Initial Environmental Examination

Document Stage: Final Document
Project Number: 47101
June 2014

India: Assam Power Sector Investment Program – Tranche 1

Prepared by Assam Power Generation Corporation (APGC), Government of Assam.

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ABBREVIATIONS

ADB	–	Asian Development Bank
AEGCL	–	Assam Electricity Grid Corporation
AERC	–	Assam Electricity Regulatory Commission
APGC	–	Assam Power Generation Corporation
APDC	–	Assam Power Distribution Company
APCB	–	Assam Pollution Control Board
ASI	–	Archaeological Survey of India
ASEB	–	Assam State Electricity Board
CEA	–	Central Electricity Authority
CERC	–	Central Electricity Regulatory Commission
CPCB	–	Central Pollution Control Board, Government of India
DC or D/C	–	Double Circuit
DPR	–	Detailed Project Report
EA	–	Executing Agency
EARF	–	Environmental Assessment and Review Framework
EHV	–	Extra High Voltage
EIA	–	Environmental Impact Assessment
EMoP	–	Environmental Monitoring Plan
EMP	–	Environmental Management Plan
ESMU	–	Environment and Social Management Unit
GHG	–	Green House Gas
GOA	–	Government of Assam
GoI	–	Government of India
GSS	–	Grid Sub-station
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
IMD	–	India Metrological Department
LRPP	–	Lakwa Replacement Power Project
LTPS	–	Lakwa Thermal Power Station
MFF	–	Multi-tranche Financing Facility
MOEF	–	Ministry of Environment and Forests, Government of India
MOP	–	Ministry of Power
MSL	–	Mean Sea Level
PCB	–	Poly Chlorinated Biphenyl
PGCIL	–	Power Grid Corporation of India
PLF	–	Plant Load Factor
PTCC	–	Power Telecom Co-ordination Committee
PIU	–	Project Implementing Unit
PMU	–	Project Management Unit
ROW	–	Right of Way
RP	–	Resettlement Plan
SC or S/C	–	Single Circuit
SF_6	–	Sulphur Hexafluoride

WEIGHTS AND MEASURES

Cusec	–	Measure of flow rate (28.317 litres per second)
Ha. (hectare)	–	10,000 sq m = 2.47105 Acre
GW	–	Giga watt
km (kilometer)	–	1,000 meters
kV	–	kilovolt (1,000 volts)
kW	–	kilowatt (1,000 watts)
MW	–	Mega Watt
MMSCMD	–	Metric Million Standard Cubic Metre per Day
Ppm	–	Parts per million

EXECUTIVE SUMMARY

1. ADB is proposing to extend a multi-tranche financing facility to the Government of Assam under Assam Power Sector Investment Program – Tranche 1. Assam State Power Generation Company (APGC) intends to fund the 70 MW Lakwa Replacement Power Project (LRPP) which will replace obsolete 60 MW Gas turbines with 70 MW Gas Engines at the gas based generation Lakwa Thermal Power Station (LTPS).

2. Based on the proposed capacity, proposed replacement project is within the existing LTPS Complex; therefore project is supposed to fall under category B of Project Activity 1(d), Thermal Power Plants <500 MW (coal/ lignite/ naptha & gas based) under the schedule as per Environment Impact Assessment notification issued on 14th September, 2006. However the project attracts general condition of the notification as the Nagaland state boundary is falling within 10 km radius from the project site (4 km in South direction) and hence the project falls under Category A of the Government of India which required an Environmental Clearance from Expert Appraisal Committee, MoEF, GoI.

3. In May 2013, a comprehensive environment assessment for the power project prepared by M/s Ramky Enviro Engineers Ltd., Hyderabad was approved by the Ministry of Environment and Forests (MoEF), Government of India for the 70 MW LRPP. However, to comply with ADB's requirements, the government-approved environment assessment for the 70 MW LRPP was supplemented by an IEE following the outline given in Annex to Appendix 1 of the SPS June 2009. This IEE was based on Appendix 3 of the ADB's 2003 Environmental Assessment Guidelines because all the sub-project components are situated inside the LTPS site and are contiguous.

4. The project activities would support cost-effective development of energy resources through modernisation of obsolete gas plant in Assam. The table below gives the list of Tranche 1 components and summary of environmental issues.

Tranche 1 Components and Summary Environmental Issues

No	Subproject	Environmental Issues
Component I: - APGC Component		
I.	Lakwa Replacement Power Project Replacement of existing 4 x 15 MW (60 MW) Gas Turbine Units with 70 MW capacity of Gas Engines and replacement of existing 3 Gas Compressor Units	• Environment Impact Assessment for the 70 MW replacement project has been prepared by M/s Ramky Enviro Engineers Ltd. which has been approved by the Ministry of Environment and Forests at the 74th Meeting of the reconstituted Expert Appraisal Committee (Thermal) held during May 20-21, 2013. • Land required for the LRPP is about 7 acres which is inside the premises of the LTPS plant. • Water requirement has been assessed as 0.9 m3/hr (21.6 m^3/day) for Gas engine based power plant. This water shall be drawn from the water clarifier inside the plant. • Desang River flows 5.5 km N of the site and Suffry canal flows 0.7 km E. LTPS is located at 110m MSL, whereas Desang River and Suffry Canal are at 99 m MSL and 103m MSL respectively thereby providing the least risk of flooding LTPS. • There is minimal habitation in the SW direction within 1.2 Km. which is most windy as per windrose diagram in environment assessment document. No Wildlife Sanctuaries or National parks exist in 4 km radius of the project site. The Chala Reserve Forest which is about 1.6 km North-west, Abhaypur Reserve Forest which is about 3.6 km south. Sola Reserve Forest is situated 8 km from LTPS in NW. Singphan Wildlife Sanctuary which lies in the state of Nagaland is 4.4 km south of the proposed project site and does not lie to the SW direction. The Panidehing Wildlife Sanctuary in Shivsagar district about 50 km lies to the NE. • Power generated will be evacuated through existing 132 kV feeders as per the scheme of State Transmission Utility (STU) and no additional feeders are envisaged.
Component II. Capacity Development Component		
2.	Capacity Building	No associated social and environment impact.

5. APGC had studied technological and location specific alternatives for replacement of obsolete gas turbines for power generation in Phase I LTPS plant. The existing plant site does not affect any biodiversity rich area, or any forest area and is situated away from any densely populated or agricultural area – with no schools, temples and other places of social and cultural importance coming within the boundary of the plant.

6. Clearances from Assam Forest Department would not be required as none of the project components require construction on any forest land or require cutting of forest trees. No additional land is being acquired for LRPP as the project will utilise the existing 132 kV power evacuation system at LTPS for power evacuation thereby eliminating the need for additional transmission lines. The LRPP Gas Based Generation plant and power evacuation substation extension is proposed to be set up on existing plant premises and therefore acquisition of land will not be required from the surrounding communities. This proposed land area is barren with some scrubs and weed plants, there is no need for removal of trees. The LRPP shall utilise the existing 132 kV LTPS's substation to connect to the Assam Electricity Grid Corporation's (AEGCL's) 132 kV network at Dibrugarh, Nazira, Namrup and Mariana GSS's through transmission lines mostly run through cultivated lands and to a lesser extent runs through human settlements.

7. The proposed project will have a number of positive impacts and negative impacts on the existing environment as follows:

Positive Impacts:

- The proposed project will improve operational efficiency and quality of power, reliability of the system and at the same time will reduce losses due to interconnection with Discom network and hence better voltage profile. Evacuation of power to the local areas will boost overall economic development of the state.
- There no emission control systems installed on the old gas turbines and the hot flue gases are escaping into the atmosphere. With this new gas engine, the system will have monitoring systems for So_x, No_x, O, CO, CO_2 and other. This will help improve the pollution footprint of the gas generation plant.
- With less gas availability, the gas engines would afford optimal generation even with seasonal variations as compared to the old system.
- There will be negligible removal of trees for the replacement power project as it is inside the Lakwa Thermal Power Station. There will be no loss of agricultural productivity due to reduction of land.
- Wastewater generated will not be substantial as it will be evaporate from the closed radiator water cooling system in the gas engines.

Negative Impacts:

- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, and vibration due to construction activities are the short term negative impacts due to proposed project.
- Since the project involves generation of power using natural gas, the emissions from the stack are inevitable. However, with appropriate emission control and monitoring measures, the pollution will be kept to the minimum as per the environment assessment and the environment management plan approved by the Government of India.

8. Project benefits outweigh negative impacts. The long term negative environmental impacts are likely to be associated with operation activities at the Gas based power generation plant – gas engines and compressors. The location impacts will be comparatively low as there will be no disposal of muck/soil outside the LTPS land. These development

activities do not involve any forest area and are situated away from any wildlife habitats. The nearest wildlife sanctuary is Singphan wildlife sanctuary (at least 4.4 km away) and Panidehing Wildlife Sanctuary in Shivsagar district about 50 km. The Kaziranga National Park in Golaghat and Nagaon districts is located at distances of 200 km towards the west direction from the LTPS plant site. No endangered or protected species of flora or fauna are reported at any of the subproject site. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Any impacts created due to the above activity can be mitigated in a cost-effective manner and will not be cumulative. Adverse impacts from air, noise emissions and wastewater, if noticed[1], during implementation and operations will be mitigated using appropriate design and management measures.

9. **Associated Facilities.** There are several power thermal projects that will connect to this power station through the AEGCL's 132 kV system. As per Central Energy Regulatory Commission (CERC) guidelines, it is mandatory for all associated generators to provide information to ensure that their facilities comply with GOI and GoA norms for environmental and social clearances before they connect to the 132 kV network.

10. **Public Consultations**. Public consultations with the project affected communities, and stakeholders focused on existing environmental conditions around the proposed project and the potential impacts that could happen due to project implementation.

11. Since the project does not involve activities that have no significant adverse impact, an IEE has been developed incorporating an environment impact matrix and environmental management plan as per ADB's Safeguard Policy Statement (SPS) 2009. The IEE report conforms to regional and national environmental regulations and is also consistent with ADB Operations Manual F1/BP and F1/OP (2003), Environment Policy, and Environmental Assessment Guidelines (2003)[2]. Accordingly, the environmental classification for the project is "Category B" as per ADB SPS 2009.

[1] APGC will monitor environment parameters according to CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

[2] ADB 2003: *Operations Manual, Environment Policy, Environmental Guidelines for Selected Industrial and Power Projects, and Environmental Assessment Guidelines*, Manila.

1.0 INTRODUCTION

1. The Assam Power Sector Investment Program (the Investment Program) is intended to finance a series of investments in the state of Assam, India including generation capacity enhancement to transmission and distribution infrastructure development. The Investment Program will also finance a number of "softer" activities, including improvements of power utility companies in operational and financial capacity, and training. The funding will be extended via a $300 million Multi-tranche Financing Facility (MFF). The objectives of the investment will be to achieve increased adequacy and efficiency of power system, including renewable energy in Assam. Providing reliable, adequate, and affordable electricity remains a major challenge. This can be achieved only by expanding the state's own generation portfolio, improving the efficiency of existing generation plants, reducing the transmission and distribution losses, and improving the institutional capacities. The government has prepared a transmission and distribution investment plan for the 12th Five Year Plan (FYP) for 2012 – 2017[3]. The Government's power sector roadmap also aims to achieve 100% village electrification by the end of the 12th FYP[4]; and attain 100% system access by 2020.

2. Assam has limited hydro potential within a range of maximum 500 MW. Development opportunities for renewable energy and off grid energy sources are not encouraging. The gas allocations to the state are fixed and no coal linkages are available, and the option of indigenous coalfield development is uncertain due to environmental concerns. Some of the gas plants in operation in the state are highly inefficient and operating beyond their economic life[5]. To meet the state's growing power supply gap at an affordable price, GOA plans to replace the aged and inefficient gas power plants with more efficient ones. It will then add to this a number of investments in clean and renewable energy from the available hydro resources. This work will be done through the state generation utility - Assam Power Generation Corporation (APGC). As per the proposed plan, during the 12th FYP, APGC requires approximately INR 50 billion investments for renovation & modernization of existing plants and new capacity addition. To meet the projected supply deficit of more than 500 MW by 2020, the generation projects totaling 480 MW will be undertaken at state level during this period – that include coal (250 MW), hydro (120 MW), combine cycle gas plant (100 MW) and 10 MW in incremental capacity from gas plant replacement. In addition, several small hydropower projects ranging from 0.1 MW - 20 MW totaling 150 MW will be developed from the private sectors/communities[6].

3. ADB's India Country Partnership Strategy (CPS) for 2009-2012 targets low-carbon investments. ADB's CPS for 2013 - 2017 continues with the same approach. First, by strengthening transmission and distribution networks to reduce technical and commercial losses and improve the financial health of state utilities; and second, by focusing on capacity issues. The new Investment Program is consistent with the government's policies and strategies. It is also consistent with ADB's on-going CPS. Additionally, sustained partnerships between ADB and Assam utilities will help sector reforms to be on track.

1.1 Background

4. Assam Power Generation Corporation Ltd. (APGC) was constituted on 1st April, 2005, after unbundling of Assam state Electricity Board (ASEB) through State Power Sector Reform Programme under the provision of Electricity Act' 2003. The company is mainly responsible for

[3] Government's 12th five year transmission and substation improvement plan includes projects for INR 16,523 million in transmission and INR 7,418 million in distribution improvement. The World Bank fund up to $500 million will be utilized in different stages. In parallel, India Government's Restructured Accelerated Power Development and Reforms Program (R-APDRP) is supporting: (i) capacity development for APDC for information technology and customer service modernization, and (ii) transmission distribution loss reduction activities.

[4] In line with the National Rural Electrification Policy 2004, Rajiv Gandhi Gramin Vidhyutikaran Yojana is being implemented for rural electrification of the state.

[5] Lakwa 4x15 MW gas turbine generators units are aged more than 30 years and their station heat rates are as much as 3,500 kcal/kWh, whereas the recommended heat rate of the gas units is 2,000 kcal/kWh or below.

[6] The total likely capacity addition in the North Eastern Region of India (excluding Sikkim and Assam) during 12th FYP will be 3,636 MW (2,810 MW hydro and 826 MW gas). Assam expects to get approximately 1,000 MW share from these central generating stations.

maximum energy generation to meet up the energy demand in the State. APGC has been incorporated on 23.10.2003 under Companies Act 1956.

5. APGC have following power stations and projects under their jurisdiction-

A. Namrup TPS (Gas based) - 134 MW (119.5 MW derated and 85 MW effective capacity)
B. Chandrapur TPS (Oil based)- 60 MW (under suspended operation) now under revival process
C. Lakwa TPS (Gas based) - 157.2 MW
D. Karbi Langpi Hydro PS - 100 MW
E. Bordikharu Hydro PS - 2 MW (under shutdown)
F. Namrup Replacement PPP- 100 MW (under construction)
G. Lower Kopili HEP - 120 MW (under development)

6. The Tranche 1 investment components include (i) Lakwa Replacement Power Project - Replacement of 60 MW of Open Cycle Gas Turbines plant in Lakwa Thermal Power Station (LTPS) with a heat rate above 3,500 kcal/kwh with a 70 MW (nominal capacity) Gas based Internal Combustion Engine plant with heat rate 1,950 – 2,000 kcal/kWh; and (ii) Capacity development, project preparation and project implementation support.

7. The APSIP Investment Program is supporting APGC under tranche 1 to finance the project to be implemented during 2013 – 2020. The financing plan is given below in **Table 1**.

Table 1: Project-Wise Cost and Financing Plan ($ million)

Item	APGC (Equity)	ADB (Loan)	Total
Lakwa Replacement Power Project	20	45	65
Capacity development, project preparation and project implementation support		5	5
Total	**20**	**50**	**70**

Source: Discussions with APGC in February 2013

8. The four units of 15 MW each at LTPS have been in operation for more than 25 years and thus have out-lived their useful life. These units are being operated in simple cycle mode of operation and the heat rate of these units is much higher in comparison a combined cycle gas based power plants. But gas turbines have poor efficiency in part load condition which is generally encountered by the unit in LTPS due to erratic gas supply pressure. A gas engine does not suffer from poor efficiency in part load condition. Hence APGC proposes to replace these units with 70 MW Gas Engines.

9. Under the 70 MW Lakwa Replacement Power Project, the replacement of open cycle gas turbine power plants with a total capacity of 15x4=60 MW at Lakwa Thermal Power Station of the Assam Power Generation Corporation (APGC) by a more efficient 70 MW Gas engine power plant using natural gas as fuel will be done. The 70 MW gas engine plant will be located within the existing APGC's LTPS. The proposed replacement project is within the existing LTPS Complex; therefore, it is brown field project. Based on the proposed capacity, the project is supposed to fall under category B of Project Activity 1(d), Thermal Power Plants <500 MW (coal/ lignite/ naptha & gas based) under the schedule as per EIA notification issued on 14th September, 2006. However the project attracts general condition of the notification as the Nagaland state boundary is falling within 10 km radius from the project site (4 km in South direction) and hence the project falls under Category A, required Environmental Clearance from Expert Appraisal Committee, MoEF, New Delhi, Govt of India. In May 2013, the EIA for the power project, prepared by Ramky Enviro Engineers Ltd., was approved by the MoEF for 70 MW LRPP.

1.2 Scope of Work and Methodology Adopted

10. The broad scope of the Environmental Assessment study is:

i) To conduct field visits to collect data relevant to the study area and also collect secondary data from the project documents (including the EIA report) so as to establish the baseline

environmental status of the study area;

ii) To assess the impacts on environmental attributes due to the location, design, construction and operation of the proposed project;
iii) To prepare a mitigation plan outlining the measures for protecting the environment including institutional arrangement and environmental monitoring;
iv) To identify critical environmental attributes required to be monitored subsequent to the implementation of the proposed project;
v) To carry out consultation with local people to identify the public perception of the project; and
vi) To establish the Environment Monitoring Plan (EMoP) for the APGC to submit environmental monitoring reports to ADB at regular intervals.

11. The land for the Lakwa Replacement Power Project (LRPP) Gas plant and the expansion of switchyard is situated within the Lakwa Thermal Power Station (LTPS) and therefore their location is fixed. The power evacuation will be undertaken on the existing 132 kV Assam Electricity Grid Corporation (AEGCL) system connecting at Lakwa Thermal Power Station. Lakwa is connected by 132 kV LTPS-Dibrugarh line, 132 kV LTPS – Nazira line, 132 kV LTPS-Namrup line and 132 kV LTPS-Mariani transmission line. Transect walks at the plant and field surveys were undertaken to assess physical and biological environment around the project site.

12. However, to comply with ADB‘s requirements, the government-approved EIA for the 70 MW LRPP was supplemented by an IEE following the outline given in Annex to Appendix 1 of the SPS June 2009. This IEE was based on Appendix 3 of the ADB‘s 2003 Environmental Assessment Guidelines because all the sub-project components is situated inside the LTPS site and are contiguous.

13. Detailed assessment of the baseline environment has been conducted at the site and the data for the IEE document has been taken from the Environment Impact Assessment (EIA) for the 70 MW Lakwa Replacement Power Project prepared by M/s Ramky Enviro Engineers Limited, Hyderabad and other technical information from APGC’s records to support the findings of the field survey. This EIA report consists of details regarding Public hearing organised by MoEF and APCB as per government norms. The 74th meeting of Re-Constituted Expert Appraisal Committee on Environmental Impact Assessment of Thermal Power and Coal Mine Projects was held during May 20-21, 2013. The Expert committee has provided its approval to the EIA with seven action items. Other information includes field survey and public consultation. The field studies were also supported by data collected from secondary sources such as internet, forest atlas, published data from GoI documents, 2001 population census statistics data, as well as documents from APGC, Assam Pollution Control Board (APCB) etc.

14. The IEE report comprises baseline data on existing condition of physical, ecological, economic, and social information, together with the anticipated environmental impacts and proposed mitigation measures as listed in the EIA document. Observations were made through transect walk at the proposed premises for replacement plant between June 2013 to August 30, 2013. Public consultations were held with the project affected communities, stakeholders, and government officers of the project area. **Annexure 4** gives details of places and persons who attended these consultations.

15. Consistent with ADB's Safeguard Policy Statement (SPS 2009), the Environmental Categorization for the ADB funded project on replacement of obsolete gas turbines to gas engines is “B”, and accordingly, the Initial Environmental Examination (IEE) for Tranche 1 has been prepared, which will be approved together with the MFF. The IEE report conforms to regional and national environmental regulations and the ADB Safeguard Policy 2009. This project categorization is based on anticipated environmental impacts.

16. The initial environment examination (IEE) report is prepared to initially assess

potential impacts likely to occur from the project's entire life cycle on the local environment and the adjoining communities. The EIA document and the IEE designate a set of impact mitigation measures as well as monitoring programs for the project to pursue in order to ensure minimized adverse impacts on the environment and communities nearby.

1.3 Applicable Environmental Policies and other Legislations

17. The Ministry of Environment and Forests, Government of India, vide its Notification No. S.O. 1533 dated 14-09-2006, reengineered the EIA process in India and also decentralized some powers and made provision to constitute the State Level Environment Impact Assessment Authority (SEIAA) and the State Level Expert Appraisal Committee (SEAC) for performing functions under the said notification. For the Assam State, the SEIAA and SEAC were constituted in year 2013. In addition, the Assam Pollution Control Board's guidelines for project proponents apply to all state projects.

18. The project will should comply with the requirements of the GoI acts, rules, notifications and standards and policies - National Environmental Policy 2006 of Government of India (GoI) and Safeguard Policy Statement 2009 of ADB and other state level guidelines that apply to project to be funded by ADB are listed in **Annexure 1**.

2.0 DESCRIPTION OF THE PROJECT

2.1 The Project

19. To meet the ever increasing demand of the reliable and sustainable power in Assam State and Northern Region, APGC is proposing the replace its existing 4 x 15 MW (60 MW) Gas Turbine Units with 70 MW capacity of Gas Engines at Phase I plant at the Lakwa Thermal Power Station (LTPS), Mybella Village, Sivasagar district, Assam.

2.2 Category of Project

20. The Tranche 1 project to be funded by ADB and APGC consists of the following components:

Table 2: Details of the proposed project

SNo	Type of the project component	Capacity	Total Power
1	Lakwa Replacement Power Project - Replacement of existing 4 x 15 MW (60 MW) Gas Turbine Units with 70 MW capacity of Gas Engines	70 MW	70 MW
2	Lakwa Replacement Power Project - Replacement of existing 3 Gas Compressor Units	3x50% duty capacity 2 Kg/cm^2 and 7 kg outlet pressure the KW	Rating of each compressor is 240 KW and will handle 0.2 MMSCD of gas

21. **Table 3** shows Tranche 1 sub-projects and their associated environmental issues under APSIP funded by ADB.

Table 3: Tranche 1 Components and Summary Environmental Issues

No	Subproject	Environmental Issues
Component I: - APGC Component		
I.	Lakwa Replacement Power Project Replacement of existing 4 x 15 MW (60 MW) Gas Turbine Units with 70 MW capacity of Gas Engines and replacement of existing 3 Gas Compressor Units	• Environment Impact Assessment for the 70 MW replacement project has been prepared by M/s Ramky Enviro Engineers Ltd. which has been approved by the Ministry of Environment and Forests at the 74th Meeting of the reconstituted Expert Appraisal Committee (Thermal) held during May 20-21, 2013. • Land required for the LRPP is about 7 acres which is inside the premises of the LTPS plant. • Water requirement has been assessed as 0.9 m3/hr (21.6 m^3/day) for Gas engine based power plant. This water shall be drawn from the water clarifier inside the plant. • Desang River flows 5.5 km N of the site and Suffry canal flows 0.7 km E. LTPS is located at 110m MSL, whereas Desang River and Suffry Canal are at 99 m MSL and 103m MSL respectively thereby providing the least risk of flooding LTPS. • There is minimal habitation in the SW direction within 1.2 Km. which is most windy as per windrose diagram in EIA document. No Wildlife Sanctuaries or National parks exist in 4 km radius of the project site. The Chala Reserve Forest which is about 1.6 km North-west, Abhaypur Reserve Forest which is about 3.6 km south. Sola Reserve Forest is situated 8 km from LTPS in NW. Singphan Wildlife Sanctuary which lies in the state of Nagaland is 4.4 km south of the proposed project site and does not lie to the SW direction. The Panidehing Wildlife Sanctuary in Shivsagar district about 50 km lies to the NE. • Power generated will be evacuated through existing 132 kV feeders as per the scheme of State Transmission Utility (STU) and no additional feeders are envisaged.
Component II: Capacity Development Support		
II.	Capacity development, project preparation and project implementation support	No associated social and environment impact.

Source: APGC

22. Adequate land within the LTPS complex is available, and no rehabilitation and resettlement (R&R) issues is involved. The project site does not affect any biodiversity rich area, or any forest area and is situated within the LTPS complex therefore there are no land acquisition and no change of land use involved.

2.3 Need for the Project

23. The present installed capacity in India, as on 31st June, 2012 is about 2,06,456.04

MW, (as per Ministry of Power, Govt. of India) out of which the Captive Generating Capacity connected to the Grid is 19509.50 MW. North-Eastern Region has a total installed capacity of 2329 MW as on 30th September, 2011. The state of Assam being part of the North-Eastern Regional Electricity Grid has the installed generation capacity of 597.2 MW and 1422.7 GWh Energy Generated as per Central Electricity Authority (CEA).

24. Rapid industrialization and increase in commercial and domestic use of electricity are the main reasons for increase in power consumption. In addition, the government policies like rural electrification, electricity to all by 2012, development of irrigation sector, minimum per capita consumption of 1000 units/year, etc. are also contributing in increasing the future power demand. To meet the above requirements, the additions in the power generation capacity would have to match with the future power demands. The 17th Electric power survey report by CEA provides a quantitative forecast of the future demands and planned/ required capacity additions. There was a shortage of power in the country during the first two quarters of 2010-11: the energy deficit is about 11.8% (energy deficit in MU) and peak deficit 13.8% (peak deficit in MW). Installed capacity of Assam system at the end of 10th plan was 1271.2 MW. Likely peak deficit of Assam system by the end of 11th plan has been projected as 301 MW.

25. Large capacity power plants are required for our country to bridge the gap between power supply and demand. To meet the shortfall in power supply as well as to gear-up for the increasing growth, the Government of India is targeting new power capacity addition of about 78,700 MW by the year 2012, to meet its agenda of 'power to all' and sustain GDP growth of over 8%. Further the Goverment of India has also planned for power addition of 82,000 MW during the five year plan ending by the year 2017.

26. The power demand in Assam (peak load) is expected to rise to 1443 MW by year 2011-12. Considering 70% utilization factor of installed capacity, Assam electricity system will need installed generating capacity of 2061 MW by year 2011-12. As per studies of CEA, likely power supply position at the end of XI Plan deficit for Assam system will be 301 MW and for North-Eastern region, the deficit will be 142 MW.

27. Lakwa Thermal Power Station is one of the major power contributors in the North Eastern region of the country. It is situated at Maybella in the district of Sivasagar. After commissioning of the project in the year 1981, the four units of 15 MW each at LTPS have been in operation for more than 25 years and thus have out-lived their useful life. These units are being operated in simple cycle mode of operation and the heat rate of these units is much higher in comparison a combined cycle gas based power plants. But gas turbines have poor efficiency in part load condition which is generally encountered by the unit in LTPS due to erratic gas supply pressure. A gas engine does not suffer from poor efficiency in part load condition. Hence APGC proposes to replace these units with 70 MW Gas Engines.

2.4 Location

28. The Lakwa Replacement power project is proposed to be implemented within the boundary of the LTPS complex situated at Mybella Village, Lakwa Taluk, Sivasagar district, Assam. The Latitude and Longitude of the proposed site lies in between 26°59'09" N and 94°55'52" E. The nearest town to the proposed site is Sonari 12 km NE. The site is located about 12 km from Sonari town the head quarter of Charaideo sub division, and 26 km from National Highway no. 37. The LTPS is approachable by main road to the LRPP site. The nearest railway station Suffry is 5 km from site. Dibrugarh airport is 100 km away from the project site and Jorhat airport is 90 km.

29. The proposed project is setting up of 10x7 MW (70 MW) capacity of Gas Engines and three gas compressors which are envisaged as a replacement of the existing 4x15 MW (60 MW) capacity of Open Cycle Gas Turbine Units. **Table 7** gives the salient features of the proposed project site. **Figure 1** gives the location of the LTPS plant with 10 km radius on

topographical sheet.

Table 7: Salient Features of the Proposed Project Site

SNo	Item	Details
1	Location	Mybella (Village), Lakwa Taluk, Sivasagar (District), Assam
2	Geographical Coordinates	Latitude: 26° 59' 07" N Longitude: 94° 55' 52" E
3	Elevation above MSL	103 - 121 m
4	Topo sheet no's (1:50,000 Scale)	83 I/16, 83 M/4, 83 J13, 83 N/1
5a	Proposed Replacement plant area required	7 acres (28,328 sq.m.)-Gas Engines, Compressors etc.
5b.	Total plant area including replacement area	25.94 acres (105,000 sq.m.)-All phases
5c.	Total LTPS area	211.8 acres (857,150 sq.m.) Total plant area consists of plant area, roads, residential buildings, schools, guest house, vacant area and dug out lakes
6	Water Requirement	21 .6 KLD
7	Project Cost	263.3 crores
8	Nearest Railway Station	Suffry Railway Station ~5 Km, NE
9	Nearest Airport	Rowriah Airport (Jorhat) ~90 Km, SW
10	Nearest National Highway	NH 37 – 26 km (NW)
11	Nearest major town	Sonari – 12 km (NE)
12	Sensitive Areas	Chala Reserve Forest - 1.6 km NW Abhaypur Reserve Forest - 3.6km S A stream is flowing adjacent the boundary of the project site in E.
13	Protected Areas	None in 4 km radius study area
14	No. of household around the plant site	About 500 in an area of 1.5 sq. kilometers.
15.	Procurement of Land Required	No additional land required. However, the original plant land was procured during the years 1976-1977.

Land Area

30. LTPS Plant layout showing the details of location of equipment proposed is shown as **Figure 2.** The GPS (Geographical Position System) readings of plant boundary are given in **Table 8**.

Table 8: GPS Readings of Plant Boundary

S.No	Code	Latitude	Longitude
1.	A	26° 59' 08.93" N	94° 55' 42.82" E
2.	B	26° 59' 09.69" N	94° 55' 44.29" E
3.	C	26° 59' 07.40" N	94° 55' 45.71" E
4.	D	26° 59' 08.44" N	94° 55' 47.75" E
5.	E	26° 59' 03.76" N	94° 55' 51.34" E
6.	F	26° 59' 02.93" N	94° 55' 49.61" E
7.	G	26° 59' 05.16" N	94° 55' 47.70" E
8.	H	26° 59' 04.72" N	94° 55' 46.98" E
9.	I	26° 59' 05.60" N	94° 55' 46.24" E
10.	J	26° 59' 05.02" N	94° 55' 44.70" E

31. The detailed breakup of the land for gas engine based power plant is given as **Table 9.**

Table 9: Land break-up of APGC Complex

Description	Area m^2
Administrative Buildings	6,690
Residential Buildings	508,440
Green Belt	243,516
Parking Area	1,338
School	2,810
Parks	1,472
Guest Houses	5,352
Lakes (Natural)	6,690
Total	776,308

Water Requirement

32. Water requirement has been assessed as 0.9 m^3/hr (21.6 m^3/day) for gas engine based power plant. The available water allocation from Water Resource Department, Govt. of Assam of 300 m^3/hr from Desang River for the Lakwa TPS which is at a distance of 5.5 km from the site. Desang River water is pumped through pipe line to raw water reservoir located within plant boundary to meet the plant water requirement. The detailed breakup of the water required for various activities are given in **Table 10.**

Table 10: Water Requirement m^3/day

S.No	Description	m^3/day
1	Potable water (Domestic)	2.0
2	Service water (Process)	10.4
3	Plant Water System	9.2
	Total	21.6

Fuel Requirement

33. Lakwa Thermal Power Station was commissioned in the year 1981. The main fuel for the project is Natural Gas and had an initial gas commitment of 0.23 Metric Million Standard Cubic Metre per Day (MMSCMD) from Oil & Natural Gas Corporation (ONGC) in the year 1977. Currently, APGC has supply agreement with Oil India Limited (OIL) and Gas Authority of India Limited (GAIL) for the supply of 0.5 and 0.4 MMSCMD of gas respectively. The total gas availability is about 0.9 MMSCMD - of this 0.54 MMSCMD will be used for the existing/ongoing (3x20 MW GT+37MW ST) CCGT and 0.36 MMSCMD for the replacement project. The composition of natural gas is expected to change on commissioning of BCPL gas cracker plant in near future.

Table 11: Details of Gas Supply

1	Plant Type	Gas Engine Power Plant
2	Fuel Type	Natural Gas
3	Quantity	0.36 MMSCMD
4	Source	OIL & GAIL
5	Composition	98.50 mol % of Methane (CH_4) and 1.04 mol % of Nitrogen (N_2) gas
6	**Parameters of Natural Gas**:	
a	Receiving pressure of Gas	5.0 – 7.5 Kg/cm^2
b	Specific Gravity	0.5966
c	Calorific Value	8200-8400 $kcal/m^3$

34. The natural gas required for the LRPP would be received at the plant boundary from the suppliers OIL and GAIL through 12 inch pipeline. The gas supply system would be provided with separate metering arrangement, filtration and moisture separation facilities.

Figure 1: 10 km Radius (from project boundary) Base Map

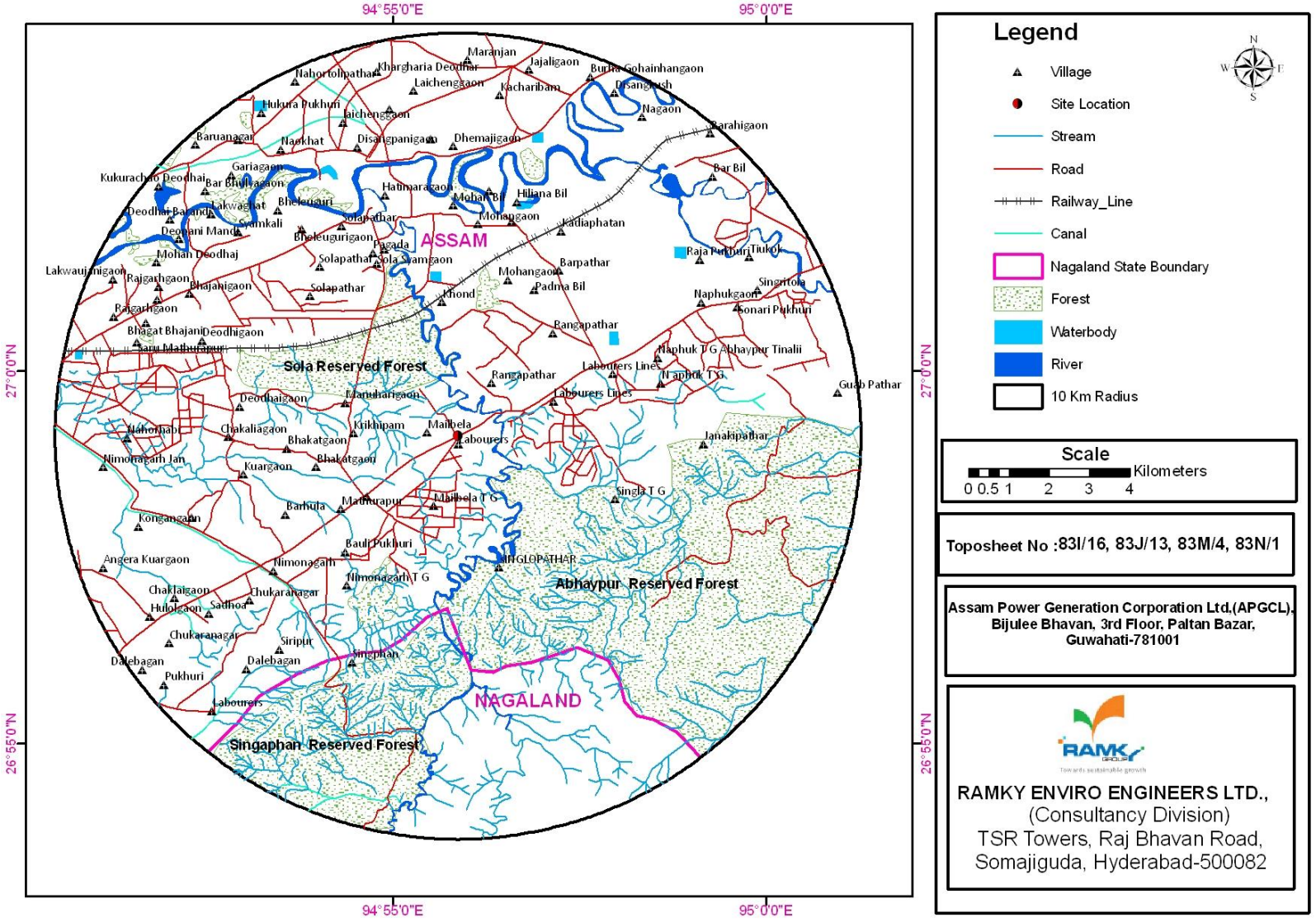
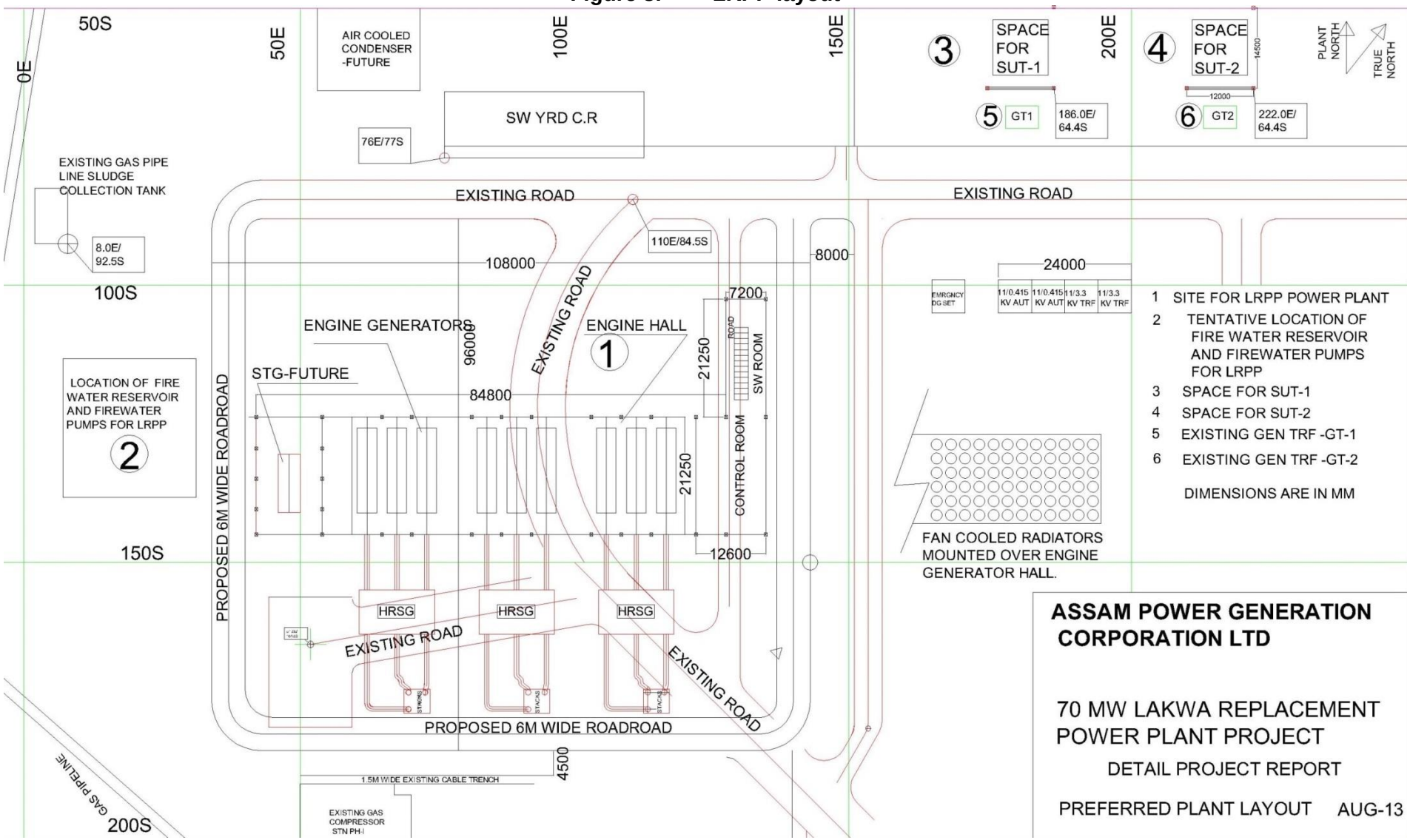


Figure 2: Location of Plant, Waste Disposal site

Figure 3: LRPP layout



2.5 Size and Magnitude of Operation

COMPONENT I: APGC Component: 70 MW Lakwa Replacement Power Project, Shivsagar district, Assam.

Ia. Gas Engine Generator Process

35. A gas engine is an internal combustion engine which runs on a gas fuel, such as coal gas, producer gas biogas, landfill gas or natural gas. Generally the term gas engine refers to a heavy-duty industrial engine capable of running continuously at full load for periods approaching a high fraction of 8,760 hours per year. Unlike a gasoline automobile engine, that has lightweight, high-revving and typically runs for no more than 4,000 hours in its entire life. Typical power ranges from 10 kW (13 hp) to over 10,000 kW. Typical applications are base load or peak -hour generation schemes, including combined heat and power, Gas engines are rarely used for standby applications, which remain largely the province of diesel engines. Gas engines that run on natural gas have typically a mechanical efficiency between 35-45%. The best engines can achieve a mechanical efficiency of slightly more than 48%. These gas engines are usually medium speed engines. Fuel energy arises at the output shaft, the remainder appears as waste heat. Large engines are more efficient than small engines.

36. The gas for the project engines will be supplied with lean natural gas at a pressure of 7 Kg/cm^2 through pipe line of 500 NB. The piped gas suppliers are Oil India Ltd. and Gas Authority India Limited with whom APGC have gas supply agreements. The proposed replacement power project will have the gas allocation of 0.36 MMSCMD meant for the power plant to be replaced. The proposed project will have eight to nine gas engine generators having a minimum capacity of 7 MW each to generate a 70 MW.

37. The gas engine will utilize lean burn technology where the combustion temperature remains at a level to prevent formation of thermic NOx form combustion air. The exhaust gas of each engine will be exhausted through individual steel stacks of 30 meter height. The gas engine will be water cooled with radiators. Having radiators the water requirement is minimum and the same can be catered from the existing clarifloculator of the steam turbine unit. Each of the gas engine will drive an alternator interconnected at 11 kV at continuous base load. The generated voltage will be stepped up 132 kV through step up transformers to be evacuated to the grid.

Gas Engine Plant Layout

38. The plant layout has been developed for natural gas based engines and will be installed inside the main machine hall. The machine hall layout envisaged longitudinal configuration of generating sets. The exhaust stack of the engines will be located on the southern side of the machine hall and the step up transformer on northern side in between 132 kV switchyard and machine hall. The radiators of the engines will be located on the rooftop of machine hall at an elevation of around 9 meters. The electrical switchgear room will be located on eastern side of the machine hall and main control of plant at an elevation of about 5 meter on the top of switchgear room.

39. LRPP Plant layout showing the details of location of equipment proposed is shown in **Figure 3**. The proposed plant will be located in between the area of the existing switchyard control room and the phase-1 gas compressor station. Two units of phase-1 be phase out first and the bays for unit no 1 & 2 generator transformers can be utilized for the Replacement Power Plant. The switchyard will not be extended as not required.

Ib. Gas compressor

40. Three new Gas compressors are required for increasing gas pressure to the level required for the engines (6-7 ata). According to the gas suppliers, the existing pipe line may not be strong enough to handle gas at the required high pressure as well as the gas suppliers will charge additional cost due to the requirement of higher pressure. Hence the additional cost of gas supply will have to be negotiated with gas suppliers. Lastly, the existing compressors are of old vintage and would any way need to be replaced to handle higher pressure supply requirement.

41. Given the above options, it is better that APGC procures gas compressors with corresponding auxiliary power consumption. The gas compressors will be of 3x50% duty capacity i.e. each compressor will handle 0.2 MMSCD of gas. One compressor will be started by the black start generator. Considering the inlet pressure of 2 Kg/cm^2 and 7 kg outlet pressure the KW rating of the compressor is 240 KW. The KW rating of gas compressor would be required for finalizing the rating of the black start generator.

Auxiliary Plant Items

42. The proposed project being a power plant the associated activities proposed are auxiliary plants like Fuel System, Plant Water System, Compressed Air System, Air-conditioning & Ventilation System, Fire Protection System, Engine Cooling system, etc. to support the process operations.

Gas composition:

43. The gas supply system would be provided with separate metering arrangement, filtration and moisture separation facilities. The typical composition/ analysis of the natural gas are given as **Table 11.**

Table 11: Gas Analysis of GAIL & OIL

GAIL Gas		
S.No		**Percentage mol**
1	Methane	87.52
2	Ethane	7.89
3	Propane	1.72
4	Iso-Butane	0.19
5	N-Butane	0.2
6	Iso-Pentane	0.05
7	N-Pentane	0.03
8	Hexane	0
9	Carbon Dioxide	2.22
10	Nitrogen	0.18
11	Sum	100
12	Sp. Gr (real)	0.6396
13	Density (Kg/SCM)	0.7822
14	Mol wt.	16.48
15	NCV (kcal/SCM)	8728.178
16	GCV (kcal/SCM)	9662

OIL Gas		
S.No		**Composition V/V %**
1	Methane	93.31
2	Ethane	4.31
3	Propane	0.66
4	Iso-Butane	0.04
5	N-Butane	0.05
6	Iso-Pentane	0.02
7	N-Pentane	0.02
8	Hexane	0.11
9	Nitrogen	0.84
10	Carbon Dioxide	0.64
11	Gas Gravity	0.5365
12	Gross Calorific Value	9140.8
13	Net Calorific Value	8244.8

44. The composition of natural gas is expected to change on commissioning of Brahmaputra Cracker and Polymer Ltd (BCPL)[7] gas cracker plant in near future. The present gas supplied by OIL is suitable for gas engine due to its acceptable methane number. The composition of the gas to be available after gas cracker plant is also suitable for gas engine. In

[7] BCPL is set to implement the gas cracker project at Lepetkata in Assam's Dibrugarh district

the event that gas cracker is not commissioned before commissioning of LRPP, then OIL gas will have to be used for the gas engines. GAIL gas can be used for the phase-2 gas turbines as gas turbines are insensitive to methane number.

Fuel Supply System

45. The transported Natural Gas to the Plant is of desired thermodynamic property (pressure). The gas supplied by GAIL and OIL contain various undesirable contaminants both liquid and solid particles delivered at a pressure of 5-7.5 Kg/cm^2. The gas piping components associated in this process are described as follows:

- *Separator (Cyclone Type-S):* The principle of the separator is to separate the heavy contaminants due to cyclonic effect created inside the separator vessel. The gas enters through the middle portion and leaves through the top. Heavier particles are collected in the bottom is taken out by the drain pipe.
- *Filters-F:* The gas from the separators is moved into the three cylinders as shown in figure. The gas after the cyclone separator is allowed to pass through ceramic or porcelain filter element placed vertically inside the filter vessel. Contaminants of size 10 micron and above are separated by these filter elements. Contaminants collected at the bottom are taken out time to time.
- *Pressure Control Valve (PCV):* The gas compressor suction pressure is designed for 1 Kg/cm^2 but the gas is received at 5-7.5 Kg/cm^2. Hence it is required to drop to the design suction pressure of the gas compressor. The pressure control valve functions to control the downstream pressure to the desired pressure of 1 Kg/cm^2. Air is normally used as the actuating media for the pressure control valve, but in some cases the natural gas itself is also used as the actuating media.

Power Evacuation

46. Single line diagram (SLD) of the electrical system has been prepared with the augmentation that all MV and LV panels have n+ 1 spare switchgear system where n denotes the number of incoming feeders or outgoing feeders is the number of equipment.

47. The generation voltage will be 11 kV or as per manufacturer's standard. The generators will be divided into two groups and paralleled at 11 kV. The total power of each group consisting of Gas Engine Generators will be stepped upto 132 kV through two step-up transformers. The step up transformers shall be accommodated in place of two generator transformers of unit 1&2. The power generated will be evacuated through existing 132 kV feeders as per the scheme of State Transmission Utility (STU) and no additional feeders are envisaged. The existing 132kv system is capable of absorbing additional 100MW power. The highest system voltage: 145kv; Basic Insulation Level: 650KVp.

48. Following minimum clearance will be maintained for 132 kV Switchyard as per CBIP (Central Board for Irrigation and Power): Phase to Phase: 1600 mm; Phase to Earth: 1380 mm; Sectional Clearance: 4000 mm. The different feeders used by entire LTPS to evacuate its power to the grid are as follows:

- 132 kV Mariani feeder,
- 132 kV Namrup feeder-I,
- 132 kV Namrup feeder-II,
- 132 kV Dibrugarh feeder,
- 132 kV Nazira feeder-I,
- 132 kV Nazira feeder-II,
- 33 kV ONGC feeder,
- 33 kV Sonari feeder,
- 33 kV Colony feeder.

Man power

49. The man power required for the project will be sourced from nearby areas to the maximum extent. The details of the man power required during construction and operation periods are given in **Table 12**

Table 12: Manpower Details

SNo	Employee Type	No. of Persons
1	Technical & Non-Technical employees (Permanent)	338
2	Security personals (Permanent)	41
3	Part time employees	10
TOTAL		**389**

Emission

50. The gas engine will emit negligible SOx as the sulphur content in the natural gas is less than traceable quantity. NOx emission will be controlled by utilizing lean burn technology where NOx will be limited in the permissible limits.

51. The engines will be house in an acoustical housing so that noise level out outside the house is within statutory limits. Earmuffs shall be used when in the vicinity of the engines. Normally attendance in the vicinity of the engines is not required.

Charge Air and Exhaust Gas Systems

52. The charge air system will be designed to take air from outside engine cell. Air will be drawn through air filters with replaceable elements. Exhaust gas driven turbocharger will be provided to compress the combustion air to required pressure before entering into cylinder. Intercoolers will be provided to cool the charge air. Exhaust gas system will be provided to conduct the fumes away from the engine to the atmosphere. Each engine will have its own separate exhaust duct ventilator system etc. Silencers and flexible compensator will be provided for both intake and exhaust systems.

Engine Cooling System

53. The gas engine will be cooled by two separate water circuits. The high temperature circuit (HT) will cool cylinder heads, cylinder liners and the turbo charger. The low temperature circuit (LT) will cool charge air and lubricating oil. Both circuits will be cooled by secondary air cooling system through radiators. The HT water cooling system will include engine driven pump, jacket cooling water preheating unit after cooling pump etc. Electrically driven circulating pump which will be of auto start of engine for circulating the hot water jacket for 15min in order to prevent boiling. The system will be complete with thermostatic valves, expansion tanks. Low temperature (LT) cooling system cover charge air coolers and lube oil cooler. The system will have expansion tanks, LT water motor driven circulating pump and thermostatic valve etc. For secondary air cooling, suitable capacity of radiators for HT & LT system will be provided.

Compressed Air System

54. The compressed air requirement both for instruments & service air is proposed to be met by compressed air system comprising adequate capacity air compressors complete with air receivers, air drying unit, associated piping and instrumentation.

Air-conditioning & Ventilation System

55. The following areas will be air-conditioned by chilling/ DX-type air-conditioning plant, packaged window/ split air conditioning (AC) as per requirement - Central control room, control equipment, relays room, computers room, uninterrupted power supply (UPS) room, battery-

charger room, shift in charge room, Engine Electrical room and other areas which contain programmed logic control (PLC) based control equipment and local control panels or C&I requiring air-conditioning, Electronic component storage area etc. The other following area will be provided with ventilation system - engine generator hall, switchgear room, cable gallery area, all pump houses, air compressor house, battery room, all toilets and any other areas where equipment heat load is high and require ventilation.

Plant Water System

56. In general, engine cooling with cooling tower is more efficient. The cost of a radiator is high, however the cooling tower cost factor increases with increasing wet bulb temperature with increased requirement of space. The water requirement of a cooling tower is high on account of evaporation loss, drift loss and blow down loss compared to that of a radiator cooling which is minimum. Table 13 depicts the barriers for both the cooling tower and radiator cooling options Lakwa Replacement project.

Table 13: Difference between the Cooling Options

S.No	Parameters	Radiator	Cooling Tower
1	Water Requirement	Minimum	Very High
2	Cost	High	Generally lower but increases with increase in wet bulb temperature
3	Space Requirement	Less	High
4	New Raw Water Intake System from the nearest river	Not required	Required
5	Cost of new raw water intake system	Not required	Required
6	Additional water drawl permission	Not required	Required
7	Effect on plant heat rate	Plant heat rate higher	Plant heat rate lower
8	Maintenance	Minimal	High
9	Clarified water reservoir size	Small	Large
10	Water treatment plant size	Small	Large

57. From above it appears that a radiator type cooling system is advantageous than cooling tower type cooling system. Therefore a radiator type cooling system is proposed for LRPP.

Fire Protection System

58. The complete fire protection and detection system will be provided as per the guidelines/ codes/ standards. The system will mainly consist of Fire water protection system with hydrants covering whole plant area, HVW spray system for the transformers, lube oil tanks & facilities, MVW spray system for cable galleries, cable vaults, cable spreaders & shafts. Fire water will be drawn from the dedicated storage of clarified water reservoir. The fire protection system will be complete with pipe works, valves, specialties such as hydrants, spray nozzles, detectors, cabling etc.

59. Selected areas will be covered under carbon dioxide gas extinguishing system:

- The CO_2 supply system will comprise of high pressure cylinder bank mounted on base of each GT with a manifold and release mechanism.
- Inert gas protection system will be provided for control room & switchyard control room. Portable Fire Extinguishers will be installed in strategic locations as per TAC requirement.
- Unmanned locations prone to fire hazard will have automatic fire sensing elements. Manual call points will also be provided wherever required. Gas/ vapour detection system will be provided in the Gas Engine area.

In-house Maintenance:

60. LTPS has a core maintenance group having expertise in carrying out all the

preventive, predictive and corrective maintenance of the gas turbine, gas compressors, various auxiliaries and their control system. It has a laboratory for the testing and repairs of Electrical & instrumentation equipment and facilities will be provided for the maintenance of sophisticated equipment of the power plant. The group will avoid breakdown maintenance and keep the machine availability factor, reliability factor at optimum level. With years of experience since 1983, the community has developed all skills for solutions to the technical issues related to power generation and its evacuation. The principle of LTPS is to avoid breakdown maintenance and keep the machine availability factor, reliability factor at optimum level.

Waste Water

61. Effluent Treatment System will be provided to collect waste water from all the sources of plant area and treated to re-use as far as possible.

Component II: Capacity Development.

62. This subproject will also fund capacity development, project preparation and project implementation support.

2.6 Implementation Plan

63. Technical data and characteristics of the project is summarized in the detailed project report (DPR) prepared by APGC. After comparing pros and cons of different gas power generation technologies, APGC has decided to employ gas engine technology for the power plants as using only the engines is advantageous to APGC in terms of both technical and economic aspects. Due to this feature, the engines will be able to started or shut-down almost instantly in case of incoherent or less gas supply.

64. The project construction works are expected to take about 18 months. The project will involve survey work, land clearance, design and engineering of plant equipment, floating tenders for procurement, civil work and system testing and commissioning of the gas engines, compressors and auxiliary parts including acoustic enclosures as well associated power evacuation upgradation and extension for connectivity to existing 132 kV network. Major civil works include land clearance and levelling, construction of buildings, foundations, internal infrastructure including drainages, disposal sites. Installation of stacks, gas engines, cooling water plant, oil circulation plant, auxiliary plant infrastructure, and switchyard extension. Besides, all electrical works are also to be finished within the construction period. The overall project implementation schedule for the project is attached as **Table 14**.

Table 14: Overall Project Implementation Schedule

Activities/Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Submission of tender																														
Evaluate tender																														
Financial closure																														
Order																														
Soil investigation and site survey																														
Piling machinery placement at site																														
Foundation works																														
Manufacture of plants and equipment																														
Dispatch of plant and equipment																														
Construction and installation																														
Commissioning and PG test																														
Take over																														

NOTE - This schedule is tentative and will be finalised based on site as well as estimated schedule indicated by bidders for each sub-project.

3.0 DESCRIPTION OF ENVIRONMENT

65. This chapter focuses on the present environmental conditions of the project area situated in the Shivsagar district of Assam. At LTPS complex, the LRPP needs 7 acres for installation of gas engines and compressors within the complex's boundary. Surrounding villages of LTPS are shown in **Table 15** below:

Table 15: Surrounding villages and their distance from LTPS

S.No.	Village	Approx. Distance (km)	Direction
1.	Madhurapur	2.8	SW
2.	Suffyq	2.5	NE
3.	Mohangaon	5.5	N
4.	Solapathar	5	NW
5.	Singloo	4.5	SE
6.	Naharhobi	8	W

Source: EIA prepared by M/s Ramky Enviro Engineers Limited

3.1 Physical Resources

3.1.1 Topography

Shivsagar district

66. Shivsagar, 55 kms away from Jorhat is an important city from the historical viewpoint. Shivsagar means the ocean of Lord Shiva. Shivsagar is a town in the Shivsagar district and it is situated at a distance of 360 kms from the capital city Guwahati of Assam. Shivsagar is well connected with Jorhat, Guwahati, Tezpur by bus service. Simaluguri at a distance of 16 kms from Shivsagar is the nearest rail-head. Buses ply regularly on Simaluguri Shibsagar route. Nearest airport is in Jorhat, which is 90 kms away. Jorhat is well connected with rest of the country with regular flight services.

67. The district is located on between 94.25 and 95.25 Longitude East and 21.45 and 27.15 Latitude North. It has elevation of 86.6 m above the main sea level (MSL). The district shares common boundaries with Dibrugarh district on the east, Jorhat district on the west, river Brahmaputra on the North and Nagaland and Arunachal Pradesh on the south. The area of district is 162,921 sq km.

3.1.2 Geology Rock and Soil

68. The soils are mostly alluvial. The northern areas, which are nearer to the river Brahmaputra have new alluvium, while the southern areas or areas near the foothills have old alluvium. The areas with older alluvium are the best sites for the cultivation of tea. Accordingly, the areas with older alluvium are dotted with a large number of tea gardens. The entire area is under humid sub-tropical climate and it receives well distributed rainfall from May to October. The process of leaching of soils in the undulating piedmont and hilly areas and stagnation and flooding in the areas with gentle slope are very prominent. As per taxonomical classification considering the aspects like soil depth, soil drainage, soil texture, areas of occurrence, slope condition, nature of the exposed surface, vulnerability to erosion and flooding - a taxonomical classification of the soils of Assam has been suggested by the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP). As per this classification, the soils of Assam belong to 4 orders, 9 sub-orders, 15 great groups, 26 sub-groups and 83 family associations. In the context of Assam it is observed that the Inceptisols are the dominant soils followed by Entisols, Aflisols and Utisols and these occupy respectively 41.4 %, 33.6 %, 11.3 % and 5.6 % of the total geographical area of the state (NBSS&LUP, 1993).

69. Coal deposits in District Shivsagar, Assam is given in **Table 16** below. **Figure 4** gives the mineralogical map of the study area. **Table 17** and **Figure 5** below give the types of soil in Shivsagar district.

Figure 4: Mineralogical Map of the Study Area

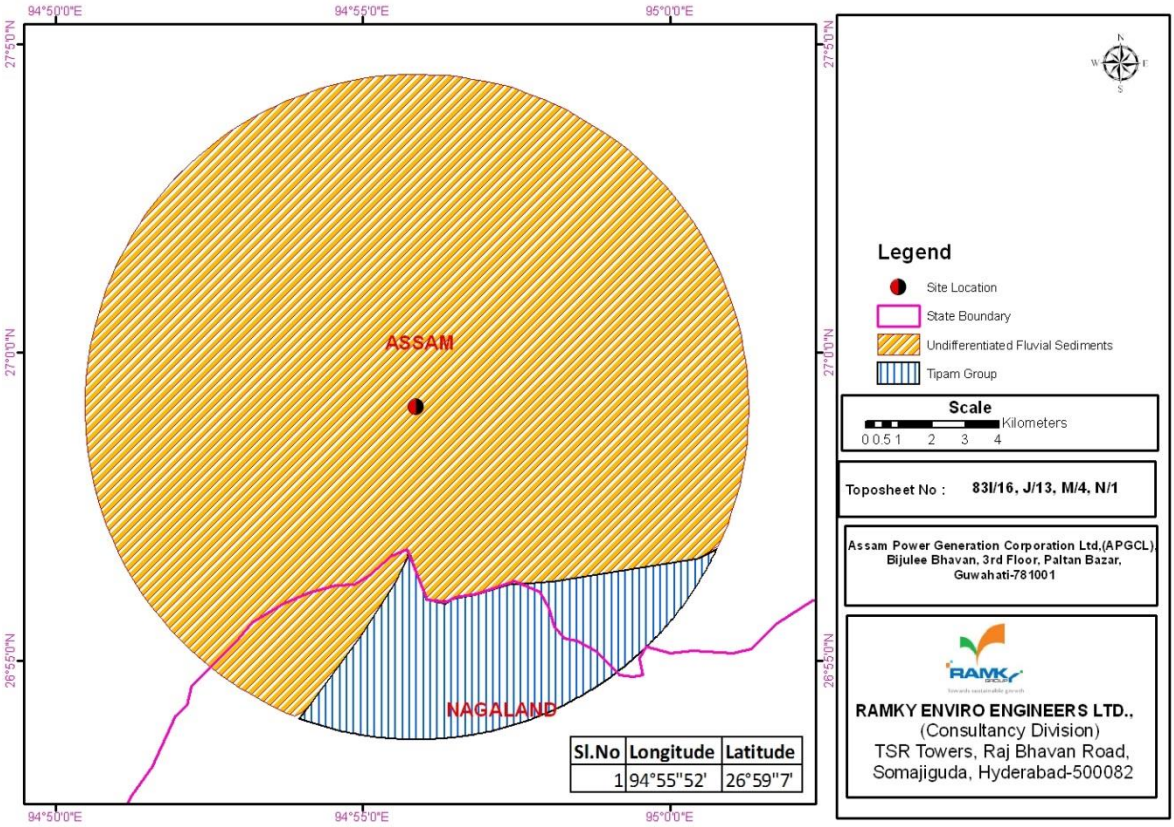


Table 16: Coal Deposits

District	Name of the place & location	Area covered	Reserve available	Name of the chemical compound & % content
Dibrugarh & Shivsagar	Dilli-Joypur, extending over to Dibrugarh and Shivsagar district. The area under exploration is bounded by the latitude 27º 5' 0"N to 27º 8' 30" N and longitude 95º 15' 0" to 95º 22' 0"	Covering an area of 40 km. long and 0.50 km wide.	The proven coal reserve in Dilli coalfield is about 24.4 million ton, while another 71 million ton of coal is expected within leasehold area of Joypur Colliery.	Moisture 3.9 to 5.2 Ash 6 to 22 Volatile matter 34 to 41 Fixed carbon 39.8 to 47.5 Sulphur

Basic statistical of NER, 1995, 2000, 02 & 03 (2). Economic Survey of Assam, 2005

Table 17: Major Soil Types in Project Area

	Major Soils types Area	('000 ha)	Percent (%) of total
1.	Inseptisol (Old Alluvial Soil)		
	Fine soils	6.932	3
	Fine Loamy	129.931	58
2	Entisol (Recent Alluvial Soil)		
	Coarse Loamy	20.63	9
	Fine Loamy	29.609	13
	Course Silty	5.647	2
	Fine Soil	32.666	15

Source: SREP, Shivsagar district, NIC

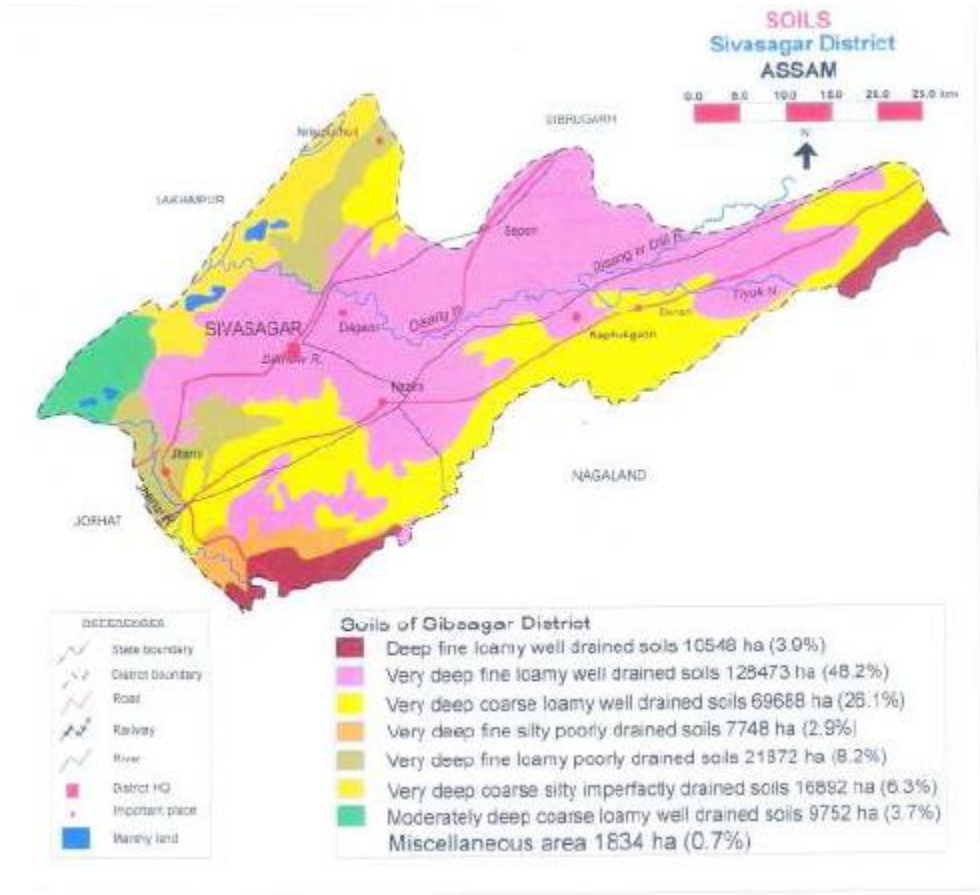


Figure 5: Soil Map

3.1.2 Siesomology

70. The great Assam earthquake of 1897 (8<M<8.1) is the largest known Indian intraplate earthquake. It raised the northern edge of the Shillong Plateau by more than 10 m, resulting in the destruction of structures over much of the Plateau and surrounding areas, and causing widespread liquefaction and flooding in the Brahmaputra and Sylhet floodplains. Shaking intensity data for the earthquake are crucial for estimating future earthquake hazards in NE India and Bangladesh since similar earthquakes will no-doubt recur.

71. The site comes under seismic zone–V, Covers the areas liable to seismic intensity MM-IX[8] and above on. This is the most severe seismic zone and is referred here as Very High Damage Risk Zone. This zone is referred as high damage risk zone. The district of Shivsagar lie in Zone V, where the maximum intensity could reach IX (MSK)[9] , including Guwahati, lie in Zone V, where the maximum intensity expected would be around MSK IX. It must be noted that Bureau of Indian Standards (BIS) estimates the hazard on previously known earthquakes. Since the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), these zones offer a rough guide of the earthquake hazard in any particular region and need to be regularly updated,

3.1.3 Climate

Meteorological Scenario of the Study Area[10]

72. The district carries a pleasant weather throughout the year. The temperature ranges

8 Modified Mercalli Intensity Scale
9 Medvedev-Sponheuer-Karnik scale
10 Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

from 8° in winter to 35° during summer. The district is characterized by highly humid atmosphere and abounded rains .The regular rains of the summer generally prevent the prevalence of the hot weather. After the rainy season the cooler autumn start from October and real cold weather prevails from the end of November and continues till the middle of February. The temperature begins to rise from the beginning of March and in July and August it reaches the maximum.

73. The details of the temperature, relative humidity and rainfall observed during study period are given in **Table 18**.

Table 18: Observed Meteorological Data

Period	Temperature (°C)		R. Humidity (%)		Rain fall	Predominant wind direction Blowing from
	Min	Max	Min	Max	(mm)	
Apr 2012	18.6	27.3	26	94	145	
May 2012	21.7	29.8	36	94	126	NE followed by NNE
June 2012	24.2	31.3	36	94	297	

Wind Speed & Direction [11]

74. Wind speed and direction data recorded during the study period is useful in identifying the influence of meteorology on the air quality of the area. Wind directions and wind speed frequency observed during study period month wise and for full season are given in **Table 19** for April 2012.

75. The winds were predominantly recorded from NE closely followed by NNE during April 2012. Calm conditions prevailed for 16.6% of the total time. Average wind speed for the month of April is 2.31 m/sec. During May 2012 winds were predominantly recorded from NE closely followed by NNE. Calm conditions prevailed for 12.6% of the total time. Average wind speed for the month of May is 2.29 m/sec. During June 2012 winds were predominantly recorded from NE closely followed by NNE. Calm conditions prevailed for 11.2% of the total time. Average wind speed for the month of June is 2.21 m/sec. For entire summer season the winds were predominantly recorded from NE closely followed by NNE. Calm conditions prevailed for 13.5% of the total time. Average wind speed for the season that is April - June 2012 is 2.29 m/sec.

Table 19: Frequency Distribution Table for April 2012

Direction	0.5-2.1 (m/s)	2.1-3.6 (m/s)	3.6-5.7(m/s)	>= 5.7(m/s)	Total
N	2.64	2.08	0.14	0.00	4.86
NNE	7.08	7.64	1.39	0.00	16.11
NE	8.06	10.42	5.42	0.42	24.31
ENE	0.42	0.42	1.25	0.42	2.50
E	2.36	5.00	1.94	0.42	9.72
ESE	1.11	1.11	0.14	0.00	2.36
SE	0.42	1.25	0.00	0.00	1.67
SSE	0.00	0.00	0.00	0.00	0.00
S	1.25	0.56	0.28	0.00	2.08
SSW	2.64	0.28	0.97	0.00	3.89
SW	0.83	0.83	1.11	0.00	2.78
WSW	1.11	0.69	0.42	0.00	2.22
W	0.69	2.92	0.97	0.00	4.58
WNW	0.00	0.00	0.00	0.00	0.00
NW	3.33	1.25	0.00	0.00	4.58
NNW	1.25	0.42	0.00	0.00	1.67
Sub total	33.19	34.86	14.03	1.25	83.33
Frequency of Calm Winds:					16.67
Average Wind Speed: 2.31 m/s				Total	100

Water Supply

Surface Water

76. Desang River with its source in the hills of Arunachal Pradesh is a major tributary of

[11] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

Brahmaputra. A part of its upper course acts as the inter district boundary between Shivsagar and Dibrugarh districts. Again, one of the tributaries of Desang called the Loka-jan forms the inter-state boundary between Assam and Arunachal Pradesh. Desang enters into the plains of Assam at Dillighat. From this point the river is known as Desang. Small rivers like Taokak, Safrai, Timon and few others which roll down from the foothills meet river Desang in the plains of Assam. Two other rivers Diroi and Dimow also meet Desang in its downstream reach. All these tributaries of Desang and their sub-tributaries together form a very complex drainage network covering an area of 3,950 sq. km. Desang flows a distance of 230 km from the source to its mouth at the Brahmaputra near Disangmukh. **Table 20** below gives the HFL for the Desang River. **Figure 6** gives the location of the river with respect to the LTPS and the reserve forests.

Table 20: Desang H.F.L. at gauge site at Nangalamora

Year	Date	H.F.L. in M observed at		Remarks
		Nangalamora	Challapathar (Lakwa)	
1	2	3	4	5
2000	19/9/2000	95.85	93.61	
2001	2/7/2001	95.18	92.93	Danger Level at Nangalamora = 94.46 m
2002	26/7/2002	95.25	93.00	
2003	7/7/2003	96.30	94.05	
2004	10/10/2004	94.95	92.70	
2005	27/08/2005	95.81	93.56	
2006	20/07/2006	94.94	92.69	
2007	7/9/2007	96.27	94.02	H.F.L. = 96.49 m on 06/09/1998 at Nangalamora MSL at LRPP site is 101.5 M
2008	17/7/2008	95.44	93.19	
2009	12/7/2009	96.04	93.79	
2010	22/7/2010	95.88	93.63	
2011	31/07/2011	94.88	92.63	
2012	4/8/2012	95.73	93.48	
2013	10/7/2013	95.03	92.78	

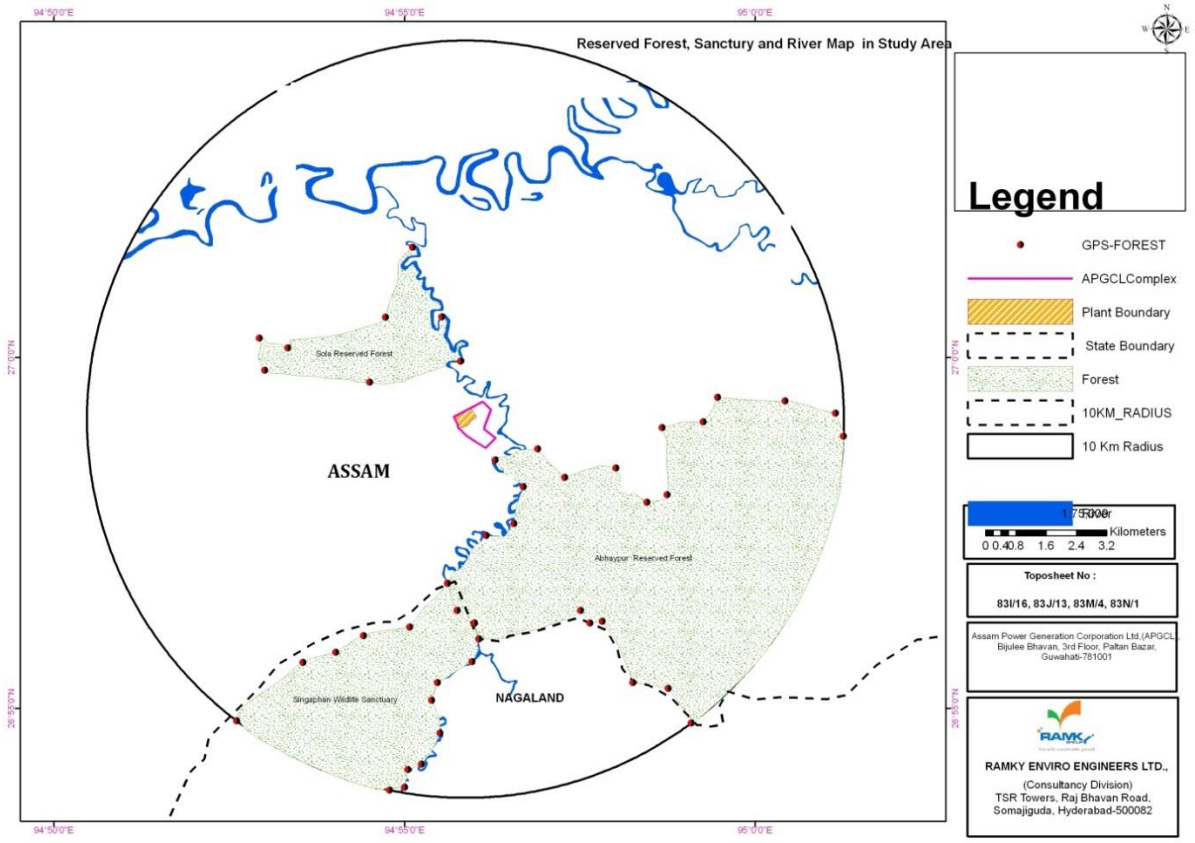


Figure 6: Reserve Forest and River Map

Ground Water

77. Ground water resource data in the proposed are is given in **Table 21**.

Table 21: Ground Water Resource and Utilisable Potential

District	Ground water resource (MCM) Dynamic	Utilisable Ground Water Resource for Irrigation (MCM)	Utilisable Ground Water Resource for drinking allied (MCM)	Gross Draft (MCM)	Balance Available (MCM)	State of Ground Water Dev.(%)
1	2	3	4	5	(3-5)=6	7=[(5/3) x 100]
Barpeta	1161	987	174	56	931	5.68
Bongaigaon	591	502	89	25	477	4.98
Cachar	817	694	123	1	693	0.15
Darrang	1407	1196	211	73	1123	6.10
Dhemaji	1660	1411	249	44	1367	3.11
Dhubri	1300	1105	195	64	1041	5.79
Dibrugarh	1635	1390	245	41	1349	2.94
Goalpara	495	421	74	20	401	4.75
Golaghat	1794	1525	269	42	1483	2.75
Hailakandi	98	83	15	3	80	3.61
Jorhat	1461	1242	219	35	1207	2.81
Karbi Anglong	584	49	88	1	495	0.20
Kamrup	1229	1045	184	71	974	6.80
Karimganj	133	113	20	4	109	3.54
Kokrajhar	1580	1343	237	35	1308	2.60
Morigaon	321	273	48	43	230	15.75
Nagaon	935	795	140	126	669	15.84
Nalbari	639	543	96	37	506	6.81
N.C.Hills	607	516	91	1	515	0.19
North Lakhimpur	1167	992	175	31	961	3.12
Sonitpur	1615	1373	242	110	1263	8.01
Shivsagar	**1658**	**1409**	**249**	**35**	**1374**	**2.48**
Tinsukia	1832	1557	275	46	1511	2.95

MCM: Million cubic metre

Data Source: Central Ground Water Board, Report-1981

3.1.5 Air/Noise Quality[12]

3.1 Ambient air Quality

78. The ambient air quality was monitored in the impact area as per Central Pollution Control Board (CPCB), MoEF guidelines. Ambient Air Quality Monitoring (AAQM) stations were set up at 10 locations with due consideration to the above mentioned points. AAQ locations were selected in downwind, cross wind and upwind direction of the proposed project location.

79. At each sampling station, monitoring was carried for a frequency of 2 days per week for 4 weeks in a month during the study period. The Common air pollutants namely Suspended Particulate Matter (SPM), Respirable Particulate Matter (PM<2.5µm, PM<10µm), sulphur dioxide (SO_2), oxides of nitrogen (NOx), Mercury (Hg), Carbon Monoxide (CO), Ozone (O_3) were sampled on 24 hourly and the results were averaged to were sampled on 24 hourly as per MoEF guidelines and results are compared with the standards stipulated by CPCB. These are shown in **Tables 22-25**[13].

Table 22: SPM Levels in the Study Area (µg/m^3) - SPM

Code	Location	Suspended Particulate Matter (SPM)			
		Min	Average	98th Percentile	Max
A1	Project Site	92.8	115.4	135.1	135.3
A2	Bhahatagoon	98.4	121.7	141.1	142.2
A3	Suffry	96.1	119.6	139.1	140.2
A4	Rangapathar	93.5	112.2	127.7	128.6
A5	Mohangaon	92.2	110.9	126.4	127.3
A6	Solapathar	81.1	101.2	117.9	118.9
A7	Madhurapur	94.2	110.7	124.5	125.3

[12] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

[13] Sampling locations are taken as per the EIA document

Code	Location	Suspended Particulate Matter (SPM)			
		Min	Average	98th Percentile	Max
A8	Singloo	93.3	109.8	123.6	124.4
A9	Naharhobi	92.7	109.2	123.0	123.8
A10	Chasmutiya	91.6	108.1	121.9	122.7

Table 23: Ambient Air Quality Levels in the Study Area (µg/m^3)

Code	Location	Particulate Matter <2.5µ				Particulate Matter <10µ			
		Min	Avg.	98th Per	Max	Min	Avg.	98th Per	Max
A1	Project Site	20	24	26	26	44	49	53	54
A2	Bhahatagoon	20	23	27	29	33	38	46	54
A3	Suffry	20	23	27	28	30	38	47	51
A4	Rangapathar	15	18	21	23	28	32	36	36
A5	Mohangaon	19	25	32	33	35	43	52	54
A6	Solapathar	16	21	25	26	30	37	42	43
A7	Madhurapur	17	22	27	29	31	39	44	45
A8	Singloo	20	24	28	29	36	41	46	48
A9	Naharhobi	18	24	29	29	35	43	54	54
A10	Chasmutiya	21	24	27	29	38	42	46	48

Table 24: Ambient Air Quality Levels in the Study Area (µg/m^3)

Code	Location	Sulphur dioxide (SO_2)				Nitrogen dioxide (NO_x)			
		Min	Avg.	98th Per	Max	Min	Avg.	98th Per	Max
A1	Project Site	6.9	9.6	12.8	13.1	9.7	14.3	18.4	20.1
A2	Bhahatagoon	7.2	8.7	11.4	12.3	9.2	11.5	13.5	18.2
A3	Suffry	6.1	7.7	9.4	10.3	10.7	16.5	23.6	25.7
A4	Rangapathar	6.1	8.2	10.1	10.6	8.9	11.9	16.2	17
A5	Mohangaon	5.5	7.2	9.3	9.6	7.1	10.6	14	16.1
A6	Solapathar	7.2	8.2	9	10.4	10.4	12.2	14.1	15.8
A7	Madhurapur	7	8.6	11.2	12.4	9	14.6	26.4	28.8
A8	Singloo	7.7	9.2	10.5	11	10.4	15.7	24.1	24.9
A9	Naharhobi	7.3	10.1	13.2	17.6	10	15	20	26.5
A10	Chasmutiya	6.3	10.4	12.2	13	9.4	15.2	18.1	19.2

Table 25: Ambient Air Quality Levels in the Study Area (µg/m^3)

Code	Location	Carbon Monoxide (CO)		Ozone (O_3)	
		Min	Max	Min	Max
A1	Project Site	1120	1210	7.5	9.5
A2	Bhahatagoon	950	1015	6.8	9.3
A3	Suffry	890	930	7.1	8.6
A4	Rangapathar	1030	1065	6.6	8.7
A5	Mohangaon	920	990	7.3	8.3
A6	Solapathar	980	1035	7.0	8.1
A7	Madhurapur	900	970	7.2	8.5
A8	Singloo	915	955	7.7	9.5
A9	Naharhobi	960	1025	6.5	7.9
A10	Chasmutiya	910	960	6.9	8.5

Note: Below Detectable Limit of O_3 = 6µg/m^3

Suspended Particulate Matter (SPM)

80. The minimum and maximum level of SPM recorded within the study area was in the range of 81.1 µg/m^3 to 142.2 µg/m^3.

Particulate Matter <2.5µ & <10µ

81. The minimum and maximum level of Particulate Matter <2.5µm recorded within the study area were in the range of 15 to 33 µg/m^3. The minimum and maximum level of Particulate Matter <10µm recorded within the study area were in the range of 28 to 54 µg/m^3. The 24 hourly average values of Particulate Matter <2.5µm and Particulate Matter <10µm were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits of residential and rural area limits for all locations in study area.

Sulfur Dioxide

82. The minimum and maximum level of SO_2 recorded within the study area was in the range of 5.5 µg/m^3 to 17.6 µg/m^3. The 24 hourly average values of SO_2 were compared with the national ambient air quality standards and it was found that all sampling stations

recorded values much lower than the applicable limit of 80µg/m^3 for residential and rural areas.

Oxides of Nitrogen

83. The minimum and maximum level of NO_x recorded within the study area was in the range of 7.1 µg/m^3 to 28.8 µg/m^3. The 24 hourly average values of NO_x were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 80 µg/m^3 for residential and rural areas.

Carbon Monoxide (CO)

84. The minimum and maximum level of CO recorded within the study area was in the range of 890 µg/m^3 to 1210 µg/m^3. The 8 hourly average values of carbon monoxide were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits of residential and rural area limits for all locations in study area.

Ozone (O_3)

85. The minimum and maximum level of O_3 recorded within the study area was in the range of 6.5 µg/m^3 to 9.5 µg/m^3. The 8 hourly average values of Ozone were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits of residential and rural area limits for all locations in study area.

Mercury (Hg)

86. Coal and oil burning in electric utilities as well as in residential, commercial and industrial facilities, incineration of solid waste (namely municipal solid waste and medical waste) and sewage sludge, and primary non-ferrous metal smelters are major combustion sources categories. Mercury Concentration in the study area was below detectable limit.

3.1.6 Sources of Noise[14]

87. The main sources of noise in the study area are domestic activities, industrial activities and vehicular traffic. Baseline noise levels have been monitored at 12 locations within the study zone, using a spot noise measurement device. Random noise level measurement locations were identified for assessment of existing noise level status, keeping in view of the land use pattern, residential areas in villages, schools, bus stands, etc., the day levels of noise have been monitored during 6 AM to 9 PM and the night levels during 9 PM to 6 AM. The results are presented in **Table 26**[15] and areas of noise sampling locations shown in the plant in **Figure 7.**

88. The values of noise observed in some of the rural areas are primarily owing to vehicular traffic and other anthropogenic activities. In rural areas, wind blowing and chirping of birds would contribute to noise levels especially during the nights. The day equivalents during the study period are ranging in between 50.2 to 66.5 dB (A) and the night equivalents were in the range of 41.1 to 44.8 dB (A). From the results, it can be seen that the Day equivalents and the Night equivalents were within the ambient noise standards of residential and industrial area standards.

[14] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

[15] Sampling locations are taken as per the EIA document

Table 26: Noise Levels in the Study Area – dB (A)

Time – Hours	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12
1	40.2	42.0	41.2	41.3	41.0	41.6	40.5	40.6	40.1	41.8	41.4	41.3
2	40.6	42.8	41.6	41.7	41.4	42.0	40.9	41.0	41.2	42.2	41.8	41.7
3	45.1	47.1	42.6	42.2	42.0	43.0	41.8	42.0	40.9	42.7	42.3	42.7
4	43.8	47.7	43.1	42.7	43.1	43.5	45.3	42.5	43.2	41.5	42.8	43.2
5	45.4	48.3	45.0	43.2	43.6	45.4	45.8	43.0	43.7	43.0	47.6	43.7
6	47.4	48.8	46.5	43.9	43.7	46.9	46.4	43.5	45.0	45.2	49.0	44.2
7	56.9	54.8	51.8	44.0	48.1	50.2	49.7	49.0	50.9	48.7	51.5	49.8
8	59.4	60.3	53.1	45.1	49.0	52.5	51.1	52.8	52.4	51.8	54.0	53.6
9	68.4	68.2	54.2	49.6	50.2	54.2	53.2	54.0	54.5	53.8	56.1	54.8
10	71.8	68.2	54.8	50.7	51.1	55.2	51.4	55.2	55.6	57.7	57.1	56.1
11	71.6	67.8	54.3	53.2	48.6	52.4	50.9	54.2	52.3	58.6	57.2	55.1
12	68.1	66.0	54.0	53.0	47.6	52.1	52.6	53.2	53.9	56.8	57.7	54.0
13	66.8	64.7	48.6	52.2	45.8	47.0	52.0	51.4	52.9	53.9	55.2	52.2
14	67.6	58.3	47.2	51.1	46.7	45.6	49.5	50.5	50.7	52.3	55.9	51.3
15	70.1	64.7	47.6	53.3	51.9	50.1	50.2	52.4	53.3	53.2	54.7	53.2
16	63.1	65.4	51.5	53.9	55.2	54.2	53.0	53.3	54.3	56.0	55.2	54.1
17	63.6	55.7	58.4	52.0	56.3	47.3	49.1	52.4	55.2	57.3	56.1	53.2
18	57.3	50.7	55.5	52.5	50.6	44.4	47.2	49.8	52.3	56.0	55.2	50.5
19	54.4	50.0	50.0	48.6	45.6	43.5	45.3	47.9	51.5	54.1	49.7	48.6
20	52.5	49.1	49.1	45.7	44.7	42.6	44.4	47.0	51.0	52.9	50.6	47.7
21	54.4	48.5	48.2	45.2	43.8	41.7	43.9	45.1	49.7	49.0	45.6	45.8
22	46.4	45.0	45.0	43.2	41.6	41.1	43.0	43.9	48.8	45.8	43.4	44.6
23	42.7	43.8	45.4	41.8	41.2	40.6	42.1	42.5	48.0	41.4	42.7	41.2
24	41.5	40.3	44.9	41.0	41.0	40.2	41.3	41.7	46.9	40.9	38.4	38.4
Minimum	40.2	40.3	41.2	41.0	41.0	40.2	40.5	40.6	40.1	40.9	38.4	38.4
Maximum	71.8	68.2	58.4	53.9	56.3	55.2	53.2	55.2	55.6	58.6	57.7	56.1
Lday	**66.5**	**63.5**	**52.9**	**50.8**	**50.3**	**50.6**	**50.2**	**51.8**	**52.8**	**54.7**	**54.8**	**52.6**
Lnight	**42.9**	**44.2**	**43.1**	**41.5**	**41.1**	**41.3**	**41.8**	**41.5**	**44.8**	**42.0**	**41.5**	**41.6**
Ldn	**64.8**	**62.0**	**52.9**	**51.0**	**50.6**	**50.9**	**50.8**	**51.7**	**53.6**	**54.0**	**53.9**	**52.3**

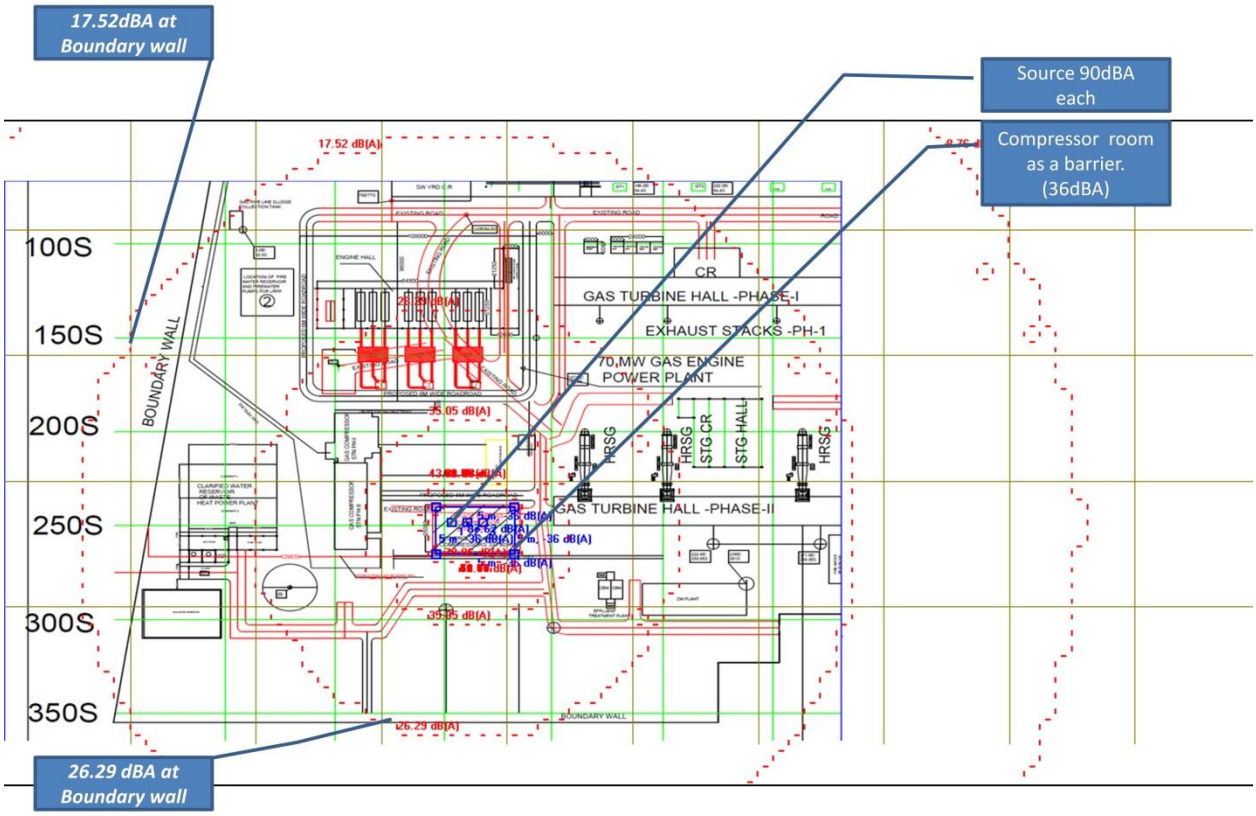


Figure 7: Location of Noise sampling locations

Soil Quality[16]

89. For studying the soil types and soil characteristics, 10 sampling locations[17] were selected to assess the existing soil conditions representing various land use conditions and geological features. The soil analysis results are shown in **Table 27**.

90. The pH of the soil is an important property; plants cannot grow in low and high pH soils. The normal range of the soils from 6.0 to 8.5 is called as normal to saline soils. Most of the essential nutrients like N, P, K, Cl and SO_4 are available for plants at the neutral pH, except for Fe, Mn and Al which are available at low pH range. The soils having pH below 7 are considered to be acidic from the practical standpoint, those with pH less than 5.5 and which respond to liming may be considered to qualify to be designated as acid soils. On the basis of pH measurements, the degree of soil acidity may be indicated. The pH values in the study area are varying from 7.61 to 9.1.

91. Based on the electrical conductivity, the soils are classified into 4 groups (Normal, Critical for germination, Critical for growth of the sensitive crops, Injurious to most crops). The electrical conductivity in the study area is varying from 62 to 113 µmhos/cm indicating that soils falling under Normal category. The organic carbon in the study area is varying from 0.98 to 1.51 %. The other important parameters for characterization of soil for irrigation are N, P, K. Nitrogen, Phosphorus and Potassium are known as primary nutrients; Calcium, Magnesium and Sulphur as secondary nutrients. The available Nitrogen as N in the study area is varying from 126 to 226 kg/ha. In the study area available Phosphorus is varying from 1.6 to 7.7 kg/ha, which indicates that all samples are falling in lower range. The available potassium in the study area is varying between 31.2 to 268.32 kg/ha which indicates 7 samples are falling in low category and rest of the samples are falling under medium category.

Table 27: Soil Analysis Results

SNo	Parameters	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	**pH(10% Solution)**	-	8.45	8.17	7.67	7.61	9.1	8.32	7.72	8.72	7.98	7.63
2	**EC(10% solution)**	µMho/cm	85	81	62	69	113	97	77	86	67	64
3	**Total Carbon**	%	1.53	2.01	1.85	1.42	1.68	1.3	1.3	1.94	1.56	1.8
4	**Organic Carbon**	%	1.15	1.51	1.39	1.07	1.26	0.98	0.98	1.46	1.17	1.35
5	**Texture**	-	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps	Wet Lumps
6	**Bulk Density**	gr/cc	1.29	1.3	1.32	1.3	1.33	1.32	1.29	1.3	1.3	1.29
7	**Sodium as Na**	mg/ kg	64	90	95	104	152	84	88	45	82	80
8	**Potassium as K**	kg/ha	33.54	83.2	54.12	36.4	79.8	34.3	140.6	111.8	31.2	268.3
9	**Lead as Pb**	mg/ kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	**Calcium as Ca**	mg/ kg	275	173	244	189	244	291	212	259	196	298
11	**Magnesium as Mg**	mg/ kg	162	81	128	129	205	160	124	148	114	162
12	**Chloride as Cl**	mg/ kg	197	177	216	256	216	157	197	256	236	216
13	**SAR**	-	7.58	1.41	1.22	1.43	1.73	0.98	1.18	0.55	1.15	1.07
14	**Total Nitrogen as N**	%	0.13	0.24	0.13	0.12	0.22	0.27	0.13	0.1	0.2	0.1
15	**Phosphates as P**	Kg/Ha	1.6	7.5	2.6	3.8	5.2	2.0	7.2	3.5	2.4	1.6
16	**Sulphates as SO_4**	mg/ kg	88.4	155	109	201	293	287	350	168	135	93

3.2 Ecological Resources

3.2.1 Forest

Forest Area

92. The Recorded Forests Area (RFA) of Assam is 26,748 km^2 (35% of the total geographical area). It includes Reserved Forests (RF) (312 RFs, 13,870 km^2, 52% of the RFA), Proposed Reserved Forests (145 PRFs, 3,103 km^2, 12% of the RFA), Protected Areas (3,925 km^2, 15% of the RFA) and Unclassed State Forests (5,865 km^2, 33% of the RFA).

[16] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

[17] Sampling locations are taken as per the EIA document

Protected Areas

93. Assam has 5 National Parks and 18 Wildlife sanctuaries. Together they cover 3,925 km^2, which is nearly 5% of the total geographical area of the Assam State.

Forest Cover

94. The forest cover in the State, based on interpretation of satellite data of October 2006 – January 2007, is 27,692 km^2, which is 35.30% of the State's geographical area. In terms of forest canopy density classes, the State has 1,461 km^2 very dense forest, 11,558 km^2 moderately dense forest and 14,673 km^2 open forest. This is shown in **Figure 8**.

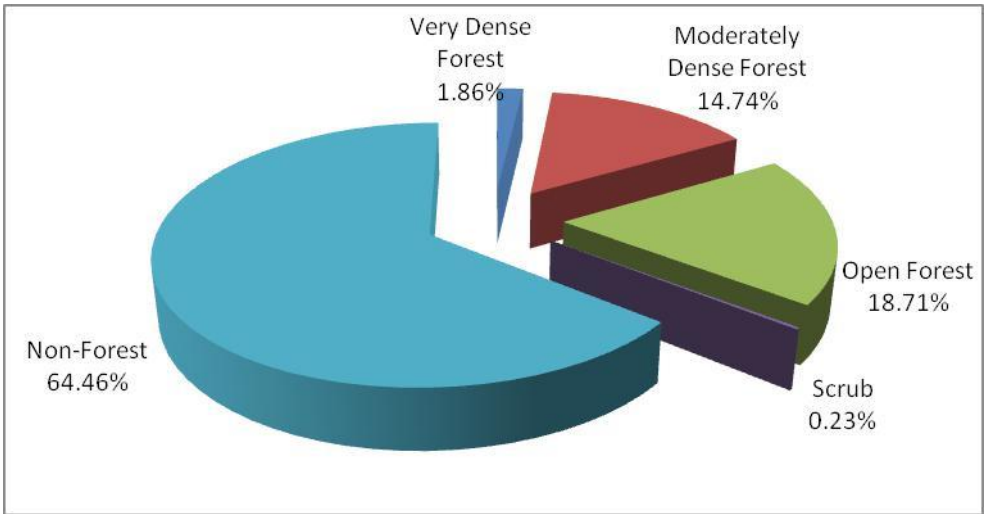


Figure 8: Forest Cover

95. Comparison of the latest forest cover (satellite data of Oct 2006 – Jan 2007) with the previous assessment (satellite data of Nov – Dec 2004 and Jan-Mar 2005) shows a loss of 66 km^2 of forest cover, as shown below in **Table 28**. The reserve forests that occur in Shivsagar division are shown in **Table 29**.

Table 28: Forest cover and net change in Forest Cover

Category	Forest Cover (Km^2)		Net Change (Km^2)
	Assessment 2005 (SFR-2007)	Assessment 2007 (SFR-2009)	
Very Dense Forest	1,464	1,461	-3
Moderately Dense Forest	11,653	11,558	-95
Open Forest	14,641	14,673	+32
	Net Change		**-66**

Table 29: Reserved Forests in Shivasagar Division during 2006-07

SNo.	Name of Reserve Forest	Area in Ha
1.	Abhayapur	6,738
2.	Dilli	3,108
3.	Deroi	4,834
4.	Geleki	5,927
5.	Sapekhati	736
6.	Solah	683
7.	Panidihing	2,022
	Total	**24,048**

Source: Forest Department, Government of Assam

Major Forest Types with list of major species:

96. In the "Revised Survey of Forest Types in India", Champion and Seth categorized as many as fifty one different forest types/ sub types for north-east region. However, broadly speaking the forests in Assam can be described into the following types/ sub-types:

97. Tropical Wet Evergreen Forests are found in the districts of Golaghat, Jorhat, Shivsagar, Tinsukia, Dibrugarh and in a narrow stretch in Lakhimpur and Dhemaji districts

along foot hills. These forests also occur in the southern part of the State at lower elevations in Borail Range, and in Loharbund, Sonai, Longai and Dholia Reserve Forests in Cachar and Karimganj districts. Top canopy consists of *Dipterocarpus macrocarpus* (hollong), *Ailanthus integrifolia* (Borpat), *Altingia exelsa* (Jutuli), *Artocarpus chaplasa* (sam), etc. The middle canopy consists of *Mesua ferrea* (Nahar), *Michelia champaka* (Teeta chopa), etc. Third storey is bamboo, etc. Forests in Southern Assam have, however, top canopy consisting of *Dipterocarpus terbinatus*(Garjan), *Palanquium polyanthum* (Kurta), *Diospyros embryopteris* (Kendu), etc. Middle canopy has *Mesua ferrae* (Nahar), *Bischofia javanica* (Urium), *Podocarpus nerifolia* (Jiri) etc. The third storey has bamboo etc.

98. Tropical Semi Evergreen Forests have mostly medium sized trees with few large trees. Shrubs, lianas, climbers, orchids and ferns grow copiously. At the fringe bamboos and canes occupy the space. Species association and frequency of their occurrence vary from forest to forest, but the ones commonly found are *Actinodaphnae obovata* (Petarichawa), *Aesculus* species (Ramanbih), *Artocarpus chaplasa* (Sam), *Albizia stripulata* (Siris), *Albizia procera* (Koroi), *Lagerstromia parviflora* (Sida), *Lagerstromia speciosa* (Ajar), *Anthocephalus chinensis* (Kadam), *Duabanga grandiflora* (Khakan), *Castonopsis* species (Hingori, Dhobahingori, Kanchan), *Dillenia indica* (Ou-tenga), *Bauhinia purpurea* (Kanchan), *Magnolia insignis* (Phulsopa), *M.griffithii* (Gahorisopa), *M.bailonii* (Khariksopa), *Terminalia belerica* (Bhomora), *T.chebula* (Silikha), *Terminalia myrocarpus* (Holok), *Pterospermum acerifolium* (Hati pulia), *Trewia nudiflora* (Bhelkor) etc.

99. Moist Deciduous Forests can further be described as Sal Forests and Mixed Deciduous Forests. Sal Forests occupy considerable forest area in the Central and Lower parts of the State in the Districts of Nagaon, Morigaon, Kamrup, parts of Nalbari and Barpeta, Darrang, Dhubri, Kokrajhar and Goalpara. In these forests, Sal grows in association with *Lagerstroemia* species (Jarul, Ajar), *Schima Wallichii* (Ghugra), *Stereospermum personatum* (Paruli), *Adina cordifolia* (Haldu), *Artocarpus* species (Sam), *Ficus* species (Bor, Dimoru, Dhupbor, Bot, Athabor, tengabor, Lotadioru, Khongaldimoru), *Bischofia javanica* (Uriam), *Gmelina arborea* (Gomari), *Michelia champaca* (Teeta champa), *Terminalia* species (Hilikha, Bhomora, Bahera), *Toona ciliata* (Poma) etc.

100. Moist Deciduous Mixed Forests occur at the foot of hills in Lakhimpur, Dhemaji, Karbi-Angong and N. C. Hills districts. Trees are mostly deciduous with sprinkling of few evergreen and semi-evergreen species. Important plant species growing in these forests include *Adina cordifolia* (Haldu), *Albizia* species (Siris, Kolasiris, Koroi, Sau), *Alstonia scholaris* (Satiana), *Artocarpus chaplasa* (Sam), *Careya arborea* (Kumbhi), *Dalbergia* species(Sissoo, Medelua), *Ficus* species (Bot, Bor, Dimoru), *Lagerstroemia* species (Jarul, Ajar), *Mallotu* species (Senduri, Joral, Dudhloti), etc. Bordering Moist Deciduous Forests in rain shadow areas are found forests which has been referred to as “Dry Forests” by Kanjilal. Important species include, *Aegle marmelos* (Bel), *Albizia* species (Siris), *Cassia fistula* (Sonaru), *Bombax ceiba* (Simul), *Alstonia scholaris* (Satiana), *Ficus* bengalensis (Bor), *Litsea* species (Loban, Bagnola, Mezankori, Honwalu,Digloti) *Melia azedarach* (Neem), *Moringa oleifera* (Sajana), *Oroxylum indicum* (Bhatgila), *Mallotus* species(Senduri), *Terminalia belerica, T.chebula* etc.

101. Sub-tropical Broad Leaf Hills forests and Sub-tropical Pine forests occur in the districts of Karbi-Anglong and N. C. Hills. Species commonly occurring are *Alseodaphne petiolaris* (Ban-hanwalu), *Antidesma bunius, Betula alnoides, Cleidon speciflorum* etc. Higher up pure stands of *Pinus kesiya* (Khasi-pine) are found, particularly in the Hamren sub-division in Karbi-Anglong district.

102. Grass land and Savannahs are grass dominated biomes and form the major part of vegetation in Kaziranga National Park, Orang N.P., Dibru-Saikhowa N.P., Pobitora, Sonai-Rupai, Laokhowa, Barnadi, Burachapori Wildlife Sanctuaries and some part in Manas

National Park. Grasslands support important wildlife population in Assam. Important grasses are *Apluda mutica*, *Phragmatis karka*, *Sclerostachya fusca*, *Saccharum* species, *Arundodonax* etc. These species grow gregariously at the onset of monsoon and grow even upto 6 metres tall.

103. Littoral and Swamp forests have almost lost their identity because of biotic pressure on land. Presently sedges and grasses form the largest component of vegetation. Important species include *Ageratum conyzoides, Alocasia* species, *Alpinia* species, *Amaranthus* species, *Bacopa* species, *Blumea* species, *Bombax* species, *Crotolaria* species etc.

Forest Cover

104. The forest cover in the state, based on interpretation of satellite data of Nov 2008-Jan 2009 is 27,673 km^2 which is 35.28% of the state's geographical area. In terms of forest canopy density classes, the state has 1,444 km^2 supporting very dense forest, 11,404 km^2 moderately dense forest and 14,825 km^2 open forest. District-wise forest-cover in different canopy density classes along with the changes compared to 2009 assessment are given in **Table 30.**

Table 30: District Wise Forest Cover (Area in km^2)

District	Geographical area	Very dense forest	Moderate dense forest	Open forest	Total	% Total of GA	Change	Scrub
Barpeta	3,245	35	179	183	397	12.23	-4	2
Bongaigaon	2,510	33	267	221	521	20.76	3	3
Cachar	3,786	81	975	1,180	2,236	59.06	5	18
Darrang	3,481	12	91	367	470	13.50	-16	2
Dhemaji	3,237	7	124	160	291	8.99	1	10
Dhubari	2,798	21	201	196	418	14.94	1	10
Dibrugarh	3,381	29	165	564	758	22.42	0	0
Goalpara	1,824	1	71	265	337	18.48	1	8
Golaghat	3,502	6	122	397	525	14.99	4	0
Hailakandi	1,327	13	373	400	786	59.23	0	5
Jorhat	2,851	2	113	498	613	21.50	3	0
Kamrup	4,345	68	612	753	1,433	32.98	1	26
Karbi Anglong"	10,434	566	3,819	3,554	7,939	76.09	-19	24
Karimganj	1,809	3	318	539	860	47.54	4	48
Kokrajhar	3,169	208	716	220	1,144	36.10	-19	2
Lakhimpur	2,277	4	118	171	293	12.87	5	6
Morigaon	1,704	6	41	86	133	7.81	1	4
North Cachar Hills	4,888	135	1,553	2,562	4,250	86.95	-6	1
Naogaon"	3,831	40	353	403	796	20.78	7	8
Nalbari	2,257	4	70	208	282	12.49	0	0
Shivsagar	2,668	8	144	543	695	26.05	2	1
Sonitpur	5,324	56	280	624	960	18.03	7	0
Tinsukia	3,790	106	699	731	1,536	40.53	0	4
Grand Total	**78,438**	**1,444**	**11,404**	**14,825**	**27,673**	**35.28**	**-19**	**182**

Source: India State of Forest Report 2011

National Parks and Sanctuaries

105. **Figure 9** shows the location of wildlife sanctuaries in Assam state.

106. Singphan Reserve Forest located in Mon district of Nagaland was declared a wildlife sanctuary in 2009. This sanctuary forms an important elephant corridor with Abhaypur Reserve Forest of Assam and is also home to wild elephants, wild boars, civet etc. The wildlife sanctuary is spread over an area of 5,825 acres (2,357 ha.). Singphan Wildlife Sanctuary is known for its diverse flora and fauna in terms of the magnificent Hollong and Makai tree species and several animal species such as leopards, elephants, wild boar, and birds such as the hornbill, peafowl and Hill myna.

107. Panidehing Wildlife Sanctuary in Shivsagar district is a rich wetland eco-system of 33.93 sq. km. on the southern bank of river Brahmaputra in the Shivsagar district. A paradise of migratory and resident birds, so far 165 species of Birds have been identified and recorded. A place for quite high concentration of geese and other migratory birds. the

common birds seen are bar-headed goose, grey leg goose, spot billed duck, mallard, gadwall, wigeon, gargany, shoveller, red crested pochard, common pochard, ferruginous duck, adjutant stork, lesser adjutant stork, open bill stork, white necked stork etc. varieties of fishes have been identified along with various species of frogs and snakes etc.

108. Dibru Saikhowa National Park is situated about 100 km from LTPS near Tinsukhia and separates from mainland by the river. This park is habituated by rare White-winged wood duck, the park is also home to other rare creatures such as water buffalo, wild horse, the tiger and capped Langur.

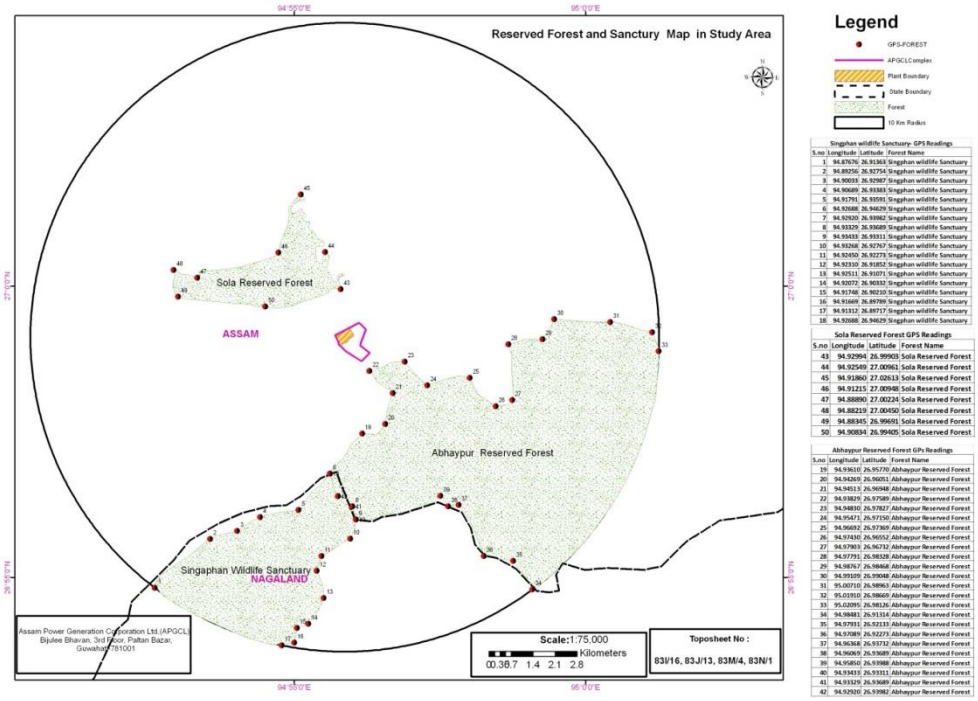


Figure 9: Reserved Sanctuary and WLS map (from EIA report)

3.2.3 Flora and Fauna[18]

109. The primary data[19] was collected through visual observation of species in the study area which are listed below:

Table 31: Existing Flora Details within the Study Area – Primary Data

S. No.	Botanical Name	Common Name	Local Name
1	*Bauhinia variegata*	Orchid tree	Kanchan-phul
2	*Polyalthia longifolia*	Mast tree	Umboi
3	*Dendrocalamus hamiltonii*	Rhinoceros Bamboo	Kako
4	*Pseudostachym polymorphum*	Bamboo	Bojal
5	*Borassus flabellifer*	Palmyra palm	Tal
6	*Lagerstroemia speciosa*	Queens Pride	Ajahar
7	*Dillenia indica*	Elephant apple	Outenga
8	*Pterygota alata*	Buddha Coconut	Tula
9	*Ficus elastica*	Rubber tree	Atha bor
10	*Terminalia myriocarpa*	East Indian almond	Hollock
11	*Hibiscus rosa-sinensis*	China Rose	Joba
12	*Mangifera indica*	Mango	Aam
13	*Bergera koenigii*	Curry leaf	Bishahari
14	*Musa bulbisiana*	Banana	Athia-kol
15	*Neolamarckia cadamba*	Kadam	Kodom
16	*Phragmites karka*	Tall Reed	Nal
17	*Bombax ceiba*	Red Silk Cotton	Simalu
18	*Ipomoea aquatic*	Swamp morning glory	Kolmou
19	*Ipomoea carnea*	Bush morning glory	Pani votora
20	*Dalbergia sissoo*	Indian rosewood	Sisu

[18] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

[19] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

S. No.	Botanical Name	Common Name	Local Name
21	*Albizia lebbeck*	Siris	Sirish
22	*Calamus erectus*	Cane palm	Bet

110. Rice cultivation and tea gardens are commonly seen around the study area. Goats and turkey are the common domesticated animals and birds observed in the study area. The primary data[20] was collected through visual observation of species in the study area which are listed below:

Table 32: Existing Fauna Details within Study Area – Primary Data

S.No.	Zoological Name	Common Name	Local Name
Mammals			
1	Macaca mulatta	Rhesus Monkey	Moluva Bandor
2	Lepus nigricollis	Hare	Hoha Pohu
3	Sus scrofa	Wild Pig	Bonoria Gahori
Birds			
4	Corvus splendens	House crow	Paati kaori
5	Columba livia	Rock Pigeon	Paar Sorei
6	Dinopium benghalense	Woodpecker	Kaathroka
7	Dicrurus macrocercus	Black Drongo	Phenchu
8	Merops orientalis	Small Green Bee Eater	Harial Sorai
9	Motacilla cinerea	Grey Wagtail	Haldiya balimahi
10	Pyenonotus cafer	Red vented Bulbul	Bulbuli sorai
11	Streptopelia Chinensis	Spotted Dove	Pati Kopou
12	Copsychus saularis	Oriental Magpie Robin	Dahikataraa
13	Turdoides striatus	Jungle Babbler	Xaatbhani
Reptiles			
14	Ptyas mucosus	Indian Rat Snake	Machoa Gom
15	Hemidactylus frenatus	House Gecko	Chipkali
16	Calotes versicolor	Garden lizard	Giragiti
Amphibians			
17	Hoplobatrachus tigerinus	Common Frog	
18	Bufo melanostictus	Toad	

111. Grasshoppers, Beetles, Mosquitoes and Fireflies were the commonly seen insects at the study area. The butterfly species observed at the study area are listed below:

Table 33: Butterfly species[21]

S.No.	Family	Common name	Scientific name
1	Papillionidae	Common Bluebottle	Graphium sarpedon
2		Crimson Rose	Atrophaneura hector
3		Lime butterfly	Papilio demoleus
4	Nymphallidae	Peacock Pansy	Junonia almana
5		Common Castor	Ariadne merione
6		Common Evening Brown	Melanitis leda
7		Plain Tiger	Danaus chrysippus
8	Pieridae	Common Jezebel	Delias eucharis
9		Common grass yellow	Eurema hecabe
10		Great Orange Tip	Hebomoia glaucippe
11	Lycaenidae	Common Cerulean	Jamides celeno
12		Common Pierrot	Castalius rosimon

Wildlife Sanctuaries/National Parks/Reserve Forest areas and Direction of wind/plume

112. As per the literature available from the Department of Environment, and site visit, no Wildlife Sanctuaries or National parks exist in 4 km radius of the project site except Chala Reserve Forest which is about 1.6 km North-west and Abhaypur Reserve Forest which is about 3.6 km south of the project site. The Singphan Wildlife Sanctuary is situated 4.4 km away from the LTPS in the SW direction in the Nagaland state. The Panidehing Wildlife Sanctuary in Shivsagar district is 50 km situated NE away from the project site. As can be seen in **Figure 10**, the sanctuary is situated away in the South direction of the Wind Rose whereas the most likely position of wind is SW. Sola Reserve Forest is situated to North

[20] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

[21] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

West of the project about 8 km from LTPS. The Sola reserve forest is endowed with luxuriant vegetation and is rich in bio-diversity.

Endangered species

113. Based on the survey conducted, no living species which are endangered or threatened as per the IUCN Red list were identified or observed in the core zone or buffer zone of the project site. There will not be any adverse impact of the proposed project on the ecological resources as the project is coming up in an already existing power plant area.

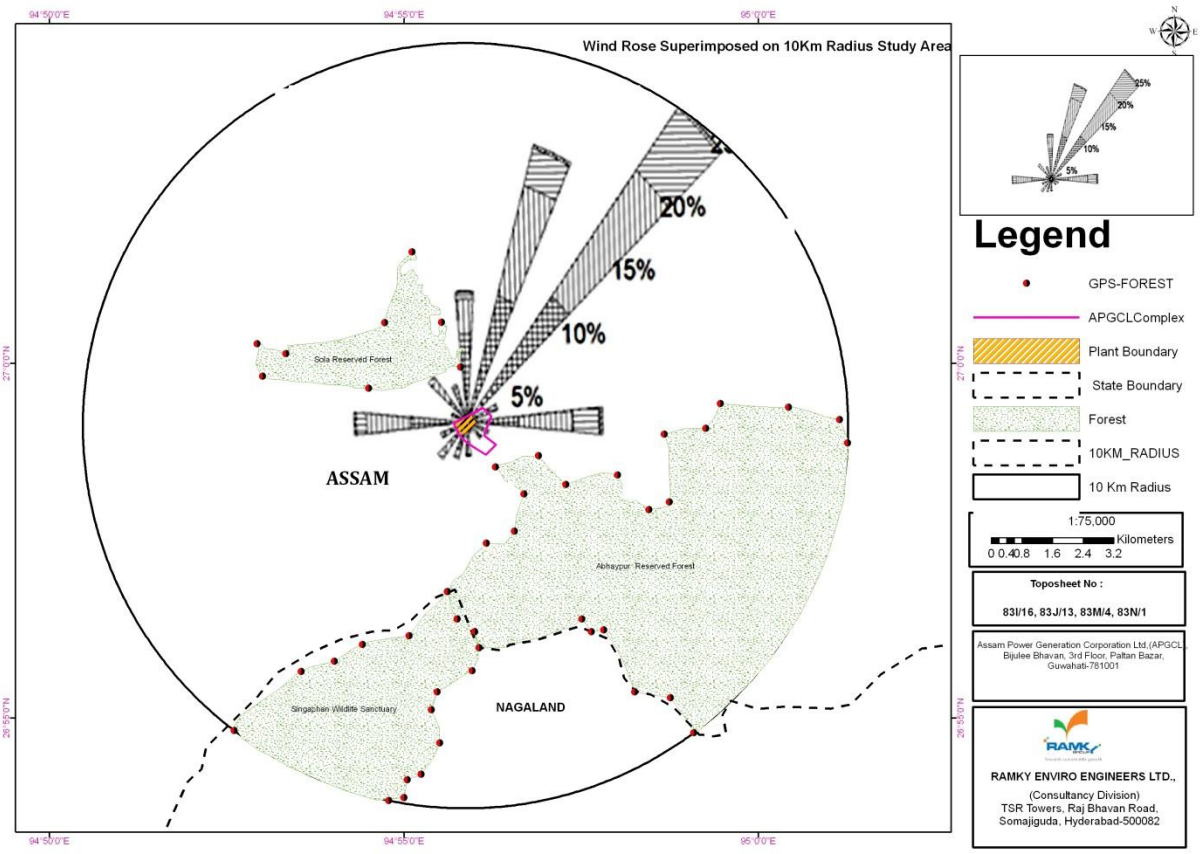


Figure 10: Windrose and Forest reserves

3.2 Socio-Economic Environment

114. The villages under study area are in Shivsagar district. Socio-economic status of six villages under study area is collected around the site. Location of villages surveyed is given in **Table 15**.

3.3 Economic Development

3.3.1 Land use pattern

115. The population of the state is 31.17 million (Census 2011). Rural and urban population accounts for 85.92% and 14.08% respectively. The population density is 397 persons per km^2. The livestock population of the state is 17.23 million (Livestock Census 2007). The Land use pattern in the state is given in **Table 34.**

Table 34: Land Use Pattern

Land Use	Area in '000 ha	Percentage
Total geographical area	7,844	
Reporting area for land utilization	7,850	100.00
Forests	1,853	23.60
Not available for cultivation	2,626	33.45
Permanent pastures and other grazing lands	160	2.04
Land under misc. tree crops and groves	196	2.50
Culturable wasteland	77	0.98
Fallow lands other than current fallows	59	0.75
Current fallows	126	1.61
Net area sown	2,753	35.07

Source: Land Use Statistics, Ministry of Agriculture, GOI, 2008-09.

Land use/ Land cover details[22]

116. The methodology adopted in analysis and interpretation of FCC-Liss III data of Indian Remote Sensing Satellite (IRS – IC) covering the study area. The data was analyzed adopting a man-machine interactive approach through an interactive process of combining field observations and data interpretation. The image processing software "ERDAS Imagine 9.2 V" was used for the Image Analysis and Map Composition. The base map information such as major roads, railways network and drainage networks were extracted from the available Survey of India (SOI) topo-sheets on 1:50,000 scale vectorized using "ARC/INFO" (Geographic Information System) Software. The land-use and land cover of the study area (10 km radius of the project site) is provided in **Figure 11.** The land utilization pattern in 10 km radius study area is given in **Table 35.**

Table No 35: Land Utilization Pattern of the study area (area in Ha.)

SNo	Description	Area
1	Buildup	1,359
2	Water Body	29
3	River	1,329
4	Agricultural	5,562
5	Current Fallow	498
6	Plantation	12,476
7	Dense Forest	4,347
8	Open Forest	3,325
9	Scrub Forest	2,075
	Total	**31,000**

[22] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

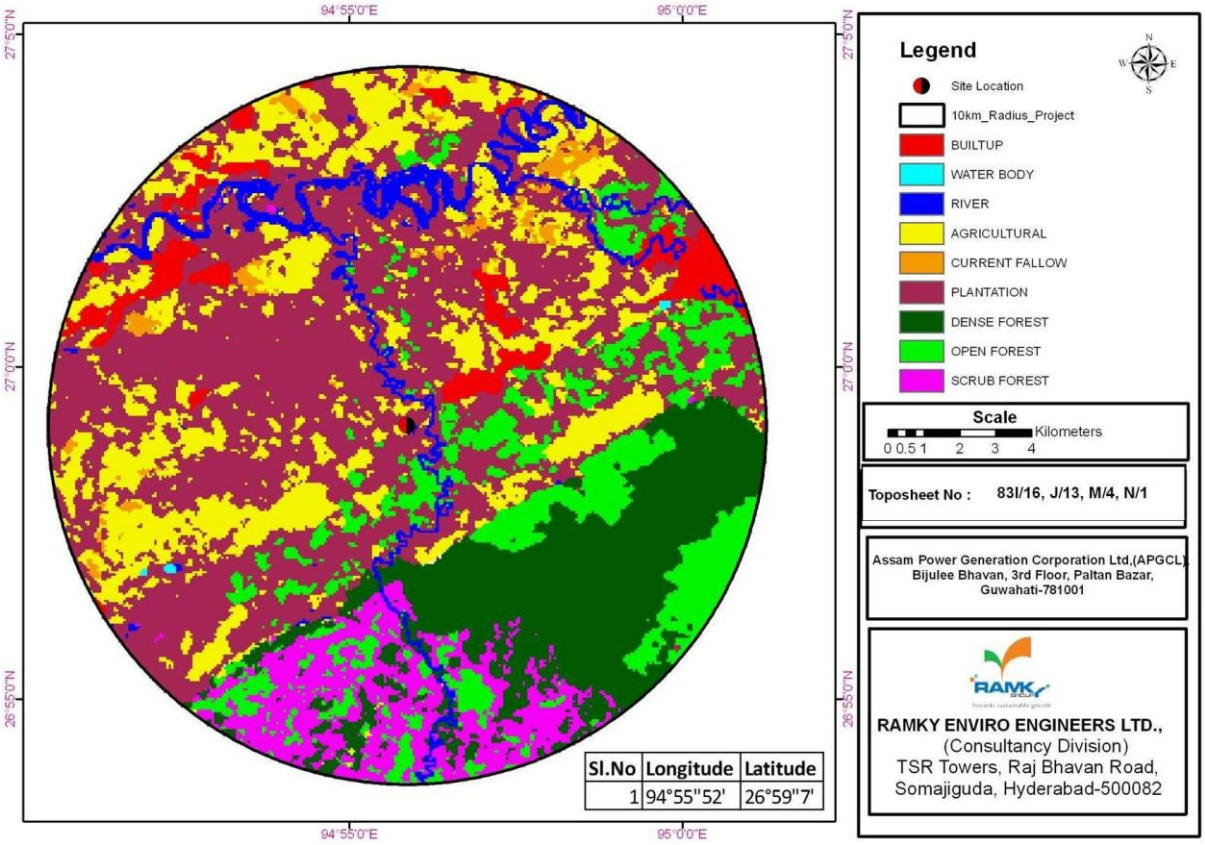


Figure 11: Land Use/Land Cover Map of the 10 km study area

3.3.2 Agriculture/Horticulture

117. Data are according to 1991 Census Report and from 1999-2000 Statistical Reports of the Shivasagar district. Crops and cropping pattern in the districts is given below in **Table 36**.

Table 36: Crops and cropping pattern in the district

(a)	**Net area shown:1998-99:**	**126,106 (Hect)**
(b)	**Area sown more than once**	**16,692 (Hect)**
(c)	**Total cultivated area**	**142,798 (Hect)**
(d)	**Area under principal crops**	
(i)	Autumn paddy:1998-99:	1,443 Hect
(ii)	Winterpaddy:1999-2000:	96,019 Hect
(iii)	Summerpaddy:	1,26 Hect
(iv)	Wheat:	366 Hect
(v)	Sugarcane	98 Hect
(vi)	Rape and Mustard	2,084 Hect
(vii)	Potato	1,224 Hect
(viii)	Rabi Pulses	3,225 Hect
(e)	**Production of Principal crops**	
(i)	Autumn Paddy:1998-99:	1,986 Tonnes
(ii)	Wheat:1999-2000	469 Tonnes
(iii)	Sugarcane (Gur)	3,888 Tonnes
(iv)	Rape and Mustard	2,159 Tonnes
(v)	Potato	8,739 Tonnes
(vi)	Rabi Pulses	1,552 Tonnes
(vii)	Summer Paddy	280 Tonnes
(viii)	Winter Paddy	175,077 Tonnes

3.3.3 Industries

118. The main industries in Sivasagar are oil industry and tea industry. Majority of the population are agrarian. Some food processing units making pickles, jams and squashes

have come up. **Table 41** gives the distribution of workers in Shivsagar district.

Table 37: Distribution of Workers

	Total Workers	Main workers	Marginal Workers	Non-Workers	Cultivators	Agricultural Laborers	House-hold Industries	Other Workers
Persons	430,277	287,162	143,115	622,525	155,222	30,918	11,910	232,227
Male	280,348	218,736	61,612	266,217	90,618	15,817	4,413	169,500
Female	149,929	68,426	81,503	356,308	64,604	15,101	7,497	62,727

Source: Government of India, (1991 &2001 census)

3.4 Social and Cultural Development

3.4.1 Population

Table 38: Population (1991&2001census)

Population		Sex Ratio(Female	Per 1000 (Male)	Density (per Sq. K.M.)		Literacy Rate	
1991	**2001**	**1991**	**2001**	**1991**	**2001**	**1991**	**2001**
907983	1052802	907	928	340	394	64.46	75.33

3.4.2 Education

Table 39: Education Statistics in the district

Number of Institutions	Shivsagar district
(a) Primary school Nos.	1,805
(b) Middle schools Nos.	426
(c) Secondary & Senior secondary school	226
(d) Colleges	6

Source: Government of Assam

3.4.3 Infrastructure

Table 40: Rail/Road Statistics in the district

	P.W.D (Roads)	
(a)	National Highway	68 km
(i)	Blacktopped	68 km
(ii)	Gravelled	Nil
(b)	NEC (Road)	55.08 km
(i)	Blacktopped	55.08 km
(ii)	Gravelled	Nil
(c)	Other P.W.D (Roads)	1746.17 km
(i)	Blacktopped	426.80 km
(ii)	Gravelled	1319.37 km
	Railway	
(i)	Broad Gauge	153 km
(ii)	Metre Gauge	Nil

3.4.4 Health Environment

119. Shivsagar has 150 bedded central hospital. **Table 41** gives the health facilities in the districts of Assam.

Table 41: Health Facilities in the districts

SNo.	Districts	Block PHC	Mini PHC	SHC	State Dispensary	Sub-centre	Total
Upper Assam							
1	Dibrugarh	6	12	0	9	236	263
2	Jorhat	7	18	1	9	144	179
3	Shivsagar	8	22	4	1	230	265
4	Golaghat	5	27	2	5	154	193
5	Lakhimpur	6	12	3	5	166	192
6	Dhemaji	5	10	1	3	99	118
7	Tinsukia	4	10	1	5	163	183
Total		41	111	12	37	1192	1393
Central Assam							
1	Kamrup Rural	13	23	0	27	350	413
2	Kamrup Metro	1	8	0	14	5	28
3	Nagaon	11	24	3	19	355	412
4	Sonitpur	7	23	6	8	293	337

SNo.	Districts	Block PHC	Mini PHC	SHC	State Dispensary	Sub-centre	Total
5	Darrang	7	22	3	14	308	354
6	Morigaon	3	3	6	13	117	142
Total		42	103	18	95	1428	1686
Lower Assam							
1	Nalbari	7	35	5	15	211	273
2	Bongaigaon	6	18	4	14	119	161
3	Goalpara	5	16	2	12	146	181
4	Dhubri	7	10	5	13	275	310
5	Kokrajhar	4	5	7	24	139	179
6	Barpeta	9	28	4	8	327	376
Total		38	112	27	86	1217	1480
Barak Valley & Hills district							
1	Cachar	8	13	2	2	264	289
2	NC Hills	3	2	2	2	65	74
3	Hailakandi	4	6	1	2	104	117
4	Karbi-Anglong	8	25	7	9	104	153
5	Karimganj	5	8	2	6	218	239
Total		28	54	14	21	755	872
TOTAL (ASSAM)		**149**	**380**	**71**	**239**	**4592**	**5435**

Source: District wise Health Infrastructure in Assam (As per the Facility Survey), Government of Assam, National Rural Health Mission, Assam

3.5 Historical, Cultural and Archaeology Sites/Places

120. Sivasagar-Earlier known as "Rangpur", the historical city of Assam is situated 363 km east of Guwahati (The capital of Assam). Earlier, Sivasagar was the capital of the mighty Ahoms, who ruled Assam for more than six hundred years before the advent of the British. The most remarkable landscape of the town is the 200 year old Sivsagar tank.

121. On its banks are three temples-- the Shivadol, the Vishnudol and the Devidol-- all three built by Queen Madambika, wife of Siva Singha, in the year 1734. The Shivadol is believed to be the highest Siva Temple in India, having a height of 104 feet and the perimeter 195 feet. The tank is situated in the heart of the town but the water level is above the level of the town.

122. Joysagar, 5 km off the Sivasagar town, said to be biggest man made tank in the country, in an area over 318-acres.Sivasagar is also famous for 'Talatal Ghar', and 'Rang Ghar'. Rang Ghar amphitheatre was built by King Pramatta Singha. This two storied oval shaped pavilion is one of the largest of its kind in Asia. The main tourist attractions of Sivsagar district are Ranghar, Kareng Ghar & Talatal Ghar, Gargaon Palace, Charaideo, Joysagar Tank, Gaurisagar Tank and Temple, Rudrasagar Tank and Temple, Namdang Stone Bridge and Ajan Pir Dargah Sharif.

4.0 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

4.1 Analysis of Alternatives (Technology & Site)

4.1.1 Site Selection Criteria[23]

123. **Criteria used by GOI**. In order to help the concerned authorities and the entrepreneurs, MoEF, GOI has framed certain broad guidelines for siting an industry. The broad environmental guidelines recommended for siting of industries to ensure optimum use of natural and man-made resources in sustainable manner with minimal depletion, degradation and or destruction of environment are given in **Table 42**.

Table 42: Site Selection Criteria – Areas to be Avoided

Land Procurement	Sufficient land to meet the demand of greenbelt development, reuse of treated water, storing of solid waste before final disposal
Coastal areas	At least 500 m from high tide line
Estuaries	At least 200 m away from the estuary boundaries
Flood plains of the Riverine system	At least 500 m from flood plain or modified flood plain, or by flood control systems
Transport/ communications system	At least 500 m from highway and railway
Major settlements	At least 25 km from the project growth boundary of the settlement (3 lakh population)
Ecologically and or otherwise sensitive area	At least 10 km (Archaeological monuments, National parks & Sanctuaries, Biosphere reserves, Hill resorts, Scenic areas, etc.)
Ecologically and/ or otherwise sensitive areas include: 1) Religious & historic places, 2) Archaeological monuments, 3) scenic areas, 4) Hills resorts, 5) Beach resorts, 6) Health resorts, 7) Coastal areas rich in coral, mangroves, breeding grounds of specific species, 8) Estuaries rich in mangroves, breeding ground of specific species, 9) Gulf areas, 10) Biosphere reserves, 11) National parks and sanctuaries, 12) Natural lakes and swamps, 13) seismic zones, 14) Tribal settlements, 15) Areas of scientific and geological interest, 16) Defence installations, specifically those of security importance and sensitive to pollution, 17) Border areas (International), 18) Airports,19) Tiger reserves/ elephant reserves/ turtle nestling grounds, 20) Habitat for migratory birds, 21) Lakes/ reservoirs/ dams.	

124. In siting the power plant, care should be taken to minimise the adverse impact of the power plant on the immediate neighbourhood as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to power plant impacts because of the nature and extent of fragility. With a view to protecting such an industrial site shall maintain the above mentioned distances. Since the proposed project site is the replacement of the existing plant, no alternative sites are proposed.

125. **Criteria as per ABS SPS 2009**. All new projects will be screened for compliance with selection criteria listed below prior to preparation of any additional documents. Project that will be planned and implemented shall meet the following specific environmental criteria:

- Projects will not be located within national parks, wildlife sanctuaries and nature reserves, or wetlands, unless unavoidable for technical reasons.
- Any monument of cultural or historical importance is not affected by the project.
- Projects do not create any threat to the survival of any community with special reference to tribal community.

[23] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

- Minimise impacts to large habitations, densely populated areas, crossings of national highways, railway lines, and airport areas, other EHV lines, hydrocarbon pipelines etc. to the extent possible.
- Requires minimal clearing of any existing forest resources in the project area – wherever it is unavoidable, can be minimized and compensated as per regulatory criteria.
- Any community utility services like playgrounds, schools, cemetery etc. and any other similar establishments etc. will not be adversely affected.

126. The Survey of India (SOI) topographic maps[24] were referred during the study. For any site consideration, data for about 10 km extent on each side has been covered as statutory requirement. As per primary survey, the power plant and its components are situated within or passing through Reserve Forest/Protected Areas/National Park/Sanctuary any protected area. The nearest wildlife sanctuary is 4.4 km away from the LTPS. The 10 km radius topographical map of the site is given in **Figure 1.**

127. The following factors have influenced the setting up of the LRPP site.

- The project site is located within the boundary of existing Lakwa TPP in Mybella, Shivasagar district, Assam. The site is located about 12 km from Sonari town. The nearest railway station Suffry is 5 km from the site and the nearest airport is Dibrugarh 90 km away from the site.
- Adequate vacant land owned by Lakwa TPP is available for replacement of 60 MW with 70 MW power plant and no additional land is required.
- APGC has supply agreement with OIL and GAIL for the supply of required amount of Natural Gas for the project.
- Pipeline for Gas transport from OIL and GAIL has already been laid for the existing plant and a Tap off will be provided for the proposed plant from the existing gas terminal facilities.
- The approach road to the site has already been developed while implementing existing LTPS.
- The site is accessible by road from and adjacent to Simaluguri road from South-West direction.
- There are no R&R issues and no change in land use is involved.
- Land at the site is barren with sparing vegetation of mainly weeds.
- Water requirement has been allotted from existing system of the Waste heat plant. Although water from Desang river is already being used by existing LTPS.

4.1.2 Technology Selection

128. **Table 43** illustrates various types of project components.

Table 43: Type of Projects components

Type of Sub-projects	Main Components	Infrastructure
Gas Engines – 70 MW Gas Compressors 11/33/132 kV substation Facilities, buildings	Electrical and Mechanical Equipment	Gas Engines, Water and Oil Cooling system, Generators, Air compressors, Control Room Panels, Turbines, Switchyard equipment, Transformers
	Steel/Concrete structures	Conductors, oil, water and gas piping to supply compressors and engines
	Civil Works	Buildings- gas engine and compressor housing facility, stacks for exhaust, storage for water and new and used oil, control room, other equipment housing facilities

129. Power can be generated from natural gas on a commercial scale in the following manner:

- Conventional thermal power plant using gas for firing in the boiler instead of coal.

[24] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

- Gas engine driven generator
- Gas turbine in simple cycle
- Gas turbine in co-generation cycle
- Gas turbine in combined cycle

130. A comparison of the thermal efficiencies of various types of prime movers, as a function of the capacity of the unit indicates the gas turbine is at the bottom of the scale with efficiencies as poor as 25% for the smaller capacity units. On the other hand, the gas turbine in combined cycle operation, particularly with a multi pressure waste heat recovery system, the efficiency is achievable up to 55-60% for units of higher ratings at ISO conditions. The efficiency of gas engines of 8 to 10 MW capacity in combined cycle mode of operation is of the order of 49%. The comparison of the three technology options considered for the proposed Power Plant is given in **Table 44.**

Table 44: Comparison of different Technologies: Synopsis of Power Generation[25]

Parameters	Combined Cycle Gas Turbine	Combined Cycle Gas Engine	Gas Engine
Gas Availability	0.36 MMSCMD		
Gas Price	Rs 6,511/ per 1000 SCM		
Gross Heat Rate (kCal/ kWhr)	1803	1825	2000
Installed Plant Capacity (MW)	68.6	73.2	68.0
Gross Plant Output (MW) based upon available gas 0.36 MMSCMD	68.6	68	62.25
Auxiliary Power Consumption (%)	2.4	1.8	1.7
Net power available (MW)	67	66.8	61.2
Capital Cost (Rs Crores)	391.56	347.982	263.3
Cost per MW (Rs Crores)	5.72	4.75	4.23
Availability	15 days shut down per year for routine maintenance of the plant. Major overhauling of the plant will be after 5 years.	15 days shut down for routine maintenance of the engine is required.	15 days shut down for routine maintenance of the engine is required.
PLF (%)	90	90	90
Fixed cost of generation 1st year (Rs/kWhr)	1.55	1.51	1.41
Fuel Consumption Cost per year (Rs Crores)	85.29	85.29	85.29
Lube oil cost	Negligible	High	High
Total Cost of Generation 1st year (Rs/kWhr)	3.02	3.02	3.196
Levelised Cost of Generation (Rs/kWhr)	2.96	2.96	3.140
Construction Period (months)	30	22	15-20
Land Requirement (Acre)	12 - 15	8 - 9	7
Water Requirement (m3/hr)	500	4.5	0.9
Operation & Maintenance cost (Rs Lakhs/MW/Year)	18.49*	22 *	22*

*Based on CERC recommendation.

131. The gas engine based thermal power plant can be commissioned in less time period from 'Zero date' when compared to that of Gas turbine in Combined Cycle Power Plant. Also for water requirement for such plants would be minimum. This implies that the gas engine based technology is most suitable for the proposed power plant.

4.2 Environmental Impacts

132. The impacts on the environment from various activities of the project can be categorised as follows:

- Impact on Physical Resources
  - Impact on Topography
  - Impact on Climate

- Impact on Environmental Resources
  - Impact on Air Quality
  - Impact on Noise Levels

[25] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

  - Impact on Surface Water Quality
  - Impact on Ground Water Quality
  - Impact on Soils and Geology

- Impact on Ecological Resources
- Impact on Terrestrial Ecology
  - Wild Life
  - Aquatic Ecology

- Impact on Human Environment
  - Health and Safety
  - Agriculture
  - Socio-economics
  - Resettlement and Rehabilitation
  - Cultural sites
  - Traffic and Transport
    - Interference with other utilities and traffic
  - Waste Disposal
    - Solid waste disposal
    - Liquid waste disposal.

133. During the design, construction, and operation of the project, APGC will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's *Environment, Health and Safety Guidelines*[26]*.* These standards contain performance levels and measures that are normally acceptable and applicable to all projects. Wherever CPCB regulations differ from these levels and measures, APGC will achieve whichever is more stringent and ensure compliance by all equipment manufacturers as per contract conditions of supply, O&M and warranty.

134. The impacts of the project activities on various environmental attributes are discussed in subsequent sections.

4.2.1 Impact on Physical Resources

Impact on Topography

135. During the construction of power plant, the topography will change due to excavation of foundations, fill and cut for leveling the foundations. This will lead to change in the surface features. The impact will be irreversible as the present features along the plant will be changed due to presence of the new buildings. No topographical changes are envisaged during the operation phase of the plant.

Impact on Climate

136. The area outside the plant is mostly agricultural area with predominantly rice growing areas with scrubs or medium size trees in the area. However, impact on the climate conditions from the proposed project both during the construction and operation phases will not be significant.

4.2.2 Impact on Environmental Resources

Impact on Air Quality

137. During the construction phase, the activity would involve excavation for the foundations, buildings, movement of transporting vehicles carrying the construction material etc. along the haul road. All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which although will be transitory in nature.

[26] World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines.* Washington, DC.

Sprinkling of water during excavation will reduce the dust emission to a great extent.

138. The power plant operation will have significant impact on the air quality of the area. The stack emissions as specified in the EMP will be monitored continuously to avoid any negative impact on the air quality in the region during the operation phase.

Impact on Noise Levels

139. During the construction phase, the major sources of noise pollution are movement of vehicles transporting the construction material and equipment to the site. The major work of the construction is expected to be carried out during the day time. There will be very limited presence of population being exposed to noise generated during the construction phase.

140. Following measures will help to keep noise and vibration in acceptable level during construction phase:

- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise not to exceed 75 db[27] (for compacters/rollers, loaders and cranes as per CPCB norms) and regularly maintain all construction vehicles and machinery that should meet the national emission standards.
- Contractor shall preferably limit working time for activities that create noise within normal waking hours of the public except for construction site near public sensitive receptors. Construction related activities closer to sensitive receptors have to be scheduled in coordination with the relevant authorities.
- Contractor and its suppliers of construction materials should strictly implement noise control regulations stipulated by the Noise Pollution (Regulation and Control Rules 2000) Act for all construction vehicles and equipment.

141. During the operation phase of the project, there may be noise from the gas engines and the compressors during the operations for which proper noise monitoring will have to be done at the machine plant as well as outside the plant upto 15 to 30 m area. Proper acoustic enclosures with required noise reduction as per CPCB standards shall be installed in the plant. The O&M contractor shall ensure that the ambient noise level meets the CPCB standard for residential areas (55 dB(A) during daytime and 45 dB(A) during night time.

142. Nuisance to the community during operations around the site can occur requiring provision of appropriate noise barriers around the site.

Impact on Surface Water Quality

143. The construction of the plant will not have any major impact on the surface and ground water quality in the area. Contamination of water bodies may result due to spilling of construction materials and surface runoff from the construction site joining the water body. There may be increase in the turbidity levels temporarily where the proposed alignment is crossing and if the surface runoff during construction meets the river. This can be avoided by careful selection of the construction material storage and disposal material to avoid surface runoff which should not flow into the drain/river.

144. During operation, make up water will be required for engine radiators as well as close system for cooling radiators will be required. Though the disposal of water outside the plant is minimal as most of it will evaporate, it is recommended to ensure that water disposal meets the CPCB effluent norms in entirety.

145. Proposed activities will create temporary impacts to the existing drainage system in the area including natural flow paths and also earth and line drains. Thus, it will create

[27] CPCB daytime Industrial area limits

temporary inundation closer to the above locations during rainy season. Stagnation of water will create temporary breeding sites to mosquitoes which will have direct impact on public health. Thus, incorporation of following measures will minimise anticipated impact due to obstruction of natural flow paths and existing drainage:

- Provisions of temporary drainage facilities to the particular locations if existing drains are obstructed due to construction activities.
- Maintenance of all drainage paths by avoiding blockages at all times.
- Contractor should minimise excavation of any streams, ponds, irrigation systems, and other water resources available in the project affected area.

146. Care shall be taken to locate the temporary construction worker sheds away from the water bodies. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution. Provision of adequate washing and toilet facilities should be made obligatory. This should from an integral component in the planning stage before commencement of construction activity.

Impact on Ground Water Quality

147. Ground water pollution can take place at the plant site during construction and operation, if chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table. The discharge from the earth work around water bodies, oil, grease and fuel release from the construction vehicles / equipment and spoil from construction and other construction related activities such as raw sewerage from worker accommodation sites will mix with runoff water. This situation will increase during the rainy season and have a critical impact on surface and ground water. Thus following measures will be required in order to prevent deterioration of water runoff from the construction and construction related activities:

- All construction vehicles and equipment should be maintained in proper conditions without any leakages,
- Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water bodies to avoid entering of cement particles, rock, rubbles and waste water to the surrounding water bodies,
- Waste oil should be collected properly and disposed to the approved location.

Impact on Soil and Geology

148. Project activities including excavation, cut and fill operations, and removal of trees enhance the soil erosion during the rainy season. Leveling and stabilisation of power plant area will be done after completion of construction activity. The impacts associated with excessive erosion and other civil works can be avoided or minimised by following mitigation measures:

- Effort to minimise loose stacking of dismantled waste material at the plant site.
- Minimise obstruction or destruction to natural drainage pattern of the surrounding area.
- Piling activities will preferably be stacked properly as the piled materials will spread all over the area and contaminate and choke the drains.

4.2.3 Impact on Ecological Resources

149. Since power plant is constructed in the existing site within the LTPS complex boundary, there is no displacement of people or animals. It will not cause any disturbance to the life of people and local animals and birds movement. Although, due to dynamic equipment and moving machinery causing noise pollution, water and air pollution proper mitigation measures are to be implemented by the company during operation. There is no national wildlife park, bird sanctuary, wetland at the project site. The ecological impacts are briefly described in the following sections

Effect on Flora and Fauna

150. None of the declared environmentally sensitive areas is located adjoining the plant site. It is not expected that any flora and fauna that are rare, endangered, endemic or threatened will be affected. Also, noise, vibration and emission from construction vehicles, equipment will occur during construction and pre-construction stages in temporary manner. The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals and fishing in water bodies.
- Selection of approved locations for material storage yards and labour camps away from the environmental sensitive areas.
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding drains and water bodies.

Impact on Terrestrial Ecology

151. There is no sensitive ecological area / protected forest area such as national wildlife park, bird sanctuary crossings near the site. Air pollutants which impact the ecology would be primarily confined to the project site during construction phase and would be minimised through adoption of mitigation measures like paving, surface treatment and water sprinkling.

Removal of Trees

152. A minimal number of domestic trees inside the LTPS complex shall be removed during the construction at the plant site.

Effect on Local Road Network

153. Gas Engines, Compressors, generators, equipment, iron bars, concrete materials, piling equipment, etc. will be transported through the local road network to the project site. Transporting of large quantities of materials using heavy vehicles could exceed the carrying capacity of the road. This would lead to physical damages to local road network. Thus it may be necessary to obtain consent from Public Works Department (PWD) or national highway Authority to use local/national highway roads prior to transportation of heavy loads. Also contractor should properly maintain all road sections, which will be utilised for the construction related activities.

Disposal of Debris

154. As a result of construction related activities, spoil and debris will be generated during the construction stage. Improper disposal of the debris will have an impact on the surrounding ecology, public health and scenic beauty. Following measures will minimise the impacts associated with disposal of debris:

- Spoil materials (soil, sand, rock etc.) generated from construction activities shall be used wherever possible for site levelling, back-filling etc. Dismantled and demolished structural materials, if any, would be dumped within the plant at designated sites.
- Preparation of Disposal Management Plan for the project and selection of the disposal site is necessary by the contractor. Prior approval may be obtained, if required, for such dumping grounds / land fill sites from relevant local authorities.
- Dumped materials should not interfere with the drainage pattern of the area and must be planned properly.

Wild Life

155. The nearest wildlife sanctuaries – Singphan wildlife sanctuary in Nagaland and the Panidehing Wildlife Sanctuary in Shivsagar district in Nagaland and Shivsagar district are located at distances of 4.4 km south–west direction and 50 km north-east direction respectively towards the from the proposed site and therefore does not cause any negative

impact due to project activities.

Impact on Aquatic Ecology
156. There are no rivers or tributaries in the alignment of project. No significant impacts on aquatic ecology of the river are envisaged.

4.2.4 Impact on Human Environment

Health and Safety
157. Necessary training regarding safety aspects to the personnel working at the plant will be provided by the contractor. Personal protective equipment like safety gloves, helmet, mufflers etc. will be provided during construction period and during the maintenance work. First aid facilities will be made available with the labor gangs and doctors called in from nearby towns when necessary. Workers are also covered by the statutory workmen compensation as per GoI laws by the contractor.

158. Project activities may create accidental damage to the construction workers. Therefore, contractors should take necessary action to enhance personal safety during the construction through following measures:

- Organise awareness programs relevant to personal safety of the workers and general public in the area;
- Installation of warning signs to particular locations such as transverse points of road network within the plant;
- Provide protective safety belts, footwear, helmets, goggles, eye-shields and clothes to workers depending on their duty; and
- Arrangement of proper first aid unit and transport facilities to take injured people to the hospitals.

Socio-Economics
159. Construction of plant will generate local employment, as number of unskilled labourers (both men and women) will be required at the time of construction activities. Local employment during this period will increase socio-economic standards.

Resettlement and Rehabilitation
160. For the construction of power plant, no land acquisition is required, hence there is no resettlement and rehabilitation involved in the project.

Cultural sites
161. There are no archaeological, historical or cultural important sites adjoining the project site; hence there is no envisaged impact.

Waste Disposal
Solid Waste Disposal
162. The solid waste generation will be at the site which will include metal scraps, wooden packing material etc. Wooden waste and metal scrap will be collected and disposed of in compliance with applicable regulations and rules.

Sanitary Waste Disposal at Construction Sites and Labour Camps
163. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution. Provision of adequate washing and toilet facilities should be made obligatory. This should from an integral component in the planning stage before commencement of construction activity.

164. There should be proper solid waste disposal procedure to enhance sanitation of

workers who stay in camps. Thus possibilities of infecting water borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure. Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the aquatic; terrestrial lives and general public inhabited in the area. Surroundings of labour camps, garbage disposal sites and material storage yards provide favourable habitats for vectors of diseases such as mosquitoes, rats and flies. Thus following measures are needed to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned above by reducing or avoiding the construction of labour camps, thus the selection of majority of skilled and unskilled workers from the project influence area will be a proper measure in this regard.
- Contractor should provide adequate facilities to manage its wastes in accordance with the guidance given by the Central and State Pollution Control Board.
- Provision of the solid waste disposal, sanitation and sewage facilities at all site of the construction/labour camps to avoid or minimise health hazards and environmental pollution.
- Contractor should handle and manage waste generated from the construction/labour camps without contamination to natural environment and it will reduce risk to general public who stay close to sites. Also contractor should be responsible to enhance the quality of environment.

165. Adequate supply of water should be provided to the urinals, toilets and wash rooms of the workers' accommodation. Contractor should provide garbage bins to all workers accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area.

Liquid Waste Disposal

166. The waste oil or chemical waste will be generated during the decommissioning and erection process of the plant. Proper waste handling measures as per EMP will need to be implemented and monitored closely.

Electric Shock

167. This may lead to death or injury to the workers and public in the area. This can be minimised or avoided by providing security fences around plant site, establishment of warning signs, and careful design using appropriate technologies to minimise hazards.

Oil Spillage

168. Contamination of water on land/nearby water bodies by the engine/compressor/transformer oil can occur during operation due to leakage or accident. Substation transformers are normally located within secure and impervious areas with a storage capacity of 100% spare oil. Also proper drainage facilities will be constructed during the construction stage to avoid overflow or contamination with natural flow paths especially during the rainy season. APGC will maintain account of the usage of oil, has inbuilt technical methods and procedures for oil monitoring mechanism, and has mitigation plan for any oil spillage.

169. During operation, the waste oil will be generated from the Gas engines and compressors. Proper waste oil handling procedures as per EMP will need to be implemented and monitored closely.

Leakage of Sulphur Hexa Floride (SF_6), a potent GHG gas

170. Very high grade sealing system and erection methodology to keep the loss of SF6

within 0.01% every year. SF_6 gas handling system for evacuation and storage is always used for the maintenance of the circuit breaker. SF_6 gas leakage is one of the checks in every shift of the operation. Stock SF_6 records are maintained in each equipment. This allows tracking of any release of SF_6 gas to the atmosphere. SF_6 handling is part of technical specification for contract and required design and routine testing by the manufacturer of the circuit breaker.

4.3 Environmental Management Plan

171. The environmental management plan (EMP) attached in **Annexure 2** has been prepared for the project that discusses the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, site-specific mitigation measures and monitoring plans were developed and will be implemented during the project implementation phase.

172. A summary environmental impact matrix and the mitigation measures are given in **Table 45** below which details an environmental analysis of project facilities and review of environmental impacts of typical gas based generation projects. The mitigation measures for subsequent projects will be developed in the spirit of the principles agreed upon in this EMP framework. The APGC and its Engineering, Procurement and Construction (EPC) contractor will document any unanticipated consequence of any project activity.

4.3.1 Implementing the EMP mitigation measures

173. The EMP identifies feasible and cost-effective measures to be taken to reduce potential significant adverse impacts to acceptable levels. In **Annexure 2**, proper mitigation measures are proposed for each potential impact, including details on responsible parties for implementation of mitigation measures and supervision. The EPC Contractor/subcontractors shall comply with all applicable national, provincial, and local environmental laws and regulations, social issues and obligations. The Contractor shall (a) establish an operational system for managing environmental impacts as well as the social issues, (b) carry out all of the monitoring and mitigation measures which shall be set forth in the Environmental Management Plan to be provided by APGC at the contract negotiation stage, and (c) include provisional sums in the contract which will be utilized by acceptance of the Employer on the Contractor’s proposal to ensure that such measures are carried out. The Contractor shall submit quarterly reports on the carrying out of such measures to the Employer.

Table 45: Potential Environmental Impacts

SNº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Management Plan	Project Phase
				Low	Medium	High		
	TRANCHE 1 (APGC)							
A.	**Physical Resources**							
1.	Topography	Change in the surface features and present aesthetics due to the construction of the project.	Direct/Local/ irreversible			X	Greenbelt surrounding the power plant area to improve aesthetics. No other mitigation required	Construction
2.	Climate	Impact on the climatic conditions	Indirect/Local/ irreversible	X			No visible impact	Construction
			Indirect/Local/ irreversible		X		Due to stack emissions	Operation
		Monitoring of SF_6 gas from Electrical equipment.	Direct/Local/ irreversible	X			Switchgear equipment	Operation
B.	**Environmental Resources**							
1.	Air Quality	Impact on air quality during the construction period due to increase in the dust emission.	Direct/Local/ reversible			X	Watering at construction site, limited bare soils, maintenance of project vehicles etc.	Construction
		Stack emission control and monitoring is required.	Direct/Local/ reversible			X	Proper stack emission monitoring.	Operations
2.	Noise	Noise due to general construction activities.	Direct/Local/ reversible		X		Restriction of noise generating activities at night and use of personal protective equipment like ear plugs, mufflers etc.	Construction
		Noise arising from operation of gas engines and compressors	Direct/Local/ reversible			X	Proper maintenance of equipment/ machineries so the ambient noise standard is met.	Operation
3.	Surface and Ground Water quality	Wastewater from the construction site.	Direct/Local/ reversible			X	Domestic waste treatment at construction site required using separation tanks.	Construction
		Oil spillage	Indirect/Local/reversible	X			Containment structures, oil water separation, adopting good practices for oil handling and maintenance works.	During construction and operation
		Oil contamination during maintenance	Indirect/Local/reversible		X		Oil trap installation for separation of oil from water.	During operation
		Water treatment for make-up water for radiators	Direct/Local/ reversible	X				Operation
4.	Soils and Geology	Digging and pile foundations for engines, generators, compressors etc.	Direct/Local/ reversible	X			Avoiding sites, which are prone to the soil erosion. Leveling of construction sites	Construction
		Improper Debris removal/accumulation	Direct/local/reversible		X		Proper planning for debris removal from power plant area to be stored temporarily/used for site reclamation	Design and construction
		Damage due to seismic activity.	Direct/regional / reversible		X		Site selection and design considering the geological conditions and seismicity.	Construction/Operation
C. Ecological Resources								
1.	Terrestrial Ecology	Loss of vegetation.	Direct/Local/ irreversible	X			Location of power plant is a thinly vegetated area.	Construction

SNº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Management Plan	Project Phase
				Low	Medium	High		
2.	Terrestrial Fauna	Disturbance to the local fauna during construction.	Direct/Local/ reversible	X			Some wildlife species are reported to be seen about 4 km away from the plant.	Construction
	Avifauna	Disturbance to the local fauna during operation.	Direct/Local/ reversible	X			Hot effluent gases from the stack will harm avifauna in the area	Operation
3.	Aquatic Ecology	Disturbance to fish	Direct/Local/ reversible			X	Runoff from construction site from construction material and spillage oils etc.	Construction
			Direct/Local/ reversible		X		Effluent water laced with oil and chemicals during wastewater discharge	Operation
D. Human Environment								
1	Fire Safety	Fires, explosion and other accidents at the Power generation plant site	Indirect/Local	X			Use of personal protective equipment during construction and maintenance. Prepare and implement safety and emergency manual at plant site. Regular inspection of equipment for faults prone to accidents.	Construction
			Direct/Local	X				Operation
2.	Health and Safety	Exposure to electromagnetic fields	Direct/Local/ continuous	X			Manpower at site of operation. No houses near the plant.	Operation
3.	Agriculture	Permanent and temporary loss of agriculture land.	Direct/Local/ reversible	X			No agricultural land used for construction.	Construction
4.	Socio-economics	Beneficial impacts job opportunities	Direct/regional	X			Hiring for temporary construction jobs	Construction
			Direct/regional				Overall industrial and economic growth of the region.	Operation
5.	Resettlement	Resettlement of any household	Direct/Local/ reversible	X			Resettlement issues and mitigation measures are separately discussed in the Social Assessment Report.	Construction/ Operation
6.	Cultural sites	Archaeological, historical or cultural important sites are affected by the construction of gas based generation plant.	Direct/Local/ reversible	X			No mitigation required	Design
7.	Traffic and Transportation	Traffic congestion due to movement of construction vehicles.	Direct/Local/ reversible	X			Avoid high density areas, proper traffic signs at the construction site, ensuring proper access roads	Construction
8.	Solid Waste Generation	Probability of surface and ground water pollution.	Direct/Local/ reversible		X		Spillage of Oil from dismantling of equipment	Construction
			Direct/Local/ reversible		X		The oil sludge should be separately stored in the containers. Used oil to be collected and reclaimed by contractors through the Office of Stores and Purchase. Separated oily waste and scrap will be collected and disposed of in compliance with the Environmental Protection Act, 1986, and applicable regulations and rules.	Operation

4.4 Social, Labor Issues and Corporate Social Responsibility (CSR)[28]

174. APGC has an annual budget for Corporate Social Responsibility (CSR) activities for providing most benefits to the community. It takes into account public participations in its operation and contribution to sustainable development of the local communities. To name a few, the project gives importance to local people to work in its plants, as well as encouraging the EPC contractors to hire local workers for the project construction. It also provides communication channels for the public to exchange messages, either complaints or information/suggestions, with the company. **Annexure 3** also lists some requirements of the clearance.

175. Rainwater harvesting as per EIA clearance in **Annexure 3** is mandatory for APGC to set up at the LTPS as well regenerate a water body within 5 km of the plant.

176. APGC will also comply with the applicable labor laws in relation to the project and will take specific measures in relation to internationally-recognized core labor standards in compliance with ADB's Social Protection Strategy.

Employment potential associated directly with project

177. Since the proposed project is the replacement of the existing power plant, during construction phase, it is expected that around 500 people will have direct employment. The employment opportunities for skilled will also be available based on skill set.

Corporate Social Responsibility

178. The existing Lakwa Thermal Power Station is already implementing CSR activities to help the local people financially. CSR activities like electrification of nearby schools, accommodating students from nearby localities in APGC's LTPS school, providing medical treatment to nearby residents, street lighting, water supply etc. are being implemented by the existing unit. An amount of Rs. 32 lakhs is allotted towards recurring CSR Activities, as a contribution to the existing CSR plan of APGC, from the proposed unit initially. The CSR activities are given in **Table 46**. A mandatory one-time expenditure of Rs. 1 crore CSR activities and provision of drinking water supply (approximately costing 10 lakhs) are mandated as per EIA clearance costs by MoEF.

Table 46: Action plan for CSR (Rs. In Lakhs)

SNo	Type of Activity	First Year
	Costs of CSR as per EIA	
1	Extending medical treatment to nearby residents in LTPS dispensary	15
2	Educational training programs to acquire traditional/basic skills for BPL families	15
	Costs of CSR as per Environmental Clearance	2
	Total	**32**

[28] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

5.0 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PROGRAMME

179. The Government of Assam would chair the Steering Committee for the MFF which would include representatives from Government of Assam. The key institutions involved in project management and implementation, including the environmental assessment and review process for sub-projects are PMU, APGC, and the PIU as described below.

PMU

180. The PMU will be responsible for overseeing sub-project compliance with environmental and social safeguard requirements based on the EARF provisions that include: (i) sub-project selection taking into account environmental screening criteria; (ii) sub-project environmental assessments prepared in accordance with the requirements set out in this EARF; (iii) appropriate public consultations and disclosures; (iv) effective management of the grievance redress mechanism; and (v) EARF compliance reported in the environmental monitoring report. The PMU or its appointed technical consultants will conduct routine visual inspections of construction activities, including site pegging, vegetation clearance, earthworks, etc.

181. The PMU structure is shown in **Figure 12**. The PMU Director will be responsible for coordinating all external functions with ADB, GOI, DEA, GOA as well as coordinates the internal functions. Deputy General Manager (DGM), PMU will coordinate Environment and Social/R&R reporting, Legal, Finance and Accounts, Procurement and Contracts, and other functions under the direction of Director PMU. The APGC PIU shall work under the guidance of the DGM PMU.

182. PMU has designated one Assistant General Manager (AGM) incharge of Environment and Social Management Unit (ESMU) who has oversight responsibilities for monitoring for all sub-projects in areas such as Environment, R&R and Social safeguards. To assist ESMU in these specialist functions, APGC will hire appropriate Environment and Social Consultants at PIU level, as deemed necessary or as stipulated by MoEF's environmental clearance to assist ESMU in day-to-day coordination and reporting for various subproject activities.

183. The duties of the ESMU will include at a minimum: (i) oversight of field offices and construction contractors for monitoring and implementing mitigation measures; (ii) liaising with the field offices and contractors and seeking their help to solve the environment-related issues of subproject implementation; and (iii) preparation of environmental management reports every 6 months (as required by ADB). ESMU must coordinate with PIU for monitoring as well as designing appropriate mitigation measures to address environmental and social issues[29].

APGC/PIU

184. The PMU shall implement the ADB loan at the corporate level and the PMU will be supported for implementation activities through the APGC field offices/ Project Implementing Unit (PIU). The PIU/field offices of APGC will assume primary responsibility for the environmental assessment as well as implementation of EMPs through contractors or third party consultants in consultation with ESMU. The PIU/Project Head will be assisted by the ESMU.

[29] ADB advises that all EAs develop in-house capability for environmental, health, and safety (EHS) program consistent with international best practices. The EHS program should include accounting for environmental benefits resulting from investment projects within three months of loan approval. The monitoring agency shall report on semi-annual basis directly to ADB and determine whether sound environmental management practices have been achieved, and suggest suitable recommendations and remedial measures for midterm correction and improvement.

185. The PIU/field offices of APGC will have overall responsibility to manage the site activities. For management of EMPs, APGC will conduct overall coordination, preparation, planning, implementation, and financing of all field level activities. Keeping in view to enhance the planning implementation, environment and social safeguard skills at the PIU level, PIU staff shall be sent for capacity building training programs periodically by ADB and others in consultation with ESMU. These trainings will be identified by PMU in consultation with ADB.

Consultants, Construction Contractors, Equipment Suppliers, and Other Service Providers

186. APGC will ensure that contractors engaged for each sub-project are engaged in regular EMP monitoring and implementation. The construction contractor will have primary responsibility for environmental and social management, and worker health and safety at sub-project construction sites under their control. They will be required to adhere to all national and state level environmental, health, and safety (EHS) guidelines and implement relevant sub-project environmental and social management measures prior to and during construction.

Asian Development Bank

187. ADB will review the subproject IEE prior to ADB Board consideration and desktop environmental assessments; review project monitoring reports; and officially disclose environmental safeguards documents on its web site in accordance with the ADB Public Communications Policy (2011). ADB will also review proposed sub-projects activities and provide guidance to APGC/PMU on SPS (2009) requirements.

188. Further details on agencies responsible for EMP implementation activities are shown in Table 47.

Table 47: Institutional Roles and Responsibilities for EMP Implementation Activities

Activity	Responsible Agency
Project Initiation Stage	
Assign field offices for each subproject	APGC
Clearances/approvals from relevant GOI/GoA agencies-forest, roads, rivers, railways, telecom etc.	APGC/ESMU
Disclosure of subproject EMP details on APGC website	PMU/ESMU/APGC
Conducting discussions/meetings/workshops with APs and other stakeholders	PMU/ESMU/APGC
Updating of EMP mitigation measures based on discussions	PMU/ESMU
EMP Implementation Stage	
Meetings at community/household level with APs	Field Office/ESMU/Contractor
Implementation of proposed EMP mitigation measures	Field Office/ESMU/Contractor
Consultations with APs during EMP mitigation measures implementation	Field Office/ESMU/Contractor
Grievances Redress	PMU/ ESMU/ District Authorities/ Council Administration
Internal monitoring	PMU/ESMU
External monitoring*	External Experts

ADB-Asian Development Bank; AP-Affected Persons; EA-Executing Agency; EMP-Environmental Management Plan; PMU- Project Management Unit; ESMU-Environmental and Social Management Unit

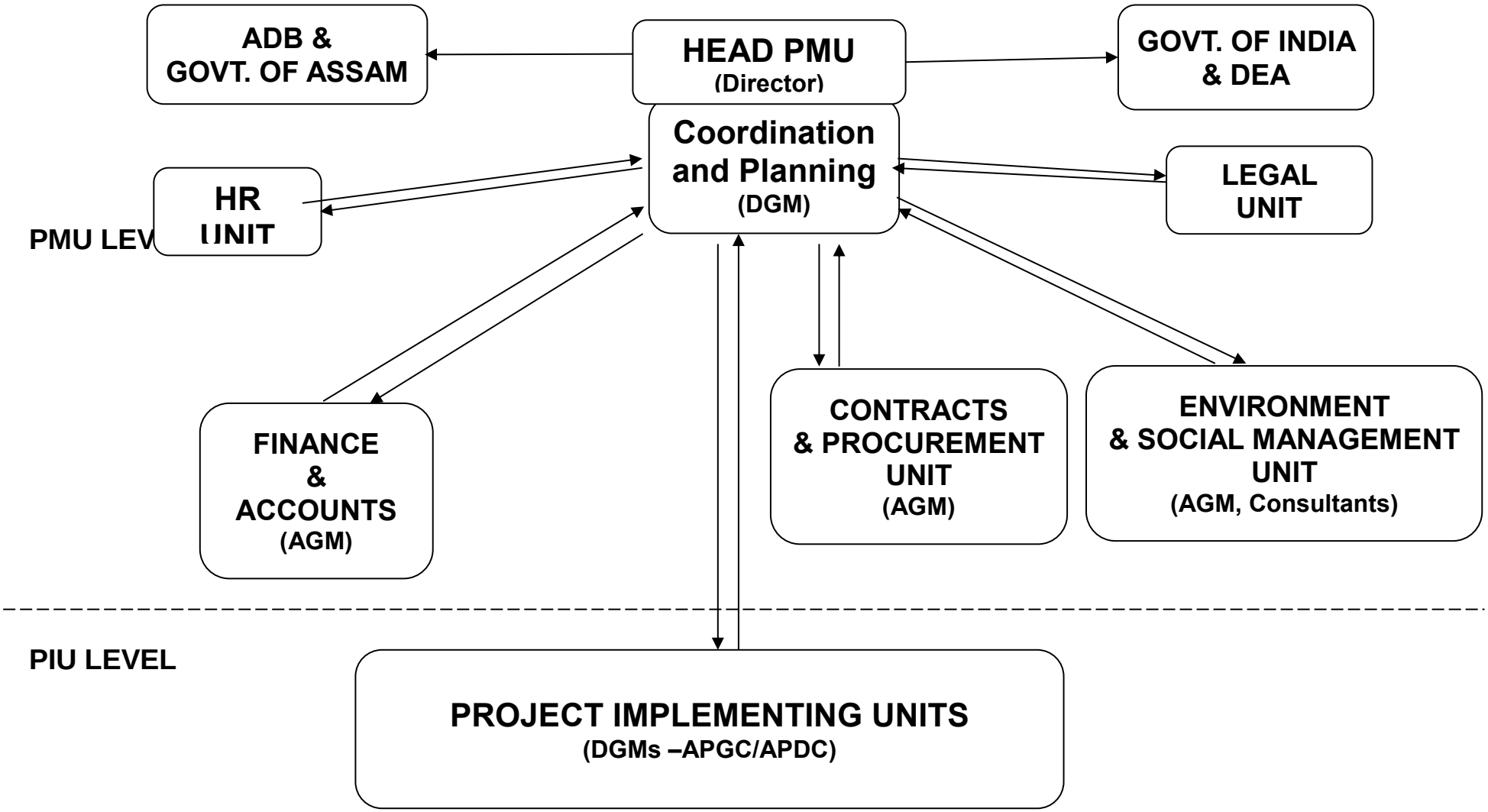
*Note –External monitoring only required when projects are noticed to have significant adverse environmental impacts.

189. APGC will be responsible for implementing internal monitoring systems for EMP implementation, and will forward semi-annual progress reports to the Government of Assam and ADB. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. On-going consultation measures will be incorporated in the EMP.

Long term maintenance contract (LTMC) with OEM

190. Besides the operation and maintenance support for initial three years for entire plant from EPC contractor, the LTPS will in built a provision of long term maintenance contract starting from 4th year for engine and auxiliaries with OEM in the specification. This LTMC will also adhere to monitoring of EMP as per the EIA for the project. The LTMC contractor shall ensure that the equipment supplied to APGC complies with CPCB's pollution norms for stack emissions, water, and noise at that point of time.

Figure 12: PMU STRUCTURE



5.2 Environmental Monitoring Plan (EMoP)

191. The mitigation measures suggested requires monitoring of environmental attributes both during construction and operational phase of the project by the APGC. During the construction and operation phase of this project, the monitoring of the environmental aspects shall be done by the designated Environment Officer of the APGC. During the construction phase, the contractor should ensure that activities like dismantling of gas turbines, compressors, foundations and auxiliary equipment, digging of foundations, handling of earth works, construction of new building etc. is done properly to have minimum impact. This in turn should be monitored by the Project Head/DGM-in-Charge of the project.

192. The field office of APGC and (its EPC contractors) will adhere and comply with all measures and procedures identified in the EMP. The plans, endorsed by the APGC and GoA, will be monitored in accordance to ADB Safeguard Policy 2009 requirements. Mitigation measures related to construction as specified in the EMP will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. In addition, contractors will be requested to submit monthly progress reports on the implementation of EMP measures. The APGC in turn will be expected to report to ADB on progress achieved against the EMP activities and milestones on a quarterly basis. Progress reports will include a description of implementable activities and their status; identify the responsible party (ies) involved in their implementation; and provide project management schedules and timeframes for doing so, along with their associated costs.

193. In addition to the EMP, to ensure that project would not be generating a negative impact to the overall environment quality, an EMoP will be prepared. The monitoring activities of the project include site supervision, verification of permits, monitoring of water quality, soil, noise and air. Monitoring of the quality of water, soil, air and noise during the construction stage is the responsibility of the contractor by the approved government agency. Field office, APGC will supervise the contractor. Monitoring report should be prepared once in six months with the corrective action plan for the problem areas. A sample Environment Monitoring Report is attached as **Annexure 5**, which will be required to submit bi-annually by APGC to ADB. **Annexure 5.3** gives the sample report to be prepared by the EPC and the **Annexure 5.4** gives the parameters to be monitored and their frequency of monitoring.

194. The field office will be responsible for internal monitoring of the EMP implementation, and will forward quarterly progress reports to the PMU with details of activities and progress made during EMP implementation. The PMU will submit semi-annual monitoring reports to ADB. APGC will be responsible for implementing internal monitoring systems for EMP implementation, and will forward semi-annual progress reports to the Government and ADB. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. On-going consultation measures will be incorporated in the EMP.

195. If project activities are noticed to have significant adverse environmental impacts, ADB requires APGC to retain qualified and experienced experts[30] or qualified Non-Government Organisation (NGO) or Community Based Organization (CBO) to verify the report. If required, these external experts/NGO or CBO will report on a semi-annual basis directly to ADB to verify if sound environmental management practices were followed during implementation. In case the implementation of EMP measures is not satisfactory, the external experts/NGO or CBO will recommend actions to enhance environmental compliance.

196. APGC will monitor the project based on the CPCB standards or The World Bank Group, 2007. Environmental, Health, and Safety General Guidelines whichever is more stringent. **Table A1.4 in Annexure 1** has been inserted to provide an illustrative comparison

[30] External expert who is not involved in day-to-day project implementation or supervision

table between the environment standards of CPCB vs. World Bank EHS guidelines. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

5.3 Critical Environmental Review Criteria

(i) Loss of irreplaceable resources

197. The replacement power project will not involve any large scale excavation and land acquisition. The plant shall be erected within 7 acres of the existing Lakwa station. Also, for LRPP, about 10 trees inside the premises will be cut. The Assam Forest Department and APCB require development of a green belt around the perimeter of the LTPS. This compensatory afforestation will be more that requirement. The EMP includes compensation for the loss by minimising the impact of loss of vegetation, if any, as per existing norms of GoA and MoEF. Thus, there will be no net "Biodiversity Loss" for the Gas Based Generation project implementation as a whole.

(ii) Accelerated use of resources for short-term gains

198. The project will not use any natural resources occurring in the area during construction, operation and maintenance phases. The construction material such as engines, compressors, generators, panels, panel mounts, steel, cement etc. shall come from factories while the excavated soil shall be used for backfilling to restore the surface. Thus the project shall not cause any accelerated use of resources for short term gains.

(iii) Endangering of species

199. No endangered species of flora and fauna exist in the project area as well as in the affected forest thus there seems to be no possibility of endangering/causing extinction of any species.

(iv) Promoting undesirable rural-to urban migration

200. The project will not cause any loss of land holdings that normally trigger migration. It also does not involve acquisition of any private land holdings. Hence, there is no possibility of any migration.

(v) Increase in affluent/poor income gap

201. The project will increase availability and reliability of power in Assam state. It is well known that power is a key input to the economic development of any area. Past experience indicates that economic development leads to generation of more jobs which in turn should raise the living standards of poor. Thus the project is expected to contribute in reduction of affluent/poor income gap by providing opportunities for employment and rural based economic activities.

5.4 Environmental Management Plan Budget Costs

202. The main benefits of the environmental mitigation plan are (i) ensuring that environmental standards are met during design, construction, and operation of the project; (ii) providing offsets to negate project impacts especially ecological impacts. Without such expenditures, the project might generate significant environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly depressing the economies of local communities.

203. In order to comply with the environmental protection measures as suggested in the above sections, the management has made a budgetary provision for Environmental Protection and Safety measures. The compliance with the EMP has been prepared based upon optimum and reasonable costs that are derived upon minimisation of mitigation measures on a "least-cost" basis. The illustrative costs towards environmental mitigation measures (both capital and recurring) are given in **Table 48**. It is estimated that 1% of the total project costs would be included as the EMP costs –both one time and recurring. The cost components include items such as cost towards implementation of EMP (contractor's scope),

EMP implementation and monitoring, green belt development, training for HIV/AIDS prevention and independent audit. All other costs mentioned in the EIA document towards stack lean burners, acoustic enclosures and fire safety equipment at the LRPP are considered as part of capital equipment mandatory to meet norms of the CPCB, Government of India.

Table 48: Illustrative Costs towards Environmental Mitigation Measures[31]

	Particulars	Capital Cost (Rs. in Lakhs)	Recurring Cost/annum (Rs. In Lakhs)
1.	Cost towards EMP (Contractors cost) (details in Table 49 below)	160	
2.	EMP implementation Monitoring (details in Table 49 below)		180
3.	Greenbelt around the plant [a]	60	
4.	Medical camps for workmen and society including checkups of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS and health awareness program on regular basis		5
5.	Independent Audit		5
	Total	**220**	**190**
		Max 1% of Total Project Costs over life of project	

[a] Cost taken from EIA document

Table 49: Summary of Estimated Costs for EMP Implementation

	Activity (listed in Table 48 above)	Units	Unit cost in $	Total Cost in $.	Total Cost in Rs Lakhs
1	**Cost of EMP (Contractors Cost)**				
a.	Civil works	1 site	n/a	100,000	
b.	Utilities and sewage	1 site	n/a	30,000	
c.	Drainage controls	1 site	n/a	30,000	
e.	Site access controls	1 site	n/a	40,000	
f.	Fire safety and suppression	1 site	n/a	40,000	
	Contingency (10 %)			24,000	
	Total Cost towards EMP (Contractors cost)			**264,000**	**160 lakhs**
2	**Implementation Monitoring**				
a.	Test of Air Pollution Environmental parameters	lump sum		65,000	
b.	Environmental Training	lump sum	-	15,000	
c.	Consultant Services (remuneration)	18 p-m	5,000	80,000	
d.	Consultant Services (per diem)	Per month	3,450	55,200	
e.	Consultant Services (transportation)	Per month	1,875	30,000	
f.	Field Visit by ESMU to site	Per month	2,500	20,000	
g.	Report/Communication	Lump sum	-	5,000	
	Contingency (10 %)			27,020	
	Total - Implementation Monitoring			**297,220**	**180 lakhs**

[a] Estimated costs are indicative only for expected implementation effort as per assumptions and have been depicted for Tranche 1 only.

Assumptions:

1. Design and construction costs: route survey @ 100% of DPR estimate; civil works @ 33% of DPR estimate; utilities and sewage @ 33% of DPR estimate; drainage controls @ 100% of DPR estimate; site access controls @ 50% of DPR estimate; fire safety & suppression @ 100% of DPR estimates. Total = 0.9% of total project cost.
2. Air and noise sampling/testing at substations @ Rs 5000 per sample and Rs 3000 per sample. Air and water sampling at construction camps @ Rs 5000/per sample and Rs 5000/per sample respectively. Total of 60 samples each (of air, noise, and water) x 4 events. Testing frequency proposed at commencement of construction, and every 6 months afterward for the following 18 months, for a total of 4 testing events.
3. Environmental monitoring and compliance training for ESMC personnel estimated at 2 person-months domestic consultants @$5000/month + $5000 associated costs (travel, per diem, document preparation, seminar rooms, etc.)
4. Consultant services for total of 4 person-months per monitoring event x 4 events spread over initial 18 month implementation period; domestic consulting @ $5000/p-m
5. ESMU Staff to conduct field inspections; 2 people x 4 months during the 18 month project period; 8 pm @ $2500/p-m
6. Total environmental services = 15% of design and construction cost = 0.14% of total project cost
7. USD 1 = INR 60

Source: ADB staff and consultants estimates.

[31] Data taken from EIA document prepared by Ramky Enviro Engineers Limited for LRPP, APGC

5.5 Associated facilities

204. The proposed LTPS gas based generation plant is connected to nearby thermal power plants through the different 132 kV lines used by entire LTPS to evacuate its power to the grid are as follows:

- 132 kV Mariani feeder,
- 132 kV Namrup feeder-I,
- 132 kV Namrup feeder-II,
- 132 kV Dibrugarh feeder,
- 132 kV Nazira feeder-I,
- 132 kV Nazira feeder-II,
- 33 kV ONGC feeder,
- 33 kV Sonari feeder,
- 33 kV Colony feeder.

205. Therefore, the plant will be connected to the following existing power generating projects. Most of them are old plants and the new ones are under development. **Table 50** gives the list of associated facilities.

Table 50: Associated Facilities

SNo.	Power Generating Plant	Details
1	Namrup TPS (Gas based)	134 MW (119.5 MW derated and 85 MW effective capacity)
2.	Chandrapur TPS (Oil based)	60 MW (under revival process)
3.	Karbi Langpi Hydro PS	100 MW
4.	Bordikharu Hydro PS	2 MW (under shutdown)
5.	Namrup Replacement PPP	100 MW (under construction)
6.	Lower Kopili HEP	120 MW (under development)
7.	Margherita -Joint Venture with NEEPCO/ NTPC.	250 MW coal based plan (under development)

5.6 Disaster Management, Health and Safety

Disaster Management

206. Assam State Disaster Management Authority has been formed by the Government of Assam has been designated to take care of disaster management issues.

Health and Safety Issues Management

207. To avoid/ minimize inherent risks during construction, operation and maintenance, APGC will follow national and international Environment, Health and Safety Procedure for the Operations and Maintenance (O&M) period. All power producing elements shall be solidly connected to earth to ensure the safety of operating personal. Some other implications and mitigations from safety point of view as identified in the EIA document.

5.7 Disposal of Dismantled Gas Turbine Power plant:

208. As the project is a replacement of the existing phase-1 power plant, the gas turbine building and the control room and gas compressor building may be kept for use as office and storage. The gas turbine, along with generators and generator transformers and gas compressors may be disposed by way sale to reseller on approval of APGC management and as per statutory norms.

209. Following environment safeguards, **Table 52** below gives the mode of disposal and **Table 53** gives the list of disposable items that will be sold to authorized dealers for the existing phase-1 plant:

Table 52: Mode of Disposal

Group No	Item	Mode of Disposal
B	Gas turbine, generator, transformers, cables and switchgears	To be sold to authorized dealers through bidding. The details of recycler used for Lakwa waste material - Calcutta address M/s Bristol India Pvt Ltd, 26/5/D-E, A M Ghosh Road, Budge Budge, 24 Parganas (S) PIN- 700137 for disposal of waste Lube oil and Transformer Oil
B	Oil and Lubricants	To be sold to authorized dealers.
C	Foundation of Turbine &	About 50 CM of concrete rubbles are expected to be generated in dismantling

	generator:	of the foundations. The rubbles may be used for landfill and covered with excavated earth form the land fill site, to promote vegetation growth. Reinforcement steel shall be disposed through authorized dealers
D	Tentative Quantity of dismantled material (Glass, Iron, Metals, Plastics, concrete, bricks	Not applicable. No building is to be dismantled

Table 53: List of disposable items

Group no	SNo	Items	Ratings	No/Qty	Method of disposal
A	1	Gas turbines	15 MW	4	Through reseller
	2	Exhaust stack	19 M high 4 M dia	4	Through reseller
	3	Exhaust duct with silencers	-	4	Through reseller
	4	Air filter and inlet duct with silencers	-	4	Through reseller
	5	Generators with exciters	-	4	Through reseller
	6	Control and instrument systems	-	4 sets	Through reseller
	7	Control and Power cables of Turbo generators	-	4 sets	Through reseller
	8	Auxiliary equipment of turbo generators		4 sets	Through reseller
	9	Control and Power cables of Turbo generators	-	4 sets	Through reseller
	10	Generator transformers	22.5 MVA	4 nos	Through reseller
	11	132 KV MOCB circuit breakers without oil	-	4 sets	Through reseller
	12	Gas compressors with motors and auxiliaries		5 sets	Through reseller
	13	Gas compressor control panel & switch gears		5 sets	Through reseller
	14	Control and Power cables of gas compressors		5 sets	Through reseller
	1	Turbine lubricants		4000 liters	Approved recyclers
B	2	Gas compressor lubricants		250 liters	Approved recyclers
	3	Transformer oil & circuit breaker oil		4000 liters	Approved recyclers
C	1	Concrete rubbles from foundations		50 CM	As land fill in designated waste disposal area within the power plant complex

Procedure for Disposal

210. The old Lakwa gas turbine based power plant will be sold to resellers and recyclers through open competitive bidding. The procedure will involve the following steps.

1. Proposal to APGC Board for disposal.
2. Approval of APGC Board
3. Valuation of disposal items through Government Approved Valuer of assets
4. Floating of tenders for Main Plant and Recyclable items.
5. Lifting order to Reseller and Recycler within stipulated period

Figure 13: Implementation Plan for Disposal

SNo	Time Line	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
	Items	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	APGC Board's Approval one Year after commissioning of the Gas engine plant																
2	Valuation																
3	Tendering Process																
4	Dismantling and removal form site as per environmental standards																

211. APGC has scrapped the entire Bangaigaon Thermal Power Station (BTPS). in 2009 following an established system of valuation of plant, machinery etc. though open bids. The scrapping consists of total plant, machinery and piping etc. entirely by the buying agent. The buyer is would remove all waste materials from the site as per terms of the bid.

6.0 GRIEVANCE REDRESS MECHANISM

Information Disclosure

212. APGC will submit to ADB the following documents for disclosure on ADB's website:

(i) the final IEE;
(ii) a new or updated IEE and corrective action plan prepared during subproject implementation, if any; and
(iii) the environmental monitoring reports.

213. APGC will provide relevant environmental information, including information from the above documents in a timely manner, in an accessible place and in a form and local language(s) understandable to affected people and other stakeholders in accordance with the *ADB Public Communications Policy 2011.* For illiterate people, other suitable communication methods will be used.

214. IEE results will also be communicated to the local community before commencement of construction through their posting on the website of APGC as well as providing a mechanism for the receipt of comments.

Consultation and Participation

215. APGC will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultation process undertaken under the directions of the ESMU (i) will begin in the subproject preparation stage and will carried out on an on-going basis throughout the subproject cycle[32]; (ii) will provide timely disclosure of relevant information that is understandable and readily accessible to groups and individuals, and specially women; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) will be gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) shall enable the incorporation of all relevant views of affected people and other stakeholders into decision making, such as subproject design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results will be documented and reflected in the environmental assessment report.

216. The APGC may also hold public hearings[33] as per the GOI environmental clearance norms to determine or investigate any matter that it considers necessary in the public interest conducted prior to construction regarding the scope of the subproject, procedure of construction activities, utility of resources, identified impacts and mitigation measures..

Grievance Redress Mechanism (GRM)

217. APGC does not have any specific Environment or Social Safeguards Policy regarding generation/distribution subprojects currently. ADB procedures require APGC to establish a Grievance Redress Mechanism (GRM) having suitable grievance redress procedure to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the subproject's environmental performance. The grievance mechanism will be scaled to the risks and adverse impacts on environment due the subproject type, size, type of area (sensitive area) and impacts. It should address affected people's concerns and complaints promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. This GRM would consist of a Grievance Redress Committee (GRC)

[32] For environment category A projects, such consultations will necessarily include consultations at the early stage of EIA field work and when the draft EIA report is available during project preparation, and before project appraisal by ADB.
[33] A public hearing is a public investigation or inquiry which is held in a public forum and in which those who are affected by the matter(s) being heard or investigated.

headed by the Project Head. The committee would consist of the following constitution as listed in **Table 54**.

Table 54: Constitution of Grievance Redress Committee

1	Project Head, APGC
2	Sub District Magistrate/District Revenue Officer or their nominee
3	Representative of local Panchayat/Council
4	Representative Women representative of village/council
5	Representative of EPC* contractor
6	AGM of Environment and Social Management Unit (ESMU) at PMU or nominee

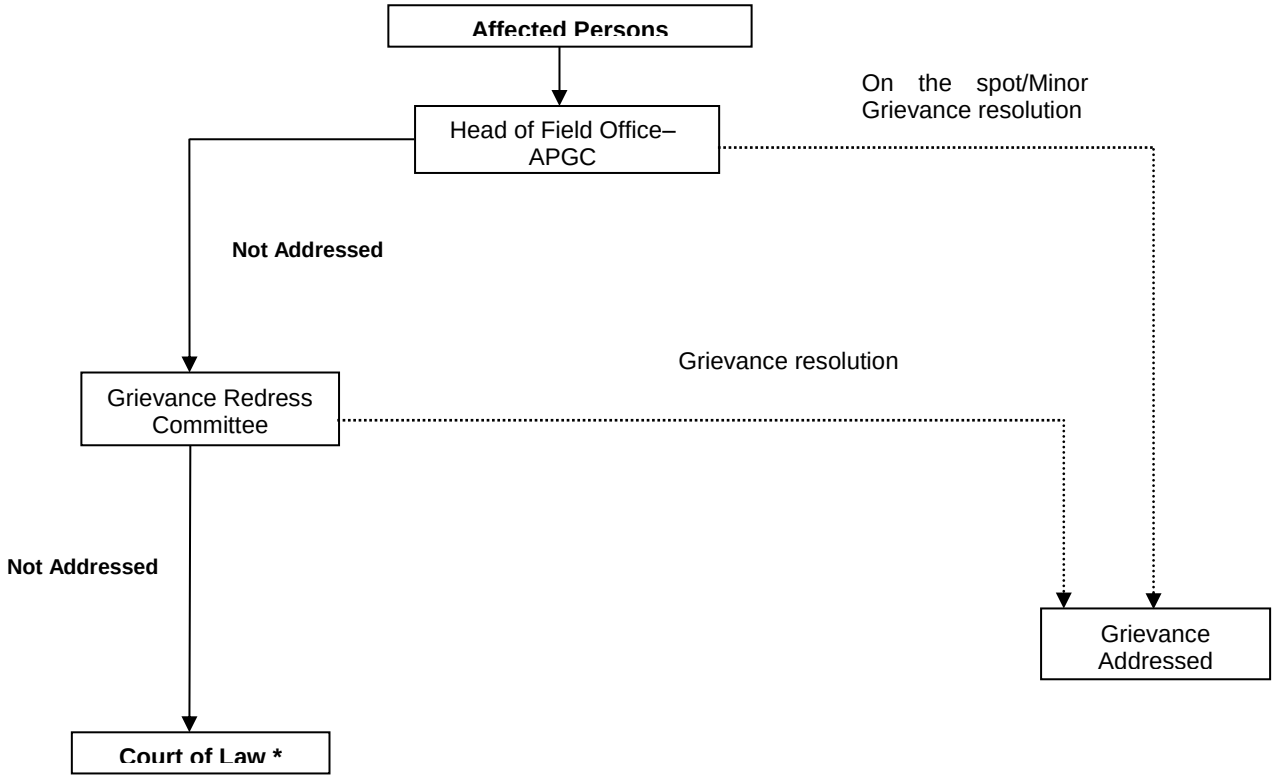
* (EPC) - Engineering, Procurement and Construction Contractor
AGM=Assistant General Manager

218. This Grievance Redress Mechanism (GRM) would provide an effective approach for resolution of complaints and issues of the affected person/community. Project Management Unit (PMU) shall formulate procedures for implementing the GRM, while the PIU shall undertake GRM's initiatives that include procedures of taking/recording complaints, handling of on-the-spot resolution of minor problems, taking care of complainants and provisions of responses to distressed stakeholders etc. paying particular attention to the impacts on vulnerable groups.

219. Grievances of affected persons (APs) will first be brought to the attention of the Project head of the PIU. Grievances not redressed by the PIU will be brought to the Grievance Redress Committee (GRC) set up to monitor subproject Implementation for each subproject affected area. The GRC will determine the merit of each grievance, and resolve grievances within an outer time limit of three months of receiving the complaint. The proposed mechanism does not impede access to the country's judicial or administrative remedies. The AP has the right to refer the grievances to appropriate courts of law if not satisfied with the redress at any stage of the process.

220. The PIU will keep records of all grievances received including: contact details of complainant, date that the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome. The flow chart showing Grievance Redress Mechanism is presented in **Figure 14**.

Figure 14: Flow chart showing Grievance Redress Mechanism



(*) Affected Persons can approach the court of law at time during the Grievance redress process.

7.0 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1 Information Disclosure

221. APGC will ensure that information will be disclosed through public consultation and more formally by making documents at locations in which they can be easily accessed by stakeholders. This would involve making draft summary environmental and social reports available at public locations and providing a mechanism for the receipt of comments. The documents may be made available through ADB and the APGC's website. Normally, For Category A projects, the full EIA must be made available to the public and ADB's Board of Directors at least 120 days before board considers the loan as per SPS 2009 and in accordance with the ADB Public Communications Policy 2011 in English and local language. In line with ADB's Public Communications Policy, APGC is required to ensure that relevant project information about social and environment safeguard issues is made available during the initial stages to affected people and other stakeholders, including the general public at district headquarters where it is publicly accessible in English and vernacular local languages. ADB and APGC will also post these documents on their respective websites.

222. Incorporation of the environmental concerns of APs through the public consultation in the decision making process will avoid or minimise conflict situations during the implementation process as well as enable them to provide meaningful inputs into the project design and its implementation. APGC can conduct public consultation and information disclosure through public meetings and notice.

7.2 Public Consultation

223. During the project formulation stage and the EIA finalisation, M/s Ramky Enviro Engineers Limited, Hyderabad has documented the Public Hearing that was conducted by APCB and APGC. Accordingly, considerable dialogue was held between APGC representatives, APCB, individuals, and groups from the community to make them aware of the proposed project and seek/clarify their objections. MoEF in their final EIA approval have taken note of their suggestions and have requested APGC to adhere to certain requirements that meet the community's aspirations.

224. Although, this project was classified as Category A due to its proximity to state boundary with Nagaland (within 10 kms) by MoEF norms, this project has been classified as per Category 'B" project as per ADB SPS 2009 guidelines. Accordingly, the following disclosure of project information and public consultation was held by APGC and Assam Pollution Control Board on February 11, 2013 to verify the impacts of the project with the local community in the project area.

225. The community were also informed about the Grievance Redress Mechanism (GRM), which will be followed both by APGC as per procedures described in MoEF.

7.3 Consultation Findings

226. Public consultations were conducted in rural areas with persons of proposed project affected areas from July 2013 to August 2013. **Annexure 4** gives the names of all participants of the public consultation conducted by the team. **Annexure 4** also indicates a summary of public consultations conducted during the field survey of project villages. Consultations were also carried out with various stakeholders of the project area.

227. The community consulted was requested to air their opinions freely, on the project, its impact, and suggestions for mitigating adverse impacts. People participated in voluntary public consultation sessions to express their view about the proposed project. No major environmental issues were raised during the consultation process. Local people are waiting eagerly for the implementation to start so they could receive better power and that some

employment may be generated. They informed that there are no health facility is available in the villages. The LTPS has a government dispensary and hospital. The community wanted one separate day for OPD to be set aside for them and that they would need doctors to visit their villages once a month. There is no chronic disease prevalent in area; however they felt their womenfolk needed more awareness about HIV/AIDS. There is no NGO/CBO in the area.

228. Most of the land in the area was agricultural and depended heavily on river, ponds or rain. There was no major industry or income generating projects in the area. People hoped that LTPS would hire some of the trained local youth. On the whole, the people felt the LTPS has provided them with development in the area and gave their assurance for supporting the project activities.

229. In one grievance they mentioned that atleast twice a month when the water would be cleaned in the plant, the drains get a lot of oil and chemicals that spoil the crop as well as also kill the fish in the area. The second one was related to having the 132 kV lines being sagged to low in some places that may be harmful to local public.

230. Some of them demanded that village roads, drains etc. should be cemented, medical facility for the villagers, free power supply for domestic use or at very low cost per month, drinking water facility to be created inside the village. They also demanded that the government should provide more vocational training program for the youth. They felt that APGC should help in development of roads, dispensary etc. in the area.

8.0 FINDINGS AND RECOMMENDATIONS

231. Impacts are manageable and can be managed cost effectively - environmental impacts are likely to result from the construction activity at the dismantling of the gas turbines, stacks, generators, and the erection of replacement gas engines, generators, compressors, cooling systems, stacks and other associated auxiliary equipment as well extension of the switchyard within the plant area. Careful mitigation and monitoring measures and review/assessment procedures have been specified to ensure that minimal impacts take place. The detailed design by the EPC contractor would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction site.

232. The selected 7 acre land area for the replacement power plant is inside the LTPS and hence there is no acquisition of land required from the surrounding communities. Since proposed land for replacement project is nearly barren, the tree removal inside the plant will be minimal for which no approval from forest department will be required.

233. The proposed project will have number of positive impacts and negative impacts to the existing environment as follows:

- Significant improvement of the quality and reliability of the electricity supply to the project affected area according to current demand is the main positive impact.
- There will be no land acquisition and near zero removal of trees for the replacement power project which is the main positive impact to the proposed project area.
- Since the LRPP area is situated entirely inside the plant, there is no need for approval from forest authorities. The EIA approval for the project has already been awarded the MoEF and APCB.
- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, smoke, vibration etc. due to construction activities inside the plant area will not impact the community in the adjoining area; although, it is a very short term negative impact due to proposed project.

234. Proper GRM will have to be implemented by APGC to overcome public inconvenience during the proposed project activities. It is highly recommended to adhere to the directions of the MoEF requirements of the EIA approval with appropriately financed by APGC.

235. Benefits far outweigh negative impacts - the proposed project will improve operational efficiency and quality of power, reliability of the system and at the same time will reduce losses. Supply of power to the region will boost economic development of the area and by strengthening the power generating infrastructure. Overall, the environmental impacts associated with LRPP are limited to the construction period and can be mitigated to an acceptable level by implementation of recommended measures[34] and by best engineering and environmental practices. The impact matrix depicts that the project will not have significant negative environmental impacts and the project would help in improving the socio-economic conditions of this developing state. As the project falls in category B as per the ADB's guidelines, no detailed EIA study is required.

[34] CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

9.0 CONCLUSIONS

236. Based on the proposed capacity, proposed replacement project is situated within the existing LTPS Complex; therefore project is supposed to fall under category B of Project Activity 1(d), Thermal Power Plants <500 MW (coal/ lignite/ naptha & gas based) under the schedule as per EIA notification issued on 14th September, 2006. However the project attracts general condition of the notification as the Nagaland state boundary is falling within 10 km radius from the project site (4 km in South direction) and hence the project falls under Category A of the Government of India which required an Environmental Clearance from Expert Appraisal Committee, MoEF, GoI.

237. APGC studied several options to select a suitable technology that used least land and water resources, best utilisation of minimal gas allocation combined with seasonal fluctuations, its containment within the existing LTPS. Accordingly an EIA was prepared by APGC and the due process was followed to secure MoEF approval which was awarded in May 2013. In accordance with the ADB's Safeguard Policy Statement 2009, the proposed project comprising of replacement of 60 MW obsolete gas turbines 70 MW gas engines and new compressors was categorised as Category B. The impacts are limited to the LTPS boundary which is not co-located with any community or national park/ sanctuary etc. Hence an IEE report has been prepared for the project.

238. Based on the Environment and social impact analysis in the APGC's EIA report as well as the IEE, it is found that there is no adverse impact on the migration of habitat, any natural existing land resources and affect in the regular life of people. The environment and social impact associated with project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provisions that cover monitoring, measuring and mitigation. The main project impacts are associated with decommissioning of old plant, construction waste management and excavation and disposal of waste/obsolete equipment.

239. Potential negative impacts can be expected during project construction phase - decommissioning of obsolete gas turbines in the form of noise and air emissions and erection of new gas engines and compressors. The project has foreseen these concerns as it proposed a set of mitigation measures and a monitoring plan in the form of EMP for its contractors and staff to strictly pursue. There will be significant impacts during Operations on a continuous basis due to emissions of air, noise into the atmosphere and water into the ground if not monitored on a continuous basis. APGC will install suitable equipment to reduce these emissions and shall adhere to guidance provide in the MoEF clearance with respect to monitoring of all environmental parameters during operations. Consequently, it is therefore expected that adverse impacts from the project's life cycle will be minimised.

240. The establishment of the LRPP at LTPS is supported by local communities and the district, resulting from the information disclosure and consultation programs implemented at both levels. The people expected that the emergence of such project will not pose significant negative impacts on the environment. Instead, it would contribute to stabilization of local energy supply in sustainable way. The community's expectation on the project is in line with the project's commitment on environmental and social responsibility.

241. EMP has been prepared and attached as **Annexure 2**. One round of public consultation was conducted at the LRPP site and adjoining villages. The results indicate broad support for the project based on perceived economic and social benefits. Most impacts are expected to occur during the construction phase and are considered to be of temporary nature.

242. No endangered or protected species of flora or fauna are reported at the subproject

site. LTPS is located on land owned by GoA. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The IEE performed is adequate for purposes of project implementation. The potential cumulative and residual impacts of the LRPP as a whole indicate the project classifies as a Category “B”, in accordance with ADB’s Safeguards Policy Statement 2009. The project is not considered highly sensitive or complex.

ANNEXURES

ANNEXURE 1: SUMMARY OF NATIONAL, LOCAL, OTHER APPLICABLE ENVIRONMENTAL LAWS, REGULATIONS, AND STANDARDS

Environmental Regulatory and Policy Framework Selection

1. Government of India, (GoI), State Governments, State Pollution Control Boards and ADB's SPS 2009 policies and procedures apply to all projects. Category A may apply to projects located in environmentally sensitive areas[35]. For each major investment component, an Environment and Social Impact Assessment (ESIA) will be prepared by APGC following ADB's Safeguard Policy Statement, 2009, Environmental Assessment Guidelines, 2003 and applicable National environmental laws and regulations. Based on these ESIA reports, the environmental management plan (EMP) and a corresponding budget will be prepared for each project.

National/Local Government Environment Classification

2. Under the GoI's Environment Impact Assessment (EIA) Notification 2009, the environmental classification of projects is determined by Ministry of Forest and Environment (MoEF), GoI and there are two possible outcomes:

- **Category A**: A subproject is classified as Category A if it is likely to have significant negative impacts and is thus one of the types of project listed in this category in the EIA Notification. Such projects require EIA, plus Environmental Clearance (EC) from MoEF; and
- **Category B**: A subproject is classified as Category B if it is likely to have fewer negative impacts and is listed in this category in the EIA Notification. These projects require EC from the State Environment Impact Assessment Authority (SEIAA), who classify the project as B1 (requiring EIA) or B2 (not requiring EIA), depending on the level of potential impacts. Projects classified as B2 require no further study.

3. As per EIA Act 2009, any thermal project < 500 MW (coal/lignite/naphtha & gas based) the category specified is "B" but this is superseded by the General Condition that "Any project or activity specified in Category 'B' will be treated as Category 'A', if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972; (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time; (iii) Eco-sensitive areas, as notified under section 3 of the Environment (Protection) Act, 1986, such as Mahabaleshwar, Pancgani, Matheran, Panchmarhi, Dhanu, Doon valley, and (iv) inter-State boundaries and international boundaries".

Table A1.1: Indian Regulations for APGC's projects

S.No.	Name of Regulation	Applicability	Remark
ENVIRONMENTAL REGULATIONS			
1	National Green Tribunal Act, 2010	Yes	
2	The Environment (Protection) Act; 1986 and Environment (Protection) Rules 1986 and amendments	Yes	Umbrella Act to the Air, Water and Noise Acts
3	EIA Notification 2006 - Environmental Clearance and Public Consultation	Yes	Situated within 10km of interstate boundary
4	Environmental Statement as per Rule 14 to the Environment (Protection) Rules, 1992	Yes	
5	The Hazardous Waste (Management, Handling and Trans-boundary Movements) rules, 2008	Yes	

[35] Environmentally-sensitive areas include National Parks, Wildlife Sanctuaries, Bio-reserve zones, Eco Sensitive Zones, or wetlands as declared by GoI and areas declared as heritage sites. Environment and wildlife Department's approval is required for right-of-way and sites located in reserved forests, wildlife preserves, national parks, and other designated sensitive areas

S.No.	Name of Regulation	Applicability	Remark
6	Batteries (Management and Handling) Rules, 2001 and further amendments	Yes	
7	Ozone Depleting Substances (Regulation) Rules, 2000 as amended in 2005	No	
8	Forests (Conservation) Act, 1980 and Rules 1981	Yes	
9	The Wildlife (Protection) Act, 1972	Yes	
10	The Biodiversity Act, 2002	Yes	
11	The Air (Prevention and Control of Pollution) Act, 1981 Including Rules 1982 and 1983	Yes	
12	Noise Pollution (Regulation and Control) Rules, 2000 and the Noise Pollution (Regulation and Control) (Amendment) Rules, 2010	Yes	
13	The Water (Prevention and Control of Pollution), Act, 1974 including Rules, 1975 (as amended up to 1988)	Yes	
14	The Water (Prevention and Control of Pollution), Cess Act, 1977 including Rules 1978 and 1991	Yes	
15	The Indian Forest Act 1927	Yes	
16	The National Environmental Appellate Authority Act, 1997	Yes	
17	The Bio-medical Waste (Management and Handling) Rules, 1998	Yes	
SOCIAL REGULATIONS (REGULATIONS RELATED TO LAND AND LABOUR)			
1	The Land Acquisition Act, 1894 and 1984 amendments	Yes	When Governmental Land is used for project
2	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 & rules 2007	Yes	In case project location is situated on Tribal land
3	The Provision of the Panchayats (Extension to the Scheduled Areas) Act, 1996	Yes	
4	The Indian Telegraph Act, 1885	No	Only if APGC has to setup its own transmission corridor
5	Indian Treasure Trove Act, 1878 (as modified upto September 1949)	Yes	
6	The Antiquities and Art Treasures Act, 1972	Yes	
7	The Child Labour (Prohibition and Regulation) Act, 1986	Yes	
8	The Bonded Labour (Abolition) Act 1976	Yes	
9	The Trade Union Act, 1926	No	
10	Minimum Wages Act, 1948	Yes	
11	Workmen's Compensation Act, 1923	Yes	ESI Act or Workmen Compensation Act applicable to APGC
12	The Contract Labour (Regulation & Abolition) Act, 1970 and Rules	Yes	
13	The E.P.F. and Miscellaneous Provisions act, 1952	Yes	
14	Factories Act 1948	Maybe	In-case APGC employees more than ten full time employees during the operations phase of the project
15	ESI Act, 1948 (Employees State Insurance Act, 1948)	Yes	ESI Act or Workmen Compensation Act applicable to APGC
16	Payment of Gratuity Act, 1972	Yes	
17	Employers' Liability Act No. 24 of 1938	Yes	
18	Building and Other Construction Workers Act 1996	Yes	Key legislations providing guidelines for onsite labour and worker management and welfare
19	Interstate Migrant Workers Act 1979	Yes	In case workers and labourers working at the project sites are migrants from other states
20	State Specific Shops and Establishment Act	Yes	Specific to state of establishment
OCCUPATIONAL HEALTH AND SAFETY			
1	The Indian Factories Act, 1948 and State Rules	Maybe	Reason same as above
2	The Shops and Establishment Act and State Rules	Yes	
3	The Petroleum Act, 1934 and the Petroleum Rules	Yes	
4	Gas Cylinder Rules and Static and Mobile Pressure Vessels (Unfired) Rules, 1981	Yes	

S.No.	Name of Regulation	Applicability	Remark
5	Central Electricity Authority (Safety Requirements for Operation, Construction and Maintenance of Electric Plants and Electrical Lines) Regulations 2008	Yes	
6	CGWA Notification No.21-4/Guidelines/CGWA/2009-832 dated 14th October 2009	Yes	
7	Indian Electricity Act	Yes	
INTERNATIONAL ENVIRONMENT HEALTH AND SAFETY			
1	The World Bank EHS guidelines 2007	Yes	

4. Apart from the above mentioned regulations, the Government of India has also structured a number of policies that are relevant to APGC's initiatives. The key policies have been provided in Table A2.

Table A1.2: Indian Policies in India related to Projects

SNo.	Name of Regulation	Applicability	Remark
ENVIRONMENT, FOREST & LAND RELATED POLICIES			
1	National Forest Policy, 1988	Yes	
2	National Environmental Policy 2006	Yes	
3	Wildlife Conservation Strategy 2002	Yes	
4	National Policy for Resettlement and Rehabilitation 2007	Yes	

5. Relevant Acts of Government of Assam
   a. Assam Ancient Monuments and Records Act, 1959.
   b. Assam Forest Regulation, 1891 (Assam Regulation 7 of 1891) as applied vide Meghalaya Forest Regulation (Application & Amendment) Act, 1973 (Meghalaya Act 9 of 1973)
   c. Assam National Park Act, 1968
   d. Assam Land and Revenue Regulation, 1886
   e. Assam Irrigation Act, 1983
   f. Assam Fishery Rules, 1953
   g. Assam Forest Policy, 2004
   h. Assam Government's Guidelines for Compensatory Afforestation, 2000
   i. Assam Panchayat Act, 1994
   j. Assam Khadi and Village Industries Board Act, 1955
   k. Assam Forest Protection Force Act 1986
   l. Assam Cooperative Agriculture and Rural Development Act 1960

Asian Development Bank's Safeguards Policies

6. At an initial stage of identifying an investment, the Corporate EHS will apply the following ADB's Prohibited Investment Activities List (described below). If the investment involves a prohibited activity, APGC will not consider the investment.

ADB Prohibited Investment Activities List (PIAL)

7. The following type of projects do not qualify for Asian Development Bank financing:

(i) production or activities involving harmful or exploitative forms of forced labour[36] or child labour[37];'

(ii) production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phase outs or bans, such as (a) pharmaceuticals[38], pesticides, and herbicides[39],(b) ozone-depleting

[36] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

[37] Child labor means the employment of children whose age is below the host country's statutory minimum age of employment or employment of children in contravention of International Labor Organization Convention No. 138 "Minimum Age Convention" (www.ilo.org).

[38] A list of pharmaceutical products subject to phaseouts or bans is available at http://www.who.int.

[39] A list of pesticides and herbicides subject to phaseouts or bans is available at http://www.pic.int.

substances[40], (c) polychlorinated biphenyls[41] and other hazardous chemicals[42], (d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora[43], and (e) trans-boundary trade in waste or waste products[44];

(iii) production of or trade in weapons and munitions, including paramilitary materials;

(iv) production of or trade in alcoholic beverages, excluding beer and wine[45];

(v) production of or trade in tobacco;

(vi) gambling, casinos, and equivalent enterprises;

(vii) production of or trade in radioactive materials[46], including nuclear reactors and components thereof;

(viii) production of, trade in, or use of unbonded asbestos fibers[47];

(ix) commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and

(x) marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

Asian Development Bank's Environment Classification

8. The ADB's Safeguard Policy Statement (SPS), 2009 is applicable to all projects. These projects can be categorized as A, B, or C. Table A3 below provides a list of categorisation of the activities related to Environment, Involuntary Resettlement, and Indigenous Peoples Safeguards, as per ADB's Safeguard Policy Statement 2009. Requirements:

Table A1.3: Environment and Social Safeguards Categorization: Definition

Category	Environment	Involuntary Resettlement	Indigenous Peoples[48]
A — Significant	Investments that anticipate 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.	Investments where 200 or more persons will 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).	Investments that are expected to significantly' affect the dignity, human rights, livelihood systems, or culture of Indigenous Peoples or affects the territories or natural or cultural resources that Indigenous Peoples own, use, occupy, or claim as an ancestral domain or asset.
B — Less Significant	Investments with potential adverse impacts that are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be more readily designed than for Category A investments.	Investments with involuntary resettlement impacts that are not deemed significant.	Investments that are likely to have limited impacts on Indigenous Peoples.
C — Minimal or impact	Investments that have minimal or no adverse environmental impacts.	Investments with no involuntary resettlement impacts.	Investments that are not expected to have impacts on Indigenous Peoples.

[40] A list of the chemical compounds that react with and deplete stratospheric ozone resulting in the widely publicized ozone holes is listed in the Montreal Protocol, together with target reduction and phaseout dates. Information is available at http://www.unep.org/ozone/montreal.shtml.

[41] A group of highly toxic chemicals, polychlorinated biphenyls are likely to be found in oil-filled electrical transformers, capacitors, and switchgear dating from 1950 to 1985.

[42] A list of hazardous chemicals is available at http://www.pic.int.

[43] A list is available at http://www.cites.org.

[44] As defined by the Basel Convention; see http://www.basel.int.

[45] This does not apply to investee companies who are not substantially involved in these activities. Not substantially involved means that the activity concerned is ancillary to an investee company's primary operations.

[46] This does not apply to the purchase of medical equipment, quality control (measurement) equipment, and any equipment for which ADB considers the radioactive source to be trivial and adequately shielded.

[47] This does not apply to the purchase and use of bonded asbestos cement sheeting where the asbestos content is less than 20%.

[48] The significance of impacts on Indigenous Peoples is determined by assessing (i) the magnitude of impact in terms (1) of (a) customary rights of use and access to land and natural resources; (b) socioeconomic status; (c) cultural and communal integrity; (d) health, education, livelihood, and social security status; and (e) the recognition of indigenous knowledge; and (ii) the level of vulnerability of the affected Indigenous Peoples community

COMPARISON OF ENVIRONMENTAL STANDARDS FOR GAS-BASED THERMAL POWER PLANTS

9. The table below gives the comparison of standards prescribed by the Central Pollution Control Board, GoI and the The World Bank's Environmental Health and Safety Guidelines 2007. The EA shall follow the CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

Table A1.4: Environment Standards: CPCB vs. World Bank EHS guidelines

	Parameters	**Standards as perThe Environment (Protection) Rules, 1986"**	**Standards as per World Bank's Environmental, Health, and Safety Guidelines 2007**
A.	**SO_2 Emissions**	**Stack Height/Limit**	
1	Less than 200 MW/210 MW	H-14(Q)$^{0.3}$ where Q is emission rate of SO_2 in *kg/hr. and *H Stack height in metres subject to a minimum of 30 meters.	500 g/m^3
B.	**Particulate Matter Emissions**		
1	Generation capacity less than 210 MW	350 mg/m^3 (Depending upon the requirement of local situation, such as protected area, the State Pollution Control Board and other implementation agencies under the Environment (Protection) Act, 1986 may prescribed a limit of 150 mg/m^3, irrespective of generation capacity of the plant.	50g/m^3
C.	**NOx emissions**	**Limit for Stack NOx emission [v/v) at 15% excess oxygen]**	
1	For existing units	150 ppm (v/v) at 15% excess oxygen.	200 g/m^3
2	Gas turbine less than 400 MW but upto 100 MW	75 ppm for the units burning natural gas.	200 g/m^3
3	Gas turbines Less than 100 MW	100 ppm for units burning natural gas or naphtha as fuel	200g/m^3 no emissions guideline
4	Gas Engines	No emissions guideline	No emissions guideline
D.	**Liquid waste discharge limit**		
1	pH	6.5-8.5	6-9
2	Temperature	As applicable for other thermal power plants	+3 degrees from ambient temperature
3	Free available chlorine	0.5 mg/l	Compliance with national or local standards
4	Suspended solids	100.0 mg/l	Compliance with national or local standards
5	Oil and grease	20.0 mg/l	Compliance with national or local standards
6	Copper (total)	1.0 mg/l	Compliance with national or local standards
7	Iron (total)	1.0 mg/l	Compliance with national or local standards
8	Zinc	1.0 mg/l	Compliance with national or local standards
9	Chromium (total)	0.2 mg/l	Compliance with national or local standards
10	Phosphate	5.0 mg/l	Compliance with national or local standards

10. Higher performance levels than these in the Table should be applicable to facilities located in urban / industrial areas with degraded airsheds or close to ecologically sensitive areas where more stringent emissions controls may be needed Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.

ANNEXURE 2: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Project activity /stage	Potential impact	Proposed mitigation measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Pre-construction						
Location of plant and design of disposal site	Exposure to safety related risks	Setback of dwellings to designed in accordance with permitted level of air quality deterioration and the regulation of supervision at sites.	Air quality, disposal points with respect to nearest dwellings	Setback distances to nearest houses - once	APGC	Detailed alignment survey and design
Escape of polluting materials	Environmental pollution	Gas Engines/Transformers designed with oil spill containment systems, and purpose-built oil, lubricant and fuel storage system, complete with spill cleanup equipment.	Equipment specifications with respect to potential pollutants	Tender document to mention specifications - once	APGC	Part of detailed equipment design /drawings
		Power plant to include drainage and sewage disposal systems to avoid offsite land and water pollution.	Power plant sewage design	Tender document to mention detailed specifications - once	APGC	Part of detailed layout and design /drawings
Equipment specifications and design parameters	Release of chemicals and gases in receptors (air, water, land) during decommissioning of old power plant	PCBs not used in transformers or other project facilities or equipment.	Equipment design	Exclusion of PCBs in transformers stated in tender specification - once	APGC	Part of tender specifications for the equipment
		Processes, equipment and systems not to use chlorofluorocarbons (CFCs), including halon, and their use, if any, disposal required from existing processes and systems should be phased out and to be disposed of in a manner consistent with the requirements of the Government	Process, equipment and system design	Exclusion of CFCs stated in tender specification – once	APGC	Part of tender specifications for the equipment
				Disposal schedule to be prepared in case still in use – once		Part of equipment and process design
Plant location and design	Exposure to noise	Design of plant enclosures to comply with noise regulations.	Expected noise emissions based on design	Noise levels to be specified in tender documents - once	APGC	Part of detailed siting survey and design
Interference with drainage patterns/Irrigation channels	Flooding hazards/loss of agricultural production	Appropriate siting of plant facilities to avoid channel interference	Site location (distance to nearest flood zone)	Consultation with local authorities and design engineers – once	APGC	Part of detailed alignment survey and design
Equipment submerged under flood	Contamination of receptors (land, water)	Plant facilities constructed above the high flood level (HFL) by raising the foundation pad.	Design to account for HFL (elevation with respect to HFL elevation)	Base height as per flood design - once	APGC	Part of detailed layout and design/drawings
Explosions/Fire	Hazards to life	Design of plant to include modern fire control systems/firewalls.	Design compliance with fire prevention and control codes	Tender document to mention detailed specifications - once	APGC	Part of detailed layout and design /drawings
		Provision of fire fighting equipment to be located close to power generation equipment.				
Construction						
Usage of Equipment for mechanized construction	Air Emissions	All equipment are operated within specified design parameters.	Random checks of equipment logs/ manuals	Periodic	APGC, Contractor through contract provisions	Construction period
		Any dry, dusty materials stored in sealed containers or prevented from blowing.	Stockpiles or open containers of dusty materials.	Periodic during construction activities		
		Ambient air quality within the premises of the proposed unit to be monitored.	The ambient air quality will conform to the standards for SPM, RSPM, SO_2, NO_x, and NH_4	As per CPCB*/ APCB requirement		
	Noise, vibration and operator safety,	List of all noise generating machinery onsite along with age to be prepared. Construction	Construction equipment – estimated noise emissions	Complaints received by local authorities - every 2	APGC, Contractor	Construction period

Project activity /stage	Potential impact	Proposed mitigation measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
	efficient operation	equipment to be well maintained.		weeks	through contract provisions	
		Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances, and enclosures).	Mufflers/enclosures shall be in place. Site working practices records, noise reading	Periodic during construction activities - monthly		
		All equipment operated within specified design parameters.	Random checks of equipment logs/ manuals			
		Vehicle trips to be minimized to the extent possible	Vehicle logs			
	Noise, vibration, equipment wear and tear	Proper maintenance and turning off plant not in use. Noise to be monitored in ambient air within the plant premises.	Construction equipment – estimated noise emissions and operating schedules	As per CPCB*/APCB requirement-every 2 weeks	APGC, Contractor through contract provisions	Construction period
Construction schedules	Noise nuisance to neighbouring properties	Construction activities only undertaken during the day and local communities informed of the construction schedule.	Timing of construction (noise emissions, [dB(A)])	Daytime construction only - every 2 weeks	APGC, Contractor through contract provisions	Construction period
Equipment layout and installation	Water pollution	Construction activities involving significant ground disturbance	Seasonal start and finish of major earthworks (pH, BOD/COD, suspended solids, other)	Timing of major disturbance activities - prior to start of construction activities	APGC, Contractor through contract provisions	Construction period
Power Plant construction	Drainage and effluent Management	No direct discharge of wastewater to be made to surface water, groundwater or soil.	No discharge hoses shall be in vicinity of watercourses.	Periodic during construction activities	APGC, Contractor through contract provisions	Construction period
		The discharge point would be selected properly and sampling and analysis would be undertaken prior to discharge	Discharge norms for effluents as given in permits	Periodic during construction activities		
		Take care in disposal of wastewater generated such that soil and groundwater resources are protected.	Visual inspection of drainage and records thereof			
		The design to incorporate existing drainage pattern and avoid disturbing the same.				
Surplus earthwork/soil	Runoff to cause water pollution, solid waste disposal	Excess soil excavation from plant disposed of next to roads or around houses	Location and amount (m^3) of fill disposal	Appropriate fill disposal locations - every 2 weeks	APGC, Contractor through contract provisions	Construction period
Storage of chemicals and materials	Contamination of receptors (land, water, air)	Fuel and other hazardous materials securely stored above high flood level.	Location of hazardous material storage; spill reports (type of material spilled, amount (kg or m^3) and action taken to control and clean up spill)	Fuel storage in appropriate locations and receptacles - every 2 weeks	APGC, Contractor through contract provisions	Construction period
Provision of facilities for construction workers	Contamination of receptors (land, water, air)	Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities.	Amenities for Workforce facilities	Presence of proper sanitation, water supply and waste disposal facilities - once each new facility	APGC, Contractor through contract provisions	Construction period

Project activity /stage	Potential impact	Proposed mitigation measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
Flooding hazards due to construction impediments of natural drainage	Flooding and loss of soils, contamination of receptors (land, water)	Avoid natural drainage pattern /facilities being disturbed /blocked /diverted by the on-going construction activities	Contract clauses (e.g., suspended solids and BOD/COD in receiving water)	Incorporating good construction management practices – once for each site	APGC (Contractor through contract provisions)	Construction period
Equipment submerged under flood	Contamination of receptors (land, water)	Equipment stored at secure place above the high flood level (HFL).	Store room level to be above HFL (elevation difference in meters)	Store room level as per flood design - once	APGC	Construction period
Health and safety	Injury and sickness of workers and members of the public	Contract provisions specifying minimum requirements for construction camps	Contract clauses (number of incidents and total lost-work days caused by injuries and sickness)	Contract clauses compliance – once every quarter	APGC (Contractor through contract provisions)	Construction period
		Contractor to prepare and implement a health and safety plan.				
		Contractor to arrange for health and safety training sessions				
Inadequate construction stage monitoring	Likely to maximise damages	Training of APGC environmental monitoring personnel	Training schedules	Number of programs attended by each person – once a year	APGC	Routinely throughout construction period
		Implementation of effective environmental monitoring and reporting system using checklist of all contractual environmental requirements	Respective contract checklists and remedial actions taken thereof.	Submission of duly completed checklists of all contracts for each site - once		
		Appropriate contact clauses to ensure satisfactory implementation of contractual environmental mitigation measures.	Compliance report related to environmental aspects for the contract	Submission of duly completed compliance report for each contract - once		
Operation and Maintenance						
Air Emission	Emissions from Stack beyond limits specified by CPCB* norms	Stack emissions from Power Plants	Gaseous emissions (SO_2 & NOx)	Continuous monitoring using on-line equipment during operation phase-daily	APGC and O&M Contractor	During operations
		AAQ within the project premises and nearby habitations (3 places at 120°) to be monitored. All vehicles to be PUC certified.	SPM, RPM, SO_2 & NOx, NH4 Vehicle logs to be maintained.	As per CPCB*/ APCB requirement	APGC and O&M Contractor	During operations
		Meteorological data	Wind speed, direction, temp., relative humidity and rainfall.	Continuous monitoring using automatic weather station - daily	APGC and O&M Contractor	During operations
Noise related	High noise level to operators/workers at plant	Noise generated from operation of compressor power plant, cooling towers to be monitored	Spot Noise levels recording (dB(a))	Noise levels at boundary nearest to properties and consultation with affected parties if any - once	APGC and O&M Contractor	Operations
Wastewater Discharge	Release of wastewater in receptors (air, water, land)	Compliance to wastewater discharge standards	pH, TSS, TDS, BOD, COD & Oil& Grease.	Periodic or As per CPCB*/ APCB requirement	APGC and O&M Contractor	Operations
Solid Waste/ Hazardous Waste	Release of Solid waste and HW in receptors (air, water, land)	Check compliance to HWM rules	Quality & quantity monitoring	Periodically-monthly	APGC and O&M Contractor	Operations
Oil spillage	Contamination of	Compressors, Gas Engines, Switchyard	Pits designed ("as-built"	Pits capacity and	APGC and	During operations

Project activity /stage	Potential impact	Proposed mitigation measure	Parameter to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule
	land/nearby water bodies	transformers located within secure and impervious pit areas with a storage capacity of at least 100% of the capacity of oil in transformers and associated reserve tanks.	diagrams)	permeability - once	O&M Contractor	
Power generating equipment maintenance	Exposure to electromagnetic interference	Equipment design to comply with the limits of electromagnetic interference within floor area	Required vibrations level, instrumentation	Instrumentation regular monthly	APGC and O&M Contractor	Operations
Groundwater Quality and Water Levels	Reduction in ground water level	Monitoring ground water quality, around plant site and levels	Comprehensive monitoring as per IS 10500 Groundwater level BGL	Periodically - monthly	APGC and O&M Contractor	Operations
Inadequate provision of staff/workers health and safety during operations	Injury and sickness of staff /workers	Careful design using appropriate technologies to minimise hazards	Usage of appropriate technologies (lost work days due to illness and injuries)	Preparedness level for using these technologies in crisis – once each year	APGC and O&M Contractor	Design and operation
		Health check camps, safety awareness raising for staff.	Health camps, Training/awareness programs and mock drills	Regular checkups as per factories act Number of programs and percent of staff /workers covered – once each year		
		Preparation of fire emergency action plan and training given to staff on implementing emergency action plan				
		Provide adequate sanitation and water supply facilities	Provision of facilities	Complaints received from staff /workers every 2 weeks		
Electric Shock Hazards	Injury/mortality to staff and public	Careful design using appropriate technologies to minimise hazards	Usage of appropriate technologies (number of injury incidents, lost work days)	Preparedness level for using these technologies in crisis – once a month	APGC and O&M Contractor	Design and Operation
		Security fences around plant and equipment	Maintenance of fences	Report on maintenance – every 2 weeks		
		Barriers to prevent climbing on/dismantling of equipment	Maintenance of barriers			
		Appropriate warning signs on facilities	Maintenance of warning signs			
		Electricity safety awareness raising in project areas	Training /awareness programs and mock drills for all concerned parties	Number of programs and percent of total persons covered – once each year		
Operations and maintenance staff skills less than acceptable	Unnecessary environmental losses of various types	Adequate training in O&M to all relevant staff/maintenance crews.	Training/awareness programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	APGC and O&M Contractor	Operation
		Preparation and training in the use of O&M manuals and standard operating practices.				
Inadequate periodic environmental monitoring.	Diminished ecological and social values.	APGC staff to receive training in environmental monitoring of project operations and maintenance activities.	Training/awareness programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	APGC and O&M Contractor	Operation
Greenbelt	Reduction of green cover around plant	Vegetation, greenbelt / green cover development	Number of plants, species	Once a year	APGC, Forest Department	Operations

* CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

ANNEXURE 3: APPROVAL OF ENVIRONMENT IMPACT ASSESSMENT

MINUTES OF THE 74TH MEETING OF RE-CONSTITUTED EXPERT APPRAISAL COMMITTEE ON ENVIRONMENTAL IMPACT ASSESSMENT OF THERMAL POWER AND COAL MINE PROJECTS

The 74th Meeting of the reconstituted Expert Appraisal Committee (Thermal) was held during **May 20-21, 2013** at SCOPE Convention Centre, Lodi Estate, New Delhi. The members present were:

1. Shri V.P. Raja – Chairman
2. Dr. C.R. Babu - Vice-Chairman
3. Shri T.K. Dhar - Member
4. Shri J.L. Mehta - Member
5. Dr. G.S. Roonwal - Member
6. Shri M.S. Puri - Member
7. Dr. Saroj - Member Secretary

Member Secretary, CPCB; Dr. CBS Dutt, Dr. K.K.S. Bhatia, Dr. S.D. Attri and Shri V.B. Mathur were absent.

In attendance: Sh. W. Bharat Singh, Deputy Director, MoEF.

The deliberations held and the decisions taken are as under:

ITEM 2.16 Modernization of 70 MW Lakwa Power project (LRPP) of M/s. Assam Power Generation Corporation Ltd. at Village: Mybella,
Tehsil Lakwa, Distt. Sivasagar, Assam- reg. Environmental Clearance.

The proposal is for consideration for environmental clearance. The project proponent made a presentation along with its consultant M/s Ramky Enviro Engineers Ltd., Hyderabad and provided following information:

The proposal is an inter-state case (Assam-Nagaland) and hence is being dealt at the Centre. The proposal is for modernization of 70 MW Lakwa Power project (LRPP) at village Mybella, in Tehsil Lakwa, in Distt. Sivasagar, in Assam. Existing capacity of the plant is 157 MW (4x15 MW + 3x20 MW+ 1x37 MW [WHRB]) and the proposed replacement of 4x15 MW Gas turbine units with 10x7 MW Open cycle gas engine. The total capacity after modernization and expansion will be 167 MW. The existing land of Lakwa Thermal Power Station is 212 acres and 7 acres is needed for proposed replacement which is within the existing APGC complex. The co-ordinates of the site are located within Latitude 26059'02.93" N to 26059'09.69" N and Longitude 94055'42.82" E to 94055'51.34" E. Natural Gas requirement will be 0.36 MMSCMD. Water requirement of 3108m3/day will be sourced from the existing plant reservoir, which receives it from Haldia Development Authority (HAD), through existing pipeline at a distance of about 24 km from the project site. Water cooled condenser will be installed for cooling system. There are 3 Reserve Forests (RF) i.e. Chala RF which is 1.6 km North-west from the project site, Abhaypur RF 3.6 Km from the south of the project site, and Singphan RF is 4 km south adjacent to Abhaypur RF. Public Hearing was held on 11.02.2013. There are no wildlife sanctuary/national parks, tiger reserve etc. within 10 kms of the project site. Cost of the project will be Rs.263 Crores.

The Committee discussed the issues raised in the Public Hearing and the responses made by the project proponent. The major issues raised were effect on nearby paddy fields due to discharge of wastewater from the plant, effect on noise level, human health hazards associated with project, effect on Reserve Forests located nearby, any existence of Tigers in the study area, Singphan RF is situated at 10 km radius and was proposed to declare as wildlife sanctuary etc. The project proponent informed that there were no litigation pending pertaining to the power project.

On the issue of effluent generated and impact on nearby paddy field, the project proponent stated that no waste water will be discharged into nearby fields as the effluent generated from service water and engine cooling will be treated in existing ETP. It was also stated that there are no tigers in the study area and the same was confirmed by local villagers.

Based on the information and clarifications provided the Committee recommended *environmental clearance for the proposed modernisation* subject to stipulation of the following specific conditions:

i) The project proponent shall regenerate degraded water body (if any) located nearby within 5.0 km atleast.

ii) COC of 5.0 shall be adopted.

iii) Monitoring of surface water quantity and quality shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall be undertaken.

iv) The leveling in plant area should be minimum with no or minimal disturbance to the natural drainage of the area.

v) Well designed acoustic enclosures for the DG sets and noise emitting equipments to achieve the desirable insertion loss viz. 25 dB(A) should be provided.

vi) A well designed rain water harvesting system shall be put in place within six months, which shall comprise of rain water collection from the built up and open area in the plant premises

vii) CSR schemes identified based on need based assessment shall be implemented in consultation with the village Panchayat and the District Administration starting from the development of project itself. As part of CSR prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken. Company shall provide separate budget for community development activities and income generating programmes.

viii) Special package with implementation schedule for providing free potable drinking water supply in the nearby villages and schools shall be undertaken in a time bound manner.

ix) An amount of Rs 1.0 Crore as one time investment shall be earmarked for activities to be taken up under CSR during construction phase of the Project. Recurring expenditure for CSR thereafter shall be Rs 0.20 Crores per annum till the life of the plant. Social Audit by a reputed University or an Institute shall be carried out annually and details to be submitted to the Ministry besides putting it on Company's website.

x) An Environmental Cell comprising of atleast one expert in environmental science / engineering, occupational health and social scientist, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the head of the organization who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.

FORM-1

MOEF Notification No.S.O.1533 dated 14th September 2006

Submitted To:

Ministry of Environment & Forests Government of India, Paryavaran Bhawan CGO Complex, Lodhi Road New Delhi-110 003

Assam Power Generation Corporation Ltd
Bijulee Bhavan, 3rd Floor
Paltan Bazar, Guwahat-781001

Prepared by:
RAMKY Enviro Engineers Ltd.
TSR Towers, Rajbhavan Road, Somajiguda, Hyderabad – 500 082.

APPLICATION FOR PRIOR ENVIRONMENTAL CLEARANCE FOR "A" CATEGORY PROJECTS

(I) Basic Information

SNo	Item	Details
1	Name of the Project /sites	70 MW Lakwa Replacement Power Project (LRPP) of Assam Power Generation Corporation Limited (APGC) / No alternate sites
2	S.No. in the Schedule	1(d) Thermal Power Plants
3	Proposed capacity / area / length / tonnage to be handled /command area / lease area / number of wells to be drilled	70MW Power Plant. Plant Layout is given as Annexure-1
4	New / Expansion / Modernization	Modernization
5	Existing Capacity / Area etc.	Existing Capacity – 157 MW Area – 211.8 acres Area for proposed Modernization - 7 Acres (existing plant site) Land break-up details Provided as Annexure -2
6	Category of Project i.e. 'A' or 'B'	"A"
7	Does it attract the general conditions? If yes, please specify	"Yes" The project site is 4 km away from Assam – Nagaland State boundary in South direction Digitized map of 10 km radius around the project site is given as Annexure 3
8	Does it attract the Specific conditions? If yes, please specify	"No"
9	Location	Latitude: 26^0 59' 07" N Longitude: 94^0 55' 52" E
	Plot / Survey / Khasra No	-
	Village	Mybella
	Tehsil	Lakwa
	District	Sivasagar
	State	Assam
10	Nearest railway station / airport along with distance in kms	Suffry Railway Station ~5 Km, North East Rowriah Airport (Jorhat) ~75Km, South West
11	Nearest town, city, district headquarters along with distance in kms	Town and district headquarters is Sivasagar which is located at 46 Km away from proposed site in West direction
12	Village Panchayats, Zilla Parishad, Municipal Corporation, Local body (complete postal addresses with telephone no.s, to be given)	Sukapha Gaon Panchayat President :Shri Jogen Kahar, P.O Nimanagarh, Dist Sivasagar. pin -785690
13	Name of the applicant	Assam Power Generation Corporation (APGC)
14	Registered Address	Assam Power Generation Corporation Ltd,(APGC), Bijulee Bhavan, 3rd Floor, Paltan Bazar, Guwahati-781001
15	Address for Correspondence	
	Name	Mr. K. Phatowali
	Designation (Owner/Partner/CEO)	The Chief General Manager
	Address	Assam Power Generation Corporation Ltd,(APGC), Bijulee Bhavan, 3rd Floor, Paltan Bazar, Guwahati-781001
	Pin Code	Guwahati-781001
	E-mail	APGCamguri@yahoo.com
	Telephone no	0361-2739546
	Fax no	0361-2739546
16	Details of Alternate Sites examined, if any. Location of these sites should be shown on a topo sheet.	No alternative sites were examined as the proposed modernization project will be commissioned in the existing power plant complex.
17	Interlinked Projects	None
18	Whether separate application of interlinked project has been submitted	Not Applicable
19	If yes, date of submission	Not Applicable
20	If no, reason	Not Applicable
21	(a) Whether the proposal involves approval / clearance under: if yes, details of the same and their status to be given The Forest (Conservation) Act, 1980? The Wildlife (Protection) Act, 1972? The C.R.Z. Notification, 1991?	Nil
22	Whether there is any Government Order / Policy relevant / relating to the site	No
23	Forest Land involved (hectares)	Nil
24	(a) Whether there is any litigation pending against the project and / or land in which the project is proposed to set up? Name of the Court Case No	Nil
	(b)	
	(c) Orders / directions of the court, if any and its relevance with the proposed project (c)	

(II) Activity

1) Construction, operation or decommissioning of the project involving actions, which will cause

physical changes in the locality (topography, land use, changes in water bodies, etc.)

SNo	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
1.1	Permanent or temporary change in landuse, land cover or topography including increase in intensity of landuse (with respect to local landuse plan)	No	No topographical or Land Used Land Cover changes are envisaged as the proposed project is within the existing plant site.
1.2	Clearance of existing land, vegetation and buildings?	No	No vegetation clearance is involved as the proposed project is the modernization of the existing power plant.
1.3	Creation of new land uses?	No	Existing land will be used for modernization Details of Land break up is given in Annexure-2
1.4	Pre-construction investigations' e.g. bore holes, soil testing?	Yes	Geo-technical investigation of the site was carried out while setting up existing plant.
1.5	Construction works?	Yes	Structural construction works will be carried out to accommodate Boiler, Turbine, Generator, Condenser, Cooling water system, natural Gas handling system, Switchyard and other civil, mechanical and electrical plant and equipment.
1.6	Demolition works?	Yes	Restructuring of the existing power plant to meet the requirement of the proposed Open Cycle Gas Engine
1.7	Temporary sites used for construction works or housing of construction workers?	Yes	Temporary shelters and sanitation facilities for construction workers shall be provided within plant area.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	Yes	As mentioned in the item 1.5
1.9	Underground works including mining or tunneling?	No	The proposed project is the modernization of the existing power plant. Hence no underground activities are envisaged
1.10	Reclamation works?	Yes	The proposed project is the modernization of the existing power plant.
1.11	Dredging?	No	Not applicable
1.12	Offshore structures?	No	Not applicable
1.13	Production and manufacturing processes?	Yes	Process Description as presented as Annexure 4
1.14	Facilities for storage of goods or materials?	Yes	Storage area for materials will be provided as per the requirement.
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?	Yes	ETP & STP will be provided to collect waste water from process and domestic activities of plant area for treatment and re-use. No increase in the domestic waste generation is anticipated
1.16	Facilities for long term housing of operational workers?	No	As the proposed project is the modernization of the existing power plant, the existing facilities will be utilized by operational workers
1.17	New road, rail or sea traffic during construction or operation?	No	The proposed project is the modernization of the existing power plant. Hence, all the approach roads and internal roads were already developed which can sustain the proposed project activities.
1.18	New road, rail, air, waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	No	As mentioned in the item 1.17
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	No	Not Applicable
1.20	New or diverted transmission lines or pipelines?	No	Not Applicable
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	Not envisaged
1.22	Stream crossings?	No	nil
1.23	Abstraction or transfers of water from ground or surface waters?	No	No change in abstraction or transfer of water from ground or surface waters as the required water is proposed to be met from the existing raw water system which is sourced from the Desang river which is 5.5 km from the site.
1.24	Changes in water bodies or the land surface affecting drainage or runoff?	No	Nil
1.25	Transport of personnel or materials for construction, operation or decommissioning?	Yes	Transportation is required for labour from nearby villages and construction materials for the project.
1.26	Long-term dismantling or decommissioning or restoration works?	No	As the proposed project is the modernization of the existing power plant certain structural changes are envisaged due to which short-term dismantling or decommissioning takes place.
1.27	Ongoing activity during decommissioning which could have an impact on the environment?	No	Not envisaged
1.28	Influx of people to an area in either temporarily or permanently?	Yes	During the modernization of the power plant certain due to construction activities the influx of temporary workers from nearby villages is expected.
1.29	Introduction of alien species?	No	No Introduction of alien species
1.30	Loss of native species or genetic diversity?	No	No loss of native species or genetic diversity
1.31	Any other actions?	No	None

2) Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply)

SNo	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)	No	Land available for the existing power plant will be used for the proposed project
2.2	Water (expected source & competing users) unit: KLD	Yes	Water requirement for the proposed power plant is 21.6 KLD. Source of water will be from existing plant which is sourced from Desang river 10 km from the site in North Direction.
2.3	Minerals (MT)	No	None
2.4	Construction material – Cement, steel, stone, aggregates, sand/soil (expected source – MT)	Yes	Cement: 3500 MT, Reinforcement Steel: 200 MT Sand: 4200 m^3, Aggregate: 8400 m^3, Soil Nil, finished ground level
2.5	Forests and timber (Source – MT)	No	There is no requirement of Timber for this project except for the office furniture.
2.6	Energy including electricity & fuels (source, competing users) Unit: Fuel (MT) Energy (MW)	Yes	Fuel: Natural Gas (0.36 MMSCMD) Electricity: During construction 1 MW power is required. Power required will be supplied from the existing power plant
2.7	Any other natural resources (use appropriate standard units)	No	No Natural Resources would be used except mentioned in item No 2.5 for construction purpose.

3) Use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health

SNo	Information/ Checklist confirmation	Yes/No	Details thereof (with approximate Quantities/rates wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)	No	No major hazardous materials will be used
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	No diseases are anticipated due to the proposed project
3.3	Affect the welfare of people e.g. by changing living conditions?	No	Improve living conditions of the local people and quality of life (QOL)
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	No	Natural gas based power plant is environment-friendly due to complete combustion of methane and ethane. Hence there are no emissions like SO2 and Particulate Matter, except low emissions of NOx from the gas fuel. The NOx Emissions will be controlled by pollution control equipments like a lean burn system which limits the NOx emission. There is no effect envisaged for the vulnerable groups of people who could be affected by the project.
3.5	Any other causes	No	No other causes envisaged

4) Production of solid wastes during construction or operation or decommissioning (MT/month)

SNo	Information/ Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	The proposed project is the modernization of the existing plant hence no overburden is envisaged
4.2	Ash/Municipal waste (domestic and or commercial wastes)	No	No commercial waste Perhaps certain amount of domestic waste will be generated which will not increase the waste generation quantity from the existing plant
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)	No	Spent Lubricant will be stored in containers and disposed as per pollution control norms.
4.4	Other industrial process wastes	No	There will not be any other industrial process wastes generated from the proposed plant
4.5	Surplus product	No	There is no surplus product generation.
4.6	Sewage sludge or other sludge from effluent treatment	Yes	Not Significant
4.7	Construction or demolition waste	Yes	The demolition waste generated will be used for filling of low lying areas within the plant.
4.8	Redundant machinery or equipment	No	Most of the equipment used for the construction will be hired.
4.9	Contaminated soils or other materials	No	No contamination is anticipated.
4.10	Agricultural wastes	No	Not Envisaged
4.11	Other solid wastes	No	No other solid wastes

5) Release of pollutants or any hazardous, toxic or noxious substances to air (Kg / hr)

SNo	Information/Checklist Confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	Natural gas based power plant is environment-friendly due to complete combustion of methane and ethane. Hence there are no emissions like SO_2 and Particulate Matter, except low emissions of NO_x from the gas fuel. NO_X Emission: Oxides of nitrogen are emitted out of the combustion process. The gas engine will have a lean burn system which limits the NO_x emission of 100 ppm (v/v) at 15% O_2 for gas based plant of capacity less than 100 MW as set by CPCB. Eight stacks of 30 m height will be provided which will reduce the impact of emission on ground level concentration and ambient temperature.
5.2	Emissions from production processes	Yes	As mentioned in the Item # 5.1
5.3	Emissions from materials handling including storage or transport	Yes	Fugitive emissions to limited extent
5.4	Emissions from construction activities including plant and equipment	Yes	Temporary in nature which may originate during construction of building which will be taken care by proper dust suppression by sprinkling of water.
5.5	Dust or odors from handling of materials including construction materials, sewage and waste	Yes	Dust generated due to handling construction material will be controlled by sprinkling of water.
5.6	Emissions from incineration of waste	No	No incineration is proposed
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	No material will be openly burnt in air.
5.8	Emissions from any other sources	No	Emissions from other sources are not envisaged

6) Generation of noise and vibration and emissions of Light and Heat:

SNo	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	Noise will be generated during operation of generator, Turbines, compressors, pumps, fans, etc. The expected noise level during those operations is 85 dB (A), necessary PPEs (Ear Muffs, closed chambers) will be provided for the personnel working in those areas. Noise level will be limited as per CPCB's Ambient Noise Standards/ MoE&F notification on Noise Pollution (Regulation and control) Rules 2000. Suitable acoustic enclosures will be provided to control the noise level. Most of the equipment structures are static. The vibration effect of these will be only local and the design of supports and foundations will nullify the intensity of vibration. Light emissions are not envisaged in the project. Heat emissions will be felt nearby boiler, generator areas.
6.2	From industrial or similar processes	Yes	As explained in section 6.1.
6.3	From construction or demolition	Yes	Noise generated from drilling, dismantling and welding will be temporary.
6.4	From blasting or piling	No	No blasting or Piling is envisaged
6.5	From construction or operational traffic	Yes	During the construction activities care will be taken to control the noise within the standards. While operation, traffic will contribute some noise level.
6.6	From lighting or cooling systems	Yes	All equipment in the Gas Engine Plant will be designed to have a total noise level not exceeding 85 dB(A) at a distance of 1 meter.
6.7	From any other sources	No	No other sources envisaged

7) Risks of contamination of land or water from release of pollutants into the ground or into sewers, surface waters, ground water, coastal waters or the sea

SNo	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials	No	Stored equipment and materials will be located in pre identified and stored in defined areas to maintain a neat and orderly site. Stored equipment and materials will be adequately supported and protected to prevent damage.
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	No	ETP and STP will be provided to collect waste water from all the sources of plant area and treated to re-use as far as possible.
7.3	By deposition of pollutants emitted to air into the land or into water	No	Eight stacks of suitable height will be provided which will reduce the impact of emission on ground level concentration and ambient temperature. A fully certified continuous emission monitoring system will also be provided for Exhaust gases to determine emissions of NOx and PM, opacity monitor will also be provided as recommended by Gas engine supplier. Hence there will not be any chance of contamination of land and water by deposition of pollutants emitted to air.

7.4	From any other sources	No	No other sources
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?	Yes	But within the prescribed limits by proper Environmental Management Plan (EMP), Long term risk of pollutants can be minimized.

8) Risk of accidents during construction or operation of the project, which could affect human health or the environment

SNo	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
8.1	From explosions, spillages, fires etc. from storage, handling, use or production of hazardous substances	No	No chemicals will be required
8.2	From any other sources	No	Adequate safety measures will be taken
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc.)?	No	It is situated in earthquake zone-V as defined in IS: 1893-2002.

9) Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

SNo	Information/ Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g. Housing development, Extractive industries, Supply industries, Others	No	As the proposed project is the modernization of the existing power plant.
9.2	Lead to after-use of the site, which could have an impact on the environment	No	Not Envisaged
9.3	Set a precedent for later developments	Yes	Development of local community Improvement in Quality of life Ecological balance by sustainable development
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects.	No	As the present project is the modernization of the existing power plant.

(III) Environmental Sensitivity

SNo	Areas	Name/Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Yes	There is stream flowing adjacent to the boundary of the project site. While tea gardens are present within the study area at a distance of about 6 km. Desang river is at 5.5 km in North direction
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests.	Yes	Chala Reserve Forest - 1.6 km North West Abhaypur Reserve forest - 3.6km South. A stream is flowing adjacent the boundary of the project site in East side.
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	No	None in the study area
4	Inland, coastal, marine or underground waters	Yes	Desang river is at 5.5 km in North direction A stream is flowing adjacent to the boundary of the project site
5	State, National boundaries	Yes	The project site is 4 km away from Assam –Nagaland State boundary in South direction
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	None in the study area
7	Defence installations	No	None in study area
8	Densely populated or built-up area	Yes	Sonari town is seen ~10 Km from the study area.
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Yes	Mathurapur Health care Hospital - ~2.4km West Mathurapur bagicha L P high school - ~2.3 km West PKB Girls High School - 8.2 km North East Sonari junior college - 8.4 km North East Shankar Dev Shishu Nikethan - 8.5 km North East
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Yes	Chala Reserve Forest - 1.6 km North West Abhaypur Reserve forest - 3.6km South Borahi Tea Estate – 6 km North East Banamalie Tea Estate – 5.7 km North
11	Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)	No	None
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	No	The project area is situated in earthquake zone-V as defined in IS: 1893-2002

(IV) Proposed terms of reference for EIA studies

“I hereby give undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance given, if any to the project will be revoked at our risk and cost.

Date: 03-05-2012 Place: Assam
Signature of the applicant with Name and Full Address Name: Mukut Das Designation: Assistant General Manager Address: Bijulee Bhavan, 3rd Floor, Paltan Bazar, Guwahati-781001

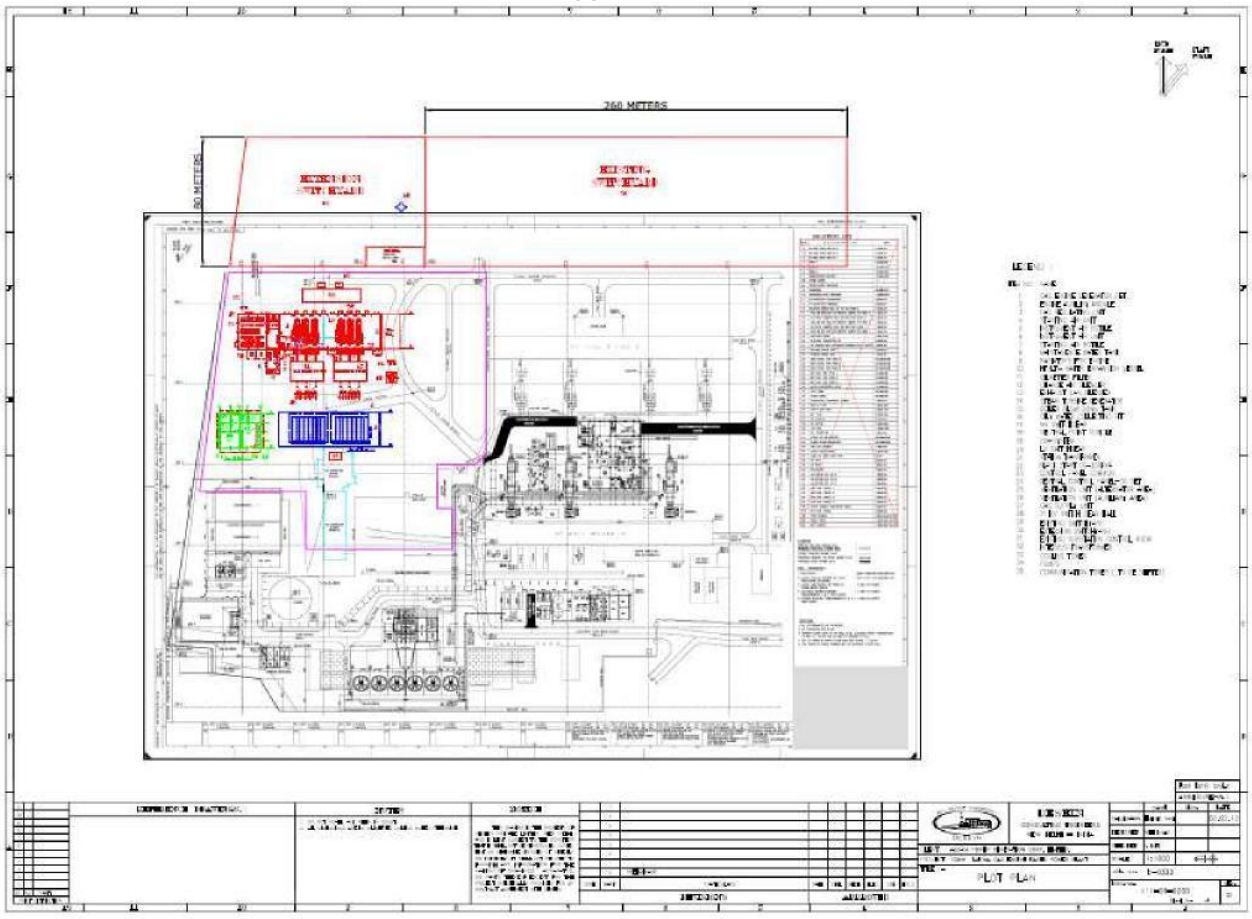
Note:
The projects involving clearance under Coastal Regulation Zone Notification, 1991 shall submit with the application a C.R.Z map duly demarcated by one of the authorized agencies, showing the project activities, w.r.t. C.R.Z (at the stage of TOR) and the recommendations of the State Coastal Zone Management Authority (at the state of EC). Simultaneous action shall also be taken to obtain the requisite clearance under the provisions of the C.R.Z Notification, 1991 for the activities to be located in the CRZ.

The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon (at the state of EC).”

All correspondence with the Ministry of Environment & Forests including submission of application for TOR/Environmental Clearance, subsequent clarifications, as may be required from time to time, participation the EAC Meeting on behalf of the project proponent shall be made by the authorized signatory only.

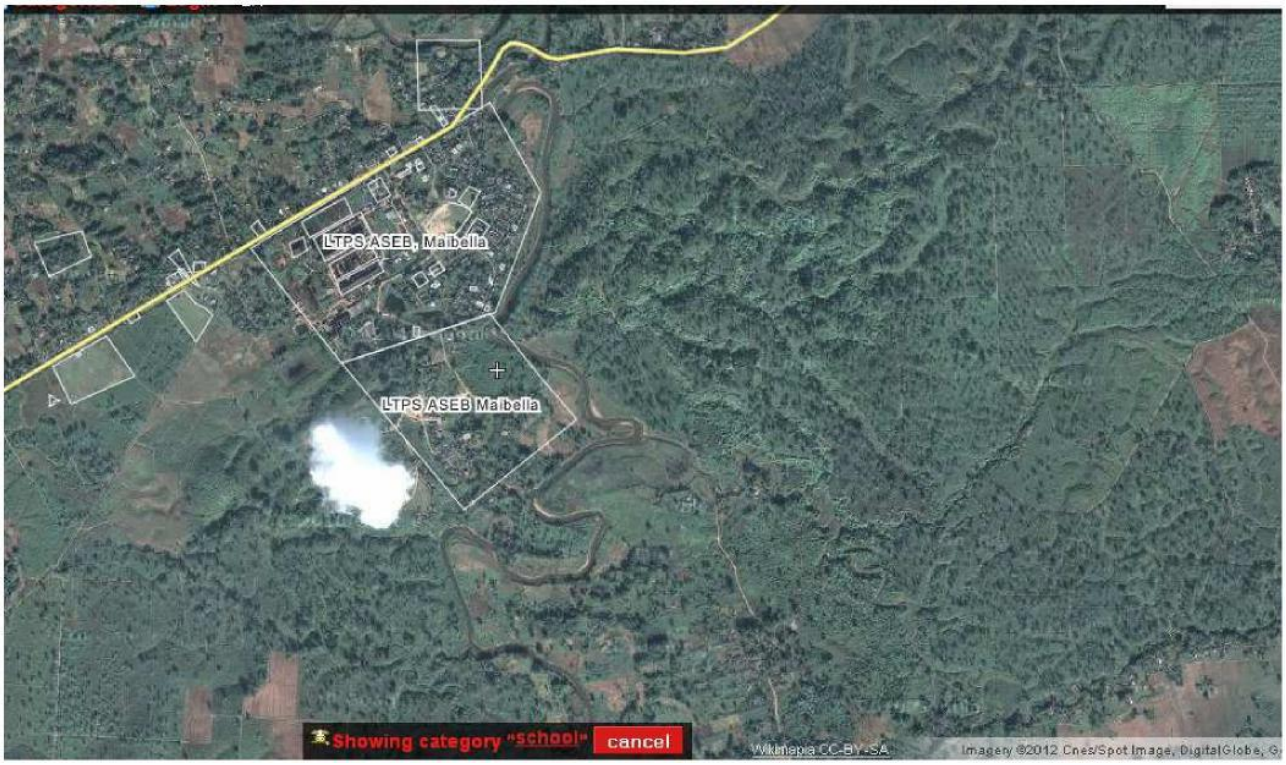
The authorized signatory should also submit a document in support of his claim of being an authorized signatory for the specific project.”

Appendix 1



Layout of the project site

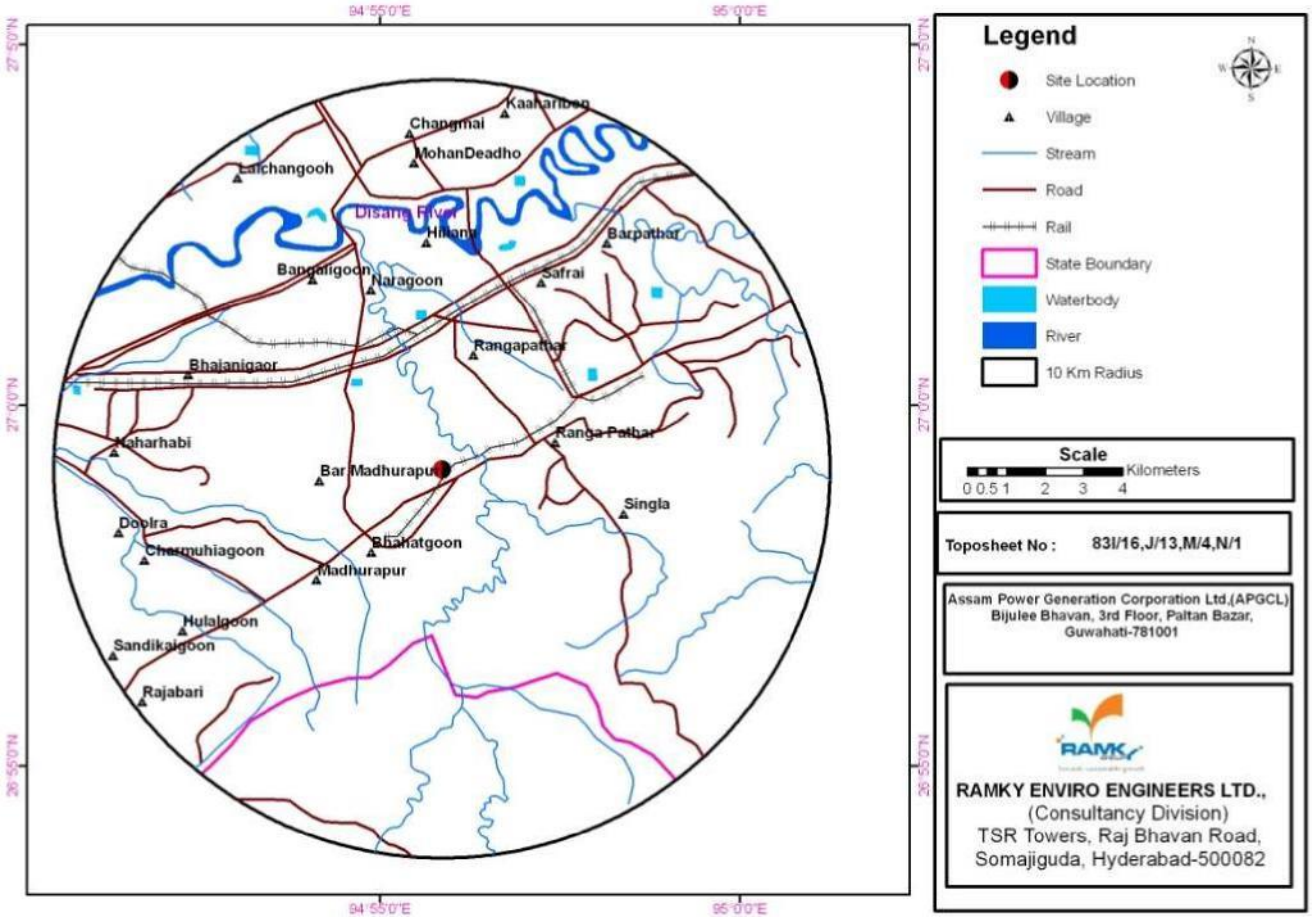
Satellite image of the project site



Appendix 2
Land breakup details

Description	m^2	acres
Proposed modernization plant area	28328	7.0
Total plant area including new area	105000.00	25.94
Total LTPS area	857150.00	211.80
Total LTPPS area is measured from Google earth. Total plant area consists of plant area, roads, residential buildings, schools, guest house, vacant area, dug out lakes.		

Appendix 3
Digitized map of 10 kms radius of the project site



ANNEXURE 4: PUBLIC CONSULTATION

Table A4.1: SUMMARY DETAILS OF PUBLIC CONSULTATIONS

S N	Issues Discussed	People's Views and perception
1.	General perception about the Lakwa Thermal Power Station and the awareness about the proposed project.	People are well aware of project, very positive. They want more industry for local development and perceive that project will increase employment opportunity and increase land value. They feel some industries will be setup and would ensure better job opportunities and all round development of the area. They felt that due to LTPS, the area and people are developed. They were not aware of replacement project, but expressed that they support the project. They felt that without power there is no development.
2.	Support of local people for the Lakwa Thermal Power project?	People are ready to support the project without any condition or criteria. They felt that more power would mean better all-round development of the area and good opportunities for income generation.
3.	Any critical issue or concern by the local people regarding the project?	There is no critical issue or concern raised by the local people. However they felt that 132 kV lines in some places were too low in sag which may harm the local people.
4.	Does the Lakwa Thermal Power project siting adversely impact the water or soil resource in the locality	Local people complained Suffery river crossing near the LTPS periodically had oil/chemical in the discharge which pollutes the water and causes fish to die and making the water unusable for agricultural fields.
5.	Status of Air pollution caused by Lakwa Thermal Power Station	People felt that there was high sulfur content in the air exhaust causing humidity, heat in the atmosphere. Others were not aware of air-pollution caused by LTSP.
6.	Near to any religiously sensitive sites, historical or archaeological sites.	No religiously sensitive sites, cultural, historical or archaeological sites present in this area.
7.	Near to Sanctuary/National Park/protected forest	None of the villages were situated near any sanctuary, national park or protected area. Protected areas are normally taken care by Department of Forests.
8.	Presence of any wildlife in Sanctuary/National Park/protected forest	In protected areas elephant, monkey, deer, leopard, hyena and variety of birds are found in the area.
9.	Proximity to Reserve Forest	LTPS is situated between Abhaypur and Sola pathar reserve forests and has no negative impact on wildlife. All the villages surveyed were situated within 1-4 kms of LTPS and the reserve forests. In some villages near the forest, the elephants would come into the fields and damage the agriculture in search of food.
10.	Presence of any wildlife in Forests	Elephant, monkey, birds, small animals are found. They felt earlier there were lots of them, but now due to deforestation and other development activities, their population has reduced.
11.	Historical status of flooding in the area	The area is well known as a wetland area due to Suffrey river and the hill. During heavy rains, the area gets flooded and damage to crops and houses is common. The villagers feel that LTPS or government should provide them with Bunds that protects them from flooding.
12.	What other organizations of a social nature (NGOs/CBOs/ Civil Society) active in the area? Name of these organizations	There are no NGO or civil societies active in the area. Most work is done by Forests department or relevant government departments in the state government.
13.	General socio-economic standing: What are the economic activities? Land use, cropping pattern (Seasonal), types of crops, value of the crops, Average land holding size etc.	Generally people are tea garden workers, farmers, small business and few government service. The land is fertile and major crops are paddy, tea, betel leaves, banana and vegetables. The average landholding for middle level farmer is 10-15 bighas. A small farmer would work under the middle level farmer. The education in the villages is good but the need more employment as agriculture cannot support the entire family.
14.	Is the land Irrigated and what are the sources of Irrigation?	Crops are fully dependent on proximity to river and ponds for irrigation or through rains. Few farmers use lift irrigation using diesel pumps; otherwise villagers get only single crop per year due to lack of irrigation facility.
15.	Any other Issues they may feel to share:	• The villagers hope that the project will provide better infrastructure like roads, power supply, medical facilities, and better employment. Employment for local youths has not been done by LTPS for a long time. Road and drainage system need to be developed - Village road and open drain should be cemented properly. • Health facility in the village needs to be improved. • Free power for domestic purpose similar to ONGC which gives 24x7 free power to operational areas Regular power supply for irrigation. • Drinking water facility needs to be improved. • In most villages, no health facility is available. They want LTPS to help provide them some health care facilities at its health centre.

Table A4.2: VILLAGE WISE LIST OF PARTICIPANTS

SNo	Name of the Participants		Male/Female	Occupation
I	Name of the Village:	Sanglo Pathar		
	Name of the District:	Shivsagar		
	Distance from the Project Site:	6 Km		
	Number of Participants:	18		
1.	Biren Sonwal		Male	Gram Buddha
2	Uma Tanti		Male	Gram Buddha
3	Kukhsari Sonwal		Female	Housewife/farmer
4	Manikant Sonwal		Female	Housewife/farmer
5	Luchan Sonwal		Male	Farmer
6	Jayanta Sonwal		Male	Farmer
7	Saini Ram Sanwal		Male	Farmer
8	Bina Sonwal		Male	Farmer
9	Jati Hatimuria		Male	Farmer
10	Lakhi Sonwal		Female	Housewife/farmer
11	Teleswari Saikia		Female	Housewife/farmer
12	Pinki Sonwal		Female	Housewife/farmer
13	Shina Sonwal		Female	
14	Achuk Tanti		Female	Housewife/farmer
15	Lakhi Ram Tantabari		Female	Housewife/farmer
16	Madhari Sonwal		Female	Housewife/farmer
17	Beena Sonwal		Female	Housewife
18	Rekha Dwara		Female	Housewife
II	Name of the Village:	Mybella Cooperative		
	Name of the District:	Shivsagar		
	Distance from the Project Site:	1 Km		
	Number of Participants:	20		
1.	Dhanu Deni Chetri		Female	Ward Member
2	Padumi Nath		Female	Asha Member
3	Bhadram Patar		Male	Business
4	Charitra Chetia		Male	Unemployed
5	Nar Bahadur Chetri		Male	Unemployed
6	Nipen Gogoi		Male	Unemployed
7	Manik Nath		Male	Unemployed
8	Ramesh Shama		Male	Unemployed
9	Ganesh Shama		Male	Unemployed
10	Bular Gogoi		Male	Unemployed
11	Indrajit Chetri		Male	Student
12	Debajit Baruah		Male	Student
13	Raju Lama		Male	Unemployed
14	Hemanta Gogoi		Male	Student
15	Gakul Baruah		Male	Unemployed
16	Dipa Lahan		Female	Housewife
17	Niru Dutta		Female	Housewife
18	Ranu Nath		Female	Housewife
19	Niru Dutta		Female	Housewife
20	Mera Dutta		Female	Housewife
III	Name of the Village:	Mohan Gaon/Bara Pathar		
	Name of the District:	Shivsagar		
	Distance from the Project Site:	5 Km		
	Number of Participants:	17		
1.	Mohd. Abdas Matlila		Male	Farmer/Member
2	Hemant Changma		Male	Gram Buddha
3	Sudhir Changma		Male	Gram Buddha
4	Krishna Newar		Male	Gram Buddha
5	Debabrata Singha		Male	Gram Buddha
6	Mohd. Abdul Hussain		Male	Gram Buddha
7	Mohd. Enaj Ali		Male	Business
8	Guruprasad Dika		Male	Business
9	Mohd Atikur Rahman		Male	Business
10	Mohd. Nazman Ali		Male	Business
11	Ramu Gupta		Female	Housewife
12	Razia Begum		Female	Housewife
13	Anjana Kalwar		Female	Housewife
14	Moni Sinha		Female	Housewife
15	Jyotsana Katwar		Female	Housewife
16	Sarita Katwar		Female	Housewife
17	Rinki Katwar		Female	Housewife
IV	Name of the Village:	Suffry / Ranga Pathar		
	Name of the District:	Shivsagar		
	Distance from the Project Site:	2.2 Km		

SNo	Name of the Participants		Male/Female	Occupation
	Number of Participants:	20		
1.	Anil Teli		Male	Teacher
2	Diru Chetia		Male	Unemployed
3	Kalpana Devi		Female	Housewife
4	Kamlu Rai		Female	Unemployed
5	Sangita Gorch		Female	Unemployed
6	Mod. Azizur Rahman		Male	Unemployed
7	Jitul Chetia Phukon		Male	Unemployed
8	Tilak Gogoi		Male	Unemployed
9	Krishna Borzgohada		Male	Teacher
10	Jadu Chetia		Male	Service
11	Utpal Chetia		Male	Teacher
12	Lulit Mohan		Male	Teacher
13	Pinku Kalindi		Male	Farmer
14	Sabitoy Chetia Phukam		Male	Unemployed
15	Navneeta Thakur		Female	Housewife
16	Bobby Thakur		Female	Housewife
17	Mansha Roy		Female	Housewife
18	Sona Prabha Gogoi		Female	Housewife
19	Sangita Gorh		Female	Housewife
20	Kalparu Dev		Female	Housewife
V	Name of the Village: Name of the District: Distance from the Project Site: Number of Participants:	Sola Pathar Shivsagar 2 Km 16		
1.	Ashok Shyan		Male	Unemployed
2	Bikash Shyan		Male	Farmer
3	Geetanjali Shyan		Male	Student
4	Shiprity Shyan		Male	Student
5	Monika Shyan		Male	Student
6	Pramod Shyan		Male	Student
7	Prafulla Shyan		Male	Student
8	Babu Shyan		Male	Business
9	Dhrubar		Male	Farmer
10	Kanseng Shyan		Male	Farmer
11	Ritu Shyan		Female	Farmer
12	Kalpana		Female	Service
13	Pankaj		Male	Student
14	Lusan		Female	Student
15	Biran		Female	Housewife
16	Baikut		Female	Housewife
VI	Name of the Village: Name of the District: Distance from the Project Site: Number of Participants:	Mathurapur Shivsagar 2.2 Km 19		
1.	Md. Moinuddin Ahmad		Male	Cultivator
2	Rabi Ray		Male	Tea Worker
3	Mohendra Bor		Male	Contractor
4	Nanayan Mal		Male	Contractor
5	Sri Radhu Choudhary		Male	Contractor
6	Nipu Gogoi		Male	Contractor
7	Rajesh Mal		Male	Tea worker/service
8	Pranab Bor Gohain		Male	Contractor
9	Ritu		Male	Service
10	Raju Bentaku		Male	Business
11	Pranath Neog		Male	Business
12	Ranjit Chetia		Male	Business
13	Aditya Barthakur		Male	Service
14	Md. Islam Ahmad		Male	Business
15	Nirad Barthakur		Male	Service
16	Md. Kutub Ahmad		Male	Service
17	Raghu Raj Kumar		Male	Student
18	Ananda Tamli		Male	Student
19	AdityaBonthadur		Male	Teacher
20	Bhanu Prabha Gogoi		Female	Asha Women Worker
21	Monik Fukan		Female	Housewife
22	Barnali Fukan		Female	Housewife
23	Meena Jani		Female	Housewife

ANNEXURE 5: ENVIRONMENT MONITORING REPORT

Illustrative Contents of Environment Monitoring Report

A5.0 Table Details of work award

Locations	Sub-project components (Package No.)	Starting date of Implementation	Projected months of completion	Schedule date of completion (Extended date of completion)	Physical progress (%) as on -----

A5.1 Table: Details of On-going works

Locations	Sub-project Components (Package No.)	Listing of works under the package	What type of works continued at present	Expected changes from approved scope	Fulfillment of objectives- Type of remedial measures needed	Key assumptions and risks that affect attainment of the objectives

A5.2 Table: Progress of Environmental Management Plan

S. No.	Environmental components related to project activities	Compliance		Explanation (in case of done or not done justification necessary)
PRECONSTRUCTION STAGE				
		YES	**NO**	
1	Site preparation work completed by PIU including necessary clearance.			
CONSTRUCTION STAGE				
2	PCBs not used in transformers or other project facilities or equipment. Processes, equipment and systems not to use chlorofluorocarbons (CFCs), including halogen Use of PCBs and CFCs in the existing systems should be dismantled and to be disposed of in a manner consistent with the requirements of the government.			
3	Better design to ensure noise will not be a			

S. No.	Environmental components related to project activities	Compliance		Explanation (in case of done or not done justification necessary)
	nuisance.			
4	Appropriate placement of equipment to avoid drainage/channel interference.			
5	Equipment specification with respect to potential pollutants.			
6	Construction technique and machinery selection to minimize noise disturbance.			
7	Construction equipment to be well maintained and turn of the plant not in use to avoid noise, vibration and operator safety.			
8	Construction workers prohibited from harvesting wood in the project area.			
9	Dispose scrap materials such as batteries, transformers, conductors, capacitors etc. in environmentally sound manner.			
10	Excavated earth to be stored and reused for back filling.			
11	Fuels and other hazardous materials to be stored above high flood level.			
12	Noisy construction activities shall be carried out during day time.			
13	Construction workforce facilities to include proper sanitation, water supply and waste disposal facilities.			
14	Ensure health and safety of workers.			
15	Training to the APGC environmental monitoring personnel.			
16	Effective environmental monitoring system using checklist.			
17	Hiring of Environment and Social Consultant (s) by APGC for implementation and monitoring of EMP.			

A5.3: Schedule of Reporting

The Bidder shall complete the schedules included as part of the environmental data requirement; the following information shall also be provided:

SAMPLE DATA REPORT

Environmental Parameters *	Units	Detail	
Stack Parameters			
* Stack height	m		
* Multi-flue stack	Yes/No		
* Stack diameter	m		
* Stack exit velocity (average/max)	m/s		
* Stack exit temperature (average/max)	°C		
Stack Monitoring			
* Type			
* Manufacturer			
* Temperature	°C		
* O_2	mg/Nm^3		
* NO_x (indicate NO/ NO_2 / N_2O)	mg/Nm^3		
* PM10, Suspended Particle Matter	mg/Nm^3		
* CO	mg/Nm^3		
* SO_x	mg/Nm^3		
* Other			
Water Effluent - Predicted discharge composition limits (refer also to guarantee schedules)		**Gas engines**	**Whole Plant**
* Toxicity	TU		
* Suspended solids	mg/L		
* Ammonia (as N_2)	mg/L		

* pH units			
BOD	mg/L		
COD	mg/L		
Oil and Grease	mg/L		
* Sodium	mg/L		
* Iron	mg/L		
* Copper	mg/L		
* Zinc	mg/L		
* Chloride	mg/L		
* Sulphate	mg/L		
* Acrylate copolymer	mg/L		
* Halogen resistant azole	mg/L		
* Free residual chlorine	mg/L		
* Phosphate	mg/L		
* Ammonia	mg/L		
* Hydrazine	mg/L		
* Total Coliform	MPN/100ml		
Environmental Impact	**Units**	**Detail**	
* Temperature; plant effluents, river (50m upstream) and at edge of mixing zone within the river.	°C		
* Total dissolved solids	mg/L		
* Total phosphorous	mg/L		
* Total nitrogen	mg/L		
* Volume discharge rate (average/max) Monitoring	m^3/s		
* Description of method of monitoring effluent discharge as required for compliance with Resource Consents.			
Source Noise Level			
* Stack Control Room (interior)	dB(A)		
* Air inlets to Gas Engine	dB(A)		
* Gas Engine hall noise breakout	dB(A)		
* Gas Engine power transformers	dB(A)		
* Compressor hall noise breakout	dB(A)		
* Other significant sources and source	dB(A)		
Water Requirements (Make-up)		**Raw Water**	
* Maximum (Resource Consent limit)	m^3/ s		
* Minimum	m^3/s		
* Average	m^3/s		
* Average	tonnes/yr		
* Chemicals dosing	type/rate		
Vehicle Movements			
Workforce transit:			
* Maximum	Daily		
* Average (averaged/month)	Daily		
Equipment transit:			
* Maximum	Daily		
* Large loads (100%, 75%, 50%, 25%)	Project		
Stack Emission Concentrations		**Average**	**Maximum**
* NO_x (mg/Nm^3, -----% O_2, dry, ------ bar, 0°C)	24 hour		
* SO_x (mg/Nm^3, -----% O_2, dry, ------ bar, 0°C)	24 hour		
* CO (mg/Nm^3, -----% O_2, dry, ------ bar, 0°C)	24 hour		
* Dust (mg/Nm^3, -----% O_2, dry, ------ bar, 0°C)	24 hour		
Construction Workforce			
Monthly average no. of persons over project:			
* Civil			
* Mechanical			
* Electrical			
* Services			

* CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.

A5.4 Frequency of Monitoring

Environmental component	Project stage	Parameters to be monitored	Location	Frequency	Standards	Implementation	Supervision
Air Quality	Pre-construction stage (The project once assigned to contractor)	PM_{10}, $PM_{2.5}$, SO_2, NOx, SPM, CO along with Meteorological data- temperature Humidity, wind speed, wind direction	Inside the proposed site	One time	National Air quality standards of CPCB*	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Construction Stage	PM_{10}, $PM_{2.5}$, SO_2, NOx, SPM, CO along with Meteorological data- temperature Humidity, wind speed, wind direction	Inside and outside (0.5 km) of the proposed site	Two times	National Air quality standards of CPCB*	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Operation Stage	PM_{10}, $PM_{2.5}$, SO_2, NOx, SPM, CO along with Meteorological data- temperature Humidity, wind speed, wind direction	Stack and outside (0.5 km) of the proposed site	One time	National Air quality standards of CPCB*	Contractor by CPCB* approved laboratory	PIU
Water Quality	Pre-construction stage (The project once assigned to contractor)	EC, TSS, DO, BOD, P^H Oil and grease, Pb,	Nearest downstream spring around the site	One time	National water quality standards of CPCB*	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Construction Stage	EC, TSS, DO, BOD, PH, Oil and grease, Pb	Nearest downstream spring around the site	Three times/year	National water quality standards of CPCB*	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Operation Stage	EC, TSS, DO, BOD, P^H Oil and grease, Pb	Nearest downstream spring around the site	Yearly	National water quality standards of CPCB*	Contractor by CPCB* approved laboratory	PIU
Noise/ Vibration	Pre-construction stage (The project once assigned to contractor)	Noise level (dB level)	Inside plant and outside the proposed site	A single time	CPCB* standards for Noise and vibrations	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Construction Stage	Noise level (dB level)	Inside plant and outside the proposed site	2 times/ year	CPCB* standards for Noise and vibrations	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Operation Stage	Noise level (dB level)	Inside plant and outside the proposed site	3 times/year	CPCB* standards for Noise and vibrations	Contractor by CPCB* approved laboratory	PIU
Soil	Pre-construction stage (The project once assigned to contractor)	PH, Sulfate (SO_3), Chloride, ORP, water Soluble salts EC, Organic Matter, Moisture Content	2 locations at the proposed site	A single time	Technical specifications	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Construction Stage	PH, Sulfate (SO_3), Chloride, ORP, water Soluble salts EC, Organic Matter, Moisture Content	2 locations at the proposed site	Two times	Technical specifications	Contractor by CPCB* approved laboratory	Contractor/ PIU
	Operation Stage	PH, Sulfate (SO_3), Chloride, ORP, water Soluble salts EC, Organic Matter, Moisture Content	2 locations at the proposed site	A single time	Technical specifications	Contractor by CPCB* approved laboratory	PIU

ESMU –Environment & Social Management Unit of PMU

Abbreviations:

SO_2- -Sulphur Dioxide; NO_2- - Nitrogen Dioxide; CO- Carbon Monoxide; EC – Electric Conductivity;
Pb – Lead; $PM_{2.5}$ - Particulate Matter <2.5; PM_{10} - Particulate Matter <10; TSPM- Total suspended Particulate Matter;
EC - Electrical Conductivity; DO - Dissolved Oxygen; TSS - Total Suspended Solids;
BOD - Biological Oxygen Demand; NAAQS - National Ambient Air Quality Standards;
NWQS - National water Quality Standards;
ORP – Oxidation Reduction Potential

* CPCB standards or The World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines* whichever is more stringent. The World Bank EHS guidelines 2007 are available on the website www.ifc.org/ehsguidelines.