

No	Order	Family	Species	English Name	Local Name	IUCN Status*
1	Galliformes	Phasianidae	<i>Gallus gallus</i>	Red Junglefowl	Bon Morog/ Murgi	LC
2	Anseriformes	Anatidae	<i>Anas poecilorhyncha</i>	Spotbill Duck	Pati hans	LC
3			<i>Anas indicus</i>	Bar-headed Duck	Raj hans	NE
4			<i>Anas anser</i>	Greylag Goose	Raj hans	NE
5	Piciformes	Picidae	<i>Blythipicus pyrrhotis</i>	Red headed Bay Woodpecker	Lalmatha kathtokra	LC
6			<i>Chrysocolaptes guttacristatus</i>	Greater Flameback	Baro- kathtokra	LC
7			<i>Dinopium bengalensis</i>	Black-rumped Flameback	kathtokra	NE
8			<i>Picus xanthopygaeus</i>	Streak-throated Woodpecker	Dagi-gola Kathkuruli	LC
9		Megalaimidae	<i>Megalaima asiatica</i>	Blue-throated Barbet	Basanta Bauri	NE
10	Upupiformes	Upupidae	<i>Upupa epops</i>	Burmes Hoopoe	Hudhud Pakhi	LC
11	Coraciiformes	Alcedinidae	<i>Alcedo atthis</i>	Common Kingfisher	Sotto Machhranga	LC

No	Order	Family	Species	English Name	Local Name	IUCN Status*
12	Cuculiformes	Cuculidae	<i>Eudynamys scolopaceus</i>	Asian Cuckoo/Koel	Kokil	LC
13	Psittaciformes	Psittacidae	<i>Psittacula krameri</i>	Rose-ringed Parakeet	Tia	LC
14	Apodiformes	Apodidae	<i>Apus nipalensis</i>	House swift	Ababil	LC
15	Strigiformes	Tytonidae	<i>Tyoto alba</i>	Barn Owl	Laxmi Pencha	NE
16	Columbiformes	Columbidae	<i>Columba livia</i>	Rock Pigion	Jalali Kobutor	LC
17			<i>Stigmatopelia chinensis</i>	Spotted Dove	Tila Ghughu	LC
18	Falconiformes	Accipitridae	<i>Accipiter trivigathus</i>	Crested Goshawk	Baj	NE
19			<i>Buteo buteo</i>	Common Buzzard	Baj Pakhi	LC
20			<i>Haliaster indus</i>	Brahminy Kite	Shankho Cheel	NE
21	Podicipediformes	Phalacrocoracidae	<i>Microcarbo niger</i>	Little Cormorant	Paan-Kowri	LC
22			<i>Phalacrocorax carbo</i>	Great Cormorant	Brihat Paankowri	LC
23		Ardeidae	<i>Ardeola grayii</i>	Indian Pond Heron	Kani Bok	LC
24			<i>Egretta intermedia</i>	Little egret	Chhoto Bok	NE
25	Passeriformes	Corvidae	<i>Corvus leuallantii</i>	Jungle Crow	Daar Kak	LC
26			<i>Corvus splendens</i>	House Crow	Pati Kak	LC
27			<i>Oriolus xanthornus</i>	Black-hooded Oriole	Holdey Pakhi	LC
28			<i>Dicrurus macrocerus</i>	Grey Drongo	Fingey	LC
29		Muscicapidae	<i>Copsychus malabaricus</i>	White-rumped Shama	Shama	LC
30			<i>Copsychus saularis</i>	Oriental Magpie	Doel	LC
31		Sturnidae	<i>Sturnus contra</i>	Asian Pied Starling/Myna	Go Shalik	LC
32			<i>Sturna malabarica</i>	Chestnut-tailed Starling	Kath Shalik	LC
33			<i>Acridotheres fuscus</i>	Jungle Myna	Jhuti Shalik	LC
34			<i>Acridotheres grandis</i>	Bank Myna	Gang Shalik	LC
35			<i>Acridotheres tristis</i>	Common Myna	Bhat Shalik	LC
36			<i>Gracula religiosa</i>	Hill Myna	Moyna	LC
37		Pycnonotidae	<i>Pycnonotus cafer</i>	Red-vented Bulbul	Bangla Bulbuli	LC
38		Nectariniidae	<i>Leptocoma zeylonica</i>	Purple-rumped Sunbird	Moutushi	NE
39		Passeridae	<i>Passer domesticus</i>	House sparrow	Chorai	LC
40		Ploceidae	<i>Ploceus philippinus</i>	Baya Weaver	Babui	LC
41		Monarchidae	<i>Terpsiphone paradisi</i>	Asian paradise flycatcher	Asio-Shabulbuli	LC
42		Motacillidae	<i>Dendronanthus indicus</i>	Forest wagtail	Bon-Kanjon	LC

*LC = Least Concern, NE= Not Evaluated, CD= Conservation Dependent according to IUCN Bangladesh (2000).

4.9.3 Aquatic Fauna/Fish

The fish species recorded from the impact zone (5 km radius) of the SNPL UNIT II along with their IUCN status are given in Table 4.7.

Table 4.7: Fish species identified in the impact zone of the SNPL UNIT II, Narayanganj.

Scientific Name	English/Common Name	Local/Bangla Name	IUCN status*
1. <i>Hypophthalmichthys molitrix</i> (Valenciennes in Cuvier and Valenciennes, 1844)	Silver carp	Silver carp	-
2. <i>Hypophthalmichthys nobilis</i> (Richardson, 1845)	Bighead carp	Bighead carp	-
3. <i>Ctenopharyngodon idella</i> (Valenciennes in Cuvier and Valenciennes, 1844)	Grass carp	Grass carp	-
4. <i>Cyprinus carpio</i> (Linnaeus, 1758)	Common carp	Common carp	-
5. <i>Cyprinus carpio</i> var <i>specularis</i> (Lacepède, 1803)	Mirror carp	Mirror carp	-
6. <i>Oreochromis mossambicus</i> (Peters, 1852)	Mozambique mouth-breeder	Tilapia	-
7. <i>Pangasius hypophthalmus</i> (Sauvage, 1878)		Thai pangas	-
8. <i>Brachirus pan</i> (Hamilton, 1822)		Kathal pata, Pan oata	-
9. <i>Cynoglossus cynoglossus</i> (Hamilton, 1822)	Bengal tongue sole	Kukur jeeb	NO
10. <i>Cynoglossus lingua</i> (Hamilton, 1822)	Long tongue sole	Kukur jeeb	NO
11. <i>Monopterusuchia</i> (Hamilton, 1822)	Cuchia, Rice eel	Kuchia, Kuicha, Kunche	VU
12. <i>Tetraodon cutcutia</i> (Hamilton, 1822)	Ocellated puffer fish	Tepa, potka	NO
13. <i>Xenentodon cancila</i> (Hamilton, 1822)	Freshwater garfish, Silver needlefish	Kakila, Kaikka	NO
14. <i>Hyporhamphus limbatus</i> (Valenciennes in Cuvier and Valenciennes, 1847)	Congaturi halfbeak	Ek Thuita, Ek Thota	-
15. <i>Aplocheilichthys panchax</i> (Hamilton, 1822)	Blue Panchax	Techoukka, Kanpona	NO
16. <i>Aplocheilichthys panchax</i> (Hamilton, 1822)		Bechi, Kanpona	DD
17. <i>Channa striata</i> (Bloch, 1793)	Stripped snakehead	Shol	NO
18. <i>Channa marulius</i> (Hamilton, 1822)	Great snakehead	Gajar	EN
19. <i>Channa barca</i> (Hamilton, 1822)	Barca snakehead	Tila	CR
20. <i>Channa punctata</i> (Bloch, 1793)	Green snakehead	Taki, Lata, Lati, Okol, Chaitan	NO
21. <i>Channa orientalis</i> (Bloch and Schneider, 1801)	smooth-breasted snakefish, Walking snakehead	Gachua, Raga, Cheng	VU
22. <i>Securicula gora</i> (Hamilton, 1822)		Ghora chela	NO
23. <i>Esomus danricus</i> (Hamilton, 1822)	Flying barb	Dankina, Danrika, Darka, Dadhika	DD
24. <i>Rasbora rasbora</i> (Hamilton, 1822)	Darkina	Gangetic scissortail rasbora	EN
25. <i>Rasbora daniconius</i> (Hamilton, 1822)	Slender rasbora	Darkina	-
26. <i>Amblypharyngodon mola</i> (Hamilton, 1822)	Mola carplet	Mola, Molongi, Moya	NO
27. <i>Labeo gonius</i> (Hamilton, 1822)	Karia labeo	Ghainna, Goni, Kurchi	EN
28. <i>Labeo calbasu</i> (Hamilton, 1822)	Orange fin labeo	Kalibaus, Baus, Kalia	EN
29. <i>Labeo rohita</i> (Hamilton, 1822)		Rui, Rou	NO
30. <i>Cirrhinus cirrhosus</i> (Bloch, 1795)	Mrigal	Mrigal, Mirka	NO
31. <i>Cirrhinus reba</i> (Hamilton, 1822)		Bhagna, Raik, Tatkini,	VU

Scientific Name	English/Common Name	Local/Bangla Name	IUCN status*
		Bata, Laacho	
32. <i>Puntius sarana</i> (Hamilton, 1822)	Olive barb	Sarpunti, Sarnaputi, Saralpunti	CR
33. <i>Puntius chola</i> (Hamilton, 1822)	Swamp barb	Chala punti	NO
34. <i>Puntius gunganio</i> (Hamilton, 1822)	Glass barb	Mola punti	NO
35. <i>Puntius conchoni</i> (Hamilton, 1822)	Rosy barb	Kanchan punti, Taka punti	NO
36. <i>Puntius ticto</i> (Hamilton, 1822)	Two-spot barb	Tit punti	VU
37. <i>Puntius sophore</i> (Hamilton, 1822)	Pool barb	Punti, Jat punti, Vasipunti	NO
38. <i>Gibelion catla</i> (Hamilton, 1822)	Catla	Catla, Katal	NO
39. <i>Acanthocobitis botia</i> (Hamilton, 1822)	Mottled loach	Bilturi, Natwa, Balichata	-
40. <i>Somileptes gongota</i> (Hamilton, 1822)	Gongota loach	Poia, Pahari gutum	NO
41. <i>Botia dario</i> (Hamilton, 1822)	Bengal loach	Rani	EN
42. <i>Lepidocephalus guntea</i> (Hamilton, 1822)	Guntea loach	Gutum	NO
43. <i>Lepidocephalus annandalei</i> (Chaudhuri, 1912)	Annandale loach	Gutum	NO
44. <i>Clarias batrachus</i> (Linnaeus, 1758)	Walking catfish	Magur	NO
45. <i>Wallago attu</i> (Bloch and Schneider, 1801)	Freshwater shark	Boal	NO
46. <i>Ompok bimaculatus</i> (Bloch, 1794)	Butter catfish	Kani pabda, Boali pabda, Puhta, Pahta	EN
47. <i>Heteropneustes fossilis</i> (Bloch, 1794)	Stinging catfish	Shingi, Shing	NO
48. <i>Chaca chaca</i> (Hamilton, 1822)	Squarehead catfish	Cheka, Gangainna	EN
49. <i>Pangasius pangasius</i> (Hamilton, 1822)	Yellow tail catfish	Pangas	CR
50. <i>Ailia coila</i> (Hamilton, 1822)	Gangetic ailia	Kajuli, Baspata	NO
51. <i>Pseudeutropius atherinoides</i> (Bloch, 1794)	Indian potasi	Batasi	NO
52. <i>Rita rita</i> (Hamilton, 1822)	Rita	Rita	CR
53. <i>Sperata aor</i> (Hamilton, 1822)	Long whiskered catfish	Ayre	VU
54. <i>Mystus cavasius</i> (Hamilton, 1822)	Gangetic mystus	Kabashi-tengra, Golsha-tengra, golsha	VU
55. <i>Mystus tengra</i> (Hamilton, 1822)		Bajari-tengra, Ghuita-tengra	NO
56. <i>Mystus gulio</i> (Hamilton, 1822)	Long whiskers catfish	Nuna-tengra	DD
57. <i>Gangra viridescens</i> (Hamilton, 1822)		Gang tengra	-
58. <i>Bagarius bagarius</i> (Hamilton, 1822)	Dwarf goonch	Baghair	CR
59. <i>Hara hara</i> (Hamilton, 1822)		Kutakanti	NO
60. <i>Chitala chitala</i> (Hamilton, 1822)	Featherback, Clown knife fish	Chital	EN
61. <i>Notopterus notopterus</i> (Pallas, 1769)	Asiatic knifefish, Bronze feather back	Foli	VU
62. <i>Gudusia chapra</i> (Hamilton, 1822)	India river shad	Chapila	NO
63. <i>Corica soborna</i> (Hamilton, 1822)	Ganges river sprat	Kachki	NO
64. <i>Macrognathus aculeatus</i> (Bloch, 1786)	Elephant trunk fish. Lesser spiny eel	Tara baim	VU
65. <i>Mastacembelus armatus</i> (Lacepède, 1800)	Zig-zag eel, Spiny eel	Baim, Bam, Sal baim	EN
66. <i>Macrognathus pancalus</i> (Hamilton, 1822)	Indian mastacembelid	Guchi, Baim, Pankal,	NO

Scientific Name	English/Common Name	Local/Bangla Name	IUCN status*
1822)	eel	turi, Chirka	
67. <i>Rhinomugil corsula</i> (Hamilton, 1822)	Corsula	Khorsula, Bata, Khalla, Arwari, Halla, Hira, Khor, Urul	NO
68. <i>Colisa fasciata</i> (Bloch and Schneider, 1801)	Banded gourami	Khailsha, Khaila, Cheli, Chopra, Khoksa	NO
69. <i>Colisa lalia</i> (Hamilton, 1822)	Doarf gourami	Lal Khailsha, Boicha, Ranga Khailsha	NO
70. <i>Anabas testudineus</i> (Bloch, 1792)	Climbing perch	Koi	NO
71. <i>Pseudapocryptes elongates</i> (Cuvier, 1816)		Chewa, Chiring	-
72. <i>Apocryptes bato</i> (Hamilton, 1822)		Chiring	NO
73. <i>Glossogobius giuris</i> (Hamilton, 1822)	Tank goby	Bele, Bailla	NO
74. <i>Odontamblyopus rubicundus</i> (Hamilton, 1822)		Lal chewa	NO
75. <i>Nandus nandus</i> (Hamilton, 1822)		Meni, Bheda	VU
76. <i>Chanda nama</i> (Hamilton, 1822)		Chanda, Nama chanda	VU
77. <i>Pseudambassis ranga</i> (Hamilton, 1822)	Indian glass fish	Chanda, Ranga-chanda, Lal chanda	VU

*Status DD=data deficient, CR=critically endangered, EN= endangered, VU= vulnerable and NO=not threatened are based on IUCN Bangladesh, 2000.

4.10 Meteorological Condition

Climate

The climate of this region is tropical, with monsoons, characterized by a change of four seasons: pre-monsoon (March to May), monsoon (June to September), post-monsoon (October to November) and dry season (December to February). Typical parameters of the weather elements, as recorded for the period of last few years of observations (2003-2012) at Dhaka Meteorological Station are presented in Table 4.8 to 5.12 below.

Rainfall

The annual rainfall is about 2000mm and approximately 80% of it occurs during the monsoon. Average monthly rainfall during monsoon period varies between 300mm to 450mm. Maximum daily rainfalls during this period recorded in September 2007 is 668 mm. The rainfall follows the general climate pattern with the highest rainfall in the summer month of June to September and minimum rainfall in the cooler and drier months of November to March. Table 4.8 presents average monthly rainfall for the period of last 67 years (1953-2009), average number of rainy days per month and average number of days per month when rainfall is greater than 10 mm. It is evident that extreme rainfall events occurred during the monsoon (June-September). Average monthly rainfall values for Dhaka area since 2006 are presented in Table-4.8. Long term rainfall data is essential for designing the drainage system within the plant and additionally provide data for land filling requirements for being above maximum flood level in the area.

Table 4.8 Monthly Average Rainfall in the project area (2014- 2005)

Year	Rainfall in mm (Month)											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep	Oct.	Nov	Dec.
2014	4	3	29	289	143	180	227	309	201	143	2	1
2013	2	1	32	245	198	225	267	322	198	132	3	0
2012	10	1	37	269	137	175	226	389	189	122	4	1
2011	0	0	20	123	235	314	356	409	207	112	0	0
2010	0	48	22	37	177	308	167	340	169	174	0	81
2009	1	1	43	14	168	170	676	482	298	74	4	0
2008	23	56	45	91	205	577	563	319	279	227	0	0
2007	0	30	11	163	185	668	753	505	179	320	111	0
2006	0	0	0	181	185	326	331	167	663	61	5	0
2005	1	3	155	91	291	259	542	361	514	417	3	0

Relative Humidity

As would be expected, relative humidity during the wet season is significantly higher than those occurring at other period of the year. This is well depicted by the data as shown in the Table - 4.9 for relative humidity of Dhaka during the period 2014-2005

Table 4.9: Average Monthly Relative Humidity of the Project Area in last 6 years

Humidity in %	Monthly Mean Humidity												
	Jan.	Feb.	Mar	Apr.	Ma y	Jun	Jul	Au g	Sep	Oct	Nov	Dec	Annua l
2014	65	65	56	63	75	80	79	83	76	71	63	71	71
2013	73	54	61	71	74	79	80	82	78	73	68	69	70
2012	66	52	57	69	74	78	77	81	79	75	71	66	67
2011	69	54	57	64	76	80	79	82	77	73	67	73	70
2010	71	56	59	67	71	79	77	78	79	74	68	66	70
2009	72	55	53	66	72	74	80	82	81	73	66	69	70
2008	69	61	67	64	70	80	83	81	81	77	69	79	73
2007	68	68	54	69	70	81	84	80	80	78	77	78	73
2006	73	55	57	68	70	76	74	76	74	72	65	67	70
2005	70	57	54	62	71	72	78	81	82	71	63	66	71

Source: BMD

Temperature

The annual average temperature of this district varies from maximum 33.5°C to minimum 10.5°C

Wind Speed and Direction

The maximum wind speed varies from 86 and 98 knots (Meteorological Department). The prevailing wind direction is south and south-east in most part of the year. The following Table shows the round year wind speed and its directions.

Year	Month	wind Speed (Knots)	Wind Direction
2014	Jan	2.4	West
	Feb	3.0	West
	March	2.5	South
	April	2.6	South
	May	2.5	South
	June	3.0	South
	July	2.3	South-East
	Aug	2.5	South-East
	Sep	2.2	South-East
	Oct	2.1	North- West
	Nov	2.2	West
	Dec	2.3	South-East

Year	Month	wind Speed (Knots)	Wind Direction
2013	Jan	3.3	West
	Feb	4.1	West
	March	4.0	West
	April	4.1	South
	May	3.8	South
	June	3.1	South
	July	4.3	South-East
	Aug	2.8	South
	Sep	4.2	South-East
	Oct	2.3	East
	Nov	2.8	North
	Dec	2.4	North-West

Year	Month	wind Speed (Knots)	Wind Direction
2012	Jan	2.4	West
	Feb	3.0	West
	March	2.5	South
	April	2.6	South
	May	2.5	South
	June	3.0	South
	July	2.3	South-East
	Aug	2.5	South-East
	Sep	2.2	South-East
	Oct	2.1	North- West
	Nov	2.2	West
	Dec	2.3	South-East

Year	Month	wind Speed (Knots)	Wind Direction
2011	Jan	2.2	West
	Feb	2.4	West
	March	3.8	South
	April	2.4	South
	May	3.0	South
	June	2.7	South-East
	July	2.4	South-East
	Aug	2.4	South-East
	Sep	2.6	South-East
	Oct	2.0	North-West
	Nov	2.3	West
	Dec	2.1	North-West

Year	Month	wind Speed (Knots)	Wind Direction
2010	Jan	2.9	North - West
	Feb	3.3	West
	March	3.8	South
	April	4.1	South
	May	3.7	South
	June	3.0	South
	July	2.4	South
	Aug	2.2	South
	Sep	2.6	South-East
	Oct	2.0	North-East
	Nov	2.9	North
	Dec	2.4	North

Year	Month	wind Speed (Knots)	Wind Direction
2009	Jan	3.3	West
	Feb	4.1	West
	March	4.0	West
	April	4.1	South
	May	3.8	South
	June	3.1	South
	July	4.3	South-East
	Aug	2.8	South
	Sep	4.2	South-East
	Oct	2.3	East
	Nov	2.8	North
	Dec	2.4	North - West

Year	Month	wind Speed (Knots)	Wind Direction
2008	Jan	3.6	North
	Feb	3.2	North
	March	3.8	South
	April	3.4	South
	May	3.4	South
	June	3.3	South
	July	3.4	South
	Aug	2.8	South
	Sep	2.8	South
	Oct	2.6	North-East
	Nov	2.5	North-East
	Dec	3.3	West

Year	Month	wind Speed (Knots)	Wind Direction
2007	Jan	2.9	North
	Feb	3.1	North-West
	March	4.2	North
	April	3.8	South
	May	3.5	South
	June	3.1	South
	July	3.1	South
	Aug	3.1	South
	Sep	3.2	South
	Oct	4.1	North
	Nov	5.5	North-East
	Dec	2.9	North-West

Year	Month	wind Speed (Knots)	Wind Direction
2006	Jan	3.3	North
	Feb	3.1	North
	March	3.8	South
	April	3.4	South
	May	3.4	South
	June	3.3	South
	July	3.4	South
	Aug	2.7	South
	Sep	2.8	South
	Oct	2.6	North-East
	Nov	2.5	North-East
	Dec	3.1	West

Year	Month	wind Speed (Knots)	Wind Direction
2005	Jan	3.2	North
	Feb	3.1	North-West
	March	3.2	North
	April	3.5	South
	May	3.3	South
	June	3.2	South
	July	3.4	South
	Aug	3.2	South
	Sep	3.3	South
	Oct	4.3	North-East
	Nov	5.1	North-East
	Dec	3.1	North-West

Source: BMD

4.11 Wind roses for the proposed SNPL UNIT II project area

Wind rose gives very succinct but information-laden view of how wind speed and direction are typically distributed at a particular location. Presented in a circular format, the wind rose shows the frequency of winds blowing from particular directions. The length of each "spoke" around the circle is related to the frequency of time that the wind blows from a particular direction. Each concentric circle represents a different frequency, emanating from zero at the center to increasing frequencies at the outer circles. The wind roses shown here contain additional information, in that each spoke is broken down into discrete frequency categories that show the percentage of time that winds blow from a particular direction and at certain speed ranges. All wind roses shown here use 16 cardinal directions, such as north (N), NNE, NE, etc.

The wind roses for four different months are shown in the Figures 4.1 to Figure 4.2 for the months January, April, July and October.

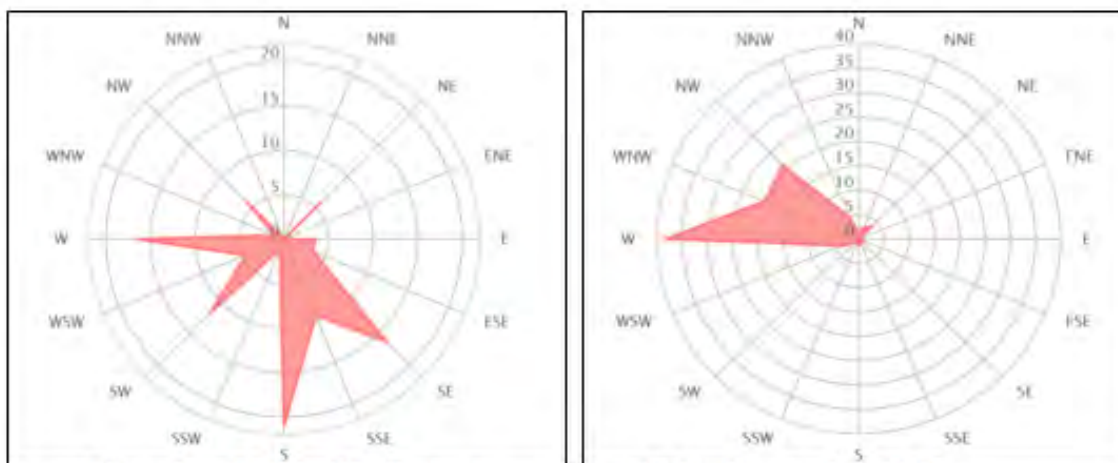


Figure 4.5: Wind rose from January to July

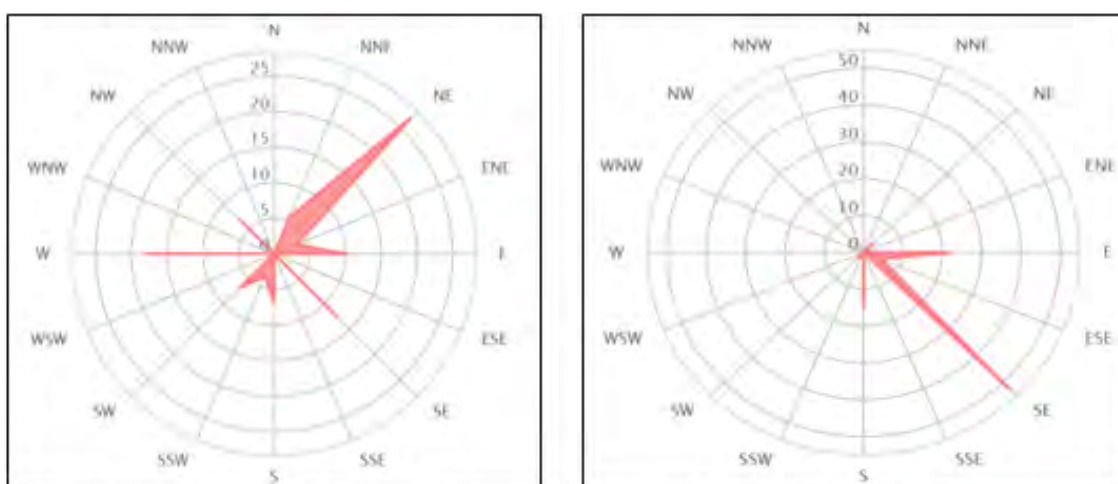


Figure 4.6: Windrose from July to December

The seasonal wind roses indicate shows that in Bangladesh the predominant wind direction are from North West in the winter months and from South West direction in the monsoon months. The prevalent wind directions will determine the AQM sampling locations. The wind roses indicate the prevalent wind direction in an area during the different seasons. During the preparation of the ESIA the wind roses determines the effective points where the air quality needs to be measured. This is primarily guided by the the most prevalent wind direction in the project area at the time of measurements. In addition, during environmental monitoring after commissioning of the project, depending on the time of the year when monitoring is done, wind rose indicating the prevalent direction of wind at the time where the air quality will be measured as the concentrations of the pollutants will be the highest in that direction. The wind speed and direction is important in assessing the stack height of the plant and the air dispersion model that needs to done to assess the concentrations of the emission pollutants with respect to distance from the plant.

4.11.1 Ambient Air Temperature

In the summer (April to September) the temperature of the country varies with the amount of rainfall During this period maximum temperature raise 39.6 degree Celsius which was observed in April 2009 where the average minimum temperature was 8.2 degree Celsius in

January 2011. Rainfall pattern in the project area likely to be more or less similar that of Dhaka. The ambient air temperature is essential for the engine design as the efficiency of the engine is dependent on the ambient temperature.

Table 4.10: Monthly Ambient Temperature of the Project Area in 2014, 2013 and 2012

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	13.4	25.3	15.32	Jan	25.3	32.1	15.32	Jan	22.4	24.5	14.1
Feb	19.4	31.2	23.4	Feb	23.4	31.2	19.4	Feb	24.45	29.1	18.3
March	21.9	33.2	23.23	March	23.23	33.2	21.9	March	24.55	32.2	22.4
April	23.8	33.7	19.32	April	19.32	33.7	23.8	April	26.43	34.4	24.1
May	24.9	33.7	26.34	May	26.34	33.7	24.9	May	24.44	33.2	24.2
June	26.1	32.3	26.43	June	26.43	32.3	26.1	June	25.43	33.4	26.8
July	26.6	32.3	23.33	July	23.33	32.3	26.6	July	23.45	31.4	25.8
Aug	26.5	32.5	32.43	Aug	32.43	32.5	26.5	Aug	24.33	32	26.6
Sep	25.8	31.9	26.43	Sep	26.43	31.9	25.8	Sep	25.40	32.7	26
Oct	24.6	32.2	24.30	Oct	24.30	32.2	24.6	Oct	23.45	30.5	24.3
Nov	19.9	29.6	23.44	Nov	23.44	29.6	19.9	Nov	18.12	29	19.8
Dec	15.8	26.8	523.44	Dec	523.44	26.8	15.8	Dec	19.55	27	15.6

Table 4.11: Monthly Ambient Table Temperature of the Project Area in 2011, 2010 and 2009

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	14.5	29.0	9.6	Jan	14.2	27.8	8.2	Jan	15.6	28.8	9.6
Feb	19.8	34.2	12.0	Feb	19.8	31.0	13.0	Feb	19.2	30.8	12.6
March	25.6	37.3	18.4	March	24.0	34.5	16.0	March	23.2	36.7	15.0
April	28.3	37.9	20.8	April	26.4	35.8	20.2	April	26.7	35.9	18.1
May	28.8	36.9	21.3	May	27.6	35.3	21.3	May	29.3	37.5	22.3
June	28.8	35.8	23.2	June	29.1	36.0	23.2	June	28.5	35.9	22.0
July	29.6	35.1	25.3	July	29.2	35.4	23.9	July	28.5	34.8	23.4
Aug	29.5	35.1	25.0	Aug	29.0	35	24.5	Aug	29.3	35.9	24.2
Sep	28.8	34.0	24.8	Sep	29.0	36.2	23.7	Sep	28.3	34.9	24.5
Oct	26.9	35.7	21.5	Oct	27.4	34.5	22.0	Oct	26.8	35.6	19.5
Nov	23.1	33.2	16.6	Nov	21.9	32.4	17.2	Nov	23.1	31.8	16.8
Dec	17.8	29.7	11.0	Dec	16.8	30.0	11.0	Dec	17.4	28.2	11.3

Table 4.12: Monthly Ambient Temperature of the Project Area in 2008, 2007 and 2006

Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)	Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	16.7	29.0	10.5	Jan	17.0	28.1	11.1	Jan	22.4	24.5	14.1
Feb	18.0	30.6	10.8	Feb	20.4	33.9	12.2	Feb	24.45	29.1	18.3
March	24.3	34.6	16.5	March	23.9	36.0	15.8	March	24.55	32.2	22.4
April	27.0	36.9	19.6	April	27.2	39.6	20.4	April	26.43	34.4	24.1
May	27.9	36.7	20.3	May	27.6	37.8	21.6	May	24.44	33.2	24.2
June	28.4	35.4	22.5	June	29.8	36.5	22.6	June	25.43	33.4	26.8
July	28.8	34.0	24.6	July	29.6	35.7	24.4	July	23.45	31.4	25.8
Aug	28.6	36.0	23.6	Aug	28.9	34.3	24.3	Aug	24.33	32	26.6
Sep	28.7	34.8	24.4	Sep	29.3	35.3	24.5	Sep	25.40	32.7	26
Oct	26.3	34.8	18.0	Oct	26.5	35.8	20.6	Oct	23.45	30.5	24.3
Nov	22.1	32.3	16.3	Nov	22.2	33.9	15.2	Nov	18.12	29	19.8
Dec	19.1	29.0	13.0	Dec	17.3	29.0	11.4	Dec	19.55	27	15.6

Ambient Temperature of the Project Area in 2005

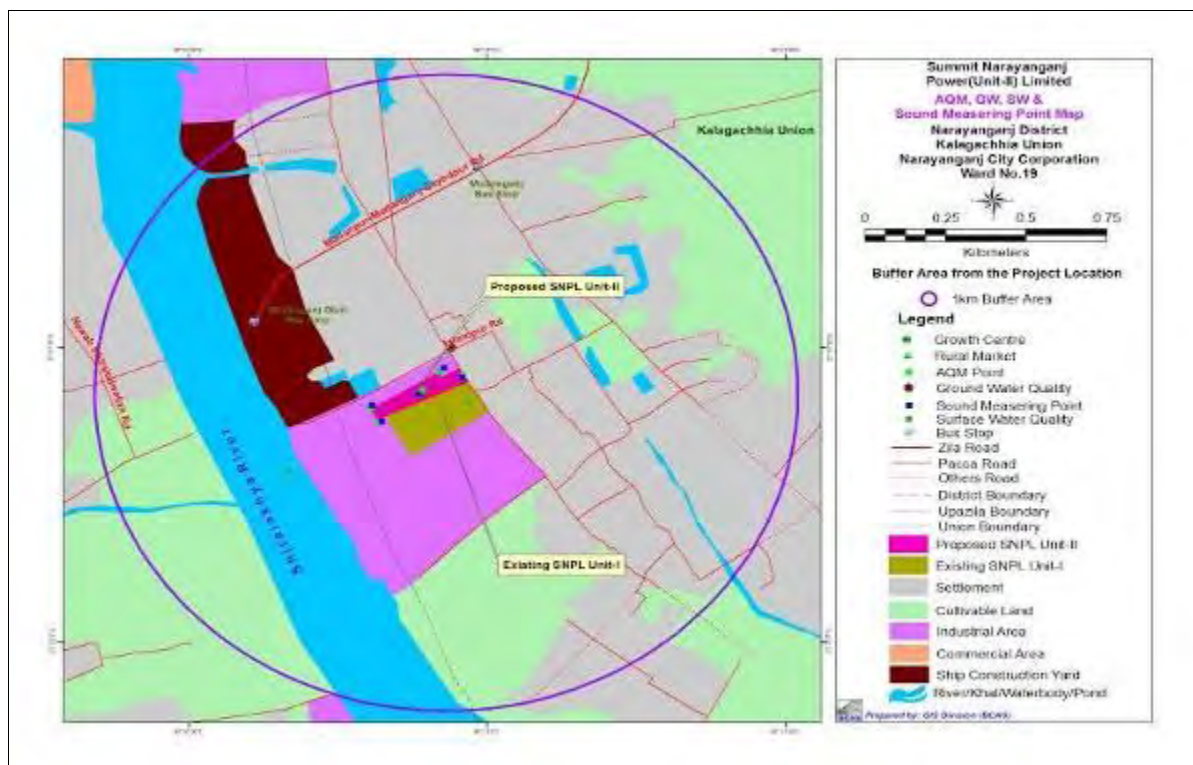
Month	Mean temp (°C)	Max temp (°C)	Min temp (°C)
Jan	15.32	25.3	13.4
Feb	23.4	31.2	19.4
March	23.23	33.2	21.9
April	19.32	33.7	23.8
May	26.34	33.7	24.9
June	26.43	32.3	26.1
July	23.33	32.3	26.6
Aug	32.43	32.5	26.5
Sep	26.43	31.9	25.8
Oct	24.30	32.2	24.6
Nov	23.44	29.6	19.9
Dec	23.44	26.8	15.8

Source: BMD

4.12 Ambient Air Quality

Air quality at the project site is typical of a rural environment. Ambient pollutant concentrations are relatively low to practically non-existent. Suspended particulate matter (SPM) increases intermittently in areas where winds pick up dust over unpaved roads and exposed surfaces. The primary sources of emissions, however, are traffic-derived emissions from the Dhaka-Chittagong National Highway and the district road from Dhaka-Narayanganj running in a north- South direction approximately 1.5 km to the South-East of the project site at its nearest point.

A survey of the ambient air quality was undertaken in the vicinity of the project site in October 2015 to determine pollutant concentrations after the monsoon. The survey undertaken in October used five sampling locations situated to the north, south, east, west and Central point of the project site. The sampling points are shown in Map 4.4. It may be noted that the same sampling points have been done noise and air quality measurements.



Map 4.4: Showing the air quality, water and sond quality measurent points

For the air quality measurements use was made of a high volume sampler for the particulate matters and continuous separate Sox, NO_x and CO monitors. For particulate matters special filters were used. The filter papers were accurately weighed and placed in the air intake duct. The filter paper was taken out after every eight hours and weighed again from the difference in initial weight and the final weight was recorded and the calculations of the concentrations were done from the total volume air intake during that period. The air sampling equipment and instruments are shown in the photos:



Photo 4.1: Respirable Dust Sampler for SPM, PM₁₀ and SO₂, NO_x, CO measurement instruments and measurement activities.

The air quality data as collected from the proposed plant site. **Table 4.8** shows the average ambient air quality in terms of 6 major indicators SPM, PM 10, PM 2.5, NO_x, SO_x and CO.

Monitoring was conducted in respect of the following parameters:

- Total Suspended Particulate Matter (SPM)

- (ii) Particulate Matter of 10 micron (PM10)
- (iii) Sulphur Di- Oxide (SO₂)
- (iv) Oxides of Nitrogen (NO_x)
- (v) Carbon Monoxide (CO)

The air quality data shows that the concentrations of SPM, PM10, NO_x and SO₂ were higher compared to the than rural areas as the SNPL UNIT II Unit 1 having a capacity of 100MW power plant adjacent to SNPL UNIT II Unit II which HFO based and was in operation during the air quality monitoring. The main source of particulate matter is from the Bashundhara Cement plant which is just outside the southern boundary of SNPL UNIT II Unit II. Additionally the time of air monitoring was in October and being the beginning of the dry season the particulate matter concentration showed higher results.

Table 4.13: The air quality data as collected from the proposed SNPL UNIT II site

Sample Location	Date	Ambient Air Pollutants Concentration µg/m³					Remarks
		SPM	PM10	NOX	SO2	CO	
The analysis of the ambient air was done by Enviro Quality Laboratory, Dhaka(24 hourly data)							
23° 35' 26.7" N 90° 30' 54.4" E	21.11.20 15	213.17	143.90	70.11	50.34	Nil	NE Corner Settlement and open space
23° 35' 23" N 90° 30' 55.2" E	22.11.20 15	239.74	147.54	74.40	53.03	Nil	SW Corner Basundhara Cement
23° 35' 26.8" N 90° 30' 57.4" E	23.11.20 15	220.48	139.36	71.44	47.56	Nil	SE Corner Road and market
23° 35' 19.85" N 90° 30' 37.07" E	24.11.20 15	202.48	131.54	69.59	46.83	Nil	NW Corner Sitalakha River
Air Quality Standard		200 Annually	150 (24 hourly)	100 Annually	200 Annually	10mg/m ³ 8hourly	-----
		Gravimetric	Gravimetric	West-Geake	Jacob&Hochheiser	CO Meter	
Instruments Used		Respirable Dust Sampler Envirotech APM 460NL	Respirable Dust Sampler Envirotech APM 460NL	Gaseous Sampling Attachment Envirotech APM 411TE	Gaseous Sampling Attachment Envirotech APM 411TE	Digital Instrument AE 14343 Taiwan	

4.13 Ambient Noise Quality

The Project site is found to have ambient noise level with a range of 39-84 dBA at different time of the day. There was 24 hours noise monitoring at 5 locations in the project site, which has been provided in Table 4.14 Based on this data, 24 hours ambient noise data have been presented in the following Figure 4.6 and 4.7

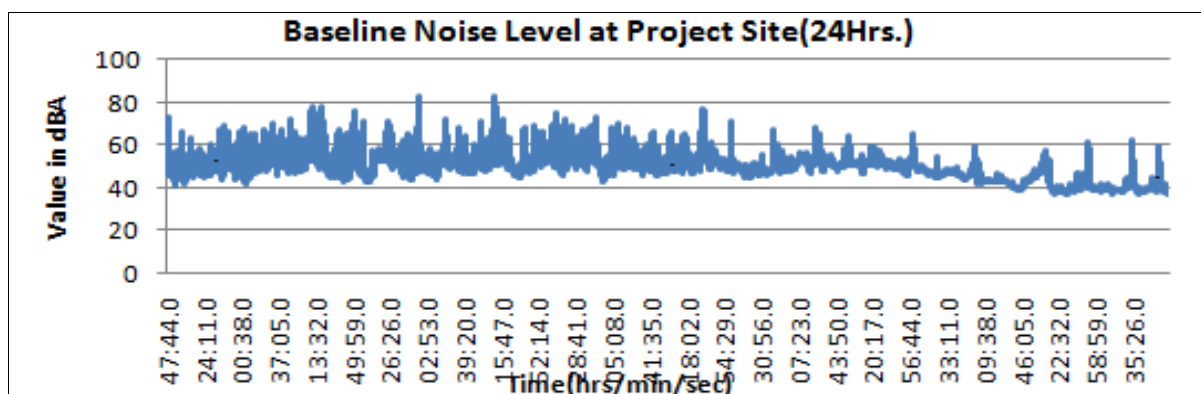


Figure 4.6: Baseline ambient noise level data at night time (24hrs)

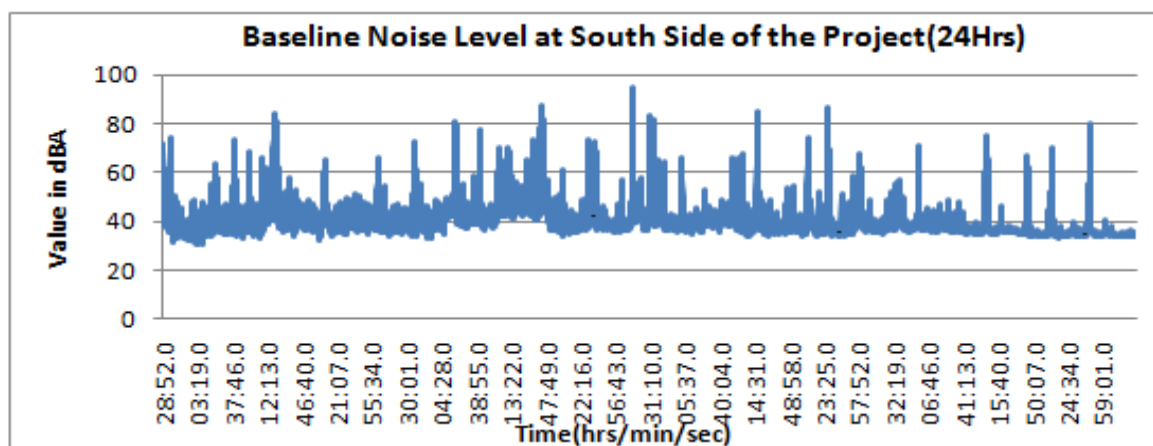


Figure 4.7: Baseline Noise Level Data at South Side of the Project at day time (24hrs.)

The ambient noise data was measured at different distances from the plant for 24 hours as shown in Figures 4.6 and 4.7. The average values for different locations are shown Table 4.9.

Table 4.14: Average Ambient Noise Level at Project Site for 24 hours

Location/Direction	Distance from Engine Hall of the proposed plant in meters	Noise level dB(A)	Noise level dB(A)	BD Standard dB(A) for Mixed Area dB(A)
		Day	Night	Day/Night
South(SNPL UNIT II Unit I and Basundhara Cement)	50	55.4	56.4	65/55
North (nearest village)	40	70.0	68.5	
East(Road and commercial area)	50	60.1	59.6	
West(Vacant land and river)	50	56.8	54.2	

Source: Field Survey, October, 2015; by Digital Sound Level Meter-AR814.

The above figures show that noise level data varies with different directions along with the time. The noise level data was measured at 4 locations during October 2015. The baseline noise level of the plant site has been measured as Minimum level 54.20, Maximum level 70.0. The periodic peaks in sound level recorded is due to heavy vehicle passing through the sampling area.

4.14 Surface and Ground Water Quality

Surface water hydrology: There are numerous rivers in the study area connected by cross channels. The main rivers are the Shitalakshya River. These rivers eventually fallen directly into the Bay of Bengal. This river has been carrying water from *different channels* to Bay of Bengal. Lots of beels, ghers, ponds and reservoirs of surface water are found in the study area. All water bodies of study area are tidal river and carry saline water five to eight month in year row.

Ground water hydrology: Groundwater condition is determined by high rainfall and flooding in monsoon period and geological setting of the country. Aquifers belong to thick semi-consolidated to unconsolidated fluvio-deltaic sediments of Miocene to the present. Except the Dupitila Sandstone Formation of the Plio-Pleistocene age, others are too deep to consider for ground water extraction.

Water Quality Analysis

The project site is nearby to **Shitalakha River**. Water samples were collected from the river using specified protocol. The sampling location with picture and quality of that sample represented below:

Table 4.15: Water quality data for surface water samples were collected from Sitalakha River

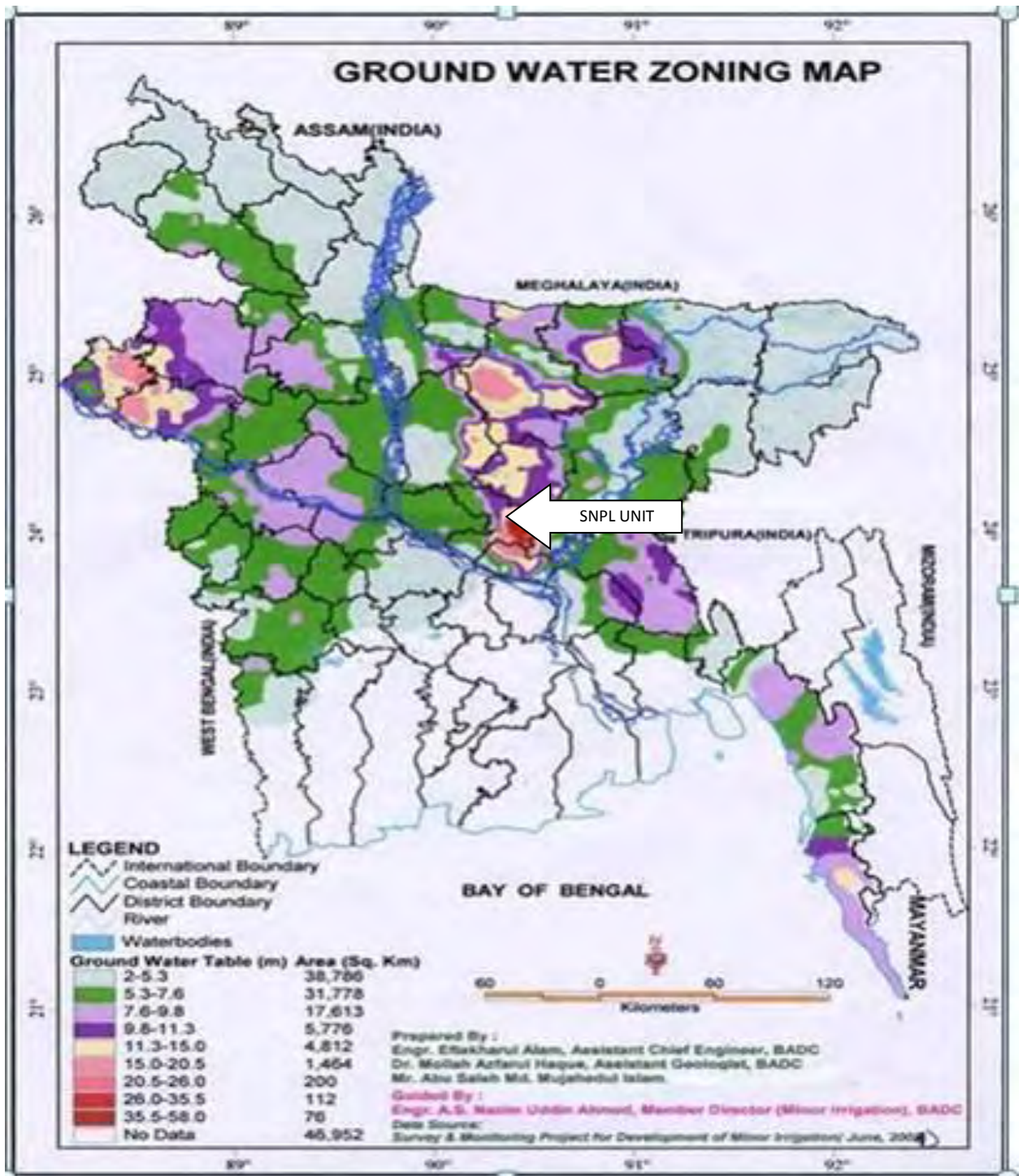
Parameters	Units	Location 1 (100m Upstream of the power plant)	Location 2 (100m Downstream of the power plant)	Bangladesh Standard
pH at 24.5°C	mg/L	7.71	6.90	6.5-8.5
TDS	ppm	190	230	1000
EC	μ S/cm	390	420	1200
Temperature	°C	27.1	25.1	-
DO	ppm	3.91	9.84	4.8-8
BOD5	mg/L	54	57	50
Arsenic	mg/L	< 0.01	< 0.005	0.05
COD	mg/L	108.0	120.0	200
Manganese	mg/L	< 0.05	0.098	5
Phosphate	mg/L	0.52	1.39	-
Phosphorus	mg/L	0.55	0.45	1
Conductivity	μS/cm	160	64.3	-

Source: ECL Laboratory (October, 2015)

The parameters show that, DO is in limit and BOD5 exceed the surface water quality limit of the DOE.

Ground Water Features in the Vicinity of the Site

Ground water level exists at a moderate (generally below 8.0 m) depth, which is being recharged mainly by infiltration of rainwater. According to Bangladesh Water Development Board the ground water level of Narayangang is about 6.5 m from MSL. The ground water zoning map is shown in Map 4.5



Map 4.5: Ground Water Zoning Map of Bangladesh

As with other parts of the country, there is a good availability of groundwater that is being used by hand pumps for drinking and domestic purposes. To determine quality of ground water, water sample was collected from the tube well of the existing plant of the company and analyzed for different parameters. The results shows that all the parameters remain within the allowable limit of drinking water value as per as Environmental Quality Standards for Bangladesh. The parameters which have been analyzed during this study are presented below in **Table 4.16**

Table 4.16: Ground water quality (limited parameters) around the Project vicinity

Parameter	Units	Value	Bangladesh Standard For Inland Surface Water
pH at 26.9°C	mg/L	7.1	6.0 - 9.0
TDS	ppm	90.0	1000
Iron	mg/L	0.8	(0.3 – 1.0)
Alkalinity	mg/L	78.0	-
Hardness	mg/L	68.0	(200 – 500)
Chloride	mg/L	16.4	(150 – 600)
TSS	mg/L	4.8	10
COD	mg/L	11.7	NS
BOD	mg/L	5.5	NS
Arsenic	mg/L	0.050	0.05
Conductivity	µS/cm	696	NS

Source: ECL Lab (water collected on 15.10. 2015 and tested on 23.10.2015)

Performance of ETP

It is planned that the existing ETP for SNPL UNIT II Unit 1 will be used as it has sufficient capacity to treat liquid effluents from SNPL UNIT II Unit II. The basic function of the ETP is to separate the oil from the oily water generated. The first step is neutralisation followed by emulsifying which separates the oil from water. There are some monitoring data of waste water treatment of the existing ETP which was done by the DoE. The inlet quality and outlet water quality is given below.

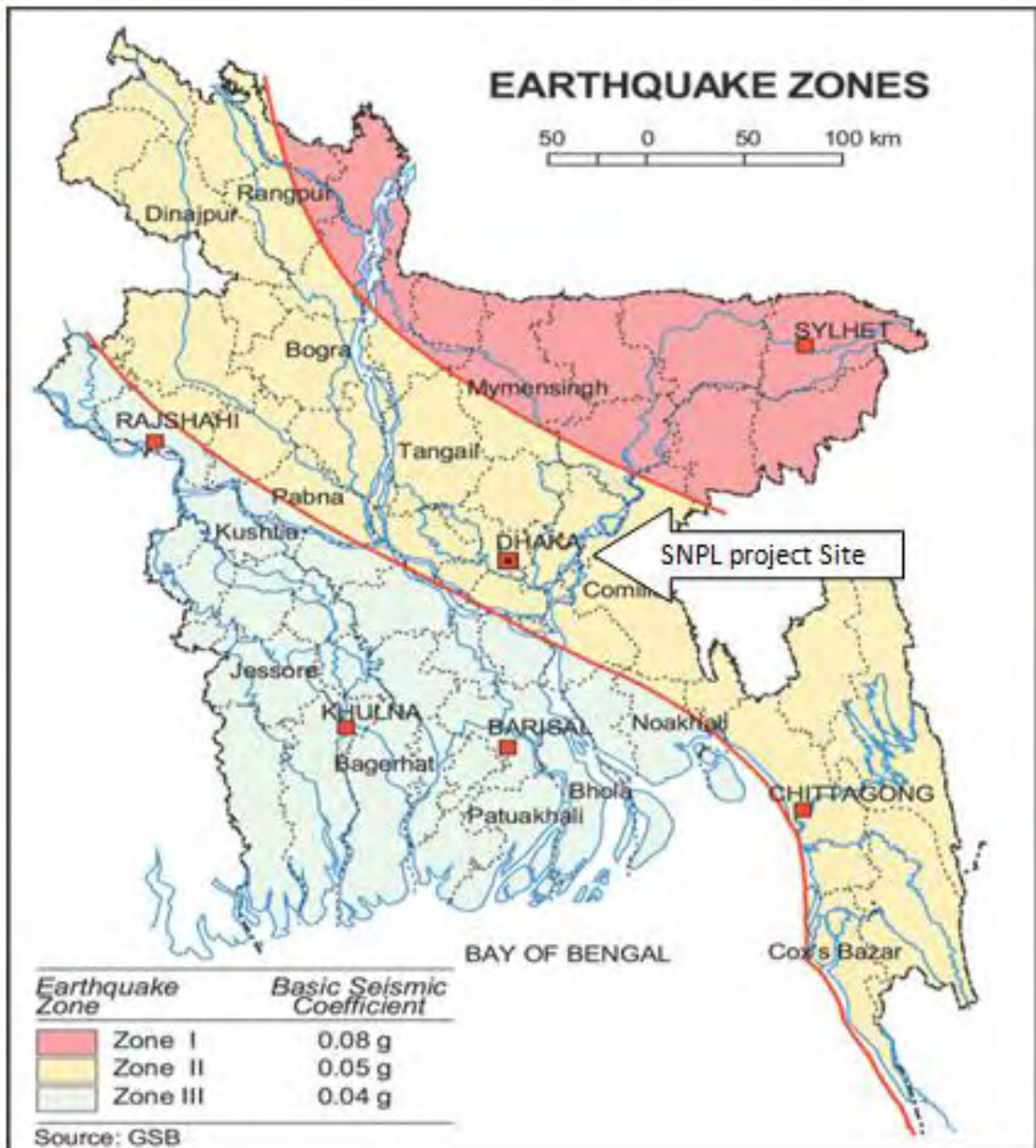
Sample	Date	pH	DO	BOD	COD	TDS
Inlet	25/03/2013	8.1	0.0	150	508	1006
Outlet		7.71	4.8	12	48	565
Inlet	15/04/2014	6.75	0.0	250	729	2320
Outlet		7.80	6.0	36	99	510
Industrial Wastewater Standard, ECR 1997		6.0-9.0	4.5-8.0	≤50.0	≤200.0	≤2100.0

Source: DoE monitoring Report of SNPL UNIT II, 2013 and 2014.

4.15 Vulnerability to Climate change and natural hazard

Geology and Seismicity

Bangladesh has been classified into three seismic zones where Zone-I the most severe and Zone-III the least impact. The project area falls in Zone-III, which means that there is considerable risk regarding earthquake. However, the project area is comparatively less prone to earthquake compared to northern part of Bangladesh. The seismic zones of Bangladesh have been provided in Map 4.6.



Map 4.6: Earthquake Zones in Bangladesh

The following Table 4.17 shows the seismic zones of Bangladesh where indicated that the project area is fallen in the II category which is quieter than Zone I . This has been considered in the civil construction design so that the construction can withstand earthquake of 7 on the Richter Scale according to SNPL UNIT II Unit II.

Table 4.17: Seismic Zoning of Bangladesh

Zoning	Area Marcella Scale
I	North and eastern regions of Bangladesh (Seismically most active)
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Narayanganj, Comilla, Noakhali and eastern part of Chittagong Folded belt. (Seismically relatively quiet)
III	Khulna division S-E Bangladesh (Seismically relatively quiet)

Flooding

Monsoon floods and flash floods occur in the lower parts of the project area. The Sitalakha river is adjacent to the western side of the project area which floods the proposed power plant site. In addition to this river, there are beels and canals around the project site that add to the floods during monsoon season. Flash floods occur during April to May in the area.

The Bangladesh Water Development Board has constructed an embankment on the banks of the river adjacent to the project site, to protect agriculture from flood damage. This embankment, which is also used as village roads by local transport, is elevated to 9 metres above sea level (m asl) and acts as a barrier to normal floods against inundation of the project site. However, water levels in excess of 9 m above sea level cause inundation of the projects site with the potential to cause loss of livelihoods (i.e. agricultural crops) and damages to physical infrastructure.

Water level data for the Daleshwari River was obtained from the Mokhtarpur Bridge hydrological data collection point, located .4 km downstream of the proposed project site. Data at the Mokhtarpur Bridge monitoring station has been collected by the Bangladesh Water Development Board (BWDB) since 1982 and data up to December 2009 was provided. According to the data, illustrated in Figure 4.8, the highest recorded water level between 1982 and 2009 was 9.68 m asl in 2004. The following figure 4.8 shows the highest water level of from 1982-2009 of the Daleshwari river is shown in the Map 4.7.

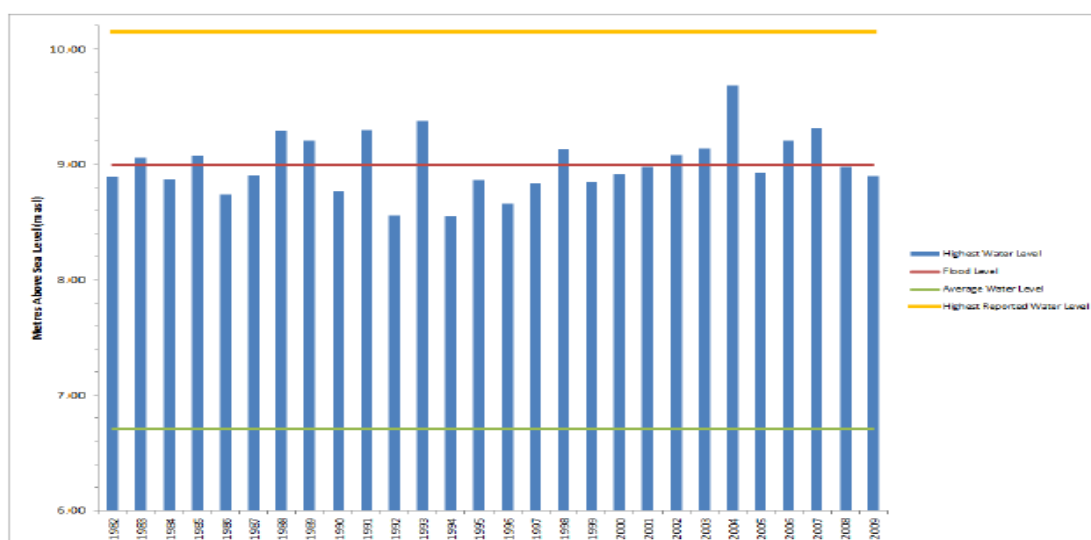
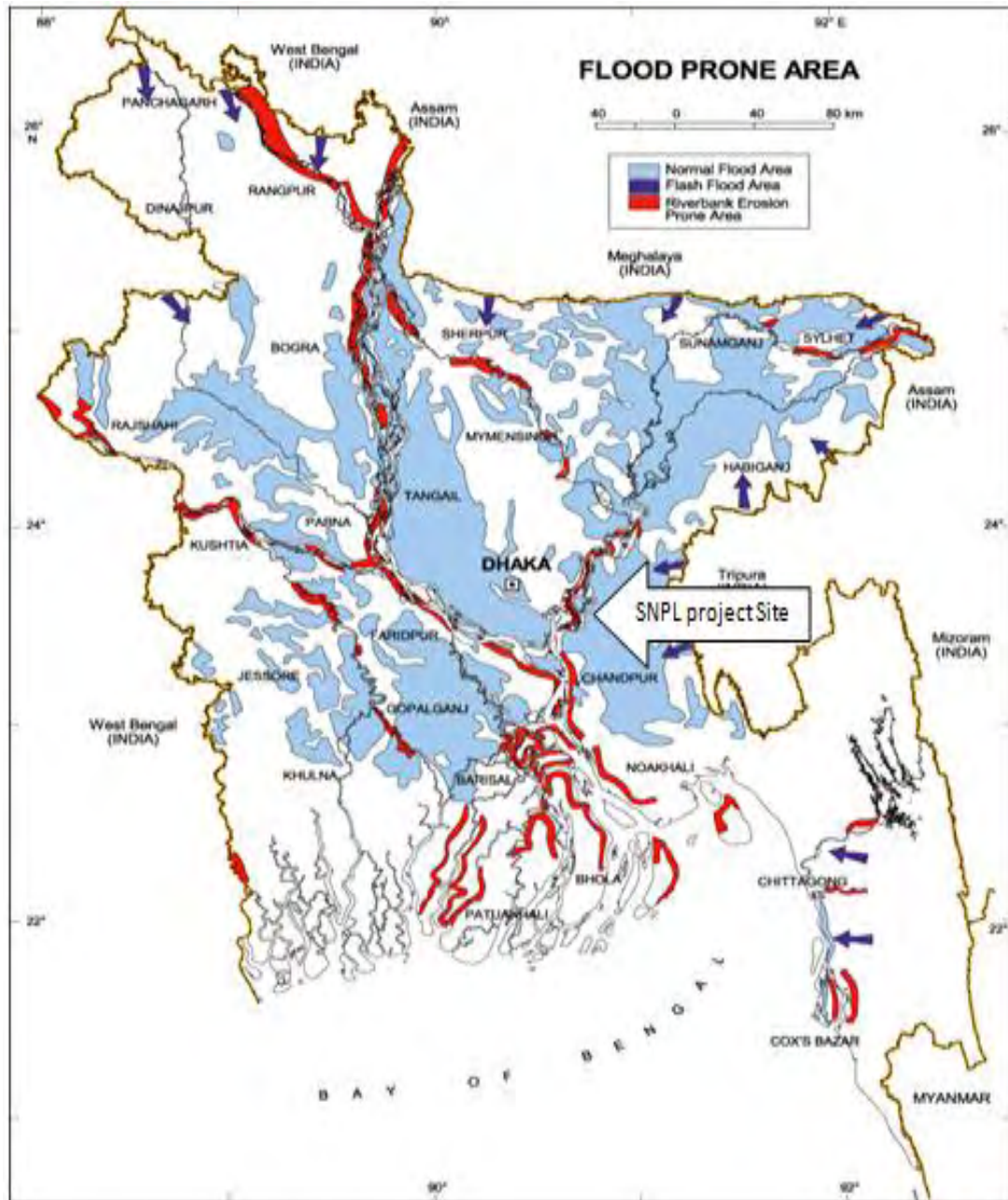


Figure 4.8: River Daleshwari – Highest Water Level (1982-2009)



Map 4.7: Flood affected area of Bangladesh

Natural Hazards Analysis

Bangladesh can be regarded as being susceptible to natural calamities. This is due to its unique combination of physiographic, morphological and other natural features, which have lead to direct loss of life and physical property on a massive scale. Natural calamities experienced include floods, cyclones and storm surges, and earthquakes.

Cyclones

Bangladesh is also cyclone prone. The country experiences, at times, catastrophic cyclones that cause loss of life and property. However, cyclones usually decay rapidly after coming into contact with land and such losses are largely confined to coastal regions.

4.16 Traffic Survey

Two methods are available for conducting traffic volume counts: (1) manual and (2) automatic. Manual counts are typically used to gather data for determination of vehicle classification, turning movements, direction of travel, pedestrian movements, or vehicle occupancy. Automatic counts are typically used to gather data for determination of vehicle hourly patterns, daily or seasonal variations and growth trends, or annual traffic estimates.

In this study, manual counts method is followed. Manual counts are typically used for periods of less than a day. Normal intervals for a manual count are 5, 10, or 15 minutes. Traffic counts during a Sunday morning rush hour and a Thursday evening rush hour may show exceptionally high volumes and are not normally used in analysis; therefore, counts are usually conducted on a Monday, Tuesday, or Wednesday. Manual counts are recorded using one of three methods: tally sheets, mechanical counting boards, or electronic counting boards. Tally sheets are used in this study.

Data was recorded tally sheets. The data was recorded with a tick mark on a prepared field form. A stopwatch was used to measure the desired count interval. A blank traffic volume count intersection tally sheet is provided in Annex 10. When preparing for a manual count study, a checklist was used.

The number of lanes or crosswalks, the volume level of traffic, the number of personnel were observed in this study. In our survey team, one observer recorded certain types of vehicles while another counted total volumes. The observers conducting manual traffic counts are well trained on this type of traffic survey. To avoid fatigue, observers relieved periodically. Every hour observers took a 10 to 15 minute break. Observers were positioned where they had a clear view of the traffic. Observers were positioned away from the edge of the roadway. Visual contact was maintained as there were multiple observers at a site. The data forms were carefully labeled and organized. On each tally sheet, the observer recorded the location, time and date of observation, and weather conditions

Road and River Traffic Survey near Project Area

Table 4.18: Traffic Survey Locations

Traffic Survey Type	Location	GPS Reading
River	Shitalakha River	22°18'59.27"N 91°49'21.24"E
Road	Modonganj Main Road near SNPL UNIT II Unit II entrance	23°35'26.8"N 90°30'57.8"E

The road traffic is very light at the above road location. There is no bus service on that route. The supplies of food grain, consumer goods, grocery items, edible oil, clothing and garments, cement and other construction materials, petroleum products, electronics, medicine, machinery and equipment, etc received by **Modonganj** in 122 trucks. Other passenger vehicles include car, micro bus, rickshaw, van, motor cycle, baby taxi which were 13, 12, 7, 51, 36, 23 and 14 respectively during the observation and around 47 units of river vehicles were moved through the **Shitalakha River** during observation.

The plant construction and operation will require movement of goods and people. Therefore it is required to have information about present traffic scenario in the locality. The major machineries and materials for the project will be brought by **Shitalakshya River**. Other

requirements will be met by transporting by road. The site is nearby to an important **River Shitalakha** where a number of factories are served by this river. Besides, there are some ship building and servicing workshops too. **Shitalakha River** being one of the most important and big rivers of the country is extensively used for goods and human transportation. Fishing activities also goes on this river extensively. With this background one day long Traffic Survey was carried out at 1) Shitalakshya River 2) Modonganj Main Road. The monitoring locations was given in Table 4.18. The implication of the road traffic survey is that since the power plant has already gone into operation ther will no additional traffic for the project as all the construction wark is complete and hence it will have no impact on the existing traffic. For river traffic the project will transport HFO in tankers but since the supply will be intermittent there will be no impact on the river traffic.



Photo 4.2: Road traffic was counted at the project side



Photo 4.3: River traffic was counted at Daleswari (downstream of Sitalakha)

CHAPTER 5

BASELINE SOCIO-ECONOMIC CONDITION

The socio-economic baseline survey was carried out within 1 kilometer of the plant location which has been considered as the impact zone for the project. A total number of 100 HHs were surveyed. The 5 kilometer radius survey was not done as Modongang comes within this radius which is highly populated urban area the number of HHs that needed to be surveyed would be prohibitively large in number to be representative. Additionally, the socio-economic impacts of the project will not extend over 1 kilometer radius. Both primary and secondary sources data are utilized for understanding socio economic condition at the project area.

Narayanganj was a sub-division of former Dhaka district. It was upgraded to a district on 15th February, 1984. Narayanganj, the oldest and the most prominent river port of Bangladesh, grew into a prominent place of trade and commerce in the long past for which it was previously known as a Ganj.

Economic Situation: The district is pioneer in merchandising and manufacturing of jute, yarn and dying items. Cottage industry like weaving abounds in this district. International trading, import and export business, garments industries, knitwear garments, shipyard po v brickfield etc, create employment opportunities to the people facilitating additional income to the household population. The rural economy of Narayanganj is agricultural. Out of total 532,415 holdings of the district 22.44 % holdings are farms that HYV paddy, vegetables, spices, cash crops, pulses and others. Various fruits like banana, guava are grown and fish of different varieties abound in this district. Varieties of fishes are caught from rivers, channels, creeks and from paddy fields during rainy season. The major income generating activities of the people in this district is business and working in the mill and factories.

The status of non-farm activities in the district is increasing. The following Table 5.1 shows the number of establishments and their distribution by major industries and the persons engaged by sex and activity.

Table 5.1: Physical and cultural resources and the persons engaged by activity

Activity	Establishments			Person Engaged		
	Total	Urban	Rural	Total	Male	Female
Manufacturing	5	4	1	213	206	7
Electricity, gas and water supply	12805	7452	5353	208074	172734	35340
Construction	30	24	6	477	464	13
Wholesale and retail trade	37	37	0	1641	1451	190
Hotels & Restaurants	46120	33010	13110	104872	102144	2728
Transport, storage and communication	4808	3333	1475	13543	12974	569
Bank, insurance and financial institution	1389	850	539	5780	5177	603
Real estate and renting	281	255	26	3743	2729	1014
Public administration and defense	226	160	66	3373	3086	287
Education	1635	645	990	8818	6813	2005
Health and social work	3790	3666	124	80239	6936	1103
Community, social and personal services	7569	4671	2898	19529	17572	1957
Narayanganj district	79557	54776	24781	381012	335136	45876

Source: Census of non-farm economic activities 2011-2013

To assess the baseline socio-economic condition in the project area relevant stakeholders including respective officials of Narayangonj City Corporation, Local Government and public representatives, and key informants were met. As a source of secondary data, Bangladesh Bureau of Statistics (BBS), Banglapedia, concerned books and periodicals were also consulted. The socio economic information has been taken within the area of one Kilometer radius from the project site.

Household Socio-Economic Study

5.1. Socio economic study

In order to assess the baseline conditions of the population living within the air-shed of 1 kilometers from the Project site, a socio-economic questionnaire survey of 100 families was carried out. The 100 families represent a sample of the total households which were covered by the baseline survey carried out by BCAS in October 2015.

The total number of households surveyed was 100, which constitutes the total number of households affected by the Project-related land acquisition. The households affected by the land acquisition have been covered by the survey.

Study Methodology

The methodology for the social baseline study included different methods and tools, as follows:

- Collection of Secondary Data through literature survey;
- Sample-based household survey of 100 HHs;
- Focus Group Discussions (FGD) with day laborers, women groups and the land owners who have lost the land to the power plant project; and
- Consultations with project affected persons, representatives of the local elite, local government, local administration and chairman of the local union parishad (the local government administration and members of the Union parishad).

Secondary data on demographic and socioeconomic issues of the study area have been collected from various sources including the population census of Bangladesh Bureau of Statistics (BBS) and from Upazila level offices and Ward Council.

Household Survey

For the purposes of the household survey, the overall impact area of the Project was divided into two zones, namely: high impact zone and low impact zone. The geographical area within a radius of 1km to 5km from the power plant site has been defined as the low impact zone and the area within 1 km radius is considered as high impact zone. The HH baseline survey was carried out in the high impact zone. BCAS representatives taking interview with the household heads.



Photo 5.1: Field Enumerator at the Respondent Premises

Coverage of the survey

For socio-economic baseline study the household surveys were carried within 1km in radius from the plant in the settlements Katpatti and Islampur cluster of settlements in the North side. On the east side PM Road and Pikker More , Naya Para and on the south side MM Ghoshal Road Lakkar Char. The complete lists of all households located in in theabove mentioned areas have been prepared to generate sampling frame of the study population. The sampling frame has enumerated from the households of these locations. Based on the sampling frame, a total of 100 households have been randomly selected from the study areas. Each sample household has been interviewed by a Field Investigator and data/ information has been gathered from the sample households using a questionnaire. (refer to Annex 7).

Data Processing and Analysis

Survey data have been processed and analyzed using SPSS package programme. Statistical outputs such as one way and two-way tables and descriptive statistics including mean, median, and percentage have been calculated for interpretation of results obtained from survey data.

Introduction:

For the purposes of the household survey, the overall impact area of the Project was divided into two zones, namely: high impact zone (0.6km) and low impact zone (0.4km). The geographical area within a radius of 1 km from the power plant site has been defined as the impact area. 60 households are considered from high impact zone and 40 households are from low impact zone amounting in total to 100 households surveyed in all the impact areas. It may be mentioned that the area is so densely populated that statistically derived sample size will be prhobitively high and will not add value to the ESIA and soci-economic baseline survey

5.2 Socio-Demographic Characteristic of the Project Area

i) Household size and Sex-ratio

According to the household survey, males and females constitute 56.2% and 43.8% respectively of the population in the study area (Table-5.1). In the high impact zone, males and females constitute 55.5% and 44.5% respectively, whereas in the low impact zone males and females constitute 57.1% and 42.9% respectively. The average sex-ratio in the project area is 128.2, which indicates prevalence of male population in the study area (Table-5.2). The national sex-ratio was found to be 98.21 according to the population census of 2011.

Table-5.2: Sex Distribution of Household Members by Study Area

Study Area	Percentage		
	Male	Female	Total
High	55.5	44.5	100.0
Low	57.1	42.9	100.0
All	56.2	43.8	100.0

According to the household survey, the average household size is 4.1 in all impact area (i.e. the average number of persons per household). Overall, the average household size in the Project area is lower than the national average household size which is 4.5 persons (BBS, 2011). The following Table shows the average family size of the project area

Table-5.3: Average Family Size and Sex Ratio of Household Members by Study Area

Study Area	Average Family Size(number)	Sex Ratio
High	3.9	124.8
Low	4.4	132.9
All	4.1	128.2

ii) Age Distribution of the Population and Marital Status

Age distribution of the population in all impact zone obtained from survey data shows that 6.1% of the population is children (0-4 years), 19.9% are adolescents in the 5-14 years old group, 32.0% are 15-30 years of age, 26.4% are of age 31-45, 12.3% are of age 46-60 and the remaining 3.3% are above 60 years (Table-5.4). In the high impact zone, 14.8% population is aged between 46-60 years whereas it is 9.0% in the low impact zone.

Table-5.4: Age Distribution of Household Members

Age Group (Year)	Percentage		
	High	Low	All
Up to 4	5.9	6.2	6.1
5-14	19.5	20.3	19.9
15-30	30.5	33.9	32.0
31-45	26.7	26.0	26.4
46-60	14.8	9.0	12.3
Above 60	2.6	4.6	3.3
Total	100.0	100.0	100.0

Table 5.5 presents marital status of the population in the study area. It is revealed from the table that, 56.6% of the population in the study area is married in all impact zone. The percentage of unmarried people in all impact zone is 42.5. However, 0.7% and 0.2% of the population in the study area are widow and divorced respectively. In the high impact zone, 56.3% of the population is married whereas the percentage is 57.1 in the low impact zone of the study area.

Table-5.5: Marital Status of Household Members of Study Area

Marital Status	Percentage		
	High	Low	All
Married	56.3	57.1	56.6
Unmarried	42.4	42.4	42.5
Divorced	0.4	-	0.2
Widow	0.9	0.5	0.7
Total	100.0	100.0	100.0

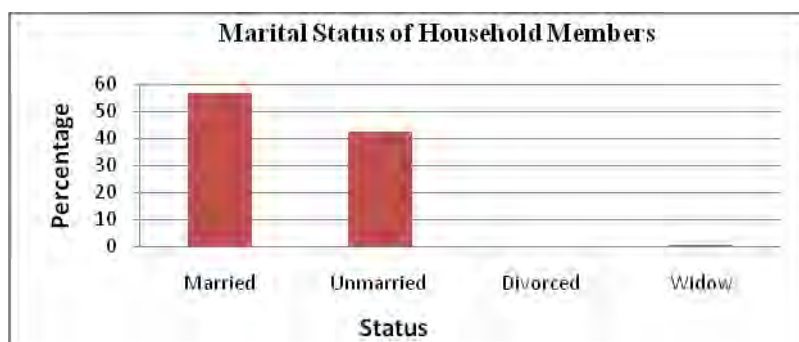


Figure 5.1: Marital status of the project area

iii) Educational Status

According to the survey, in all impact zones of the study area, 0.3% of the population is illiterate and 5.4% of the population can sign their name, although they can neither read nor write. The population in both the impact zones having primary level education (upto 5 years of schooling) and secondary level education (up to 10 years of schooling) are 34.9% and 32.3% respectively. Based on the data collected from the socio-economic survey, 14.6% of the population in both the impact zones has a Secondary School Certificate (S.S.C) and equivalent. It has been found that 8.2% of population has Higher Secondary Certificate (H.S.C) and equivalent and 4.3% of the population in all impact zones has Bachelors/ equivalent degree and above (Table-5.6). The national literacy rate is estimated at 57.91%, according to BBS 2011.

The population having primary level education in the high impact zone is 35.4% whereas it is 34.1% in the low impact zone of the study area. 12.6% of the population in the high impact zone has Secondary School Certificate (S.S.C) and equivalent whereas it is 17.4% in the low impact zone of the study area.

Table-5.6: Educational Status of Household Members of Study Area

Educational Status	Percentage		
	High	Low	All
Illiterate	0.4	-	0.3
Can sign only	5.4	5.4	5.4
Primary	35.4	34.1	34.9
Secondary	33.2	31.1	32.3
S.S.C and equivalent	12.6	17.4	14.6
H.S.C and equivalent	8.1	8.4	8.2
Degree and above	4.9	3.6	4.3
Total	100.0	100.0	100.0

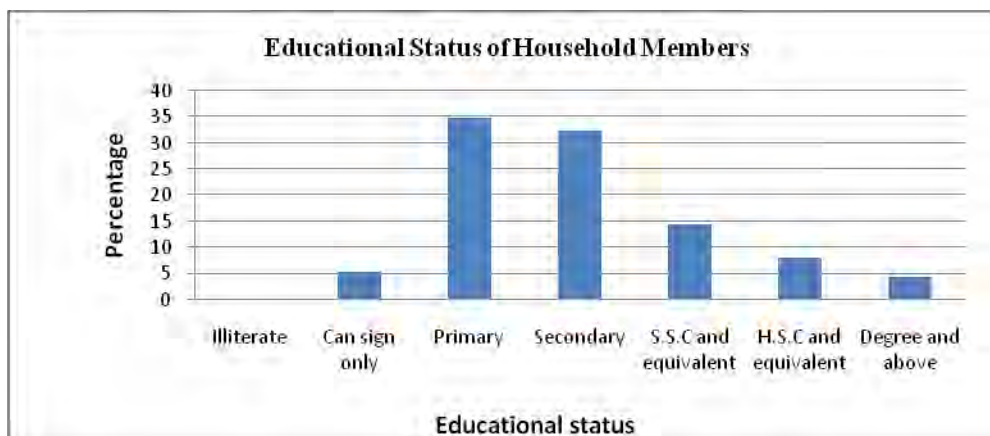


Figure 5.2: Educational status in the project site

iv) Occupation and Employment

The household heads in the surveyed are engaged in different types of primary occupation such as service and business etc. The survey reveals that, in all impact zones, the highest percentage (51.0%) of the workforce is engaged in Business followed by different types of services (29.0%); only 4.0% household heads are wage laborer and 8.0% of the household heads is engaged in household work (Table-5.7).

In the high impact zone, 55.0% of the household heads is engaged in business compare to 45.0% in the low impact zone. Service constitutes 28.3% and 30.0% in the high and low impact zones of the study area respectively. Only 7.5% of the household heads are wage laborer in the low impact zone whereas 10.0% of the household heads is engaged in rickshaw/auto driving in the low impact zone of the study area (Table-5.7).

Table-5.7: Percentage Distribution of Household Heads by Main Occupation

Main Occupation	Study Area		
	High	Low	All
Service	17 (28.3)	12 (30.0)	29(29.0)
Business	33(55.0)	18(45.0)	51(51.0)
Wage labor	1(1.7)	3(7.5)	4(4.0)
Household work	6(10.0)	2(5.0)	8(8.0)
Rickshaw/auto	2(3.3)	4(10.0)	6(6.0)
Others	1(1.7)	1(2.5)	2(2.0)
Total	60(100.0)	40(100.0)	100(100.0)

Note: Figures within parentheses represent percentages

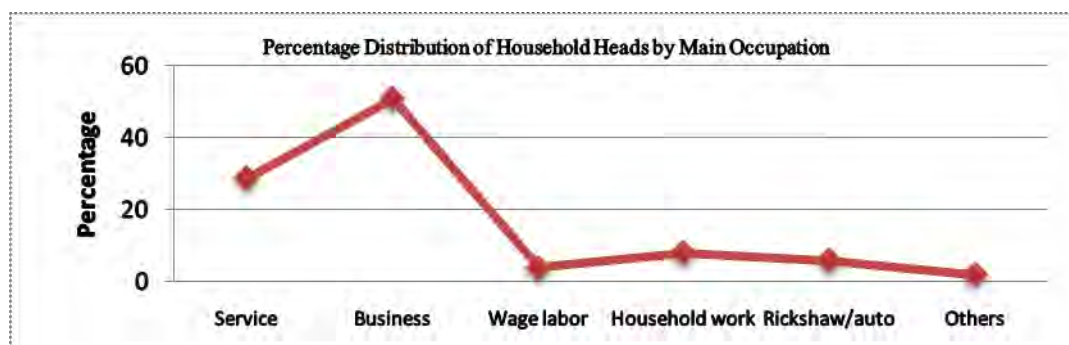


Figure 5.3 : Main occupation of household heads in project area

However, the survey reveals that 33.3% of the household heads are engaged in business as secondary occupation whereas 66.7% of the household heads are engaged in wage labor in the study area (Table-5.8).

Table-5.8: Percentage Distribution of Household Heads by Secondary Occupation

Secondary Occupation	Study Area		
	High	Low	All
Wage labor	-	2(100.0)	2(66.7)
Business	1(100.0)	-	1(33.3)
Total	1(100.0)	2 (100.0)	3 (100.0)

Note: Figures within parentheses represent percentages

v) Religion status of the study area

According to the survey, 100% of the household heads in the study area are Muslim by Religion. The survey reveals that 60.0% of those household heads are in the high impact zone whereas rest of the 40.0% of the household heads is Muslim by Religion in the low impact zone of the study area (Table-5.9).

Table-5.9: Percentage Distribution of Household Heads by Religion

Religion	Study Area		
	High	Low	All
Muslim	60(100.0)	40(100.0)	100(100.0)
Total	60(100.0)	40(100.0)	100(100.0)

Note: Figures within parentheses represent percentages

vi) Land Use pattern and Household land Ownership:

According to the household survey, about 3.0% of household land is allocated for the agricultural lands. Other types of household land use include: 100% for homestead and 2.0% for pond/ditches respectively (Table-5.10).

Table-5.10: Percentage Distribution of Households Surveyed by Different Uses Pattern of Land

Pattern	Study Area		
	High	Low	All
Homestead	100.0	100.0	100.0
Agricultural land	1.7	5.0	3.0
Pond/Ditch	1.7	2.5	2.0

The land use patterns among the different impact zones are very different. 100% households have homestead land in the high impact zone as well as in low impact zone (Table-5.11). There are only 1.7% households that have agricultural land in the high impact zone.

According to the survey, the average size of land plot owned per household is 5.9 decimal in the study area. There is a narrow variation in the size of household land plots among the different impact zones. It is 5.4 decimals in low impact area and 6.2 decimals in high impact area (Table-5.11).

Table-5.11: Average Land Size of Households Surveyed by Study Area

Study Area	Average Land Size (decimal)	Standard Deviation(decimal)
High	6.2	7.6
Low	5.4	4.3
All	5.9	6.4

vii) Household Income, Expenditure and Distribution

According to the survey, average annual income per household in all impact zone is Taka 160,140 in the study area whereas the average annual expenditure per household in all impact zone is Taka 84,040 in the study area. Average annual income per household in the high impact zone is Taka 161,317 whereas it is Taka 158,375 in the low impact zone. Average annual expenditure per household in the high impact zone is Taka 81,367 compare to Taka 88,050 in the low impact zone of the study area (Table-5.12).

Table-5.12: Average Annual Income and Expenditure Per Household by Study Area

Study Area	Average Annual Income Per Household(Tk.)	Average Annual Expenditure Per Household(Tk.)
High	161,317	81,367
Low	158,375	88,050
All	160,140	84,040

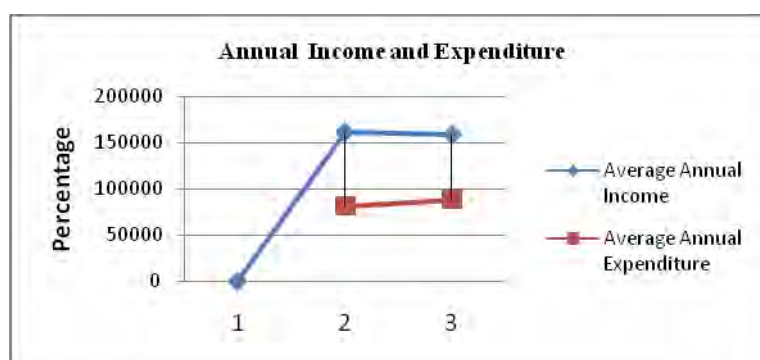


Figure 5.4: average annual Income and Expenditure

Average annual income per household at current price was estimated at taka 137,748 at the national level, according to BBS 2011. However, according to BBS 2011, at the national level, average annual expenditure per household was estimated at taka 134,400 at current price.

The distribution of household income as obtained from the survey reflects that about 5.0% of households in the study area have annual income of Taka 250,000 and above. 12.0 % of households belong to the annual income bracket ranging from Taka 200,000-250,000. According to the survey, 34.0% households belong to the average income ranging from Taka 150,000 to Taka 200,000 and 33.0% households belong to the average income ranging from Taka 100,000 to Taka 150,000. The survey reveals that, 16.0% of the households in the study area have annual income of Taka 100,000 and below (Table-5.13a).

In the high impact zone, 16.7% of the households belong to the average income ranging from Taka 200,000 to Taka 250,000 compare to 5.0% in the low impact zone. The survey also reveals that 42.5% of the household have the annual income in the range of Taka 100,000-150,000 in the low impact zone whereas it is 26.7% in the high impact zone.

Table-5.13a: Percentage Distribution of Households Surveyed by Total Annual Income

Total Annual Income (Tk)	Study Area		
	High	Low	All
Up to 100000	10 (16.7)	6 (15.0)	16 (16.0)
100000-150000	16(26.7)	17(42.5)	33(33.0)
150000-200000	23(38.3)	11(27.5)	34(34.0)
200000-250000	10(16.7)	2(5.0)	12(12.0)
250000+	1(1.6)	4(10.0)	5(5.0)
Total	60(100.0)	40(100.0)	100(100.0)

Note: Figures within parentheses represent percentages

The survey reveals that annual expenditure is upto Taka 100,000 for about 74.0% of the households in the study area. 26.0% of the households belong to the average annual expenditure ranging from Taka 100,000-150,000 (Table-5.13b). In the high impact zone, 81.7% of the households have annual expenditure upto Taka 100,000 compare to 62.5% in the low impact zone.

Table-5.13b: Percentage Distribution of Households Surveyed by Total Annual Expenditure

Total Annual Expenditure (Tk)	Study Area		
	High	Low	All
Up to 100000	49(81.7)	25(62.5)	74(74.0)
100000-150000	11(18.3)	15(37.5)	26(26.0)
150000-200000	-	-	-
200000-250000	-	-	-
250000+	-	-	-
Total	60(100.0)	40(100.0)	100(100.0)

Note: Figures within parentheses represent percentages

viii) Sources of Household Income

According to the survey, business is one of the major sources of livelihood accounting for 45.2% of household income in the study area, succeeded by service that contributes 29.0% to household income. The survey also reveals that, 8.1% of the households' income source is house rent (Table-5.14).

In the high impact zone, 51.4% of household income is business compare to 37.0% in the low impact zone. 28.6% of household income in the high impact zone is service whereas it is 29.0% in the low impact zone. In the high impact zone, 7.1% of household income is house rent in the study area (Table-5.14).

Table-5.14: Percentage Distribution of Households by Source of Income

Source	High	Low	All
Service	28.6	29.0	29.0
Business	51.4	37.0	45.2
Daily labor	1.4	9.3	4.8
Foreign remittance	4.3	9.3	2.4
Rickshaw/auto	2.9	7.4	4.8
House rent	7.1	-	8.1
Others	4.3	8.0	5.7
Total	100.0	100.0	100.0

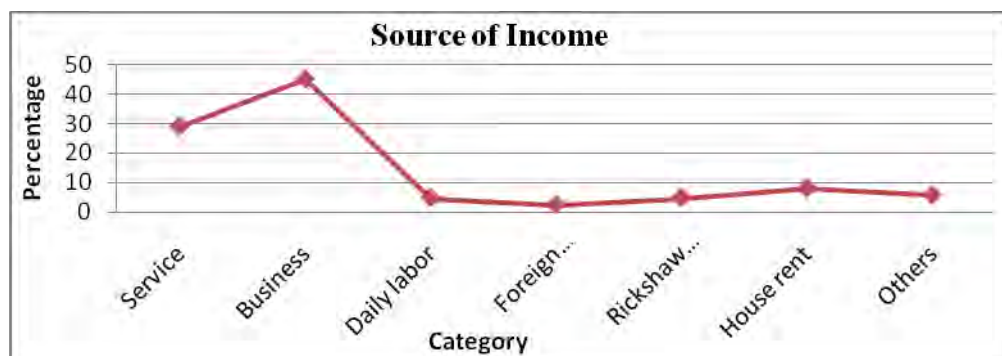


Figure 5.5: Distribution of household source of income

ix) Economic Status

The analysis of the households' economic situation has been focused on accessibility and affordability of food, clothing, educational facilities, medical facilities, transport facilities etc. With respect to availability of food, it is considered "satisfactory" by 52.0% of the households under the survey. Food availability is considered "good" by 44.9% of the households in the study area. The situation with respect to clothing is considered "satisfactory" by 68.0% of the respondents and considered "good" by 29.0% of the respondents in the study area. As for housing /accommodation facilities, they are found "satisfactory" by 33.3% of the respondents, 18.2% of the respondents found them "good" and 48.5% of the respondents found them "unsatisfactory". Educational facilities are considered "good" and "satisfactory" by 6.3% and 78.9% of the respondents, respectively. Medical facilities are generally considered "satisfactory" by 42.9% of the respondents in the study area whereas 53.1% of the respondents found them "unsatisfactory". However, transportation facilities were scored as "satisfactory" by 79.4% of the respondents, while only 7.2% considered them as "unsatisfactory". Entertainment facilities are considered "satisfactory" by 48.0% of the respondents whereas 46.9% of the respondents found them "unsatisfactory" in the study area (Table-5.15).

Table-5.15: Economic Status of Households

Sector	Percentage			
	Good	Satisfactory	Unsatisfactory	Total
Food availability	44.9	52.0	3.1	100.0
Clothing	29.0	68.0	3.0	100.0
Accommodation/houses	18.2	33.3	48.5	100.0
Educational facilities	6.3	78.9	14.8	100.0
Medical facilities	4.0	42.9	53.1	100.0
Transport facilities	13.4	79.4	7.2	100.0
Entertainment	5.1	48.0	46.9	100.0

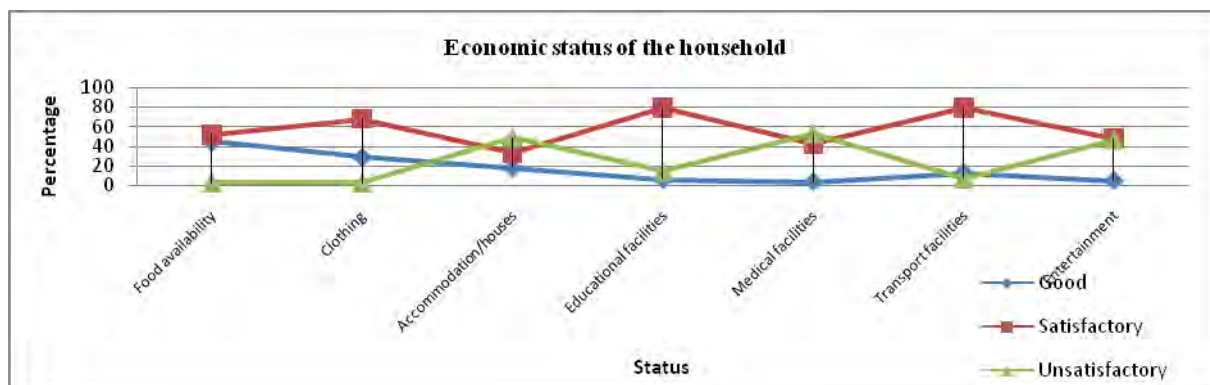


Figure 5.6: Household economic status

x) Involvement with NGOs/CBOs

About 93.0% households in the study area are not involved with non-governmental and community-based organizations (NGOs/CBOs) whereas 7.0% family member has involvement in NGOs/CBOs (Table-5.16).

In the high impact zone, 95.0% of households in the study area are not involved with non-governmental and community-based organizations (NGOs/CBOs) compare to 5.0% involvement of the family member. In the low impact zone, 90.0% of households in the study area are not involved with NGOs/CBOs compare to 10.0% involvement of the family member.

Table-5.16: Percentage Distribution of Households Surveyed Having Family Member Involvement in NGOs/CBO

Study Area	Yes	No	Total
High	3(5.0)	57(95.0)	60 (100.0)
Low	4(10.0)	36(90.0)	40 (100.0)
All	7(7.0)	93(93.0)	100 (100.0)

Note: Figures within parentheses represent percentages

xiii) Housing Structures

Housing structures in the project impact area are of different types in terms of construction materials used. Most of the housings (57.3%) are brick floor with tin wall and roof in the study area. Housings with tin roof, tin wall and earthen floor constitute 25.0% of all HHs in the study area (Table-17). 11.3% of the households are buildings, 2.4% of the households are thatched and 4.0% of the households are made of earthen floor, thatch wall and tin roof in all impact zones of the project area. According to BBS 2011, at the national level the highest 38.46% of the household heads lived in house made of CI sheet/wood in the walls, 16.72% of the households were found living with wall made of mud/brick/wood whereas, same material was found in the roof of 1.52% households, fence/straw/bamboo was observed in the wall of 19.29% households and 3.09% roofs of the households.

In the high impact zone, most of the housings (63.4%) are brick floor with tin wall and roof compare to 49.1% in the low impact zone. 30.2% of the households are with tin roof, tin wall

and earthen floor in the low impact area whereas it is 21.1% for the similar housing structure in the high impact area (Table-5.17).

Table-5.17: Percentage Distribution of Households Surveyed by Housing Structure

Housing Structure	Study Area		
	High	Low	All
Building	14.1	7.5	11.3
Brick floor+tin wall+tin roof	63.4	49.1	57.3
Earthen floor+tin wall+tin roof	21.1	30.2	25.0
Earthen floor+thatch wall+tin roof	-	9.4	4.0
Thatch	1.4	3.8	2.4
Total	100.0	100.0	100.0

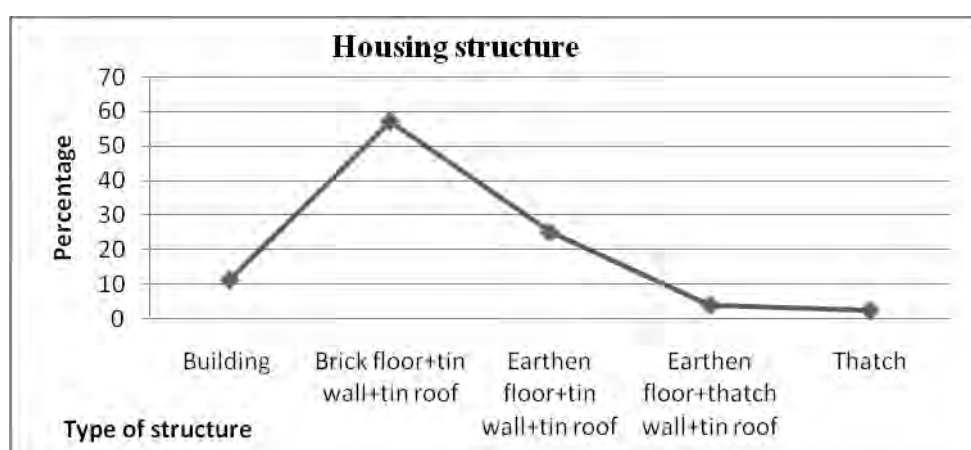


Figure 5.7: Household distribution by housing structure

5.4. Survey of Environmental Issues

Environmental problems that are perceived by the respondents in the study area includes water pollution, air pollution, industrial pollution, noise pollution over population, deforestation, diseases, poor sanitation, arsenic contamination of ground water, river bank erosion, sedimentation of water bodies etc.

According to the survey, the most pressing problem is air pollution in terms of the percentages of responses. The survey reveals that, air pollution have been mentioned by 37.8% followed by industrial pollution (3.0%), water pollution (2.0%), and Burning fuel, trees and agriculture residue (1.0%). Besides, health and sanitation problem and over population have also been mentioned by 97.0% and 91.9% respectively as low status of problem. The survey also reveals that 6.2% of the households mentioned noise pollution as moderately impacted problem in the study area (Table-5.18).

Table-5.18: Percentage Distribution of Households Surveyed Showing the Status of Environmental Problem

	Status of Environmental Problem				
	No problem	Severe	Moderate	Low	Total
Water pollution	15.3	2.0	3.1	79.6	100.0
Air pollution	-	37.8	22.4	39.8	100.0
Industrial pollution	-	3.0	4.1	92.9	100.0
Burning tree leaves and agricultural residues	53.2	1.0	-	45.8	100.0

	Status of Environmental Problem				
	No problem	Severe	Moderate	Low	Total
Over population	1.0	-	7.1	91.9	100.0
Deforestation	100.0	-	-	-	100.0
River/canal bank erosion	92.8	-	-	7.2	100.0
Land erosion	99.0	-	-	1.0	100.0
Flash floods	97.9	-	-	2.1	100.0
Arsenic contamination	94.6	-	-	5.4	100.0
Sedimentation of water bodies	99.0	-	-	1.0	100.0
Health and sanitation problem	3.0	-	-	97.0	100.0
Disease	-	-	-	100.0	100.0
Noise pollution	46.9	-	6.2	46.9	100.0

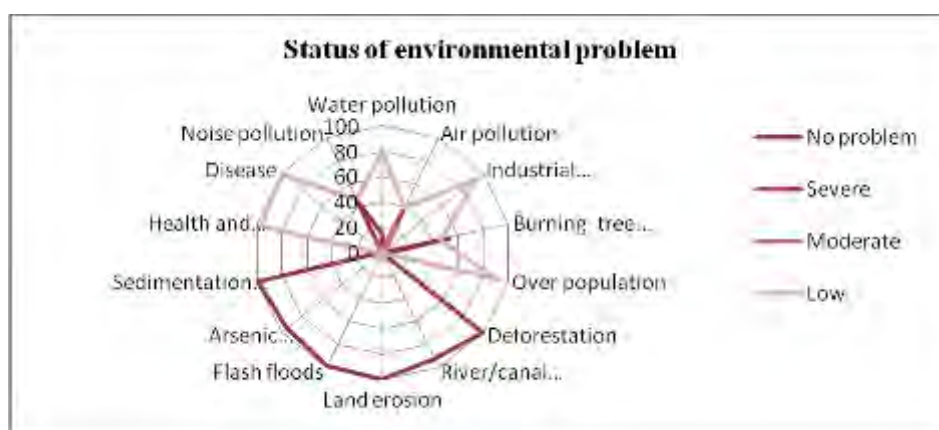


Figure 5.8: Status of environmental problem

5.4.1 Sources of Noise Pollution

According to the survey, respondents have attributed noise pollution to different types of vehicles that ply over the roads in all impact zones of the study area. 4.0% of the respondents attributed noise pollution to vehicles, construction work (7.1%) and pollution from big industries (3.0%) as moderate; whereas 84.9% and 26.3% mentioned commercial areas and small industries as low impacted sources of noise pollution respectively (Table-5.19).

Table-5.19: Percentage Distribution of Households Surveyed for Status of Noise Pollution Problem

Source	Status of Noise Pollution Problem				
	No problem	Severe	Moderate	Low	Total
Vehicles	39.4	-	4.0	56.6	100.0
Big industries	23.2	-	3.0	73.8	100.0
Small industries	73.7	-	-	26.3	100.0
Construction work	28.3	-	7.1	64.6	100.0
Households sources (Generator)	100.0	-	-	-	100.0
Power supply (irrigation engine)	100.0	-	-	-	100.0
Commercial areas	13.1	-	2.0	84.9	100.0

5.4.2 Sources of Air Pollution

According to the survey, 16.2% of the respondents mentioned big industries as the most pressing source of air pollution in the study area (Table-5.20). Various sources which contribute to air pollution, identified as low problem by the respondents, include vehicular emission (78.8%), open defecation (2.2%), small industries (26.3%), diesel engine (22.7%) and commercial areas (92.9%). Construction work (2.0%) has been identified as moderately impacted source of air pollution in all impact zones of the study area.

Table-5.20: Percentage distribution of households surveyed for status of air pollution problem

Source	Status of Air Pollution Problem				
	No problem	Severe	Moderate	Low	Total
Brick field	100.0	-	-	-	100.0
Vehicles	21.2	-	-	78.8	100.0
Construction work	23.2	-	2.0	74.8	100.0
Small industries	73.7	-	-	26.3	100.0
Big industries	22.2	16.2	-	61.6	100.0
Power plant	77.3	-	-	22.7	100.0
Commercial areas	7.1	-	-	92.9	100.0
Gas field	97.9	-	-	2.1	100.0
Burning fuel, trees and agriculture residue	69.1	-	-	30.9	100.0
Open defecation	97.8	-	-	2.2	100.0

5.5 Respondents Awareness and Perception about the Proposed Project

i) Respondents' Awareness about the Project

The survey reveals that 97.0% respondents in the study area are generally aware and have heard of the project. The survey also reveals that, rests of the 3.0% of the respondents do not have knowledge about the proposed project. In the high impact zone, 98.3% of the respondents have knowledge about the proposed project compare to 95.0% in the low impact zone of the study area (Table-5.26).

Table-5.21: Percentage Distribution of Households having knowledge about the Proposed Project

Study Area	Yes	No	Total
High	59(98.3)	1(1.7)	60 (100.0)
Low	38(95.0)	2(5.0)	40 (100.0)
All	97(97.0)	3(3.0)	100 (100.0)

Note: Figures within parentheses represent percentages

ii) Project Affected People

According to the survey, 99.0% of the households would be affected due to the project activities especially for noise. 98.3% households in the high impact zone and 100% of the households in the low impact zone mentioned that they would be personally affected due to the project respectively (Table-5.27).

Table-5.22: Percentage Distribution of Households Surveyed perception on negative impact due to project.

Study Area	Yes	No	Total
High	59(98.3)	1(1.7)	60(100.0)
Low	40(100.0)	-	40(100.0)
All	99(99.0)	1(1.0)	100(100.0)

Note: Figures within parentheses represent percentages

iii) Perceived Positive Impacts of the Project

Respondents also perceived that various benefits were expected to result from the

implementation of the project. These benefits, as perceived by the respondents, include; creation of employment opportunity, access to roads, enhanced socio-economic conditions, and overall national development in the area.

According to the survey, creation of employment opportunities is perceived as a beneficial effect of the project for 98.0% of the respondents. The implementation of the project will lead to national development, according to the opinion of 87.0% of the respondents. Enhanced local socio-economic activities and access to road infrastructure in the local area have been mentioned as positive outcomes of the project by 36.0% and 94.0% of the respondents respectively. Access to electricity (30.0%) and availability of irrigation water (10.0%) have also been mentioned by the respondents (Table-5.23).

In the high impact zone, creation of employment opportunities have been mentioned by 98.3% of the respondents whereas 97.5% of the respondents expect better access to infrastructure road in the low impact zone.

Table-5.23: Percentage Distribution of Households Surveyed Expecting Positive Impacts

Positive Impact	Study Area		
	High(n=60)	Low(n=40)	All(N=100)
More employment opportunity	98.3	97.5	98.0
Access to electricity	26.7	35.0	30.0
Access to infrastructure road	91.7	97.5	94.0
More local socio economic activities	33.3	40.0	36.0
Availability of irrigation water	15.0	2.5	10.0
National development	85.0	90.0	87.0

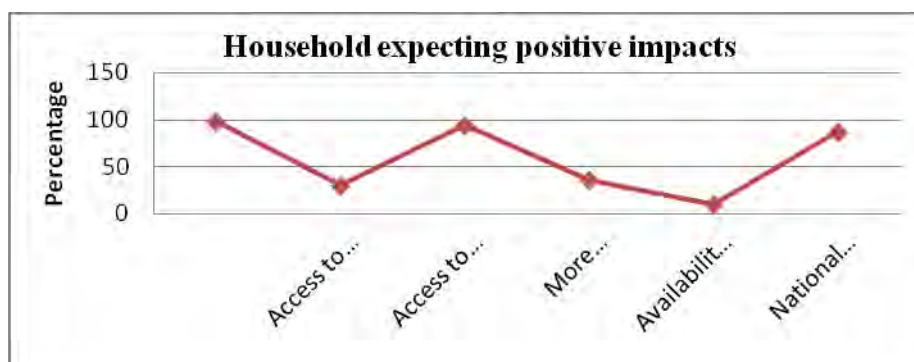


Figure 5.9: Household expecting positive impacts due to project

Table-5.24: Percentage Distribution of Households Surveyed for Affected People by Different Diseases

Name of Disease	Study Area		
	High	Low	All
Cold fever	42.8	55.3	46.6
Diarrhea	8.0	4.3	6.7
Jaundice	2.9	2.9	2.9
Typhoid	1.4	1.4	1.4
Diabetes	9.4	-	6.3
Asthma	30.4	30.0	30.3
Hypertension	5.1	1.4	3.8
Stroke	-	1.4	0.5
Others	-	3.3	1.5

Total	100.0	100.0	100.0
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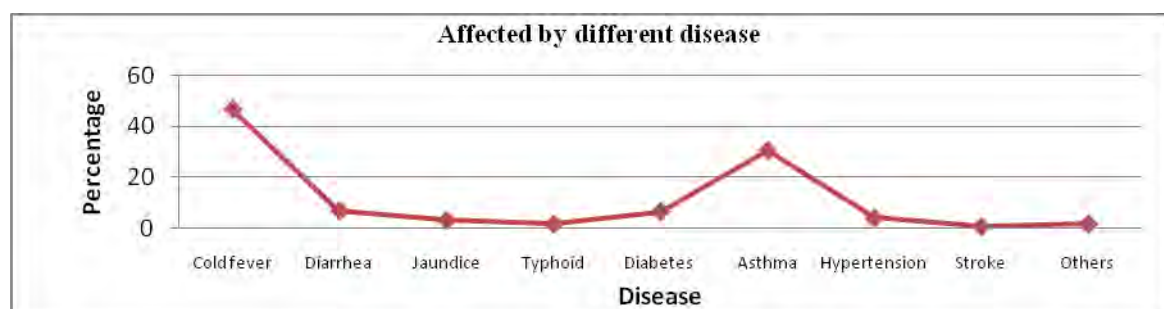


Figure 5.10: Affected by different disease

According to the survey, on an average 1.5 adult male get cold fever whereas 1.2 adult female and 1.1 young boys get affected by the same disease. The survey reveals that on average 1.2 number of young girl get affected by asthma in the study area (Table-5.25)

Table-5.25: Average Number of People Affected by Different Diseases

Name of Disease	Average Number of People Affected by Different Diseases			
	Male	Female	Boy	Girl
Cold fever	1.5	1.2	1.1	1.1
Diarrhea	1.0	1.0	1.0	-
Jaundice	1.0	1.0	1.0	1.0
Typhoid	-	1.0	1.0	1.0
Asthma	1.0	1.0	1.0	1.2
Hypertension	1.0	1.0	-	-
Diabetis	1.0	1.0	-	-
Others	1.0	1.0	1.0	-

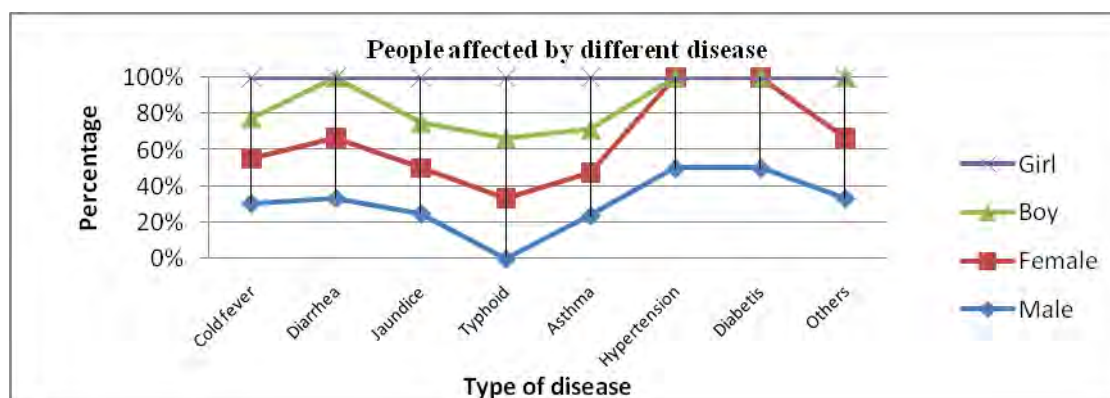


Figure 5.11: Average Number of People Affected by Different Diseases

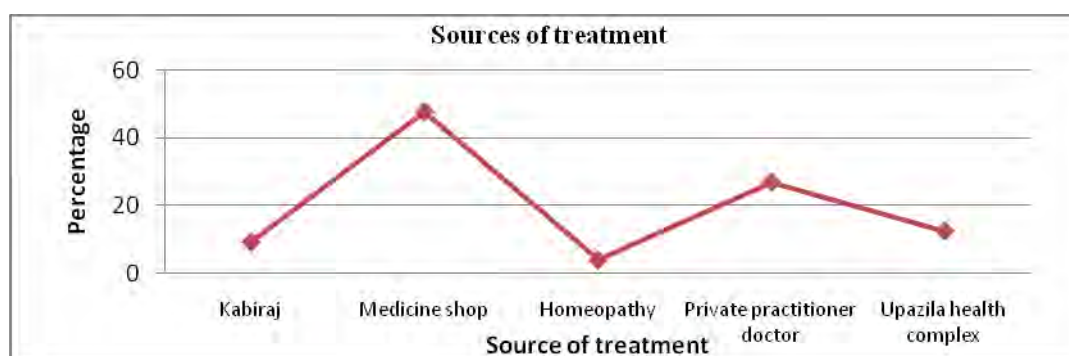


Figure 5.12: Source of treatment

CHAPTER – 6

ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

6.1 General

This section evaluates the identified impacts on different environmental parameters due to construction and operation of the proposed plant. After studying the existing baseline environmental scenario, monitoring environmental parameters, reviewing the process and related statutory norms, detailing the waste management measures, the major impacts can be identified during construction and operation phase. Relevant important aspects of environment are therefore selected which may have significant impacts due to project activities.

6.2 Impacts on Air Quality

As the fuel for the boiler operation furnace oil, the impact on air quality is significant for the project. **SO_x, NO_x and PM₁₀ will be generated from the plant.** However, hot (about 1000C) exhausted gas may affect the ambient air quality in terms of thermal pollution. Furthermore, some heat will be being generated inside the working area of factory building due to the presence of mass workers.

Emission of sulfur dioxide (SO₂): The emissions of SO₂ are dependent on the sulfur content of the gas. The Sulphur content of the last consignment of HFO obtained from the Bangladesh Petroleum Corporation (BPC) was 3.5%. This value was used in the air quality dispersion modeling in this assessment.

Emission of Nitrogen Oxides (NO_x)

An effect on ambient air quality has been assessed based on preliminary air quality modeling results. An advanced air emission dispersion modeling was conducted for preliminary environmental impact assessment for the proposed power plant at Madongonj, Narayangang. In the study, the NO₂ emissions for the reciprocating gas engine system discharged through stack were modeled to obtain maximum possible downward concentration. USEPA certified AEROMOD model was used to estimate emission concentration from the plant. The exhaust specifications and stack parameters for the proposed reciprocating gas engine is used as input to AEROMOD model. The individual engine stack data was used as point source of NO₂ SO₂ emission as per engine design has been considered for air dispersion modeling. The parameters and corresponding values are summarized in the Table 6.1.

Table 6.1: Summary of the exhaust specifications and stack parameters

Parameters	Values
Stack height	40 m
Design Stack diameter (m)	1.1 meter
Stack gas exit velocity (m/s)	27m/s
2 Engines with Exhaust Gas Boilers	32m/s
Other 4 Engines with no Exhaust Gas Boilers	
Exhaust temperature, 2 Engines with Exhaust Gas Boilers	240 +(-) 15 °C335+(-) 15 °C
Other 4 Engines with no Exhaust Gas Boilers	
NO ₂ emission rate as NO ₂ (mg/ Nm ³)	1460

Parameters	Values
SO ₂ emission rate (mg/ Nm ³)	2200
Ambient temperature (K)	305
PM 10 (mg/ Nm ³)	100

The modeling was conducted for the 6 individual engines releasing gaseous emission as point source with simple terrain using USEPA approved AEROMOD model. The model assumes the stack tip downwash with receptors on flat terrain and no flagpole receptor heights. The NO₂ concentration contour have been analysed with 50m interval with a radius of 7500m from the point source. The NO₂, SO₂ and PM₁₀ concentrations contour of annual average of maximum concentration has been analysed.

Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) for Bangladesh is given in Table 6.2.

Table 6.2: National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	Objectives	Averaging period
Carbon Monoxide (CO)	10 mg/m ³	8 hours(a)
	40 mg/m ³	1 hours(a)
Lead (Pb)	0.5 µg/m ³	Annual
Nitrogen Dioxide (NO ₂)	100 µg/m ³	Annual
Particulates of ~10µm (PM ₁₀)	50 µg/m ³	Annual (b)
	150 µg/m ³	24 hours (c)
Particulates of ~2.5µm (PM _{2.5})	15 µg/m ³	Annual
	65 µg/m ³	24 hours
Ozone (O ₃)	235 µg/m ³	1 hours (d)
	157 µg/m ³	8 hours
Sulphur Dioxide (SO ₂)	80 µg/m ³	Annual
	365 µg/m ³	24 hours (a)
Notes:		
(a) Not to be exceeded more than once per year;		
(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 µg/m ³ ;		
(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 µg/m ³ is equal to or less than 1; and		
(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 235 µg/m ³ is equal to or less than 1 (Source: AQMP, DoE).		

6.3 Air Quality Monitoring and Modeling Results

During the pre-construction (land rising) and construction phases, potential air quality impacts include exhaust from heavy equipment and generator sets, and fugitive dust in the immediate vicinity of the project site or haul route. Impacts are likely to be localised and relatively short-term in nature. To assess potential impacts during the operational phase, the AEROMOD dispersion model was used.

It was therefore selected as an appropriate model for this assessment. This model is therefore suited to a wide range of applications. Whilst AERMOD is the preferred dispersion mode of the EPA, calculations used in the AERMOD model rely on a large suite of meteorological parameters and does not work well with supplemental, off-site information. Therefore, given the relatively limited suite of meteorological data available in Bangladesh, it was concluded

that available meteorological data was not of sufficient quantity or quality to perform dispersion modeling in the newer AERMOD model. AERMOD requires a smaller suite of meteorological data inputs, can be used to assess concentrations from several types of sources associated with industrial source complexes, can account for building downwash, urban or rural dispersion coefficients, flat or elevated terrain, and averaging periods fro

Background

As per the ToR for the project, air dispersion modeling was completed to predict ground level concentrations (GLCs) of pollutants, including NO_x, CO, PM₁₀, for the required averaging period across the modeled domain (a 7.5 km × 7.5 km grid around the stacks). The predicted GLCs were assessed in isolation and also the cumulative impact of emissions from the proposed power plants and from the background values recorded in the project area between October-December 2015.

Modeling Methodology

Modeling results of NO_x for 40m stack height

Annual average concentration values of NO_x (μg/m³) for 40m stack height at different receptors are given in Appendix-1

Table 6.3: Project highest Annual average concentration (μg/m³) of NO_x for 40 m stack height

Pollutant	Highest Concentration (μg/m ³)	Avg. Period	High	Type
NO _x	17.79	Annual	1ST	GC

Isopleths of NO_x for 40m stack height (annual average concentration in μg/m³) around the plant site are given in Figure 6.1

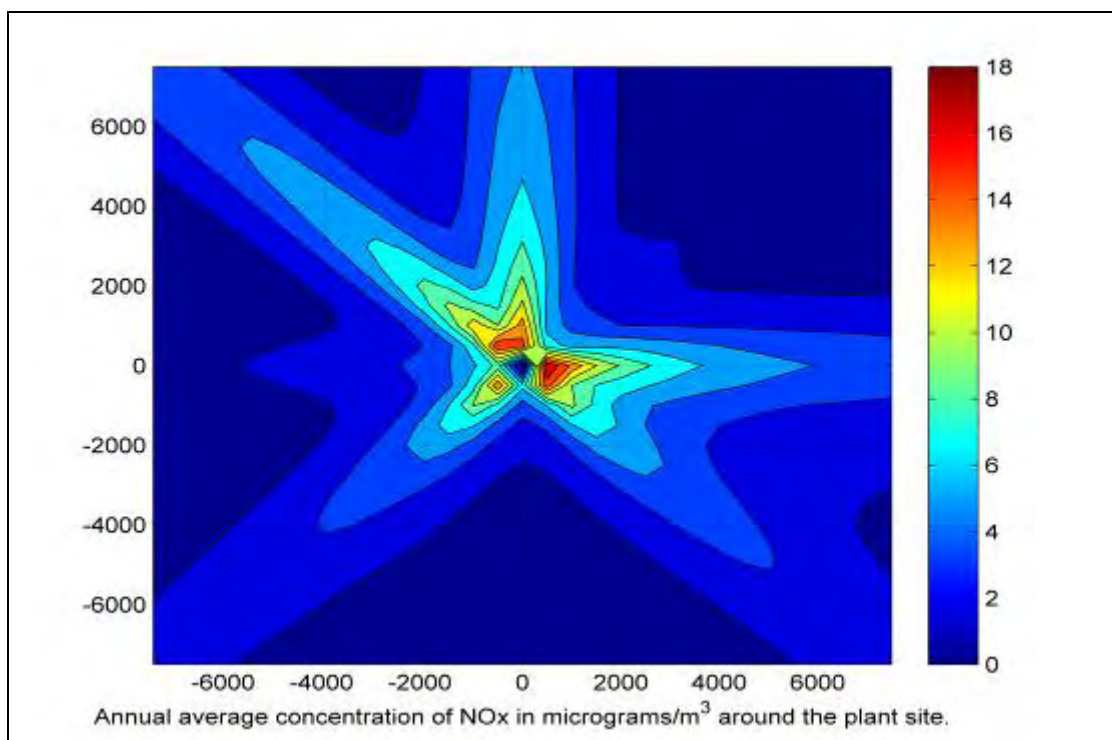


Figure 6.1: Annual average concentration of NO_x in μg/m³ around the plant site.

Table 6.4: Maximum 10 annual average concentration ($\mu\text{g}/\text{m}^3$) values of NO_x

High	Avg. Conc.	Receptor (m)		Elev. (m)	Type
		X	Y		
1st	17.79	500.00	0.00	0.00	GC
2nd	16.18	-500.00	500.00	0.00	GC
3rd	15.37	500.00	-500.00	0.00	GC
4th	15.07	0.00	500.00	0.00	GC
5th	14.35	-500.00	-500.00	0.00	GC
6th	14.25	1000.00	0.00	0.00	GC
7th	13.72	0.00	1000.00	0.00	GC
8th	12.55	-1000.00	1000.00	0.00	GC
9th	11.73	0.00	1500.00	0.00	GC
10th	11.37	1500.00	0.00	0.00	GC

Modeling results of SO_2 for 40m stack height

Annual average concentration values of SO_2 ($\mu\text{g}/\text{m}^3$) at different receptors for 40 m stack height are given in (Appendix-2)

Table 6.5: Project highest Annual average concentration ($\mu\text{g}/\text{m}^3$) of SO_2 for 40 m stack height

Pollutant	Highest Concentration ($\mu\text{g}/\text{m}^3$)	Avg. Period	High	Type
SO_2	26.82	Annual	1ST	GC

Isopleth of SO_2 (annual average concentration in $\mu\text{g}/\text{m}^3$) around the plant site are given in Figure 6.2

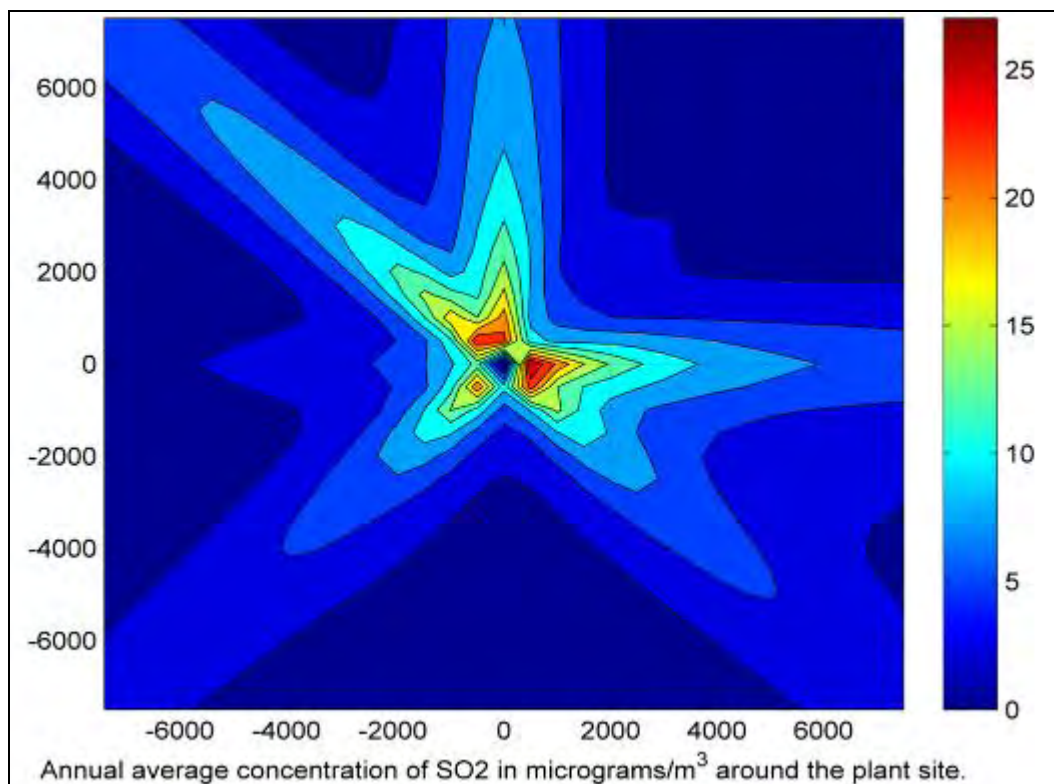


Figure 6.2: Annual average concentration of SO_2 in $\mu\text{g}/\text{m}^3$ around the plant site.

Table 6.6: Maximum 10 annual average concentration ($\mu\text{g}/\text{m}^3$) values of SO_2

High	Avg. Conc.	Receptor (m)		Type
		X	Y	
1st	26.82	500.00	0.00	GC
2nd	24.40	-500.00	500.00	GC
3rd	23.18	500.00	-500.00	GC
4th	22.72	0.00	500.00	GC
5th	21.63	-500.00	-500.00	GC
6th	21.48	1000.00	0.00	GC
7th	20.69	0.00	1000.00	GC
8th	18.93	-1000.00	1000.00	GC
9th	17.69	0.00	1500.00	GC
10th	17.14	1500.00	0.00	GC

Modeling results of PM_{10} for 40m stack height

Annual average concentration values of PM_{10} ($\mu\text{g}/\text{m}^3$) at different receptors for 40 m stack height are given in (Appendix-2)

Table 6.7: Project highest Annual average concentration ($\mu\text{g}/\text{m}^3$) of PM_{10} for 40m stack height

Pollutant	Highest Concentration ($\mu\text{g}/\text{m}^3$)	Avg. Period	High	Type
PM_{10}	1.22	Annual	1ST	GC

Isopleth of PM_{10} (annual average concentration in $\mu\text{g}/\text{m}^3$) around the plant site are given in Figure 6.3

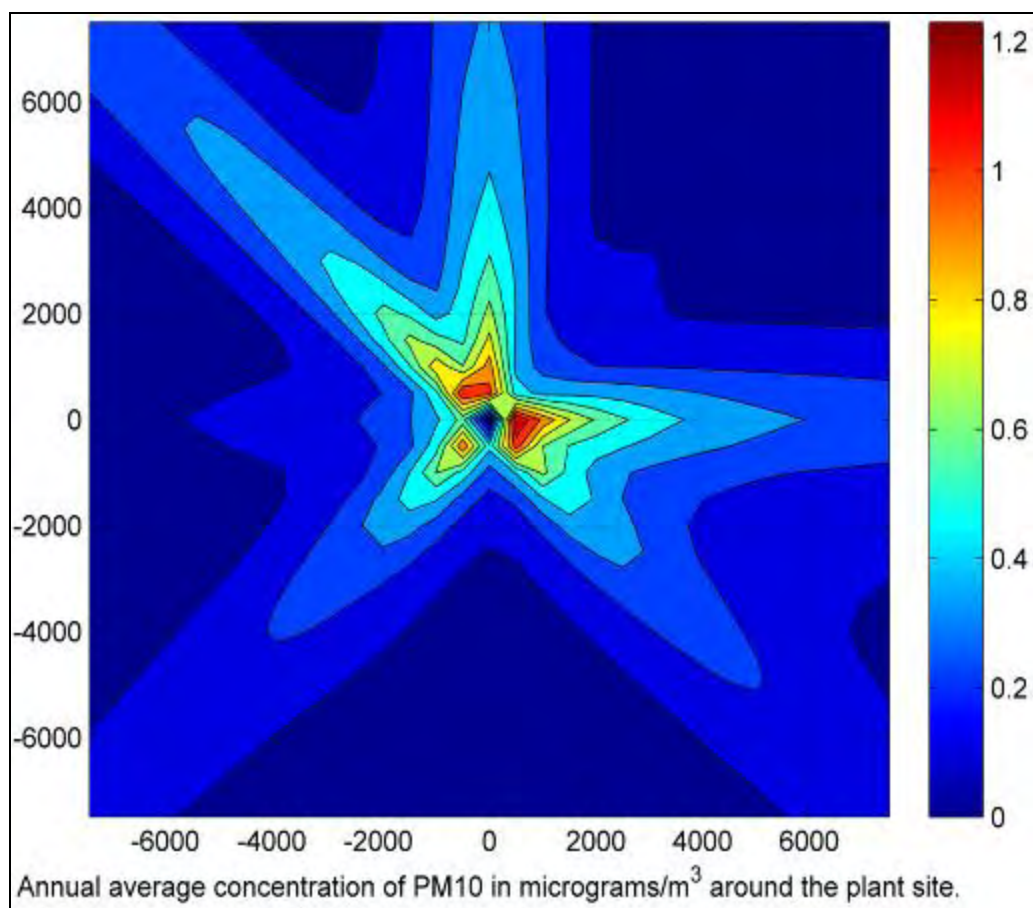


Figure 6.3: Annual average concentration of PM_{10} in $\mu\text{g}/\text{m}^3$ around the plant site.

Table 6.8: Maximum 10 annual average concentration ($\mu\text{g}/\text{m}^3$) values of PM_{10}

High	Avg. Conc.	Receptor (m)		Type
		X	Y	
1st	1.22	500.00	0.00	GC
2nd	1.11	-500.00	500.00	GC
3rd	1.05	500.00	-500.00	GC
4th	1.03	0.00	500.00	GC
5th	0.98	-500.00	-500.00	GC
6th	0.97	1000.00	0.00	GC
7th	0.94	0.00	1000.00	GC
8th	0.86	-1000.00	1000.00	GC
9th	0.80	0.00	1500.00	GC
10th	0.78	1500.00	0.00	GC

The predicted highest values for NO_x and SO_2 contributed by the plant are given in the table below:

Table 6.9: Project highest annual average concentration ($\mu\text{g}/\text{m}^3$)

Pollutant	Project highest annual average concentration ($\mu\text{g}/\text{m}^3$)
NO_x	17.79
SO_2	26.82
PM_{10}	1.22

Summary of maximum GLCs over the model domain is given in Table 6.10.

Table 6.10: Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging period	DOE Bangladesh Std ($\mu\text{g}/\text{m}^3$)	Background conc ($\mu\text{g}/\text{m}^3$)	Predicted Maximum contribution by the plant ($\mu\text{g}/\text{m}^3$)	Combined value ($\mu\text{g}/\text{m}^3$)
NO_2	Annual	100	74.4	17.79	92.19
SO_2	Annual	100	53.03	26.82	81.65
PM_{10}	24 hourly	150	147.54	1.22	148.76

Impact assessment due to SNPL UNIT II Unit II

Modeling results indicate that the NO_2 and SO_2 emissions around the power plant site during the operation of the plant will remain much below the DOE standards. The PM_{10} concentration is marginally below DOE standards as the plant location is adjacent to a large cement clinker grinding industry and that the construction of the proposed plant was ongoing. Additionally the air quality monitoring was carried out in December 2015 and during dry season the concentrations of particulate matter is usually higher compared to the wet seasons.

Impact due to Liquid Discharge

Proposed power plant will not create any process liquid from the production process. The power plant will have a radiator cooling system where small amount of water will be required as makeup water. In addition, small amount of water will also be used for occupational floor, equipment washing and for domestic purposes. This wash water will not contain significant amount of pollution, which may impact the surface water quality.

The domestic liquid waste will be disposed through a septic tank with a soak pit. The project will have planned drainage system to discharge the surface runoff. The surface drainage network would be connected with an interceptor prior to discharge through natural water. The interceptor will trap all oily matter present in the water. The following figure shows the ETP for oily water.

The oily water is collected in a buffer tank. The oily water is then transferred after adding the emulsifying agent to the multistage filter where multiphase emulsion process is takes place

The principle of Multi Phase Emulsion Breaking for sepeartion of oil from water: An emulsion is formed when two nonsoluble liquids (e.g., an oil and water) are agitated together to disperse one liquid into the other, in the form of drops. Emulsions can either be oil-in-water (O/W) or water-in-oil (W/O), depending on whether the continuous phase is the water or the oil, respectively. Drop sizes normally vary from 1 μm to 50 μm . When the agitation stops, if the drops coalesce and the two phases separate under gravity, the emulsion has been temporary. To form a stable emulsion, an *emulsifying agent* must be added to the system.

The Figure 6.4 shows the flow diagram of the existing ETP plant being used for SNPL UNIT II Unit I and Figure 6.5 shows the principle of multiphase emulsion breaking In any oil and water separation.

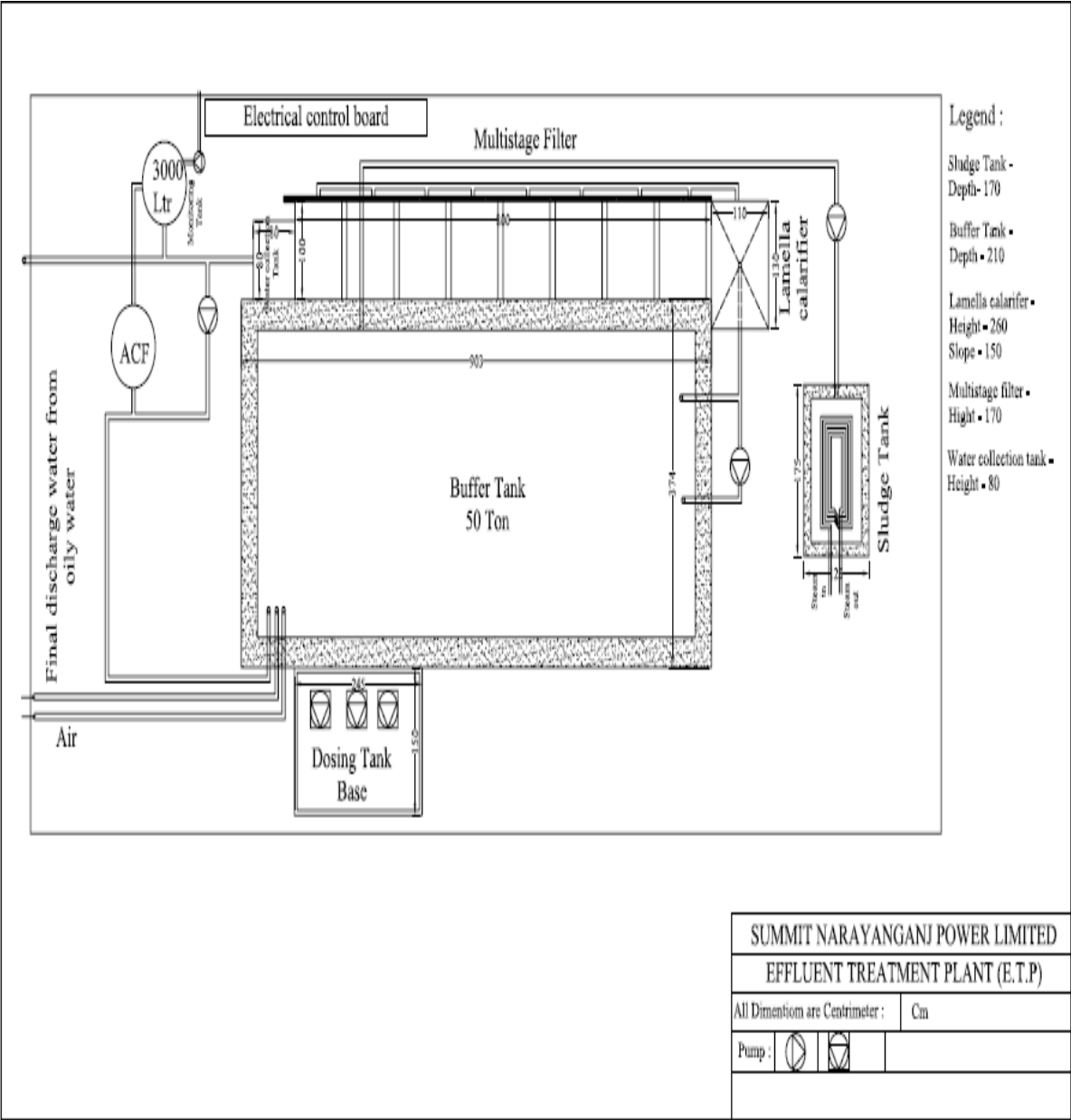


Figure. 6.4: Oily matter separator

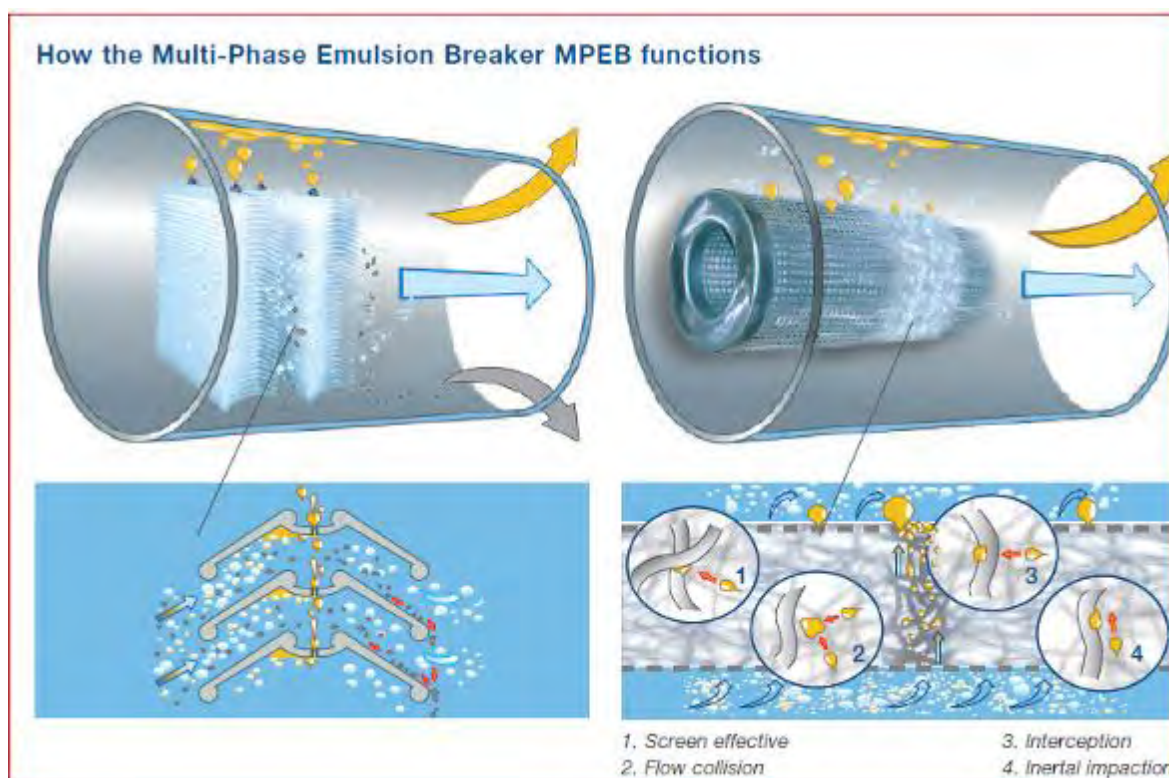


Figure 6.5: Multi-phase emulsion breaker MPEB functions

Noise, Vibration and Heat Generation Mitigation

From the specification of Wartsila engines to be used the noise level measurements according to Standard ISO 9614-2:1996 at a frequency of 60Hz the sound power to the frequency is 85 dB. It is recommended that the noise level be kept below the standards set by the DOE by sophisticated acoustic measures. The noise will be dispersed to the surrounding atmosphere to a certain extent.

Mitigation measures

To reduce the effect of noise, 100mm composite walls capable to result in transmission loss of 48 dB (Reference: “Sound Transmission through Buildings Elements like Massive Walls and Floors” www.EngineeringToolBox.com). Moreover, vibration pads should also be used at the bed of all power generation units to prevent the vibration (Detail in Annex 18, a,b,c,d,e,f).

The SNPL UNIT II Unit II will be established in mixed commercial and rural settings which fall under the mixed area zone category of Bangladesh standard. The noise modeling report is shown in the following Map 6.1

6.4 Noise modeling calculation

SNPL UNIT II Unit II appointed International Consultant ND Technology (SEA PTE LTD.) in 2nd April 2015 to carry out a detailed noise analysis and its impact due to SNPL UNIT II II. During this analysis the existing SNPL UNIT II Unit I was fully operational. The aim of the study was to assess noise level and suggest control measures to mitigate the noise impact specially on the north part of the project where the nearest settlement is which is about 40 meters. Average noise level measured at the boundary wall of the north east settlement was

found to be 66.7dBA. This is above the DoE Standard for mix zone. The following mitigation measures have been suggested:

1. Construction of an acoustic boundary wall the following mitigation measures have been undertaken. The boundary wall is constructed with bricks upto 5 meters and additionally 2.5meters extension with especial sound absorbing material. The detail drawing is shown in Annex 18
2. Material of construction of Engine hall consists of a composite type i.e sanwich brickwalls with an inner layer of fibre glass wool. The detail as shown in Annex 18
3. The engine hall will be equipped with sophisticated air ventilation system with noise attenuators located on the roof of the engine hall. The ventilator system has inbuilt silencer device. The detail as shown in Annex 18

The above mitigation measures will ensure that the sound level at the nearest settlement is within the Bangladesh Standard level.

Beyond the boundary walls of SNPL UNIT II Unit II a noise modeling has been carried out by this study which is based on the method documented by the International Energy Agency. It is a simple model which assumes spherical spreading from a point source either in free space (spherical) or over a reflective plane (hemi-spherical). For this case, spherical spreading has been used because sound wave is propagating uniformly in all directions and the crests and troughs of the sound waves can be pictured as spheres centered on the source location. The total noise from each engine is logarithmically added according to the formulae given below:

$L_A = 10 \log_{10} (10^{L_A/10})$ dBA, Where: LA = Sound Source 1 (i.e. SNPL UNIT II power plant)

The model presents a 'worst-case scenario' as it does not take into account factors which would reduce noise propagation, such as:

- Uneven topography
- Large obstructions in the propagation path, e.g. barriers etc
- Refraction of noise, e.g. due to atmospheric effects such as temperature inversion
- Wind speed or direction effects
- Any change in the propagation with changing frequency
- The noise level is conservatively assumed to be 85 dB

The mathematical formula for the noise model is shown below:

$$L_P = L_W - 10 \log_{10} (2\pi^2) - ar$$

$$L_P = L_W - 10 \log_{10} (4\pi^2) - ar$$

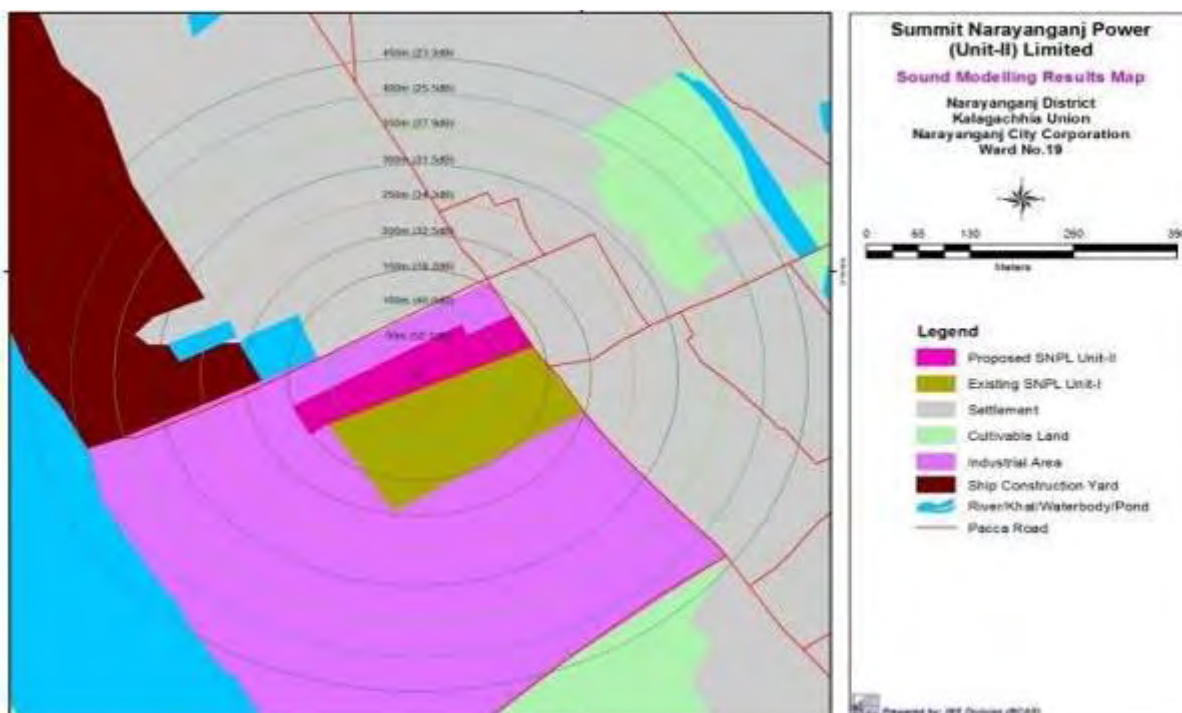
Where: r is the distance from source to receiver;

a is the absorption due to the atmosphere (dB/m), which is most commonly used as 0.005dB/m;

L_W the sound power level of the engine room; and

L_P the output sound power level of the engine room at different radius away from the source.

Graphic User Interface (GUI) software was built based upon the model using MATLAB programming language for enhancement in calculation and analysis. The results of noise level prediction simulation at increasing radius using a MATLAB code is given in Map 6.1.



Map 6.1: The map described the noise concentration around 500m of the plant site

6.4.1 Noise Modeling Results

Table 6.11: At 85 dB noise input (for each Engine), the predicted noise output is as follows

Radius (m)	1	50	100	150	200	250	300	350	400	450
Predicted value(baseline +log ₁₀ of model value)	85	52.3	46.0	38.2	36.5	34.3	31.5	27.9	25.5	23.2

The relationship between the adjacent area and noise level in terms of noise generated from the engine room and the radiator fans are presented in the aboveTable. However, there are few homestead at the north side, west and south-west side of the project within the 100m radius of the proposed project where the noise contribution from the project would be around 28 dBA. The ambient noise standard of IFC and Bangladesh Government is mentioned in the following Table 6.12.

Table 6.12: Standards of noise level

Standard	Zone	Day time dBA	Night time dBA
World Bank EHS Guideline 2007	Residential, institutional, educational	55	45
	Industrial, commercial	70	70
Bangladesh ECR, 1997	Mixed area	60	50
	Commercial	70	60
	Industrial	75	70

Impact on the diodiversity

This study identifies a wide range of plant, animal and fish species in the SNPL UNIT II Unit II impact zone areawhich indicate a healthy ecosystem. The IUCN category for threatened

status was checked for each of these species. Most of the identified plants were either least concern (LC) or not evaluated (NE); only 3 were conservation dependent (CD). For amphibian, 1 species was listed as endangered (EN) and others were either list concern (LC) or not evaluated (NE). For reptilian, 6 species were listed as vulnerable (VU), 1 species as EN and others as LC. In case of mammals, 3 species were listed as VU, 3 species as EN and others as LC. All the bird species were either LC or NE. For fish, 11 were VU, 9 were EN, 4 was critically endangered (CR) and rest were either data deficient (DD) or not threatened (NO). During FGDs and key informant interviews the respondents of this study were asked about the availability of each species in their locality and reasons for any change. The respondents were especially asked to explain carefully if there are any impacts of SNPL UNIT II on the local biodiversity especially on the species listed as CR, EN and VU. They identified some reasons for changes in biodiversity such as over fishing, pouching, industrial encroachment, effluent discharge from industries, habitat destruction, changes in weather climate etc. However, currently, they did not found any considerable impact of the SNPL UNIT II on the local biodiversity. They said that the SNPL UNIT II is comparatively newly established that's why no impact on biodiversity has found so far, however, in future it may have negative impacts when it will grow older. Thus monitoring need to be done in order to identify any impacts in future.

6.5 Significant Environmental Impacts

The potential significant environmental impacts, prior to mitigation measures, associated with the Proposed Development are summarized in the following tables:

- Table 6.7 – Construction phase;
- Table 6.8 – Operational phase; and
- Table 6.9 – Decommissioning phase.

All pre-construction works have now been completed at the Project Site, therefore the assessment of impacts has not been presented in this ESIA. It is understood that all measures recommended in previous versions of the EIA were implemented by the EPC Contractor and other sub-contractors during the works.

Impacts during the decommissioning phase will be similar to those for the construction phase and as such have not been assessed separately.

Impacts have been categorized into 'Minor', 'Medium' and 'Major' Impacts (assessed prior to consideration)

Minor Impact: The impact, if any, is not considered significant and no mitigation will be necessary.

Medium Impact: The impact will be localized and/or temporary in nature and some migration will be necessary.

Major Impact: There is potential for a significant impact and mitigation, and monitoring of the effectiveness of the proposed mitigation, will be required. If appropriate and effective mitigation is not possible, alternative course of action (i.e. alternative site, method or technology) will be required.

Negligible: No beneficial or adverse impact.

Table 6.13: Anticipated Impacts and Impact Management during the Construction Phase

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
1. Air Emissions			
Exhaust from heavy equipment and generator sets	Major	Air Emissions and Ambient Air Quality of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants. Whilst emissions from vehicles and other combustion engines will be isolated and temporary in nature, the EPC Contractor will ensure: • Equipment and generators in good running condition through adequate maintenance; and • Switching off engines when not in use. In order to mitigate dust emissions, the EPC Contractor will carry out: • Periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emission; • Cover all stockpiles with canvas or plastic sheets during windy periods; • Clean road vehicle wheels before leaving the site; and • Prohibit rubbish burning within the construction site.	Regular checks by the EPC Contractor to ensure implementation of good management practices. Maintaining liaison with the public including systematic recording and investigation of any complaints.
Fugitive dust in the immediate vicinity of the Project Site or haul route:	Major		
Primary emissions of NO _x , SO ₂ , PM _{2.5} and PM ₁₀ , CO, CO ₂ , VOCs, etc.	Major		

2. Noise			
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
Noise impact on nearby homesteads and/or sensitive receptors.	Major	Implementation of Noise Prevention and Mitigation measures as mentioned in 1.0 Environmental, Sub-section 1.7 Noise of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environments of IFC EHS Guidelines for Thermal Power Plants. The EPC Contractor will: • Select equipment and construction techniques that cause minimum noise. Maintain equipment in good working order; • Construction activities, such as piling, which generate significant noise, will be carried out during the Day time; • Install noise reduction equipment i.e. silencers and mufflers, on noisy plant and frequently check the efficiency of noise attenuation equipment; and • Agrievance mechanism will be established as part of a stakeholder engagement plan. To mitigate potential noise from construction traffic, construction materials road vehicles are required, these will be routed in a way that the primary residential areas are avoided and the movement takes place during day time.	Daily check of noise management by the EPC Contractor. Maintaining liaison with the public including systematic recording and investigation of any complaints.
3. Terrestrial and Aquatic Habitat			
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
Potential for impacts on wildlife (i.e. loss of habitat, hindrance to wildlife movement).	Minor	Boundary fencing of the Project Site area will ensure wildlife choose alternative routes. Provision of landscaped areas, where possible, around and within the Project Site using indigenous species to supply habitat for terrestrial and riparian species and improve aesthetics. Construction workers will be prohibited from felling trees, hunting wildlife and fishing in the vicinity of the project site.	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase.
Potential for impacts on aquatic habitat and nearby fisheries.	Negligible	Provision of appropriate treatment plants for liquid and other wastes and/or facilities which allow the collection and storage of harmful and hazardous wastes in safe containersto minimize potential pollution impacts on the Sitalakha River.	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase. Maintaining liaison with the public including systematic recording and investigation of any complaints.

4.HumanSanitaryWastes			
Potential for impairment of surface water quality, as well as health impacts.	Major	Implementation of management measure as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual(2010); and Section 1.0 Environmental, Sub-section 1.6 Waste Management of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants and ensuring: • Provision of appropriate number of toilets and hand- washing points at the work-site; • Provision of on-site treatment of sanitary wastes; and proper disposal.	Regular check by EPC Contractor to ensure implementation of sanitary requirements. Periodic inspection of operational sewage treatment facilities by EPC Contractor. Water quality sampling every 3 months, including BOD.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		• Training of construction employees on projects sanitation	
5.Solid Wastes			
Solid waste generation and disposal (potential for land, surface water and groundwater contamination).	Major	Implementation of management measure as mentioned in ADB SPS (2009) and Section F1/BP of ADB Operations Manual(2010); and Section 1.0 Environmental, Sub-section 1.6 Waste Management of IFC General EHS Guidelines and Section 1.0 Industry-Specific Impacts and Management, Sub-section 1.1 Environment of IFC EHS Guidelines for Thermal Power Plants. • Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. • Segregate wastes by types and provide appropriate Waste containers for the storage of all waste streams. • Provide a specific area for the storage of solid Hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). • Prohibit the burning of wastes. • Arrange a waste removal contract and schedule at least weekly waste collection to prevent the build-up of waste materials. • Audit waste contractors to ensure appropriate disposal Methods are applied according to the waste stream.	Regular inspection by EPC Contractor to ensure implementation of good waste management practices.

6.Surface Water Quality			
Sedimentation and run-off of hazardous materials (i.e. oils and fuels) to neighboring water bodies.	Moderate	An earth bund will be constructed to prevent the discharge of sediment and hazardous materials to neighboring water bodies. Storm water will be discharged via a settlement tank and an oil separator to the Sitalakhya River.	Waters samples will be obtained quarterly from the water bodies in the area pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, Arsenic and BOD.
7. Release of Contaminating Materials			
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
Environmental contamination due to spillage or accidental release of hazardous materials (i.e. fuels, lubricants, solvents) onsite.	Minor	Measures should include: • Prohibition of dumping any contaminating material on the Project Site or elsewhere; • Storage and routine handling of fuels, lubricants, oils, solvents and other potentially contaminating substances in a weather-protected area equipped with a secondary containment system for spills; • Requisite steps should be taken toward spill prevention and, to this end, spill contingency plan should be undertaken. Necessary equipment and materials should be made available on-site to execute cleanup operations; and • All materials recovered during clean-up operations should be stored in labelled and secured containers for	EPC Contractor should: • Monitor refueling and other material transfer process; and • Report all significant spills (i.e. volumes ☐ 5 liters) to concerned group for notifying appropriate GoB agency for proper action.
Environmental contamination due to spillage or accidental release of hazardous materials (i.e. fuels, lubricants, solvents) during off-site transportation.	Minor	Measures should include: • Safety program, including signage, speed restrictions, lights on trucks, truck load restrictions, equipment inspection (brake, horn, etc.); and • Establishing spill response procedure to allow quick response to clean up any off-site spills.	Inspection of vehicle safety equipment – periodically by EPC Contractor, daily by vehicle operators. EPC Contractor to report upon all spills associated with the project.

8. Traffic Safety			
Community disturbance and potential safety hazard.	Medium	Implementation of Section 3: Community Health and Safety and Sub-section 3.4: Traffic Safety of the IFC General EHS Guidelines and Section 1.0: Industry-Specific Impacts and Management and Sub-section 1.3: Traffic Safety of the IFC EHS Guidelines for Thermal Power Plants. Prepare a traffic and transportation plan for the construction phase, which includes (but not limited to):	EPC Contractor to: - Implement the traffic and transportation plan. - Record and investigate all accidents and near misses. - Visual inspection of roads used by construction vehicles. - Review of complaints received via the formalised grievance mechanism.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		- avoid the transportation of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and drive traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area; - provide training on safe driving; - prevent unauthorized access (i.e. public access) to the Project Site; - load trucks in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the construction site. Resolve potential river traffic navigation problems and construction of a jetty along the river bank. No significant increase in river traffic volume is anticipated. A grievance mechanism established as part of a stakeholder engagement plan.	

Road Traffic Capacity of existing roads (weight/load limit and width of existing bridges, obstacles, e.g., power and telephone lines).	Medium	Survey of roadway for detecting weaknesses and obstacles that could be affected by project traffic.	EPC Contractor to investigate into all complaints.
River Traffic Community disturbance	Medium	Resolving potential navigational problems in respect of the project vis-à-vis river traffic and construction of jetty along the bank of the Sitalakha River.	EPC Contractor to investigate all potential related complaints.
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
9. Occupational Health and Safety			
Work-related injuries and health problems.	Major	Implementation of Occupational Health and Safety Programme (OHSP) to address all aspects of worker health and safety in relation to the construction process of the project. Such a programme needs, inter alia, to taking into account all the necessary aspects detailed in ADB SPS(2009) and Section F1/BP of ADB Operations Manual(2010); and Section 2.0: Environment and Sub-section 2.2: Occupational Health and Safety of the IFC EHS Guidelines for Thermal Power Plants. Notify local clinics and hospitals before commencement of construction works. Job specific medicals for all employees. EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorized access to the Project Site. Preparation of an EHS Plan for approval by SNPL UNIT II UNIT II, including: • EHS Policy and Objectives; - Appointment of qualified EHS specialist(s) who will be on-site throughout the construction project;	EPC Contractor to monitor EHS Performance, including regular audits.
Exposure of personnel to hazardous substances in the workplace.	Major		

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		• Project EHS rules; • Details of how rules and updates (if required) will be communicated to workers • Identification and risk assessment of hazardous activities and high risk areas; • Safe working methods for hazardous activities; • Ensure all personnel are provided with all required Personal Protective Equipment (PPE) for the environment they are in and the tasks they are performing; • Implementation of a Lock-out Tag-out program; and • Reporting and investigation procedure for all severe and minor accidents, and near misses. Ensuring all subcontractors (if any) sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with.	
Vector-borne and Food contamination related diseases	Minor	EPC Contractor will be required to put in place a program aimed at reducing the risk of occurrence of vector-borne diseases among construction personnel. This needs to include elimination of potential insect breeding sites and provision of preventive medication, where applicable.	Regular check of workplace personnel's health by designated medical team. Informing the work place personnel of possible symptoms of diseases they might be exposed to and approaching on-site medical team as then necessity arises.

Concentration of Labor force	Major	Bangladesh has ratified key International Labour Organization (ILO) convention, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	SNPL UNIT II UNIT II to review recruitment policy and worker employment contracts.
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Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		<i>Bangladesh – First Edition, May, 1996</i>) and World Bank as well as ADB health and safety guidelines will be met. Key Chapters in Labour and Industrial Law of Bangladesh – First Edition, May, 1996 include: • Chapter 1: Workman's Compensation (Workman's Compensation Act, 1923); • Chapter 3: Health (Factories Rules, 1979); and • Chapter 4: Health and Safety (Factories Act, 1965).	
10. Emergency Response			
Emergency Response (i.e. Fire, Earthquake, Flood etc.)	Major	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, for approval by SNPL UNIT II UNIT II. The ERP will include: • what should be done and who should do it; • what equipment is required and where this will be located; and • staff training requirements and inductions for new workers and site visitors. In addition, the ERP will include: • a method for communication of the ERP to all workers and people arriving on-site; • an emergency contacts document which is maintained and up to date; • - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable	Emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		emergency, ensure suitable resources are available at the site and trained/equipped to respond; and - Liaison with local emergency services to ensure they are familiar with the site layout and potentially hazardous locations.	
11. Social Concerns			
Economic dislocation of agricultural plot holders, shared croppers, day laborers, etc.	Minor	The required land SNPL UNIT II Unit II was purchased from willing sellers at mutually agreed land price. There were no share croppers or agricultural work in the project area.	No monitoring required
Influx of Temporary Laborers	Major	The EPC will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of an influx of workers in the project area. The on-site labor camp should meet the relevant standards. The Grievance Redress mechanism is to address any complaints from local people.	The project entrepreneur and the EPC contractor will monitor the social impacts on the local villages during the construction of the SNPL UNIT II UNIT II Power Plant and will work with local Community leaders to mitigate any adverse impact.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
12. Procurement of Local Labor, Goods and Services			
Economic benefits to the people of Project area	Major	Review the suitability and capacity of local workers. The EPC Contractor will be encouraged to recruit local labor, goods and services, wherever these are available provided acceptable quality and price. The EPC Contractor will be required to follow a local procurement policy. The EPC Contractor will develop a Recruitment Policy for approval by SNPL UNIT II. The Recruitment Policy will include: i. ensure equal opportunities, fair treatment recruitment, compensation, remuneration, working conditions and terms of employment; ii. a means of expressing grievances; and iii. engaging subcontractors and suppliers who do not employ child labor or forced labor, and operate appropriate management systems consistent with requirements (i) and (ii).	The EPC Contractor will provide SNPL UNIT II with details of the amount of local labor, goods and services. SNPL UNIT II to review recruitment policy and worker employment contracts.

6.6 The Operational Phase

Table 7.14: Anticipated Impacts and Impact Management during the Operational Phase

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
1. Air Emissions			
NO _x , SO _x emissions	Major	Installation of a 40 m stack to ensure effective dispersion of the pollutants. Install Continuous Emission Monitoring Systems (CEMS) for continuous monitoring of emissions rates.	CEMS for stack emissions: -NO _x ; -SO ₂ ; -PM ₁₀ ; -CO; -O ₂ ;and -Flowrate. The quantity and quality of the HFO supplied and consumption per KWH
Green house Gases	Minor	Monitoring operating load conditions.	Annual GHG audit to be prepared.
2. Noise			
Noise levels at nearby receptors.	Major	The Engines will be installed in buildings equipped with acoustic walls and enclosures along with sophisticated ventilation system fitted with silencers on the roof of the engine hall . Silencers and mufflers will be installed on all site vehicles. Post warning signs in areas where the noise level exceeds 80 dB(A) and ensure workers are provided with hearing protection when working in these areas. Establish a grievance mechanism as part of a stakeholder engagement plan.	Noise monitoring for at the nearest residential properties to the north, east and west of the power plant. Review of complaints received via the formalized grievance mechanism. Inspect all equipment and vehicles to ensure it is maintained in a good working order.
3. Surface Water Quality			

Discharge of waste water to surface water	Minor	Prior to discharge, the effluent will be treated in an ETP to primarily remove oil from water. The treated water quality is to be monitored to ensure it meets the effluent quality standards detailed in the DOE standards and IFC EHS Guidelines.	Monitoring of effluent quality will be undertaken prior to discharge for pH, TSS, Oil & Grease, Total residual Chlorine, Chromium (total), Copper, Iron, Zinc, Cadmium, Mercury, and Temperature.
Water Consumption	Negligible	Radiative cooling system will be used and as such the requirement of water is low.	Water consumption to be monitored and compared with design consumption values
Site operations, including the storage of hazardous materials (i.e. oils, fuels and chemicals), have the potential to impact the neighboring Sitalakha River.	Major	Surface water monitoring will be carried out downstream of the site to ensure compliance with the Bangladesh water quality standards. Hazardous materials will be stored with appropriate secondary containment to prevent accidental release to the river. The storm water drainage system will comprise oil/water interceptors and all drainage in the vicinity of designated hazardous materials storage areas will discharge to the ETP.	Water quality will be monitored once during the first 3 months following commissioning and subsequently once per year.
4. Terrestrial and Aquatic Habitat			
Potential for impacts on wildlife (i.e. loss of habitat, hindrance to wildlife movement).	Minor	Boundary fencing of the Project Site will ensure wildlife choose alternative routes. Planting of indigenous trees, where possible, around the boundary of the Project Site. Provision of landscaped areas, where possible, around and within the Project Site using indigenous species to supply habitat for terrestrial and riparian species and improve aesthetics.	The planted trees will be inspected to ensure they become established. Any planted trees which do not successfully establish will be replaced.

Potential for impacts on aquatic habitat and nearby fisheries due to effluent discharges to the River Sitalakha	Negligible	Provision of appropriate treatment plants for liquid and other wastes and/or facilities which allow the collection and storage of harmful and hazardous wastes in safe containers to minimize potential pollution impacts on the River. Treated effluent will be monitored to ensure it meets the effluent quality standards detailed in the DOE standards and IFC EHS Guidelines.	Monitoring population of terrestrial and aquatic organisms of the area in every six months during the construction phase. Maintaining liaison with the public including systematic recording and investigation of any complaints.
5. Human Sanitary Waste			
Potential for impairment of surface water quality, as well as health impacts.	Medium	Provision of an appropriate number of toilets and hand-washing points.	Regular checks of the sewage treatment system by the EHS Manager to ensure continuation of proper functioning.
		Provision of on-site treatment of sanitary wastes using soak pits of sufficient size. Training on sanitation practices.	Surface water quality sampling with analysis for COD/BOD
6. Solid Waste			
Solid waste generation and disposal (potential for land, surface water and groundwater contamination)	Medium	Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. Segregate wastes by type and provide appropriate waste containers for the storage of all waste streams. Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). Prohibit the burning of wastes. Arrange a waste removal contract and schedule at least weekly waste collections to prevent the build-up of waste materials. Audit waste contractors to ensure appropriate disposal methods are applied according to the waste stream.	Periodic checks by EHS Manager to ensure that waste management procedures are being followed.

7. Hazardous Materials Management			
Soil, Groundwater and Surface water impacts as a result of poor hazardous materials management	Major	Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. Periodic checks of all HFO tanks and pipelines.	Periodic checks by EHS Manager to ensure mitigation measures are implemented and enforced.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		Hazardous materials (i.e. oils, fuels, chemicals) will be stored in containers comprising appropriate secondary containment. Spill kits will be available to contain any accidental release of hazardous materials. A 'Spill Prevention, Control and Contingency Plan' will be developed, outlining the power plant design features and spill prevention and control measures. Drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil and waste oil storage tank areas will flow to a sump to be pumped to oil-water separator. No underground storage tanks (USTs), containing oils, fuels or chemicals, will be located on-site.	
8. Site Run-off			
Alteration in site drainage patterns and flows in vicinity of the SNPL UNIT II UNIT II Power Plant. Potential for flooding along the adjacent lands.	Major	Site design will be made in such a way as to diverting the Project Site drainage to minimize the impact on the land and water system adjacent to the Project Site. Provision of stormwater management drains to divert on-site surface flows.	Effectiveness of stormwater run-off attenuation measures will be monitored by EHS Manager. Maintaining liaison with the public including systematic recording of complaints relating to increased offsite flooding and follow-up.
		On-site storage of stormwater, to attenuate and regulate run-off rates, will be incorporated into the drainage design.	

9.Potentially Contaminating Wastes			
Release of sludge, waste oil, hydraulic fluids, paints, solvents and similar materials to the environment.	Major	Imposing strict prohibition of dumping or burial of any potentially contaminating waste. Potentially oil-contaminated drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil, waste oil storage tank areas and car parks will flow to a sump to be pumped to oil-water separator. All the other potentially contaminating wastes (used oil, drained hydraulic fluid, spent solvents, etc.) will be recovered in separate, properly labeled containers and disposed to off-site recycling facilities. Where viable options of incineration are available (e.g., refining of lubricating oil, solvent recovery, etc.), these will be pursued upon verification of environmental acceptability.	Site waste management will be continually monitored by the EHS Manager.
10.Accidental Spills			
Spills of fuel or other contaminating wastes.	Medium	Tank storage areas will comprise impermeable surfacing and secondary containment of sufficient capacity to ensure containment of worst case spills.	Hazardous materials storage facilities will be inspected by the EHS Manager. Periodic testing and check of spill response readiness and emergency response equipment

and material will be carried out on a continued basis.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		A facility-specific 'Spill Prevention, Control and Contingency Plan' will be developed outlining the power plant environmental design features, spill prevention and control procedures. Materials and equipment required to respond to the various types of potential spill incidents will be available on-site or nearby on a standby basis.	and material will be carried out on a continued basis.
11.Health, Safety and Emergency Response			

Poor health and safety practices may result in serious risk to workers.	Major	Notify local clinics and hospitals before commissioning of the SNPL UNIT II Power Plant. Job specific medicals for all employees prior to start of work and updated annually. EHS training and safety induction for all employees and 6 monthly updates. First aid kits and trained first aid practitioners on-site at all times. Access restrictions (barriers and signage) will be used to prevent unauthorized access to the Project Site. Preparation of an EHS Plan, including: - EHS Policy and Objectives;	Weekly site safety inspections shall be conducted and the results documented using a weekly inspection checklist. Analysis of minor accidents and near miss statistics to identify 'hot spots' and take appropriate action.
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		• Appointment of qualified EHS specialist(s) who will be on-site throughout operations; • Project EHS rules; • Details of how rules and updates (if required) will be communicated to workers • Identification and risk assessment of hazardous activities and high risk areas; • Safe working methods for hazardous activities; • Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing; • Implementation of a Lock-out Tag-out program; and • Reporting and investigation procedure for all severe and minor accidents, and near misses. Ensuring all subcontractors sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure that the procedures are fully understood and complied with. Formation of an EHS Committee, chaired by the EHS Manager and comprising representative staff from a wide variety of levels and roles.	

Exploitation and discrimination of workers.	Major	Bangladesh has ratified key International Labour Organization (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	SNPL UNIT II to write employment contracts and employ a Human Resources Manager responsible for enforcing ILO conventions Bangladesh Labour Law.
Natural Hazards, including earthquakes, cyclones, tornados and floods, as well as fires and explosions, may severely impact upon power plant operations.	Major	Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies. The ERP will include: • What should be done and who should do it; • what equipment is required and where this will be located; and • staff training requirements and inductions for new workers and site visitors. In addition, the ERP will include: • a method for communication of the ERP to all workers and people arriving on-site; • an emergency contacts document which is maintained up to date; • a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the Project Site and trained/equipped to respond; and • liaison with local emergency services to ensure they are familiar with the Project Site • layout and potentially hazardous locations	At least quarterly emergency drills, which are documented and critiqued. The drills should cover all emergencies and, where shift work is undertaken, include all shifts to ensure full staff participation. A weekly schedule for inspections of Emergency equipment located around the site, to ensure it is in the correct location and in a suitable condition to be used.
Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
15. Traffic and Transportation			
Increased congestion and safety implications on local roads, although traffic associated with the operational phase of the power plant is considered to be minor.	Minor	Prepare a traffic and transportation plan for SNPL UNIT II Unit II, which includes (but not limited to): - avoid the delivery of materials or machinery during peak traffic	Implement the traffic and transportation plan. Record and investigate all accidents and near misses.

Issues/Concerns	Anticipated Impact	Mitigation/Management Measures	Monitoring
		periods; ▪ stick to agreed traffic routes, avoiding narrow roads and villages; ▪ enforce local road and river traffic rules; ▪ implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the power plants area; ▪ provide training on safe driving and safe unloading of HFO from barges; ▪ prevent unauthorized access (i.e. public access) to the Project Site; ▪ load trucks (if used) in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and ▪ maintain and/or repair any private and public highways that have been damaged by vehicles from the power plants site (if applicable). Resolve potential river traffic navigation problems and construction of a jetty along the river bank. No significant increase in river. Traffic volume is anticipated during operation except for the HFO barges which are infrequent A grievance mechanism established as part of a stakeholder engagement plan.	Visual inspection of roads used by site vehicles. Review of complaints received via the formalized grievance mechanism.

6.7 The Decommissioning Phase

Table 6.15: Management Aspects during the Decommissioning Phase

Issue/Concerns	Management Measures	Net Effect	Monitoring
Closure, Decommissioning and Rehabilitation	Closure / Decommissioning may involve adverse impacts not perceived at this stage of the project. A detailed decommissioning and rehabilitation plan will be prepared prior to closure of the power plants. Such a plan might include: - strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible; - disposal of hazardous waste materials in a legal and responsible manner; - remediation of soil and/or groundwater contamination (if applicable); and - rehabilitation and enhancement of terrestrial habitats within the power plants footprints. - Mitigation measures to control dust and air emissions during the construction phase will be implemented.	Plant closure and rehabilitation of the site area.	Soil and groundwater monitoring to determine subsurface impacts (if any) of the power plants operation. Restoration to baseline conditions, as detailed in Section 4 of this report.

CHAPTER-7

ANALYSIS OF ALTERNATIVES

7.1 ‘No Project’ Alternative

From physical and environmental points of view, the ‘do-nothing’ is preferable to any project implementation, since it would avoid creation of any of the adverse impacts associated with the project. But the ‘without project alternative’ is not acceptable since this will strongly reduce the potential for socio-economic development of the country. In spite of having greater potentiality, the industrial growth is retarded mainly due to inadequacy of electricity facility.

So, it is concluded that the ‘No build’ alternative is unacceptable, and the potential socio-economic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an allowable level.

7.1.1 Analysis of Technology and Fuel Alternatives

Bangladesh Power Development Board (BPDB) in October 26, 2010 issued a request for proposal (RFP), Number is P1000478, Quotation number Q1001181AIR, mentioning the relevant technical, financial and commercial aspects. *Under Section 2: Project information and scope*, it has been clearly mentioned that the Projects sponsor has to use reciprocating engine and has to use the BDPC substation for transmitting the electricity. In addition, it is clearly mentioned that the fuel of the power plant will be High Furnace Oil (HFO). So, there is vast scope for SNPL UNIT II to think for alternative technology and fuel. Since at the moment there is no new gas connection available the power plant will be run on HFO until gas is available.

7.1.2 Analysis of Site Alternatives

Analysis of site alternatives (AoA) helps to justify the need for starting, stopping, or continuing of selection of a site for a particular project. They are done because decision makers need reliable, objective assessments of the options for providing required capabilities. AoA identifies potentially viable solutions and provide comparative cost, effectiveness, and risk assessments of each solution to a baseline; this baseline is typically the current operating system.

It is already mentioned that while identification of project site for a power plant project, some parameters are taken into consideration like:

- i) availability of evacuation line and substation,
- ii) availability of land,
- iii) fuel transport facility through sea
- iv) Infrastructure facility (road, telecommunication, administration etc).

Taking all these into consideration the best possible site for the project is at the proposed location.

7.1.3 Location and Area of Available Land

During site visit, information about physical location of the sites was collected from local people as well as representatives of SNPL UNIT II. To assess the geographic location a GPS

receiver was used. Based on the available information, physical, geographic location and proposed area of the project site are depicted in **Table 8.1**.

Table 7.1: Comparison of sites with respect to location and area

Site	Physical Location		Ward	Geographic location		Area in acre
	Mouza	Municipality		Latitude	Longitude	
Site-1: Main plant	Madang onj	Madangonj	19	23° 59'01.37"N	90° 51'36.47"E	2.22
Site-2: Alternative	Modong onj	Modangonj	19	23°58'60.49"N	90°51' 65.82"E	3
Site-3: Alternative	Modong onj	Madangonj	19	23°58' 60.49' N	91° 51' 65.82"E	3



Map 7.1: Two alternative sites view for the alternative plant mentioned in the above image



Photo 7.1: Site view for the main plant SNPL UNIT II Unit II



Photo 7.2: Site view for the alternative plant site 1



Photo 7.3: Site view for the alternative plant site 2

Table 7.2: Comparison of sites with respect to topography and land use pattern

Location	Topography	Land use pattern
Site-1	- The site is basically a plain terrain. - The site requires 3-4 feet land filling. - Closed to summit Narayangang Power Plant Unit-I - The overall shape of the site is rectangular making it more suitable for a power plant.	- Agricultural land - Developed land
Site-2	- The site is basically a plain terrain. - The site requires about 6-7 feet land filling. - The overall shape of the site is rectangular - Out site from the road connection - Need more compensation	- Wetland for aquatic life - Agricultural activities - Comprehensive agricultural activity
Site-3	- The site has moderate a plain terrain - There are some settlement in the site - The site requires about 2-3 feet land filling - Need resettlement to another site - Need more compensation - Public impact severe than others site - Near to the market and settlement - Near to the religious place	- Agricultural activity - Vegetable farming land - Plain developed land

7.1.4 Distance from Major Infrastructure

While selecting a power plant site, distance from major infrastructure is important consideration. Because of construction of transmission line requires considerable amount of financial involvement and sophisticated technology. As the proposed project will be a furnace oil based power plant, proximity to oil storage facility is also a major issue to develop with. In the

following **Table 7.3**, the sites are evaluated based on distance from some important infrastructures.

Table 7.3: Comparison of sites with respect to distance from major infrastructure

Sl. No	Major Infrastructure	Approx Areal Distance from Site (km)		
		Site-1	Site-2	Site-3
1	Substation	1.0	1.5	1.25
2	DPDC office	1.0	1.5	1.25
3	Narayanganj Bandar	2.75	3.0	3.25
4	Madangonj Upazila Office	1.0	1.2	1.75
5	LGED office	1.0	1.2	1.75
6	Upazila health complex	1.0	1.2	1.75
7	Upazila police station	1.0	1.2	1.75
8	Madangonj bus stand	15	16	16
9	Sitalakha river	1.0	1.2	1.0
10	Daleswari river	1.0	1.2	1.75

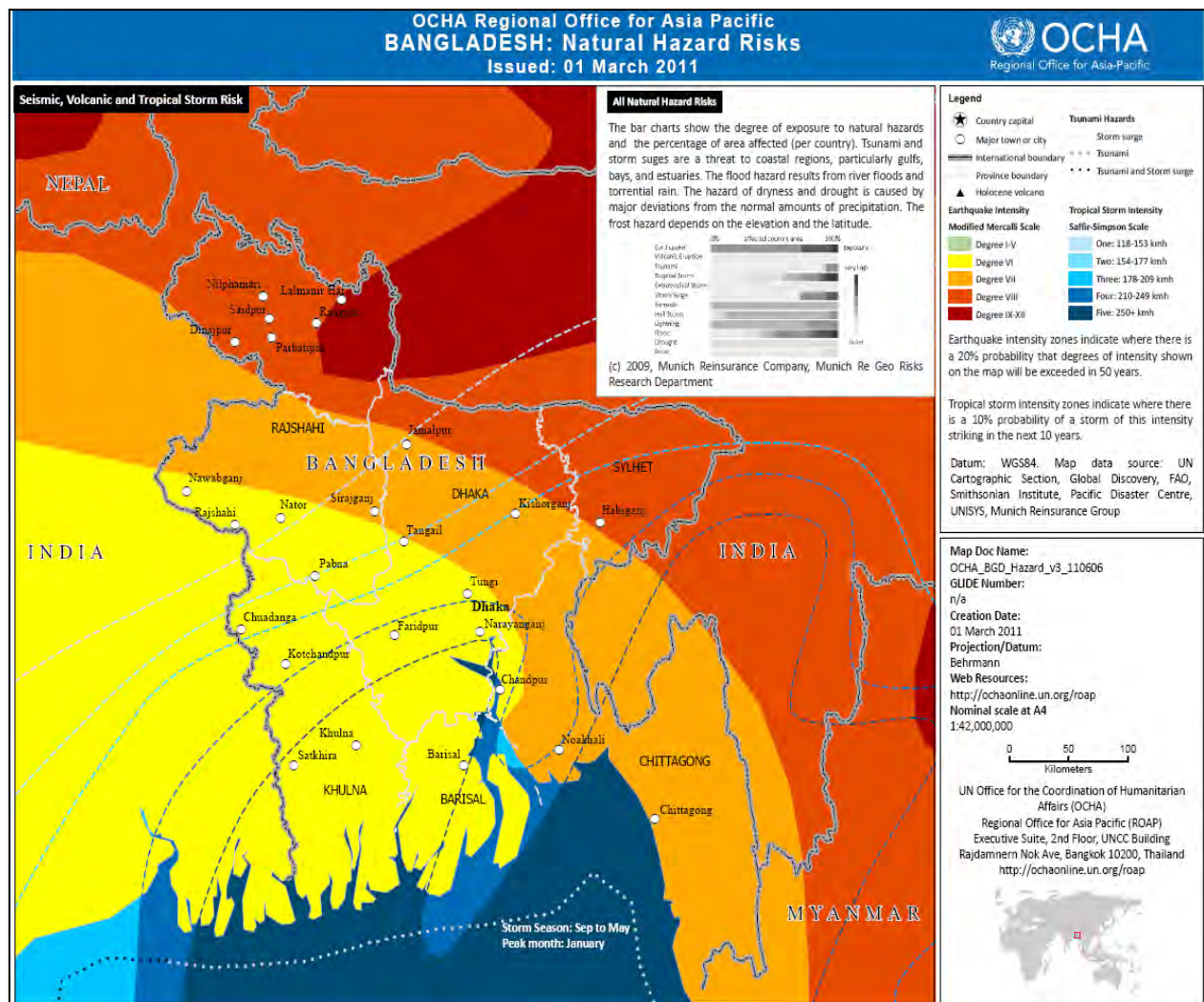
Source: BCAS field representative

The analysis shows that even the alternative locations size and area is adequate for the proposed power plant but for the following reasons the proposed by the sponsors seems to be the most advantageous and suitable.

- Close proximity to the DPDC substation
- No natural wetlands will not be disturbed
- No resettlement require
- Local people want to sell the land willingly for the sake of power plant
- Close proximity to the main road and Sitalokshya river for transportation of construction equipments and HFO during construction and operation period
- Proximity to transmission line
- Land filling requirement will be less than others
- Administrative head quarter is closed to the plant site
- Land price comparatively less than other site

7.1.5 Vulnerability to Natural Calamity

According to the earthquake zoning of Bangladesh the three sites have fallen under Zone II, which means that the sites have moderate risk of earthquake. On March 1, 2011 UN Office for the Co-ordination of Humanitarian Affairs (OCHA) published a composite map of vulnerability to natural calamity for Bangladesh. According to this map, the sites have less significant risk associated with Tsunami and storm surge. But the tropical storm intensity is about 210 kmh. There is no risk of volcanic eruption for these sites. According to this map earthquake risks for the three sites is Degree VI according to the Modified Mercalli Scale. The following Map 7.2 depicted the Natural Hazard Risk of Bangladesh.



Map 7.2: Natural Hazard Risk Map of Bangladesh prepared by OCHA

7.1.6 Environmental and social safeguard aspects

There are two major components in safeguards aspects. They are environmental and social issues. In this section, the sites will be evaluated based on some project specific environmental and social parameters. The shortlisted three sites have been compared with respect to environmental and social aspects.

7.1.7 Comparative Valuation of the Proposed Sites

Land price is dependent on a number of factors. Among this factors accessibility to the site and proximity to major infrastructure are two major factors. Similarly the land rate was found to vary from site to site. The source of this land price was collected by the representative of BCAS in discussion with the local people and the representative of SNPL UNIT II Unit II. In the following **Table 7.4**, the tentative unit price of three sites is evaluated.

Table 7.4: Land price of short-listed sites

Site	Market price (taka/decimal)
Site-1	400,000
Site-2	350,000
Site-3	350,000

Source: BCAS representative

CHAPTER 8

ENVIRONMENTAL AND OCCUPATIONAL MANAGEMENT PLAN

8.1 Introduction

This chapter deals at length with the measures that SNPL UNIT II Unit II will take in response to the need for sound environmental management throughout the various phases of the proposed project. The chapter also outlines measures that will be taken in relation to the management of social impacts and the need to address grievances that the various project stakeholders might have, in respect of various stages of project implementation, throughout the life of the proposed project.

The mitigation measures proposed in Chapters 5 and 6 of this ESIA Report, which are designed to avoid or minimize impacts during pre-construction, construction, operational and decommissioning phases of the project form the basis of this Chapter. This Chapter presents the specific plan for implementing the mitigation and monitoring requirements and addressing community grievances within the framework of an Environmental and Social Management and Monitoring Plan (ESMMP). The following principles were used to guide the preparation of the ESMMP:

- focus on occupational health, safety, and environment risk prevention;
- affordable, safe technologies are used wherever failure of equipment would have a significant effect on safety, health, or the environment;
- conformance with relevant standards, codes, and practices will be considered in the application of the safe technologies;
- all activities will be performed in a safe and effective manner and all equipment will be maintained in good operating conditions for the protection of health and safety of all persons and the conservation of the environment and property;
- all necessary precautions are carried out to control, remove, or otherwise correct any hazardous materials leaks and/or spills, or other health and safety hazards;
- all activities and components related to construction of the power station will meet relevant international standards which ensure sufficient technical levels of safety; and
- necessary measures will be ensured to redress grievances that the communities within and in the proximity of the Project Site might experience.

This Chapter describes the ESMMP of the SNPL UNIT II Unit II Power Plant project and addresses the following key components:

- management activities and systems;
- plans, procedures, and programs;
- monitoring activities;
- implementation schedule; and
- plans for integrating the ESMMP within the overall development plan for the SNPL UNIT II Unit II Power Plant project.

8.2 Environmental and Social Management Plan (ESMMP)

SNPCL Unit II is committed to constructing and operating the power plant in an environmentally responsible manner and in compliance with relevant environmental laws, regulations, and guidelines in force in the country and also those prescribed by lending agencies, including the IFC and other financing agencies. SNPCL Unit II will implement an Environmental Management System (EMS), including an environmental policy that states the principles and intentions of the enterprise in relation to its overall environmental performance. Such principles and intentions will be communicated to each employee as well as the nature of their individual environmental responsibilities. Where appropriate, staff training will be undertaken to ensure their continued environmental performance. In addition, SNPCL Unit II will aim to obtain International Organization for Standardization (ISO) 14001 accreditation for the EMS within the first three years of operation.

SNPCL Unit II is also committed to the creation and implementation of programs to reduce the probability of occurrence of adverse impacts upon the environment. As required, contingency plans will be developed for mitigating potential adverse incidents. SNPCL Unit II will expect the same level of environmental performance from its agents, suppliers, and contractors and will stipulate this in any legally binding agreements it enters with these parties.

SNPCL Unit II will also ensure that appropriate corporate resources, personnel and reporting and accountability systems, are in place for the successful implementation of the ESMMP. They will, on a continuing basis, review the objectives of the ESMMP as well as the company's success in achieving them.

Where objectives are not being achieved, corrective action will be taken. The ESMMP objectives will also be modified over the life of the SNPCL Unit II Power Plant, as appropriate, to reflect changing environmental laws, regulations, standards

8.3 Plans, Procedures and Programs

As part of the ESMMP objectives, several plans, procedures, and programs have been developed to guide every stage of project construction, operation, and decommissioning so that the environmental performance of the power plant is optimized. While formulating a detailed ESMMP for the proposed SNPCL Unit II Power Plant project, the pertinent impacts during the three phases, (i.e. construction, operation and decommissioning) have been taken into consideration. The pertinent impact aspects during the three project stages, as applicable, have been as under the following major headings:

1. Air Quality (dust and other particulate matter generation, stack emissions);
2. Noise and Vibration;
3. Hydrology and Surface Water Quality;
4. Drainage and Flood Control;
5. Terrestrial Ecology;
6. Aquatic Ecology;
7. Land Use;
8. Water Use;
9. Traffic and Transportation;
10. Solid Wastes;
11. Occupational Health and Safety;
12. Emergency Response;
13. Socio-Economics; and
14. Public Relations.

The following sections present an overview of the plans, procedures, and programs that will be developed for the SNPCL Unit II Power Plant.

8.4 Environmental and Social Management and Monitoring Plan (ESMMP)

The ESMMP is sub-divided into the following phases of development:

- Table 8.1: Construction Phase;
- Table 8.2: Operational Phase; and
- Table 8.3: Decommissioning Phase.

8.4.1 The Construction Phase

Table 8.1: EMP for the Construction Phase

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Dust Emissions / Noise Emissions	☐ Periodic sprinkling of water throughout the area subject to land excavation to arrest dust emissions. ☐ Cover all stockpiles with canvas or plastic sheets during windy periods. ☐ Limit the speed of heavy goods vehicles over unpaved surfaces. ☐ No Piling after 6pm or before 7am.	Continuous.	Contractor
Health and Safety	☐ Risk Assessments and Safe Working Methods will be prepared and implemented at the site. ☐ Access restrictions (barriers and signage) will be used to prevent unauthorized access to the Project Site.	Continuous Weekly	Contractor
Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Waste Management	☐ Ensure good waste management practices, with appropriate provisions for the storage of Hazardous wastes. ☐ Ensure that wastes are removed by an accredited and competent party under fully 'duty of care' (i.e. understand final location of disposal / treatment facilities).	Continuous	Contractor
Hazardous Materials Management	☐ Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. ☐ Spill kits will be available to contain any accidental release of hazardous materials (including within vehicles when transporting hazardous materials). ☐ All hazardous materials will be provided with secondary containment. ☐ Any hazardous materials to be transported to or from the Project Site will include suitable protection (in the form of manufacturer / supplier recommended packaging or as stated in the relevant Material Safety Data Sheet (MSDS)) to mitigate against any accidental release.	Continuous	Contractor

Dust Emissions	☐ Periodic sprinkling of water throughout the area subject to the site preparation and land raising process to arrest dust emissions. Cover all stockpiles with canvas or plastic	Continuous Quarterly	Contractor
Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	Sheets during windy periods. ☐ Limit the speed of heavy goods vehicles over unpaved surfaces. ☐ Cover materials during transport to site. ☐ Clean road vehicle wheels before leaving the site. ☐ Prohibit rubbish burning within the construction site.		
Air Emissions	☐ Vehicle and construction plant combustion engine emissions will be isolated and temporary in nature. However, in the event that vehicles are left standing for significant periods, their engines will be switched off. In addition, the Contractor will ensure that all plant is maintained in a satisfactory manner so as to minimize emissions.	During routine maintenance and during start-up and shut-down. Schedule a monthly inspection of equipment.	Contractor
Noise	☐ Select equipment and construction techniques that cause minimum noise. ☐ Maintain equipment in good working order. ☐ Construction activities, such as piling, which generate significant noise, will be carried out during the daytime. ☐ Install noise reduction equipment i.e. silencers and mufflers, on noisy plant and frequently check the efficiency of noise attenuation equipment. ☐ A grievance redress mechanism will be established as part of a stakeholder engagement plan.	Daily check of equipment and whenever complaints are received. Schedule a monthly inspection of equipment.	Contractor
Surface Water Quality and Hydrology	☐ An earth bund will be constructed to prevent the discharge of sediment and hazardous materials to neighboring water bodies. ☐ Stormwater will be discharged via an oil separator and settlement tank to the water bodies	Daily visual inspections. Water sampling every three months	Contractor

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	Nearest water bodies.	and three locations: 50 m upstream; adjacent to the Project Site; and 50 m downstream of River Sitalakha.	
Groundwater Quality	☐ All hazardous materials will be provided with secondary containment to limit the potential for subsurface impacts.	Quarterly from on-site deep and shallow tubewells.	Contractor
Terrestrial and Aquatic Ecology	Trees will be planted around the boundary of the Project Site during the construction phase. ☐ New species will not include invasive or alien species.	-	Contractor

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Traffic and Transportation	☐ Prepare a traffic and transportation plan for the construction phase, which includes (but not limited to): - avoid the transportation of materials or machinery during peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and river traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the construction area; - provide training on safe driving; - prevent unauthorized access (i.e. public access) to the construction site; - load trucks in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the construction site. ☐ Resolve potential river traffic navigation problems and construction of a jetty along the river bank. No significant increase in river traffic volume is anticipated. ☐ Aggravated redress mechanism established as part of a stakeholder engagement plan.	At the start of the project. When necessary. Monthly When necessary.	Contractor
Solid Wastes	☐ Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible.	Weekly	Contractor

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	☐ Segregate wastes by types and provide appropriate waste containers for the storage of all waste streams. ☐ Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). ☐ Prohibit the burning of wastes. ☐ Arrange a waste removal contract and schedule at least weekly waste collection to prevent the build-up of waste materials. ☐ Audit waste contractor to ensure appropriate disposal methods are applied according to the waste stream.		
Human and Sanitary Wastes	☐ Provision of an appropriate number of toilets and hand-washing points. ☐ Provision of on-site treatment of sanitary wastes. ☐ Training on sanitation practices.	Continuous observations. Surface water and groundwater quality sampling every 3 months.	Contractor
Hazardous Materials Management	☐ Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. ☐ Spill kits will be available to contain any accidental release of hazardous materials. ☐ All hazardous materials will be provided with secondary containment.	Continuous	Contractor

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Occupational Health and Safety	☐ Notify local clinics and hospitals before commencement of construction works. ☐ Job specific medicals for all employees. ☐ EHS training and safety induction for all employees and 6 monthly updates. ☐ First aid kits and trained first aid practitioners on-site at all times. ☐ Access restrictions (barriers and signage) will be used to prevent unauthorized access to the Project Site. ☐ Preparation of an EHS Plan for approval by SNPCL, including: - EHS Policy and Objectives; - Appointment of qualified EHS specialist(s) who will be on-site throughout the construction project; - Project EHS rules; - Details of how rules and updates (if required) will be communicated to workers - Identification and risk assessment of hazardous activities and high risk areas; - Safe working methods for hazardous activities, including confined space working and working at heights; - Ensure all personnel are provided with all required PPE for the environment they are in and the tasks they are performing; - Implementation of a Lock-out Tag-out program; and - Reporting and investigation procedure for all severe and minor accidents, and near misses. ☐ Ensuring all subcontractors (if any) sign and agree to the site EHS Plan. Provide training for all subcontractors to ensure site procedures are fully understood and complied with (in	Weekly	Contractor EHS Plan to be approved by SNPCL Unit II management.

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	Appropriate languages as required)		
Labor Conditions	□ Bangladesh has ratified key International Labor Organization (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	At the start of employment	Contractor
Emergency Response (i.e. Fire, Earthquake, Flood etc.)	□ Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, for approval by SNPCL Unit II. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and inductions for new workers and site visitors. □ In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained up to date; - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the Project Site layout and potentially hazardous locations.	At least every three months. Weekly	Emergency Coordinator (appointed by SNPL UNIT II Unit II)
Socio-Economics	□ The Compliance Manager will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities	To be confirmed by SNPL UNIT II Unit II.	EHS Manager SNPL UNIT II Unit II

Aspect	Mitigationmeasures/compensation	Timeframe	Responsibility
	arising out of an influx of workers in the project area. ☐ A grievance mechanism through a committee responsible to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SNPCL management and elected local representatives. ☐ Review the suitability and capacity of local workers. The Contractor will be encouraged to recruit local labor, goods and services, wherever these are available at an acceptable quality and price. The Contractor will be required to follow a local procurement policy. ☐ The Contractor will develop a Recruitment Policy for approval by SNPCL Unit II. The Recruitment Policy will include: iv. ensure equal opportunities, fair treatment and nondiscrimination in relation to recruitment, compensation, remuneration, working conditions and terms of employment; v. a means of expressing grievances; and vi. engaging subcontractors and suppliers who do not employ child labor or forced labor, and operate appropriate management systems consistent with requirements (i) and (ii).	Quarterly At the outset of the project.	SNPCL Unit II
Public Relations & Stakeholder Engagement	☐ Conduct proactive public relations (PR) exercises consisting of news/information dissemination to increase understanding of the project. The PR will be carried out using local media, leaflets and meetings/seminars on the progress of the project and environmental and social enhancement measures	-	SNPCL Unit II
Aspect	Mitigationmeasures/compensation	Timeframe	Responsibility
	A Public Relations Plan will be prepared by SNPCL Unit II, in order to: - establish clear stakeholder engagement channels. People in the neighboring villages should have clear lines of communication to SNPCL Unit II; - communicate how environmental mitigation measures will be implemented. - receive, investigate and address any complaints and/or concerns from all stakeholders.		

8.4.2 The Operational Phase

Table 8.2: EMP for the Operational Phase

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Environmental Management System (EMS)	□ SNPCL Unit II will implement an EMS, including an environmental policy, and aim to obtain ISO 14001 accreditation within the first three years of operation. □ SNPCL Unit II will appoint a suitably qualified Environmental Health & Safety (EHS) Coordinator, who will be responsible for implementation of the EMS. The EHS Coordinator will report directly to the Plant Manager who will have overall responsibility for EHS Management.	Three years	SNPCL and the EHS Coordinator
Health & Safety Management System	□ SNPCL will implement a Health and Safety Management System, and aim to obtain OHSAS 18001 accreditation within the first three years of operation.	Three years	SNPCL and the EHS Coordinator
Aspect	Mitigation measures/compensation	Timeframe	Responsibility
Air Quality	□ Use of 40m high stacks to optimize dispersion of exhaust gases. □ Monitoring ground-level NOX, Sox and particulate matters concentrations at three locations in neighboring settlements and villages.	Monitoring ground-level NOX, SOX and Particulate matters concentrations (at a minimum of three locations) for a 24-hour period annually.	SNPCL Unit II
Noise	□ Engines, Radiator fans, waste heat boilers will be installed in buildings equipped with acoustic walls and enclosures. □ Silencers and mufflers will be installed on all site vehicles. □ Postwarning signs in areas where the noise level exceeds 80dB(A) and ensure workers are provided with hearing protection when working in these areas. □ Establish a grievance mechanism as part of a stakeholder engagement plan.	During the first 3 Months following commissioning and subsequently at least once per year. If/when complaints received. During routine maintenance.	EHS Coordinator
Effluent Discharge	□ Treated effluent shall be analysed and held in a tank and	Prior to discharge.	SNPCL
	Then discharged to the river. Prior to discharge, the will be monitored and the effluent treatment plant (ETP) is designed to ensure it meets the effluent quality standards detailed in the DoE Guidelines.	Quarterly during the first year of Operation to monitor the effectiveness of the ETP. subsequently annually.	

Surface Water Quality	☐ Surface water monitoring will be carried out downstream of the site to ensure compliance with the DoE water quality standards. ☐ Hazardous materials will be stored with appropriate secondary containment to prevent accidental release to the river. ☐ The storm water drainage system will comprise oil/water interceptors and all drainage in the vicinity of designated hazardous materials storage areas will discharge to the effluent treatment system.	Once during the first 3 months following commissioning and subsequently at least once per year.	EHSCoordinator
Terrestrial and Aquatic Habitats	☐ Boundary fencing will make terrestrial wildlife choose alternative routes. ☐ Planting of indigenous trees, where possible, around the boundary of the Project Site. ☐	Following the first year of operation.	SNPCL II
Traffic and Transportation	☐ Prepare a traffic and transportation plan for the operational phase, which includes (but not limited to): - avoid the delivery of materials or machinery during	At the start of the project. When necessary.	SNPCL II

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	Peak traffic periods; - stick to agreed traffic routes, avoiding narrow roads and villages; - enforce local road and driver traffic rules; - implementation of a safety program (signage, speed restrictions, lights on trucks, truck load restrictions etc.) within the SNPCL Unit II Power Plant; - provide training on safe driving; - prevent unauthorized access (i.e. public access) to the Project Site; - load trucks (if used) in accordance with legal requirements and cover transported materials to prevent them falling off during transit; and - maintain and/or repair any private and public highways that have been damaged by vehicles from the power plant site (if applicable). ☐ A grievance mechanism established as part of a stakeholder engagement plan.	Annually When necessary.	

Waste Management	☐ Apply the waste hierarchy and reduce, reuse or recycle wastes wherever possible. ☐ Segregate wastes by types and provide appropriate waste containers for the storage of all waste streams. ☐ Provide a specific area for the storage of solid hazardous wastes (i.e. batteries, fluorescent lighting tubes, used oil filters, aerosol cans etc.). ☐ Prohibit the burning of wastes. ☐ Arrange a waste removal contract and schedule at least weekly waste collection to prevent the build-up of waste materials. ☐ Audit waste contractors to ensure appropriate	Monthly	EHSCoordinator
Human and Sanitary Wastes	☐ Provision of an appropriate number of toilets and hand-washing points. ☐ Provision of on-site treatment of sanitary	Continuous observations.	EHSCoordinator

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	wastes. ☐ Training on sanitation practices.	Quarterly water quality sampling.	
Hazardous Materials Management	☐ Refuelling, washing and maintenance of plant and vehicles will be prohibited in the vicinity of water bodies. ☐ Hazardous materials (i.e. oils, fuels, chemicals) will be stored in containers comprising appropriate secondary containment. Material Safety Data Sheets (MSDS) will be retained for all hazardous materials used on-site. Copies will be available in the areas where they are used. ☐ Spill kits will be available to contain any accidental release of hazardous materials (including within vehicles when transporting hazardous materials). A 'Spill Prevention, Control and Contingency Plan' will be developed, outlining the power plant design features and spill prevention and control measures. ☐ Drainage from the powerhouse floors, fuel unloading areas and fuel oil, lubricating oil and waste oil storage tank areas will flow to a Sump to be pumped to oil-water separator. ☐ No underground storage tanks (USTs), containing oils, fuels or chemicals, will be located on-site.	Continuous	EHSCoordinator

Aspect	Mitigationmeasures/compensation	Timeframe	Responsibility
	☐ Anyhazardous materials to betransportedto or fromthe Project Site will includesuitable protection (inthe formofmanufacturer / supplierrecommended packagingor as stated intherelevantMaterial Safety Data Sheet (MSDS) tomitigateagainstany accidental release.		
Occupational Health and Safety	☐ Notify local clinics and hospitals before commissioning of theSNPCLPower Plant. ☐ Job specific medicals for all employees prior tostartof work and updated annually. ☐ EHS trainingand safety induction for all employees and 6monthlyupdates. ☐ First aid kits and trained firstaidpractitioners on-site at all times. ☐ Accessrestrictions(barriers and signage)will beusedto prevent unauthorized accessto the ProjectSite. ☐ Preparationofan EHS Plan, including: -EHSPolicyandObjectives; -ProjectEHSrules; -Detailsofhowrulesandupdates(ifrequired)willbe communicated toworkers -Identificationandriskassessmentofhazardous activitiesandhighriskareas; -Safeworking methodsforhazardousactivities, includingconfinedspaceworkingandworkingat heights; -Ensureallpersonnelareprovidedwithallrequired PPEfortheenvironmenttheyareinandthetasks theyareperforming; -ImplementationofaLock-outTag-outprogram;and -Reportingandinvestigationprocedureforallsevere andminoraccidents,andnearmisses. ☐ Ensuringallsubcontractorssignand agreeetothe siteEHSPlan.Providetrainingforall	Monthly Quarterly Annually	EHSManger EHSCoordinator IndependentSafety Consultant

Aspect	Mitigationmeasures/compensation	Timeframe	Responsibility
	Subcontractorstoenuresiteproceduresarefully understoodandcompliedwith. ☐ FormationofanEHSCommittee,chairedbythe EHSMangerandcomprisingrepresentative stafffromawidevarietyoflevelsandroles.		

Greenhouse Gas Emissions	☐ Undertake an annual greenhouse gas emission audit to quantify greenhouse gases associated both with the Project Site and off-site linked activities. The finding of the audit should include identification of feasible measures to reduce or off-set emissions.	Annually	SNPCL to appoint a suitably competent auditing party.
Labor Conditions	☐ Bangladesh has ratified key International Labor Organisation (ILO) conventions, to ensure the work conditions are reasonable and safe, and employees are free from any form of discrimination.	At the start of employment	SNPCL to appoint a Human Resources (HR) Department
Emergency Response	☐ Appoint a suitably qualified Emergency Coordinator(s). Develop an Emergency Response Plan (ERP), covering all foreseeable emergencies, including HFO leaks and air risk assessment. The ERP will include: - what should be done and who should do it; - what equipment is required and where this will be located; and - staff training requirements and inductions for new workers and site visitors. ☐ In addition, the ERP will include: - a method for communication of the ERP to all workers and people arriving on-site; - an emergency contacts document which is maintained up to date; - a review of local emergency services capability and resources. Where they cannot respond to a foreseeable emergency, ensure suitable resources are available at the site and trained/equipped to respond; and - liaison with local emergency services to ensure they are familiar with the site layout and potentially hazardous locations.	At least every three months Weekly	Emergency Coordinator (appointed by SNPCL)
Socio-Economics	☐ The Compliance Manager will monitor social impacts on the local villages due to increased demand for goods, services and public health facilities arising out of additional workers (operating the SNPCL Unit II) ☐ A grievance mechanism through a Committee Will be proposed to address the grievances related to the resettlement and compensation. The committee will comprise representatives of the PAPs, a representative of SNPCL Unit II management and elected local representatives.	To be confirmed	SNPCL, the Compliance Manager and local community leaders.

Aspect	Mitigation measures/compensation	Timeframe	Responsibility
	☐ SNPCL Unit II will look to procure local goods and services, wherever these are available at an acceptable quality and price. SNPCL will adopt a Recruitment Policy including: i. Implementation of training programmes to facilitates skill development and enhancement of locally recruited workers; ii. ensure equal opportunities, fair treatment and non discrimination in relation to recruitment, compensation, remuneration, working conditions and terms of employment; iii. a means of expressing grievances; and iv. engaging subcontractors and suppliers who do not employ child labor or forced labor, and operate appropriate management systems consistent with requirements (ii) and (iii).		
Stakeholder Engagement	☐ A Stakeholder Engagement Plan will be prepared by SNPCL, in order to: - establish clear stakeholder engagement channels. People in the neighboring villages should have clear Lines of communication to SNPCL Unit II; and - receive, investigate and address any complaints and/or concerns from all stakeholders.	If/when received	SNPCL

8.4.3 The Decommissioning Phase

Table 8.3: Management Aspects during the Decommissioning Phase

Issue/Concerns	Anticipated Effect	Management Measures	Monitoring
Closure, Decommissioning and Rehabilitation	Major	Closure / Decommissioning may involve adverse impacts not perceived at this stage of the project. A detailed decommissioning and rehabilitation plan will be prepared prior to closure of the SBIIPCL Power Plant. Such a plan might include: - strict adherence to all appropriate waste management techniques, including the reuse and recycling of materials wherever possible; - disposal of hazardous waste materials in a legal and responsible manner; - remediation of soil and/or groundwater contamination (if applicable); and - rehabilitation and enhancement of terrestrial habitats within the power plants footprints. Mitigation measures to control dust and air emissions during the construction phase will be implemented.	Soil and groundwater monitoring to determine subsurface impacts (if any) of the power plant's operation. Restoration to baseline conditions, as detailed in Section 4 of this report.

CHAPTER-9

INSTITUTIONAL ARRANGEMENT AND ENVIRONMENTAL MONITORING

9.1 Institutional Requirements

For ensuring the construction and operation of the power plant according to the required compliance, there should be designated entity/institution or unit. The institution will be fully responsible to maintain the safeguard compliances. SNPL UNIT II has realized the importance of establishing a separate entity for environmental monitoring and management. So, to maintain the environmental and social compliances, SNPL UNIT II has planned to establish an individual compliance unit operating under the guidance of Head of Operation. They are planning to name the unit as Environmental and Social Monitoring Unit (ESMU). The detail of the ESMU has been discussed in the following sections.

9.1.1 Environmental and Social Monitoring Unit

SNPL UNIT II is in principal obligated to relevant national and international environmental and social compliances and standards. It has informed that it will try to maintain all relevant compliances during construction and operational phases. In doing so, it has planned to form ESMU as is mentioned in the earlier section. The duties of the ESMU will include to:

- ensure environmental and social safeguard compliances;
- coordinate environmental monitoring process;
- act as liaison with the public, local organizations and government;
- ensure and supervise record keeping, data storage for follow-up actions;
- monitor hazardous materials storage and handling;
- promote environmental awareness and safety measures; and
- prepare environmental management and periodic monitoring reports as required by DOE.

9.1.2 Composition of Environmental and Social Monitoring Unit

The ESMU will be based on three tiers operational mechanism. It will be led by Head of Operation of the power plant. Head of Operation will serve as General Manager (Planning, Administration and Safeguard Compliance). Under his guidance there will be one Compliance Manager, who will be supported by two Compliance Officers. One Compliance Officer will be responsible for all sorts of environmental aspects and standards and another one will be assigned to maintain social and occupational health and safety aspects and standards.

Consulting services will be mobilized as necessary to assist in initial operations, to ensure that the ESMU will be self-sufficient for EMP implementation, submission of progress reports, and preparation of environmental assessment for subsequent construction works. Additional third-party services may be employed by the SNPL UNIT II as necessary. Qualified and experienced construction contractor will be responsible for implementation of mitigation measures during the construction phase.

To look after the EHS aspects during the Construction Phase, SNPL UNIT II has already deployed an EHS Officer having Master Degree in Environmental Engineering. Based on the performance, he will be extended for the Operation Phase or a new EHS officer will be recruited. The major responsibilities of the EHS Officer are as follows:

- Monitor the environmental, health, safety, fire protection and emergency response matters;
- Ensure the compliance of the Department of Environment;
- Ensure the compliance of other external stakeholders;
- Monitor the implementation of the EMP;
- Develop standard operational procedure (SOP) for EHS aspects;
- Conduct safety inspections; provide safety training to promote a safe working environment for the employees.

9.1.3 Environmental Training

Training is an integral part of a preventive strategy. Environmental and disaster management training will be required to ensure proper implementation of effective environmental management and monitoring plan; and disaster management plan. However, training could be organized by ESMU involving relevant staff. As a trainer, competent Consultant can be outsourced. Important training under the spectrum of ESMU needs to include:

- Training on fire fighting;
- Training on environmental regulations and standards;
- Staff training on environmental monitoring;
- Training on environmental health and safety measure.

9.2 Environmental Monitoring

Environmental monitoring is an essential component of environmental management plan, as it provides the basic scenario of the impact of the project on baseline condition. The prime objectives of environmental monitoring are:

- assess the effectiveness of proposed mitigation measures by comparing monitoring result with baseline data/environmental standards;
- identify the extent of environmental impact;
- determine project compliance with regulatory requirements;
- adopt remedial action and further mitigation measures if found to be necessary.

During the Construction Phase, the construction contractor will ensure that activities like land leveling, clearing work, access road construction, putting proper traffic signals etc. have been accomplished properly to minimize the level of impact. This in turn has to be monitored by the Compliance Manager and Compliance Officers of ESMU of the power plant, in operation phase. Preventive maintenance should be carried out to identify and resolve problems related to cooling oil, gaskets, circuit breakers, vibration measurements, and other monitoring activities at regular intervals. Monitoring of oil water separation and sanitary waste treatment should be done periodically to avoid water pollution. Other environmental good practices include noise abatement, maintaining hygienic conditions, maintenance of fire and safety equipment etc. and clearing of grass should be done periodically and medium height tree plantation around the substation wall should be done at the plant areas.

SNPL UNIT II should develop a working relationship with the DOE by undertaking a joint monitoring program to monitor ambient air quality and also to assess whether there exists any significant noise problem; or they may exchange data and information or submit periodic report on self monitoring to the DOE or as the situation may require.

The proposed monitoring program should be in compliance with national environmental standards. The importance of this monitoring program is also for ensuring that the plant does

not create adverse environmental changes in the area and provide a database of operations and maintenance, which can be utilized if unwarranted complaints are made.

9.2.1 Environmental Monitoring Parameters

Environmental monitoring requires set of parameters that could be conveniently measured, assessed and evaluated periodically to observe the trends of change in base line environmental quality. A list of possible parameters to be tested, sample number and sampling frequency are given in **Table 9.1**.

Table 9.1: Monitoring parameters and frequency of monitoring during trial run

Key parameters to be monitored: (1) Ambient Air Quality			
location	frequency	parameter	submission
At Project site, residential/institutional/commercial areas within 500m outside from plant boundary (4 locations)	Once during trial run	SO _x , NO _x and CO	Submit to Barisal Divisional Office of DOE.
Key parameters to be monitored: (2) Noise			
location	frequency	parameter	submission
At four corners of Project boundary, residential/institutional /commercial areas within 100m and 300m outside from plant boundary	Hourly basis for 24 hours during trial run	Limits in dBA	Submit to Barisal Divisional Office of DOE.

Table 9.2: Monitoring parameters and frequency of monitoring during operation phase

Key parameters to be monitored: (1) Ambient Air Quality			
location	frequency	parameter	submission
At Project site, residential /institutional /commercial areas within 500m outside from plant boundary	Quarterly (routine) analysis	SPM, PM ₁₀ , PM _{2.5} , SO _x , NO _x and CO	Report compilation and quarterly submission to Barisal Divisional Office of DOE.
Key parameters to be monitored: (2a) Surface Water			
location	frequency	parameter	submission
Project site at Barisal, Barisal	Bi-annual basis in each year (pre-monsoon and post-monsoon)	pH, Temperature, DO, BOD, COD, TDS, TSS, Oil and grease	Report compilation and yearly submission to Barisal Divisional Office of DOE.
Key parameters to be monitored: (2b) Ground Water			
location	frequency	parameter	submission
Project site at Barisal	Bi-annual basis in every year (pre-monsoon and post-monsoon)	pH, Temperature, DO, BOD, COD, TDS, Oil and grease	Report compilation and yearly submission to Barisal Divisional Office of DOE.
Key parameters to be monitored: (3) Noise			
location	frequency	parameter	submission
At four corners of Project boundary, residential/institutional /commercial areas within 100m and 300m outside from plant boundary	Quarterly (routine) analysis (four times in each year)	Limits in dBA	Report compilation and quarterly submission to Barisal Divisional Office of DOE.

9.3 Environmental Monitoring and Management Budget

Environmental monitoring is conducted to compare the change between baseline condition and after project scenario, by testing some environmental parameters of air, water and noise and in case of necessity soil is tested. ESMU is fully responsible for environmental monitoring as well as implementation of environmental management plan. As testing environmental parameters required sophisticated instruments, it is suggested that ESMU should outsource consulting firm for testing and analyzing environmental parameters. But it will have to be equipped with required instruments gradually by purchasing required instruments. However, a tentative environmental monitoring budget has been proposed in **Table 9.3**. Laboratory analysis fees considered as per monitoring fees format of DOE/private laboratories.

Table 9.3: An annual tentative budget for environmental monitoring (Operation Phase)

Activity	Units	Total Cost (Tk.)
Fire fighting and suppression equipments, training and annual fire safety drill	1 site	150,000
Cost of occupational health and safety equipment	1 site	125,000
Quarterly test of ambient air quality (SPM, SO _x , NO _x)		75,000
Half yearly test of surface water (pH, Temperature, DO, BOD, COD, TDS, Oil and grease)		75,000
Half yearly test of ground water (pH, Temperature, DO, BOD, COD, TDS, Oil and grease)		75,000
Quarterly noise monitoring		25,000
Environmental Training	lump sum	125,000
ESMU Staff's annual salary (3 persons)	lump sum	800,000
Sub Total in Tk.		14,50,000
Contingency (10 %)		145,000
Total in BDT		15,95,000
Note: (Considering USD 1 = Tk. 80.0)		USD 19937.5

9.4 Financial Arrangement for Environmental Monitoring and Management

SNPL UNIT II will provide the full financial support to Environmental and Social Monitoring Units (ESMU). For ensuring smooth and uninterrupted functioning of ESMU, it is suggested that SNPL UNIT II will allocate the required fund based on analysis of estimated budget proposed by ESMU early in the every financial year. So, ESMU can run its operation to ensure environmental monitoring as well as implementation of proposed environmental management plan as may cause due to the unavailability of fund.

9.5 Environmental Monitoring and Management Reporting

As a part of environmental and social compliances, SNPL UNIT II will submit quarterly EHS compliance report of the Project to IDCOL. This report will contain the analysis of testing various environmental parameters during monitoring phase. It will also describe in detail about the status of implementation of environmental management plan. IDCOL will monitor the EHS compliance half-yearly. Based on the findings of half-yearly monitoring, IDCOL will submit annual EHS monitoring report to ADB. The schedule of reporting the monitoring arrangement has been presented in the following **Table 9.4**.

Table 9.4: Reporting schedule

Reporting entity	Frequency of Report	Entity to whom the report will be submitted
SNPL UNIT II	Quarterly EHS Compliance Report	IDCOL
IDCOL	Annual ESDDR Report based on the findings of half-yearly monitoring of the power plant	ADB

CHAPTER 10

RISK ASSESSMENT AND EMERGENCY RESPONSE PLAN

10.1 Introduction

According to classical definition, hazard could be regarded as among the adverse consequences of an activity or a combination of several activities or involvement of the use of certain materials in an activity or in a combination of several activities that has the potential of initiating or propagating an unanticipated event/sequence of events that can be termed as an accident. Identification of hazard involves knowing how such a material is likely to behave in the process of related activities, such as its storage and transport.

Materials being used in power plant processes include fuels and chemicals, including natural gas and chlorine. Apart from the chemical and process characteristics of the material, the size and layout of the plant and equipment need specific consideration in order to assess the hazard potential. Similarly, natural hazards such as floods and earthquakes cannot be ignored, in the same way as domino or secondary effects of accidents occurring in the surroundings cannot be disregarded or ignored.

Identification of hazards in a power plant is of primary significance in the analysis, quantification and cost effective control of accidents involving the raw materials and/or chemicals utilized in the power generation process. The type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. In the proposed project, hazard identification during storage and transport are particularly relevant.

10.2 Hazard Criteria

The criteria, that will be employed for preliminary identification and evaluation of hazard potential, include but not limited to:

- a) Potential for uncontrolled exothermic reactions;
- b) Potential for loss from containment; and
- c) Potential for possible ignition sources.

10.2.1 Flammability, Instability and Toxicity

Hazardous substances will be classified into the following three main classes:

- a) Flammable substances: Such substances require identification with air for their hazard to be realized. Under certain circumstances the vapors arising from flammable substances when mixed with air may be explosive, especially in confined spaces. However, if present in sufficient quantity such clouds may explode in open air also.
- b) Unstable substances: Such substances are liquids or solids, which may decompose with such violence so as to give rise to blast waves.
- c) Toxic substances: As the class refers to, such substances are toxic in nature causing danger and substantial damage to life when released into the atmosphere.

10.3 Risk Criteria

HFO, due to its highly flammable and explosive properties, could cause jet fire as well as explosion when released. Similarly, chlorine gas is highly toxic to exposure, and the scenario

may develop due to leakage valve bodies, corroded pipelines, ruptured pipelines etc. In the event of partial failure of pressurized pipelines, natural gas will be released in the form of a jet and will lead to jet fire when in contact with naked flame or hot material. Explosion may also occur due to release of natural gas through leakage. Such a situation has the potential to cause significant harm to human health and damage to property.

10.3.1 Thermal Radiation

Thermal radiation due to jet flame may cause various degrees of burn on human bodies. Also its effect on objects like equipment, piping, building and other objects need to be evaluated. Physiological effects vis-à-vis degrees of burns caused due to thermal radiation are as under:

1st Degree Burn: Involve only epidermis, blister may occur; e.g., sunburn.

2nd Degree Burn: Involve whole of epidermis over the area of burn plus some portion of dermis.

3rd Degree Burn: Involve whole of epidermis and dermis; subcutaneous tissues may also be damaged.

10.3.2 Blast Overpressure

As mentioned above in the beginning of this sub-section, release of HFO and fire through leakage may also cause explosion leading to blast over-pressure.

10.3.3 Toxic Exposure

Damaging consequences may also be due to exposure to chlorine gas (approximately 25 tonnes of chlorine will be stored on-site). The physiological responses of human bodies to exposure to chlorine are: slight symptom after several hours (concentration 1.0 ppm/3.0 mg/m³), coughing (concentration 30 ppm/87 mg/m³), lethal for 50% of population after 30 minutes exposure (concentration 500 ppm/1450 mg/m³), fatal in 30 min or less (concentration 1000 ppm/2900 mg/m³) and fatal in 10 minutes (concentration 1800 ppm/5200 mg/m³).

10.4 Hazard Risk Assessment

(a) Objective: Hazard Identification Risk and Assessment and Control (HIRAC) has been applied for the project. The risk matrix is as follows:

The objective of carrying out a Hazard Risk Assessment (HRA) for the proposed Power Plant project is to study the risks involving hazardous materials and their consequences. In this exercise, the study objectives are outlined hereunder.

The HRA process includes the following sequential steps:

- a) Hazard and Risk Identification
- b) Release Assessment
- c) Exposure Assessment
- d) Consequence Assessment
- e) Risk Estimation

(i) Hazard Identification and Visualization of Maximum Credible Accident (MCA) Scenarios: Identification of potential hazards due to construction and operation of power generation plants and visualization MCA scenarios are carried out toward the following purposes:

- a) To identify major hazards relating to fire, explosion and toxic release due to failure of pipeline/containment.
- b) To visualize the MCA scenarios.

- c) To assess the consequences of these accidents. d) To study past accident information in order to visualize worst accident situations.

(ii) Visualization of MCA Scenarios and Assessment of their Consequences: Such an aspect of HRA is undertaken toward analyzing and quantifying the primary and secondary effects as well as the damage potential of identified MCA scenarios with recourse to mathematical and analytical models.

(iii) Consequence Analysis: The scope of work for study of the consequences of MCA scenarios due to nature of exposures and characterization of risk levels on-site and off-site population and environment involves the following aspects:

- a) Detailed study of engineering information, diagrams, and lay out plans for the plants as well as chlorine storage facility.
- b) Identification of chemical and process hazards.
- c) Preliminary identification of hazardous section of the plant and storages with resources to Fire-Explosion and Toxicity Index (FETI).
- d) Past accident data analysis to identify possible worst accident scenarios.
- e) Visualization of Maximum Credible Accident (MCA) scenarios.
- f) Analysis of identified MCA scenarios and quantification of primary and secondary effects with recourse to mathematical models pertaining to cases of:
 - (i) Toxic Dispersions
 - (ii) Heat Radiations
 - (iii) Vapour Cloud Explosion
- g) Determination of damage criteria for heat radiation, pressure wave and toxic concentration levels with respect to health criteria, dose-response relations and vulnerability models.
- h) Study of on-site and off-site population characteristics.
- i) Characterization of risk analysis through study of nature of exposures, pathways and consequences of MCA scenarios and presentation of results in terms of damage distances.

10.4.1 Hazard Awareness

Awareness should be built up among the various strata of employees at the proposed power plant about the various types of hazards associated with power plants, their consequences and means to avoid them. All the sections of the power plant premises where hazardous activities are to be carried out or in which materials that could lead to various hazards are to be used should be labelled with stickers.

10.5 Hazardous Materials and Wastes

Hazardous materials related to power plants could be classified into the following four groups on the basis of their respective threshold quantities for safe use:

- | | |
|---------|------------------------------|
| Group 1 | – Toxic substances |
| Group 2 | – Highly reactive substances |
| Group 3 | – Explosive substance |
| Group 4 | – Flammable substances |

A Hazard Identification and Risk Assessment have been carried out in terms of hazard severity and risk factors have been analysed and the following Tables 9.1, 9.2 and 9.3 are shown below. The detailed Risk Assessment during construction and operation period is shown in Annex 19.

Table 10.1 Hazard Severity & Likelihood

Hazard Severity	Risk Type	Personnel Risk	Environmental Impact	Affected	Downtime	Socio-Political/Reputation
	1 Minor	Minor Injury (e.g. First Aid) - No loss of time	Minimal pollution effect. Contained locally	None	None	No internal disruption
	2 Low	Injury/Minor health effects require treatment by medical qualified persons. Effects are reversible. Short term absence from work. Complete recovery	Minor pollution slight impact negligible remedial/recovery work	Discipline	1 day	Minor internal disruption/Limited community impact/Reportable to regulatory authorities
	3 Medium	Potentially life threatening injury causing temporary disability. Major health effect to individual requiring medical aid to hospital facilities. Potential long term absence	Pollution with some on-site/off-site impact & recovery work. Possible outside assistance required to contain. Some local and possible regional media interest.	Project	1-7 days	Internal disruption that could require outside help to manage. Community discussion adverse local or financial publicity. Lawsuits possible
	4 High	Major life threatening injury or major health effects to several persons. Long term absence within complete recovery/permanent disability	Significant pollution with off-site impact & recovery work. Local, Regional and possible National media interest	Business Unit	4 weeks	Serious internal disruption adversely affecting ongoing business and requiring third party help to manage. Widespread interest. Adverse shareholder and broker reaction. Lawsuits possible.
	5 Major	Fatality or multiple fatalities multiple permanent disabling injuries from occupational illness or injury	Massive pollution with significant site impact & recovery work. Regional and possible National and Global media interest.	Corporate	More than 1 month	Very serious business disruption and impact. Oil company operations. National/International media interest adverse publicity.

S=Severity, L=Likelihood

Table 10.2 Detail definition of Likelihood

likelihood	AUnlikely	An incident which is not expected to occur under any normal circumstances and would only result from a combination of extremely improbable factors. The probability of an "Unlikely" incident occurring is regarded as less frequent than 10^{-5} peryear
	BRemote	An incident is not expected to occur under normal circumstances but may occur under exceptional circumstances. The probability of a "Remote" incident occurring is regarded as being between 10^{-5} and 10^{-4} peryear
	CPossible	An incident which has the possibility of occurring under normal circumstances. The probability of a "Possible" incident occurring is regarded as being between 10^{-4} and 10^{-2} peryear
	DProbable	An incident which is likely to occur at some point or regularly during normal circumstances and would require no extraordinary factors for its occurrence. The probability of a "Probable" incident occurring is regarded as being between 10^{-2} and 10^{-1} peryear.
	EVeryLikely	An incident which is almost certain going occurs during normal circumstances if conditions remain unchanged. The probability of a "Very Likely" incident occurring is regarded as being between 10^{-1} and 1 peryear

Table 10.3: Risk Matrix

		Likelihood				
		A Unlikely Could only occur under a freak combination of factors. (Less frequent)	B Remote May occur only in exceptional circumstances	C Possible Could occur at sometime	D Probable Would require extra ordinary factors to occur at sometime	E Very Likely Almost certain to happen, if conditions remain unchanged
HAZARD SEVERITY	1 Minor Minor injury/Minimal pollution effect/No loss time/No internal disruption/No downtime	A1	B1	C1	D1	E1
	2 Low Injury which requires medical attention/1-3 days loss time/Minor pollution effect/Minor internal disruption/1 day downtime	A2	B2	C2	D2	E2
	3 Medium Potentially life threatening injury causing temporary disability (e.g.: Fractures) and/or requiring medication/Potential long term absence/Pollution with some on-site or off-site impact/Disruption possibly required outside help to manage/Downtime between 1 to 7 days.	A3	B3	C3	D3	E3
	4 High Major life threatening injury or causing permanent disability (e.g.: Loss of limb)/Incomplete recovery/Pollution with significant impact/Very serious business disruption/Upto 4 weeks downtime	A4	B4	C4	D4	E4
	5 Major Fatality or multiple fatalities, or multiple life threatening injuries causing permanent disabilities/Massive pollution with significant recovery work/Over 1 month downtime	A5	B5	C5	D5	E5

	Any task that has this risk ranking is generally acceptable. The work environment and methodology presents minimal risk to personnel.
Medium	Any task that has this risk ranking is only acceptable if the Risk is As Low As Reasonably Practicable (ALARP). Personnel completing this task should be fully aware of the risk which exists and the control measures should be put in place to minimize them.
High	Any task that has this risk ranking must not be completed. It should be refined or further control measures put in place to reduce risks.

The following Risk Assessment Tasks from 1-13 are attached in Annex-19 in detailed.

RiskAssessment Results (Blank sheet)

Task 1: LiftActivities

Task 2: Erection of SteelStructure

Task 3: HeavyLifts inGeneral

Task 4: HeavyLiftingNearInstalled Equipments

Task 5: All HotWork

Task 6: OperationConfined Space

Task 7: Man LiftOperations

Task 8: Connectionsto High Voltage

Task 9: OperationsNearLive Line

Task 10: Handling ofDangerous Chemicals inSignificantQuantities

Task11 : DemolitionActivities

Task12 : DemolitionActivities

Task 13: Working atHeight in Different Level

10.6 Emergency Plan

In recent years public awareness of hazards from industry have increased considerably. Local people and employees have now better legal safeguards against industrial disasters. The management today has more responsibilities in respect of any kind of disaster in its project. So a specific management plan to encounter a disaster situation is of utmost importance. As disaster types, sources, effects are different; it needs a multidisciplinary and multi-organizational approach to tackle such situations.

Types of Disaster: Disaster is an event which causes severe disruption to life of number of people or to the project activities resulting in suffering and loss of life and property. Disasters can be one or several of the types as under:

- i) Plant oriented - due to design errors, operational defects, chemical changes, failure of equipment human error etc. (in the plant area).
- ii) Natural - flood, cyclone, fire, earthquakes, biological disaster.
- iii) Manmade - war, riot, sabotage.

Degrees of Disaster: Disaster can be classified into 3 types depending on its effects:

- a. Low – Such disasters are capable of causing injury, illness and equipment damage, but, are not, however, very serious and could be quickly manageable.
- b. Medium – Disasters of this type can give rise to critical situations, can cause serious injuries to personnel, serious illness property and equipment damage.
- c. High – Disasters of this extreme type lead to catastrophic situations, pose major danger to life and property. Such disasters cannot be immediately controlled. These can cause deaths, major widespread illness, injuries, loss of major property and equipment.

The contingency plan should provide for a Chief Coordinator. The Chief Coordinator will declare the contingencies arising out of the type of disaster that has taken place along with the mode of action in respect of the disaster type. The following could be prescribed as the mode of action during various degrees of disaster.

High Disaster – Catastrophic condition. All employees need to be evacuated. Local administration is to be properly informed and interacted with.

Medium Disaster – All project activities should be stopped. All employees are to be in safe place. To be ready for High disaster situation. Local administration should be properly informed and interacted with.

Low Disaster – Activities in the affected area stopped. To be ready for Medium type of disaster condition.

10.6.1 Objective of Emergency Plan

On site Emergency Plan is required to meet the emergency condition during disastrous event in the plant. Its objectives are to:

- a) Rescue and treat casualties
- b) Safeguard other people & Installations
- c) Minimize damage
- d) Control initially and restore ultimately to normal situation
- e) Arrange rehabilitation of the affective people

10.6.2 Implementation of Emergency Plan

Based on the nature of disasters anticipated during the three phases (pre-construction, construction and post-construction) of the project and the objectives of the emergency plan, necessary human resource and infrastructural facilities need to be made available on board toward effective operation and execution of the plan. The plan could be revised and detailed after the commissioning of the plant when all the units are in final shape. Exact name and designations of all personnel could be then accommodated in the plan.

Actions during Emergency: At times of emergency due to any of the above types of disaster, the general employees of the proposed power plant should proceed to/contact the Emergency Assembly Point in their area. Designated persons will carry out the actions detailed in the Individual Plant Emergency Procedure. Their presence at the Emergency Assembly Point should be verified and ascertained through roll-calls. Personnel not at their normal work place must also move to the emergency assembly point and await necessary safety instructions.

Contractor's employees should also be instructed of the Emergency Procedures before commencing work on this site. They will report to the emergency assembly point on this site. Personnel Manager will guide them in case a major decision like evacuation from the factory is taken.

Infrastructure for Execution of Emergency Plan:

a) *Fire Fighting Facilities:* The plant will have adequate firefighting aids including fire hydrants close to the various sections of the power generation area and Portable Fire Extinguishers of various types and sizes need to be installed at conveniently reachable locations.

b) *Disaster signalling Siren:* Siren to be used for raising the alarm and also for ALL CLEAR signal should be installed within the power plant premises.

c) *First Aid Boxes* should be provided at specific locations including at the Assembly point for administering preliminary treatment. A number of employees will be trained for first aid use.

d) *Emergency Control Centre* should be at a central as well as safe location in the plant premises wherefrom the Site Controller could direct the movements of Personnel and Equipment during an Emergency.

e) *Contents of Emergency Control Centre* should be as under:

- (i) External telephone line and a list of relevant telephone numbers to contact at times of emergency.
- (ii) Internal telephone and telephone list of Emergency Assembly Points.
- (iii) List of Emergency Control Team, who must be called showing addresses and telephone numbers.
- (iv) Emergency Controller's Red & White Helmet.
- (v) A list of all persons (by title) responsible for groups of employees.
- (vi) Logs and Emergency Controller's checklist.
- (vii) Emergency lighting.
- (viii) Copy of the emergency plan.
- (ix) List of persons trained in First Aid & Fire Fighting.
- (x) List of safety cabinets and their contents & locations.
- (xi) Battery operated torches.
- (xii) Detailed site plan.
- (xiii) First aid equipment including stretchers (in surgery).

Assembly Point is a place containing an internal telephone and paging system, where people can wait in a group during emergency to receive instructions from the Emergency Controller. External Communication will be done by Site Controller. The following persons and offices may be given updated information as necessary and asked for necessary help:

- Upazilla Nirbahi Officer (UNO)
- Police
- Fire Brigade
- Upazilla Health Complex/District Hospital
- Factory Inspector
- Local Media
- Upazilla Magistrate

CHAPTER 11

LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT

The land required in the SNPL UNIT II Unit II has been procured from willing sellers at a negotiated price. The site was previously used as a factory producing rice puffs. There were no agricultural workers, share croppers and squatters. Therefore there is no issue of resettlement or compensation due to livelihood loss.

The list of land willing land sellers are as follows and the was formally bought by Mr. Mahmud Hasan who is the Financial Controller of SNPL UNIT II Unit II who was delegated to carry out the transactions:

Table 11.1: List of the land owner

Land area In Decimale	Name of the title holder	SA Dag No.	RS Dag No.	Khatian No	Buyer
13	Tajul Islam, Shahab Uddin, Ali Hossain	558	1728	2654,1990	Mahmud Hasan
20	Tajul Islam, Shahab Uddin, Ali Hossain	558	1728	380,126,6 62,572	Mahmud Hasan
10	Ali Hossain	557	1732,1733	2616	Mahmud Hasan
3	Md. Liakat Ali	557	1733	1486	Mahmud Hasan
5	Ashura, Abdul Halim	557	1733	2352	Mahmud Hasan
5	Shahin Mia	557	1733	1054	Mahmud Hasan
4	Gias Uddin, Jamila Khatun	557	1733	1119	Mahmud Hasan
6	Md. Jahinur Mia	557	1733	2691	Mahmud Hasan
8.25	Awlad Hossain Khoka	557	1733	2327	Mahmud Hasan
53.61	Khaleda Akhter, Masuda Akter, Ayesha Khatun, Salim Ahmed, Shamim Azaz, Nasrin Akhter, Samsad Tania, Md. Silpi Sadik, Rajon, Anwar Sadat, Nima Sultana	557,558, 559	1732,1729 ,1726,172 6,1725	1922,2142	Mahmud Hasan
148.45	Md. Hafijur Rahman	571,572,573,57 4,575,576,559	1724,1727		Mahmud Hasan

CHAPTER 12

STAKEHOLDER ANALYSIS, CONSULTATION, PUBLIC AWARENESS AND DISCLOSURE

12.1 Stakeholder Analysis

During preliminary survey the following meetings and consultations with the villagers and public had already taken place to disseminate information on the project activities among the project affected peoples (PAPs) and individual household survey with the structured questionnaire. The consultation approach was based on a combination of Formal and Informal meetings, Focus Group Discussions (FGDs), Key Informant Interview (KII) with the local elite, school teachers, freedom fighters, women group, administration and Ward Councilor. The formal meetings were held through prior notice, appointment and invitation including all the PAPs and households, district administration, local administration and other stakeholders in the affected area. The basis for selecting the stakeholders was based on the following criteria:

- i) Identifying the Project Affected People
- ii) List the PAPs directly impacted due to land acquisition
- iii) List the number of share croppers or impacted in any other way in the acquired land
- iv) Identify the government agencies connected with the project
- v) Identify local elites and academicians for their view on the project
- vi) Identify the closed households or commercial institutions of the project site and make them aware about the impacts of the project and noted their concerns and reporting.
- vii) Identify the local NGOs working in the area

One large public consultation meeting which included all the PAPs, representatives from the project impacted areas, district and local administration, as well as other community representatives including prominent local people, lawyers, journalists, academicians and the representative from Summit Power Narayangang Unit I and Unit II limited. Meeting minutes of the consultation with the stakeholders are shown in the later part of the report.

The following table shows the type of stakeholders consulted during the study period.

Table 12.1: List of Stakeholders for information dissemination and disclosure

SN.	Stakeholder	Issues and concerns discussed
1.	a) Upazila Administration b) Upazila Nirbahi Officer (UNO)	Follow up on the land purchase process. Mrs. Minara Naznin Upazila Nirbahi Officer(UNO) Bandar, Narayangang Mobile: 01714220019 • To keep the sound in ambient level so that the nearest people don't face any problem(TNO) • Public nuisance should reduce as much as possible • To pay the Land price to the actual land owner • Be careful when the heavy vehicle move in the road so that the road structure may not damage • Ship movement should be careful in the river
	Ward Counselor	Faisal Md. Sagor, Commissioner Bandar, Narayangang Mobile:  • To help the affected people by giving jobs in the power plant • To provide continuous help to the mosque, madrasa, graveyard and other social institutions • To provide first aid and employ a doctor for treatment the affected people • To provide clothes to the vulnerable people during winter season • To construct the thickness wall and tree plantation to check the sound
2.	Project Affected People (PAPs) and the community	Abdul Haque Matabbar Ex Member PaschimIslampur, Madangonj, Narayangang Mobile No: 01980853340  • Informal meeting held with all the PAPs in the area during socio-economic and PAP survey. • The people's concerns were recorded on the household level. • One formal meeting took place to discuss all issues/impacts resulting from the project. • During the surveys the 

SN.	Stakeholder	Issues and concerns discussed
		environmental issues were communicated to the stakeholders. • The major concern was the sound to be affected the locality during the plant operation period • The local people are very much concern about their contracted house which have cracked by the pilling activities of the power plant • The present sound affect their lives, children study, old people, patient and other activities • Continuous jerking and vibration of the construction work hamper their life.
3.	Bangladesh Power Distribution Company Ltd.(BPDC)	Afazzal Haque Sub Assistant Engineer DPDC, Madangonj, Narayangang Mobile: 01755541599 The major issue was whether the T-line being built by BPDC to transmit power from SNPL UNIT II and other plants/ projects in & around Narayangang zone Finally it was decided and constructs the line by the SNPL UNIT II Unit II to substation. It is about 750m away from the SNPL UNIT II Unit II area
4.	Bangladesh Inland Water Transport Authority(BIWTA)	Mrs. Shirin Akhter Asst. Director, BIWTA Mobile: 01746303883 AKM Arifuddin Joint Director, BIWTA Mobile: 01712537027 The issue of exclusivity of the HFO pipeline and the ship which will be used for carrying the HFO from outside of the area was discussed, i.e. that there will be no other way except the river of Sitalakha to carry the HFO and filling the tank in the plant that will be used exclusively for the purposes of the Project. • River excavation is needed to avoid the marine traffic congestion • To keep Fire accessories always ready to avoid the fire hazards • HFO carrying Ship always use the signal light even in the birthing time at night • To check the oil spillage in the river • Jetty should be in the upland of the river because the river is narrow • Sound should keep in ambient level
5	Fire Service and Civil Defense	Ahmed Hossain, Leader Bandar Fire Service and Civil Defense, Narayangang Mobile: 01912220570 Ibrahim Khalil, Fireman Bandar Fire Service Station Mobile : 01920482449



SN.	Stakeholder	Issues and concerns discussed
		• Hidden point must be installed • Water reservation is necessary • Hose drill must be installed • Extinguisher at around 500m2 must be placed with CO, heat detector and other accessories • First aid, fix alarm system, PA system, splinger system is needed • Every 6 month interval a training to the staff on fire equipment is needed 
6.	Local Elite, Journalists, Professor, Freedom Fighters, Businessman	Mr. Sarwar, Businessman Mr. Saiful, Teacher Mr. Jakaria, Service Mrs. Rahima, Housewife Amina Begum, Service Mrs. Begum, Housewife F. Fighter Md. Noor Hossain Mrs. Lutfa Begum, Professor They were very much concern about they can live in their father resident where they have been living from generation to generation and now it is going to turn an industrial zone Their main concern was ensuring sound below ambient level. Employment opportunity in the plant Meaningful community development for the people in the affected areas was demanded. 

Stakeholder's Consultation

Stakeholder consultation meeting is an important part of the ESIA study. The main objective of the consultation meeting is to apprise the local inhabitants about the Proposed Project and to seek their opinion regarding the tentative impacts. It is a fundamental principle of any environmental assessment study. The inclusion of the feedback of public consultation helps to ensure that the decision making process is equitable and fair and leads to more informed choice and better environmental outcomes. The findings from the public consultations carried out as a part the ESIA study were utilized in the development of the EMP, especially in identifying the significant impacts of the proposed project and developing the corresponding mitigation measures.

The objectives of the consultations were as follows:

- To dissemination of information about the Project among the stakeholders;
- To have a better understanding of existing environmental conditions;
- To aware stakeholders to contribute meaningfully to in different phases of project;
- To reduce psychological distance between project sponsor and stakeholders;
- To ensure the sustainability of the project.

- To help the local vulnerable group, project affected people, social establishment etc.
- To ensure the pollution free environment during operation etc.

12.2 Consultation and Participation Mechanism

12.2.1 Consultation

Public consultation has been carried out during different activities in the Project cycle, using different techniques such as public meeting, small group meeting, informal meeting as per environmental social and procedures of BCAS. Meeting minutes of consultation with the stakeholders are shown in the end of this chapter. During such consultations the public was informed about the project in general and in particular about the following:

1. Finalization of the Project plan.
2. Design standards of the Summit Narayangang Unit II Power plant limited in relation to the applicable in IDCOL, international standards like IFC, ADB etc.
3. Health Impacts and their mitigation as part of the Environmental Management Plan (EMP).
4. Measures taken to avoid public utilities and other social infrastructure such as school, hospital, roads etc. as well as to generate employment opportunities, and assist with the development of a small enterprise.
5. Other impacts associated with Right Way of Alignment (RoW) for grid connection, Access Road with an approach to minimize and mitigate the effects.
6. To ensure the pollution free environment during operation etc.
7. Land procurement details and other social and corporate responsibility and policies.
8. Any other compensation for any damages associated with the project development.

12.2.2 Stakeholders' Participation Mechanism

A series of public discussion activities were undertaken by BCAS. These programme included Participatory Rapid Appraisal (PRA), Key Informant Interview (KII) and discussion with the groups of Project Affected People (PAPs) and community leaders.

In conducting the baseline survey, three types of stakeholders were consulted. In the following sections the consultation process is briefly depicted.

12.2.3 Public awareness and disclosure

In general community stakeholders are categorized into two broad categories: directly affected and indirectly affected. Directly affected community stakeholders include people who will have the potentiality to be directly impacted through loss of land, crops and other assets, environmental and social adverse impact due to the project. Indirectly community stakeholders include those people of the project area who have the potentiality to be affected by the project activity at a limited extent.

The methodology used for the disclosure process was as follows:

- i) A 100% questionnaire-based census was carried out on the PAPs during which information on the project activities was disseminated and the nature of impact and compensation issues were discussed.

ii) During the sample-based socio-economic survey which had covered 100 households within the impact zones, dissemination of information on the project activities was also taken and information disclosure carried out.

iii) Preliminary Informal meetings with various categories of the people

iv) A public meetings which included all the PAPs, representatives from the three project impacted areas, district and local administration, as well as other community representatives including prominent local people, lawyers, journalists and academician

Preliminary Informal meetings with various categories of the PAPs and households were completed during survey period.

Table 12.2 : Stakeholder consultation meeting with different groups are as follows:

No.	Village	No. of people attended	Date	Occupation
1	PM Road Ideal Club, Madangonj	15	20.11.2015	Civil society, Service holder Businessman, Agriculture, Day Labourer, Teacher, Housewife
2	Islampur Road, Madangonj	11	21.11.2015	Social worker, Businessman, Professor, Service Holder, Housewife, Student
3	Plant site, SNPL UNIT II Unit II, Madangonj	14	22.11.2015	Day labourers
	Modongonj Govt. model Primary School	65	26.1.2016	Social worker, Businessman, Professor, Service Holder, Housewife, Student, Journalist, political leaders

12.3 The Results of Consultation Meeting and Concern Raised

The results of the focus group discussions and stakeholder's consultation with project affected persons are detailed in section 11.8 of this Chapter. The information presented below discusses how concerns raised and recommendations made during the consultation process were addressed.

The following queries were raised by the affected people during Public consultation and informal group meetings:

1. Whether land compensation due to Power plant, access road, evacuation line and T-line will be paid without any hindrance?
2. Whether the village will get uninterrupted power supply or not?
3. Whether there will be any adverse environmental hazard due to HFO and power plant?
4. Whether the sound and vibration generated from the power plant unit I and the next plant unit II would be minimised or not
5. Whether the local people and the project affected people will be engaged in the plant construction works and in the operation time as office employee?
6. Would the local people benefited from electricity supply to their villages through this plant?
7. Whether the local people will get the additional facilities like hospital, school, college, paved road, graveyard, eidgha math, club, training on small enterprise establishment?

8. Whether the local vulnerable poor people will get the blanket and other clothes for protect them from cold

The following clarifications were provided by SNPL UNIT II Unit II and BCAS staff in response to the aforementioned questions:

1. Land purchase and compensation related issues for the plant site is completed. The compensation for land has already been given by the SNPL UNIT II unit II authority.
2. Potential impacts on the environment, sound, and associated mitigation measures were discussed during all the formal and informal meetings held. The ESIA provides detailed description of potential impacts and mitigation and is also supplemented by a comprehensive Environmental Management Plan to ensure the compliance.
3. Skilled and unskilled people from the locality will be engaged in the construction works such as sand supply, filling material supply, general labour and local transportations. This commitment was endorsed by SNPL UNIT II Unit II on several formal meetings. Uninterrupt electricity to the village will be undertaken by the Distribution of Power and distribution Company(DPDC) of the Government of Bangladesh. The latter will play a principal role in arranging the power supply. Villagers were informed about the government's target to provide electricity to all households in the country by 2020 as per Master plan "Vision 2020" that is being implemented by the Government of Bangladesh.
4. People are conscious about the proposed Project but do not have a clear idea about when the project will commission and when they will get electricity;
5. The project affected people will be benefited from the health, education and communication facilities that will be set up by the project. The Project sponsors have committed to appoint a doctor for the treatment and supply some drugs to the poor people and will help the poor vulnerable people develop the communication system. The SNPL UNIT II Unit II project manager pointed out that a doctor already been employed for the firstaid treatment with drugs.

Specific outcomes of the consultations with the stakeholders, including actions that have been taken by the Project in response to concerns expressed by the affected people in the following Table 12.2

Table 12.3: Outcomes of the consultations with the stakeholder

Purpose	Outcome	Action/ Mitigation
Determine an extent of local support for SNPL UNIT II	The local people are in favour of the planned work since they believe that this power plant will create employment opportunities and will improve socioeconomic conditions in the locality.	Project sponsor made a commitment in formal meeting with locals to provide employment priority and local community development to ensure economic benefits.
Identify key environmental impacts	The perceived environmental and health impacts associated with sound emission, air quality and waste water were clarified by SNPL UNIT II and BCAS.	These issues have been identified and examined in the ESIA.
Identify key socio-economic impacts in the implementation of SNPL UNIT II and the expectation of the local people.	All Stakeholders expect obtaining employment at the power plant.	These aspects have been covered in the IEE and SNPL UNIT II will give priority, as well as through consultations with all the stakeholders.

Purpose	Outcome	Action/ Mitigation
Identify expectations of Project Affected People	PAPs expect obtaining employment at the power plant and receiving fair compensation and cash assistance for the loss of their lands and other assets. It is also expected that educational and health care facilities will be established by the Project.	These aspects will be covered as well as through consultations with all the stakeholders.
Assess the significance of the socio- economic impacts	Loss of agricultural lands will disrupt production of rice for subsistence and market sale.	Daily labourers whose livelihoods depend on land will be compensated and will be able to avail of employment opportunities generated by the Project.
Determine PAP preferences for compensation and mitigation	In addition to fair compensation for their land and dwellings, PAPs expect availability of jobs at the plant. Some people expressed their preference to receive compensation directly from SNPL UNIT II Unit II, being concerned about possible delays of the government compensation payment system.	The land purchased from willing saler and paid them actual cost based on the market situation and some case the price was more than other areas.

12.4 Information disclosure process

Public disclosure is a continuous process. SNPL UNIT II Unit II has initiated the process through the IEE study. During the IEE preparation process BCAS undertook several Stakeholder Consultations. The public consultations conducted to date have thoroughly covered the issues related to environmental and social issues which allowed all proposed measures to be developed with sufficient input from the affected stakeholders, using the mechanism of participatory, inclusive and informed consultation.

The methodology used for the disclosure process was as follows:

- i) A 100% questionnaire-based census was carried out on the PAPs during which information on the project activities was disseminated and the nature of impact and compensation issues were discussed.
- ii) During the sample-based socio-economic survey which had covered 100 households within the impact zones, dissemination of information on the project activities was also taken and information disclosure carried out.

Preliminary Informal meetings with various categories of the PAPs and households were completed

During consultations and engagement process with people in the Project locality, BCAS field staff explained impacts and benefits of the Project, payment of required compensation for the damage to crops, trees, residential structures, ponds etc., and measures taken by the Project to avoid public utilities and community infrastructure such as schools, roads, common property resources etc.

12.5. Plan for further consultation and community participation during Project implementation

The proposed plan for future public consultations is as follows:

1	Detailed/Check survey	Public Meeting and individual affected household survey will be carried out as per the monitoring programme. The survey will be focused on compensation, rehabilitation and community development programme related to the different Project components, including the plant, T-Line etc	In every six month
2	Construction Phase	Localised group meetings, Distribution of information leaflets and brochures, Public display	Throughout construction period
3	Operations Phase	Information brochures, Operation field offices in the affected localities, Monitoring and providing response to public enquiries, Press releases	Continuous during Project operations

12.6 Consultation

Two forms of public consultation were used during preparation of the ESIA to discuss the project and involve the community in planning the mitigation measures and developing the Environmental Monitoring Plan. These are:

(i) Public meetings were held in the project area, to which representatives of the stakeholders were invited. Attendees were informed about the aim of the relevant project and the benefits they would bring, together with their likely impacts and the ways in which they would be mitigated. Participants were invited to discuss their views and concerns, which were then incorporated into the ESIA.

(ii) Ad hoc discussions were also held on site with people and communities who could be affected by the project, so that views could be expressed in a less formal setting. These were also considered in preparing the ESIA.

Despite various issues discussed and evaluated due to possible impacts from the proposed project activities upon the surrounding physical, social and biological environment, a significant issue is also considered during the ESIA study which is termed as public consultation. Considering the value of the suggestions and opinion of the local people, Government and Non-government officials it has become a mandatory criteria to incorporate their suggestion prior to ESIA approval i.e. environmental clearance from the department of Environment. As such, a brief Public consultation was conducted followed by individual interviews with respective government and non-government officials and concerned person of the locality.

12.7 Issues Discussed

The local people were interviewed three times. In open type public meeting, some prefixed agenda relating to proposed project work were discussed. The issues were raised in such way that everybody was able to express his /her opinion without hesitation. A friendly atmosphere was created prior to starting of the informal discussion.

The issues were as follows:

- An overview of the work, its background, justification of settling and future prospect etc.
- Overall impacts on surrounding physical, biological and social environment as observed or anticipated by participants due the proposed plant's setting and future operational stage.
- Overall safety and other precautionary measures taken against any kind of accidental hazard.
- Local people's aspiration about proposed activities of this project.

The findings of the meetings are briefly discussed in the following paragraph:

- The power plant will be generating a frequent amount of noise up-to a certain buffer level from the industry. The frequency of the noise might cause some vibration up to a tolerable level. The vibration is felt more by the nearer residents around the industry. Hopefully there are little amount of residents household around the industry location. A compensation scheme is already developed to help the affected households. Though the amount of affected people is not much of the concern. The disclosed issues about the vibration are given below:
- Noise & vibration due to noise level is high nearer to the industry.
- Up to the buffer level of about 30 meter the noise intensity is moderate.
- After the 30 meter buffer the intensity is negligible.
- It will supply electricity in the urban area, so good for economy and environment.
- Employment will generate for the local peoples and also at the national level.
- Though it is seen that the current nature of the industry is not taking in the direct employment from the local people as the education level for such job offerings is not enough or up-to the mark for the local people, but indirect benefits have been attained by the local shops and other industries.
- The project area will be separated with buffer zonation along the boundary to reduce the noise level up to a certain extent.
- After all this project is utilizing *bilan* land thus land value will increase around the project area.

12.8 Minutes of the Stakeholders' Consultation Meeting

A consultation meeting on Environmental and Social Impact Assessment (ESIA) of the Summit Narayangonj Power Unit II Limited was held in the conference hall of Modongonj Govt. model primary school on 26th January 2016. The meeting was presided over by Faisal Md. Sagor, Counselor, 19 No. Ward, Narayangonj City Corporation, Narayangonj. A PowerPoint presentation was delivered by the Dr. MI Sharif, Team Leader of the project. He described the environmental situation will be raised due to project. He mentioned that we have conducted a baseline study on 5km radius of the project. We have collected Air quality data through high volume air sampler, analysed the surface and ground water quality, taking people perception on the project, knowing the potential impact what will be during construction and operation period. About 65 participants including a large portion of female from different classes was present there. The participant list is attached herewith.

During the discussion Hazi Amzad Hossain, community leader and advisor of Summit Modongonj Power Limited pointed out that the project authority made an advisory committee of the project. There they included the community leader of the Modongonj but they don't discuss with us the crucial issue like sound and vehicle movement due to project. Our home

structure already crackdown and the black dust from Power plant Unit I blacken our residence. What should they do and how to mitigate it they never discuss. He told that they are doing business here and our people sufferings so they have to contribute to our social establishment like graveyard, club etc. they can participate by giving blanked to the poor vulnerable people during winter season to save the people from severe cold. They can give some firstaid treatment to the local poor people.

Hazi Abdul Haque Matbar, Community Leader of Islampur and Advisor of Summit power has pointed out that the authority should compensate the local people who are affected due to project. We could not sleep at night and our children can't read. Old and sick people can't sleep soundly. The authority should take measure to mitigate the sound. They need to develop the road and social institute

Mr. Modabbir Hossain, Freedom Fighter and the community leader has pointed out that sound pollution hamper our sound sleep and natural life. The authority should take sound mitigation measures. We expect pollution and black dust free environment. They can appoint a doctor to give first aid to the local people. They can donate to the mosque and help to the poor vulnerable people.

Mr. Mofiz Prodhan told that Summit authority should take sound mitigation measures and help to the local people.

Mr. Faisal Md. Sagor, Counselor, 19 No. Ward, Narayangonj City Corporation thanked to the Environment and Social Consultant for their neutral role play to collect information from the local people. They used equipments to identify the pollution rate, collect water to analysed its quality, collected people perception, visiting the house premises, conducting group discussion, organize the consultation meeting to share their information what they collected. I think that they will recommend good things infavour of us. I suggest to the Summit authority for checking the sound source and should adopt new technology for sound mitigation. They have to do such thing which may help to keep the environment pollution free. I request the authority to set up high brick wall around the four side of the plant. I also request to the local people to help the power plant authority. Summit authority can employ local people based on their skill. They can increase their contribution to the social establishment.

Initiatives Taken

Mr. Faridul Islam, Deputy Project Manager, Summit Narayangonj Power Unit II Limited addressed the issues come from the local people that-

We have already setup high brick wall around the project and going to setup equisetetic sound wall which will protect the excessive sound.

We run a model to predict the pollution due to project and will take mitigation measures accordingly

We contributed to the social institutions like mosque, club, graveyard etc.

We appointed a doctor to give first aid with drug among the local people

We engaged local labour to the construction work and will appoint if we get suitable people

We distributes blanked among the local poor people during winter season

We developed road connectivity and we have a future plan to assist the local people.

Finally I thank to the local people to help us.

Mr. Abdul Hamid Explained “The Summit Narayanganj Power (Unit II) Limited surely will reduce their local burden and help them with certain issues like job, training etc.”

Md. Borhan Uddin “Suggested to extend the wall barrier and to use tree plantation to reduce the noise level”

Md. Emon “Summit is helping the affected people with remuneration, the cost estimation for actual affected peoples have been done and provided with the help. The others showing the problems at minor level”

Abdul Wahed “Summit has been helping the local community since the beginning they heard from the people about their loss, held meetings with local peoples at different times and also helped community to advance further development of their locality”

Helps Provided by Summit Narayanganj Power (Unit-2) Limited

- 8 Local Mosques with Donation of about 25 thousands for each
- Warm Clothes distribution at winter time
- Financial support up to a certain extent of people to repair their house
- Financial support for Graveyard Land Filling
- Arranged Awareness programs etc

Table 12.4: List of people who imparted in the consultation meeting

SN.	Name	Address	Occupation	Mobile Number
1	Md. Hazrat Ali	Islampur,	Day Labourer	01672652568
2	Md. Abdur Rashid	Islampur,	Pickup Driver	01823182334
3	Md. Monir	Islampur,	Grocery Shopkeeper	01790425278
4	Md. Jahangir	Islampur,	Business	01961890554
5	Akter Mia	Islampur,	Day Labourer	Not Available
6	Md. Shahid	Islampur,	Business	01945296553
7	Abdur Rashid	Islampur,	Labourer	Not Available
8	Md. Roni sarder	Islampur,	Business	01920214751
9	Modabber Hossen	Islampur,	Business	01737363690
10	Atiar Molla	Islampur,	Day Labourer	Not Available
10	Mr. Abubakar	Islampur,	Service	01734583665
11	Mr. Md. Amanullah	Islampur,	Service	01726007848
12	Mr. Shahabuddin	Islampur,	Service	01815372666
13	Mr. Mohsin	Islampur	Student	019344977758
14	Mrs. Shahin Akhter	Islampur	Housewife	01934823240
15	Mr. Shakil	Islampur	Student	01851699886
16	Mr. Kazimuddin	Islampur	Student	Not Available
17	Mr. Anof Ali	Islampur	Student	01684832738
18	Mr. Wahabullah	Islampur	Student	01711127497
19	Mr. Saiful Islam	Islampur	Business	Not Available
20	Mr. Abdullah	Islampur	Business	Not Available
21	Mrs. Mousumi	Islampur	Housewife	Not Available
22	Mrs. Setu Begum	Islampur	Housewife	Not Available
23	Mrs. Labonno	Islampur	Housewife	Not Available
24	Mrs. Rabeya	Islampur	Housewife	Not Available
25	Mrs. Shati	Islampur	Housewife	Not Available
26	Alafa Khatun	Islampur	Housewife	Not Available
27	Mrs. Rashida Khatun	Islampur	Housewife	Not Available
28	Mrs. Mariam Begum	Islampur	Housewife	01947486219

SN.	Name	Address	Occupation	Mobile Number
29	Mrs. Mamuna Begum	Islampur	Housewife	Not Available
30	Mrs. Rikta Begum	Islampur	Housewife	Not Available
31	Mrs. Rashida Begum	Islampur	Housewife	Not Available
32	Mrs. Lili Khatun	Islampur	Housewife	Not Available
33	Mrs. Masum	Islampur	Business	Not Available
34	Hazi Amzad Hossain	Islampur	Business	01705593360
35	Mr. Mofiz Prodhan	Islampur	Social worker	01717323130
36	Faisal Md. Sagor	Islampur, 19 No. Ward	Ward Counselor	
37	Muktijodda Nur Hossain	Islampur	President Modongonj Primary Govt. School	Not Available
38	Mr. Modabber Hossain	Islampur	Freedom Fighter	Not Available
39	Mr. Fazlul Haque	Islampur	Social worker	Not Available
40	Hazi Piar Ali	Islampur	Soocial worker	Not Available
41	Mrs. Zrina Begum	Islampur	Housewife	Not Available
42	Mrs. Rina Akhter	Islampur	Housewife	Not Available
43	Mrs. Mafi Begum	Islampur	Housewife	Not Available
44	Mrs. Mozila	Islampur	Housewife	Not Available
45	Mrs. Aklima Akhter	Islampur	Housewife	Not Available
46	Mrs. Asia Khatun	Islampur	Housewife	Not Available
47	Mrs. Sufia Akhter	Islampur	Housewife	Not Available
48	Mrs. Fatema Begum	Islampur	Housewife	Not Available
49	Mrs. Khorshida khatun	Islampur	Housewife	Not Available
50	Mrs. Rahima Khatun	Islampur	Housewife	Not Available
51	Mrs. Masuma Akhter	Islampur	Housewife	Not Available
52	Mrs. Shuha Khatun	Islampur	Housewife	Not Available
53	Mrs. Mina Begum	Islampur	Housewife	Not Available
54	Mrs. Hagira Khatun	Islampur	Housewife	Not Available
55	Mrs. Asma Begum	Islampur	Housewife	Not Available
56	Mrs. Rukhsana Begum	Islampur	Housewife	Not Available
57	Mrs. Shahida Begum	Islampur	Housewife	Not Available
58	Mrs. Laila Khatun	Islampur	Housewife	Not Available
59	Mrs. Luki	Islampur	Housewife	Not Available
60	Mrs. Maksuda begum	Islampur	Housewife	Not Available
61	Mrs. Rahima Begum	Islampur	Housewife	Not Available
62	Mrs. Nasima Akhter	Islampur	Housewife	Not Available
63	Mrs. Lima	Islampur	Housewife	Not Available
64	Mrs. Keya Moni	Islampur	Housewife	Not Available
65	Mrs. Nasima	Islampur	Housewife	Not Available

Some pictorial views of the consultation meeting are given below



CHAPTER 13

GRIEVANCE REDRESS MECHANISM

13.1 Grievance Redress Mechanism

The objective of a grievance procedure is to ensure all comments and complaints from any project stakeholder, including local/regional authorities, residents of nearby residential areas, SNPL UNIT II employees and other interested parties, are acknowledged and responded to within a reasonable timeframe.

SNPL UNIT II will accept all comments and complaints associated with the project. The comments and complaints will be summarized and listed in a Complaints/Comments Log Book. Any person or organization may send comments and/or complaints in person or via post, email or facsimile using the contact information.

All comments and complaints will be responded to either verbally or in writing, in accordance with preferred method of communication specified by the complaint in the Comments and Complaints Form. All grievances will be registered and acknowledged within 5 days and responded to within 20 working days. SNPL UNIT II will keep a grievance log and report on grievance management, as part of half-yearly project progress reports, available at SNPL UNIT II website and on request at the plant office

13.2 Stakeholders Engagement Plan

SNPL UNIT II stakeholder's engagement will take place in a variety of contexts, and using a range of vehicles. Against this background, engagement will include consultation, joint planning, capacity building, partnerships, community-based monitoring and reporting. **Table 13.1** presents the scope and duration of existing and planned stakeholder engagement initiatives.

Table 13.1: Stakeholder engagement plan

Engagement vehicle	Stakeholders Involved	Engagement Tools	Duration of Initiatives	Frequency of structured meeting/ consultation
Public liaison Committee	All stakeholders in the project impacted (direct and indirect) area	Interaction between Stakeholder Liaison Officer, SNPL UNIT II and representatives of stakeholders.	Life time of the project	Half-yearly
Community Development Plan	Communities in the project impacted area	Stakeholder Liaison Officer, SNPL UNIT II	Life time of the project	Half-yearly
Community Health Safety Plan	Communities in the project impacted area	Stakeholder Liaison Officer, SNPL UNIT II	Life time of the project	Quarterly
Corporate Communication Programme	All stakeholders	Corporate Communication Manger, SNPL UNIT II	Life time of the project	Half-yearly
Grievance Management Mechanism	Directly/indirectly affected stakeholders	Stakeholder Liaison Officer and Corporate Communication Manager, SNPL UNIT II and representatives of stakeholders.	Life time of the project	Quarterly

13.3 Resources and Responsibilities

To ensure proper caring on grievances raised by stakeholders the resource and responsibilities to be allocated in two levels as are mentioned in the following sections:

13.3.1 Plant Level Resource and Responsibilities

Management of SNPL UNIT II will have dedicated persons to play the role of Stakeholder's Liaison Officer at Plant site. He will have the overall responsibility for handling the consultation and information disclosure process, including:

- Organization of consultation process,
- Communication with identified stakeholder groups
- Collecting and processing comments/complaints,
- Responding to any such comments and complaints, and
- Depending on the nature of a comment/complaint, some comments/complaints will be provided to the appropriate person in the company for a response.

13.3.2 Corporate Level Resource and Responsibilities

As a senior representative from SNPL UNIT II Unit II will play the role as required at the corporate level in dealing with addressing stakeholder's consultation. He is expected to review the findings/observations forwarded to plant level and who will be responsible for implementing the decisions.

Table 13.2: Contact detail of resource persons

Level	Name of the person and tentative title	Phone	e-mail
Plant level	Mr. Abu Bakar Siddik Stakeholder's Liaison Officer	01761593959	asiddik.snpl unit II@gmail.com
Corporate level	Mr. Arafat Corporate Communication Manager	01725037723	arafat.snpl unit II@gmail.com

13.4 Reporting

There is requirement of two tiers reporting as are discussed briefly in the following section.

13.4.1 Internal Reporting

Local reporting relevant to the stakeholder's engagement will be undertaken under the corporate Communication Programme. At a corporate level, stakeholder's engagement will be reported in Annual Reports and in other relevant corporate documentation.

Management reporting on the stakeholder's engagement will take place through the Stakeholder's Liaison Officer. The Corporate Communication Manager will receive a quarterly report on engagement activities.

13.4.2 External Reporting

External Reporting means the reporting requirement for external client including funding agency, government and other regulatory bodies and so on. SNPL UNIT II will provide stakeholders Engagement Report to them according to the requirement of them. Corporate Communication Manager is expected to manage the external reporting requirement also.

CHAPTER 14

CONCLUSION AND RECOMMENDATION

14.1 General

The ESIA study of proposed Summit Narayanganj Power (Unit-II) Limited has been concluded that the all environmental, metrological, geographical, biological aspects are well suited for the project. By adopting all documents of proposed project such as layout, total land, proposed activities (during construction and operational stage), project cost, utilities requirement, transportation mode the team found out the possible impact of project on surrounding environment, socioeconomic condition of project area. Observing all legal issues related to proposed project, the team gave a set of management plan to minimize the negative impacts and enhance the positive impacts. The management plan/mitigation measures have been given to run the proposed plant environment friendly way without damaging ambient conditions. The conclusions of ESIA are as follows:

- The proposed plant will have cummalative impacts on the environment such as air and noise. The mitigation measures suggested will abate the adverse impacts within accepatable limits and is manageable.
- The additional impact on air quality and water quality will be within the limits set by the DOE
- An extensive stakehoulder's consultation process has contributed to removal of certain wrongly perceived notions about the impacts of the project especially the impact of noise due to SNPL UNIT II Unit II.

It is recommended that the Environment and Social Management Plan be followed in the construction, operation and decommissioning phase of the project. The plans and procedures that have been specifiessd in the ESIA report should be elaborated by the SNPL UNIT II Unit II for management of smooth and safe operation of the plant.

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ANNEXURE

ANNEX -1: Land Purchase Deed

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Iscc Rule 277 (ii), (vi) and (xi) of the Bengal Practice and Procedure Manual

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(See Rule 277 (ii), (vi) and (xi) of the Bengal Practice and Procedure Manual)

চেক রসিদ নং: সি/সি/১৪৩৬/১৪৩৬

তারিখ: ২১/১১/১৪

কাহার নিকট: ২১/১১/১৪

কাহার বাবদ: ২১/১১/১৪

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০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

০০৭-১৭৬৩-১১১১

বিশেষ দৃষ্টব্য : — জনসাধারণকে জ্ঞাত করিয়া দেওয়া যাইতেছে যে কেবলমাত্র সরকারি মুদ্রিত রসিদ
বহি হইতে ক্রমিক নম্বরযুক্ত প্রদত্ত রসিদই গ্রহণযোগ্য হইবে।

বারান্দা-২০১৩/১৪-১০০০৬(কম-সি) মুদ্রণাদেশ নং-২১/১৩-১৪—১,০০,০০০ বই, ২০১৪।

(अनुसूचित २.७०६)

ଅବସ୍ଥିତି ୩୫

022650

ভূমি উন্নয়ন করণ পরিশোধ বসিদ

শিটি কর্পোরেশন/বোম্বাই/ইউনিয়ন কৃষি অফিসের নথি

[illegible]

निर्देश: प्रत्येक प्रश्न के लिए दिए गए विकल्पों में से सही उत्तर चुनिए।

সরকারি টাঙ্গার অফিসের নথি নং ৩ টি

2968

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01925

মহানগরী পরিষদ				
পরিষদের কার্য আইন	কমিটি উদ্যোগ কল	সং	বিবরণ	ফলাফল
সং ৩৪২২৪০ ১০/১০	২৩৪০/১	-	-	২৩৪০/১

महोदय ! एक वारा इमि उन्नयन कर जेवना शीतल होयत दिवतल ।

नईपति आका (कलकत्ता) १०/१०/१९३६

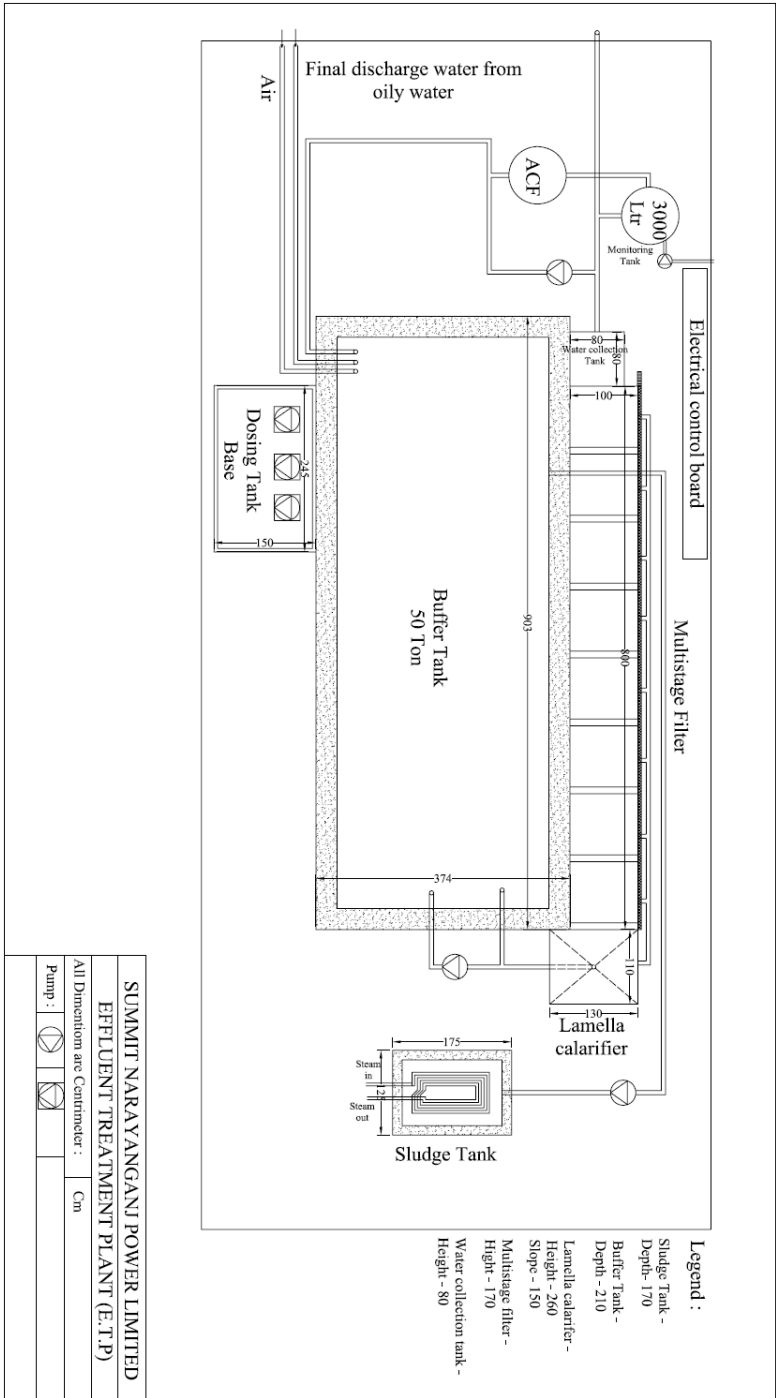
[illegible]

স্বাক্ষরিত তারিখ ও স্থান: ১৫/০৭/১৯৮০ খ্রিঃ ১৯৮০

दिनांक २२/०५-२३/०५-०६-२०१३
 मुकुन्दराव शिंदे (संस्थापक अध्यक्ष)

[Faint handwritten notes at the bottom of the page]

ANNEX-2: ETP Drawing



ANNEX-3: DoE Site Clearance Certificate

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
নারায়ণগঞ্জ জেলা অফিস
১২৬/১১(৩য় তলা), উত্তর চাষাড়া, চাঁনমারী, নারায়ণগঞ্জ
www.doe.gov.bd

স্মারক নং-পঅ/নারা: জে: অ/৩০.৬৭.০৬.০৪.১৪.১৯০৩১৫/২০১৫/ছাড়পত্র-৪৯

তারিখ: ২২/০৪/১৪২২বঙ্গাব্দ
০৫/০৮/২০১৫খ্রি:

বিষয়: অবস্থানগত ছাড়পত্র।

সূত্র: ছাড়পত্র সংক্রান্ত উদ্যোক্তার ১০/০৩/২০১৫খ্রি: তারিখের আবেদনপত্র।

উপর্যুক্ত বিষয় ও সূত্রের প্রেক্ষিতে আপনার আবেদনপত্র ও সংশ্লিষ্ট কাগজপত্র পর্যালোচনাস্তে এবং লাল শ্রেণির পরিবেশগত ছাড়পত্র বিষয়ক কমিটির ৩৮৮তম সভার কার্যবিবরণীর সিদ্ধান্ত (চ/৭) মোতাবেক এম এন ঘোষাল রোড, মদনগঞ্জ, বন্দর, নারায়ণগঞ্জ এ অবস্থিত সামিট নারায়ণগঞ্জ পাওয়ার লিমিটেড (ইউনিট-২) নামক ৫৫ মেগাওয়াট বিদ্যুৎ উৎপাদনের লক্ষ্যে প্রস্তাবিত কারখানাটির অনুকূলে নিম্নলিখিত শর্তে অবস্থানগত ছাড়পত্র প্রদান করা হলো:

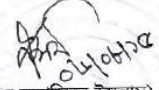
শর্তাবলী:

- ০১। এ ছাড়পত্র শুধুমাত্র ৫৫ মেগাওয়াট বিদ্যুৎ উৎপাদনের লক্ষ্যে প্রয়োজনীয় অবকাঠামো নির্মাণ ও যন্ত্রপাতি স্থাপনের জন্য প্রযোজ্য হবে। জায়গা সম্প্রসারণ এবং তৎসংশ্লিষ্ট পে-আউট প্লানের কোনো প্রকার পরিবর্তনের জন্য পরিবেশ অধিদপ্তরের পূর্বানুমতি/ছাড়পত্রের প্রয়োজন হবে।
- ০২। নির্মাণকালীন সময়ে সৃষ্ট সকল বর্জ্য পরিকল্পিত উপায়ে সংগ্রহ অথবা পরিশোধনপূর্বক পরিবেশসম্মতভাবে অপসারণের ব্যবস্থা নিশ্চিত করতে হবে।
- ০৩। অগ্নি-দুর্ঘটনা নিয়ন্ত্রণকল্পে কারখানায় যথোপযুক্ত অগ্নি নির্বাপক ব্যবস্থা গড়ে তুলতে হবে।
- ০৪। অবকাঠামোগত উন্নয়নের আওতায় অন্যান্য বিষয়ের মধ্যে আইইই প্রতিবেদনে বর্ণিত সকল মিটিগেশন মেজার্স যথাযথভাবে বাস্তবায়ন করতে হবে।
- ০৫। অনুমোদিত TOR এর ভিত্তিতে আইইএ প্রতিবেদন প্রণয়ন করতে হবে এবং উক্ত আইইএ প্রতিবেদন পরিবেশ অধিদপ্তরের অনুমোদনের নিমিত্তে পেশ করতে হবে।
- ০৬। আইইএ প্রতিবেদনে এ প্রকল্প সৃষ্ট গ্যাসীয় পদার্থের নিঃসরণ এবং বস্তুকণার (Particulate Matters) নির্গমন পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এ উল্লিখিত মানমাত্রার মধ্যে রাখা, ফুলিং ওয়াটার পুনঃব্যবহারের ব্যবস্থা, বর্জ্য ব্যবস্থাপনার ক্ষেত্রে প্রতিটি রিডাকশন স্টেজের বিস্তারিত ও বাস্তবসম্মত বর্ণনা এবং ১০০% ওয়াটার রিসাইক্লিং এর বিষয় অন্তর্ভুক্ত করতে হবে।
- ০৭। আইইএ প্রতিবেদনে নিজস্ব লোকবল ও ইকুইপমেন্ট এর সমন্বয়ে ইন-হাউজ এনভায়রনমেন্টাল মনিটরিং সিস্টেম গড়ে তোলার বিষয়ে প্রয়োজনীয় কারিগরি ও আর্থিক প্রস্তাবনা অন্তর্ভুক্ত করতে হবে।
- ০৮। আইইএ অনুমোদিত না হলে আমদানীতব্য যন্ত্রপাতির অনুকূলে L/C খোলা যাবে না।
- ০৯। প্রকল্প চক্রের ন্যূনতম ৩০% জায়গা উপযুক্ত প্রজাতির ফলজ ও বনজ গাছ লাগিয়ে সবুজায়ন করতে হবে।
- ১০। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য রক্ষার্থে সকল ব্যবস্থা যেমন: হার্ড হেলমেট, নোজ মাস্ক, বুট, চশমা ইত্যাদি ব্যবস্থা রাখতে হবে।
- ১১। ৪-১০ এর সিদ্ধান্ত বাস্তবায়নপূর্বক পরিবেশগত ছাড়পত্রের জন্য আবেদন করতে হবে।
- ১২। এই ছাড়পত্র ভূমির মালিকানা স্বত্ব নির্ধারণ করে না।
- ১৩। পরিবেশগত ছাড়পত্র ব্যতিরেকে প্রকল্প চালু করা যাবে না।
- ১৪। কারখানাটি বন্ধ/অন্যত্র স্থানান্তর/নাম পরিবর্তন/সম্প্রসারণ/পরিবর্তন করতে হলে এ কার্যালয়ের অনুমতি গ্রহণ করতে হবে।
- ১৫। কার্য দর্শনো ব্যতিরেকে ছাড়পত্রের যেকোনো শর্ত পরিবর্তন/সংশোধন/সংযোজন করার ক্ষমতা পরিবেশ অধিদপ্তর সংরক্ষণ করে।
- ১৬। নির্মাণকালীন সময়ে আইইই প্রতিবেদনে উল্লিখিত পরিবেশগত নেতিবাচক প্রভাব মোকাবেলায় গৃহীত প্রশমনমূলক পদক্ষেপ এবং সংশ্লিষ্ট সকল সেবা প্রদানকারী প্রতিষ্ঠান/সংস্থার সুপারিশ যথাযথভাবে বাস্তবায়ন করতে হবে।
- ১৭। নির্মাণ চলাকালীন সময়ে রাস্তার উপর কোনো ধরনের নির্মাণ সামগ্রী রেখে জনসাধারণ/যানবাহন চলাচলে কোনোরূপ প্রতিবন্ধকতা সৃষ্টি করা যাবে না।
- ১৮। কারখানাটির কোনো কর্মকাণ্ড ও প্রক্রিয়া দ্বারা কোনোভাবেই মাটি, পানি, বায়ু ও শব্দ দূষণ করা যাবে না।
- ১৯। কারখানাটির বিরুদ্ধে ভবিষ্যতে পরিবেশ দূষণমূলক কোনো অভিযোগ উত্থাপিত ও তা প্রমাণিত হলে এ কার্যালয়ের নির্দেশিত নিয়ন্ত্রণ/ সংশোধনমূলক ব্যবস্থাদি (স্থানান্তর/কার্যক্রম বন্ধসহ) গ্রহণ করতে হবে।

অ: পু: দ্র:

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- ২০। এ ছাড়পত্র কোনো অবস্থাতেই হস্তান্তর করা যাবে না।
- ২১। এ পর্যায় প্রাপ্ত ও পরিবেশিত তথ্যের ভিত্তিতে এ ছাড়পত্র প্রদান করা হলো। পরবর্তীতে কোনো তথ্য অসম্পূর্ণ, ত্রুটিপূর্ণ, অসত্য কিংবা গোপন করা হয়েছে মর্মে প্রমাণিত হলে এ ছাড়পত্র বাতিল করা হবে।
- ২২। ছাড়পত্রের একটি কপি কারখানাটির এমন স্থানে ঝুলিয়ে রাখতে হবে যেন তা সহজেই দৃষ্টিগোচর হয় এবং এ অবদিক্তরের কোনো কর্মকর্তা/পরিদর্শক পরিদর্শন বা নমুনা সংগ্রহের সময় তাকে সকল প্রকার সহযোগিতা প্রদান করতে হবে।
- ২৩। বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ এবং পরিবেশ সংরক্ষণ বিধিমালা, ১৯৯৭ এর সংশ্লিষ্ট ধারা/বিধি অনুযায়ী পরিবেশ সংরক্ষণ, পরিবেশগত মান উন্নয়ন এবং পরিবেশ দূষণ নিয়ন্ত্রণ ও প্রশমনের উদ্দেশ্যে মহাপরিচালক কর্তৃক সময়ে সময়ে প্রদত্ত নির্দেশনাসমূহ যথাযথভাবে প্রতিপালন করতে হবে।
- ২৪। এ ছাড়পত্র জারির তারিখ হতে পরবর্তী ০১ (এক) বৎসরের জন্য বহাল থাকবে এবং মেয়াদ শেষ হবার অন্তত: ৩০ (ত্রিশ) দিন পূর্বে নবায়নের জন্য আবেদন করতে হবে। নবায়নের জন্য পেশকৃত আবেদনপত্রের সাথে ফায়ার সার্ভিস ও সিভিল ডিফেন্স কার্যালয় কর্তৃক প্রদত্ত লাইসেন্স জমা দিতে হবে।
- ২৫। উপবৃক্ত ১-২৪ অনুচ্ছেদে বর্ণিত যে কোনো শর্ত ভঙ্গ করলে এ ছাড়পত্র বাতিল বলে গণ্য হবে।


(মুহাম্মদ মুজাহিদুল ইসলাম)
সহকারী পরিচালক
ফোন: ০২-৭৬৪২৪১১

ব্যবস্থাপনা পরিচালক
সমিটি নারায়ণগঞ্জ পাওয়ার লিমিটেড (ইউনিট-২)
এম এন ঘোষাল রোড, মদনগঞ্জ, বন্দর, নারায়ণগঞ্জ।

অনুলিপি: সদয় জ্ঞাতার্থে-

- ১। পরিচালক (ঢাকা অঞ্চল), পরিবেশ অধিদপ্তর, ঢাকা অঞ্চল কার্যালয়, ঢাকা।
- ২। পরিচালক (পরিবেশগত ছাড়পত্র) ও আস্থায়ক, পরিবেশগত ছাড়পত্র বিষয়ক কমিটি, পরিবেশ অধিদপ্তর, ঢাকা।
- ৩। অফিস কপি।

ANNEX-5: Fire License

ক্রমিক নং

অনিবেশ ০০৩
প্রথম সংস্করণ ২০১২

ফায়ার লাইসেন্স

লাইসেন্স নম্বর: ৬ ডি/৮ ক/২৮৭২/১৫

এতদ্বারা অগ্নি প্রতিরোধ ও নির্বাণ আইন ২০০৩ এর ৪ ধারা অনুযায়ী এবং উল্লেখিত শর্তাবলী সাপেক্ষে ফায়ার লাইসেন্স ইন্স্য করা হইল।

১। মালগুদাম/কারখানার মালিক/ব্যবহারকারী/কর্তৃপক্ষের নাম, পদবী ও ঠিকানা :

প্রতিষ্ঠানের নাম : মেসার্স সামিট নারায়ণগঞ্জ পাওয়ার ইউনিট-২ লিমিটেড

মালিকের নাম : পক্ষে- মাহমুদ হাসান

ফোন : ফ্যাক্স : ই-মেইল :

২। মালগুদাম/কারখানার অবস্থান ও (ক) প্লট নং/হোল্ডিং নং : টিকার মোড়, মদনগঞ্জ, বন্দর, নারায়ণগঞ্জ।

(খ) দাগ নং : (গ) খতিয়ান নং : (ঘ) জে এল নং :

(ঙ) মৌজা : (চ) রোড নং : (ছ) ডাকঘর :

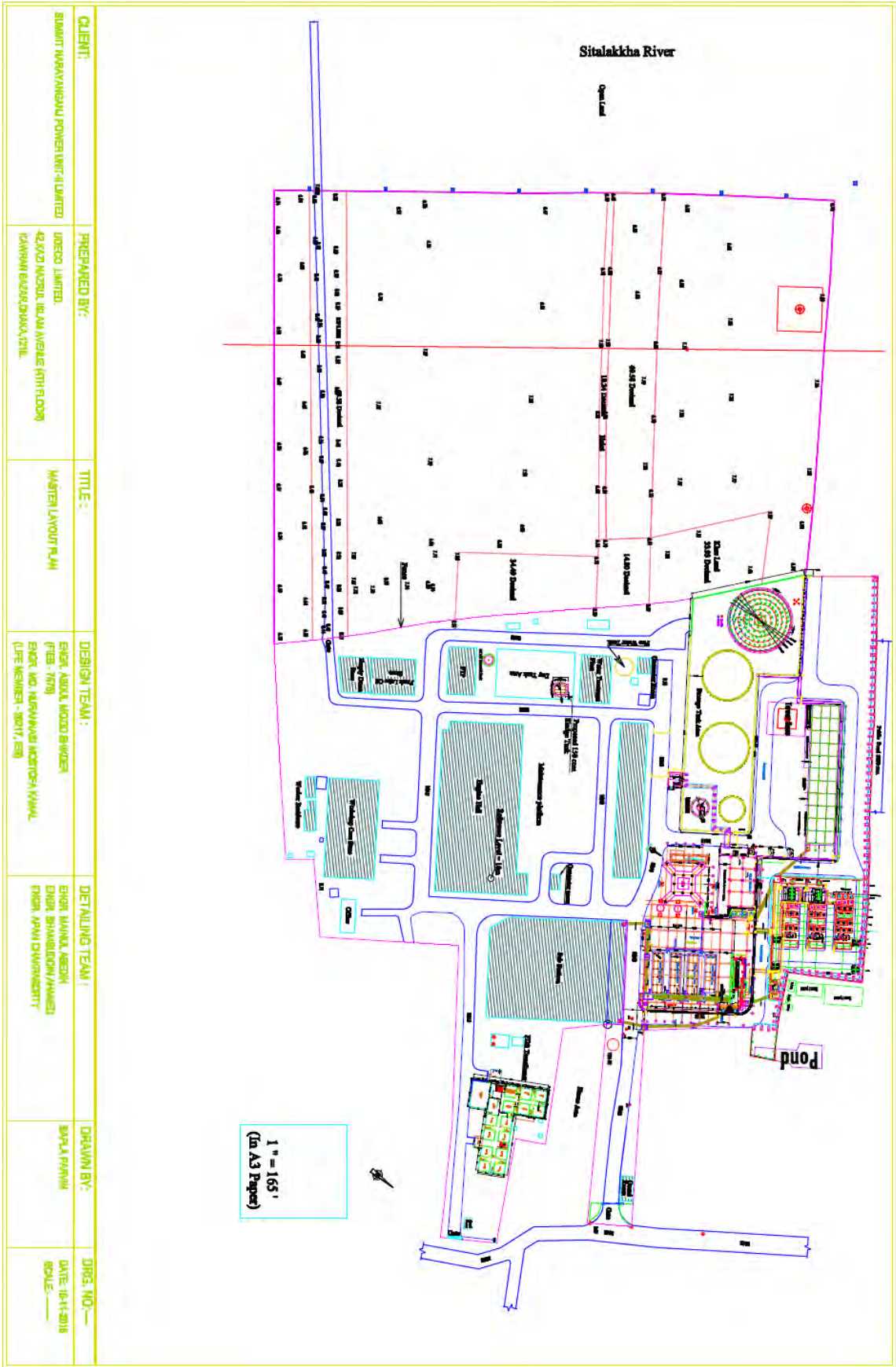
(জ) থানা : বন্দর (ঝ) উপজেলা : (এং) জেলা : নারায়ণগঞ্জ

৩। ভবনের ব্যবহার শ্রেণী : এফ-৫

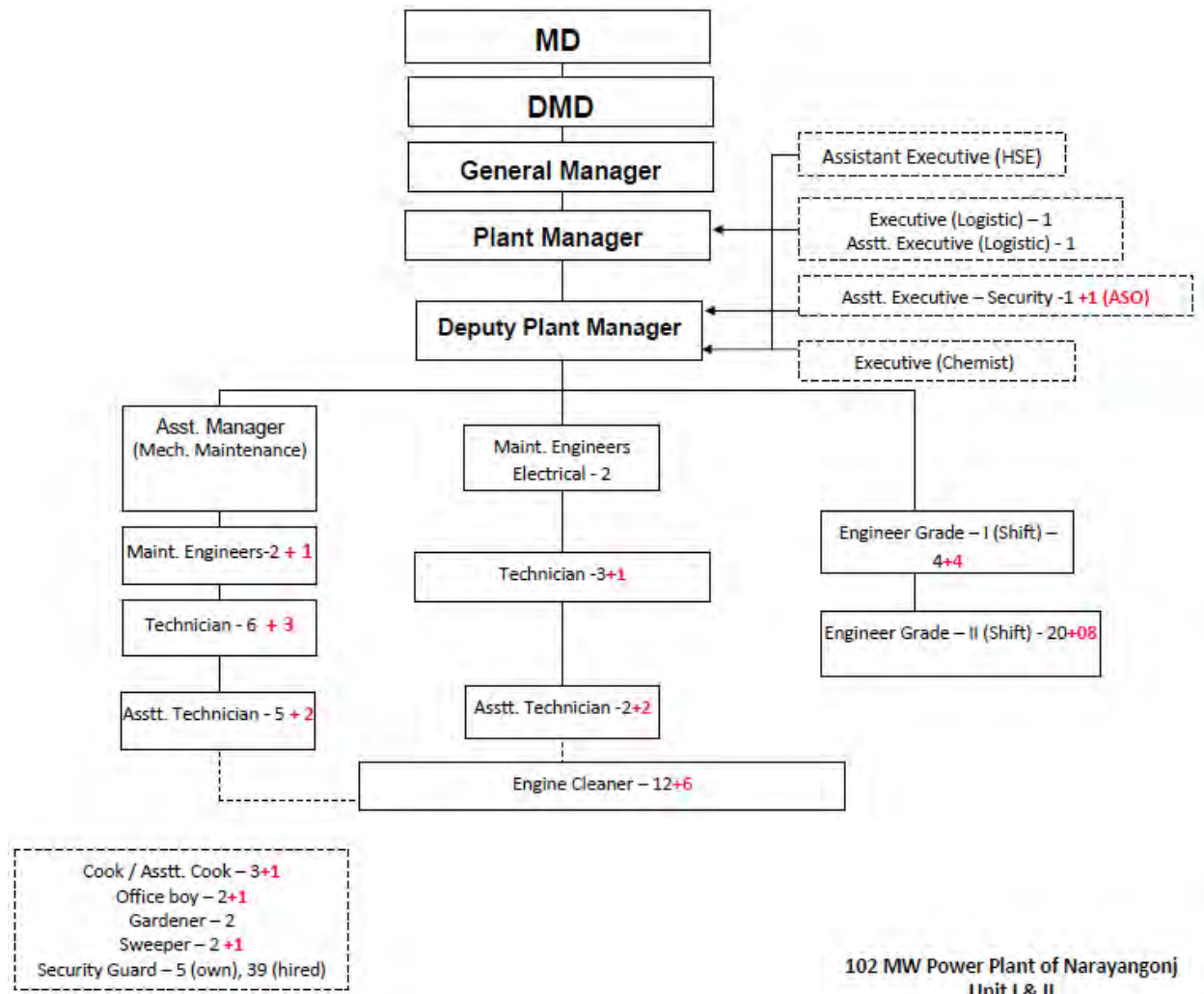
৪। ভবনের নির্মাণ শ্রেণী ও পরিমাপ : সেমিপাকা ভবন।

শ্রেণী-১	শ্রেণী-২	শ্রেণী-৩	দৈর্ঘ্য	প্রস্থ	উচ্চতা	মোট মেঝের ক্ষেত্রফল (বর্গ মিটার)
	✓					৯৪৮৩ বর্গফুট

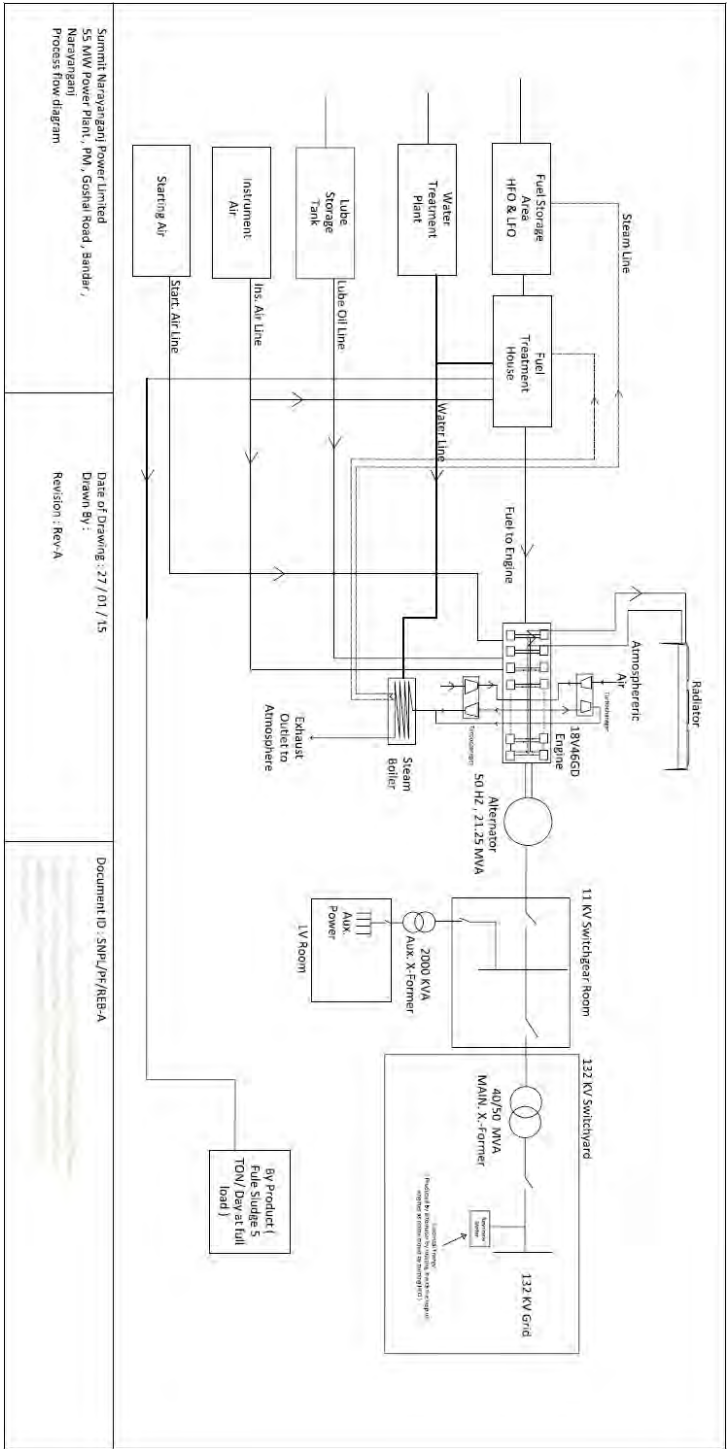
ANNEX-6: Sound Protection Wall



ANNEX-7: Organogram



ANNEX-8: Process Flow Diagram



ANNEX-9: Fuel Quality Requirement



Project name: Barisal
Created by: TVI006
Document Id: TS 001
Document creation date: 26 August 2014

Below are the main parameters for the major operating media of the stationary power plant. The complete specification and requirements for all needed operating media are given in the Operation and Maintenance Manuals delivered for the stationary power plant.

Fuels

Wärtsilä engines are designed and developed for continuous operation on fuels with a quality within the recommended limits below. These values indicate the limits for the power plant and the individual limits for the engines. Fuels having one or several values close to this limit might have a negative impact on the performance and component lifetime.

Heavy fuel oil (HFO)

The limits in the table "fuel quality, before treatment" are based on the demands of standards and design of the stationary power plant. Project requirements, actual fuel availability or customer preferences may set other limits on the fuel quality. The stationary power plant will be designed according to the fuel specified in the table "fuel quality, before treatment"

Fuel quality, before treatment

Parameter	Limit	Unit	Test Method reference
Viscosity, plant design ¹	Maximum 380	cSt at 50°C	ISO 3104
Density	Maximum 1010	kg/m ³ at 15°C	ISO 3675 or 12185
CCAI	Maximum 870		ISO 8217, Annex F
Water	Maximum 0,5	% Vol.	ISO 3733 or ASTM D6304-C
Sulphur	Maximum 4,5	% mass	ISO 8754 or 14596
Hydrogen sulfide	Maximum 2,00	mg/kg	IP 570
Acid number	Maximum 2,5	mg KOH/g	ASTM D664
Ash	Maximum 0,15	% mass	ISO 6245 or LP 1001
Vanadium	Maximum 450	mg/kg	ISO 14597 or IP 501, IP 470
Sodium	Maximum 100	mg/kg	IP 501 or IP 470
Aluminium + silicon,	Maximum 60	mg/kg	ISO 10478 or IP 501, IP 470
Carbon Residue	Maximum 20	% mass	ISO 10370
Asphaltenes	Maximum 14	% mass	ASTM D3279
Flash point (PMCC)	Minimum 60	°C	ISO 2719
Pour point	Maximum 30	°C	ISO 3016
Total Sediment existent aged	Maximum 0,10	% mass	ISO 10307-2
Calcium	Maximum 30	mg/kg	IP 501 or 470
Zinc	Maximum 15	mg/kg	IP 501 or 470
Phosphorus	Maximum 15	mg/kg	IP 501 or 470

¹ Design specific value



Project name: Barisal
Created by: TVI006
Document Id: TS 001
Document creation date: 26 August 2014

Used lubricating oil²

In addition to the quality limits listed above, the engine requires the following quality limits to be met after treatment of the heavy fuel oil.

Fuel quality, after treatment

Parameter		Limit	Unit	Test Method reference
Injection viscosity	Minimum	16	cSt	ISO 3104
	Maximum	24	cSt	ISO 3104
Water	Maximum	0,3	% Vol.	ISO 3733 or ASTM D6304-C
Sodium	Maximum	30	mg/kg	IP501 or IP470
Aluminium + silicon	Maximum	15	mg/kg	ISO 10478 or IP501 or 470

Compatibility between HFO and LFO, as well as with previous delivery according to 1/1 ASTM-D 4740 should be assured.

The fuel quality limits before treatment above are based on the demands of:
- ISO 8217:2010(E), ISO-F-RMA 10 – RMK 700.

Specific emission requirements may set stricter limits for the fuel quality.

The fuel should not include any added substance or chemical waste, which jeopardizes the safety of installations or adversely affects the performance of the engines or is harmful to personnel or contributes overall to additional air pollution.

Light fuel oil (LFO)

The limits in the table below are based on the demands of standards and engine specific requirements. Project requirements, actual fuel availability or customer preferences may set other limits on the fuel quality.

Parameter		Limit	Unit	Test Method reference
Viscosity	Minimum	2 ³	cSt at 40°C	ISO 3104

² The fuel shall be free from used lubricating oil (ULO). A fuel shall be considered to contain ULO when either one of the following conditions is met: Calcium > 30 mg/kg and zinc > 15 mg/kg or Calcium > 30 mg/kg and phosphorus > 15 mg/kg

³ If ambient temperature is >40°C, the minimum viscosity is limited to 2,8 cSt at 40°C



Project name: Barisal
Created by: TVI006
Document Id: TS 001
Document creation date: 26 August 2014

	Maximum	11		
Injection viscosity ⁴	Minimum	2,0	cSt	ISO 3104
Density	Maximum	900	kg/m ³ at 15°C	ISO 3675 or 12185
Water	Maximum	0,3	% Vol.	ISO 3733
Sulphur	Maximum	2,0	% mass	ISO 8754 or 14596
Ash	Maximum	0,01	% mass	ISO 6245
Carbon Residue	Maximum	0,3		ISO 10370
Flash point (PMCC)	Minimum	60	°C	ISO 2719
Hydrogen sulfide	Maximum	2,00	mg/kg	IP 570
Acid number	Maximum	0,5	Mg KOH/g	ASTM D664
Oxidation stability	Maximum	25	g/m ³	ISO 12205
Pour point	Maximum	6	°C	ISO 3016
Cetane Index	Minimum	35		ISO 4264
Total sediment existent by hot filtration	Maximum	0,10 ⁵	% mass	ISO 10307-1
Appearance		Clear and bright		
Lubricity, corrected wear scar diameter	Maximum	520	µm	ISO 12156-1

The limits above are based on the demands of ISO 8217:2010(E) standard and covers the fuel categories ISO-F-DMA, DMB and DMZ.

The fuel should not include any added substance or chemical waste, which jeopardizes the safety of installations or adversely affects the performance of the engines or is harmful to personnel or contributes overall to additional air pollution.

Lubricating oil

Only lubricants that are approved by Wärtsilä are allowed to be used. The major lubricating oil suppliers have certain lubricating oils which are approved by Wärtsilä.

The properties of the fresh lubricating oil must meet the following requirements.

Viscosity class		SAE 40	
Viscosity Index (VI)	Minimum	95	
Alkalinity (BN) ⁶ , LFO operation		10 - 30	mg KOH/g
Alkalinity (BN) ⁶ , HFO operation		30 - 55	mg KOH/g

⁴ Engine specific requirement

⁵ If the sample is clear and with no visible sediment or water, the total sediment existent and water tests shall not be required.

⁶ Required alkalinity depends on the used fuel oil.

ANNEX-10: Noise Modeling Result

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RCB NO. 199301141G**

NOISE SURVEY AT SNPL 11 POWER PLANT BANGLADESH

**Submitted To:
SUMMIT NARAYANGANJ POWER LIMITED**

DATE: 9 April, 2015

PREPARED BY: ND TECHNOLOGY (SEA) PTE LTD

CHRIS BEAL

REPORT NO: 98209R/04/2015

**NOISE SURVEY AT
SNPL 11 POWER PLANT**

Report Ref. No. 98209R/04/2015

ND Technology (SEA) Pte Ltd.

Page 1 of 8

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- 1.0 Introduction
- 2.0 Noise Survey
- 3.0 Boundary Noise Criteria
- 4.0 Discussion of Results
- 5.0 Recommendations
- 6.0 Conclusions

APPENDIX A: Measured Sound Pressure Levels 2011 and 2015

APPENDIX B: Site Plan With Noise Measurements

APPENDIX C: Measured Sound Pressure Levels 2015

**NOISE SURVEY AT
SNPL 11 POWER PLANT**
Report Ref. No. 98209R/04/2015

1.0 INTRODUCTION

ND Technology has been requested to carry out a review of the noise impact for the new power plant to be built at Narayanganj, SNPL11. As part of the review, a noise level survey, around site of the new power house, has been carried out at Narayanganj, near Dhaka, Bangladesh.

The aim of the noise survey being to determine the current boundary noise levels, from the existing power house, SNPL1.

This report presents the results of the survey and proposes noise control measures.

2.0 NOISE SURVEY

The noise survey was carried out on the 2nd April 2015 at Narayanganj Power Plant.

Measuring Equipment: Ono Sokki precision integrating sound level type LA-5110.

The equipment was calibrated using a Cesva sound calibrator type CB-5.

The sound level meter was calibrated prior to taking measurements. Noise levels were measured at 1.5m above the ground at the North boundary and at various locations around the outside of the Power house as well as inside. The data are presented in Table 1.

3.0 BOUNDARY NOISE CRITERIA

The maximum noise levels at the Power plant boundary, as set out in Schedule - 4, Standards for Sound, under the category of Mixed area, are as follows:

Daytime, 6am to 9pm	60dB(A)
Night time, 9pm to 6am	50dB(A)

4.0 DISCUSSION OF RESULTS

Noise levels were measured along the new North boundary, adjacent to the village houses. These ranged from 63 to 72dB(A). Compared to the noise survey the noise levels have increased, especially at the low frequencies, especially 63Hz. The high frequency turbocharger noise however is not prominent as it was in 2011.

Noise levels were also measured at various locations inside the Power Plant site.

The major sources identified are the radiators and now the exhaust stacks, especially towards the North-East Boundary, near the Mosque.

Noise levels measured inside the power house near the turbocharger show a significant reduction at the 2kHz octave band of 8dB, due to fitting of the pipe acoustic cladding.

The exhaust noise does not contribute to the boundary noise excess, however, if lower boundary noise levels are required to be achieved than those currently assigned, then remedial action would be required.

Vibration levels were not measured during the survey, however there was no feelable vibration in the outlying buildings on the site. The engines are on high efficiency vibration isolators and supported on large concrete foundations. This, together with the sandy soil, would provide significant attenuation of the engine vibration, leading to imperceptible levels in the area surrounding the power station.

Any cracks in the walls of nearby houses are likely to be caused by local vibration arising from heavy lorries on the poor road surfaces, rather than ground borne vibration from the power station.

5.0 RECOMMENDATIONS

There are 3 areas of noise control which should be implemented, to reduce noise from the existing power station, SNPL1 and to minimise the impact of the new power station, SNPL11.

These are:-

- 1) Erect a noise barrier wall at the North and North-East boundary to reduce noise from the current and new radiators. The wall should be 7.5m high and be sound absorptive at the upper part. The height is based on a maximum height of the new radiators not exceeding 7m.

2) Improve the sound insulation of the power house with the following:

- Full height brick wall on 3 walls (excluding the wall to the switchgear room.
- Sound absorption on the upper walls.
- Double skin roof .
- Use acoustic doors at all entrances to the power house or fit sound locks.
- Apply acoustic lagging to the pipe between the turbocharger and the silencer, similar to the treatment at SNPL1.

3) Check the internal condition of the existing exhaust silencers and repair if they are found to have degraded. Depending on the results of the inspection, additional silencers may be required in the horizontal exhaust pipes near the power house, especially for the engines without a heat recovery boiler.

6.0 CONCLUSIONS

Noise levels at the North East boundary exceed the boundary noise limit and are higher than measured in 2011.

High frequency noise from the turbochargers has been reduced

Several recommendations are made to reduce the existing noise levels and minimise the impact of the new power station SNPL11.

APPENDIX A: Measured Sound Pressure Levels 2011 and 2015

NOISE SURVEY MEASUREMENT SHEET
PROJECT: NARAYANGANJ POWER PLANT

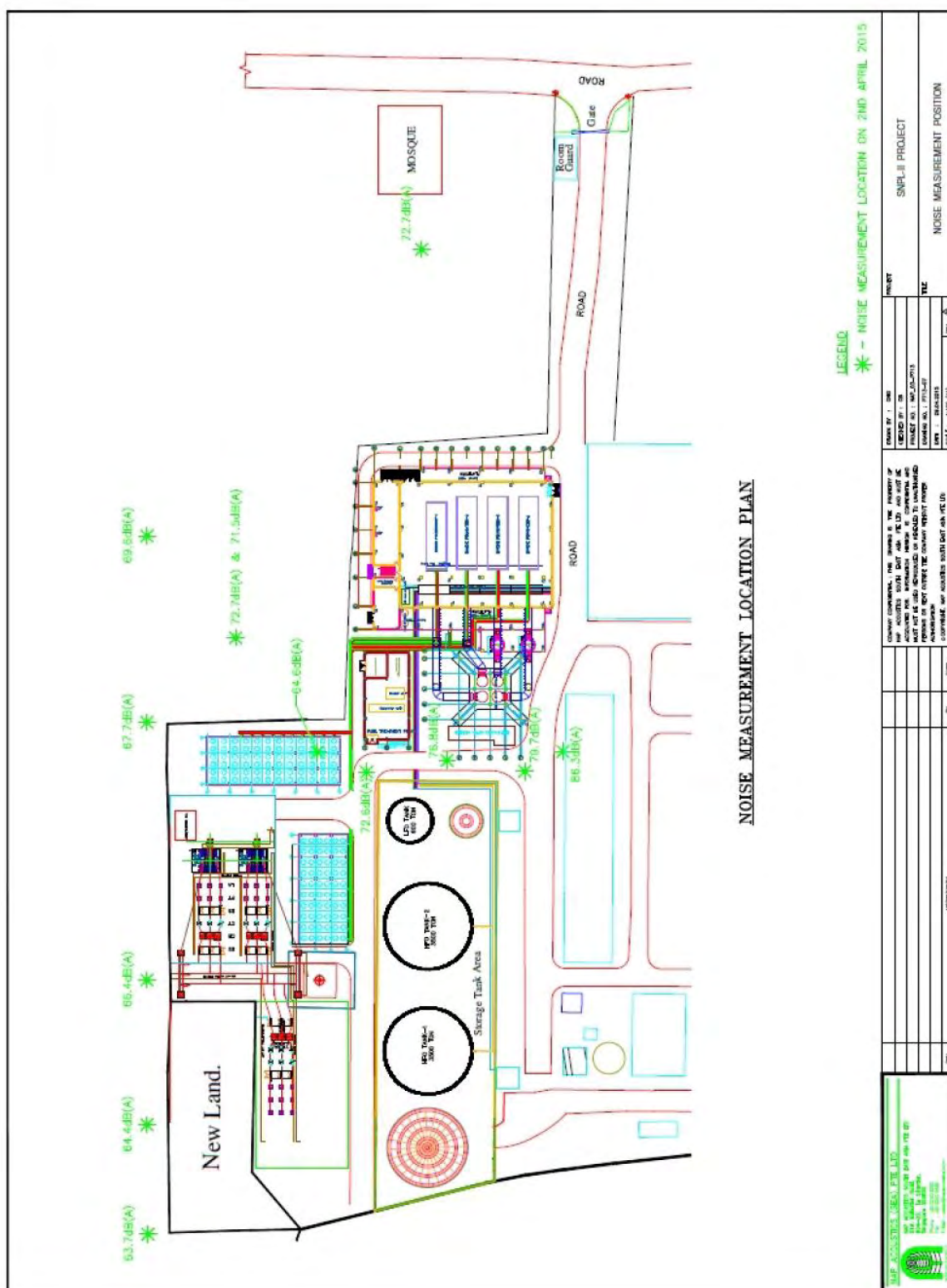
ND TECHNOLOGY SEA PTE LTD
DATE: 06-12-2011 & 02-04-2015
SHEET: 1

Noise levels in red taken on 2 April 2015

REC NO.	LOCATION	dBA	OCTAVE BAND CENTRE FREQUENCIES, Hz.								REMARKS
			63	125	250	500	1000	2000	4000	8000	
1	At air inlet to engine hall at No.1 eng	86	87.1	88.2	86.4	85.9	80.5	74.7	67.6	54.3	
2	1m from door to engine hall	82.7	84.8	85.8	81.2	78.4	75	78.3	71.2	55.2	Noise leakage around door frame
			82.3	90.9	86.5	83.9	80.9	76.2	73	66.5	53.5
3	3m from air inlet at No. 2 engine	79.8	86.2	83	81.1	78.9	74.5	70.4	62.4	50.3	
4	1m from main double door	85	82.1	85.6	82.1	83.5	79.7	78.3	71.1	56.2	"
5	4m from power house end wall	70.3	81.2	77.5	71.9	70	63.4	58.8	50.9	38.6	
6	Near heat recovery boiler	73.9	87.8	79.2	74.4	73.4	67.2	64.2	56	47.2	Not a noise source
7	On top of radiators	92.3	99.2	96.6	92.2	91.1	87.3	83.2	75.2	69	
8	45 deg. x 1m from fan outlet										
8	Centre – top, 1m & 90 deg	86.2	94.5	92.1	89.1	85.9	78.8	75	66.8	60.5	
9	3m from charger air intake and Auxiliary engine intake	84.4	92.2	87.7	83.1	79.2	76.1	80.2	73.7	64.7	
10	1m from door next to No. 1 engine	84.7	89.7	89.6	82.2	80.2	77.2	80.1	73.7	60.2	
11	1m from charge air intake of No. 2	87.9	91.8	88.4	83.4	78.9	76.9	85.1	78.3	69.7	Engine full load
12	1m from charge air intake on No. 1	89.1	92.6	88	84.1	79.4	77.6	86.7	78.3	69.7	High frequency tone Engine 60% load
13	1m from inlet on No. 4 engine	81.5	89.1	87.1	83.1	78.6	74	74.9	68.7	57.9	Engine down.
14	1m from inlet on No. 6 eng on	81.8	91.2	87.5	82.4	79.2	75.1	75.2	69.1	58.4	Fan noise only engine down
15	Side of No. 1 charge air intake next to Power house wall	86.9	92.3	88.1	82.8	78.6	77.6	83.7	77.3	70.4	"
16	Under LH bank of radiators	91.3	96.4	95.1	92.4	91	85.9	80.1	70.9	59.2	All fans on
17	At edge of radiator bank	86	93.2	89	87.2	86	80.5	73.9	65.2	54.5	Radiator noise dominant
			86.3	93.3	90.4	87.3	86	81.2	74.2	64.8	52.1
18	10m from Radiators	81.9	90.4	85	82.4	82.1	76.2	70.3	61.9	51.2	"
			79.7	91	84.1	81.8	79	74.2	66.9	57.2	44.9
19	20m from Radiators	77.9	88.8	83.6	77.5	77.5	72.6	66.4	58.5	48.3	"
			76.8	91.9	82.7	77.5	76.1	71.4	64.2	54.8	43.7
20	40m from Radiators	73.4	85.6	80.9	74.8	71.4	67.8	63.6	56.1	44.8	"
			72.6	91.2	81.1	72.9	70.5	66.7	60.2	51.5	43.5
21	4m from Boundary wall	70.2	84.6	79.6	71.3	66.7	63.7	62.1	54.7	41.9	Radiator and turbocharger noise audible
23	4.30pm outside Boundary wall	62.5	76.4	67.6	60.3	60.7	56.9	55.1	48	31.9	Noise from children playing
24	5m from Boundary wall Lmin										
24	As above, at 5pm	60.8	72.4	64.3	58	58.7	54.2	52.1	44.2	30.5	Turbo Audible + Radiators
			64.6	83.5	71.2	63.6	61.7	59.9	53.2	45.1	36.8
25	Inside Power House 3m from turbo charger No. 1 engine	114.4	105.2	105.5	108.1	109.7	102.9	111.5	104.1	89.3	
			109.3	106	106.6	106.2	107.3	102	103.9	98.5	87.9
26	Below exhaust & inlet pipes to No. 1 entrance	112.1	103.6	106	107	106.5	101.5	109	101.9	89.6	
27	1m from elbow before turbocharger	119.7	109.7	106.2	106.2	108.3	103.2	117.2	109.8	93.4	Peak at 2kHz OB Strong tone
28	Next to No. 1 alternator, near door	112.3	105.4	107.8	108.2	108.8	103.9	108.5	101.1	85.8	

NOISE SURVEY AT
SNPL11 POWER PLANT
Report Ref. No. 98209R/04/2015

APPENDIX B: Site Plan With Noise Measurements



APPENDIX C: Measured Sound Pressure Levels 2015

NOISE SURVEY MEASUREMENT SHEET
PROJECT: SNPL 1 & 2

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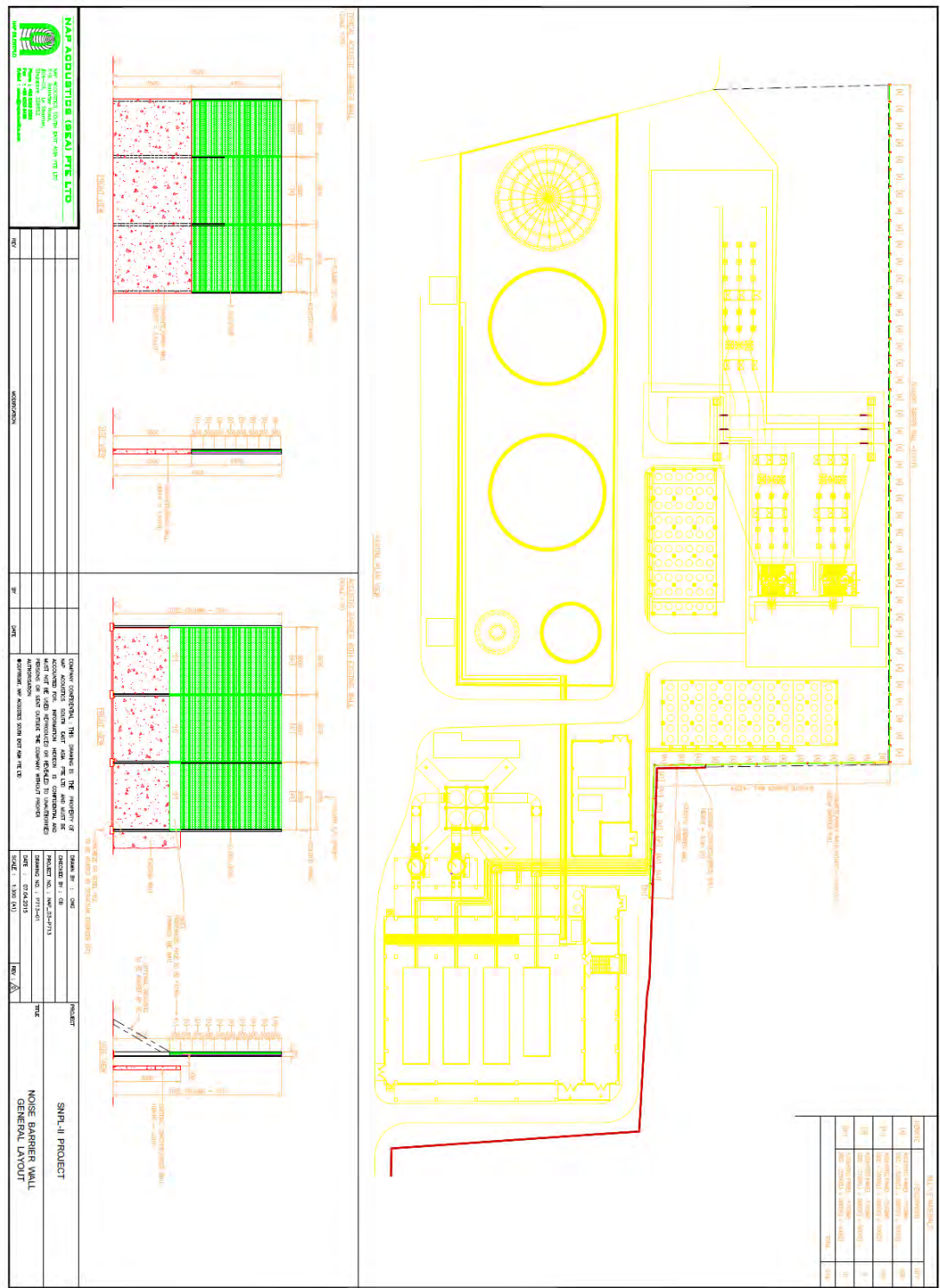
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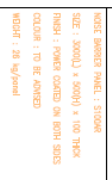
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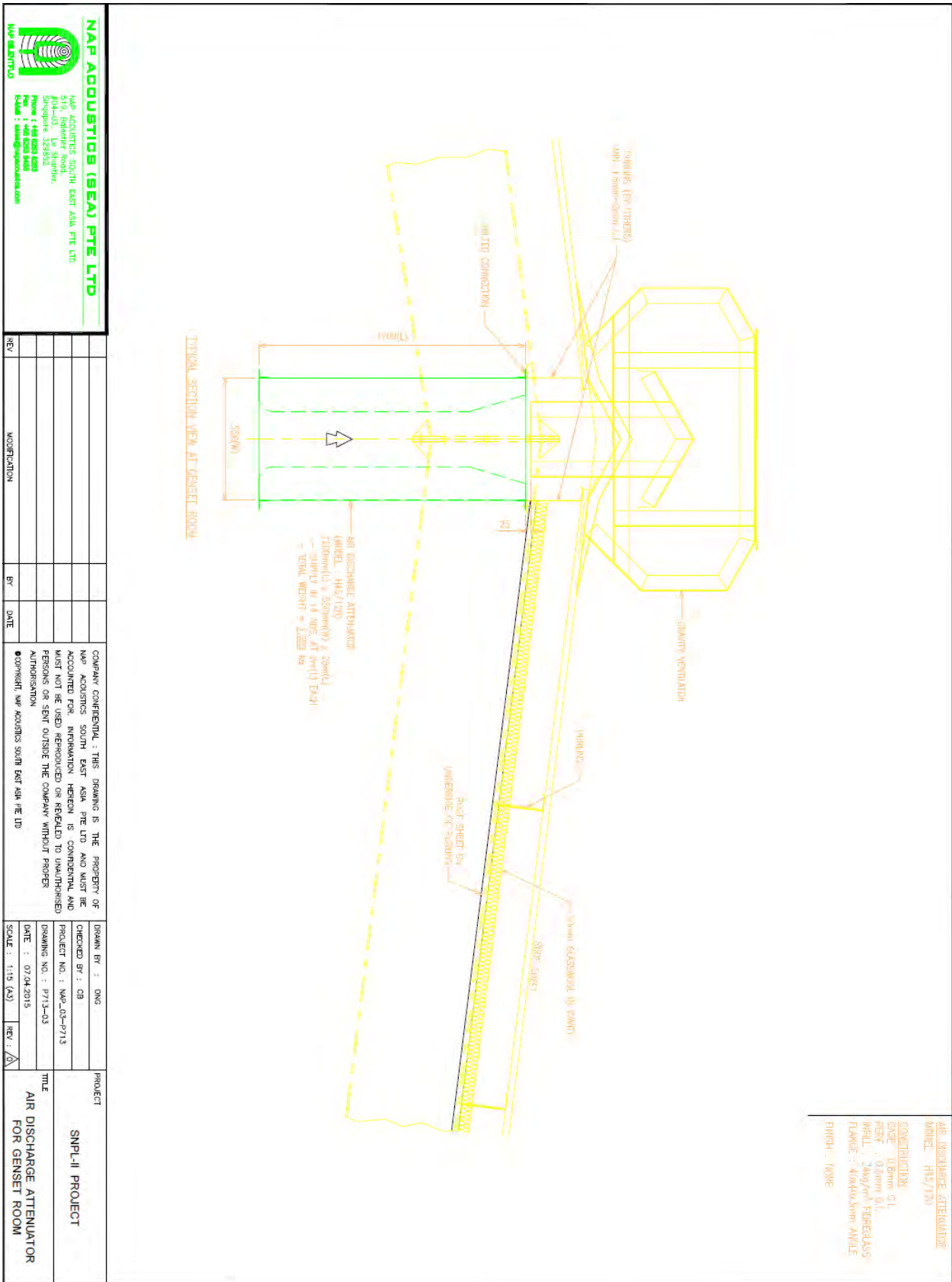
REC NO.	LOCATION	dBA	31.5	OCTAVE BAND CENTRE FREQUENCIES, Hz.								REMARKS
				63	125	250	500	1000	2000	4000	8000	
1	At end of new Boundary	63.7										
2	Along Boundary	64.4										
3	In Line with 2 storey house clear line to radiators	66.4										
4	End of boundary turning 90deg to new power house	67.7	83.7	85.9	71.2	68.3	67.1	61.1	56.9	50.8	41.1	
5	In line with edge of new power house	69.6										
6	On waist land towards new power house	72.7										
7	Next to Mosque	72.2	91.5	92.4	82.3	70.8	68.4	66.3	56.7	47.6	36.8	
8	Edge of radiators	88.4										
9	Edge of radiators near to exhaust stack	88.8										
10	Outside radiators towards Power House	78.6										
11	Behind container shielding from radiators but near exhaust	77.4	99.7	94	85.2	79.7	74.7	72.4	64.1	56.2	45.1	
12	Rear (alt. End) of power house at No. 1 engine on road	79										
13	Outside door to No. 1	82.3										
14	Inside powe house next to no.1 turbocharger at ground level	109.3										
15	At edge of radiators	86.3										
16	10m from radiators	79.7										
17	20m from radiators	76.8										
18	40m from radiators	72.6										
19	5m outside boundary wall screening to rad, exhaust visible	64.6										
20	Repeat of position 6	71.9	84.3	94.6	77.3	68.1	67.5	65.4	59.3	50.7	39.7	
21	Behind power house, RH side	68.3	88.4	82.5	76.2	70.2	65.4	61.2	59.5	55	44	
22	Moving forward, clear site to exhau	74.9	94	93.4	83.3	75.5	72.3	69.7	62.5	54.7	44.7	

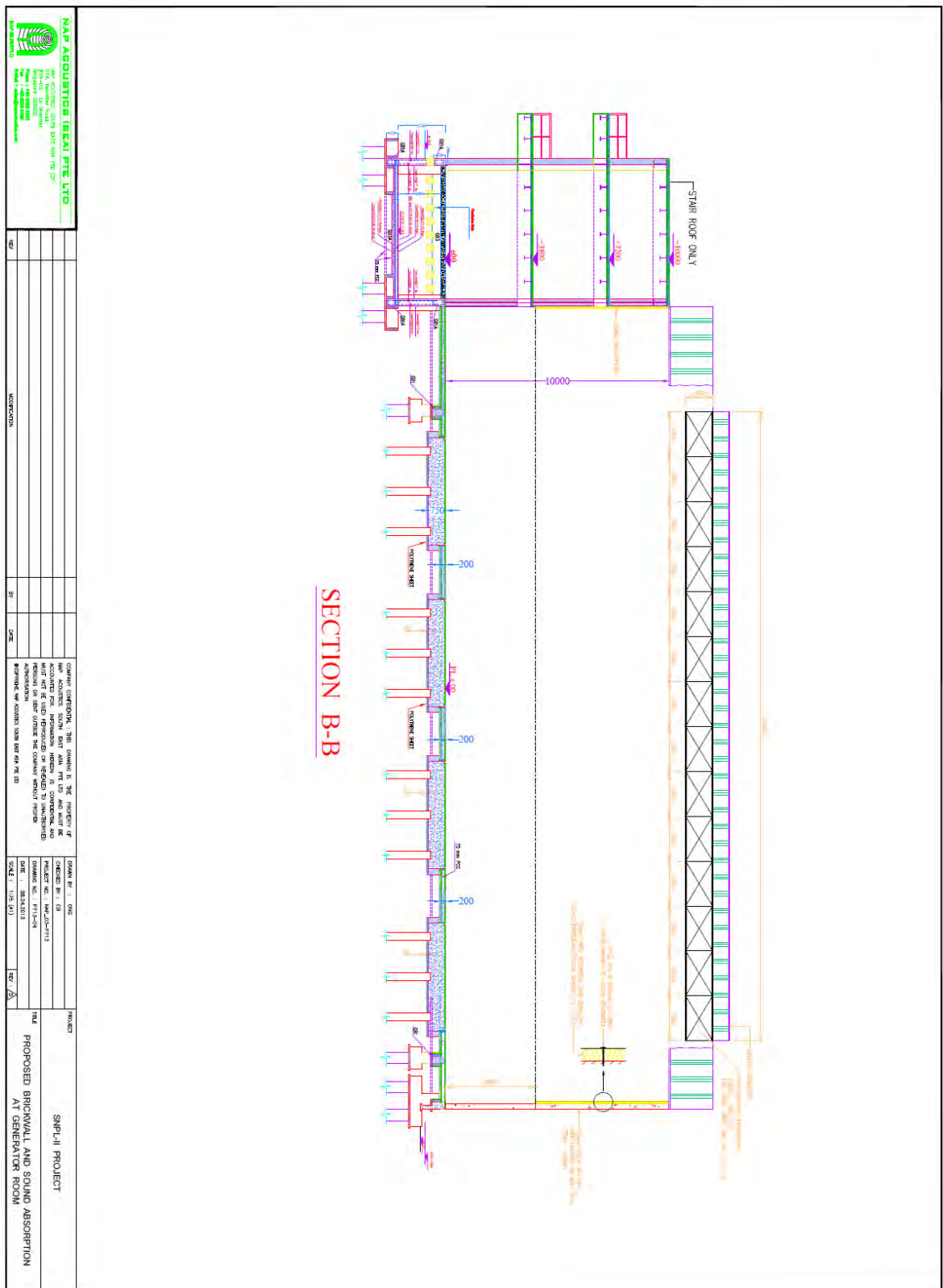
NOISE SURVEY AT
SNPL11 POWER PLANT
Report Ref. No. 98209R/04/2015

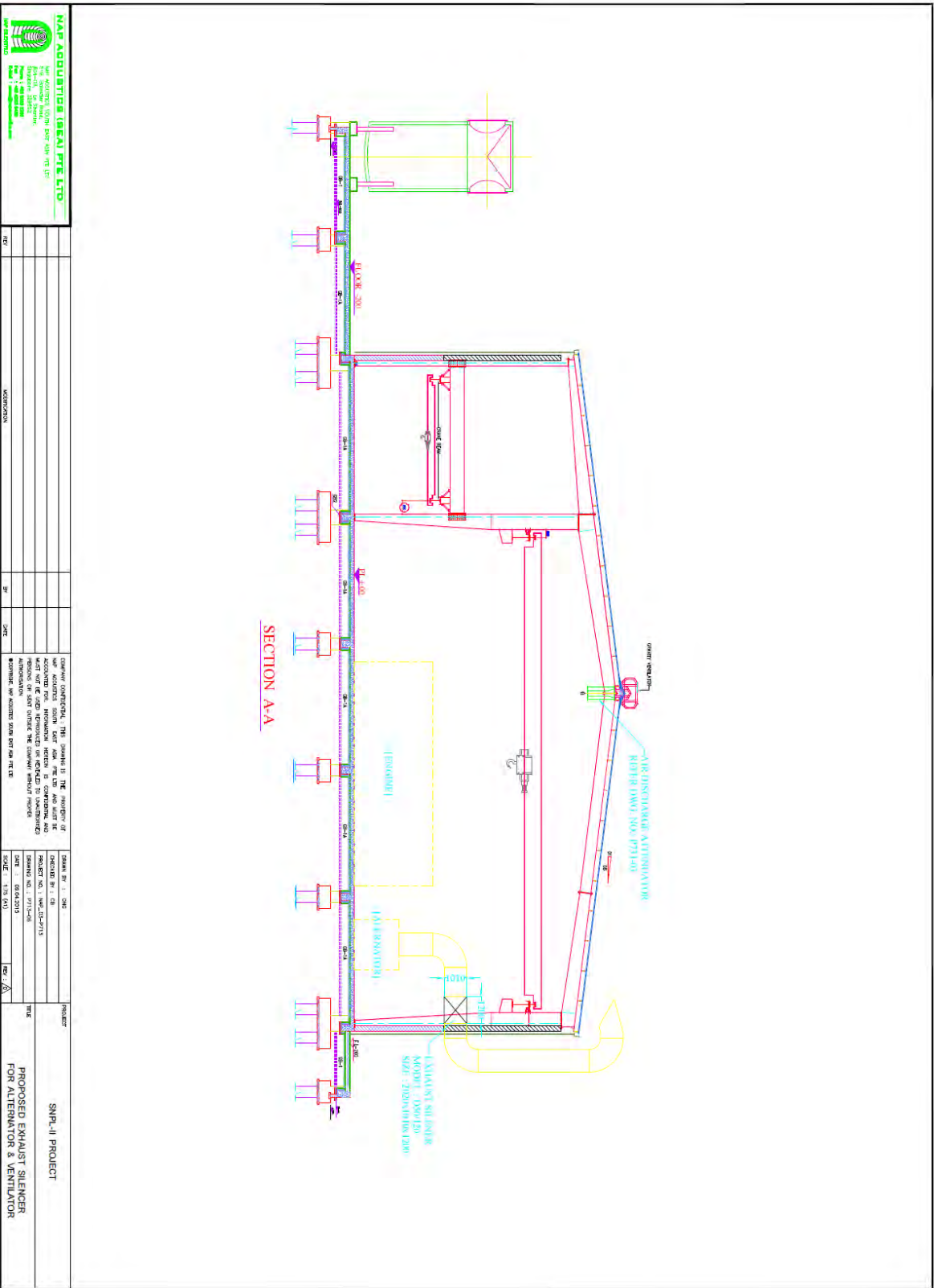
ANNEX-11: Sound Barrier

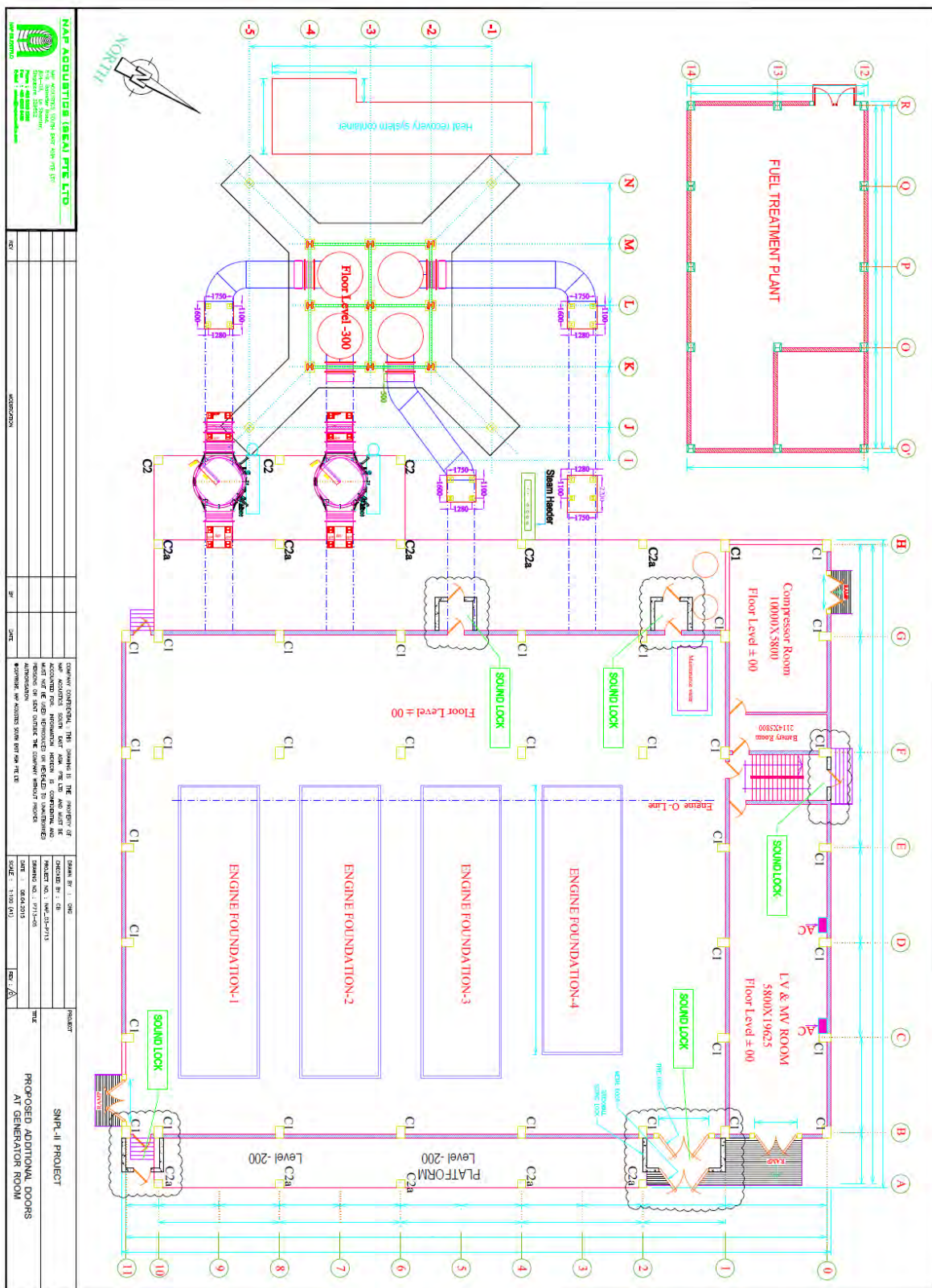




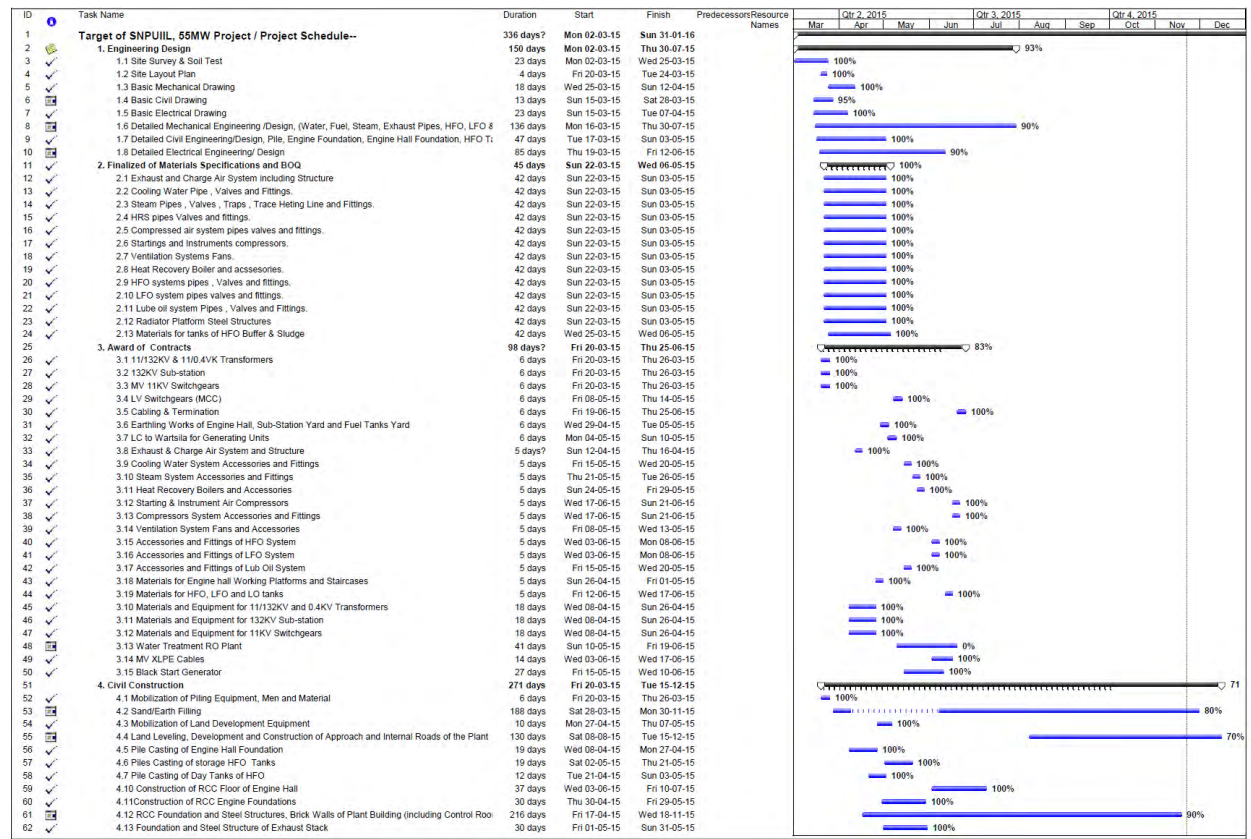




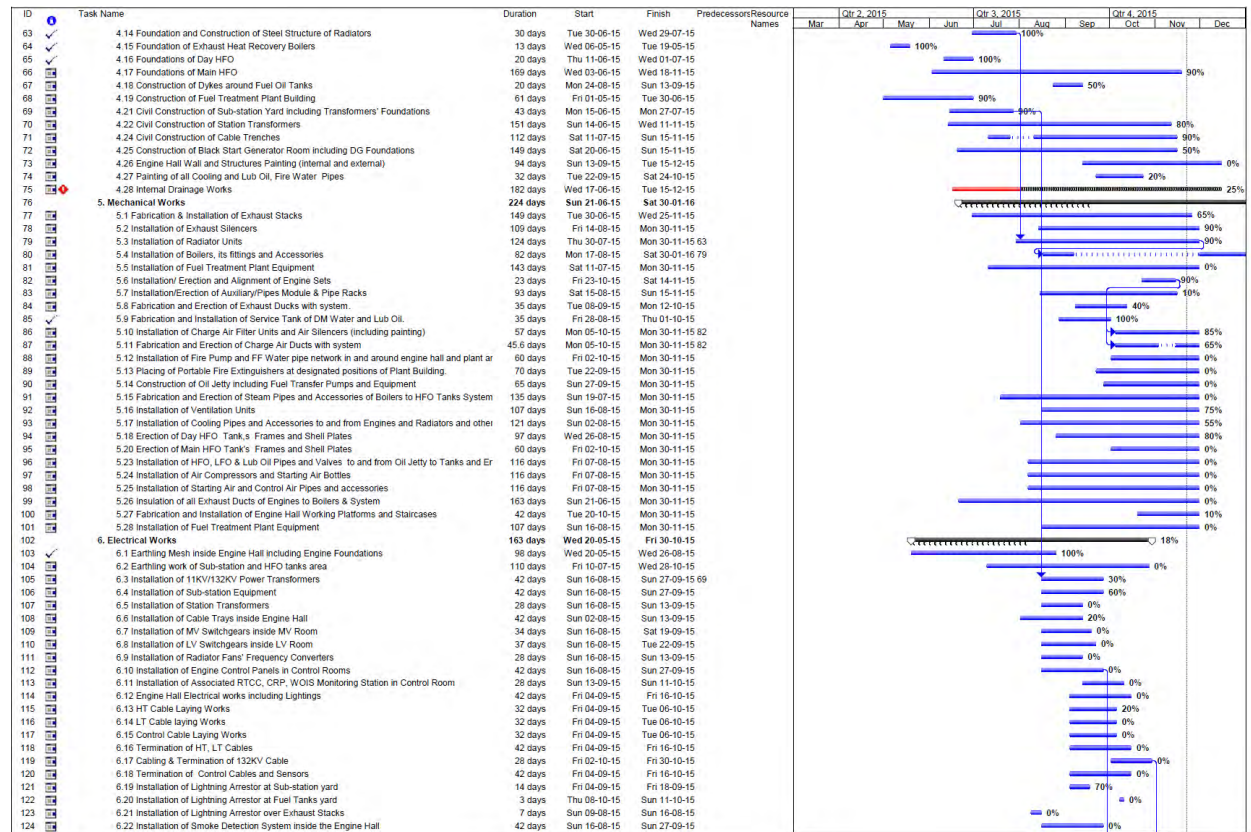


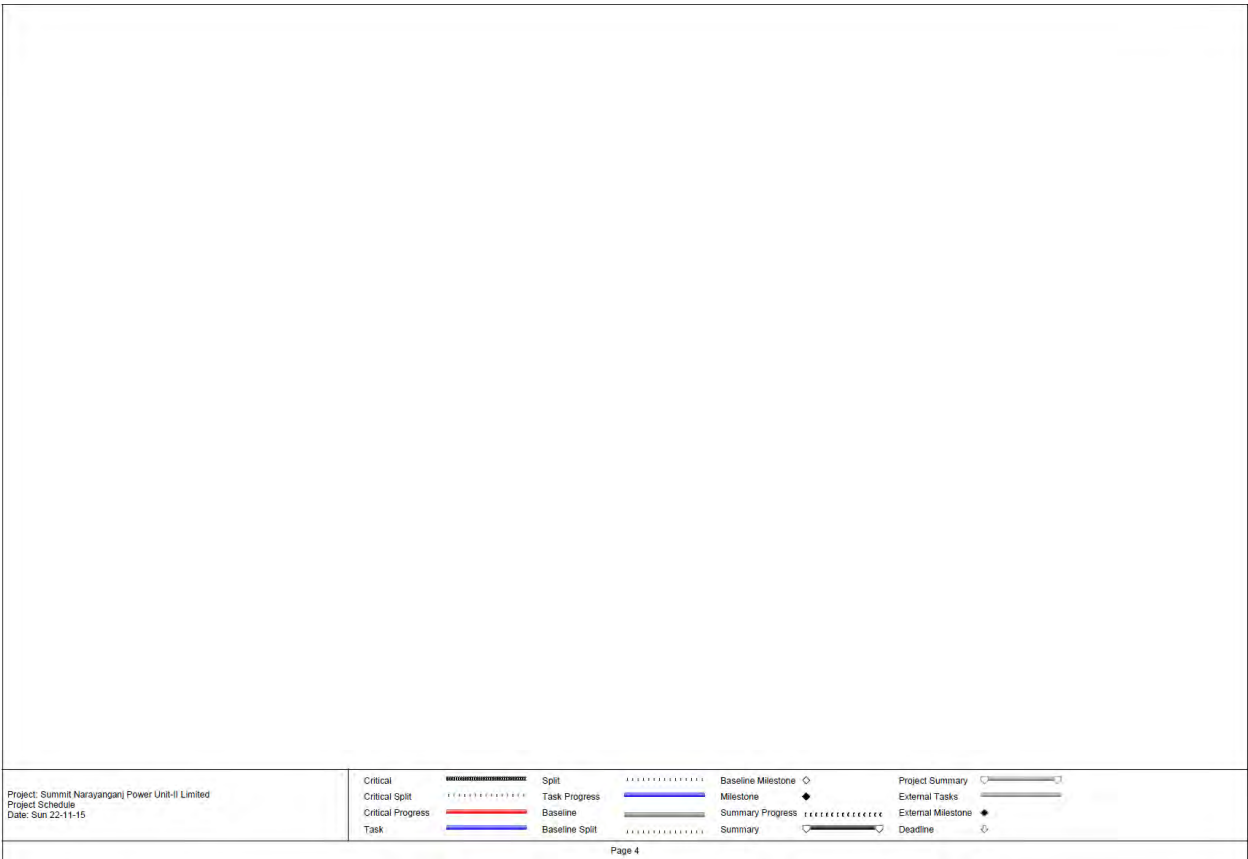
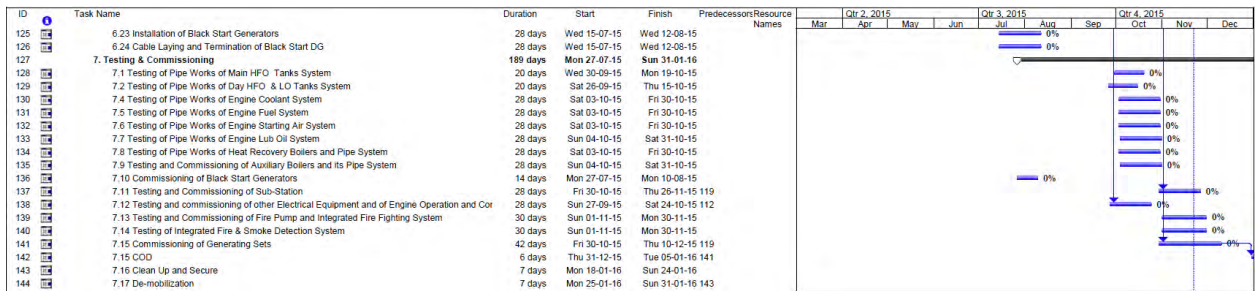


ANNEX-12: Project Time Schedule

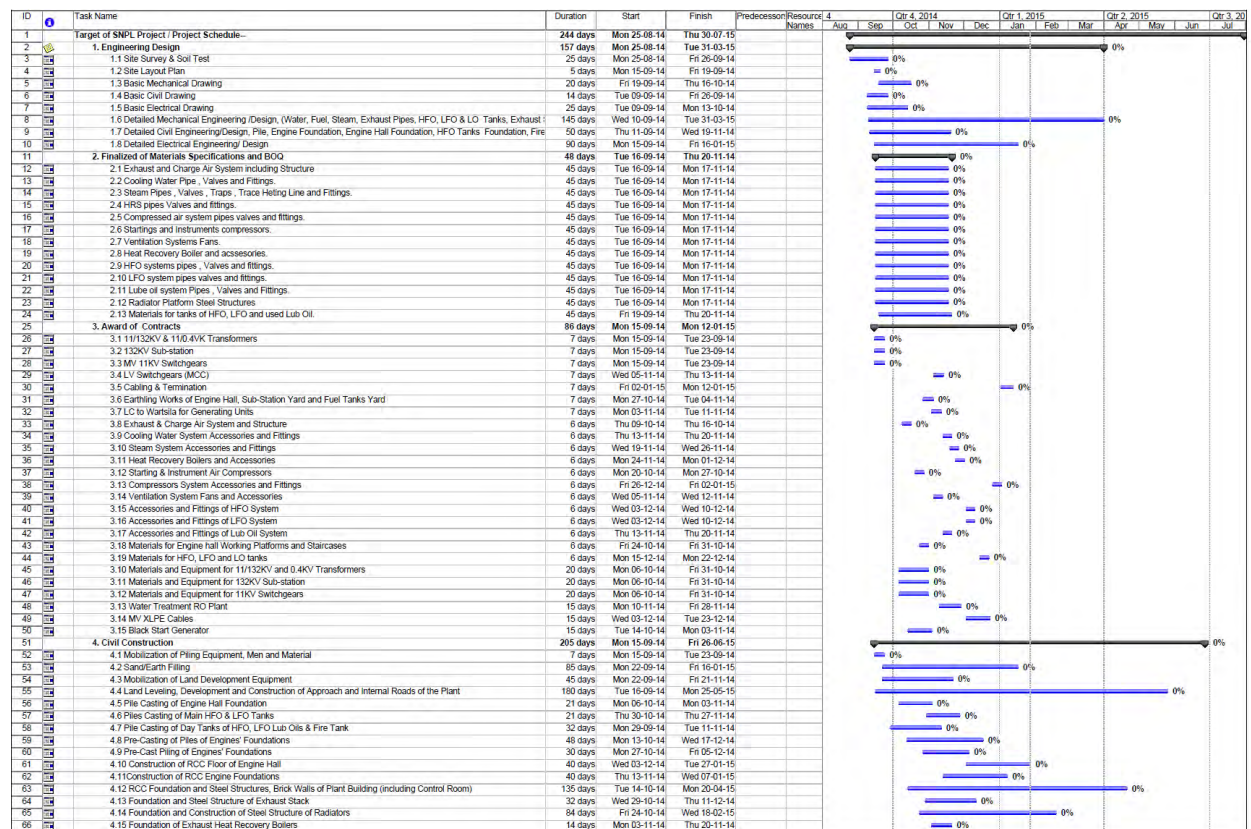


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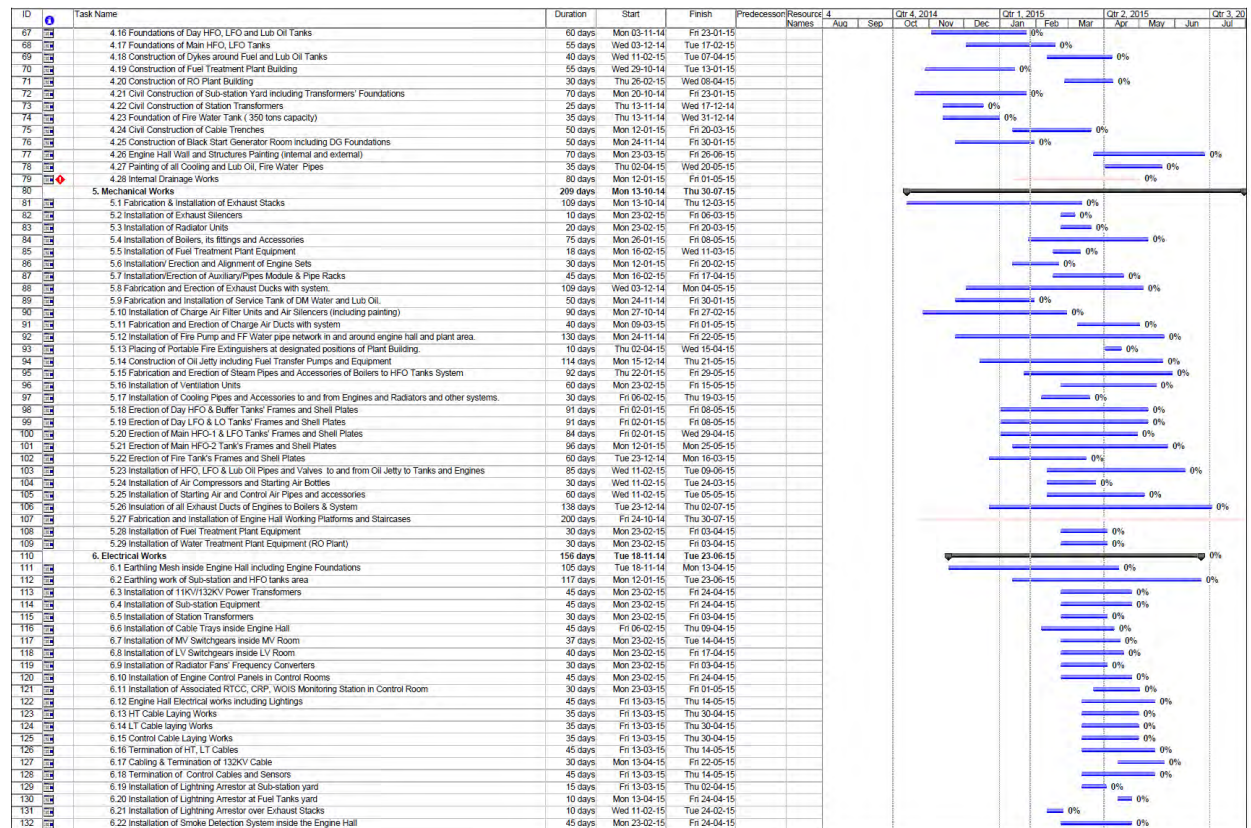


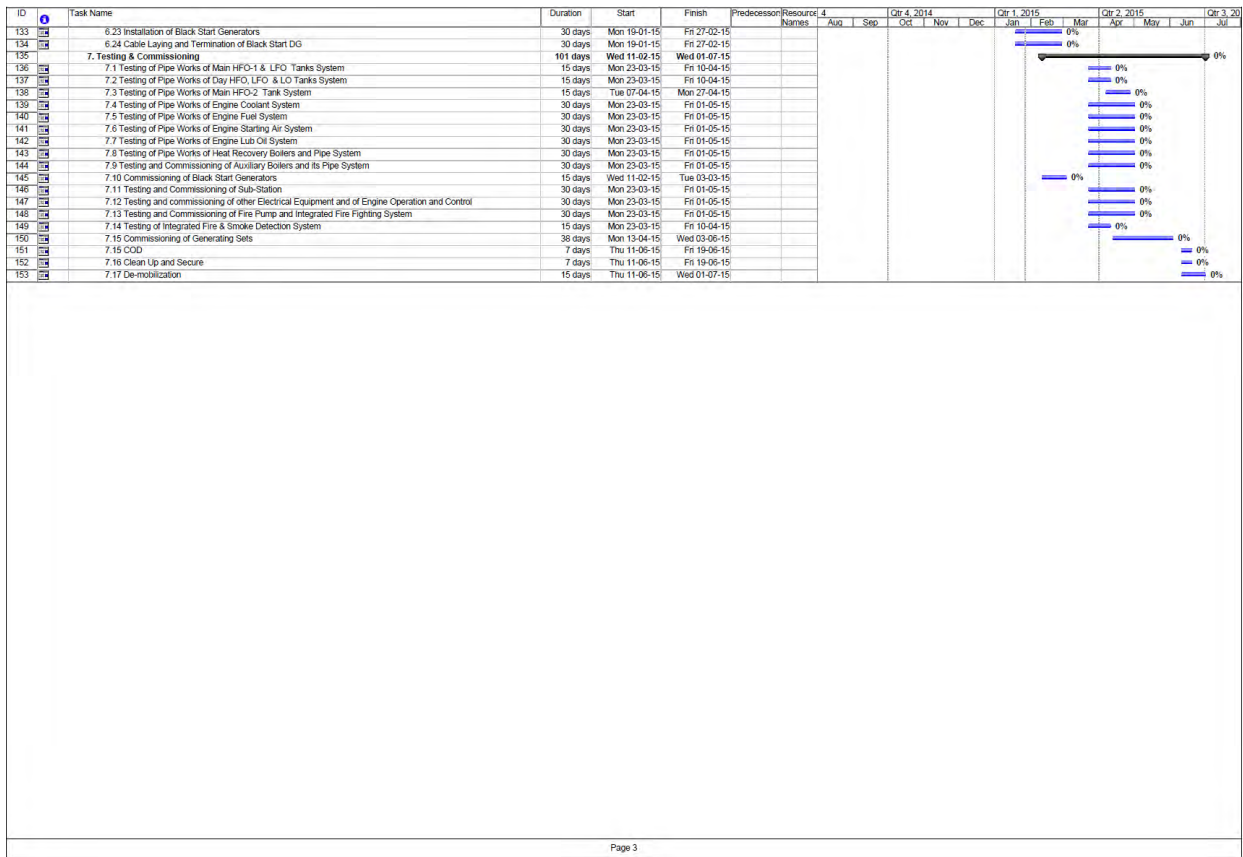


ANNEX-13: Project Time Schedule - 2



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ANNEX-14: Hazard risk analysis report

Definitions of Hazard Severity & Likelihood

Hazard Severity	Risk Type	Personnel Risk	Environmental Impact	Affected	Downtime	Socio-Political/Reputation
	1 Minor	Minor Injury (e.g. First Aid) - No Loss time	Minimal pollution effect. Contained locally	None	None	No internal disruption
	2 Low	Injury/Minor health effects require treatment by medically qualified person effects are reversible-Short term absence from work. complete recovery	Minor pollution slight impact negligible remedial/recovery work	Discipline	1 day	Minor internal disruption/Limited community impact/Reportable to regulatory authorities
	3 Medium	Potentially life threatening injury causing temporary disability Major health effect to individual requiring medical to hospital facilities. Potential long term absence	Pollution with some onsite/offsite impact & recovery work. Possible outside assistance required to contain Some local and possible regional media interest.	Project	1-7 days	Internal disruption that could require outside help to manage. Community discussion adverse local or financial publicity Lawsuits possible
	4 High	Major life threatening injury or Major health effects to several persons. Long term absence with incomplete recovery/permanent disability	Significant pollution with offsite impact & recovery work. Local Regional and possible National media interest	Business Unit	4 weeks	Serious internal disruption adversely affecting ongoing business and requiring third party help to manage Widespread interest. Adverse shareholder and broker reaction lawsuits possible.
	5 Major	Fatality or multiple fatalities multiple permanent disabling injuries from occupational illness or injury	Massive pollution with significant site impact & recovery work Regional National and possible Global media interest.	Corporate	More than 1 month	Very serious business disruption and impact Oil company operations National / International media interest adverse publicity.

S= Severity, L=Likelihood

Detail definition of Likelihood

likelihood	A Unlikely	An incident which is not expected to occur under any normal circumstances and would only result from a combination of extremely improbable factors. The probability of an "Unlikely" incident occurring is regarded as less frequent than 10^{-5} per year
	B Remote	An incident is not expected to occur under normal circumstances but may occur under exceptional circumstances. The probability of a "Remote" incident occurring is regarded as being between 10^{-5} and 10^{-4} per year
	C Possible	An incident which has the possibility of occurring under normal circumstances. The probability of a "Possible" incident occurring is regarded as being between 10^{-4} and 10^{-2} per year
	D Probable	An incident which is likely to occur at some point or regularly during normal circumstances and would require no extraordinary factors for its occurrence. The probability of a "Probable" incident occurring is regarded as being between 10^{-2} and 10^{-1} per year.
	E Very Likely	An incident which is almost certain going occurs during normal circumstances if conditions remain unchanged. The probability of a "Very Likely" incident occurring is regarded as being between 10^{-1} and 1 per year

Risk Matrix

		Likelihood				
		A Unlikely Could only occur under a freak combination of factors. (Less frequent activities)	B Remote May occur only in exceptional circumstances	C Possible Could occur at sometime	D Probable Would require extra ordinary factors to occur at sometime	E Very Likely Almost certain to happen, if conditions remain unchanged
HAZARD SEVERITY	1 Minor Minor injury/Minimal pollution effect/No loss time/No internal disruption/No downtime	A1	B1	C1	D1	E1
	2 Low Injury which requires medical attention/1-3 days loss time/Minor pollution effect/Minor internal disruption/1 day downtime	A2	B2	C2	D2	E2
	3 Medium Potentially life threatening injury causing/temporary disability (e.g.: Fractures) and or requiring medication/Potential long term absence/Pollution with some on-site or	A3	B3	C3	D3	E3

	off-site impact/Disruption possibly required outside help to manage/Downtime between 1to 7 days.					
	4 High Major life threatening injury or causing permanent disability (e.g.: Loss of limb)/ Incomplete recovery/Pollution with significant impact/Very serious business disruption/Up to 4 weeks downtime	A4	B4	C4	D4	E4
	5 Major Fatality or multiple fatalities, or multiple life threatening injuries causing permanent disabilities/Massive pollution with significant recovery work/Over 1 month downtime	A5	B5	C5	D5	E5
Low	Any task that has this risk ranking is generally acceptable. The work environment and methodology presents minimal risk to personnel.					
Medium	Any task that has this risk ranking is only acceptable if the Risk is As Low As Reasonably Practicable (ALARP). Personnel completing this task should be fully aware of the risk which exists and the control measures should put in place to minimize them.					
High	Any task that has this risk ranking must not be completed. It should be refined or further control measures put in place to reduce risks.					

TASK: Heavy Lifts in General											
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L = R			Additional Controls and Risk Reduction Measures to be developed
				S	L	R		S	L	R	
C011	Transportation of heavy steel (Steam Turbines, steel beams, steel structures , GRP pipes, steel pipes, etc.)	○ Falling ○ Other road users ○ Road Traffic accident ○ Over speeding ○ Poor journey management	○ Property damage ○ Personnel Injury ○ High medical cost ○ Single/multiple fatality	4	D	D4	○ Identify proper trailer (capacity) based on load from delivery receipts. ○ Site route survey (transport plan) ○ Ensure item secured on trailer (wood rest, sling, guards, etc.) ○ Escorting trailer during transportation ○ Weather condition (wind speed, rainfall, sand storm, etc.) parameter is translated into flag system, ○ Use of trained & experienced drivers ○ Obey site speed	2	B	B2	

							limit of 15 km/h unless otherwise specified. - Emergency response procedure- report emergency to Area Supervisor then EHS team if necessary. Maintain constant communication with EHS team during the duration of emergency. - Effective communication- Supervisor shall possess radio or other means (mobile) to connect with EHS team. English is the preferred means of communication.				
2	Lifting of heavy steel structures (Steam Turbines, steel beams, steel pipes, GRP pipes, etc.)	- Falling - Overhead electric cables - Long working hours - Heat stress - Operator's	- Property damage - Personnel Injury	5	E	E5	- Proper barricade (warning signage's). Use of Yellow tape for barricading while doing lifting operation. - Checked lifting devices (web slings, shackles, etc.)	5	B	B5	

		error Equipment Failure					- Certified equipment. - Lifting is allowed within 5 meters elevation. - Soil condition (loose, uneven, etc) - check the soil whether it is compacted or loose or uneven. Provision of base plate for outriggers on soft ground. - Regular equipment maintenance. - Pre-lift meeting (operator, supervisor, rigger, hse officer, etc.) to discuss the sequence and EHS requirements. - Drawing & planning list available - Additional taglines when needed, minimum two taglines diagonally placed at both ends. - Permit to work in				
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							- place (with proper, JHA, RA) ○ Site survey (general condition of surroundings) ○ Evaluate the risk associated to already existing equipment Nearby or services ○ Use medically fit personnel. ○ Adequate supervision of activity ○ Effective communication between operator & signal man, use of standard rigging signals. ○ Emergency response procedure- report emergency to Area Supervisor then EHS team if necessary. Maintain constant communication with EHS team during the duration of emergency. ○ Availability of				
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								trained first aiders.						
								TASK: Heavy Lifting Near Installed Equipments						
								Address Specific risks during Pre job Talks			Risk Value S x L = R			
	Activity ID		Activity Description		Hazard		Hazard Effect	Adherence to Procedure/Method Statement.			L	R		Standard Control Measures

C02 1	Transportation of heavy steel near equipment/plant	- Proximity of equipment - Struck by falling materials - Falling - Road Traffic accident - Over speeding - Poor journey management	- Property damage - Personnel Injury - High medical cost - Single/multiple fatality	4	D	D4	- Identify proper trailer (capacity) based on load from delivery receipts. - Site route survey (transport plan) - Ensure item secured on trailer (wood rest, sling, guards, etc.) - Escorting trailer during transportation - Trained operator. - Weather condition (wind speed, rainfall, sand storm, etc.) parameter is translated into flag system. - Use of trained & experienced drivers - Obey site speed limit of 15 km/h unless otherwise specified. - Emergency response procedure- report emergency to Area Supervisor then EHS team if necessary. Maintain constant communication with

							EHS team during the duration of emergency. English is the preferred means of communication. Adhere to Procedure/Method Statement
2	Lifting of heavy steel structures (Steam Turbines, steel beams, steel pipes, GRP pipes, etc.)	- Falling - Proximity of equipment - Overhead electric cables - Long working hours - Heat stress - Operator's error - Equipment Failure	- Property damage - Personnel Injury	5	E	E5	- Proper barricade (warning signage's) - Checked lifting devices (web slings, shackles, etc.) - Certified equipment. - Lifting is allowed within 5 meters elevation. - Soil condition (loose, uneven, etc)- check the soil whether it is compacted or loose or uneven. Provision of base plate for outriggers on soft ground. - Regular equipment maintenance. - Pre-lift meeting (operator, supervisor, rigger, hse officer, etc.) to ensure

							sequence and EHS requirements. ○ Drawing & planning list available ○ Additional support equipment available, if needed (forklift, man lift, man basket) as per the plan. ○ Permit to work in place (with proper, JHA, RA) ○ Site survey (general condition of surroundings) ○ Evaluate the risk associated to already existing equipment Nearby or services ○ Use medically fit personnel. ○ Adequate supervision of activity ○ Effective communication between operator & signal man, use of standard signals. ○ Emergency response procedure- report emergency to Area Supervisor then EHS team if necessary.
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							Maintain constant communication with EHS team during the duration of emergency. ○ Availability of trained first aiders. ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement
TASK: All Hot Work							
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control
				S	L	R	

	Welding	○ Fire. ○ Electrical ○ Health ○ Spatter and inhalation of Fumes	○ Electrocution ○ Respiratory System	5	C	C5	○ Permit to Work to be provided ○ Ensure Sufficient ventilation and (if required) ○ Certified /Training of competent ○ Periodic inspection for electrical ○ Use of required PPE- gloves, shield. ○ Appointment of Fire Watch ○ Provides Fire extinguisher (D ○ Removal of combustible materials
2	Gas Cutting and Grinding	○ Explosion of Compress Gas Cylinder ○ Breakages of Grinding Disc ○ Gas Leakages	○ Fatality ○ Fire / Explosion ○ Personal Injury	5	D	D5	○ Permit to Work to be provided ○ Periodic inspection for electrical ○ Certified /Training of competent ○ Removal of combustible materials ○ Provides Fire extinguisher (D ○ Use appropriate PPE and Gas ○ Install Flashback Arrestor on cylinders. ○ Proper Handling & Transport per Project procedure. ○ Appoint Fire Watchmen ○ Address specific risks during

							Adhere to Procedure/Method
3	Other works using Compressors / Generators	- Spark - Noise - Exhaust emission	- Fire and Explosion - Hearing Loss - Atmospheric Pollution				- Keep Compressors / Generator equipment. - Permit to Work to be provided - Periodic inspection for electrical - Certified /Training of competent - Provides Fire extinguisher (Dry - Use of required PPE- gloves, shield. - Appoint Fire Watchmen - Address specific risks during - Adherence to Procedure/Met
TASK: Operation Confined Space							
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures
				S	L	R	

1	Excavation	○ Oxygen deficiency. ○ Collapse of excavation ○ Material fall on personnel	○ Fatality ○ Personal Injury	5	C	C5	○ Permit to Work to be provided. ○ Stored excavated material 1.5 meters away from edge of excavation ○ Safe access to be provided, shoring & sloping ○ Confined space training for the personnel ○ Approved working platform ○ Sufficient ventilation and exhaust fan (if required) ○ Provision of hard barricades and sign board ○ Provides enough light / Flashlight during night alert pass-by vehicles and personnel. ○ Use required PPE- gloves, mask ○ Address specific risks during Pre job Talks ○ Adherence with the Procedure/Method Statement
2	Civil Works (Tanks, Foundation & Rebar)	○ Oxygen deficiency ○ Material fall on personnel ○ Works in elevated area inside of confined space ○ Poor Illumination	○ Fatality ○ Personal Injury	5	C	C5	○ Permit to Work to be provided. ○ Provides enough light / Flashlight ○ Confined space training for all involved personnel ○ The inside voltage line shall be maximum or voltage practical rated at 24V. ○ Approved working platform & proper access ○ Sufficient ventilation and exhaust fan (if required) ○ Provision of barricades in line with the guidelines and sign board

							○ Appointment of Watch man ○ Use of required PPE- gloves, mask ○ Address specific risks during Pre job Talks ○ Adherence with the Procedure/Method Statement
3	GRP Works	○ Oxygen deficiency ○ Toxic & Chemical inhalation ○ Electrical ○ Presence of Flammable gas ○ Poor Illumination	○ Fatality ○ Personal Injury ○ Fire explosion ○ Electrocution ○ Health	5	D	D5	○ Permit to Work to be provided. ○ Provides Ventilation Fan ○ Confined space training for the personnel ○ Periodic inspection for electrical equipments ○ The inside voltage line shall be maximum or voltage practical rated at 24V. ○ Proper access and working platform ○ Appointment of Watch man ○ Use of required PPE - Gas mask, and gloves ○ Provides Fire extinguisher (DCP type) ○ Provides enough light / Flash light (if necessary) ○ Address specific risks during Pre job Talks ○ Adherence with the Procedure/Method Statement

4	Field Fabrication on Tank / Blasting / Lifting	○ Oxygen deficiency ○ Toxic gas , Chemical & Fumes inhalation ○ Electrical ○ Presence of Flammable gas / Fire ○ Poor Illumination ○ Falling of personnel ○ Lifting of Materials ○ Skin and eye irritation (chemical and paint contact)	○ Fatality ○ Personal injury ○ Fire / Explosion ○ Health / Loss of hearing	5	C	C5	○ Permit to Work to be provided. ○ Confined space training for the personnel ○ Approved working platform / Provides Fall protection ○ Provides enough light / Flashlight (if necessary) ○ The inside voltage line shall be maximum or where practical rated at 24V. ○ Sufficient ventilation and exhaust fan ○ Provision of barricades and sign board ○ Used Required PPE ○ Periodic inspection for electrical equipments ○ Appointment of Watch man ○ Address specific risks during Pre job Talks ○ Adherence with the Procedure/Method Statement
5	Painting and Coating	○ Oxygen deficiency ○ Toxic gas , Chemical & Fumes inhalation ○ Electrical ○ Flammable ○ Poor Illumination	○ Fatality ○ Personal Injury ○ Fire explosion ○ Electrocutation ○ Health / Loss of hearing	5	D	D5	○ Permit to Work to be provided. ○ Sufficient ventilation and exhaust fan ○ Confined space training for the personnel ○ Approved working platform ○ The inside voltage level shall be maximum or where practical rated at 24V.

		○ Falling of personnel ○ Lifting of Materials ○ High noise ○ Skin and eye irritation (chemical and paint contact)					○ Provide Proper access ○ Intrinsically safe electrical fitting and connection ○ Appointment of Watch man ○ Use of required PPE or Gas mask ○ Provides Fire extinguisher ○ Provides enough light / Flashlight if necessary ○ Address specific risks during Pre job Talks ○ Adherence with Procedure/Method Statement
6	Inside Works in Column (Tray and Packing)	○ Oxygen deficiency ○ Toxic gas , Chemical & Fumes inhalation ○ Electrical ○ Flammable ○ Poor Illumination ○ Falling of personnel ○ Lifting of Materials ○ Skin and eye irritation (chemical and paint contact) ○ Cutting,Welding,Grinding & Bolting		5	D	D5	○ Permit to Work to be provided. ○ Provision of working platform, and safe egress/ingress. ○ The inside voltage line shall be maximum or voltage practical rated at 24V. ○ Provide suitable and proper access. ○ Provide proper working platform. ○ Sufficient ventilation and exhaust fan ○ Confined space training for the personnel ○ Periodic inspection for electrical equipments. ○ Intrinsically safe electrical fitting and connection ○ Appointment of Watch man ○ Used of required PPE or Gas mask

								- Provides Fire extinguisher(DCP type) - Provides enough light / Flashlight if necessary - Address specific risks during Pre job Talks - Adherence with Procedure/Method Statement		
TASK: Man Lift Operations										
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L =		
				S	L	R		S	L	R
1	Operation activities of man lift	- Equipment failure - Fall of Personnel outside the platform	- Fatalities /IP - Property Damage	4	D	D4	- Regular maintenance of equipment. - Conduct of regular Inspection for equipment. - Provision of barricade within the work area and working radius of equipment. - Adhere to routine maintenance plan - Address specific risks during Pre job Talks - Adhere to Procedure/Method Statement	4	B	
		Bad soil or ground condition	- Property damage - Property damage - Equipment Sinking	4	D	D4	Soil condition (loose, uneven, etc)- check the soil whether it is compacted or loose or uneven. Provision of base plate for outriggers under soft ground.	4	B	

							- Regular soil condition inspection - Route survey - Avoiding to work close to excavation where practical a 3 meters distance from edge shall be maintained.			
		Bad weather condition	- Poor visibility - Excessive Heat Index - Property Damage - Property Damage - Follow weather condition guidelines	4	D	D4	- Regular wind speed verification from site weather station. - Forecasting weather condition - Follow a weather condition guideline that is minimum of 50 meter visibility. - No work allowed during rainy day. - Address specific risks during Pre job Talks - Adhere to Procedure/Method Statement	4	B	
		Obstacles	- Property Damaged - Property Damaged	4	D	D4	- Access way inspection - Full body harness to be used with hooks connected to anchorage points. - Ground area operator usually the Man Lift Supervisor or Foreman controlling number of units who can immediately respond during emergency. - Address specific risks during Pre job Talks - Adherence with the project Procedure/Method Statement	4	B	

		○ Operators Error	○ Property Damaged ○ Property Damaged	4	D	D4	○ Certified Manlift operator with certification from approved third party body. ○ Operator shall render job assistance, not do actual job. ○ Operator shall remove the key if he is required to go away. ○ Address all risks during Pre job Talks ○ Follow Procedure/Method Statement ○ Availability of Man Lift Area Supervisor on the ground to respond in case of emergency.	4	B
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TASK: Connections to High Voltage

Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L = R			Additional Risk Measures
				S	L	R		S	L	R	
1	Live HV Panels	○ High Voltage ○ Exposed cables ○ Trip & fall ○ Equipment with moving & rotating parts.	○ Electrical ○ Shock/Fatality ○ Short Circuit ○ Personnel injury ○ Explosion/Fire ○ Burn ○ Equipment Damage	5	D	D5	○ Installation of Circuit Breakers to all electrical equipments including extension DBs. ○ Restriction on number of Personnel ○ Approved equipments by means of Certifications/Inspections and Calibrations by approved third party body. ○ No unauthorized personnel in the work area. ○ Qualified People supported by previous experience and recent	4	B	B4	

							project requirements. ○ Application of PTW system ○ Regular conduct of Tool Box Talk ○ Availability of Method Statement ○ Positioning of CO2 fire extinguishers ○ Availability of trained Fire Wardens. ○ Emergency response procedure-report emergency to Area Supervisor then EHS team if necessary. Maintain constant communication with EHS team during the emergency. ○ Appropriate PPEs in use. ○ Adequate supervision of activity. ○ Good housekeeping ○ Periodic inspection of HV panels. ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement				
2	Underground Cable	○ Unidentified Cable ○ Mechanical Equipments	○ Damage Cables ○ Electric shock	5	D	D5	○ Use of Cable Detectors ○ Work execution by manual excavation. ○ Appropriate PPE	4	B	B4	○ Use of as -

							○ Application of PTW ○ Cordon off trenches by use of barricades, and signboards. ○ Adequate supervision of activity ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement ○ Personnel to maintain enough gaps between one another during manual excavation. ○ Restrict the use of sharp tools like axes. ○ Trial ditching Personnel to maintain enough gaps between one another during manual excavation. ○ Perform Trial ditching				
3	Connection In Column Panel	○ Confined Space ○ Low Voltage/High Voltage ○ Lack of Grounding ○ Overloading ○ Unqualified People	○ Electrical Shock/Fatality ○ Short Circuit ○ Explosion/Fire ○ Burn ○ Equipment Damages	5	C	C5	○ Restriction on number of Personnel ○ Approved equipments by means of Certifications/Inspections and Calibrations by approved third party body. ○ Qualified People supported by previous experience and recent project requirements. ○ Application of PTW ○ Address specific risks during Pre job	4	B	B4	

		○ Falling objects ○ Dust ○ Flying particles ○ Poor housekeeping ○ Poor cable management	○ Eye injuries ○ Trip & fall				○ Talks ○ Adhere to Procedure/Method Statement				
4	Cable Connections & Pulling	○ Confined Space ○ Low Voltage/High Voltage ○ Lack of Grounding ○ Overloading ○ Unqualified People ○ Manual Handling ○ Poor supervision ○ Open ditches ○ Long working hours ○ Poor housekeeping	○ Electrical Shock/Fatality ○ Short Circuit ○ Explosion/Fire ○ Burn ○ Personal Injury ○ Equipment Damages ○ Trip & fall	5	C	C5	○ Restriction on number of Personnel ○ Approved equipments by means of Certifications/Inspections and Calibrations by approved third party body. ○ Qualified People supported by previous experience and recent project requirements. ○ Application of PTW ○ Address specific risks during Pre job Talks ○ Availability of Method Statement	4	B	B4	

5	Cable Tests	- Confined Space - Low Voltage/High Voltage - Lack of Grounding - Overloading - Unqualified People - Manual Handling	- Electrical Shock/Fatality - Short Circuit - Explosion/Fire - Burn - Personal Injury - Equipment Damages	5	C	C5	- Restriction on number of Personnel - Approved equipments by means of Certifications/Inspections and Calibrations by approved third party body. - No unauthorized personnel in the work area - Provide earthing. - Application of PTW system - Address specific risks during Pre job Talks - Availability of Method Statement	4	B	B4	
TASK: Operations Near Live Line											
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value $S \times L = R$	Standard Control Measures			Residual Risk Level $S \times L = R$			Additional Controls and Risk Reduction Measures to be developed
								S	L	R	

C07 1	Welding	- Proximity to ICPR - Fire hazard - Electrical - Health - Spatter and inhalation of Fumes	- Live Pipe line damage - Gas leak - Fire & Explosion - Personal injury - Electrocution - Respiratory System	5	C	C5	- Permit to Work to be provided. - Proper Ventilation and provision of extractors/fan. - Certified /Trained competent Personnel - Area Management Plan checks implementation. - Periodic inspection for electrical safety - Use of Required PPE - Appointment of Fire Watch - Provision of Fire extinguisher - Address specific risks during Permit to Work - Removal of combustible material from vicinity. - Adhere to Procedure/Method Statement
2	Gas Cutting and Grinding	- Explosion of Compressed Gas Cylinder - Breakages of Grinding Disc - Gas Leakages	- Fatality - Fire / Explosion - Personal Injury	5	D	D5	- Permit to Work to be provided. - Periodic inspection for electrical safety - Certified /Training of competent Personnel - Provides Fire extinguisher

							○ Removal of combustible material in vicinity. ○ Use of Required PPE or Gas mask ○ Installed Flashback Arrestor ○ Proper Handling & Transporting ○ Appointment of Fire Watch ○ Address specific risks during Pre ○ Adhere to Procedure/Method Sta
3	Excavation	○ Oxygen deficiency. ○ Collapse of excavation ○ Material fall on personnel	○ Fatality ○ Personal Injury	5	C	C5	○ Permit to Work to be provided. ○ Stored excavated material away from excavation 1.5 meters ○ Proper access to be provided, sloping ○ Confined space training for the p ○ Approved working platform ○ Sufficient ventilation and exhaust ○ Work shall be limited to manual e within 3 meters from the live line ○ Ensures constant supervision, and crew on site. ○ Reference to existing drawings o ○ Provision of hard barricades and

							○ Provides enough light / Flashlight ○ Use of required PPE ○ Address specific risks during Pre ○ Use cable detector to identify underground services. ○ Adhere to Procedure/Method Sta ○ Permit to Work Application from activities.
4	Civil Work (Foundation & Rebar)	○ Hitting or touching live electrical or pipeline	○ Damage to live line ○ Leaking of live pipeline	4	C	C4	○ Barricading of existing pipeline ○ Provision of Danger Signboard "High Voltage Cable or Operational Pipe" in mu ○ Maintaining 1 meter distance from live line during breaking ○ Use of buried pipeline detector b ○ Address specific risks during Pre ○ Adhere to Procedure/Method Sta ○ Isolate the existing live line prior to concrete braking. ○ Careful operation of jack hammer for concrete breaking. ○ Provide standby tank with spill kit for accidental spill/ release.

5	Lifting of heavy steel structures (Steel beams, steel pipes, GRP pipes, etc.) in ICPR.	○ Falling ○ Proximity of equipment ○ Overhead electric cables ○ Long working hours ○ Heat stress ○ Operator's error ○ Equipment Failure	○ Property damage ○ Personnel Injury	5	E	E5	○ Proper barricade (warning signa ○ Certified lifting devices (web sling etc.) ○ Checked equipment. ○ Soil condition (loose, uneven, etc soil whether it is compacted or lo Provision of base plate for outrig ground. ○ Availability of lifting plan prepare competent person. The Plan sha implemented. ○ Equipment positioned 3 meters a existing pipelines, otherwise suita is established. ○ Regular equipment maintenance ○ Pre-lift meeting (operator, super HSE officer, etc.) to ensure sequ requirements. ○ Drawing & planning list available ○ Additional support equipment av needed (forklift, man lift, man ba the plan. ○ Permit to work in place (with prop ○ Site survey (general condition of ○ Evaluate the risk associated to a equipment Nearby or services ○ Use medically fit personnel.
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									○ Adequate supervision of activity ○ Effective communication between signal man, use of standard rigging ○ Emergency response procedure- emergency to Area Supervisor through if necessary. Maintain constant contact with EHS team during the emergency ○ Availability of trained first aiders. ○ Address specific risks during Pre ○ Adhere to Procedure/Method Sta	
TASK: Handling of Dangerous Chemicals in Significant Quantities.										
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L = R		
				S	L	R		S	L	R

	Receivable and storage of chemicals & catalyst	- Leaks during loading and offloading. - Improper segregation of chemicals - Release and accumulation of toxic and explosive vapors - Dust and waterborne particles. - Over temperature	- Personal Injury - Fire Explosion - Environmental pollution - Damage to stored Chemical/catalyst	3	C	C3	- Following and executing the work method statement - Ensuring the existence of MSDS and adhere to each chemical requirements - Provision of training and information to the team - Ensure that the condition of receiving of chemicals is same as from the vendor - Segregation of incompatible materials - Warning signboards & Placarding. - Restriction of unauthorized access - Eliminating ignition sources where flammable atmosphere exists - Spill control kits shall be provided as mentioned in consortium spill contingency plan - No smoking implementation - Address specific risks	1	C	C
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							during Pre job Talks			
							Adhere to Procedure/Method Statement			
2	Transportation of chemicals from storage area to the site.	- Manual handling - Contact with hazardous, dangerous - Carcinogenic, mutagenic substances, etc - Release and accumulation of toxic and explosive vapors Dust and waterborne particles.	- Strains, back injury. Property damage due to incorrect or excessive lifting - Chemical burns to skin and eyes, inhalation and ingestion, cancers, Lung impairment, headaches, dermatitis, eye irritation, nose and throat irritation - Fire / explosion - Environmental pollution - Damage to stored chemical / catalyst	3	C	C3	- Following and executing the work method statement WMS - Use appropriate manual handling equipment such as trolleys, hoists, fork lifts. - Reading MSDS and adhere to each chemical requirements - Segregation of incompatible materials - Warning signboards & Placarding - Marking of packages - Restriction of	1	C	C

							○ unauthorized access ○ Eliminating ignition sources where flammable atmosphere exists. ○ Spill control kits shall be provided as mentioned in consortium spill contingency plan ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement			
3	Working with chemicals on site.	○ Manual handling ○ Contact with hazardous, dangerous. Carcinogenic, mutagenic substances, etc ○ Release and accumulation of toxic and explosive vapors ○ Dust and waterborne particles ○ Accidental release to the environment	○ Strains, back injury. Property damage due to incorrect or excessive lifting ○ Chemical burns to skin and eyes, inhalation and ingestion, cancers, lung impairment, headaches, dermatitis, eye irritation, nose and throat irritation ○ Explosion/Fire ○ Environmental pollution	3	C	C3	○ Following and executing the work method statement WMS ○ Reading MSDS and adhere to each chemical requirements ○ Authorized trained personnel shall work with chemicals ○ Segregation of incompatible materials ○ Warning signboards & Placarding ○ Marking of packages ○ Restriction of	1	C	C

							unauthorized access ○ Eliminating ignition sources where flammable atmosphere exists ○ Provide sun shed for chemicals on site to prevent exposure to sunlight ○ Spill control kits shall be provided as mentioned in consortium spill contingency plan ○ Portable eye wash shall be existing for emergency ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement			
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4	Chemical cleaning / alkali boil out	○ Contact with hazardous, dangerous, Carcinogenic, mutagenic substances, etc ○ Release and accumulation of Toxic and Explosive vapors ○ Accidental release to the environment ○ Use of incompatible material for temporary facilities ○ Hot surface	○ Chemical burns to skin and eyes, inhalation and ingestion, cancers, Lung impairment, headaches, dermatitis, eye irritation, nose and throat irritation ○ Fire / explosion ○ Environmental pollution ○ Damage to stored chemical / catalyst	3	C	C3	○ Following and executing the work method statement WMS ○ Reading MSDS and adhere to each chemical requirements ○ Authorized trained personnel shall work with chemicals ○ Segregation of incompatible materials ○ Warning signboards & Placarding ○ Marking of packages ○ Restriction of unauthorized access ○ Eliminating ignition sources where flammable atmosphere exists ○ Provide sun shed for chemicals on site to prevent exposure to sunlight ○ Spill control kits shall be provided as mentioned in consortium spill contingency plan ○ Portable eye wash shall be in place for	1	C	C
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							emergency			
							○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement			
5	Painting & lamination jobs	○ Contact with hazardous, dangerous, Carcinogenic, mutagenic substances, etc. ○ Release and accumulation of toxic and explosive vapors ○ Accidental release to ○ Over pressure due to improper storage ○ Improper disposal of hazardous waste	○ Chemical burns to skin and eyes, inhalation and ingestion, cancers ○ Lung impairment, headaches, dermatitis, eye irritation, nose and throat irritation ○ Explosion/Fire ○ Burn ○ Environmental pollution & soil contamination	4	C	C4	○ Reading WMS & MSDS and adhere to the mentioned instructions ○ Authorized trained personnel shall work with chemicals ○ Segregation of incompatible materials ○ Restriction of unauthorized access ○ Eliminating ignition sources where flammable atmosphere exists ○ Provide sun shed for chemicals on site to prevent exposure to sunlight ○ Approved list of paints and chemicals shall be	1	C	C

							used on site ○ Spill control kits shall be provided as mentioned in consortium spill contingency plan ○ Prohibition of No smoking ○ Follow the instruction of waste generated in waste management plan ○ Portable eye wash shall be existing for emergency ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement			
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6	Catalyst loading & resin loading	- Working in confined space - Manual handling - Exposure to dust and vapor - Working at height - High ambient temperatures - Disposal of catalyst containers	- Personal injury and irritation to respiratory system - Oxygen deficiency - Slip / trip / falls - Oxidation of catalyst - Environmental damage	4	B	C4	- Reading WMS & MSDS and adhere to the mentioned instructions - Authorized trained personnel shall work with chemicals - Segregation of incompatible materials - Restriction of unauthorized access - Eliminating ignition sources where flammable atmosphere exists - Provide sun shed for chemicals on site to prevent exposure to sunlight - Proper ventilation & continuous gas testing - Approved list of paints and chemicals shall be used on site - Follow the instruction of waste generated in waste management plan & spill contingency plan - Portable eye wash shall be provided for emergency	2	B	B2
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							○ Full implementation of No Smoking ○ Address specific risks during Pre job Talks ○ Adhere to Procedure/Method Statement			
TASK: Demolition Activities										
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L = R		
				S	L	R		S	L	R

	crete Braking of isolated foundation	1) Flying of broken concrete pieces	○ Personnel injury	3	C	C3	○ Use of eyeglass and face shield and safety helmet. ○ Barricading and screening the work area ○ Use of caution sign board such as "Beware of Flying Particles" ○ Proper selection of Equipment ○ Use of competent equipment operator ○ Permit to Work, Confined Space Entry Permit in place ○ Conduct Pre-job Toolbox Talk ○ Work Method Statement, JHA/RA shall be prepared prior to execution of activities and shall be discussed to all employees.	2	B	B2
		2) Dust	○ Respiratory disease	2	B	B2	○ Spraying concrete with water to avoid dust to develop.	1	C	C1
		3) Physical hazard due to equipment vibration	○ Occupational disease	3	C	C3	○ Changing of personnel by substitution method	2	C	C2

		4) Uncontrolled slippage of equipment	Equipment damage & personnel injury	2	C	C2	Proper handling of equipment, and regular inspection.	1	C	C1
		5) Noise	Hearing impairment	2	C	C2	- Changing of personnel through substitution method - Use of appropriate ear protection - Selection of low noise equipment - Proper equipment maintenance	2	B	B2
2	Concrete Braking at foundation close to existing facilities	1) Hitting or touching live electrical or pipeline	Damage to live line	4	C	C4	- Barricading of existing pipeline - Provision of Danger Signboard "Live electrical cable or Operational Pipe" in multiple language - Keep three (3.0) meters away from existing live line during breaking - Use of buried pipeline detector before breaking. - Isolate the existing live line, if possible. - Ensure availability of as Built documents.	2	C	C2

			Leaking of live pipeline			C4	- Isolate the existing live line prior to start concrete braking. - Careful operation of jack hammer during concrete breaking. - If possible standby chemical tank equipped with pump & with spill containment tray should be at worksite to suck up all chemical	2	C	C2
			Burst of electrical circuitry			C4	Isolate all electrical live line. Ensure lines are connected to a circuit breaker.	2	C	C2
			Collapse of some structure and support			C4	Shoring support has to be provided.	2	C	C2
			Fire			C4	Fire protection has to be provided.	2	C	C2
			Pollution			C4	Removal, transport and disposal of concrete waste has to be done as per approved waste management plan	2	C	C2
			Injury	4	C	C4	- Emergency Standby Vehicle has to be provided in case of emergency. - Emergency contact number has to be provided in work site. - Appropriate communication & reporting procedure has to be done when injury occurred. - First Aid kit has to be provided on work site.	2	C	C2
3	ing of pipelines	1) Inhalation of fumes and gases	Respiratory disease	4	D	D4	Appropriate PPE during cutting has to be provided	3	C	C3

		2) Electrical Hazards	Electric shock and equipment damage				- All existing electrical cable before cutting has to be isolated. - All cables and equipment to be use during cutting has to be provided with automatic circuit breaker	3	C	C3
		3) Ultraviolet rays from cutting by way of gouging	Eye pain, tears or delay blindness	4	D	D4	Whenever cutting has to be done in, appropriate PPE has to be provided.	3	C	C3
		4) Falling of pipes	Injury and existing pipe lines damages	4	D	D4	- Pipes to be cut have to be provided with support or platform. - Danger Signboard "Falling Object" has to be provided on site.	3	C	C3
		5) Compress gas under high pressure	Explosion			D4	- Oxygen and acetylene has to be stored in trolley in upright position with locking chain. - Never use oxygen and acetylene cylinder as part of electrical circuitry during cutting or gouging. - Cylinders should be provided with cap. - Fire Extinguisher has to be provided to all flammable chemical and equipment	3	C	C3
		6) Backfire	Fire & Explosion	4	D	D4	Flashback arrestor has to be provided to oxy-acetylene cutting equipment.	3	C	C3

		7) Unidentified pipeline	○ Fire and explosion when hit by cutting equipment ○ Leaking of pipe line ○ Environmental pollution	4	D	D4	○ Never use Pick axe or tools with sharp /pointed edge ○ Isolate the existing live line prior to start concrete braking. ○ Careful operation of jack hammer during concrete breaking. ○ If possible standby chemical tank equipped with pump & with spill containment tray should be at worksite to suck up all chemical release.	3	C	C3
		8) Working at height	○ Collapse of platform or scaffold structure	4	D	D4	○ Scaffold shall be erected, dismantled and altered by a qualified and competent scaffolder. ○ No substandard scaffold shall be made erected. ○ Platform or scaffold shall be inspected periodically by a qualified inspector or supervisor ○ Tagging of platform or scaffold shall be made to convey whether it is safe to use or not. ○ Use of fall protection has to be implemented whenever the personnel is working at height.	3	C	C3

		9) Falling of personnel material and equipment	○ Injury, material and equipment damage	4	D	D4	○ Use of fall protection has to be done whenever the personnel are working at height. ○ Secure all material and equipment while it is being lift or place on the platform. ○ Ensure that the design condition of the platform can withstand the weight of material and equipment. ○ Provide barricade on the area and restrict entry unauthorized personnel.	3	C	C3	
TASK: Working at Height in Different Level											
Activity ID	Activity Description	Hazard	Hazard Effect	Risk Value S x L = R			Standard Control Measures	Residual Risk Level S x L = R			Additional Risk Measure
				S	L	R		S	L	R	

	Erection of Scaffolding	○ Falling of materials, equipment and personnel ○ Soil integrity/collapse ○ Collapse of Scaffold ○ Substandard Scaffold ○ Unqualified personnel doing the erection ○ Uncontrolled modification/ unauthorized modification ○ Failed to inspect & update the scaffold tag ○ Failure to use fall protection ○ Misuse of scaffold structure for lifting	Personnel injury, equipment and material damage	4	C	C4	○ Scaffold shall be erected, dismantled and altered by a qualified and competent scaffolder. ○ Soil where base plate/footings/sole boards have to be erected shall be compacted and leveled. ○ All areas where excavation is adjacent to scaffold structure has to be supported or shored ○ No substandard scaffold shall be made erected. ○ No scaffold shall be erected by unqualified personnel. Personnel involved in Scaffolding work shall be competent and certified. ○ Permit to Work has to be requested prior to modification of scaffold ○ Frequent inspection has to be done to convey whether it is safe to use or not. ○ Use of fall protection has to be implemented whenever the personnel are working at height. ○ Never use scaffold for lifting	2	C	C2	
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		○ Throwing of object from height ○ Erection at different level	Personnel injury, equipment and material damage	4	C	C4	○ Never throw object while at different level instead use of gin wheel when lowering and raising material, or passing scaffold tube by catch-in system. ○ 10 meters and above needs the calculation design of Competent Designer or Engineer. ○ Rope grab, safety block shall be used. ○ Warning and Danger signboard has to be established as well as the use of barricade and red tags. ○ Competent Scaffolding Supervisor/Inspector to check the integrity of the scaffold. ○ Address specific risks during Pre job Talks ○ Adherence with project Procedure/Method Statement.	2	C	C2	
		○ Overloading of scaffold platform ○ Unauthorized working at the different level	Personnel injury, equipment and material damage	4	C	C4	○ Scaffold shall be used only for its intended design and shall not be overloaded. ○ Toolbox talk shall be made everyday to inform everyone that only authorized personnel are allowed to work at different level. ○ Danger sign “No Unauthorized Entry” in multiple languages shall be provided.	2	C	C2	

		○ Electrical Hazard	Personnel injury, equipment and material damage	4	C	C4	○ All electrical cables, lights and distribution board shall be installed as per applicable standards. ○ Regular inspection of all electrical cable, lights, circuit breaker has to be established by a competent electrician or Electrical Engineer. ○ All electrical wiring shall be provided with GFCI and it shall be earthed. ○ Fire extinguisher has to be provided for all electrical equipment. ○ No splices and joint and exposed wire have to be done during cable or wire fixing and installation.	2	C	C2	
		○ Explosion hazard	Personnel injury, equipment and material damage	4	C	C4	○ No flammable material such as acetylene and oxygen or paint shall be stored close to the electrical equipment and cable. ○ Smoking shall not be allowed & No smoking sign board has to be provided.	2	C	C2	
		○ Flying sparks and grinding particles	Eye injury	4	D	D4	○ Appropriate fire blanket, Shielding has to be provided. ○ Caution "Beware of Flying sparks or Grinding Particles have to be provided ○ Grinding should be done away from the people. ○ Provide Fire Extinguisher(DCP) ○ Use of proper PPE	2	B	B2	

Safety Hazard Identification, Risk Assessment and Control

Plant:	Section:
Risk Assessor:	Assessment Date:
Specific Job:	

Section 'A': Hazards

Energy Source		
Physical Hazards	Pinch points	
	Moving Objects	
	Moving People	
	Falling Objects	
	Hot/Cold Surfaces	
	Rotating Parts	
	Full body vibration	
	Slip/Trip Hazards	

Energy Source		
Biological Hazards	Animals	
	Toxic Plants	
	Viruses	
	Bacteria	
Psychological Hazards	Fatigue	
	General Health	
	Rushing	
	Mental Loads, Stress	

Electrical Hazards	AC/DC Power	
	Static Electricity	
	Lightning	
Chemical Hazards	Direct contact of persons with live parts	
	Indirect contact of persons with parts which have become live under faulty conditions	
	Approach to live parts under high voltage	
Radiation Hazards	Hazardous Substances	
	Dangerous Goods	
	Poisons	
Ergonomic Hazards	Harmful Gases, Fluids	
	Fibres, Dusts, Fumes, Mists	
	Fire, Explosions	
Mechanical Hazards	Radiant Heat	
	Sun – Ultra Violet Radiation	
	X-Rays	
Environmental Hazards	Lasers	
	Alpha & beta rays, electron beam neutrons	
	Ionising Radiation	
Ergonomic Hazards	Working on Height, Confined Space	
	Noise(loud sound), Bright Light	
	Lifting / Carrying / Bending	
Mechanical Hazard	Pushing / Pulling / Loosening / Tightening	
	Sitting / Standing / Reaching / Stretching	
	Unhealthy Postures, Human Behaviour	
Environmental Hazards	Inadequate Consideration of Human Body	
	Neglected of using PPE	
	Inadequate lighting	
Mechanical Hazard	Inadequate design/location of manual controls & visual display units	
	High Pressure	
	Crushing / Shearing hazard	
Environmental Hazards	Cutting / Severing hazard	
	Entanglement hazard	
	Drawing / Trapping hazard	
Mechanical Hazard	Friction / Abrasion / Punctures	
	Load Falls / collisions / machine tripping	
	Hot / Cold Weather	
Environmental Hazards	Wet / Windy / Dusty / Smoke / Waste	
	Lighting (e.g. dark / sun glare)	
	Currents	
Mechanical Hazard	Storms	
	Earthquake	
	Ventilated Contaminated Air	

Hazard Relating to Travelling Function	Movement when starting engine. Movement without driver. Movement without all parts in safe position. Excessive speed of pedestrian-controlled machinery. Excessive oscillations when moving. Insufficient ability of machinery to be slowed down / stopped / immobilized. From handling machine (lack of stability).	
mechanical Hazard & Hazardous Events	Transmission of power between machine Uncontrolled load / over load / overturning Unexpected / unintended movement of load Projectile / moving object Coupling & Towing	

Section 'B': Risk Assessment

	Hazard Name	Risk Assessment		Ri	Required Controls
		S	L		

1					
2					
3					
4					
5					
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9					
1					

Section 'C': Implementation Option

SI	Control Option	Resources	Responsible Person	Proposed Implementation Date	Due Date
1					

2					
3					
4					
5					
6					
7					
8					
9					
10					

Section 'D': Consultation:

- Has relevant staff been consulted in relation to this Risk Assessment? If yes, indicates who was consulted?

Name	Department	Date	Signature

Section 'F': Comments & Endorsements:

Comments of person carrying out the assessment:

(Signature)

Date:

Name: