Environmental Impact Assessment

April 2018

India: Assam Power Sector Investment Program – Tranche 3

120 MW Lower Kopili Hydroelectric Project
(Power Evacuation System)

Annex 31 of the EIA Report

Prepared by Assam Power Generation Corporation Limited (APGCL), Government of Assam for the Asian Development Bank.

CURRENCY EQUIVALENTS

(As of 31 December 2017)

Currency unit	–	Indian rupee (₹)
₹1.00	=	$0.01471
$1.00	=	₹67.9669

LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
ADC	-	Autonomous District Council
AEGCL	-	Assam Electricity Grid Corporation Limited
APGCL	-	Assam Power Generation Corporation Limited
APH	-	Auxiliary Power house
CEA	-	Central Electricity Authority
CMP	-	construction management plan
CPCB	-	Central Pollution Control Board
DC	-	double circuit
EA	-	executing agency
EARF	-	Environmental Assessment and Review Framework
EC	-	environmental clearance
EHS	-	Environment, Health and Safety
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EMoP	-	Environmental Monitoring Plan
EPC	-	Engineering, Procurement and Construction
GHG	-	greenhouse gas
GoA	-	Government of Assam
GoI	-	Government of India
GIS	-	Gas Insulated Substation
IEC	-	International Electro-technical Commission
IEEE	-	Institute of Electrical and Electronics Engineers
LKHEP	-	Lower Kopili Hydroelectric Project
MFF	-	Multitranche Financing Facility
MoEF&CC	-	Ministry of Environment, Forests and Climate Change
MPH	-	Main Power house
PCB	-	polychlorinated biphenyl
PCBA	-	State Pollution Control Board of Assam
PMU	-	Project Management Unit
PRF	-	proposed reserve forest
RoW	-	right of way
SPS	-	Safeguard Policy Statement
SF_6	-	sulfur hexafluoride
S/S	-	substation
SC	-	single circuit
TL	-	transmission line

NOTES

(i) The fiscal year (FY) of the Government of India ends on 31 March. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY 2016-2017 ends on 31 March 2017.

(ii) In this report, "$" refers to United States dollars.

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A. INTRODUCTION

1. Background

1. This report presents the findings and results environmental assessment of the power evacuation system for the proposed Lower Kopili Hydroelectric Project (LKHEP or the Project). The project is designed as a run-of-river scheme with diurnal storage on the Kopili river at Longku and will generate 120 MW power comprising the Main Power house (MPH) with 2 units of 55 MW each and an Auxiliary Power house (APH) with 10 MW capacity (with 10% continuous overload) to be located at the dam toe. The dam is designed as a concrete gravity dam, with a height 70.10 m and width of 345.05 m. The scheme has been planned to run at full potential in the monsoon season and operate as a peaking station in the non-monsoon season.

2. The proposed project is situated in the Karbi Anglong and Dima Hasao (also known as North Cachar Hills) Autonomous District Council (ADC) areas of Central Assam (Figure 1 and Figure 2). The proposed project will be the final stage of development of the Kopili river valley and along with the existing upstream hydropower plants, it is expected to fully harness the hydropower potential of the Kopili river.

3. The power evacuation system, an essential component of LKHEP, will be used to evacuate power it generates into the National / local grid. The power evacuation system will include the construction of a 220 kV Double Circuit (DC) transmission line (TL) from the Main Power House (MPH) site of LKHEP to an existing 132/33 kV Substation (S/S) at Sankardev Nagar (Lanka) and the construction of a 33 kV Single Circuit (SC) TL from the Auxiliary Power House (APH) site of LKHEP to an existing 132/33 kV S/S at Umrangsu. The length of TL between the MPH to Sankardev Nagar is 50 km, and between the APH to Umrangsu is 20 km. The TL corridors are envisaged to by-pass some villages / settlements and avoid forests.

4. The power evacuation system will also involve upgrading of an existing 132/33 kV S/S at Sankardev Nagar with the existing 2 power transformers of capacity 2x25 MVA to 220kV with 2 inter-connected transformers (ICT) of capacity 2 x 160 MVA. The relevant switchgear proposed type is a Gas Insulated Substation (GIS). There is no land acquisition associated with the transmission system activity, and no potential impacts on biodiversity are anticipated.

5. The power evacuation system for the project under consideration has been designed to keep the following factors in mind.

i. Efficiency
ii. Voltage regulation
iii. Reliability
iv. Cost effectiveness

6. The power evacuation system will be financed by ADB under the current MFF Tranche 3 and thus, is considered as an integral part of the LKHEP and assessed in accordance with ADB's Safeguard Policy Statement 2009 (SPS 2009). This assessment is part of the overall assessment carried out for LKHEP.

2. The Need for an Environmental Assessment

2.1 National Requirements

7. The Government of India (GoI) considers power transmission projects as environment-friendly compared to other power development projects since they do not generate and dispose of hazardous waste to land, air, and water; thus, they are not included within the realm of the Environment Protection Act 1986. In September 2006, the Ministry of Environment, Forests and Climate Change (MoEF&CC) issued a notification exempting power transmission projects from environmental clearance (EC) due to their non-polluting nature.[1] Therefore, no EC for the power evacuation system will be required from the MoEF&CC or from the State Pollution Control Board of Assam (PCBA).

8. However, under the Forest Conservation Act 1980, if a power transmission line will traverse or affect land classified as forest by the GoI, forest clearance has to be obtained from the relevant authorities to prevent deforestation and degradation. Given this stringent requirement, avoidance of land designated as forest by GoI has been included as one of the main criteria for site selection for the proposed TL corridor.

2.2 Requirements of Asian Development Bank

9. Since the power evacuation system will be financed by ADB under the current MFF Tranche 3 it is considered as an integral part of the project and it is assessed for its impacts in accordance with ADB's Safeguard Policy Statement 2009 (SPS 2009). IFC EHS guidelines for Electric Power Transmission and Distribution have also been considered while designing the transmission line and undertaking the environmental assessment.

2.3 Extent and Scope of Environmental Assessment

10. ADB SPS 2009 requires that the environmental impacts of development projects are identified and assessed as part of the planning and design process, and that action is taken to reduce the impacts to acceptable levels. This is done through the environmental assessment process which has become an integral part of lending operations and project development and implementation worldwide.

11. This assessment has been carried out for the transmission system which includes a 50 km long 200 kV transmission line and a 20 km long 33 kV line.

12. This report discusses the environmental assessment for the transmission system implementation activities, analysis of alternatives, anticipated environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works that will be covered by the transmission system of LKHEP. The Environmental Management Plan and Environmental Monitoring Plan (EMP and EMoP) for the evacuation system are included as Appendix 2 which is an integral part of the EMP of the LKHEP (Refer to the EIA Report Chapter XI: Environmental Management Plan).

[1] Notification in the Gazette of India, Extra-ordinary part II and section 3, subsection II, 14 September 2006.

13. This environmental assessment followed a number of steps:

i. Conduct field visits to collect primary or secondary data relevant to the associated facility to establish the baseline environmental condition
ii. Assess the potential impacts on environmental attributes due to the location, design, construction and operation of the associated facility through field investigations and data analysis
iii. Explore opportunities for environmental enhancement and identify measures
iv. Prepare an environment management plan (EMP) outlining the measures for mitigating the impacts identified
v. Identify critical environmental parameters required to be monitored subsequent to the implementation of the associated facility and prepare an environmental monitoring plan

14. Field visits and visual inspections were conducted in April – May 2015 during the EIA preparation (and again during November-December 2017, following finalization of the alignment of the transmission lines) to assess the existing condition of the physical and biological environment corresponding to the evacuation system, coordinate with AEGCL, local authorities, and to conduct secondary data collection. This was further supported by a preliminary (walk-over) survey report along the proposed routes, including consultations with local stakeholders who may be potentially affected.[2]

B. DETAILS OF THE POWER EVACUATION SYSTEM

1. Introduction

15. The power generated by the 120 MW LKHEP will be evacuated as follows.[3]

i. Power Evacuation for Main Power House (MPH) via one new 220 kV Double Circuit (DC) TL. The TL will start from the MPH site at village Lonku (situated on the right bank of river Kopili) and terminate at an existing 132/33 kV Substation (S/S) at Sankardev Nagar (Lanka) for total length of 50 km. The 220 kV TL is within district Dima Hasao and Karbi Anglong.

ii. The above existing 132/33 kV Substation (S/S) at Sankardev Nagar (Lanka) with existing 2 power transformers of capacity 2x25 MVA will be upgraded to 220 kV with 2 inter-connected transformers (ICT) of capacity 2 x 160 MVA. The relevant switchgear proposed type is Gas Insulated Substation (GIS). The S/S will be upgraded within its existing boundary, with no land acquisition. The S/S is located in district Nagaon.

iii. Power Evacuation for Auxiliary Power House (APH) via one new 33 kV Single Circuit (SC) TL. The TL will start from APH site at village Lonku (right bank of river Kopili) and

[2] Preliminary Survey Report for 220 kV Transmission Line prepared by Hi-tech Design Engineering & Construction, Guwahati (November 2015).
[3] Engineering details for power evacuation system are included in Chapter 11: Transmission of Power and Communication Facilities, Detailed Project Report prepared by Laymeyer India (DPR, September 2015).

terminate at an existing 132/33 kV Substation (S/S) at Umrangsu for a total length of 20 km. The 33 kV TL is within district Dima Hasao.

16. The construction of the power evacuation system for LKHEP shall be the responsibility of Assam Electricity Grid Corporation Limited (AEGCL).[4] APGCL will coordinate with AEGCL for transmission system components.

17. A preliminary survey report with proposed routes was prepared in November 2015.[5] The detailed survey, engineering, design, and implementation of the transmission lines and upgrading of existing S/S shall be implemented between 2018 (32 kV line) and 2024 (220 kV line), and shall be completed before the commissioning of LKHEP.

18. The following figures and tables have been presented in this report.

S. No.	Title	Remarks	Source
Figure 1	Location of LKHEP	Included in this report.	DPR
Figure 2	General schematic of the 220 kV and 33 kV TL to Sankardev Nagar (Lanka)	Included in this report.	Generated using IBAT
Figure 3	Proposed route map for the 220 kV TL with routing options	Included in this report.	Preliminary survey report
Figure 4	Proposed route map on Topographical sheet for the 220 kV TL	Included in this report.	Preliminary survey report
Figure 5	Proposed routes for 220 kV TL with vegetation cover	Included in this report.	Preliminary survey report
Figure 6	Site Plan of an existing S/S at Lanka	Included in this report.	Preliminary survey report
Table 1	GPS Coordinate of proposed TL corridor	Included in Appendix 1 of this report.	Preliminary survey report

2. Power Map of Assam and North Eastern Region

19. References to the Power Map and Single Line Diagram of the North Eastern Region exhibiting the transmission network of Assam is provided in Section 11.3 of Chapter 11, DPR (September 2015).

3. Load Flow Study

20. Reference to the Load Flow Study is provided in Section 11.5 of Chapter 11, DPR (September 2015).

[4] AEGCL is responsible for the coordinated development of transmission and distribution of electricity in the state along with PGCIL under central sector.

[5] Preliminary Survey Report for 220 kV Transmission Line prepared by Hi-tech Design Engineering & Construction, Guwahati (November 2015).

Figure 1: Project Location Map

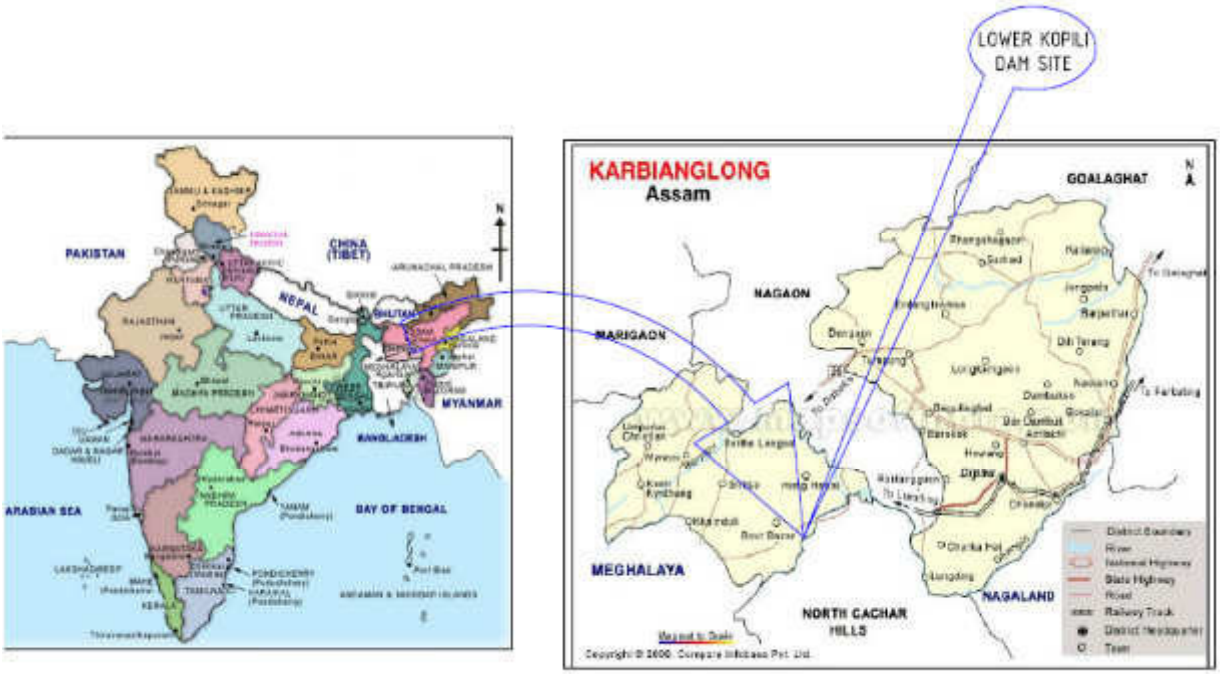


Figure 2: Map of Project Area (LKHEP and Proposed 220 kV DC TL & 33 kV DC TL Corridor)

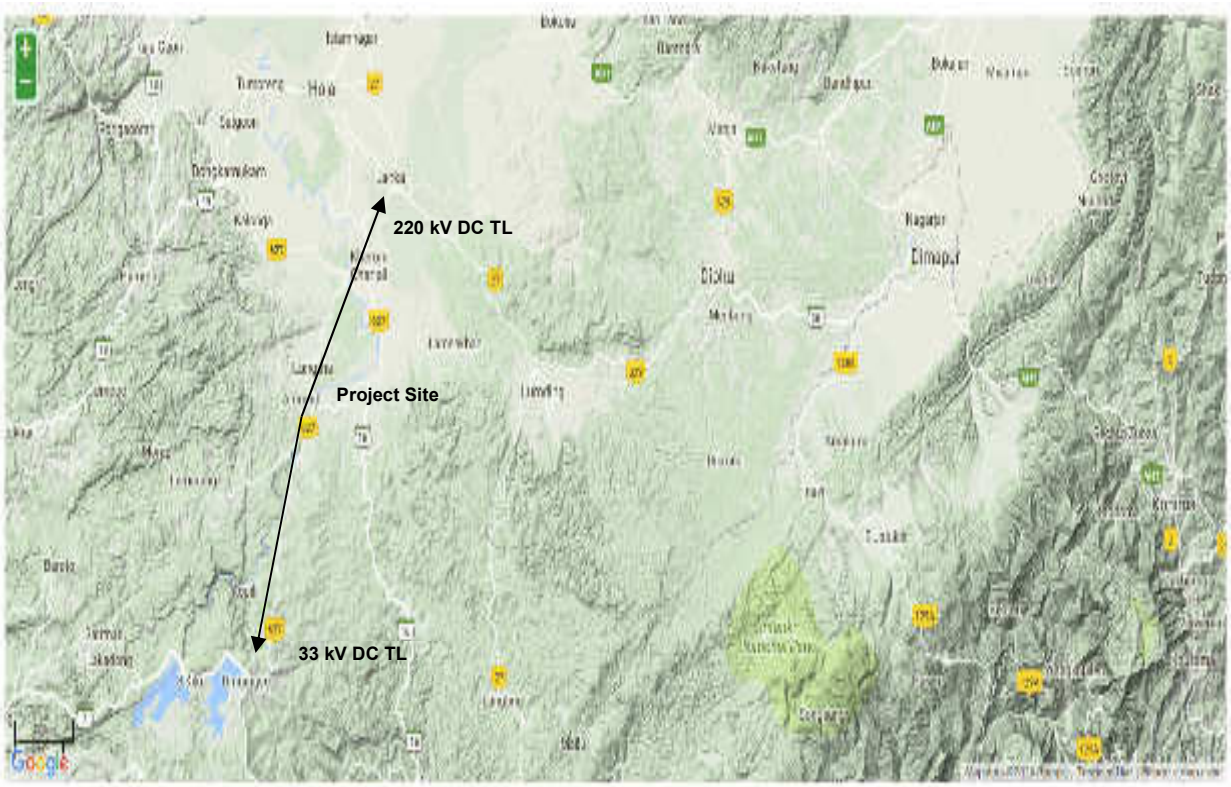

220 kV DC TL
Project Site
33 kV DC TL

Figure 3: Proposed route map for the 220 kV TL with routing options

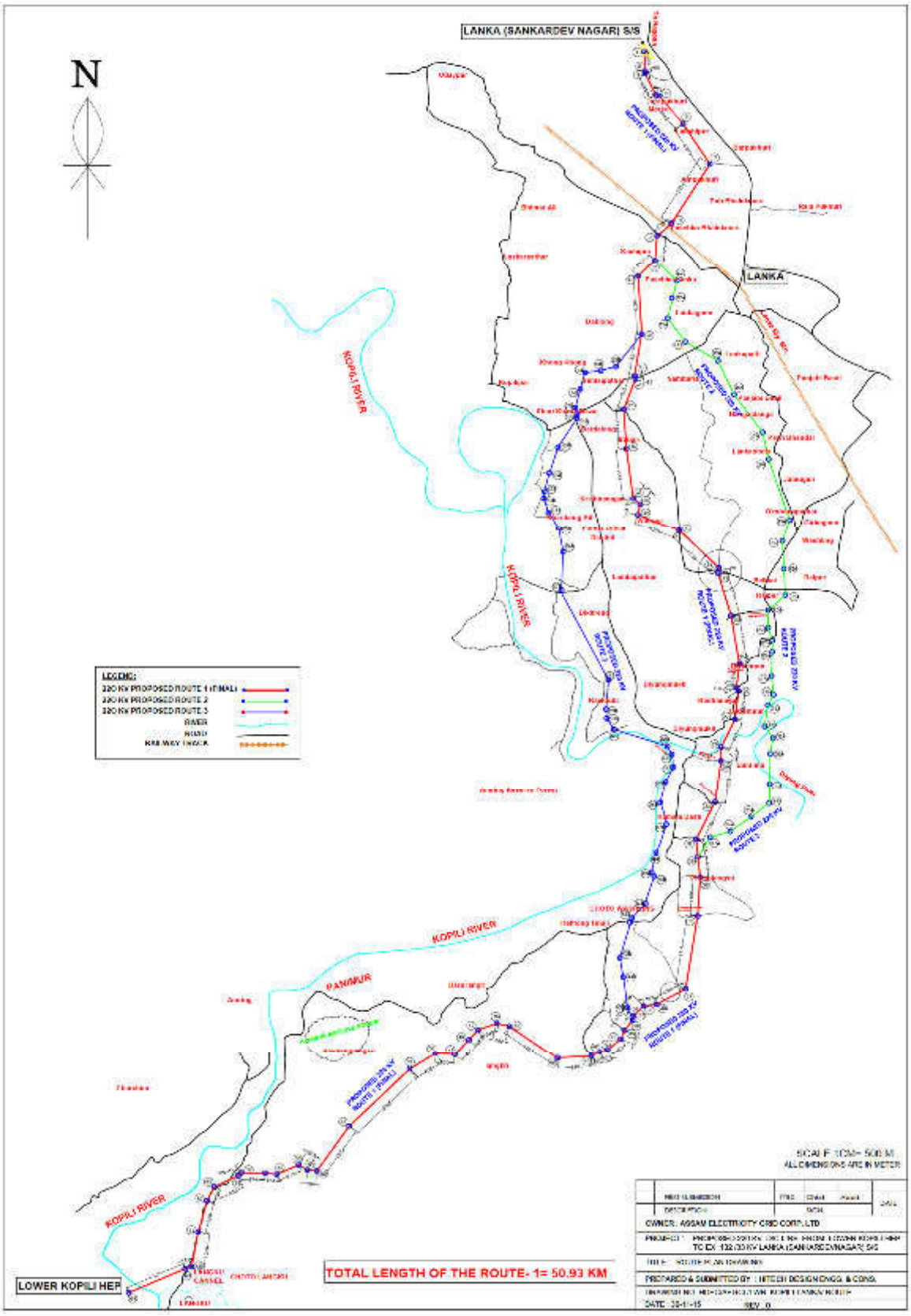


Figure 4: Proposed route map on Topographical sheet for the 220 kV TL

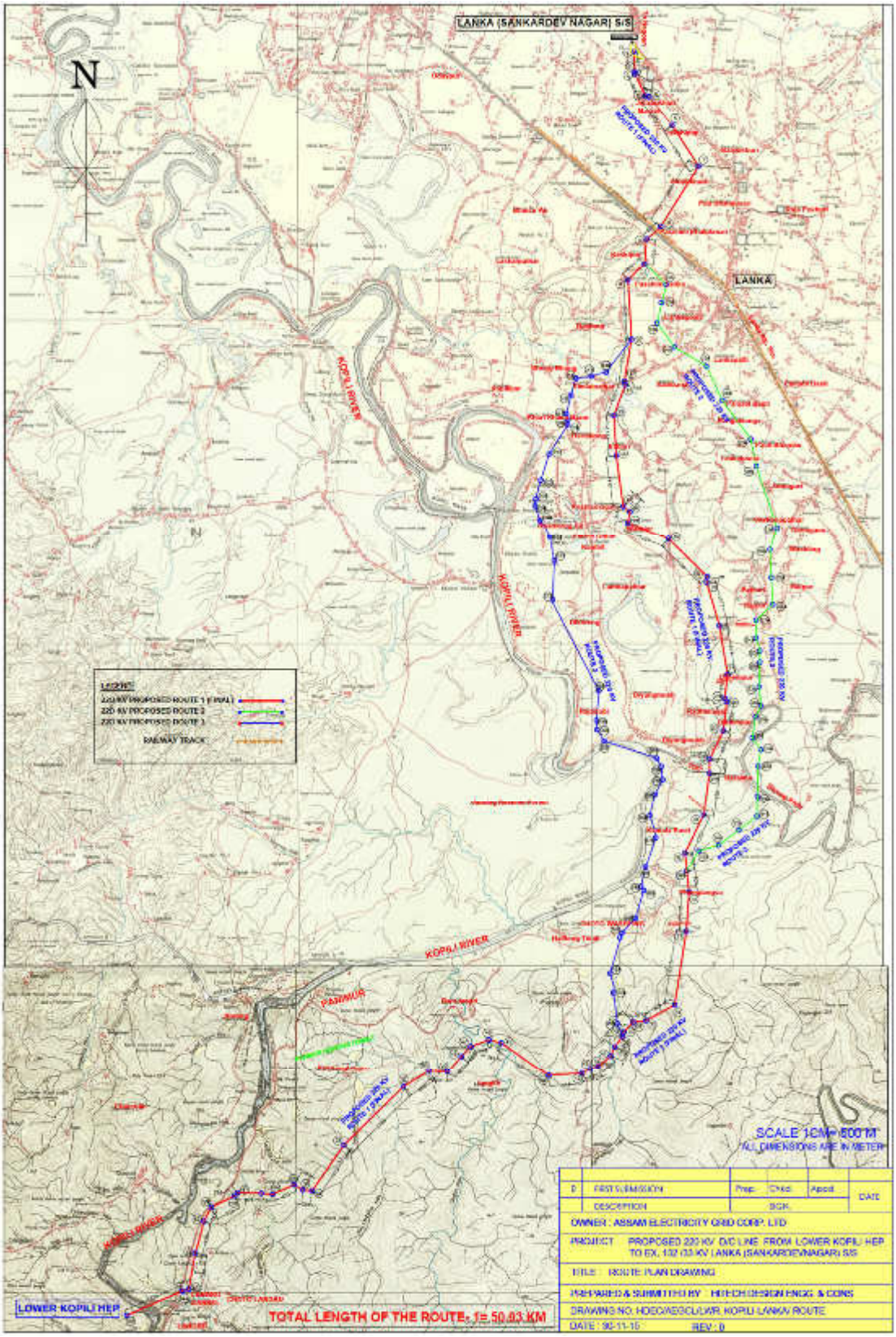


Figure 5: Proposed routes for 220 kV TL with vegetation cover

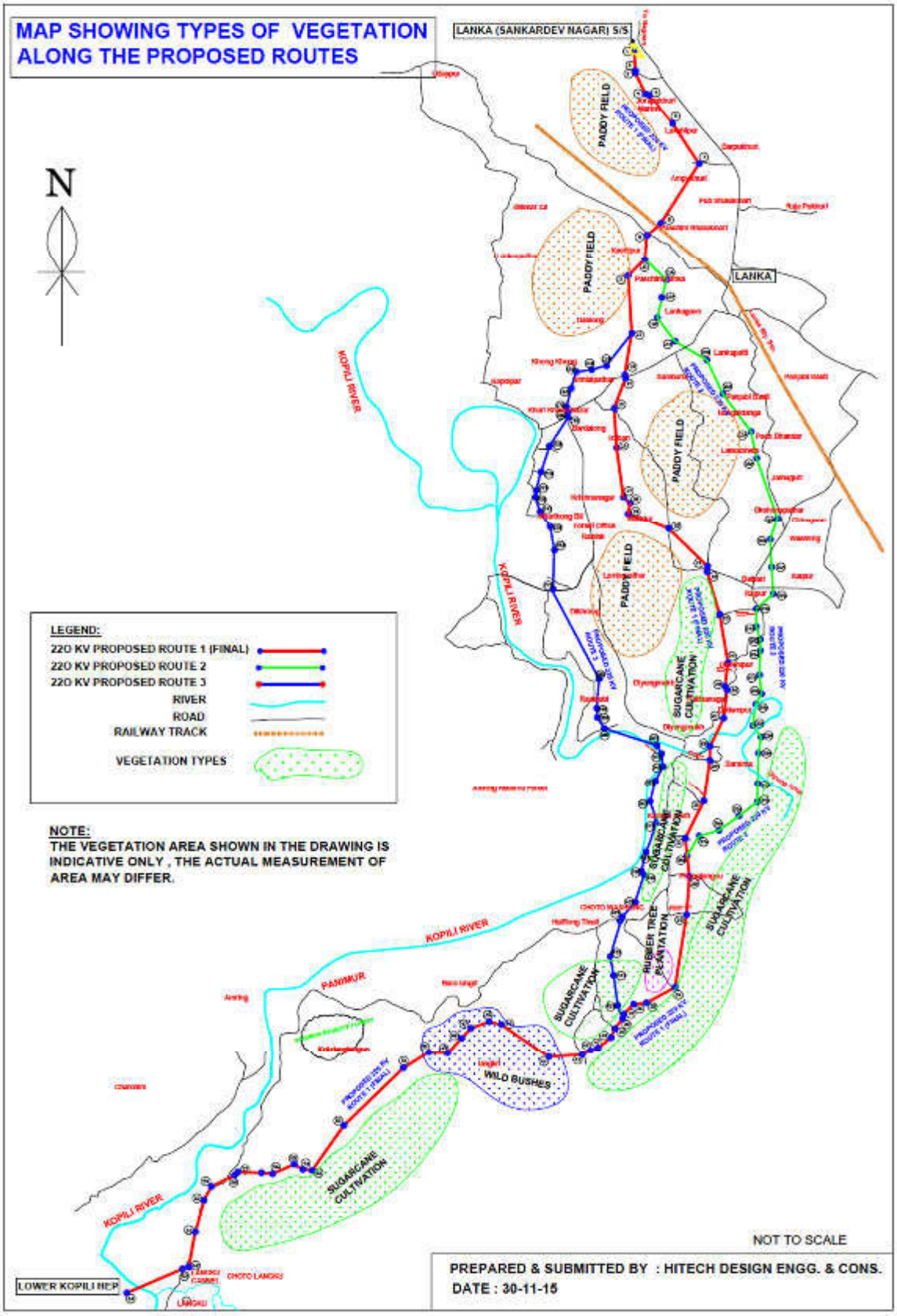
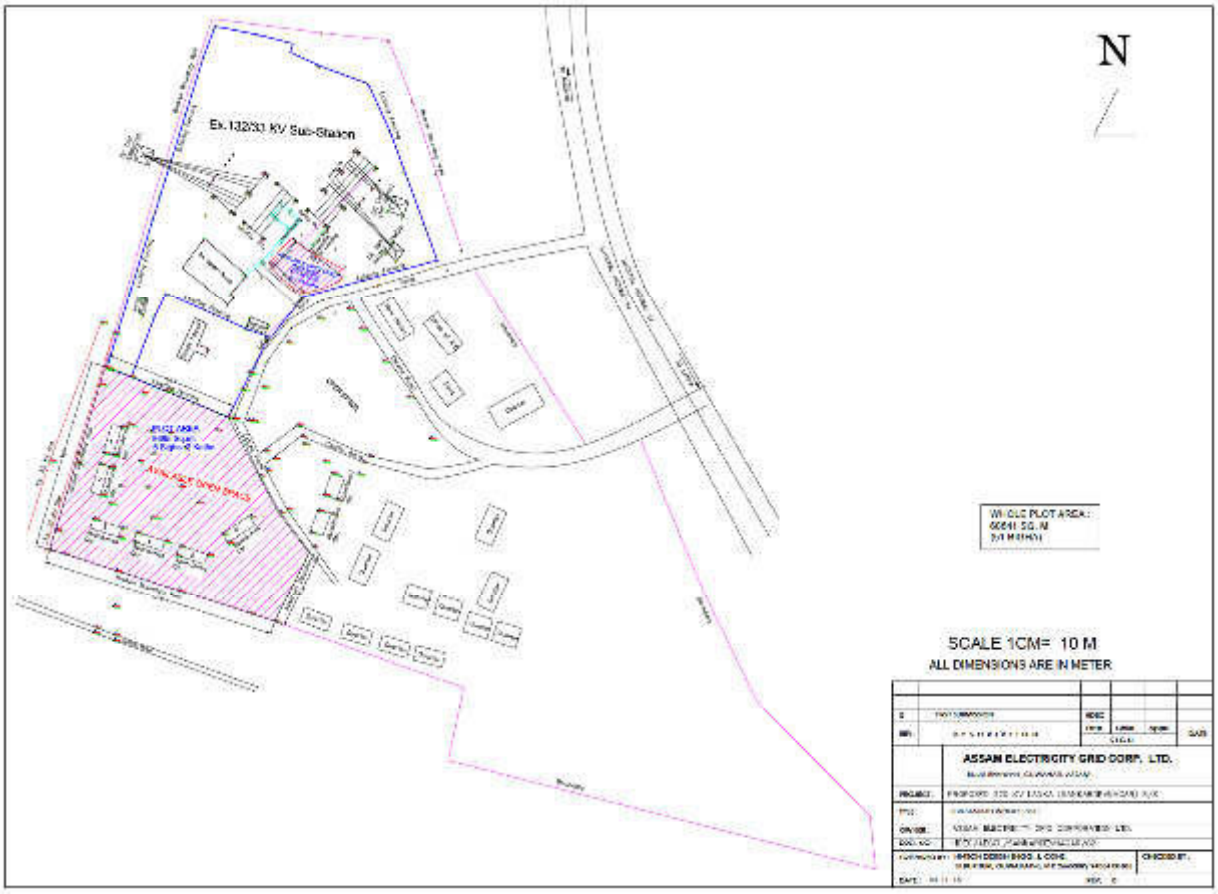


Figure 6: Site Plan of an existing S/S at Lanka



4. Description of the 220 kV Double Circuit Transmission Line

4.1 Location and Components

21. Power evacuation for Main Power House (MPH) via associated 220 kV DC TL consists of the following:

i. Voltage level: 220 kV
ii. Tapping point: Main Power House (MPH) (2 units of 55 MW each)
iii. Termination point: 132/33 kV S/S at Sankardev Nagar (Lanka)
iv. Length of line: 50 km (Approximate)[6]
v. Right of Way (RoW) width: 50 m
vi. 4 (four) nos. of 220 kV feeder bays.[7]

22. Table 1 provides the description of the components.

[6] To be finalized at the time of Detailed Survey.
[7] Redundancy in transmission shall be provided so that in case of breakdown of one line, the other line is capable of transmitting whole power from the project.

Table 1: Description of Components for 220 kV DC TL

Component	Function	Description
Towers, comprising of body, cage, cross, arms and peak	To support the conductors	• Total of about 170 towers[8] • Design (height of 30 m, width of 8.6 m) • Spacing (at a distance of 250-350 m depending on the terrain and stability of the soil) • Material Galvanized steel
Insulators (I String)	To prevent unwanted flow of electric current from conductor to earth	• Pre-manufactured electrical component made of Porcelain • For each tower 12 insulators (tension string) are required
Conductors (Double Circuit), length 50 km	To evacuate electricity	• Type used: ACSR "Zebra"

4.2 Proposed Corridor (Right of Way) For 220 kV DC TL

23. The proposed corridor for the 220 kV TL will start from the switch yard at the MPH site situated on the right bank of river Kopili (GPS Coordinates: 25°41'54.02"N, 92°48'15.98"E) and will end at an existing 132/33 kV S/S at Sankardev Nagar (Lanka) (GPS Co-ordinates: 25°59'16"N and 92°55'30"E) situated in the Sankardev Nagar area in Village Pam Gaon in district Nagaon. This S/S is being operated by AEGCL. The GPS coordinate of complete route are given in Appendix 1.

24. The switch yard at the MPH site is located 40–50 meters uphill off the right bank of river Kopili. There is an existing unpaved approach road to the MPH site; however this will require improvement. The MPH site area is uneven and may require backfilling. The MPH site has no households or settlements in the nearby vicinity.

25. From the switch yard location and for an approximate length of 2 km, the 220 kV TL will transverse in 116°SE direction towards the road easement of the Umrangsu-Lanka road. The Umrangsu-Lanka road is uneven in certain stretches and will require improvement. There are existing bamboo and other tall trees at the MPH site and all the way until the road easement of the Umrangsu-Lanka road; therefore some tree felling, tree top lopping, and clearing of heavy undergrowth will be required along the final Right of Way (ROW) of 35 meters. The 220 kV TL will cross over a water channel called "Kala nala" (length of bridge 15 meters, width of nala bank 10 meters) and alignment will be on the right hand side (RHS) of the Umrangsu-Lanka road when heading in the direction of Lanka township. The RHS of the road (when heading in the direction of Lanka Township) abuts the Panimur proposed reserve forest (PRF). This PRF is currently maintained by the Panimur forest ranger. The 220 kV TL will be pulled behind the Panimur proposed reserve forest (PRF) to avoid intrusion in the PRF, and continue along open/agricultural fields, cross River Diyung (width of river bank 70 meters) and finally the TL will head north towards the existing S/S at Sankardev Nagar (Lanka) while avoiding habitation/settlements/forests along the way.

26. The proposed corridor for 220 kV TL will pass through the following villages: Choto Langku, Choto Langpher, Choto washiling I, langphermukh, Wasubil, Choto Longfer, Boro Longfer, Phanglangsu, Kamla Basti, Baraima, Diklempur, Baphriphangaja, Matikhola, Watirjor, Krishnanagar, Irabari, Lalongdubi, Bordolong, Dablong Gaon, Paschim Lanka, Paschim

[8] Considering 300m average spacing between two 220 kV towers.

Bhalukmari, Ampukhuri, Lakshipur, Pam Gaon and finally to the existing S/S at Sankardev Nagar.[9] (See Table 1 (Route 1), Appendix 1 of this report).

4.3 Land Use

27. The land use along the 220 kV TL corridor consists of 57% plain and cultivated land and 43% hills and hillocks mixed with thin plantation/scrubs and cultivated land used for producing sugarcane and ginger, and other produce.[10] The elevation for the highest point is 772 feet from the mean sea level at the LKHEP site and a minimum of 221 feet at 132/33 kV S/S at Sankardev Nagar (See Figure 4 and 5).

28. The proposed corridor will pass alongside villages /settlements and agricultural fields. These areas are sparsely populated with semi-permanent settlements of migrant workers/non-tribal persons. The tribal communities reside deeper into the hills. The migrant workers/non-tribal persons are mostly farmers and engaged with work on leased agricultural land for sugar cane production and ginger. Other produce consists of maize and rice cultivation, and some bamboo/rubber plantations. Farmers may be potentially affected by the proposed corridor. Some wild bushes were also observed along the proposed corridor during the preliminary (walk-over) survey (See Figure 5).

4.4 Forests and Wildlife

29. The proposed corridor for the 220 kV TL has been planned by avoiding all kinds of forest in the area. Also there are no environmentally sensitive areas along the route of the transmission line.

30. Consultations with local communities and local forestry officials confirm that there are no designated corridors for movement of wildlife across the transmission line route. Biodiversity assessments carried out as part of the EIA for LKHEP (which also includes assessment of transmission line route) confirms that there are no critical habitats in the transmission line route.

31. An inventory of environmental features along the 220 kV transmission line corridor have been carried out and the same is presented in Table 2. Photographic records of walkover surveys and consultations are presented in Photographs 1 to 8.

Table 2: Environment Features-220KV Transmission Line

Marking S.No.	Chainage		Landuse	Environmental Features
	From	To		
1	0	0.1	Existing Sub station	Start point of Transmission Line at Shankerdev Nagar
2	0.1	0.5	Agriculture having plain terrain-Paddy fields	Mud road crossing (PWD)
3	0.5	1		
4	1	2		Two ponds
5	2	3		Area village- Jorapukhuri Market
6	3	4		Area village- Lakshipur
7	4	5		Village road crossing Area Ampukhuri and Pub Bhalukmari
8	5	6		Village road crossing Pub Bhalukmari and Paschim Bhalukmari

[9] Source: Preliminary (Walk-over) Survey report, November 2015.
[10] Source: Preliminary (Walk-over) Survey report, November 2015.

Marking S.No.	Chainage		Landuse	Environmental Features
	From	To		
9	6	7		Lanka –Guwahati Railway Line Crossing Paschim Bhalukmari and Kasipur
10	7	8	Agriculture with barren intermittently	Village road crossing Panchyat Bhwan and School are near to alignment for transmission line Village area-Kasipur
11	8	10	Agriculture having plain terrain -Paddy fields	Village road & seasonal stream crossing Village area-Paschim Lanka
12,13	10	11		Village area-Paschim Lanka and Dablong
14	11	12		Lanka-Garampani (PWD road) crossing Bordolong area- village Sambari
15	12	13	Water body –low laying area flooded every for two/three months	Village area- Sambari
16	13	14	Agriculture having plain terrain -Paddy fields	Village area- Irabati and Lalungdhubi Agriculture area with low laying water body
17	14	15		Village area- Lalungdhubi and Krishanangar
18	15	16		Village road crossing Village area- Krishanangar
19	16	17	Agriculture mixed with shrubs on small hill-rolling terrain-Sugarcane fields	Two village road crossing Village area- Watirjor and Matikhola,
20	17	18		
21, 22	18	19		
23	19	20		Mud road crossing at two places Village area-Baphriphangaja, Dikelmpur, Radhanagar
24	20	21		
25, 26, 27	21	22		
28	23	24	Agriculture mixed with shrubs – Diyung River crossing	Village area- Diyungmukh
29, 30, 31	24	26	Agriculture mixed with shrubs on small hill-rolling terrain-Sugarcane fields	Village area Bara washling –I,II&III
32, 33	26	28		Village area – Phanglangsu
33, 34	27	30	Agriculture mixed with shrubs on hilly terrain-Sugarcane & banana fields and private plantation (teak and rubber)	Village area – Phanglangsu and Choto Washling
35-42	30	33	Agriculture mixed with shrubs on hilly terrain (Private Land)	
43	33	34	Agriculture mixed with shrubs on hilly terrain (Private Land)	Halflong road crossing
44-47	34	37		Langkri Nala crossing
47-55	37	44		Village area-Langphermuk
55-63	44	48	Agriculture mixed with shrubs on hilly terrain (Private Land)	Village area-Langphermuk and Choto Longpher

Marking S.No.	Chainage		Landuse	Environmental Features
	From	To		
63-64	48	49.574	Forest on hilly terrain (Private Land)	Lanka-Grampani Road crossing at Longku area Land acquired under Hydropower Project

Source: Walkover survey January 2018.

Photo 1: Paddy field near tower location no. 14

Photo 2: Small vegetation in the backyard of a house near tower location no. 48

Photo 3: Hillock near tower location no. 53

Photo 4: Village road near tower location 34

Photo 5: Walkover Survey with Technical Team (January 2018)

Photo 6: Village road near tower location no. 34

Photo 7: On site discussion with technical team by ADB Mission (Project Officer and Safeguards Specialists (March 2018)

Photo 8: Onsite discussion with Forest Officials at Panimur Forest Range Office

5. Description of 33 kV Single Circuit Transmission Line

5.1 Location and Components

32. Power Evacuation for the Auxiliary Power House (AP) via the associated 33 kV SC TL consists of the following:

i. Voltage level: 33 kV
ii. Tapping point: Auxiliary Power House (APH) (1 unit of 10 MW)
iii. Termination point: 132/33 kV S/S at Umrangsu
iv. Length of line: 20 km (Approximate)[11]
v. Right of Way (RoW) width: 15 m
vi. 2 (two) nos. of 33kV feeders.[12]
vii. Necessary bays in 33 kV S/S at Umrangsu shall be constructed.

33. Table 3 provides the description of the components.

Table 3: Description of Components for 33 kV SC TL

Component	Function	Description
Towers, comprising of body, cage, cross, arms and peak	To support the conductors	• Total of 80 towers • Design (height of 21 m, width of 6.6 m) • Spacing (at a distance of 200 - 300m depending on the terrain and stability of the soil) • Material Galvanized Steel
Insulators (I String)	To prevent unwanted flow of electric current from conductor to earth	• Pre-manufactured electrical component made of Porcelain • For each tower 12 insulators (tension string) are required

[11] To be finalized during Detailed Survey.
[12] Redundancy in transmission shall be provided so that in case of breakdown of one line, the other line is capable of transmitting whole power from the project.

Component	Function	Description
Conductors (Single Circuit), length 20 km	To evacuate electricity	• Type used: ACSR “Zebra”

5.2 Proposed Corridor (Right of Way) for 33 kV SC TL

34. The proposed corridor for the 33 kV TL will start from the APH site situated on the right bank of river Kopili (GPS Coordinates: 25º40’1”N and 92º46’59”E) and will end at an existing 132/33 kV S/S at Umrangsu (GPS Co-ordinates: 25º30’42”N and 92º45’31”E) situated in the district Dima Hasao. This S/S is being operated by AEGCL.

35. From the APH site, the 33 kV TL will transverse through heavy tree and vegetation cover in 335ºN direction towards the road easement of the Lanka-Grampani road. The proposed corridor will go past the current “campsite” of the LKHEP project situated on the RHS of the road when heading in the direction of Umrangsu (GPS Coordinates of Campsite: 25º39’49”N and 92º47’38”E). It will cross the Lanku nala (length of bridge 15 meters, width of nala bank 10 meters). Note: the Lanku nala will come under the portion for submergence due to LKHEP, e.g. campsite is at 226 meters whereas after completion of LKHEP the maximum water level will be 229 meters.[13]

36. After Lanku nala, the 33 kV TL will follow the Left Hand Side (LHS) of the Lanka-Grampani road when heading in the direction of Umrangsu. The 33 kV TL will follow the alignment of an existing 11 kV distribution line linking Kheroni, Lanku and Umrangsu which runs parallel to the Lanka-Grampani road (on LHS). The proposed 33 kV TL will pass areas such as Borolanklan, 29 kilo, and 16 kilo (the names are in relation to distances in kilometers from the Meghalaya border). 29 kilo and 16 kilo are border towns with small permanent and semi-permanent populations; the Dalmia cement plant (which is the bulk consumer in the area) provides a major source of employment to persons living nearby. The 33 kV TL will connect to an existing132/33 kV S/S at 16 kilo (Umrangsu).

5.3 Land Use

37. The land use along the proposed corridor is mainly agricultural fields (maize, rice, and sugar plantations), and open fields with light vegetation. There are also some bamboo plantations. There are no big clusters of housing / settlements but these are widely spread out. The 33 kV TL will be placed 100 meters away from the existing 11 kV distribution line at appropriate intersection while avoiding villages / settlements.

38. No tree cutting is anticipated with any of the activity; however there may be some tree top lopping and clearing of vegetation and undergrowth will be required along the final Right of Way (RoW) of 15 meters.

5.4 Forests

39. The proposed corridor for 33 kV TL has been planned by avoiding all kind of forests in the area (except in the immediate dam site area, which will be cleared for the project in any case). Also there are no protected areas along the proposed route. The alignment of the 33 kV construction power line will mostly follow the alignment of existing Lanku-Umrango road.

[13] There will be re-construction of the bridge at Lanku-nala to raise the height and length (new proposed length 60 meters, height 18 meters from the nala bed. The bridge has been identified as BR-3 in the Main Map prepared by APGCL called “Infrastructure Works Layout Plan.”

6. Description of Existing 132/33 kV S/S at Sankardev Nagar (Lanka)

6.1 Location and Components

40. The upgrading of Substation (S/S) at Sankardev Nagar (Lanka) will consist of the following:

i. Voltage: Existing 132 kV with 2 no. power transformers (capacity 2 x 25 MVA) to 220 kV with 2 no. inter-connected transformers (ICT) (capacity 2 x 160 MVA).
ii. Switchgear: Proposed type is Gas Insulated Substation (GIS).
iii. 4 (four) nos. of 220 kV feeder bays at S/S.

41. The existing 132/33 kV S/S at Sankardev Nagar (Lanka) (GPS Coordinates: 25°59'16"N and 92°55'30"E) was first constructed in 1983. The existing 132 kV connectivity of S/S at Sankardev Nagar are as follows:

i. One 132 kV D/C TL to 220/132 kV S/S at Samaguri[14]
ii. One 132 kV S/S TL to Diphu (District Headquarters of Karbi Anglong Hill District)
iii. One 132 kV S/C TL to M/S. Calcom Cement Industry (bulk consumer).

42. Up-gradation will take place within the current 132/33 kV S/S at Sankardev Nagar which is enclosed with metal fencing. No land acquisition is required.

6.2 Land Use

43. The land use in and around the S/S area are mainly open fields, agricultural land. There are no villages/settlements in the immediate vicinity of the existing S/S. There are patches utilized for cattle and sheep grazing. No tree cutting is anticipated with any of the activity. Clearing of vegetation may be required.

6.3 Forests

44. There are no forests in the nearby area.

Photo 1: Existing Sankardev Nagar Substation

Photo 2: Available space within premises of existing substation

[14] 220 kV DC line from the MPH site at LKHEP will connect to 220 kV S/S at Samaguri via LILO at 132 kV S/S/ at Sankardev Nagar (Lanka) (total TL length approximately 108 km). 220 kV S/S at Samaguri is again connected to 400kV S/S at Misa and to 220kV S/S at Sarusajai. Source: DPR, Volume IA Chapter 11.

7. Implementation Activities

45. The construction of the power evacuation system (associated facility) for the LKHEP project shall be the responsibility of Assam Electricity Grid Corporation Limited (AEGCL).[15] AEGCL will work closely with the Project Management Unit (PMU) of the project proponent (APGCL) who will be overseeing the 120 MW LKHEP project.

46. Broadly, the implementation of power evacuation system will include detailed and check survey, excavation, tower site leveling, backfilling (if needed), tower erection and assembly, integration of transmission line design standards, stringing of conductors and earth-wire, pre-commissioning and commissioning. The erection of TL shall be in compliance with the following GOI standards/codes (See Table 4) and IFC EHS guidelines for Electric Power Transmission and Distribution.

Table 4: Relevant Construction Standards of the Government of India (GOI)

GOI standards and/or codes	Title
IS:5613-1995 (Part-II)	Code of practice for design, installation and maintenance of overhead power lines. Section 1 - Designs. Section 2 - Installation and Maintenance
IS:269-1967	Ordinary rapid hardening and low heat Portland cement.
IS:456-2000	Code of practice for plain and reinforced concrete
IS:1786-1966	Cold twisted steel bars for concrete reinforcements
IS:4091-1967	Code of practice for design and construction of foundation for transmission line towers & poles
IS:3072-1975	Code of practice for the installation and maintenance of switchgear
IS: 3043-1987	Code of practice for earthling
IS: 1255-1983	Code of practice for the installation and maintenance of power cables • Cable sheaths and armour bonding to the earthling system
IS: 1866	Transformer insulation oil quality analysis • Circulation and filtering of oil, heating of oil, sampling and testing of oil • Inspection, storage, installation of transformers/reactors
IS: 7205-1974	Safety code for erection of structural steelworks

8. Transmission Line Design Standards[16]

8.1 Electrical Characteristics

47. High altitudes influence on both the thermal rating and the insulation co-ordination due to the change in air density. The TL route is considered as highly polluted with a creepage distance of 25 mm/kV. The ground resistance is considered high but should be aimed to 25 ohms except for the first and last three km where the resistance is recommended aimed at 10 ohms. The line electrical characteristics are given below in Table 5.

[15] AEGCL is responsible for the coordinated development of transmission and distribution of electricity in the state along with PGCIL under central sector.

[16] Engineering details for power evacuation system are included in Chapter 11: Transmission of Power and Communication Facilities, Detailed Project Report (DPR, September 2015).

Table 5: Parameters for 220 kV Power Evacuation System[17]

S. No.	Parameter	Value
1.	Nominal voltage of a three phase system	220 kV
2.	Highest voltage of a three phase system	245 kV
3.	Rated short duration power frequency voltage (altitude <1000m)	560 kV rms
4.	Rated lightening impulse withstand voltage-peak (altitude <1000m)	1050 kVp
5.	Rated frequency	50 Hz
6.	Maximum insulator creepage distance	25 mm/kV
7.	Maximum operating conductor temperature	70 deg C

8.2 Conductors and Clearances

48. Minimum vertical and horizontal conductor clearances should be maintained at a maximum conductor temperature in still air and final sag, i.e. tower spotting temperature of 75 deg C. strictly as per Indian Electricity Act 2003, IE rule 1956 and relevant Indian Standards such as IS: 5613. IFC EHS guidelines for Electric Power Transmission and Distribution have also been considered while designing the transmission system components.

49. **Phase Conductors**: The conductors for the 220 kV TL will be ACSR "Zebra" double circuit of aluminium alloy conductor material while the supporting towers will be galvanized steel structures of two types - tension and suspension, double-circuit with bolted joints which is designed to carry the line conductors with necessary insulators, earth wire, fittings and fixtures under all loading conditions. Double circuit configuration allows for an increased long-term reliability and capacity of the transmission lines to evacuate power over long distances.[18] The electrical and other parameters of ACSR "Zebra" are presented in Table 6.

Table 6: Required Characteristics of Zebra Conductor[19]

S. No	Performance Parameter	Specific Value
1	Conductor designation	ACSR "Zebra"
2	Cross-section (mm2)	484
3	Approx. overall diameter (mm)	28.62
4	No. of Aluminium strands	54
5	No. of Steel strands	7
6	Rated DC resistance at 20 deg. C (ohms/km)	0.0674

50. Equivalent AAAC conductor in place of ACSR may also be suitable as the same shall be cost effective.

51. The 33 kV TL is generally built on Dog conductor. Its capacity is limited to 90 MW-km at unity power factor with 5% voltage regulation. By using conductor of higher size, its capacity can be increased with permissible voltage regulation. Effort has been made to limit the transmission

[17] Table 11.1 of Chapter 11, DPR (September 2015).

[18] The "Zebra" ACSR conductor for carrying load of 110 MW (plus 10%) has the required electrical characteristics and considerably high mechanical strength respectively, which are required due to topography of the alignment and high mechanical loads. The "Zebra" conductor has both the thermal capacity and limiting the voltage regulation within limit.

[19] Table 11.2, Chapter 11, DPR September 2015.

voltage to 33 kV as far as possible to have cost effective solution. Using higher size conductor (Goat/ Panther/ Bear/ Lynx/Wolf) instead of Dog may enhance the capacity of power transmission substantially. In such case, specially designed towers shall be used instead of 33 kV poles. Moreover, where span is more due to valley crossing, higher capacity towers may have to be used. In this case Lynx ACSR conductor or equivalent AAAC conductor shall be suitable for power evacuation from APH. The voltage regulation shall be kept within limit of 5.5%. The electrical and other parameters of ACSR "Lynx" are presented in Table 7.

Table 7: Required Characteristics of Lynx Conductor[20]

S. No	Performance Parameter	Specific Value
1	Conductor designation	ACSR "Lynx"
2	Cross-section (mm2)	226
3	Approx. overall diameter (mm)	19.52
4	No. of Aluminium strands	30
5	No. of Steel strands	7
6	Rated DC resistance at 20 deg. C (ohms/km)	0.1576

9. Other Infrastructure Requirements

52. The associated 220 kV TL for LKHEP will require some improvements to the current approach roads and backfilling because the take off point is at the switch yard location at the MPH site area which is uneven, and then the TL runs either through cultivated land or hills / hillocks mixed with some habitations. At regular intervals, the TL will cross the following (see Figure 3):

i. Highway crossings: between tower location no. 8 & 9; 13 &14; 15& 16; 19 &20; 21 & 22; 25&26; 43& 44; 58 &59 and 62&63.
ii. Railway Crossings: between tower location no. 8 & 9.
iii. River Crossings: river Diyung crossing between tower location no. 27 & 28.

53. The associated 33 kV TL for LKHEP will require an access road from the main Lanka-Garampani road up to the APH site, and then the TL runs along the Left Hand Side (LHS) of the Lanka-Grampani road when heading in the direction of Umrangsu.

54. The associated facility will not require any other access roads, sub-stations or construction of buildings, or other large infrastructure.

55. The upgrading of 132/33 kV S/S at Sankardev Nagar will not require new land acquisition since there is land availability within the S/S plot.

56. It is expected that staff will be required only during the pre-construction and construction period. It is planned that the power evacuation system for the LKHEP project will be placed under the responsibility of the PMU who will oversee both the 120 MW LKHEP project and works for the power evacuation system (associated facility). Therefore, while additional staff will be required, there is no need for a separate project office.

[20] Table 11.5, Chapter 11, DPR September 2015.

C. ANALYSIS OF ALTERNATIVES

57. The preliminary environmental assessment for the associated facility included an analysis of alternatives, addressing the optimal match between required technical specifications and route conditions, as well as addressing any concerns for environmental and social features along the route/TL corridor.

58. A preliminary evaluation was conducted in April–May 2015 from the switch yard location at MPH site of LKHEP to an existing 132/33 kV S/S at Sankardev Nagar (Lanka); and from APH site of LKHEP to Umrangsu. This was followed by a walk-over survey using GIS technology in November 2015.[21] The route selection was based on the interpretation of the walk-over survey and corresponding maps (topographical maps, vegetation maps) of the area while taking the following points into consideration.

1. Criteria for Optimum Route Selection

i. Avoidance of environmentally sensitive areas (ESA), critical habitat that may include National Parks (NP), Wildlife Sanctuaries (WLS), Bio-reserve zones, Eco-Sensitive Zones, wetlands, marshes, and/or areas declared as cultural / heritage sites;

ii. Avoidance of forests, and/or areas of high density of trees;

iii. Select a route that does not create any threat to the survival of migratory species / birds, or interfere in breeding;

iv. Select a route that causes minimum damage to existing land;

v. Avoidance of flood prone and/or unstable areas;

vi. Construction activities do not adversely affect the population living near the proposed TL corridors; alignments that pass through or alongside any villages/ town-ships, maintenance of the minimum ROW distance for safety measures;[22]

vii. Does not lead to uprooting of habitations, dwellings, or create a threat to the survival of any community;

viii. Consider non-interference to existing public utility services like playgrounds, schools, or hospitals.

(Note: Detailed survey and assessment will be conducted before the start of any civil works.)

2. Alternatives Considered for Route Selection

59. **Route Selection (ROW) for 220 kV DC TL:** From the output of preliminary evaluation, and criteria for optimum route selection, the following route was dropped from further study to avoid areas of high density of trees, avoid any threat to the survival of migratory species (if any) / birds or interference in breeding:

[21] Preliminary Survey Report for 220 kV Transmission Line prepared by Hi-tech Design Engineering & Construction, Guwahati (November 2015).

[22] The ROW depends on the line voltage. As per Forest Conservation Act (1980), the maximum ROW for 33 kV lines on forest land is 15 meters and minimum clearance between conductor and trees is 2.80 meters.

i. The route option of approximately 55 km (which has now been discarded) will require the TL corridor to traverse through the external fringe of the Panimur proposed reserve forest (PRF) for 9 to 10 km along the Right Hand Side (RHS) of the road when heading in the direction of Lanka town-ship. This will require a permit / clearance from the State Forest Department, tree feeling / clearing and disturbance to the natural forest habitat. Later, the TL corridor will follow open / agricultural lands while avoiding habitation / settlements / other type of forests along the way and there will be one river crossing at river Diyung.

60. Several other options were considered for the associated 220 kV DC TL route, and these described briefly below. (Note: there is no land acquisition associated with any activity).

i. Option 1: The first and preferred option of approximately 50 km traverses around the Panimur proposed reserve forest (PRF) to avoid intrusion in the dense forest, tree felling, etc. The TL corridor follows open / agricultural lands while avoiding habitation / settlements / other type of forests along the way. There will be one river crossing at river Diyung between tower location no. 27 and 28 (see Figure 3; and Table 1 (Route1), Appendix 1).

ii. Option 2: The second option of approximately 52 km traverses around the Panimur proposed reserve forest (PRF) to avoid intrusion in the dense forest, tree felling, etc. The TL corridor follows open / agricultural lands while avoiding habitation / settlements / other type of forests along the way. However, there will be two river crossing at river Diyung between tower location no. 29A, 30A and 31A; 32A and 33A (see Figure 3; Table 1 (Route2), Appendix 1).

iii. Option 3: The third option of approximately 51.5 km traverses around the Panimur proposed reserve forest (PRF) to avoid intrusion in the dense forest, tree felling, etc. The TL corridor follows open / agricultural lands while avoiding habitation / settlements / other type of forests along the way. However, there will be two river crossing at river Kopili between tower location no. 39 B and 40 B. (see Figure 3; Table 1(Route3), Appendix 1).

61. **Route (RoW) Option for 33 kV SC TL:** The route for the associated 33 kV SC TL (line length 20 km) will run parallel to the Lanka-Grampani road (on LHS) following the alignment of an existing 11 kV distribution line linking Kheroni, Lanku and Umrangsu. The TL corridor will not intrude into forests and will be placed away from settlements. Few towers will fall in agricultural land. There is no land acquisition associated with its construction.

62. **The "Do Nothing" Alternative:** The "do nothing" or "without the project" option is not viable as the associated TL are an essential component of power evacuation system from LKHEP to the national /local grid.

D. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

63. The MoEF&CC, GoI in its notification in September 2006, has exempted power transmission projects from environmental clearance requirement due to the nonpolluting nature of its activities[40] but residual impacts associated with the project cannot be entirely avoided resulting from varying topographical locations that will be traversed by the TL corridor and associated works (such as upgrading of existing S/S, etc).

64. An environmental management plan (EMP) and an environmental monitoring plan (EMoP) will help ensure that these residual impacts are mitigated and/or enhanced (Annex 2: Environmental Management and Monitoring Plan).

65. The following selection criteria were considered to ensure avoidance and minimization of environmental impacts due to the associated facility:

i. Critical environmental screening;

ii. Optimum Route Selection: As discussed in Section C.1 (Criteria for TL corridor / route selection), 8 criteria will guide the selection of optimum route);

iii. Strict adherence to the provisions of EARF, and relevant section from the FFA;

iv. Compliance to relevant provisions of Forest Conservation Act 1980, Guidelines for Declaration of Eco-sensitive zones around NP and WLS (MoEF&CC);

v. Guidelines for linear infrastructure intrusions in natural areas from the Wildlife Protection Act 1972 (amended 2010) being implemented by the National Board of Wildlife (NBW);

vi. Reference to relevant GoI standards and codes (e.g., IS 5613-1995 Part II, IS: 3072-1975, etc.);

vii. Reference to relevant provisions in the WB EHS Guidelines 2007 and the Sectoral Guidelines for Electric Power Transmission and Distribution (2007)

viii. Specific conditions to ensure that potential environmental impacts are mitigated, to be included in the Tender Documents.

1. Pre-Construction and Design Phase

1.1 Environmental Screening

66. **Loss of Irreplaceable Resources**: The associated facility will not involve any large-scale excavation or land acquisition. No trees are anticipated to be cut within the existing S/S at Sankardev Nagar (Lanka). Tree felling is anticipated in and around the MPH and APH sites and some trees may be cut along the final TL routes. For any trees that may be cleared, these will be replanted with native species by AEGCL as part of the compensatory afforestation, reforestation, rehabilitation, and landscaping activities. The activities will be coordinated with the Assam State Forest Department and with the support of Assam Biodiversity Board. The above will be reinforced by the ADB loan agreements that include assurances and conditions to the effect that forest compensation payments will go to actual afforestation and/or reforestation activities and the process to be subject to audit or other fiduciary review. Additionally, tree tops may be trimmed to maintain the required clearance. There will be minimum and targeted vegetation clearing without chemical use in preparing the base for the poles/towers.

67. The environmental management plan (EMP) includes compensation for any crop damage and loss of agricultural asset (if any) based on entitlement matrix following national laws and SPS 2009.

68. **Accelerated Use of Resources for Short-Term Gains**: The associated facility will not utilize any natural resources of the area during construction, operation and maintenance phases. Construction materials such as concrete mixers, gravel and sand, panels, panel mounts, steel,

cement, etc. shall be procured from vendors and factories. Excavated soil shall be utilized for backfilling to restore the surface area.

69. **Endangering Species:** Following selection criteria, EARF and relevant provisions in the FFA, no environmentally-sensitive area (ESA) will be affected by the associated facility. No endangered species of flora and fauna or those included in the IUCN Red List will be affected (See EIA Report Annex 5: Critical Habitat Assessment). Works in and around the tapping points for 220 kV and 33 kV TL will be coordinated with the local Forest and Wildlife Department/Forest Ranger to avoid man-wildlife conflict in case there will be wildlife crossings.

70. **Promoting Undesirable Rural to Urban Migration**: The associated facility will not involve land acquisition of any private land holdings or uprooting of habitation (including untitled land holders). The upgrading of the existing 132/33 kV S/S at Sankardev Nagar (Lanka) will be confined within the existing S/S boundary. Thus, the project is not expected to cause any loss of land holdings that normally trigger migration.

1.2 Route Selection for TL Corridors

71. The detailed walk-over survey/transect (which involves setting up of temporary tracks) helps determine the type of vegetation, land, structures, settlements within the road easements as well as the natural and physical features along the route and public utilities that may be traversed by the route. Walkover surveys may cause short and temporary disturbance to the local people within the RoW.

72. Informal and formal consultations with potentially affected persons will continue in varying stages to apprise them of the AEGCL intent and advise the community about the type, location and scale of the associated project including benefits derived from the entire project. Persons that may be affected will be compensated based on entitlements following the National laws and SPS 2009.

1.3 Choice of Technology

73. Significance of potential environmental impacts is affected by the choice of technology. Potential release of chemical and toxic gases and generation of noise and vibration could be some of the associated impacts due to inappropriate technology selection.

74. For upgrading of voltage from 132 kV to 220 kV at Sankardev Nagar S/S, the relevant switchgear proposed type is Gas Insulated Substation (GIS). GIS uses sulfur hexafluoride (SF_6) gas. SF_6 has a dielectric strength higher than air and the phase to phase spacing is reduced resulting to a more compact substation that is particularly advantageous in an urban environment where space is expensive. However, SF_6 is a potent greenhouse gas (GHG) with a global warming potential of 23,900 times compared to CO_2. In all the equipment that will be procured or installed for upgrading of the existing S/S, specifications and/or guaranteed emissions will comply with relevant standards of World Bank (WB) Environment, Health and Safety (EHS) Guidelines 2007 and CPCB / PCBA environmental standards. These specific conditions of compliance will be included in the Tender Documents.

2. Construction Phase

75. During the construction stage, activities will include the substation works at Sankardev Nagar site, transport of material and equipment to the work sites, excavation and/or backfilling (as required), vegetation clearing / tree felling / trimming along the final ROW of TL corridors, setting up of temporary access tracks, paving access roads, setting up of materials storage areas along

the route, installation of poles, and stringing of conductors. These project activities have associated environmental impacts that require mitigation measures.

2.1 Workforce Organization and Orientation

76. **Preparation of Construction Management Plan:** The construction management plan (CMP) will help to avoid unplanned activities of hired Engineering, Construction and Procurement (EPC) contractor(s) and will guide the smooth implementation of earth-moving works, civil and electrical works. The CMP will cover traffic management, temporary community/pedestrian safety, workers' safety, fire safety, spoils or muck disposal, noise and dust control, accidental drainage (sewerage and/or water spill), storm water management, material management, and waste management, as required.

77. The EPC contractor(s) will adhere to the CMP and will ensure that after completion of work, they will rehabilitate and clean up all the work sites.

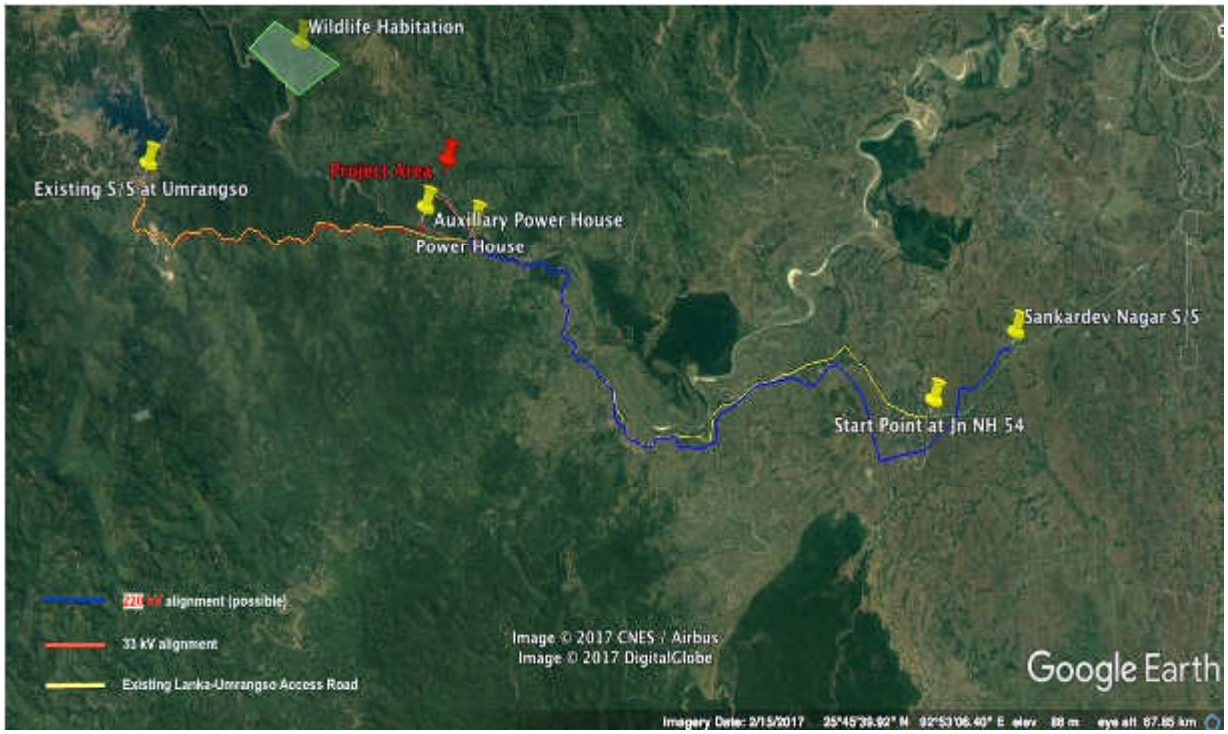
78. **Hiring of Project Staff and Workers:** It is expected that workers will be required only during the pre-construction and construction period, thus generating opportunities for local employment. While this is beneficial, it may also be a cause of conflict due to migration of workers and dispute over transparency of hiring particularly if migrant workers are recruited over local people. The EPC contractor(s) will use local labor for manual work and eligible local workforce for technical and administrative jobs. The PMU will monitor compliance of EPC Contractor(s) to local hiring.

79. **Orientation for EPC Contractor(s) and Workers:** The PMU will conduct briefing and/or orientation for EPC contractor(s) on EMP, EMOP, grievance redress mechanism (GRM), public consultation, and reporting. This will provide an understanding of their responsibility in implementing the CMP and compliance to the EMP / EMoP as well as agreement on critical areas that needs monitoring. The briefing will also include strict compliance against child labor, bonded or forced labor, and awareness of health and hygiene at work sites as well as transmitted disease (such as HIV/AIDS) to prevent potential incidence. Aside from Relevant National and State labor regulations, ADB's core labor standards will provide guidance for compliance. EPC contractor(s) will provide hired workers training / drills on safety, risks, and emergency preparedness before start of any civil works.

80. The orientation will also help in creating awareness of the potential man-wildlife conflict in and around the towers and sub-stations, if any[23]. A staff from local Forest and Wildlife Department/Forest ranger can be invited as a resource person to teach workers on man-wildlife conflict resolution.

[23] The Krugming Reserve Forest (RF) in Dima Hasao and the District Council RF in Karbi Anglong is home to wild elephants among other animals. The affected communities experience frequent movement of elephants from Longku side and Panimur side – both situated on the right bank of River Kopili in Dima Hasao. Wild elephants also cross left bank to right bank from within the District Council RF in Karbi Anglong up to and across to Dima Hasao. The movement of wild elephants is typically intensified during the rainy season when these animals move out from the Reserve Forest area in search of food to other nearby areas. Note: the forest ranger Panimur did not know of a specific elephant corridor. Additionally, the Reserve Forests also host animal species such as Stag (moso), Chinese Pangolin, Deer (meesai), Wild Boar, Monkeys (magusa), Jackal, Birds such as the wood pecker (daojgaima), and some reptiles.

Figure 7: Transmission Line Alignment Corridors and Possible Wildlife Habitat Areas



81. **Presence of Workers at Construction Sites:** The presence of workers and staff at the construction sites may increase demand for local services such as food and beverages. The localized demand of services may result in an opportunity for local livelihood generation. This will be a beneficial impact to local economy.

2.2 Site Preparation and Civil Works

2.2.1 Impacts on Land and Vegetation

82. **Upgrading of Existing S/S at Sankardev Nagar (Lanka):** Site preparation will not involve tree cutting. Some tree lopping and controlled backfilling to level the foundation may be required. Earthmoving works may cause potential soil erosion. Engineering and biological measures will be implemented to prevent soil erosion such as sowing soil binding grass. A spoil disposal plan will be strictly implemented. Landscaping or replanting of vegetation with native species will be done as soon as earthworks are completed, to stabilize the soil.

83. For any fuels and other lubricants that may be stored at construction sites, best industry practice will be followed to ensure that accidental spills and discharge to soil and water are prevented. The EPC contractor(s) will ensure that only trained workers will be engaged in handling of such material and any hazardous waste.

84. The substation transformer will be located on an impermeable floor.

85. **TL Corridors**: There will be tree felling/tree lopping/vegetation clearing (without chemical use) in and around the tapping points for 220 kV and 33 kV TL and along the final RoW[24]. This will cause loss of habitat. For any trees that may be cleared in and around the tapping points, these will be replanted with native species as part of the compensatory afforestation, reforestation, rehabilitation, and landscaping activities. These activities will be coordinated by AEGCL and APGCL with the guidance and support of the Assam State Forest Department and Assam Biodiversity Board. The above will be reinforced by the ADB loan agreements that include assurances and conditions to the effect that forest compensation payments will go to actual Afforestation and/or reforestation activities and the process to be subject to audit or other fiduciary review.

86. The loss of habitat along the final RoW due to clearing and stringing of conductors will naturally regenerate in about 2-3 years.

87. Site preparation will require minimal earthworks involving small-scale excavations and the excavated topsoil will be used for backfilling.

88. Highest flood level will be considered in site preparation for the B+ tension tower (to be confirmed during final design) at River Diyung crossing (width of river bank 70 m) for the 220 kV DC TL. This line will be a single span across river Diyung and will not require any footings on the river. Similarly, Kala-nala (width of nala bank 10 meters) and Lanku-nala (width of nala bank 10 meters) are susceptible to high flood situations. Although the embankment is not anticipated to breach, highest flood level will be considered in designing the tower location and height at these crossings.

89. For TL poles/towers, only the exact amount of construction materials (i.e., sand, gravel, concrete, etc.) will be brought on-site to avoid stockpiling that may cause localized flooding during the monsoon season and to minimize any inconvenience to local people.

90. Construction works will be scheduled to avoid farming or harvesting season, as far as practicable, to minimize crop damages. Crops/plantations that may be affected or damaged during erection of poles and stringing of conductors will be compensated based on entitlements in Schedule of Rates, Assam following the national laws and SPS 2009.

2.2.2 Impacts on Wildlife

91. Construction works in and around the tapping points for the 220 kV and 33 kV TL will be coordinated with the local Forest and Wildlife Department/Forest Ranger to avoid man-wildlife conflict in case there will be wildlife crossings. Disturbance to movement of animals is not anticipated during tree cutting, vegetation clearing and civil works along the TL corridors; however local Forest and Wildlife Department/Forest Ranger will be duly consulted on the same.

92. According to the Guidelines for linear infrastructure intrusions in natural areas (Wildlife Protection Act 1972, amended 2010), any line that follows along an animal corridor (which may exist outside the boundary of a protected area), the minimum ground vertical clearance of 6.66 m in plain areas and 9.1 m in steeper terrain will be provided and maintained. Following this requirement, the minimum ground vertical clearance for erection of poles/towers for a total of first 10 km from tapping points for 220 kV and 33 kV will be 9.1 m at maximum sag condition. The

[24] There will be minimum and targeted vegetation clearing without chemical use in preparing the base for the poles/towers.

Central Electricity Authority (CEA) guidelines for laying transmission (and distribution lines) in areas critical from the point of view of saving wildlife requires the provision of suitable spikes at the height of 2.1 m to ward off animals coming close to the poles and damaging them by rubbing their bodies against them, particularly elephants. Such poles shall be provided and maintained for the first 10 km from the tapping points for 220 kV and 33 kV.

93. Appropriate height of TL will be considered at road and railway crossings.

2.2.3 Impacts on People

94. **Workers Safety:** EPC contractor(s) will comply with relevant safety measures required by law and best engineering practices. Workers will be provided with proper safety clothes and protection gear/equipment to avoid accidents. The S/S at Sankardev Nagar (Lanka) has an existing permanent structure to house workers and sanitary facilities. EPC contractor(s) will ensure that sanitary facilities are in good condition, wash areas are clean, safe drinking water is available, garbage bins provided in designated locations, and good housekeeping is observed at all times in the work sites. These will be monitored by the PMU.

95. Designated staff and workers will be provided with communication devices to facilitate communication particularly during emergency. EPC contractor(s) will find the location of the nearest hospital, and coordinate with the hospital for arrangements in case of accidents and emergencies at the worksites. First aid treatment will be set up within the construction sites and field offices. The EPC contractor(s) will conduct a health and fitness check on its workers once every two months. Appropriate grounding and deactivation of live power on existing lines will be ensured prior to any works at the S/S at Sankardev Nagar (Lanka).

96. **Waste Generation:** There will be debris and scrap materials from construction works and dismantling activities (e.g. at S/S at Sankardev Nagar (Lanka)). Construction debris and waste will be transported to either designated dumpsites or landfill, or transported to Central warehouses located in Guwahati. The warehouse is a dedicated storage yard, for resale and auction to authorized dealers. Similarly, old transformer oil (if any) will be disposed of/sold to Government-registered recyclers only as set forth by the Hazardous Waste Management and Handling Rules 2008.

97. **Public Safety:** Construction works will be scheduled such as it does not adversely affect the population living near the proposed TL corridors; alignments that pass through or alongside any villages/settlements/town-ships, the minimum RoW distance for safety measures will be maintained.

98. The construction of transmission towers, stringing of conductors may potentially interfere with road crossings and flow of traffic. This may pose safety risks to the public. Stringing of conductors will be done following relevant Indian standards which are consistent with IEEE and IEC standards and also IFC EHS guidelines for Electric Power Transmission and Distribution. Railway crossings for TL will not cause disruption to movement of trains or public.

99. EPC contractor(s) will observe and implement the CMP for temporary community/pedestrian safety and traffic management plan and will instruct drivers of construction vehicles to strictly follow road regulations. To minimize the risks, adequate and clearly visible warning signs (such as danger, detour, cross here, works in progress, people at work, etc.) will be posted at designated sites while scaffoldings will be placed over road crossing points.

100. A 24-hour advance notice shall be provided to the affected stakeholders for interference to existing utilities (e.g., power outages during interconnection of lines, temporary shutting down of

S/S at Sankardev Nagar, temporary closing of water supply, etc.). The required machinery for construction activities will be brought on site and removed at the end of the day (if possible) to reduce obstruction to traffic flow and/or public.

2.2.4 Impacts on Air Quality, Noise, and Vibration

101. Vehicular emissions from the use of heavy equipment and construction vehicles, land clearing, road breaking, earthmoving works, and transport of construction materials may increase levels of suspended particulate matter affecting air quality. Opened and exposed land areas along the TL corridors, S/S site will be sprayed with water to suppress dust level particularly during the summer season. Storage area / warehouse for materials storage required for construction works will be provided onsite to reduce the number of trips by heavy vehicles and minimize stockpiling. Heavy vehicles transporting construction materials that generate dust will be covered with tarps.

102. EPC contractor(s) will be required to maintain heavy and construction vehicles regularly to minimize the contribution of vehicular emissions to poor air quality. Moreover, drivers will be required to observe low speed wherever necessary and minimize blowing of horns.

103. The use of heavy equipment, construction vehicles and civil works may increase the noise levels (such as during excavation works, trenching activities) and may cause vibration. Increase in noise levels and potential vibration may inconvenience local people in and around these sites. As required by CPCB guidelines and IFC EHS Guidelines, noise-generating activities will be scheduled between 9AM and 6PM while noise-generating machineries and construction areas will be covered with acoustic screens and/or temporary enclosures.

2.2.5 Impacts on Water Quality

104. Presence of workers at construction site will generate sewage that may affect water quality while earth moving works may cause localized flooding during monsoon season and in other low-lying areas.

105. Sanitary facilities are available at the S/S site at Sankardev Nagar (Lanka). EPC contractor(s) will ensure that these facilities are in good working condition. During construction works along the TL corridor, portable toilets will be provided and replaced with clean units regularly.

106. The site selection for towers/poles will avoid waterways to minimize the associated environmental impacts. No footing of towers will be placed in a water body.

107. To avoid localized flooding, construction works will be scheduled during non-monsoon period in areas prone to flooding. Note: Kala-nala (width of nala bank 10 meters) and Lanku-nala (width of nala bank 10 meters) are susceptible to high flood situations. Although the embankment is not anticipated to breach, highest flood level will be considered in designing the tower location and height at these crossings. Water quality testing will be conducted at the River Diyung, Kala-nala, and Lanku nala once prior to start of the civil works and once after completion of work.

108. During the monsoon season, drainage and storm-water management plan will be implemented by the EPC contractor(s), as needed.

3. Operation Stage

3.1 Impact on Land and Vegetation

109. The presence of transmission towers/ poles may lower the property values near or adjacent to these facilities. However, the availability of a stable and reliable power supply will attract and promote local economic development and thus, may actually enhance property values.

110. Fugitive emissions of SF_6 will be monitored following protocols consistent with the Institute of Electrical and Electronics Engineers (IEEE) and International Electro-technical Commission (IEC). Annual inventory on the use of SF_6 will be conducted to monitor usage and losses. A very high grade sealing system and erection methodology will be followed to keep the loss of SF_6 within 0.1% every year. SF_6 gas handling system for evacuation and storage will always be used for the maintenance of the circuit breaker. Relevant standards from the WB EHS Guidelines for Power Transmission and Distribution 2007 and CPCB on handling SF_6 and other hazardous materials will be complied with.

111. Any fuel and other lubricants that may be stored at the S/S will be stored on an area will have impermeable flooring. For any use of mineral oil (in transformers), EPC contractor(s) will strictly adhere to the plan for oil spill prevention and emergency response of APGCL.

3.2 Impacts on People

112. Use and handling of mineral oil (if any) may pose occupational and health risks to workers. Delivery and acceptance of mineral oil will be accompanied by material safety data sheets (MSDS) and/or be certified that it is polychlorinated biphenyl-free (PCB). India has never produced PCBs and its importation has been banned since 1998.

113. Fire extinguishers will be posted at designated locations in the S/S and storage areas; workers will be provided with training on emergency oil spill and preparedness.

114. To reduce safety risks, signage meeting the IEEE standards will be placed on all overhead lines to warn the public of electrical hazards. The transmission lines are designed to have ground wire spacing and lightning arresters as safety features following the Indian Standards consistent with IEEE and IEC standards and these will be complied with by APGCL at all times. There will be regular monitoring and maintenance to ensure safety and integrity of transmission lines and the S/S.

115. The S/S at Sankardev Nagar (Lanka) will be equipped with protection system that shuts off during power overload and similar emergencies.

116. Security and inspection personnel will be deployed on regular basis to avoid vandalism of equipment and pilferage of lines/cables which may cause accident and/or electrocution.

117. Operation of noise-generating equipment will be enclosed if possible and periodic maintenance of equipment will be conducted. Note: There are no settlements / dwellings in and around the S/S at Sankardev Nagar.

118. Safety gear for workers working at height for operation and maintenance will be used to minimize risks of accidents. Maintenance workers / linemen will be provided with safety clothing and other working gears for protection.

119. Regular training on safety and emergency preparedness will be conducted to ensure that best practices are incorporated in the Safety Plan. Only trained workers will be engaged in handling of any hazardous material (and waste).

120. Information drive to affected stakeholders/dwellings within and around the project activity area will be conducted prior to commissioning to create awareness on safety practices (e.g. adjacent to S/S at Sankardev Nagar, select sections along the TL corridor).

3.3 Impacts on Wildlife

121. While the TL corridor is not located near or adjacent to any ecologically sensitive areas (ESA), birds and other wildlife may be attracted to the presence of towers/poles particularly migratory birds. Transmission towers are designed to have ground wire spacing and lightning arresters as safety features to generally protect the public (and birds).

122. Visual inspection / spot checks of wildlife crossing particularly in and around the tapping points for the 220 kV and 33 kV TL and bird electrocution (if any) will be included as part of the maintenance work along the TL corridor. Maintenance workers will be trained to create awareness on this monitoring. Regular coordination with the local Forest and Wildlife Department/Forest Ranger will be done to prevent man-wildlife conflicts and accidental wildlife deaths.

123. An environmental management and monitoring plan has been developed for the transmission line component and provided as Appendix 2 of this report. This EMP will form part of the bidding documents for transmission line civil works component.

E. CONCLUSIONS

124. The power evacuation system involves construction of a 220 kV transmission line (50 km), 32 kV transmission line (20 km) and a 132/33 kV substation. None of these facilities are located or passing through any environmentally sensitive areas. Careful route selection has minimized involvement of forest area to the extent possible but could not be completely avoided mainly due to terrain.

125. The construction of the power evacuation system will not cause any significant adverse impacts on the environmental settings of the area. However, since the proposed activities will involve construction work, short-term adverse impacts are anticipated, mostly those associated with construction works. As per national (India) requirements the transmission line projects do not fall in the purview of the GoI's Environmental Impact Assessment (EIA) Notification, 2006. Therefore environmental clearance is not required for power evacuation system.

126. Best available technology and best management practices shall be built-in to the design of transmission lines. Also all components of power evacuation system shall be implemented and monitored in line with the government and ADB's SPS 2009 requirements and IFC EHS guidelines for Electric Power Transmission and Distribution.

127. The EMP shall be attached to the bid documents for transmission component and contractor will be responsible for implementation of the proposed mitigation measures.

APPENDIX 1: GPS COORDINATES OF PROPOSED TRANSMISSION LINES

PROPOSED 220 KV LANKA (SANKARDEV NAGAR) SS TO LANKU LOWER KOPILI HEP LINE GPS CO-ORDINATE

Route: 1

Total Line Length: 50.93 K.M.

User Login ID: lankuproject@gmail.com

Password: lankuline

AP NO.	NORTHING (In Degree)	EASTING(in Degree)	Location Name
1	25.9864	92.92555	Sankardev Nagar
2	25.981116	92.9259	Pam Gaon
3	25.98061	92.9255816	
4	25.975326	92.928894	Near Hojai-Andi Rd.
5	25.974783	92.9298	
6	25.967516	92.93646	Lakshipur
7	25.95703	92.943983	Ampukhuri
8	25.9407	92.932216	Paschim Bhalukmari
9	25.93836	92.92925	
10	25.93185	92.92863	
11	25.92745	92.92388	Paschim Lanka
12	25.91235	92.924916	Dablong Gaon
13	25.901483	92.9229	Bordolong
14	25.90073	92.92315	
15	25.89288	92.919883	Lalongdubi
16	25.88206	92.91741	Irabari
17	25.87135	92.92147	Krishnanagar
18	25.86919	92.92448	
19	25.86535	92.92388	Watirjor
20	25.85981	92.93624	Matikhola
21	25.8512	92.9465	
22	25.849816	92.9463	
23	25.83875	92.94993	Baphriphangaja
24	25.82616	92.952283	Diklempur
25	25.82008	92.95145	
26	25.81918	92.95203	
27	25.81178	92.95108	Diklempur
28	25.80448	92.94718	
29	25.80086	92.94713	Baraima
30	25.7898	92.9455	
31	25.78005	92.9402	Kamla Basti
32	25.77008	92.94131	
33	25.76011	92.9406	Phanglangsu
34	25.74128	92.93728	Digandu III
35	25.73723	92.92915	
36	25.73683	92.92551	Boro Longfer
37	25.73428	92.92273	

HI-TECH DESIGN ENGG. & CONS. GHY-3 Ph.: 2386089

AP NO.	NORTHING (In Degree)	EASTING(in Degree)	Location Name
38	25.7331	92.92243	
39	25.7304	92.92023	
40	25.72813	92.91915	Choto Longfer
41	25.72533	92.91547	
42	25.72465	92.91332	
43	25.72348	92.91095	Wasubil
44	25.72291	92.90148	
45	25.73146	92.88798	
46	25.73223	92.88446	
47	25.73053	92.8793	langphermukh
48	25.72795	92.87673	
49	25.72386	92.87275	Choto washiling I
50	25.72406	92.86743	
51	25.71993	92.86021	
52	25.70501	92.8433	
53	25.69335	92.83428	
54	25.6936	92.83165	
55	25.69488	92.82923	Choto Langpher
56	25.69243	92.8231	
57	25.69283	92.81316	
58	25.69206	92.81225	
59	25.68915	92.8057	
60	25.68553	92.8036	
61	25.67973	92.80195	
62	25.669283	92.799171	Choto Langku
63	25.668831	92.797333	

HI-TECH DESIGN ENGG. & CONS. GHY-3 Ph.: 2865089

PROPOSED 220 KV LANKA (SANKARDEV NAGAR) SS TO LANKU LOWER KOPILI HEP LINE GPS CO-ORDINATE

Route: 2

Total Line Length: 51.88 K.M.

User Login ID: lankalunkuroute2@gmail.com

Password: lankaline2

AP NO.	NORTHING (In Degree)	EASTING(In Degree)	Location Name
1	25.9864	92.92555	Sankardev Nagar
2	25.981116	92.9259	Pam Gaon
3	25.98061	92.9255816	
4	25.975326	92.928894	Near Hojai-Andi Rd.
5	25.974783	92.9298	
6	25.967516	92.93646	Lakshipur
7	25.95703	92.943983	Ampukhuri
8	25.9407	92.932216	Paschim Bhalukmari
9	25.93836	92.92925	
10	25.93185	92.92863	
11A	25.92561	92.933796	
12A	25.922681	92.933186	Lanka gaon
13A	25.917442	92.931998	
14A	25.911315	92.936963	
15A	25.90639	92.946085	Sambari
16A	25.896922	92.949862	Panjabi Basti
17A	25.887804	92.958615	Pach Bhandar
18A	25.88087	92.96023	
19A	25.864997	92.96614	Girimgaon
20A	25.85923	92.96412	
21A	25.851988	92.964526	Belbari
22A	25.845078	92.964945	Rajpur
23A	25.841154	92.96018	
24A	25.836566	92.960135	
25A	25.833191	92.960929	
26A	25.830331	92.96131	Diklempur
27A	25.824025	92.961053	
28A	25.81911	92.961649	
29A	25.81641	92.96001	Diklempur
30A	25.810907	92.959145	
31A	25.80788	92.961544	
32A	25.803712	92.960751	Baraima
33A	25.795797	92.960587	
34A	25.790474	92.960436	Indrakong
35A	25.786897	92.95535	
36A	25.783075	92.949537	
37A	25.781574	92.94392	
38A	25.776513	92.940526	

AP NO.	NORTHING (in Degree)	EASTING(In Degree)	Location Name
32	25.77008	92.94131	
33	25.76011	92.9406	Phanglangsu
34	25.74128	92.93728	Digandu III
35	25.73723	92.92915	
36	25.73683	92.92551	Boro Longfer
37	25.73428	92.92273	
38	25.7331	92.92243	
39	25.7304	92.92023	
40	25.72813	92.91915	Choto Longfer
41	25.72533	92.91547	
42	25.72465	92.91332	
43	25.72348	92.91095	Wasubil
44	25.72291	92.90148	
45	25.73146	92.88798	
46	25.73223	92.88446	
47	25.73053	92.8793	langphermukh
48	25.72795	92.87673	
49	25.72386	92.87275	Choto washiling I
50	25.72406	92.86743	
51	25.71993	92.86021	
52	25.70501	92.8433	
53	25.69335	92.83428	
54	25.6936	92.83165	
55	25.69488	92.82923	Choto Langpher
56	25.69243	92.8231	
57	25.69283	92.81316	
58	25.69206	92.81225	
59	25.68915	92.8057	
60	25.68553	92.8036	
61	25.67973	92.80195	
62	25.669283	92.799171	Choto Langku
63	25.668831	92.797333	

PROPOSED 220 KV LANKA (SANKARDEV NAGAR) SS TO LANKU LOWER KOPILI HEP LINE GPS CO-ORDINATE

Route: 3

Total Line Length: 51.54 K.M.

User Login ID: lankuproject1@gmail.com

Password: lankuline1

AP NO.	NORTHING (In Degree)	EASTING(In Degree)	Location Name
1	25.9864	92.92555	Sankardev Nagar
2	25.981116	92.9259	Pam Gaon
3	25.98061	92.9255816	
4	25.975326	92.928894	Near Hojai-Andi Rd.
5	25.974783	92.9298	
6	25.967516	92.93646	Lakshipur
7	25.95703	92.943983	Ampukhuri
8	25.9407	92.932216	Paschim Bhalukmari
9	25.93836	92.92925	
10	25.93185	92.92863	
11	25.92745	92.92388	Paschim Lanka
12	25.91235	92.924916	Dablong Gaon
13B	25.9039	92.91763	
14B	25.902906	92.913371	Simlapathar
15B	25.90231	92.90903	
16B	25.89803	92.90773	
17B	25.89323	92.90635	Khari Khana Bazar
18B	25.89176	92.9068	
19B	25.89042	92.906781	
20B	25.882484	92.899673	
21B	25.87628	92.89916	Khari Khana Gaon
22B	25.87148	92.89771	Kharikongbil
23B	25.8697	92.89748	
24B	25.8659	92.89886	Kharikongbil
25B	25.8616	92.90171	Rani Bil
26B	25.85538	92.90296	
27B	25.8453	92.90255	Dikhreng
28B	25.82183	92.91568	
29B	25.81438	92.91498	
30B	25.812	92.91516	
31B	25.80911	92.91721	
32B	25.80468	92.93211	
33B	25.80261	92.93343	
34B	25.79921	92.93383	
35B	25.7954	92.93165	
36B	25.78966	92.93016	
37B	25.78396	92.93188	
38B	25.7765	92.92898	Near Kopili River
39B	25.77151	92.92773	
40B	25.77045	92.92846	
41B	25.76337	92.92607	

AP NO.	NORTHING (in Degree)	EASTING(in Degree)	Location Name
42B	25.7598	92.92228	
43B	25.7493	92.9189	
44B	25.74435	92.919816	
45B	25.7365	92.92098	
38	25.7331	92.92243	
39	25.7304	92.92023	
40	25.72813	92.91915	Choto Longfer
41	25.72533	92.91547	
42	25.72465	92.91332	
43	25.72348	92.91095	Wasubll
44	25.72291	92.90148	
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47	25.73053	92.8793	langphermukh
48	25.72795	92.87673	
49	25.72386	92.87275	Choto washilling I
50	25.72406	92.86743	
51	25.71993	92.86021	
52	25.70501	92.8433	
53	25.69335	92.83428	
54	25.6936	92.83165	
55	25.69488	92.82923	Choto Langpher
56	25.69243	92.8231	
57	25.69283	92.81316	
58	25.69206	92.81225	
59	25.68915	92.8057	
60	25.68553	92.8036	
61	25.67973	92.80195	
62	25.669283	92.799171	Choto Langku
63	25.668831	92.797333	

APPENDIX 2: EMP AND EMOP FOR TRANSMISSION LINES

Table 1: Environmental Management Plan

Project Stage / Activity	Potential Impact	Proposed Mitigation Measures / Procedures	Parameters to be monitored	Measurement and frequency	Institutional responsibility	Implementation schedule	Mitigation Cost (USD)
A. Pre-construction							
Location of transmission towers and transmission line alignment and design	Exposure to safety related risks	Setback of dwellings to overhead line route designed in accordance with permitted level of power frequency and the regulation of supervision at sites. Design of transmission line and substations will follow CEA standards as well as IFC EHS guidelines for Electric Power Transmission and Distribution.	Tower location and line alignment selection with respect to nearest dwellings	Setback distances to nearest houses - once	AEGCL	Part of tower siting survey and detailed alignment survey and design.	Project cost
Transmission line design	Exposure to electro-magnetic interference	Transmission line design to comply with the limits of electromagnetic interference from overhead power lines as Given in IFC EHS guidelines for Electric Power Transmission and Distribution.	Electromagnetic field strength for proposed line design	Line design compliance with relevant standards - once	AEGCL	Part of detailed alignment survey and design	Project cost
Location of transmission towers and transmission line alignment and design	Impact on water bodies and land	Consideration of tower location at where they could be located to avoid water bodies or agricultural land.	Tower location and line alignment selection (distance to water and/or agricultural land)	Consultation with local authorities and land owners - once	AEGCL	Part of tower siting survey and detailed alignment survey and design	Project cost
	Social inequities	Careful route selection to avoid existing settlements	Tower location and line alignment selection (distance to nearest dwellings or social institutions)	Consultation with local authorities and land owners - once	AEGCL	Part of detailed tower siting and alignment survey and design	Project cost

		Minimise need to acquire agricultural land	Tower location and line alignment selection (distance to agricultural land)	Consultation with local authorities and land owners - once	AEGCL	Part of detailed tower siting and alignment survey and design	Project cost
Encroachment into precious ecological areas	Loss of precious ecological values/ wildlife corridor/ damage to precious species	Avoid encroachment by careful site and alignment selection	Tower location and line alignment selection (distance to nearest designated ecological protection area)	Consultation with local forest authorities - once	AEGCL	Part of detailed siting and alignment survey /design	Project cost
Transmission line through forestland	De-forestation and loss of biodiversity	Avoid encroachment by careful site and alignment selection	Tower location and line alignment selection (distance to nearest protected or reserved forest)	Consultation with local authorities - once	AEGCL	Part of detailed siting and alignment survey/ design	Project cost
		Obtain statutory clearances from the Government	Statutory approvals from Government	Compliance with regulations – once for each subproject	AEGCL		Project cost
Encroachment into farmland	Loss of agricultural productivity	Use existing tower footings/towers wherever possible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once	AEGCL	Part of detailed alignment survey and design	Project cost
		Avoid siting new towers on farmland wherever feasible	Tower location and line alignment selection	Consultation with local authorities and design engineers - once	AEGCL	Part of detailed siting and alignment survey /design	Project cost
		Farmers compensated for any permanent loss of productive land	Design of Implementation of	Consultation with affected parties – once in a quarter	AEGCL	Prior to construction phase	Project cost

			Crop Compensation (based on affected area)				
		Farmers/landowners compensated for significant trees that need to be trimmed/ removed along RoW.	Design of Implementation of Tree compensation (estimated area to be trimmed/ removed)	Consultation with affected parties – once in a quarter	AEGCL	Prior to construction phase	Project cost
			Statutory approvals for tree trimming /removal	Compliance with regulations – once for each subproject		Part of detailed siting and alignment survey/ design	Project cost
Noise related	Nuisance to neighbouring properties	Substations sited and designed to ensure noise will not be a nuisance.	Noise levels	Noise levels to be specified in Tender documents -once	AEGCL	Part of detailed equipment design	Project cost
Interference with drainage patterns/ Irrigation channels/rivers	Flooding hazards/loss of agricultural production	Appropriate siting of towers to avoid channel interference/low laying areas	Tower location and line alignment selection (distance to nearest flood zone)	Consultation with local authorities and design engineers - once	AEGCL	Part of detailed alignment survey and design	Project cost
B. Construction							
Equipment layout and installation	Noise and vibrations	Construction techniques and machinery selection seeking to minimize ground disturbance.	Construction techniques and machinery	Construction techniques and machinery creating minimal ground disturbance - once at the start of each construction phase	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Physical construction	Disturbed farming activity	Construction activities on cropping land timed to avoid disturbance of field crops (within one month of harvest wherever possible).	Timing of start of construction	Crop disturbance –Post harvest as soon as possible but before next crop - once per site	AEGCL (Contractor through contract provisions)	Construction period	Project cost

Mechanized construction	Noise, vibration and operator safety, efficient operation	Construction equipment to be well maintained.	Construction equipment – estimated noise emissions	Complaints received by local authorities - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
	Noise, vibration, equipment wear and tear	Turning off plant not in use.	Construction equipment – estimated noise emissions and operating schedules	Complaints received by local authorities - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Construction of roads for accessibility	Increase in airborne dust particles	Existing roads and tracks used for construction and maintenance access to the line wherever possible.	Access roads, routes (length and width of new access roads to be constructed)	Use of established roads wherever possible - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
	Increased land requirement for temporary accessibility	New access ways restricted to a single carriageway width within the RoW.	Access width (meters)	Access restricted to single carriageway width within RoW - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Temporary blockage of utilities	Overflows, reduced discharge	Temporary placement of fill in drains/canals not permitted.	Temporary fill placement (m^3)	Absence of fill in sensitive drainage areas - every 4 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Site clearance	Vegetation	Marking of vegetation to be removed prior to clearance and strict control on clearing activities to ensure minimal clearance.	Vegetation marking and clearance control (area in m^2)	Clearance strictly limited to target vegetation - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Trimming/cutting of trees within RoW	Fire hazards	Trees allowed growing up to a height within the RoW by maintaining adequate clearance between the top of tree and the conductor as per the regulations.	Species-specific tree retention as approved by statutory authorities (average and maximum tree height at maturity, in meters)	Presence of target species in RoW following vegetation clearance – once per site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
	Loss of vegetation	Trees that can survive pruning to comply should be pruned instead of cleared.	Species-specific tree retention as approved by statutory authorities	Presence of target species in RoW following vegetation	AEGCL	Construction period	Project cost

	and deforestation			clearance – once per site	(Contractor through contract provisions)		
		Felled trees and other cleared or pruned vegetation to be disposed of as authorized by the statutory bodies.	Disposal of cleared vegetation as approved by the statutory authorities (area cleared in m2)	Use or intended use of vegetation as approved by the statutory authorities – once per site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Wood/vegetation harvesting	Loss of vegetation and deforestation	Construction workers prohibited from harvesting wood in the project area during their employment, (apart from locally employed staff continuing current legal activities.	Illegal wood/vegetation harvesting (area in m^2, number of incidents reported)	Complaints by local people or other evidence of illegal harvesting - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Surplus earthwork/soil	Runoff to cause water pollution, solid waste disposal	Soil excavated from tower footings disposed of by placement along roadsides, or at nearby house blocks if requested by landowners.	Soil disposal locations and volume (m^3)	Acceptable soil disposal sites - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Site clearance	Vegetation	Tree clearances for easement establishment to only involve cutting trees off at ground level or pruning as appropriate, with tree stumps and roots left in place and ground cover left undisturbed.	Ground disturbance during vegetation clearance (area, m^2)	Amount of ground disturbance - every 4 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
			Statutory approvals	Statutory approvals for tree clearances – once for each site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Tower construction – disposal of surplus earthwork/ fill	Waste disposal	Excess fill from tower foundation excavation disposed of next to roads or around houses, in agreement with the local community or landowner.	Location and amount (m^3) of fill disposal	Appropriate fill disposal locations - every 2 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost

Storage of chemicals and materials	Contaminati on 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	AEGCL (Contractor through contract provisions)	Construction period	Project cost
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	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Provision of facilities for construction workers	Contami-nation 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	AEGCL (Contractor through contract provisions)	Construction period	Project cost
Encroachment into farmland	Loss of agricultural productivity	Use existing access roads wherever possible	Usage of existing utilities		AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Ensure existing irrigation facilities are maintained in working condition	Status of existing facilities	Complaints received by local people/ authorities - every 4 weeks	AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Protect/preserve topsoil and reinstate after construction completed	Status of facilities (earthwork in m^3)		AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Repair/reinstate damaged bunds etc. after construction completed	Status of facilities (earthwork in m^3)		AEGCL (Contractor through contract provisions)	Construction period	Project cost
	Social inequities	Compensation for temporary loss in agricultural production	Implementation of Crop compensation (amount paid, dates, etc.)	Consultation with affected parties – once in a quarter	AEGCL	Construction period	Project cost

Uncontrolled erosion/silt runoff	Soil loss, downstream siltation;	Need for access tracks minimised, use of existing roads.	Design basis and construction procedures (suspended solids in receiving waters; area re-vegetated in m^2; amount of bunds constructed [length in meter, area in m^2, or volume in m^3])	Incorporating good design and construction management practices – once for each site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Limit site clearing to work areas			AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Regeneration of vegetation to stabilise works areas on completion (where applicable)			AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Avoidance of excavation in wet season			AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Water courses protected from siltation through use of bunds and sediment ponds					Project cost
Nuisance to nearby properties	Losses to neighbouring land uses/ values	Contract clauses specifying careful construction practices.	Contract clauses	Incorporating good construction management practices – once for each site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
		As much as possible existing access ways will be used.	Design basis and layout	Incorporating good design engineering practices – once for each site			Project cost
		Productive land will be reinstated following completion of construction	Reinstatement of land status (area affected, m^2)	Consultation with affected parties – twice – immediately after			Project cost

				completion of construction and after the first harvest			
	Social inequities	Compensation will be paid for loss of production, if any.	Implementation of Tree/Crop compensation (amount paid)	Consultation with affected parties – once in a quarter	AEGCL	Prior to construction	Project cost
Inadequate siting of borrow areas	Loss of land values	Existing borrow sites will be used to source aggregates, therefore, no need to develop new sources of aggregates	Contract clauses	Incorporating good construction management practices – once for each site	AEGCL (Contractor through contract provisions)	Construction period	Project cost
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	AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Contractor to prepare and implement a health and safety plan.			AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Contractor to arrange for health and safety training sessions			AEGCL (Contractor through contract provisions)	Construction period	Project cost
Inadequate construction stage monitoring	Likely to Maximize damages	Training of AEGCL environmental monitoring personnel	Training schedules	Number of programs attended by each person – once a year	AEGCL	Routinely throughout construction period	Project cost
		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	AEGCL (Contractor through contract provisions)	Construction period	Project cost
		Appropriate contact clauses to ensure satisfactory implementation of contractual	Compliance report related to	Submission of duly completed compliance	AEGCL	Construction period	Project cost

		environmental mitigation measures.	environmental aspects for the contract	report for each contract - once	(Contractor through contract provisions)		
C. Operation and Maintenance							
Location of transmission towers and transmission line alignment and design	Exposure to safety related risks	Setback of dwellings to overhead line route designed in accordance with permitted level of power frequency and the regulation of supervision at sites.	Compliance with setback distances ("as-built" diagrams)	Setback distances to nearest houses – once in quarter	AEGCL	During operations	O&M Cost
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	AEGCL	Design and operation	O&M Cost
		Safety awareness raising for staff.	Training/awareness programs and mock drills	Number of programs and percent of staff /workers covered – once each year			O&M Cost
		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			O&M Cost
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	AEGCL	Design and operation	O&M Cost
		Security fences around substations	Maintenance of fences	Report on maintenance – every 2 weeks			O&M Cost

		Barriers to prevent climbing on/ dismantling of transmission towers	Maintenance of barriers				O&M Cost
		Appropriate warning signs on facilities	Maintenance of warning signs				O&M Cost
		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			O&M Cost
Operations and maintenance staff skills less than acceptable	Unnecessary environmental losses of various types	Adequate training in O&M to all relevant staff of substations and transmission line maintenance crews.	Training/awareness programs and mock drills for all relevant staff	Number of programs and percent of staff covered – once each year	AEGCL	Operation	O&M Cost
		Preparation and training in the use of O&M manuals and standard operating practices.					O&M Cost
Inadequate periodic environmental monitoring.	Diminished ecological and social values.	Power Grid 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	AEGCL	Operation	O&M Cost
Equipment specifications and design parameters	Release of chemicals and gases in receptors (air, water, land)	Processes, equipment and systems using cholofluorocarbons (CFCs), including halon, should be phased out and to be disposed of in a manner consistent with the requirements of the Government.	Process, equipment and system design	Phase out schedule to be prepared in case still in use – once in a quarter	AEGCL	Operation	O&M Cost
Transmission line maintenance	Exposure to electromagnetic interference	Transmission line design to comply with the limits of electromagnetic interference from overhead power lines Follow IFC EHS guidelines and International Commission on Non-ionizing Radiation Protection Guidelines for	Required ground clearance (meters)	Ground clearance - once	AEGCL	Operation	O&M Cost

		Electric Power Transmission and Distribution.					
Noise related	Nuisance to Neighbouring properties	Substations sited and designed to ensure noise will not be a nuisance	Noise levels (dB(A))	Noise levels at boundary nearest to properties and consultation with affected parties if any - once	AEGCL	Operation	O&M Cost