































# Lanka Hydraulic Institute Ltd

Natural Condition Survey for 400kV Sampur – Habarana Transmission Line Project



**Final Report** 

March 2015

**Tokyo Electric Power Services Co., Ltd.** 

Client		Client's	Renresenta	tive		
Tokyo Electric Power Services Co., Ltd.		Mr. Fumiyasu MINAGAWA				
Project		Project N	lo.			
Natural Condition Survey for 400kV Sampur – Habarana Transmission Line Project		1502				
Authors		Date				
Dr. D Mr. K	. P. C. Laknath . B. A. Silva	М	arch 2015			
Mr. n Ms. S	. Maiyouratnaan 5 Hewavidana	Approve	d by			
	IVIS. S. Newavidana		Mr. H. N. R. Perera Dr. K. Raveenthiran			
Revision		Ву	Checked	Approved	Date	
Key word	ls	Classific	ation			
Meteo	prological Survey		Doen			
Grou	nd level Survey					
Hydro Nume	ological Survey					
		Proprietary				
Distribution		No. of Copies:				
Tokyo Ele	ctric Power Services Co., Ltd.	Soft		На	Hard	
1-7-12, Shinonome, Koto-ku, Tokyo 135-0062, Japan		01		03		



## Lanka Hydraulic Institute Ltd

177, John Rodrigo Mawatha, Katubedda, Moratuwa, Sri Lanka. Tel. Nos. 2650409 / 2650471 / 2650472-3, Fax No. 2650470 - Email: Ihi@Ihi.lk

## TABLE OF CONTENTS

#### Chapter 1: INTRODUCTION

1.1.	Project Synopsis	1
1.2.	Scope of Service	1
1.3.	Organization of the Report	2

#### Chapter 2: METEOROLOGICAL SURVEY

2.1.	Study Area	3
2.2.	Meteorological Survey	3
2.3.	Wind	5
2.4.	Ambient Temperature	9
2.5.	Relative Humidity	. 12
2.6.	Rainfall	. 15
2.7.	Solar Radiation	. 17
2.8.	Thunder Days	. 20

## Chapter 3: HYDROLOGICAL SURVEY AND INVESTIGATIONS

rences	32
Investigation of OHWL and MHWL	24
Measurement of Elevations at Points LP1- LP11	22
	Measurement of Elevations at Points LP1- LP11

#### APPENDIX

Appendix - 1: Wind Hazard Susceptible Map of Sri Lanka	33
Appendix - 2: Site Condition during 12 <sup>th</sup> -15 <sup>th</sup> February 2015	35
Appendix - 3: Control Point Established by Surveying Department	36
Appendix - 4: Control Points Established by LHI Survey Team	37
Appendix - 5: Points LP1 – LP11	40



## List of Figures

Figure 2.1: The Proposed Transmission Line - Route Map	3
Figure 2.2: Wind Measurements – Weather Stations	5
Figure 2.3: Wind Rose Diagrams for 2010 – 2014 Period	9
Figure 2.4: Ambient Temperature Measurements – Weather Stations	10
Figure 2.5: Relative Humidity Measurements – Weather Stations	12
Figure 2.6: Rainfall Measurements – Gauging Stations	15
Figure 2.7: Solar Radiation Measurements – Polonnaruwa Weather Station	18
Figure 2.8: Thunder Day Measurements – Weather Station	20
Figure 3.1: Measurement Points (L1 – L11)	22
Figure 3.2: LB and RB Areas of River along the Transmission Line	24
Figure 3.3: Natural Features of River Banks along the Transmission Line	26
Figure 3.4: River Cross Section along the Transmission Line	27
Figure 3.5: Bathymetry of the River Reach used for 2D Simulations	28
Figure 3.6: Schematic Diagram Used for MIKE 21 HD Model	29
Figure 3.7. Water Level Variation in Study Area - MIKE21 HD Output	30



## List of Tables

Expected Details of Meteorological Parameters	4
Wind Data Measurements Duration and Availability	5
Annual Maximum, Minimum and Mean Wind Speed	6
Temperature Data Measurements Duration and Availability	. 10
Annual Maximum, Minimum and Mean Temperatures	. 11
Relative Humidity Measurements Duration and Availability	. 12
Maximum Relative Humidity at Polonnaruwa in 2014	. 13
Maximum Relative Humidity at Trincomalee in 2014	. 14
Rainfall Data Measurements Duration and Availability	. 16
Monthly and Annual Total Rainfall Values at 6 Gauging Stations	. 16
Solar Radiation Data Measurements Duration and Availability	. 18
Monthly/Daily Total Maximum and Minimum Solar Radiation	. 19
Hourly Maximum Total and Average Solar Radiation	. 19
Monthly Thunder Days	.21
Coordinates of Measurement Points (L1 – L11)	. 22
Water Levels at Point P1 for Different Return Period	. 31
	Expected Details of Meteorological Parameters

## CHAPTER 1 INTRODUCTION

#### 1.1. Project Synopsis

The Tokyo Electric Power Services Co Ltd. (TEPSCO) is the Consultant for Japan International Cooperation Agency (JICA) for the *Preparatory Study on National Transmission and Distribution Network Development and Efficiency Improvement Project* (*II*). In line with the project objectives, Lanka Hydraulic Institute Ltd. (LHI) was awarded consultancy services for "*Natural Condition Survey for 400kV Sampur - Habarana Transmission Line Project*" by TEPSCO on 30<sup>th</sup> January 2015.

#### **1.2.** Scope of Service

The Scope of Service of this project mainly focuses on (1) *Meteorological Survey* (2) *Hydrological Survey and Investigation*.

#### Meteorological Survey:

*Objective:* The objective of this task is to collect and analyse of meteorological data, such as wind speed and direction, ambient temperature, humidity, precipitation, solar radiation and thunder days.

Activities:

- Collect wind data at Trincomalee and Polonnaruwa stations for as long as possible period and analyse wind speed for maximum, minimum and mean.
- Collect wind data at Trincomalee and Polonnaruwa stations for a period of three year and analyse wind direction.
- Collect ambient temperature data at Trincomalee and Polonnaruwa stations for as long as possible period and analyse for maximum, minimum and mean of ambient temperature.
- Collect humidity data at Trincomalee and Polonnaruwa stations for a period of one year and analyse for maximum humidity.
- Collect precipitation data at Trincomalee, Polonnaruwa, Palampodaru/Alai Tank, Kantale, Habarana and Kaudulla Wewa stations for a period of five years and analyse for annual precipitation.
- Collect solar radiation data at Trincomalee and Polonnaruwa stations for a period of three years and analyse for maximum solar radiation.
- Collect thunder days data at Trincomalee and Polonnaruwa stations for a period of three years and analyse for mean thunder days.

*Output:* The analysed data is presented in tabular and graphical formats in this report.



#### Hydrological Survey and Investigation:

*Objective:* The objective of this task is to survey the levels at specified points (i.e. LP1 to LP11 points along the transmission line), and investigate the Ordinary High Water Level (OHWL) and Maximum High Water Level (MHWL), where the transmission line crosses the Mahaweli River. LP1 to LP11 locations along the transmission line are explained and illustrated in *Chapter 3*.

Activities: The following activities were carried out under this task;

- Survey the levels of LP1 to LP11 by using DGPS, Auto Level and Total Station.
- Investigate the OHWL and MHWL by using numerical model simulation (DHI MIKE21 software was used).

*Output:* The survey and modelling results are given in tabular and graphical forms.

Under the Scope of Service of LHI, following deliverables are expected to submit to TEPSCO.

- Draft Final Report
- Final Report

The Draft Final Report was submitted to client on 11<sup>th</sup> March 2015.

#### **1.3.** Organization of the Report

The brief descriptions about the content of each chapter of this "*Final Report*" are summarized as follows:

*Chapter 1* includes project synopsis, the scope of services and organization of the report.

*Chapter 2* explains about the study area, details about meteorological stations and meteorological data. Further, analysis results of each meteorological parameter are also included in this chapter.

*Chapter 3* explains about survey results and investigations about HWLs on the basis of numerical simulation and field investigations.



## CHAPTER 2 METEOROLOGICAL SURVEY

#### 2.1. Study Area

The project site is located between Sampur in Trincomalee district to Habarana district. The 400kV Sampur – Habarana transmission line starts from Sampur GS, through north of Polonnaruwa district, and ends up at Habarana GS. This transmission line will be aligned in order to connect Sampur GS and Habarana GS. The approximate distance between Sampur GS and Habarana GS is 95 km. The proposed alignment map of the transmission line is shown in *Figure 2.1*.



Figure 2.1: The Proposed Transmission Line - Route Map

### 2.2. Meteorological Survey

#### 2.2.1. Data Requirement by Client

As explained in the *Scope of Service (i.e. Section 1.2)*, expected details of meteorological parameters around the proposed transmission line with expected durations are tabulated in *Table 2.1.* Data recorded intervals, available periods and percentage availability at corresponding gauging stations are explained separately under each meteorological parameter *(i.e. from 2.3 – 2.8 Sections)*.



Item	Item Data	
Wind speed	Yearly wind data that based on hourly recorded wind data at a height of 10m at meteorological stations and/or point near transmission line	As long as possible
Wind direction	Yearly wind data that based on hourly recorded wind data at a height of 10m at meteorological stations and/or point near transmission line	3 years
Ambient temperature	Yearly ambient temperature data that based on hourly recorded temperature data at meteorological stations and/or point near transmission line	As long as possible
Humidity	Yearly humidity data that based on hourly recorded humidity data at meteorological stations and/or point near transmission line	1 years
Amount of precipitation	Yearly precipitation data that were recorded at meteorological stations and/or point near transmission line	5 years
Solar radiation	Yearly solar radiation data that were recorded at meteorological stations and/or point near transmission line	3 years
Thunder days	Yearly thunder days data that were recorded at meteorological stations and/or point near transmission line	3 years

#### Table 2.1 Expected Details of Meteorological Parameters



#### 2.3. Wind

#### 2.3.1. Stations and Data Availability

Wind speed and directions were measured at Polonnaruwa [7.87<sup>0</sup>, 81.05<sup>0</sup>] and Trincomalee [8.58<sup>0</sup>, 81.25<sup>0</sup>] weather stations (*see Figure 2.2*). Even it is expected to collect hourly recorded wind data under the scope, wind speed and directions were recorded only at 8.30 am and 5.30 pm during each day at each station. Further, at each station, average daily wind speed was calculated and given as *Daily Average Wind Run*. Wind data available duration and percentage availability at Polonnaruwa and Trincomalee stations are given in *Table 2.2*.



Figure 2.2: Wind Measurements – Weather Stations

to Magazuramanta Duratian and Availability

I able 2	Table 2.2 Wind Data Measurements Duration and Availability						
Met. Parameter		Data Availability (Period & Percentage)					
	Daily Measurements	Polonnaruwa		Trincomalee			
		Period	%	Period	%		
Wind	8.30 am, 5.30 pm, Avg.	(5 Vrc) 2010 -2014	96.2	(20 Vrc) 1004 - 2014	78.7		
Speed	wind Run	(5 113.) 2010 -2014	90.2	(20113.) 1994 - 2014	70.7		
Wind	8.30 am, 5.30 pm, Avg.	$(5 V_{rc}) 2010 2014$	06.2	(20 Yrs.) 1994 -2014	88.1		
Direction	wind Run	(5 115.) 2010-2014	90.2	(5 Yrs.) 2010 -2014	78.3		

Wind data explained in *Table 2.2* is given with enclosed CDROM in digital format (*i.e. 1.Wind.xlsx*)



#### 2.3.2. Wind Speed

Maximum, minimum and average wind speed of each year at Polonnaruwa and Trincomalee weather stations are given in *Table 2.3*.

## Table 2.3 Annual Maximum, Minimum and Mean Wind Speed at (a) Polonnaruwa and (b).Trincomalee Weather Stations

#### (a) Polonnaruwa

Voor	Speed (m/s) (Annual)			
real	Average	Maximum	Minimum	
2010	1.3	6.4	0.0	
2011	1.2	6.9	0.0	
2012	1.4	8.4	0.0	
2013	1.6	7.8	0.0	
2014	1.6	8.9	0.0	
Average	1.4	7.7	0.0	

#### (b).Trincomalee

Voor	Speed (m/s) (Annual)			
rear	Average	Maximum	Minimum	
1994	1.0	3.5	0.0	
1995	0.7	3.6	0.0	
1996	1.1	9.0	0.0	
1997	0.4	4.8	0.0	
1998	0.8	7.3	0.0	
1999	2.5	8.3	0.0	
2000	1.8	9.6	0.0	
2001	1.6	7.0	0.0	
2002	2.2	7.2	0.0	
2003	2.3	8.7	0.0	
2004	2.1	7.6	0.0	
2005	2.2	8.1	0.0	
2006	2.1	8.5	0.0	
2007	2.3	10.3	0.0	
2008	2.0	6.2	0.0	
2009	2.4	9.3	0.0	
2010	1.8	4.6	0.0	
2011	NA	NA	NA	
2012	2.7	8.2	0.5	
2013	2.3 6.3		0.0	
2014	2.4 7.2		0.0	
Average	1.8	7.3	0.0	

NA = Not Available



Maximum wind speed at Polonnaruwa and Trincomalee weather stations for the considered period are 8.9 m/s and 10.3 m/s respectively (please note that wind data is not available at Trincomalee weather station for year 2011). According to average and maximum values of wind hazard susceptible map of Sri Lanka prepared by Disaster Management Center of Sri Lanka, average wind speed in Polonnaruwa varies between 8.2 m/s - 10.3 m/s. Further, for the same area, maximum wind speed varies between 12.7 m/s - 18.0 m/s (see Appendix 1). This analysis was carried out by "Weather Research and Forecasting (WRF)" model using NCEP/NCAR re-analysis data. The spatial resolution of the model is 10 X 10 km. Data between 1958 – 2009 period has been considered for the analysis. Comparing measured wind speeds and simulated wind speed, simulated values are higher than measured values. In case of measured wind data (by Meteorological Department in Sri Lanka), wind speed was recorded only at 8.30 am and 5.30 pm during each day. Our analysis includes only above values. So there is a possibility of not recording actual maximum wind speed of each day. Further, for the provided hazard map by Disaster Management Center of Sri Lanka, they have considered data from 1958 – 2009 period. However, for our analysis we have only considered 2010 - 2014 period considering the measured data availability in Polonnaruwa weather station. These reasons could cause the discrepancy between Meteorological Department recorded and WRF simulated values.

#### 2.3.3. Wind Direction

Wind directions at Polonnaruwa and Trincomalee weather stations for the period of 2010 - 2014 are illustrated by wind rose diagrams (*Figure 2.3*). A wind rose is a graphic tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location.



#### (a). Polonnaruwa



As seen in *Figure 2.3 (a),* it is clear that wind direction is dominant between  $210^{\circ}$  N –  $240^{\circ}$  N directions at Polonnaruwa weather station. Additionally, there is a considerable amount of wind has blown from  $0^{\circ}$  N –  $30^{\circ}$  N directions.



Data - Not Available

2011



Figure 2.3: Wind Rose Diagrams for 2010 - 2014 Period at *(a).* Polonnaruwa *(b).* Trincomalee Weather Stations

As seen in *Figure 2.3 (b)*, we can see that wind has blown from various directions at Trincomalee weather station. High percentage of wind has blown between  $210^{\circ}$  N -  $300^{\circ}$  N directions. Further, wind has come from  $0^{\circ}$  N -  $150^{\circ}$  N direction at Trincomalee weather station in each year. This could be resulted due to the effect of wind coming from sea side.

#### 2.4. Ambient Temperature

#### 2.4.1. Stations and Data Availability

Daily maximum and minimum temperature values were measured at Polonnaruwa [7.87<sup>°</sup>, 81.05<sup>°</sup>] and Trincomalee [8.58<sup>°</sup>, 81.25<sup>°</sup>] weather stations (*see Figure 2.4*). At each station, maximum and minimum temperature values were recorded during each day. Mean temperature was calculated by averaging maximum and minimum temperature values. Temperature data available duration and percentage availability at Polonnaruwa and Trincomalee stations are given in *Table 2.4*.



Table 2.4 Temperature Data Measurements Duration and Availability								
		Data Availability (Period & Percentage)						
Met. Parameter	Interval	Polonnaruwa		Trincomalee				
		Period	%	Period	%			
Ambient Temperature (Max.)	Daily	(6 Yrs.) 2009 -2014	98.6	(21 Yrs.) 1994 -2014	95.0			
Ambient Temperature (Min.)	Daily	(6Yrs.) 2009 -2014	98.5	(21 Yrs.) 1994 -2014	95.6			



Figure 2.4: Ambient Temperature Measurements – Weather Stations

Temperature data explained in *Table 2.4* is given with enclosed CDROM in digital format *(i.e. 2.Temperature.xlsx)* 

Annual maximum, minimum and mean temperature values for the available periods at Polonnaruwa and Trincomalee weather stations are given in *Table 2.5*.



## Table 2.5 Annual Maximum, Minimum and Mean Temperatures at *(a)* Polonnaruwa and *(b)*.Trincomalee Weather Stations

#### (a). Polonnaruwa

Polonnaruwa										
Year	Max. Temp ( <sup>0</sup> C)	Min. Temp ( <sup>0</sup> C)	Avg.Temp ( <sup>0</sup> C)							
2009	38.5	14.4	28.5							
2010	37.3	17.9	28.1							
2011	38.3	16.5	28.3							
2012	39.0	18.0	28.8							
2013	38.2	18.2	28.6							
2014	38.5	16.4	28.6							
Average	38.3	16.9	28.5							

#### (b).Trincomalee

Trincomalee											
Year	Max. Temp ( <sup>0</sup> C)	Min. Temp ( <sup>0</sup> C)	Avg.Temp ( <sup>0</sup> C)								
1994	38.2	21.6	28.7								
1995	37.8	22.1	28.9								
1996	39.6	21.2	28.7								
1997	39.0	20.1	28.2								
1998	39.3	22.4	29.4								
1999	39.3	20.8	28.7								
2000	38.2	22.0	28.9								
2001	39.0	20.7	28.9								
2002	39.1	21.6	29.2								
2003	38.4	21.9	29.0								
2004	39.2	20.9	28.7								
2005	38.2	20.0	28.9								
2006	38.3	20.7	29.1								
2007	38.2	19.0	28.7								
2008	38.7	21.1	28.6								
2009	38.4	19.6	28.9								
2010	38.6	19.0	29.2								
2011	37.4	23.4	30.0								
2012	39.5	21.2	29.1								
2013	38.3	20.6	28.5								
2014	39.1	20.0	28.8								
Average	38.7	20.9	28.9								

From above analysis, it can be identified that maximum temperature at both stations has reached to  $39^{\circ}$ C for the considered period. Also, it clear that minimum temperature at Trincomalee is higher than Polonnaruwa weather stations for the considered common period (*i.e.* 2009 - 2014).



#### 2.5. Relative Humidity

#### 2.5.1. Stations and Data Availability

Daily maximum relative humidity values were measured at Polonnaruwa [7.87<sup>0</sup>, 81.05<sup>0</sup>] and Trincomalee [8.58<sup>0</sup>, 81.25<sup>0</sup>] weather stations for year 2014 (*see Figure 2.5*). At each station, maximum and minimum relative humidity values were recorded during each day. Hourly recorded relative humidity data is not available at both stations. In line with the Scope of the Service, maximum values of relative humidity data were considered for the analysis. Relative humidity data available duration and percentage availability at Polonnaruwa and Trincomalee stations are given in *Table 2.6*.



Figure 2.5: Relative Humidity Measurements – Weather Stations

Table 2.0 Relative fulfindity measurements buration and Availability											
		Data Availability (Period & Percentage)									
Met. Parameter	Interval	Polonnaruwa		Trincomalee							
		Period	%	Period	%						
Relative Humidity (Max.)	Daily	(1 Yrs.) 2014	83.3	(1 Yrs.) 2014	66.3						

2.6 Polative Humidity Measurements Duration and Availability

Relative humidity data explained in Table 2.6 is given with enclosed CDROM in digital format *(i.e. 3.Relative Humidity.xlsx)*. Daily maximum relative humidity values for year 2014 at Polonnaruwa and Trincomalee weather stations are given in *Table 2.7* and *Table 2.8* respectively.



Veen	Deut	Daily Maximum Relative Humidity											
rear	Day	January	February	March	April	May	June	July	August	September	October	November	December
2014	1	96	91	96	92	97	84	67	68	NA	96	87	NA
2014	2	93	97	96	92	97	76	69	64	NA	96	88	NA
2014	3	92	96	94	93	95	82	68	64	NA	93	92	NA
2014	4	86	98	95	86	97	69	68	64	NA	95	92	NA
2014	5	92	97	95	89	92	71	65	64	NA	94	93	NA
2014	6	98	96	95	93	95	66	65	65	NA	75	93	NA
2014	7	94	97	95	90	89	66	67	81	NA	69	94	NA
2014	8	94	97	94	91	96	68	67	59	NA	89	95	NA
2014	9	93	95	96	88	96	64	66	64	NA	77	96	NA
2014	10	97	96	96	89	91	64	65	63	NA	59	96	NA
2014	11	96	95	96	90	92	68	64	65	NA	62	95	NA
2014	12	94	95	96	90	91	67	65	63	NA	61	98	NA
2014	13	97	97	97	91	88	67	64	63	NA	93	98	NA
2014	14	97	96	93	93	77	66	59	57	NA	92	97	NA
2014	15	100	93	97	90	81	72	63	79	NA	94	94	NA
2014	16	99	93	94	87	78	65	71	84	NA	96	97	NA
2014	17	96	97	94	92	85	70	64	94	NA	97	98	NA
2014	18	97	97	94	92	90	64	64	96	NA	98	97	NA
2014	19	98	95	97	90	90	68	63	96	NA	98	99	NA
2014	20	97	96	96	92	93	67	67	92	NA	99	99	NA
2014	21	96	94	96	93	68	68	65	96	NA	96	88	NA
2014	22	97	96	93	93	60	62	65	75	NA	95	99	NA
2014	23	98	97	96	94	72	65	67	72	NA	97	99	NA
2014	24	97	94	94	92	72	64	67	90	NA	98	98	NA
2014	25	95	94	97	87	89	66	68	89	NA	95	97	NA
2014	26	96	99	93	87	78	68	66	67	NA	96	99	NA
2014	27	96	100	95	88	97	79	67	79	NA	96	99	NA
2014	28	99	96	95	95	98	65	64	68	NA	95	95	NA
2014	29	99		96	97	96	64	68	67	NA	96	91	NA
2014	30	97		94	98	74	67	63	66	NA	95	98	NA
2014	31	97		90		75		64	66		92		NA
Ave	rage	96	96	95	91	87	68	66	74	NA	90	95	NA

#### Table 2.7 Maximum Relative Humidity at Polonnaruwa in 2014

NA = Not Available

Yearly Avarage = 86



\_

Maan	Devi	Daily Maximum Relative Humidity											
Year	Day	January	February	March	April	May	June	July	August	September	October	November	December
2014	1	82	85	85	88	89	87	NA	NA	77	91	NA	NA
2014	2	88	84	86	91	90	81	NA	NA	73	97	NA	NA
2014	3	95	78	84	87	92	80	NA	NA	76	79	NA	NA
2014	4	97	76	83	86	96	80	NA	NA	81	0	NA	NA
2014	5	98	75	84	88	86	77	NA	NA	71	95	NA	NA
2014	6	98	73	84	86	87	77	NA	NA	0	80	NA	NA
2014	7	96	72	84	85	94	73	NA	NA	82	83	NA	NA
2014	8	95	72	79	86	93	73	NA	NA	74	83	NA	NA
2014	9	84	71	78	85	94	74	NA	NA	73	88	NA	NA
2014	10	88	81	75	86	86	75	NA	NA	73	64	NA	NA
2014	11	89	77	74	87	86	75	NA	NA	92	0	NA	NA
2014	12	92	89	78	88	88	75	NA	NA	97	87	NA	NA
2014	13	95	83	66	87	83	79	NA	NA	0	87	NA	NA
2014	14	93	86	72	86	84	78	NA	NA	83	89	NA	NA
2014	15	93	85	78	88	82	79	NA	NA	77	93	NA	NA
2014	16	89	89	82	81	76	75	NA	NA	70	94	NA	NA
2014	17	77	83	82	83	72	77	NA	NA	72	98	NA	NA
2014	18	92	84	88	88	79	76	NA	NA	73	0	NA	NA
2014	19	84	79	93	89	80	80	NA	NA	64	97	NA	NA
2014	20	87	74	90	87	83	78	NA	NA	0	94	NA	NA
2014	21	82	80	92	87	79	78	NA	NA	93	91	NA	NA
2014	22	88	84	89	90	74	78	NA	NA	86	91	NA	NA
2014	23	83	89	90	84	80	77	NA	NA	85	95	NA	NA
2014	24	76	86	89	83	83	76	NA	NA	85	87	NA	NA
2014	25	72	79	81	83	81	76	NA	NA	96	0	NA	NA
2014	26	75	97	82	86	78	73	NA	NA	98	93	NA	NA
2014	27	81	91	81	85	85	79	NA	NA	0	89	NA	NA
2014	28	86	76	90	89	88	79	NA	NA	98	94	NA	NA
2014	29	93		88	94	81	77	NA	NA	91	95	NA	NA
2014	30	95		88	90	82	80	NA	NA	92	93	NA	NA
2014	31	90		86		84		NA	NA		90		NA
Ave	rage	88	81	83	87	84	77	NA	NA	71	78	NA	NA

#### Table 2.8 Maximum Relative Humidity at Trincomalee in 2014

NA = Not Available



Yearly Avarage = 81

\_
As seen in *Table 2.7* and *Table 2.8*, maximum relative humidity at Polonnaruwa and Trincomalee weather stations were recorded as 100 and 98 respectively. Also, yearly average value at Polonnaruwa and Trincomalee weather stations were calculated as 86 and 81 respectively. Generally, relative humidity at Polonnaruwa is higher than Trincomalee weather station.

### 2.6. Rainfall

### 2.6.1. Stations and Data Availability

Rainfall data at 6 gauging stations in the vicinity of the proposed transmission line were collected. Coordinates of selected Polonnaruwa, Trincomalee Habarana, Kaudulla, Kanthale and Palampoddiar gauging stations are [7.87<sup>°</sup>, 81.05<sup>°</sup>], [8.58<sup>°</sup>, 81.25<sup>°</sup>], [8.03<sup>°</sup>, 80.75<sup>°</sup>], [8.13<sup>°</sup>, 80.93<sup>°</sup>], [8.35<sup>°</sup>, 80.98<sup>°</sup>] and [8.55<sup>°</sup>, 81.07<sup>°</sup>] respectively (*see Figure 2.6*). At each station, daily rainfall was recorded. Rainfall data available duration and percentage availability at 6 gauging stations are given in *Table 2.9*.



Figure 2.6: Rainfall Measurements – Gauging Stations



Table 2.9 Rainfall Data Measurements Duration and Availability									
		Data Availability (Period & Percentage)							
Met. Parameter	Interval	Station NM	Period	%					
	Daily	Polonnaruwa	(6 Yrs.) 2009 -2014	98.6					
	Daily	Trincomalee	(5 Yrs.) 2010 -2014	100.0					
Painfall	Daily	Palampoddiar RFGS	(5 Yrs.) 2010 -2014	91.7					
	Daily	Kanthale RFGS	(5 Yrs.) 2010 -2014	95.0					
	Daily	Kaudulla RFGS	(5 Yrs.) 2010 -2014	89.9					
	Daily	Habarana RFGS	(5 Yrs.) 2010 -2014	95.0					

Rainfall data explained in *Table 2.9* is given with enclosed CDROM in digital format (*i.e. 4.Rainfall.xlsx*). Monthly and annual total rainfall values for the considered periods at 6 gauging stations are tabulated in *Table 2.10*.

### Table 2.10 Monthly and Annual Total Rainfall Values at 6 Gauging Stations

#### (a). Polonnaruwa

Voor		Polonnaruwa-Rainfall (mm)											
rear	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Tot.
2009	-	1	161	247	21	0	35	80	20	105	301	544	1515
2010	123	29	103	247	242	0	91	92	245	183	334	81	1770
2011	663	560	45	151	2	0	39	81	7	735	519	360	3160
2012	7	239	24	63	0	0	67	4	32	550	249	661	1896
2013	390	162	207	44	108	0	12	68	12	39	143	228	1414
2014	270	62	5	58	138	0	0	51	101	319	508	1130	2642
Average	291	175	91	135	85	0	41	62	70	322	343	500	2066

#### (b). Trincomalee

Voor		Trincomalee-Rainfall (mm)											
real	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann. Tot.
2010	48	4	3	2	42	19	23	96	197	71	292	622	1419
2011	817	481	44	197	1	1	34	80	32	548	352	320	2907
2012	13	156	21	13	1	0	16	4	231	597	181	590	1823
2013	200	355	239	3	132	1	65	93	2	35	177	190	1493
2014	164	83	5	2	57	5	25	120	108	160	430	532	1691
Average	249	216	62	43	47	5	33	79	114	282	286	451	1867

#### (c). Habarana

Voor		Habarana-Rainfall (mm)											
real	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Tot.
2010	45	65	44	89	72	0	19	74	171	62	350	355	1346
2011	617	441	132	162	0	0	6	10	8	400	470	303	2548
2012	-	179	58	99	4	11	0	2	3	509	133	550	-
2013	275	154	130	89	74	0	79	90	26	83	122	124	1245
2014	248	20	0	140	79	0	0	15	261	379	-	-	-
Average	296	172	73	116	46	2	21	38	94	286	269	333	1713



(d). Kaudi	d). Kaudulla												
Voor						Kau	dulla-l	Rainfal	l (mm)				
real	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Tot.
2010	7	47	34	126	107	0	70	100	165	224	339	418	1637
2011	671	437	66	81	0	0	86	0	0	621	451		-
2012	-	99	8	125	0	0	0	0	8	672	132	625	-
2013	413	177	166	58	146	25	25	14	0	246	57	114	1440
2014	140	69	-	102	113	0	0	24	201	1	-	-	-
Average	308	166	68	98	73	5	36	28	75	441	245	386	1539

### (e). Kanthale

Voor		Kanthale-Rainfall (mm)											
real	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Tot.
2010	19	24	3	58	124	0	137	164	155	123	474	540	1820
2011	661	607	119	106	15	0	67	57	37	722	510	280	3181
2012	11	145	28	299	39	0	20	0	-	682	168	767	-
2013	239	288	221	111	154	0	5	34	0	104	190	158	1503
2014	225	63	0	29	267	0	0	118	140	385	-	-	-
Average	231	226	74	120	120	0	46	75	83	403	335	437	2168

### (f). Palampoddiar

Voor						Palam	poddia	ar-Rain	ıfall (m	m)			
rear	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Tot.
2010	44	32	70	-	202	13	87	196	334	118	462	804	-
2011	531	484	0	56	0	0	70	121	47	969	722	469	3469
2012	12	145	12	243	15	-	55	0	112	554	255	764	-
2013	201	369	196	28	107	-	1	21	1	53	154	187	-
2014	158	75	16	39	90	0	1	103	89	314	-	-	-
Average	189	221	59	92	83	4	43	88	116	402	398	556	3469

It is clear that highest rainfall has occurred during October to February period at all stations. This could be resulted due to the north-east and inter monsoon effects. Rainfall amount during June and July months are identified as lower than other months. Out of all stations, rainfall at Polonnaruwa and Kanthale stations are higher than other stations (*NB*: *Palampoddiar GS was excluded considering non data availability*). In 2011, comparatively high rainfall has occurred at all stations.

### 2.7. Solar Radiation

### 2.7.1. Stations and Data Availability

Solar radiation is radiant energy emitted by the sun. The solar radiation is expressed in watts per square meter (W/m<sup>2</sup>) and the total amount of solar radiation is expressed in joules per square meter (J/m<sup>2</sup>). Solar radiation values are available only at Polonnaruwa weather stations [ $7.87^{\circ}$ ,  $81.05^{\circ}$ ] in the vicinity of the proposed transmission line (*see Figure 2.7*). For the period of July 2011 – September 2012, total solar radiation (e.g. hourly, monthly) was



recorded by Meteorological Department. Solar radiation data available duration and percentage availability at Polonnaruwa station are given in *Table 2.11*.



Figure 2.7: Solar Radiation Measurements – Polonnaruwa Weather Station

Table 2.11 Solar Radiation Data Measurements Duration and Availability										
Mot Daramator	Intonval	Data Availability (Period & Percentage) at Polonnaruwa								
Met. Parameter	IIIterval	Period	%							
Solar Radiation Total/Max./Min.	Monthly/hourly	(1 Yrs.) 2011/7 - 2012/9	93.3							

Solar radiation data explained in *Table 2.11* is given with enclosed CDROM in digital format *(i.e. 5.Solar Radiation.xlsx)*.

Total solar radiation values for the considered periods at Polonnaruwa weather stations are given in *Table 2.12*. Generally, Meteorological Department records total solar radiation values (i.e. not an instantaneously values). In each hour, Meteorological Department records total solar radiation. Considering total of each day of each month, maximum and minimum daily total solar radiation is identified. Further, total monthly solar radiation is calculated (Table 2.12). Thus, considering the daily total, maximum solar radiation was identified as 27 MJ/m<sup>2</sup> for the considered period.



Table 2.12 Monthly/Daily Total Maximum and Minimum Solar Radiation										
Vear and Month		Solar Radiation(MJ/m <sup>2</sup> )								
	Total (Monthly total) <sup>1</sup>	Maximum (Daily total) <sup>2</sup>	Minimum (Daily total) <sup>2</sup>							
2011-07	553	25	0							
2011-08	708	26	14							
2011-09	680	26	13							
2011-10	561	24	8							
2011-11	430	21	3							
2011-12	NA	NA	NA							
2012-01	563	22	14							
2012-02	476	23	4							
2012-03	680	26	16							
2012-04	612	27	14							
2012-05	679	27	16							
2012-06	648	25	13							
2012-07	691	26	12							
2012-08	710	26	16							
2012-09	642	26	16							
Average	617	25	11							

#### Table 2.13 Hourly Maximum Total and Average Solar Radiation

Date	Hour of the Maximum	Solar Radiation						
Date	Solar Radiation Received	(MJ/m <sup>2</sup> ) (Hourly Total)	W/m <sup>2</sup>					
7/20/2011	12-13hrs	3.45	958					
8/23/2011	12-13hrs	3.54	983					
9/17/2011	12-13hrs	3.60	1000					
10/17/2011	11-12hrs	3.44	956					
11/13/2011	10-11hrs	3.06	850					
2011-12	NA	NA	NA					
1/1/2012	12-13hrs	3.22	894					
2/11/2012	11-12hrs	3.56	989					
3/24/2012	12-13hrs	3.54	983					
4/5/2012	12-13hrs	3.67	1019					
5/3/2012	11-12hrs	3.62	1006					
6/23/2012	11-12hrs	3.28	911					
7/30/2012	11-12hrs	3.47	964					
8/12/2012	12-13hrs	3.49	969					
9/2/2012	12-13hrs	3.48	967					
	Average	3.46	961					

In Table 2.12, MJ (Mega Joules) values refer to "Energy". To calculate solar radiation in W (Watt), referring "Power", it can be approximated by dividing  $MJ/m^2$  values by corresponding time period. For this purpose, maximum "hourly" total solar radiation of each month in  $MJ/m^2$  was used. Assuming constant solar radiation throughout the considered one hour of period, solar radiation was calculated in W/m<sup>2</sup>, dividing  $MJ/m^2$  by hour of time (*i.e. 60 x 60 Seconds*) (See Table 2.13).



### 2.8. Thunder Days

### 2.8.1. Stations and Data Availability

Thunder days were measured at Polonnaruwa  $[7.87^{\circ}, 81.05^{\circ}]$  and Trincomalee  $[8.58^{\circ}, 81.25^{\circ}]$  weather stations for 2011 – 2013 periods (*see Figure 2.8*). Thunder (or lightning) is counted during 24 hours of each day. If 1 or more thunder (or lightning) occurs during a day, that day is considered as a "Thunder Day". Thus, thunder days of each month was counted. Thunder days data available duration and percentage availability at Polonnaruwa and Trincomalee stations are given in *Table 2.13*.

Met. Parameter		Data Availability (Period & Percentage)							
	Interval	Polonnaruwa		Trincomalee					
		Period	%	Period	%				
Thunder Days	<i>Availability:</i> Monthly only	(3 Yrs.) 2011 - 2013	100.0	(3 Yrs.) 2011 - 2013	100.0				

### Table 2.13 Thunder Day Data Measurements Duration and Availability



Figure 2.8: Thunder Day Measurements – Weather Station

Thunder days data explained in *Table 2.13* is given with enclosed CDROM in digital format *(6.Thunder days.xlsx)*. Monthly thunder day values for 2011 - 2013 periods at Polonnaruwa and Trincomalee stations are given in *Table 2.14*. Except 2011, yearly average thunder days at both stations were calculated as 5. Further, number of thunder days at Polonnaruwa and Trincomalee during April and October months are higher than other months for 2011 – 2013 periods.



# Table 2.14 Monthly Thunder Days at (a) Polonnaruwa and (b).Trincomalee Weather Stations

(a). Polonnaruwa

Month		Year		Monthly
WORT	2011	2012	2013	Average
January	5	0	4	3
February	1	4	2	2
March	6	2	9	6
April	12	15	16	14
May	3	1	3	2
June	0	0	0	0
July	2	5	1	3
August	2	2	3	2
September	1	5	3	3
October	19	15	9	14
November	9	3	7	6
December	4	6	0	3
Average	5	5	5	5

### (b). Trincomalee

Month	Year			Monthly
wonth	2011	2012	2013	Average
January	NA	2	1	2
February	6	8	0	5
March	2	3	0	2
April	24	8	5	12
May	3	8	10	7
June	0	0	0	0
July	8	4	5	6
August	4	10	10	8
September	12	3	7	7
October	19	6	9	11
November	3	7	7	6
December	10	1	1	4
Average	8	5	5	6

NA = Not Available



## CHAPTER 3 HYDROLOGICAL SURVEY AND INVESTIGATIONS

### 3.1. Measurement of Elevations at Points LP1- LP11

### 3.1.1. Details of Points

Details of the expected measurement points (i.e. LP1 - LP 11) are given in *Figure 3.1* and *Table 3.1*.



Figure 3.1: Measurement Points (L1 – L11)

Table 3.1 Coordinates	of Measurement	Points	(L1 – I	∟11)
-----------------------	----------------	--------	---------	------

Point	Coordina	Note	
LP1	522446.43 m E	931697.93 m N	AP38
LP2	522836.37 m E	931475.79 m N	
LP3	523226.75 m E	931252.33 m N	
LP4	523809.56 m E	930918.48 m N	
LP5	524347.96 m E	930611.15 m N	AP39
LP6	524768.70 m E	930456.42 m N	
LP7	525190.93 m E	930300.70 m N	
LP8	525612.87 m E	930144.29 m N	
LP9	526033.98 m E	929987.60 m N	
LP10	526455.24 m E	929832.80 m N	
LP11	526982.92 m E	929639.64 m N	AP4



### 3.1.2. Surveying Elevations at Points LP1 - LP11

During  $12^{th} - 15^{th}$  February in 2015, LHI survey team went to the site to measure elevations of specified points (*i.e. LP1 to LP11*). However, due to the flooding condition in study are (*i.e. around Mahaweli River*), it was difficult to reach to exact locations (see Appendix 2 for site condition during  $12^{th} - 15^{th}$  of February in 2015). During this period, LHI survey team used a control point established by Surveying Department (*i.e. SLGI02* = [531862.75 m E, 936608.09 m N]) (see Appendix 3) for the present survey. Based on this control point, control points were established in site (*i.e. LHI 01* = [525532.00 m E, 930054.00 m N], and LHI 02 = [523214.00 m E, 931136.00 m N] (see Appendix 4) to measure elevations of specified points.

During  $13^{\text{th}} - 15^{\text{th}}$  March in 2015, LHI survey team measured elevations at specified location (*i.e. LP1 to LP11*). This task was carried out by using DGPS, Auto Level and Total Station. To measure elevation points LP1 – LP6 and LP7 – LP11, previously established LHI 02 and LHI 01 control point were used respectively. Pictures of LP1 – LP11 points are shown in *Appendix 5*. Measured elevations are presented in *Table 3.2*.

Point	Coordinate(UTM)		Ground Level (above MSL in m)
LP1	522446.43 m E	931697.93 m N	2.515
LP2	522836.37 m E	931475.79 m N	2.999
LP3	523226.75 m E	931252.33 m N	2.923
LP4	523809.56 m E	930918.48 m N	3.115
LP5	524347.96 m E	930611.15 m N	2.505
LP6	524768.70 m E	930456.42 m N	2.969
LP7	525190.93 m E	930300.70 m N	2.408
LP8	525612.87 m E	930144.29 m N	2.072
LP9	526033.98 m E	929987.60 m N	2.229
LP10	526455.24 m E	929832.80 m N	2.131
LP11	526982.92 m E	929639.64 m N	2.023

#### Table 3.2 Elevation of LP1 – LP11 Points



### 3.2. Investigation of OHWL and MHWL

The ordinary high water level *(OHWL)* is a line on the bank or shore to which the high water ordinarily rises each year. It is the water ward limit of upland vegetation and soil. This line is not established based on the level to which the water rises during major floods. It is generally recognizable by a visible change in the soil and vegetation. OHWL is used to define the boundary of in-water work. Any work below the OHWL is considered to be in-water work and special measures must be taken to protect the water way. To investigate Ordinary High Water Level (OHWL) and Maximum High Water Level (MHWL), attempts were made with two approaches as follows.

### 3.2.1. Field Investigation to Identify High Water Levels

On 14<sup>th</sup> of March in 2015, field investigation was carried out in left and right banks of the Mahaweli River where transmission line crosses the river. As seen in *Figure 3.2*, natural features nearby river along LP3 – LP4 was considered.



Figure 3.2: LB and RB Areas of River along the Transmission Line

Vegetation patterns and natural feature of points 1 - 4 along LP3 – LP4 line is further illustrated in *Figure 3.3*. As seen in Figure No. 1, erosion has occurred in left bank area. As a result, nearly vertical slope has formed in the collapsed left bank. Therefore, vegetation pattern in the left bank area is barely helpful to identify high water levels. Similarly, as seen in Figure No. 2 and 3, clay has deposited in the right bank side up to 2.67 m MSL. Hence, only considering vegetation pattern in right bank side, it is difficult to identify high water levels.











Figure 3.3: Natural Features of River Banks along the Transmission Line

River cross section survey was carried out along the transmission line during the same survey period. River cross selection along the transmission line is shown in *Figure 3.4 (NB: Vertical and horizontal scale are different)*.





Figure 3.4: River Cross Section along the Transmission Line (On 14<sup>th</sup> of March in 2015)

According to *John Scherek and Glen Yakel (1993),* the OHWL is the elevation of the top of the bank of the channel for watercourses such as river. As seen in Figure No. 1 and Figure 3.4, the top level of collapsed river left bank is 3.30 m MSL. However, flooding level could be higher than 3.30 m MSL during the flooding time.

To further investigate about high water levels, numerical simulation was carried out.

### 3.2.2. Numerical Simulation to Identify High Water Levels

To identify high water levels, numerical model simulation was conducted by using MIKE 21 Hydrodynamic Model (*HD*). Hydrological characteristics required for the model was obtained from calibrated rainfall - runoff (*RR*) model of MIKE 11 modelling system.

### MIKE 21 Hydrodynamic (HD) Model System

MIKE 21 HD is a modelling system for 2D free-surface flows and applicable to the simulation of hydraulic and environmental phenomena in lakes, estuaries, bays, coastal areas and seas in response to a variety of forcing functions including tide, wind, wave and river flow. It provides the hydrodynamic basis for the computations performed in the environmental hydraulics and sediment transport modules. MIKE 21 HD Model has the capability to simulate changes of depth (water level) and discharge along and across the river reaches with time. Further, computation of flow velocities and flow patterns are other important capabilities of the same model. Thus, water level at interested point was predicted by using the MIKE 21 HD model.



#### Model Set-up

The MIKE 21 HD (Flexible Mesh) was selected for the proposed study. By using flexible mesh, it is easy to model small areas with different grid resolutions. Thus, interested area can be defined with a high resolution. Further, model boundaries can be set up smoothly with flexible mesh of this model.

### Bathymetry

Bathymetry was created in 2D plane to include the flood inundation areas. Since the flood plain spreads over few kilometers from the river, wider bathymetry was prepared rather than having only a narrow river path. Surveyed river cross sectional data, 1:50,000 topographic maps and Google Earth images were used for the preparation of bathymetry. *Figure 3.5* shows the bathymetry of the project area prepared for the model with flexible mesh.







### **Boundary Conditions**

Discharge and sea levels were used as upstream and downstream boundaries respectively. By using calibrated rainfall-runoff (RR) model, upstream boundary condition was provided for HD model. These flow values are corresponded to the selected return periods to simulate different flood situations. Constant water level boundary was applied for the downstream boundary (see *Figure 3.6 for* Schematic diagram of the established model).



Figure 3.6: Schematic Diagram Used for MIKE 21 HD Model



### Model Calibration

The hydrodynamic model was calibrated using measured discharges. The bed roughness was used as the calibration parameter and Manning's coefficient of 0.029 was identified as suitable value for river bed roughness when calibrating the model.

### Model Simulation

By using MIKE21 HD model simulation, high flow analysis was conducted by taking different discharges for the upstream boundary of the model. For this purpose, extreme analysis was done for the discharge obtained from the calibrated RR model. Accordingly, *Gumbel* distribution was used to estimate discharges correspond to different return periods (i.e. 2, 5, 10, 25, 50 and 100 year). On the basis of discharges for different return periods, HWL identification was done at interested point (P1) by using simulated water level at point P1. 2D plot for the water level variation in the vicinity of LP3 – LP4 area for return period of 10 years is given in Figure 3.7.



Figure 3.7. Water Level Variation in Study Area – MIKE21 HD Output (Tr = 10 Years)

Table 3.2 shows water level at point P1 for different return periods obtained by HD model.

Return Period (Tr)	Water Level m MSL	Remarks
2	2.92	
5	3.13	Suggested OHWL
10	3.26	
25	3.38	
50	3.45	
100	3.52	Suggested MHWL

Table 3.2 Water Levels at Point P1 for Different Return Period

According to *Robert and Shawn (2008),* 5 - year flood elevation was approximated as the OHWL for their project works. Thus, on the basis of numerical simulation results and above approximation, 3.13 m MSL can be suggested as OHWL. As mentioned in *Section 3.2.1*, field investigated OHWL is approximated to 3.30 m MSL. Therefore, appropriate OHWL is required to select considering the type of construction work in the study area.

In case of MHWL, 3.52 m MSL is suggested by assuming 100 years of return period. However, considering the design life of proposed construction, most suitable MHWL can be selected from Table 3.2.



### References

J. Scherek and G. Yakel,1993, Guidelines for Ordinary High Water Level (OHWL) Determinations, Minnesota Department of Natural Resources Waters.

Lichvar, Robert W. and McColley, Shawn M., 2008, A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States, A delineation Manual; U.S. Army Corps of Engineers; p43.

http://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=18319

DHI MIKE11 User Manual

DHI MIKE21 User Manual



### APPENDIX - 1: WIND HAZARD SUSCEPTIBLE MAP OF SRI LANKA



Figure A1-1: Average Values of Wind Hazard Susceptible Map of Sri Lanka (Source: (<u>http://www.dmc.gov.lk/hazard/hazard/Tropical\_Cyclones.html</u>)





Figure A1-2: Maximum Values of Wind Hazard Susceptible Map of Sri Lanka (Source: (<u>http://www.dmc.gov.lk/hazard/hazard/Tropical\_Cyclones.html</u>)



# APPENDIX - 2: SITE CONDITION DURING 12<sup>TH</sup> -15<sup>TH</sup> FEBRUARY 2015









**APPENDIX - 3: CONTROL POINT ESTABLISHED BY SURVEYING DEPARTMENT** 



Figure A3 - 1: Control Point "SLGI02" Established by Surveying Department



Figure A3 - 2: GPS Observations at "SLGI02"



### APPENDIX - 4: CONTROL POINTS ESTABLISHED BY LHI SURVEY TEAM



Figure A4 - 1: Control Point "LHI01" Established by LHI



Figure A4 - 2: Establishment of Control Point "LHI01"





Figure A4 - 3: Establishment of Control Point "LHI01"



Figure A4 - 4: Control Point "LHI02"





Figure A4 - 5: Establishment of Control Point "LHI02"



igure 220 Figure A4 - 6: Mark nearby Control Point "LHI2"



### APPENDIX - 5: POINTS LP1 – LP11



Figure A5 - 1: Point LP1



Figure A5 - 2: Point LP2





Figure A5 - 3: Point LP3



Figure A5 - 4: Point LP4





Figure A5 - 5: Point LP5 and nearby CEB Mark



Figure A5 - 6: Point LP6





Figure A5 - 7: Point LP7



Figure A5 - 8: Point LP8





Figure A5 - 9: Point LP9



Figure A5 - 10: Point LP10





Figure A5 - 11: Point LP11



### Insulator Type -

### Glass, Standard Type, 120kN

Pollution Data with one month Interval

### Top Surface

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	October	0.0204	NA	-
2	November	0.0054	NA	-
3	December	0.0134	NA	-
4	January	0.0108	NA	-
5	February	0.0025	NA	-
6	March	0.0025	0.0208	Very Light
7	April	0.0078	0.0813	Light
8	May	0.0082	0.0521	Light
9	June	0.0360	0.1167	Medium
$\begin{array}{c} 1\\ 0\end{array}$	July	0.0313	0.1313	Medium
1 1	August	0.0025	0.0271	Very Light
1 2	Septembe r	0.0026	0.0854	Very Light
1 3	October	0.0053	0.0042	Very Light
$\begin{array}{c} 1\\ 4\end{array}$	November	0.0000	0.0042	Very Light

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	October	0.0081	NA	-
2	November	0.0019	NA	-
3	December	0.0336	NA	-
4	January	0.0320	NA	-
5	February	0.0046	NA	-
6	March	0.0092	0.0094	Very Light
7	April	0.0075	0.0174	Very Light
8	May	0.0109	0.0334	Very Light
9	June	0.0738	0.2092	Medium
$\begin{array}{c} 1 \\ 0 \end{array}$	July	0.0593	0.1627	Medium
1 1	August	0.0027	0.0276	Very Light
1 2	Septembe r	0.0078	0.0523	Light
1 3	October	0.0028	0.0073	Very Light
1 4	November	0.0019	0.0276	Very Light

#### **Bottom Surface**

### Data with 3 months interval

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	December	0.0134	NA	-
2	March	0.0025	0.0208	Very Light
3	June	0.0347	0.1229	Medium
4	September	0.0025	0.0521	Very Light

### Data with 6 month interval

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	March	0.0051	0.0417	Very Light
2	September	0.0051	0.0688	Light

Data with 12 month (yearly) interval

#	Month	ESDD	NSDD	Pollution

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	December	0.0337	NA	-
2	March	0.0121	0.0283	Very Light
3	June	0.0711	0.2367	Medium
4	September	0.0066	0.0712	Light

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	December	0.0123	0.0370	Medium
2	March	0.0056	0.0733	Light

# Month ESDD NSDD Pollution
-----------------------------

		(mg/cm <sup>2</sup> )	(mg/cm <sup>2</sup> )	Level				(mg/cm <sup>2</sup> )	(mg/cm <sup>2</sup> )	Level
1	September	0.0052	0.0771	Light		1	December	0.0047	0.0763	Light
T	I - + T		<b>D</b>	lata Esta	- 	40	01-N			

Insulator Type

- Porcelain, Fog Type, 120kN

Pollution Data with one month Interval

### Top Surface

### **Bottom Surface**

Pollution

Level

Very Light

Very Light

Very Light

Very Light

#	Month	ESDD	NSDD	Pollution		#	Month	ESDD	NSDD
#	WOITTI	(mg/cm <sup>2</sup> )	(mg/cm <sup>2</sup> )	Level		#	WOITT	(mg/cm <sup>2</sup> )	(mg/cm <sup>2</sup> )
1	August	0.0012	0.0227	Very Light		1	August	0.0024	0.0114
2	September	0.0013	0.0247	Very Light		2	September	0.0057	0.0328
3	October	0.0135	0.0021	Very Light		3	October	0.0117	0.0082
4	November	0.0012	0.0309	Very Light		4	November	0.0032	0.0170

### Data with 3 months interval

### Top Surface

#### **Bottom Surface**

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level	#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	October	0.0135	0.0062	Light	1	October	0.0160	0.0265	Light

No six month data and yearly data are available

### Insulator Type - Composite (Hybrid), Standard, 120kN

### Pollution Data with one month Interval

#### <u>Top Surface</u>

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	April	0.0100	0.0579	Light
2	May	0.0055	0.0377	Very Light
3	June	0.0298	0.1005	Medium
4	July	0.0223	0.0809	Medium
5	August	0.0009	0.0195	Very Light
6	Septembe r	0.0026	0.0433	Very Light
7	October	0.0028	0.0098	Very Light
8	November	0.0009	0.0181	Very Light

#### **Bottom Surface**

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	April	0.0081	0.0707	Light
2	May	0.0113	0.0464	Light
3	June	0.0625	0.1933	Medium
4	July	0.0524	0.1737	Light
5	August	0.0020	0.1737	Very Light
6	Septembe r	0.0101	0.0794	Light
7	October	0.0064	0.0212	Very Light
8	November	0.0061	0.0259	Very Light

### Data with 3 months interval

### Top Surface

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	June	0.0287	0.1403	Medium
2	Septembe r	0.0035	0.0670	Very Light

### **Bottom Surface**

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	June	0.0602	0.2169	Medium
2	September	0.0101	0.1367	Light

### Top Surface

#	Month	ESDD (mg/cm <sup>2</sup> )	NSDD (mg/cm <sup>2</sup> )	Pollution Level
1	September	0.0044	0.0800	Light

Bo	otto	m	Sui	face	

#	Month	Month ESDD (mg/cm <sup>2</sup> )		Pollution Level
1	September	0.0112	0.145	Light

No yearly data are available


# **GEOTECHNICAL INVESTIGATION REPORT**

ELS SI 3592

### PROJECT

Geotechnical Investigation for National Transmission and Distribution Network Development and Efficiency Improvement Project (II)

## CLIENT

Tokyo Electric Power Services Co. Ltd.

February 02, 2015.

ENGINEERING & LABORATORY SERVICES [PVT.] LTD. 62/3, Neelammahara Road | Katuwawala | Boralesgamuwa Sri Lanka. Tel: +94 114 309 494 | Fax: +94 112 509 806 Email: soil@elslanka.com | Web: www.elslanka.com



## CONTENTS

1.0	Introduction	1
2.0	Site Description	1
3.0	Field Investigation	3
4.0	Subsurface Conditions	3
4.1	Subsurface conditions across the borehole TT-01	3
4.2	Subsurface conditions across the borehole AP-09	4
4.3	Subsurface conditions across the borehole AP-17	4
4.4	Subsurface conditions across the borehole AP-20	4
4.5	Subsurface conditions across the borehole AP-32	4
4.6	Subsurface conditions across the borehole AP-36A	5
4.7	Subsurface conditions across the borehole AP-38	5
4.8	Subsurface conditions across the borehole AP-39	5
4.9	Subsurface conditions across the borehole AP-44	6
4.7	Subsurface conditions across the borehole TT-02	6

#### TABLES

Table 1: Locations of the boreholes
-------------------------------------

## FIGURES

Figure 1: Proposed tower locations	2
Figure 2(a): Sub Surface Profile at TT-01	7
Figure 2(b): Sub Surface Profile at AP-09	8
Figure 2(c): Sub Surface Profile at AP-17	9
Figure 2(d): Sub Surface Profile at AP-20	10
Figure 2(e): Sub Surface Profile at AP-32	11
Figure 2(f): Sub Surface Profile at AP-36A	12
Figure 2(g): Sub Surface Profile at AP-38	13



Engineering & Laboratory Services (Pvt) Ltd

Figure 2(h): Sub Surface Profile at AP-39	.14
Figure 2(i): Sub Surface Profile at AP-44	.15
Figure 2(j): Sub Surface Profile at TT-01	.16

#### ANNEXURE

Annexure I: Borehole Logs Annexure II: Field Photographs Annexure III: Locations of Boreholes

## GEOTECHNICAL INVESTIGATION FOR NATIONAL TRANSMISSION AND DISTRIBUTION NETWORK DEVELOPMENT AND EFFICIENCY IMPROVEMENT PROJECT (II)

#### 1.0 Introduction

Tokyo Electric Power Services Co. Ltd. (TEPSCO) is a Tokyo based engineering/ consulting company. And will perform Japanese International Coorporation Agency's (JICA) preparatory study on National Transmission and Distribution Network Development and Efficiency Improvement Project (II) in Sri Lanka as JICA study team under JICA. Under the above project 400kV electricity transmission line is proposed from Sampoor, where a coal power project is proposed, to Habarana (95km). Geotechnical Investigation was carried out for some tower locating along above tower line in order to assess the geological conditions at required tower positions.

M/s. Engineering and Laboratory Services (Pvt) Ltd. was authorized by M/s. Tokyo Electric Power Services Co. Ltd. (TEPSCO), to carry out the soil investigation at the above site and prepare the soil investigation report with recommendations for foundation design.

#### 2.0 Site Description

The boreholes were done along the proposed transmission line.

Location	Coordin	ate (UTM)
Location	Northing (m)	Easting (m)
TT-01	889756.50	469925.99
AP-09	894523.58	477707.07
AP-17	910993.46	489980.66
AP-20	916390.60	492864.38
AP-32	924330.82	504853.51
AP-36A	932097.78	513311.74
AP-38	931688.98	522443.44
AP-39	930607.46	524349.76
AP-44	934586.00	533906.00
TT-02	936689.06	534721.00

Table 1: Locations of the boreholes



Figure 1: Proposed tower locations

#### 3.0 Field Investigation

The field investigation was consisted of advancing 10 boreholes at the location marked as in Figure 1.

The boreholes were advanced by means of a rotary - drilling machine. The drilling was carried out with overburden cutting tools, and the wash boring process was adopted to remove the cuttings from the bottom of the borehole.

Standard Penetration Test (SPT) was carried out in regular intervals in the overburden. This test was carried out as specified in BS 1377.

Disturbed samples of soil were collected both from the SPT tube and the cuttings were collected from the washings.

Groundwater Level (GWL) was determined as the depth at which the water level stabilized inside the borehole.

The field investigation was commenced on 02<sup>nd</sup> January 2015 and completed on 31<sup>st</sup> January 2015.

#### 4.0 Subsurface Conditions

The results of the borehole investigation are given in Annexure I.

The bed rock level at the area is generally varies 3.5m-10m depth from the surface level except AP-39 (near to river). Generally the water level along investigated line was noted as 0.6-2m depth from the surface level.

Using this, profiles of subsurface conditions across the boreholes have been constructed and these are shown in Figure 2(a) to 2(j).

#### 4.1 Subsurface conditions across the borehole TT-01

- (i) The groundwater level (GWL) was encountered at the depth of 0.25m at the time of investigation.
- (ii) A medium dense to dense clayey sand layer was found up to the depth of 4.20m at the borehole TT-01

(iii) A completely weathered rock layer was encountered up to the rock level at the depth of 10.30m and borehole was terminated at that level

#### 4.2 Subsurface conditions across the borehole AP-09

The results indicate that,

- (i) The groundwater level (GWL) was not encountered at the time of investigation.
- (ii) A sand layer was found up to the depth of 1.00m at the borehole AP-09.
- (iii) A completely weathered rock layer was encountered up to the rock level at the depth of 4.40m and borehole was terminated at that level.

#### 4.3 Subsurface conditions across the borehole AP-17

The results indicate that,

- (i) The groundwater level (GWL) was encountered at the depth of 3.00m at the time of investigation.
- (ii) Gravels layer was found up to the depth of 1.00m at the borehole AP-17.
- (iii) Then completely weathered rock layer was encountered up to the rock level at the depth of 4.80m and borehole was terminated at that level.

#### 4.4 Subsurface conditions across the borehole AP-20

The results indicate that,

- (i) The groundwater level (GWL) was encountered at the depth of 1.10m at the time of investigation.
- (ii) A sandy clay layer was found up to the depth of 0.80m at the borehole AP-20.
- (iii) Then completely weathered rock layer was encountered up to the rock level at the depth of 8.85m and borehole was terminated at that level.

#### 4.5 Subsurface conditions across the borehole AP-32

- (i) The groundwater level (GWL) was encountered at the depth of 1.15m at the time of investigation.
- (ii) A clayey sand layer was found up to the depth of 0.80m at the borehole AP-32.
- (iii) Then firm to very stiff sandy clay layer was encountered up to the rock level at the depth of 7.30m and borehole was terminated at that level.

#### 4.6 Subsurface conditions across the borehole AP-36A

The results indicate that,

- (i) The groundwater level (GWL) was encountered at the depth of 0.60m at the time of investigation.
- (ii) A loose sand layer was found up to the depth of 3.50m (the rock level) and borehole was terminated at that level.

#### 4.7 Subsurface conditions across the borehole AP-38

The results indicate that,

- (i) The groundwater level (GWL) was encountered at the depth of 1.40m at the time of investigation.
- (ii) A stiff sandy clay layer was found up to the depth of 2.00m at the borehole AP-39.
- (iii) Then medium dense sand layer was found up to the depth of 4.50m.
- (iv) Very soft organic clay layer was found up to the depth of 7.50m.
- (v) Then completely weathered rock layer was encountered up to the rock level at the depth of 8.80m and borehole was terminated at that level.

#### 4.8 Subsurface conditions across the borehole AP-39

- (i) The groundwater level (GWL) was encountered at the depth of 1.60m at the time of investigation.
- (ii) A stiff sandy clay layer was found up to the depth of 2.00m at the borehole AP-39.
- (iii) Then medium dense to loose sand layer was found up to the depth of 6.00m.
- (iv) Very soft organic clay layer was found up to the depth of 9.00m.
- (v) Then very loose clayey organic sand layer was found up to the depth of 10.50m.
- (vi) Loose sand with organic clay layer was found up to the depth of 13.50m.
- (vii) Firm to very soft organic clay/organic sandy clay layer was noticed up to the depth of 25.00m.
- (viii) Loose clayey sand layer was found up to the depth 30.00m.
- (ix) Then dense clayey sand layer was found up to the depth of 32.00m
- (x) Then very dense to dense sand layer was encountered up to the rock level at the depth of 40.00m and borehole was terminated at that level.

#### 4.9 Subsurface conditions across the borehole AP-44

The results indicate that,

- (iii) The groundwater level (GWL) was encountered at the depth of 1.30m at the time of investigation.
- (iv) A completely weathered rock was found up to the rock level at the depth of 2.80m and borehole was terminated at that level.

#### 4.7 Subsurface conditions across the borehole TT-02

- (vi) The groundwater level (GWL) was not encountered at the time of investigation.
- (vii) A completely weathered rock layer was encountered up to the rock level at the depth of 2.60m and borehole was terminated at that level.



Figure 2(a): Possible Soil Profile at the borehole, BH-TT-01       Project: Geotecnnical Investigation for National Transmission and Distribution Network Development and Efficiency Improvement Project (II)       Vertical scale 1:13	igure 2(a): Possible Soil Profile at the orehole, BH-TT-01
--	--

Τ

Note: Profile is plotted only according to the data obtained from the borehole locations and actual soil profile may vary from this profile 7

Γ







Note: Profile is plotted only according to the data obtained from the borehole locations and actual soil profile may vary from this profile











Figure 2(h): Possible Soil Profile at the borehole, AP-39	Project: Geotechnical Investigation for National Transmission and Distribution Network Development and Efficiency	Vertical scale 1:165
	Improvement Project (II)	



Figure 2(i): Possible Soil Profile at the borehole, AP-44	Project: Geotechnical Investigation for National Transmission and Distribution Network Development and Efficiency Improvement Project (II)	Vertical scale 1:130
Note: Profile is plotted only according to the data obtained from the borehole locations and actual	I soil profile may vary from this profile 15	



Note: Profile is plotted only according to the data obtained from the borehole locations and actual soil profile may vary from this profile

16

Annexure I: Borehole Logs

Reject       Genetechnical Investigation for National Transmission and Distribution       Borehole No       T1-01         Client       Most Transmission and Distribution       Borehole No       T1-01         Client       Most Transmission and Distribution       Borehole No       T1-01         Date of Stated       Optimized Transmission and Distribution       Borehole No       T1-01         Date of Stated       Optimized Transmission and Distribution       Borehole No       T1-01         Date of Stated       Optimized Transmission and Distribution       Borehole No       T1-01         Date of Stated       Optimized Transmission and Distribution       Most Correlation (Correlation Correlation (Corr	e	b	I	El	NGIN	IEER	RINO	G & LA SITE IN	VT	") L]	ΓD.	N	O 62 Ka	/3, Ne tuway Tel: 0	eelamm wala, Sr	ahara i Lank 9 494		Format No: ELS-SI-02								
Client       Note of Proves Starkes Co. Lift         Started       100       Started       0.2010       Started       0.2010       Client       Started       0.2010       Control Multer level       0.2010         Date of Finishes       Started       0.2010       Control Multer level       0.2010         Date of Finishes       Started       Started       Started       OC         Date of Finishes       Started       Control Multer level       OC         Date of Finishes       Started       Started       Started       Started       Started       Started       OC         Date of Finishes       Started       Control Multer level       OC         Date of Finishes       Started       Started       Started       Started       Started       Control Multer level       OC         Date of Started       Stared       Control Multer level </td <td>Pro</td> <td>jec</td> <td>et</td> <td></td> <td></td> <td>Geote</td> <td>echni ork l</td> <td>ical Inve</td> <td>rans</td> <td>missio</td> <td>n an Proi</td> <td>d Dis</td> <td>stribu II)</td> <td>ution</td> <td>l</td> <td>Bore</td> <td>ehole</td> <td>No</td> <td colspan="5">TT-01</td>	Pro	jec	et			Geote	echni ork l	ical Inve	rans	missio	n an Proi	d Dis	stribu II)	ution	l	Bore	ehole	No	TT-01							
Date of Named         Sampoor         Rig         Day         Core Dimenser         Sampoor         Ground Wate (ve)         2.57           Date of Tinished         10.0         20.0	Clie	ent				M/s.	Fokv	o Electri	ic Power	r Services	s Co. L	td		rioj	cci (i	<b>(1</b> )			Shee	et			2			
Date of Primised         Out of Primised         Date of Primised         Prime Plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         Coordinates         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the plevation (m)         S 3 0.67 N. Strategy of the pleva	Loca	tio	n			Sampoor Rig Joy Core Diameter 54mm Ground Water le												er le	vel	el <u>0.</u> 25m						
Date of Funkhed         04.01 2015         Classing Diameter [76ma         Elevation (m)         Condumines         943 37.57%           3	Date	e of	Sta	rted		02.01	.2015	5	Drilling	g Method	Wash		Casing	dep	th	9.0n	1		C	oordin	otor	I	8° 3	0.6	7"N	-
Image: Note of the sector is the se	Date	e of	Fin	ishe	d	04.01	.2015	5	Casing	Diameter	76mm		Elevati	ion (	m)				C	Jorain	ates	80	)° 43	3' 37	.39"]	Ξ
and bit of the second secon	(	1				(t								Fi	ield R	Recor	ds			Mo	isture	Conte	nt - %	, ,	_	T
2       2       2       3       3       0       0       10 <th10< th=""> <th10< th=""> <th10< th=""></th10<></th10<></th10<>	h (n	ond	Ċ.	/pe	bed	h (n	pu		So			(SI	PT)	as	- 10	L	Jndrain	ed She	ar Str	ength	- t/m <sup>2</sup>		_			
10       2       2       2       2       3       3       4       5       10       17       30       5       00       10 <th10< th=""> <th10< th=""> <th10< th=""></th10<></th10<></th10<>	Dept	a. C	a.N(	a.T	educ	Dept	ege					)		10	20	SPT R	40 Acista	50 6 nce - 1	0 /0 Blows	80	90	-				
Image: Section of the section of th	0.00	S	s	S	R le	Ц	Ι			Ground lev	el			15cm	15cm	15cm	z		5 10	) 15	20	25 3	510W3	5 40	45	_
100       102       25       5       6       6       12       12         100       102       35       6       6       9       10       12         200       103       35       300       7       Dense, brown, gray, fine to coarse CLAYEY SAND       5       12       20       32	-	7	D1	DS		0.00															1					
100       102       100       1		IX	DI	20	-	0.00	: = : :														_					-
10       10 <td< td=""><td>-</td><td></td><td></td><td></td><td>G.W.L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>_</td><td></td><td></td><td></td><td></td><td>_</td></td<>	-				G.W.L																_					_
100       No       Needium dense, yellowish brown, gray, fine to coarse clays show,					0.25m		:::-														_					_
<sup>102</sup> <sup>103</sup> <sup>103</sup> <sup>104</sup>	1.00													5 6												_
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		IX	D2	SS			:::::	Mediun	n dense.	vellowish	brown	. grav	v. fine		6	6	12			A 12	_					_
200       00       00       10 <t< td=""><td>L</td><td><math>\sim</math></td><td></td><td></td><td></td><td></td><td>:<u>-</u>::</td><td>to medi</td><td>um CLA</td><td>YEY SA</td><td>ND wit</td><td>th fin</td><td>ne sub</td><td></td><td></td><td></td><td></td><td></td><td></td><td><b>1</b> 12</td><td></td><td></td><td></td><td></td><td></td><td>_</td></t<>	L	$\sim$					: <u>-</u> ::	to medi	um CLA	YEY SA	ND wit	th fin	ne sub							<b>1</b> 12						_
200       03       SS       00 <t< td=""><td></td><td></td><td></td><td>WS</td><td></td><td></td><td></td><td></td><td>ro</td><td>unded gra</td><td>vels</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>				WS					ro	unded gra	vels															
300       Pa 4 88       3.00       Dense, brown, gray, fine to coarse CLAYEY SAND       5       12       20       32         400       WS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       12       20       32         500       Po5       85       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       12       20       32         600       Po5       85       Black, yellowish brown, fine to coarse CLAYEY SAND       5       12       20       32         600       Po5       85       Black, yellowish brown, fine to coarse clayey sand with mica traces       5       12       10       19       10       19         700       WS       COMPLETELY WEATHERED ROCK       50       10       10       50	2.00						111		10																	
3.00       Vers       3.00       Dense, brown, gray, fine to coarse CLAYEY SAND       5       12       20       32       32         4.00       Vers       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       12       20       32       32         6.00       Do       Ss       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       5       12       10       5       5         6.00       Do       Ss       COMPLETELY WEATHERED ROCK       5       5       10       5       5       5         7.00       WS       COMPLETELY WEATHERED ROCK       30       1B       50	_	$\nabla$	D3	SS										6	9	10	19									
3.00       <		$\bigtriangleup$					: <u>∔</u> ::														19					
2.00       0.4       SS       3.00       Dense, brown, gray, fine to coarse CLAYEY SAND         4.00       ws       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       12       20       32         500       0.5       SS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       32       113       50       5 <td< td=""><td>-</td><td></td><td></td><td>WS</td><td></td><td></td><td>:::::</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td><math>\uparrow</math></td><td></td><td></td><td></td><td></td><td></td></td<>	-			WS			:::::														$\uparrow$					
104       SS       3.00       Dense, brown, gray, fine to coarse CLAYEY SAND       5       12       20       32       32         400       05       SS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       25       14       10       32         500       05       SS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       25       14       18       50       50       50         600       06       SS       COMPLETELY WEATHERED ROCK       8       18       50	3 00						::: <u>-</u> :														- `					
400       WS       Dense, brown, gray, fine to coarse CLAYEY SAND       30       HB       50       32         400       WS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       55       55       55         600       WS       COMPLETELY WEATHERED ROCK       5       550       50       50       50         600       Do 5       S8       (6.00-6.45)m sample changed to; yellowish brown, gray, fine to coarse clayey sand with mica traces       50       50       50       50         200       WS       COMPLETELY WEATHERED ROCK       30       HB       >50       50       50         800       D7       S8       COMPLETELY WEATHERED ROCK       30       HB       >50       50       50         900       D7       S8       COMPLETELY WEATHERED ROCK       30       HB       >50       50       50         900       WS       WS       COMPLETELY WEATHERED ROCK       30       HB       >50       50       50         900       WS       S8       S8       S8       S8       S9       50       50         10.00       WS       S8       S8       S8       S9       S9       S9	_		D4	88		3.00	• • • •							5	12	20	32				_	$\setminus$				-
400       WS       According to the second processing of the second proces and the second proces		IX	DI	55		5.00	: <del>::</del> ::							5	12	20	52				_		Хв	2		-
4.00       WS       Image: CLAYEY SAND         5.00       D5       SS         6.00       D5       SS         0       D7       SS         800       D7       SS         0       D7       SS         0       D7       SS         0       D7       SS         0       SS       COMPLETELY WEATHERED ROCK         0       D1       S9         0       D1       S9         0       S9 </td <td>-</td> <td><u></u></td> <td></td> <td></td> <td></td> <td></td> <td colspan="9">Dense, brown, gray, fine to coarse</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td>_</td>	-	<u></u>					Dense, brown, gray, fine to coarse														_					_
4.00       VS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>::<del>,</del></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>_</td> <td></td> <td></td> <td><math>\checkmark</math>+</td> <td></td> <td>_</td>							:: <del>,</del>									_			$\checkmark$ +		_					
500       D5       SS       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       Sm       HB       S60       Image: Some state sta	4.00			ws			: <u>:</u> :::									_			$\rightarrow$		_					
100       100       85       4.20       Black, yellowish brown, fine to medium sand with small amount of clay and mica traces       5       25       5							•••••														_			`		_
son bisses and with small amount of clay and mica traces traces construction of the second protection of the second prote	L					4.20	$\sim$	Black,	, yellowi	lium																
500       Image: Complete full of the space of performance of the space of		$\mathbb{N}$	D5	SS				sand w	vith smal	mica	5	25/	HB	>50												
600       06       SS       COMPLETELY WEATHERED ROCK         600       06       SS       (6.00-6.45)m sample changed to; yellowish brown, gray, fine to coarse clayey sand with mica traces       30         7.00       WS       (6.00-6.45)m sample changed to; yellowish brown, gray, fine to coarse clayey sand with mica traces       30         8.00       D7       SS       (6.00-6.45)m sample changed to; yellowish with mica traces       30         9.00       D7       SS       (6.00-6.45)m sample changed to; yellowish mica traces       30         9.00       D8       SS       (6.00-6.45)m sample changed to; yellowish mica traces       30         9.00       D8       SS       (6.00-6.45)m sample changed to; yellowish mica traces       30         9.00       D8       SS       SS       (6.00-6.45)m sample changed to; yellowish mica traces       (7.00-6.45)m sample	5.00	$\bigtriangleup$					うし			traces					5cm									>	>50	À
6.00       MWS       COMPLETELY WEATHERED ROCK         6.00       MWS       (6.00-6.45)m sample changed to; yellowish brown, gray, fine to coarse clayey sand with mica traces       30       HB       Son       Son <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>うし</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>							うし																			
600       D6       SS       COMPLETELY WEATHERED ROCK         600       M8       (6.00-6.45)m sample changed to; yellowish brown, gray, fine to coarse clayey sand with mica traces       30         7.00       WS       COMPLETELY WEATHERED ROCK       25         8.00       D7       SS       COMPLETELY WEATHERED ROCK       30         8.00       WS       COMPLETELY WEATHERED ROCK       30         9.00       D8       SS       SS       SS         10.00       WS       Sample Key/Test Key       N       Natural Messare Center       Consolidation         8.00       WS       SS       Sample Key/Test Key       N       Natural Messare Center       Consolidation       Existing ground level point rot         9.00       WS       WS       Somple Key/Test Key       N       Natural Messare Center       Consolidation       Existing ground level ground like WS-Wgrey Sample         10.00       WS       WS       W-Wate Sample       N       Natural Messare Center       Consolidation       Existing ground level ground like WS-Wgrey Sample       Sofering Gravity       Soffering Gravity       Soffered Sample       Sof				ws			$\sim$	0010																		
6.00 B D6 SS COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK B D7 SS WS D D8 SS COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK B D8 SS COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK COMPLETELY WEATHERED ROCK C Consolidation C C Consolidation C Consolidation C C C	-						$\sim$	COM	PLEIEL	Y WEAT	HERE	DRC	JCK													_
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	6.00																									_
200       1	-	k-7	D6	ss			へい	(6.00-6	15)m sa	mnle char	nged to	vell	owish		HB		<b>\50</b>				_					-
7.00       WS       WS       WS       WS       WS       WS         8.00       D7       SS       WS       WS       Software       Software         9.00       D8       SS       SS       Software       Software       Software       Software         9.00       D8       SS       SS       Software       Software       Software       Software       Software         9.00       D8       SS       SS       Software       Software<		IX	00	55			へし	(0.00-0.	arov fin	a to coarse		, yen	d with	30/	IID		/30				_				>50	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-						$\sim$	biown, g	gray, mi	mice tree	e elaye	y san	u with	Jem							_					_
7.00       ws       <				WG						nnea tract	65															_
8.00       D7       S8       S8       COMPLETELY WEATHERED ROCK       25       HB       >50       0	7.00			ws			$\sim$																			
8.00       D7       SS       SS       COMPLETELY WEATHERED ROCK       25       HB       >50       10       10       10       >50         9.00       D8       SS       SS       SS       10 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>へし</td> <td></td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td>_</td>							へし														_					_
8.00       P       P       SS       VS       COMPLETELY WEATHERED ROCK       25       HB       SO       Image: Complex content content content is given (not N-value)       Image: Complex content content is given (not N-value)       Image: Complex content content is given (not N-value)       SS       SPT Sample       Not Natural Moisture Content is given (not N-value)       Image: Complex content is given (not N-v	L						くい																			
8.00       Image: Solution of the startard of the star	Í	IV	D7	SS			$\mathbb{C}^{\prime}$							25	HB		>50									
9.00       B       SS       SS       COMPLETELY WEATHERED ROCK       30       HB       Image: Complete term of the second sec	8.00	$\vdash$					$\left[ \right]$																	>	>50	1
9.00       B       SS       SS       30       HB       SOCK       30       HB       SOCK       30       10	Í						うじ	COM	DI ETEI	VWEAT	НЕРЕІ	<u>ה</u> ש	)CK													
9.00       B       SS       SS <t< td=""><td>L</td><td></td><td></td><td>WS</td><td></td><td></td><td>へい</td><td>COM</td><td></td><td>I WEAL</td><td>TERE</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	L			WS			へい	COM		I WEAL	TERE															
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Г						$\sim$																			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	9.00						$\mathbb{N}$																	$\neg$		
Image: Second Ward Example       Second Ward Example       N - Natural Moisture Content the number of blows for the quoted penetration is given (not N-value)       Remarks       Logged By:         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation       Existing ground level         GWL       Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       S - SPT Sample       Existing ground level       D - Dinisturbed Sample         NE       Not Encountered       CS - Core Sample       C - Core Recovery (%) RQD-Rock Quality Designation (%)       V - Vane Shear Test       O - Organic content       S.M.DSamantha         Made Ground       Image: Sample       Gravel       Image: Sample       Laterite Nodules       Completely Weathered Rock       W.L.Nimal         Made Ground       Image: Sample       Sand       Organic Matter       Image: Sample       Laterite Nodules       Completely Weathered Rock       Fresh Rock	F	$\nabla$	D8	SS			いご							30	HB		>50							+		
In 0.00       WS       Sample Kev / Test Kev       Remarks       Logged By:         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample SS -SPT Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation UCT-Unconfined Compression G - Grain Size Analysis       Existing ground level considered as the zero level       D imuthu         6WL       : Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       S - Specific Gravity Test       UU-Unconsolidated Undrained pH - Chemical       Existing ground level considered as the zero level       Silt         MB       -Hammer Bounce       Cr - Core Recovery (%) RD       RQD-Rock Quality Designation (%)       V - Vane Shear Test       O - Organic content CT - Cloride Content       Completely Weathered Rock       W.L.Nimal         WL.Nimal       Image: Clay       Sand       Image: Clay       Gravel       Image: Clay       Image: Clay       Completely Weathered Rock       Fresh Rock		Ŵ	-																						>50	
10.00       WS       Sample Kev / Test Key       Remarks       Logged By:         Set of the quoted penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L Atterberg Limit Test       C - Consolidation       Existing ground level         GWL       : Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       S - Specific Gravity Test       UU-Unconsolidated Undrained pH - Chemical       D - Disturbed Sample       S. M.DSamantha         NE       Not Encountered       Cs - Core Recovery (%)       B - Bulk Density       V - Vane Shear Test       O - Organic content       SM.DSamantha         FD       - Free Down       RQD-Rock Quality Designation (%)       Gravel       Interite Nodules       Completely Weathered Rock       W.L.Nimal         WL.Nimal       Clay       Sand       Organic Matter       Silty Sand       Completely Weathered Rock       Fresh Rock	F																	-+					-		$\neg$	
Sample Kev / Test Kev         Sample Kev / Test Kev         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation UCT-Unconfined Compression CU - Consolidated Undrained UD-Unconsolidated Undrained UD-Undisturbed Sample       Existing signer (not N-value)       Existing ground level         GWL       Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       G - Grain Size Analysis       CU - Consolidated Undrained UD-Undisturbed Sample       Existing ground level         NE       Not Encountered       CS - Core Sample       V - Vane Shear Test       O - Organic content SO <sub>4</sub> <sup>2-</sup> - Sulphate Content       S.M.DSamantha         FD       - Free Down       RQD-Rock Quality Designation (%)       Gravel       Laterite Nodules       Completely Weathered Rock       WL.Nimal         WL.Nimal       Clay       Sand       Organic Matter       Silty Sand       Silty Sand       Completely Weathered Rock       Fresh Rock	10.00																	-+		_			+		-	
SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation       Existing ground level       Dimuthu         GWL       : Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       G - Grain Size Analysis       CU - Consolidated Undrained pH - Chemical       Existing ground level       Signervised By:         HB       -Hammer Bounce       Cr - Core Recovery (%) FD       - Free Down       Cr - Core Recovery (%) RQD-Rock Quality Designation (%)       V - Vane Shear Test       O - Organic content CT - Cloride Content       Silt       Silt       Silt       Silt       Silt       Organic Matter       Completely Weathered Rock       Fresh Rock	10.00	Sample Key / Test Key													<u> </u>					Rem	arks	Logg	ed By :		_	
the number of blows for the quoted penetration       SS -SPT Sample       L - Atterberg Limit Test       UCT-Unconfined Compression       Existing       Dimuthu         is given (not N-value)       W - Water Sample       G - Grain Size Analysis       CU - Consolidated Undrained       ground level       Supervised By:       Super	SPT	Γ Where full 0.3m penetration has not been achieved D - Disturbed Sample N - 1									N - N	atural Moist	ture Co	ntent	C - Cor	nsolidatio	on					1			٦	
By Curl (or r-Value)       W = Water Sample       G = Grand Marks       CU = Consolidated Undrained UU = Unconsolidated Undrained Borehole, after the saturation       ground level       Signer (used By: considered         NE       Not Encountered       CS - Core Sample       V = Vane Shear Test       O - Organic content       SM D. Samantha as the zero level       S.M.DSamantha SMDSamantha         HB       -Hammer Bounce       Cr - Core Recovery (%) FD       RQD-Rock Quality Designation (%)       V = Vane Shear Test       O - Organic content SO <sub>4</sub> <sup>2-</sup> - Sulphate Content       Drilled By: WL.Nimal         WM de Ground       X * * * X Silt       Silt       Society Gravel       Marks       Laterrite Nodules       Completely Weathered Rock       Fresh Rock	Í	the number of blows for the quoted penetration SS -SPT Sample L - Atterbo									tterberg Lin	nit Test		UCT-U	nconfine	ed Con	npressio	on	Exis	ting	ç	Dim	uthu	_		
Borehole, after the saturation       UD- Undisturbed Sample       B - Bulk Density       pH - Chemical       considered       s.M.DSamantha         NE       Not Encountered       CS- Core Sample       V - Vane Shear Test       O - Organic content       as the zero level       Drilled By:         HB       -Hammer Bounce       Cr - Core Recovery (%)       RQD-Rock Quality Designation (%)       RQD-Rock Quality Designation (%)       Drilled Sample       W.L.Nimal         WL.Nimal       Cl - Cloride Content       Cl - Cloride Content       Completely Weathered Rock       Fresh Rock         Clay       Sand       Organic Matter       Trief Silty Sand       Silty Sand       Completely Weathered Rock       Fresh Rock	GWL	is given (not N-value) W - Water Sample G - Grain Siz VL : Ground Water Level observed inside the WS-Wgrey Sample SG - Specific (									pecific Grav	iarysis ity Test	t	UU-Un	consolid	ated U	a amed ndraine	d	ground	l level	Super	viscu B	<u>19.</u>	4		
NE     Not Encountered     CS- Core Sample     V - Vane Shear Test     O - Organic content     as une Zero     Drilled By:       HB     -Hammer Bounce     Cr - Core Recovery (%)     RQD-Rock Quality Designation (%)     RQD-Rock Quality Designation (%)     Sol <sup>2</sup> - Sulphate Content     level     W.L.Nimal       W Made Ground     X X X X X     Silt     Sol <sup>2</sup> - Gravel     Laterite Nodules     Completely Weathered Rock     Fresh Rock	Í	Borehole, after the saturation UD- Undisturbed Sample B - Bulk Den									ulk Density			pH - Cł	nemical		considered				S.M.DSamantha					
FD     - Free Down     CI - Core Recovery (%)     SO <sub>4</sub> <sup>-</sup> - Sulphate Content     W.L.Nimal       FD     - Free Down     RQD-Rock Quality Designation (%)     CI - Cloride Content     W.L.Nimal       Image: Solar - Sulphate Content     CI - Cloride Content     W.L.Nimal       Image: Solar - Sulphate Content     CI - Cloride Content     W.L.Nimal       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     W.L.Nimal       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     W.L.Nimal       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate Content     Image: Solar - Sulphate Content     Image: Solar - Sulphate Content       Image: Solar - Sulphate	NE Not Encountered CS- Core Sample									V - Va	ane Shear T	est		O - Org	ganic cor	ntent	as the zero					Drilled By:				
Made Ground X X X X Silt Gravel Gravel Completely Weathered Rock Completely Weathered Rock Fresh Rock Fresh Rock	FD	-112 - Fr	ee Do	wn	~				RQD-Rock (	Quality Designa	tion (%)					SO4 <sup></sup> - CF - Ch	- Sulphate Content					W.L.Nimal				
Clay Sand Organic Matter Silty Sand	$\approx$	Made Ground ***** Silt %% Gravel									Laterit	e Nod	lules	2-2	-1 (	Comn	letelv	Weath	ered R	ock		ব		┨		
		Cla	ıy				San	đ		Organic Matt	ter	×	Silty S	and			Hig	hly V	Veath	ered Ro	ock			Fresh	Rock	

E	b		E	NGIN	NEER	TD.	N	IO 62/. Katı T	3, Ne uwav 'el: 0	eelamn vala, S 114 30	,	Format No: ELS-SI-02													
Pro	jec	et			Geote Netwo	echni ork l	ical Inve Developr	stigati nent a	on for N nd Effic	lational Tr iency Imp	ransmissio rovement	n an Proj	d Di iect (	istribı (II)	utior	ı I	Borehole No					TT-01			
Clie	ent				<b>M/s.</b> 1	Гoky	o Electri	ric Power Services Co. Ltd								S	Shee	et		2	2	of		2	
Loca	ntion	n			Samp	oor		Rig		Joy	Core I	Diam	eter	54m	n		G	roun	d Wa	ter le	evel		0.2.	5m	
Date	of	Sta	rted		02.01	.201	5	Drilli	ng Meth	od Wash	Casing	g dep	th	9.0m			C	di.		ļ	8° .	<b>3'</b> 0.	.67"	Ν	
Date	of	Fin	ishe	d	04.01	.201:	5	Casin	ıg Diame	eter 76mm	Elevat	ion (:	m)	ļ			C	Joran	lates	8	<b>30°</b> 4	13,3	57.39	Э"Е	
					()							Fi	ield	Recor	de			Mo	oisture	Conte	ent - S	%			
E (B	puc		pe	pa	ı (m	р		ç	Soil Des	rintion		11	iciu (S	DT)	us		U	Indrair	ed Sh	ear St	rengt	h - t/1	$m^2$		
epth	ı. Ci	NO.	ı.Ty	el /el	epth	ger			5011 DC5	emption			(3	PT)		10	20	30	40	50	60	70 8	30 9	90	
<u> </u>	S	Sa	S	Re	D	L		0				Scm	Scm	Scm	z	_		SPT	Resista	ance -	- Blows/ft				
10.00																<u> </u>	10	15	20	25	30	35	40	45	
						~			ROCKI	LEVEL															
L					10.30		END (	OF TH	E BORI	EHOLE AT	10.30m														
									DEP	TH															
11.00																									
Г																						<u> </u>			
F																	-		_						
12.00																	$\rightarrow$		_		-				
12.00																	$\rightarrow$		_	_	<u> </u>		$\vdash$		
																			_						
L																									
13.00																									
Γ																									
14.00																									
F																	+				-	<u> </u>			
																	-								
-																	-		_		-	-			
																	-		_		-				
15.00																	-+		_	_					
																	_		_						
L																			_						
16.00																									
Γ																									
17.00																	-				-	<u> </u>			
-																	+					<u> </u>			
																	-			-		-			
F												1	1			$\vdash$			_	-	-	-	$\vdash$		
10.00												1	1			$\vdash$					-				
18.00												1	1			$\vdash$	-+		_	-	-	-	$\vdash$		
1												1	1	1		$\vdash$	_			-	-				
F																				-	<u> </u>	<u> </u>			
1												1	1								<u> </u>	<u> </u>			
19.00												1	1							_					
L																									
Г												1	1												
20.00										L	L	L													
			0.5						Sample Key /	Test Kev		_	_						Ren	narks	Los	ged By	<u>y :</u>		
SPT	When	e full	0.3m p er of b	enetration lows for th	has not been	en achie	ved	D - Distu SS -SPT	irbed Sample Sample		N - Natural Mois	ture Co mit Test	ntent	C - Cons	solidatio	n d Compr	ession		т ·			р	imutho		
1	is g	given (	not N-	value)	1.000 pt	uut		W - Wat	er Sample		G - Grain Size A	nalysis		CU - Co	nsolidat	ed Undra	ained		Exi	sting	1 Sur	pervise	d By:		
GWL	: Gro	ound V	Vater I	evel obser	ved inside	the		WS-Wgre	ey Sample		SG -Specific Grav	vity Test	t	UU-Unc	onsolida	ted Undi	rained		cone	idered	i				
NE	Boi	rehole	after 1	the saturati	ion			UD- Und	isturbed Samp	le	B - Bulk Density	est		pH - Che	emical	tent			as th	e zero	) Dr:	S.M.D	Sama	ntha	
HB	-Ha	mmer	Bounc	e				Cr - Core	Recovery (%	6)	• - • and Shear I	031		SO4 <sup>2-</sup> - S	une con ulphate	Content			le	evel					
FD	- Fr	ee Do	wn					RQD-Ro	ck Quality De	signation (%)				Cl' - Clo	ride Cor	ntent						W.L.Nimal			
$\approx$	Ma	de C	roun	d	*****	Silt		ୢୖୄୖୄୖୄୖୄୖୄୖୄ	Gravel		Laterit	e Nod	ules	:-:-	. ] (	Compl	etely	Weath	nered I	Rock		${ \ } { \ }$			
	Cla	ıy	-		••••••	San	d	Organic Matter						$\overline{\sim}$	Hig	ghly W	eath	ered R	ock			Fres	h Ro	ck	

Project         Geotechnical Investigation for National Transmission and Distribution Network Development and Efficiency Improvement Project (II)         Sheet         A P-05           Client         Ms. Tokyo Electric Power Services Co. Ld         Sheet         1         of           Location         Sampoor         Rig         JOy         Core Diameter 154mm         Ground Water level           Date of Started         30.01         2015         Casing Diameter [76mm         Elevation (m)         Coordinates         B8974721           Date of Started         30.01         2015         Casing Diameter [76mm         Elevation (m)         Coordinates         B8974721           Big         Big         Big         Big         Soil Description         Field Records         Sign 20078         Big 20078         Coordinates         Big 20078         Big	1 "N 7"E			
ClientSince of the over Service Co. LidSheet1decome Service Co. LidGround Water levelJout of Strated30.01.2015Casing Diameter 76mmElevation (m)Ground Water level $\frac{g}{g}$ <td <="" colspan="2" td=""><td>1 "N 7"E</td></td>	<td>1 "N 7"E</td>		1 "N 7"E	
Office         Data of Started         Data of Started         Data of Started         Solut Dot Interview         Data of Started         Solut Data of Started         <	"N 7"Е			
Date of Started         30.01 2015         Drilling Method Wash         Casing depth         3.0m         Coordinates         86° 5' 32.7           Date of Finished         30.01 2015         Casing Diameter 76mm         Elevation (m)         3.0m         Coordinates         86° 5''''''''''''''''''''''''''''''''''''	"Ν 7"Ε			
Date of Finished         30.01.2015         Casing Diameter 176mm         Elevation (m)         Coordinates         800° 47° 35°         Coordinates         80° 47° 35°         Coordinates         S0° 47° 35°         Coordinates         S0° 47° 35°         S0° 4	mat No: S-SI-02			
Image: second level       Image: second level       Field Records (SPT)       Monsture Content: %       Monsture Content: %         000       Image: second level       Image: second lev				
End       Description       Indext (SPT)       Undefinited Shear Strength - Unif (SPT)         000       0				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				
<sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>1</sup>	90			
0.00       0.00	40			
100       100       Brown, fine to medium, SAND         100       100       Brown, yellowish brown, silty, fine to coarse sand with mica traces         200       D3       SS       COMPLETELY WEATHERED ROCK       3       3       5       8         300       SS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       7       15       22         400       WS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22         400       WS       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1         500       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1         600       1       1       1       1       1       1       1         7.00       1       1       1       1       1       1       1         8.00       1       1       1       1       1       1       1         100       1       1       1       1       1       1       1         100       1       1       1       1       1       1       1         100       1	45			
100       D2       S8       1.00       Brown, fine to medium, SAND       2       3       7       10				
1.00       D2       SS         2.00       D3       SS         3.00       D4       SS         4.00       SS         5.00       SS<				
100       D2       SS       1.00       Brown, yellowish brown, silty, fine to coarse sand with mica traces       2       3       7       10 <td></td>				
D2       SS       1.00       Brown, yellowish brown, silty, fine to coarse sand with mica traces       2       3       7       10				
2.00       MS       ws       coarse sand with mica traces       3       3       5       8         2.00       D3       SS       COMPLETELY WEATHERED ROCK       3       3       5       8         3.00       D4       SS       (3.00-3.45)m sample changed; yellowish brown, black, fine to coarse, silty sand       6       7       15       22         4.00       ws       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1         5.00       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1       1         6.00       N       N       END OF THE BOREHOLE AT 4.40m       1       1       1       1       1       1         7.00       N       N       N       N       N       N       1				
2.00       NS       WS       COMPLETELY WEATHERED ROCK       3       3       5       8         3.00       D4       SS       (3.00-3.45)m sample changed; yellowish brown, brown, brown, black, fine to coarse, silty sand       6       7       15       22       22         4.00       WS       4.40       COMPLETELY WEATHERED ROCK ROCK LEVEL       6       7       15       22       22         500       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1       1         600       H       H       END OF THE BOREHOLE AT 4.40m       H       1       1       1       1       1         7.00       H <td< td=""><td></td></td<>				
200       D3 SS       WS       COMPLETELY WEATHERED ROCK       3       3       5       8         300       D4 SS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22         400       WS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22         500       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1         5.00       4.40       END OF THE BOREHOLE AT 4.40m       1       1       1       1       1         6.00       I       I       I       I       I       I       I       I       I       I         7.00       I	+			
200       D3       SS         300       D4       SS         400       WS         400       END OF THE BOREHOLE AT 4.40m         400       END OF THE BOREHOLE AT 4	+-1			
103       85       COMPLETELY WEATHERED ROCK       3       3       3       4       5       5       5       5       6       7       15       22         300       0       88       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       22       1       22         400       WS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       1       22       1       <	+-			
3.00       D4       SS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       22       1	+-			
3.00       M*S       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       22       1         4.00       WS       COMPLETELY WEATHERED ROCK ROCK LEVEL       1				
3:00       D4 SS       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       22       1       22       1 <t< td=""><td></td></t<>				
4.00       (3.00-3.45)m sample changed; yellowish brown, brown, black, fine to coarse, silty sand       6       7       15       22       22         4.00 <td< td=""><td></td></td<>				
4.00       ws       brown, brown, black, fine to coarse, silty sand         4.00       ws       COMPLETELY WEATHERED ROCK         4.40       END OF THE BOREHOLE AT 4.40m         5.00       END OF THE BOREHOLE AT 4.40m         6.00       END OF THE BOREHOLE AT 4.40m         7.00       END OF THE BOREHOLE AT 4.40m				
4.00       ws       COMPLETELY WEATHERED ROCK ROCK LEVEL       Image: Complete term of the second	1			
4.00 WS COMPLETELY WEATHERED ROCK ROCK LEVEL 44.40 FILE BOREHOLE AT 4.40m 5.00 6.00 7.00 7.00 7.00 7.00 7.00 7.00 7	+ -			
4.00       No       ROCK LEVEL       Image: Contract of the contract	+-			
4.40        END OF THE BOREHOLE AT 4.40m	+-+			
4.40       Image: Constraint of the BOREHOLE AT 4.40m         5.00       Image: Constraint of the BOREHOLE AT 4.40m         6.00       Image: Constraint of the BOREHOLE AT 4.40m         6.00       Image: Constraint of the BOREHOLE AT 4.40m         7.00       Image: Constraint of the BOREHOLE AT 4.40m         8.00       Image: Constraint of the BOREHOLE AT 4.40m				
5.00 6.00 7.00 8.00 5.00				
5.00       I				
	+ - 1			
	+-			
	+-			
	$\square$			
	+			
	+-1			
8.00				
8.00				
	$\square$			
	+			
	+-			
	+			
10.00				
Sample Key / Test Key Remarks Logged By :				
SPT Where full 0.3m penetration has not been achieved D - Disturbed Sample N - Natural Moisture Content C - Consolidation				
the number of blows for the quoted penetration SS-SP1 Sample L - Atterberg Limit Test UC1-Unconfined Compression Existing Dimu is given (not N-value) W - Water Sample G - Grain Size Analysis CLL-Consolidated Lindrained	1			
GWL : Ground Water Level observed inside the WS-Wgrey Sample SG -Specific Gravity Test UU-Unconsolidated Undrained ground level				
Borehole, after the saturation UD- Undisturbed Sample B - Bulk Density pH - Chemical Indu	Indunil			
NE Not Encountered CS- Core Sample V - Vane Shear Test O - Organic content as the Zelo Drilled By:				
HB -Hammer Bounce Cr - Core Recovery (%) SO <sub>4</sub> <sup>2-</sup> - Sulphate Content	ala			
Made Ground Laterite Nodules Collection Completely Weathered Rock				
Clay Sand Organic Matter	ock			

(	b		E	NGIN	NEEF	RIN(	G & LA SITE INV	BORA	PVT	") L'	ΓD.	N	VO 62/ Kat	'3, Ne uwaw Fel: 01	elamma /ala, Sri	,	Format No: ELS-SI-02									
Pro	ojec	et	1		Geote	echni ork I	ical Inves	stigation	n for Nat d Efficier	ional T	Frans prove	missio	n an Proi	d Dis ect (	strib II)	utior	1	Bore	hole l	No		AP-17				
Cli	ent				M/s. '	<u>Foky</u>	o Electri	ic Powe	r Service	s Co. L	td.	linent	iioj					Shee	t		1		Format No: ELS-SI-02 AP-17 of 1 3.0m 4' 29.26"N 54' 32.47"E % h - t/m <sup>2</sup> 70 80 90 vs/ft 35 40 45 50 550 550 47 47 47			
Loc	atio	n			Samp	oor	•	Rig		Joy		Core D	Diamo	eter	54m	m	ľ	G	round	Wat	er le	evel		3.0	m	
Date	e of	Sta	rted		28.01	28.01.2015 Drilling Method Wash Casing									4.50	m		Ca	andin	ataa	8	3° 14	1' 29	).26	"N	
Date	e of	Fin	ishe	ed	28.01	.201.	5	Casing	Diameter	76mm	n i	Elevati	on (1	m)	1			0	orain	ates	8	0° 5	4'3	2.47	/"E	
Ē					(1	1							Fi	ield F	Recor	ds			Moi	sture (	Conte	nt - %	/o			
n (n	ond	Ċ.	'pe	eq	u (n	ри		Sc	oil Descrir	otion				(S)	PT)	u.s		U	ndraine	d She	ar Str	rengtl	a - t/r	n <sup>2</sup>		
eptl	a. C	a.NC	a. Ty	educ vel	eptl	egei		~~~	1					(5)			10	20	30	40	50 6	50 7	0 8	.0 9	70	
	S	Š	S	R e	Д	<u> </u>			Ground lev	rel			5cm	5cm	5cm	z	5	10	5F1 K	20	25	30	35	40	45	
	k7	D1	DS		0.00				Ground lev	01			-	_	-			10	15	20		<u> </u>		10	-5	
	IX	DI	05		0.00	•																				
-	$\sim$					°.°	Offw	hite, fin	e to medi	um GR	AVE	LS										<u> </u>				
						.00																				
1.00						0.0	ŧ						ļ							_						
	IX	D2	SS		1.00		(1 45-2	2 00)m v	washed sa	mple cł	hange	ed to:	2	HB		>50								_		
_	$\sim$					うじ	(	brown f	fine to me	dium s	and	,												>50	ן מ	
			ws			へし		010 001, 1		urunn b	unu															
2.00						<u>``</u>																				
	$\nabla$	D3	SS			$\mathbb{C}^{1}$	COM		VWEAT			OCK	9	HB		>50										
	$\bigtriangleup$							LEIEL	LI WEAL	HEKE	DRU	JCK												>5	0	
-			ws			いじ																			-1	
3 00				•		へし																			1	
_	$\nabla$	D4	SS	<u> </u>	1	$\sim$							14	22	25	47									+	
	ľŇ	2.	00				(3.00-3.4	(3.00-3.45)m sample changed; fine to coarse							23	- 1				-			-	47		
-				G.W.L			sand with fine to medium gravels													_					+	
			11/0	at 3.0m		うじ																			++	
4.00			ws			2	<b>GO</b> 10																		+	
						COMPLETELY WEATHERED ROCK																				
L																										
	IX	D5	SS					R	OCK LEV	/EL			18	HB		>50										
5.00	$\sim$				4.80		END	OF THE	E BOREH	OLE A	AT 4.8	80m											>	>50		
									DEPTH	[																
6.00																										
-																										
7.00																										
7.00																										
-																				_						
8.00																										
																				_						
_																										
9.00																										
Γ																										
10.00																										
	·							Sa	mple Key / Tes	t Ke <u>y</u>	т.				1			1	_	Rem	arks	Log	ged By	<u>r :</u>		
SPT	When	e full	0.3m	penetration	has not be	en achie	wed	D - Disturb	ed Sample		N - Na	atural Moist tterberg Lin	ture Con	ntent	C - Coi	nsolidati	ion ied Com	nression		- ·			Di	muthe	_	
	is g	given (	(not N-	value)	quoteu p	anou du 0		W - Water	Sample		G - Gr	rain Size An	alysis		CU - C	onsolida	ated Und	Irained	·	Exis	ting	1 Sup	ervised	I By:		
GWL	: Gr	ound V	Water	Level obse	rved inside	the		WS-Wgrey S	Sample		SG -Sp	pecific Grav	ity Test	:	UU-Un	consolic	lated Un	drained	1			-				
NE	Bo	rehole	, after	the saturat	ion			UD- Undistu	urbed Sample		B - Bu	ulk Density	oct		pH - Cl	nemical	ntant			as the	e zero	D-1	In	dunil		
HB	Not l -Ha	ncou mmer	ntered Boun	ce				CS- Core Sa Cr - Core Ro	mpie ecovery (%)		v - Va	ane snear T	cst		50 - Org	anic co Sulnhat	inent	nt		lev	vel	Dril	icu By			
FD	- Fr	ee Do	wn					RQD-Rock	Quality Designa	tion (%)					CI - CI	oride Co	ontent						Sum	athipa	la	
$\times\!\!\times\!\!\times$	× Ma	de (	Grour	nd	******	Silt		ୢୄୄୄୄୄୄୄୄୄ	Gravel			Laterit	e Nod	lules	$\langle \cdot \rangle$	-1 (	Compl	letely	Weathe	ered R	.ock	6	${ \ } { \ }$			
-1-1-1	Cla	ıy				San	d	1.11	Organic Mat	ter	x . X	Silty Sa	and			Hi	ghly W	/eathe	ered Ro	ck			Fres	h Roc	зk	

e	b		E	NGIN	NEER	RIN	G & LA SITE INV	BOR /ESTI	RATO (GATI)	RY ONS	SERV DIVIS	VIC. SION	ES (P	VT	') L]	ΓD.	NC	) 62/3, Katuv Te	Neelan vawala, ŀ 0114	mahara Sri Lan 309 494	Road ka.	,	Forr ELS	nat N S-SI-	lo: 02
Pro	jec	et			Geote	echn	ical Inves	stigatio	on for l	Natio	onal Ti	ransi	mission	n an Duoi	d Dis	stribu	ition	В	orehol	e No			AP-2	0	
Clie	- •nt				M/s.	ork i Foky	zo Electri	<u>ent a</u> c Pow	na Em ver Serv	vices	<u>cy imp</u> Co. Lt	rove d	ment	Proj	ect (1	11)		SI	neet		1	1	of		1
Loca	tio	n			Samp	oor	° 2100011	Rig		1005	Joy	(	Core D	liam	eter	54m	m	51	Grou	nd Wa	ter le	evel		1.10	m
Date	e of	Sta	rted		05.01	.201	5	Drilli	ng Metl	hod	Wash	(	Casing	dep	th	7.5n	1		Coord	inates	1	8° 17	1' 25	.02"	'N
Date	e of	Fın	ishe	d	05.01	.201:	5	Casin	g Diam	leter	/6mm	1	Elevati	on (1	m)					loisture	Cont	$80^\circ$	<u>&gt;6´6</u>	.71	Έ
(B)	pu		e	ъ.	(B)	-		c		. ,				Fi	eld F	Recor	ds –		Undra	ined Sh	ear St	rengtl	a - t/m	2	
pth	°,	NO.	Typ	duce el	spth	gene		2	Soil Des	script	10n				(SI	PT)		10	20 30	40	50	60 7	0 80	9	0
Ď	Sa	Sa.	Sa	Re lev	ď	Le			Crown	dlava	1			бст	5cm	5cm	z	-	SPT	Resist	ance -	Blow	's/ft	<b>A</b>	
0.00		D1	DS			÷ ,			Groun	la leve	1			1			┣━━┩.	5	10 15	20	25	30	35 40	0 4	.5
	К	DI	05			<u> </u>	Brow	n fine	e to coar	rse S	ANDY	CLA	AY				-	_							
F						<u> </u>	Bion					C Di													
1.00					0.80	- // /	i																		
-	$\bigtriangledown$	D2	SS	<u> </u>		2								2	4	8	12								
	riangle			GWI		1.	Brown,	fine to	coarse	sand	l with n	nica	traces							2					
-			ws	at		$\sim$	-	and s	mall an	noun	t of cla	у													
2.00				1.10m		い														X					
-	$\nabla$	D3	SS			$\sim$								8	10	17	27								
	Δ					$\sim$																27			
			WS			んご																$\setminus$			
3.00	_	,				$\sim$																	$\mathbf{N}$		
	IX	D4	SS			$\sim$	COMI	PLETE	ELY WI	EATI	HEREI	) RO	OCK	2	14	29	43								12
L	$\sim$					N)	COM	LLIL				<i>,</i> no	- CIL											1	43
						$\sim$																			
4.00			ws														_								$\vdash$
						へい	·												_						$\downarrow$
L						$\sim$	(1.50)				1.														$\rightarrow$
	IX	D5	SS			$\sim$	(4.50-4	1.95)m	i sample	e cha	nged to	); brc	own,	13	21/	HB	>50		_					<u>ک ۲</u>	
5.00	<u> </u>					んご	DIACKIS	sn brov	wn, fine	e to c	oarse s	and v	with		5cm									>50	
			we			<u>\</u>		weath			agmen	15					-								
-			** 5														-								
6.00						へい													_						
0.00	k7	D6	SS			$\sim$								12	25/	HB	>50								
	Ň														25/ 5cm		-							>50	-
-						1											-				-				
7.00			ws			$\sim$	COMI	PLETE	ELY WI	EATI	HEREI	) RO	OCK												
_						N.,																			
						2																			
1	$\overline{\mathbb{N}}$	D7	SS			1) : 								25	HB		>50								
8.00	Р					んご																		>50	
						$\sim$																			
L			WS														_								
						<u>`</u> ,			ROCK	LEV	EL		6												
9.00					8.85		END	OF IE	IE BOR	\ЕН( ртµ	JLE A	1 8.8	Sin				-								
									DEI														$\vdash$	_	
F																									
10.00																									
SPT	Whe	e full	0.3m	penetration	has not be	en achie	wed	D - Distu	Sample Key arbed Sample	/ Test I e	Key	N - Na	tural Moist	ure Co	ntent	C - Cor	solidatio	1		Rei	narks	Log	ged By :		
1	the	numb	er of b	lows for th	e quoted p	enetratio	on	SS -SPT	Sample			L - At	terberg Lin	nit Test		UCT-U	nconfined	Compre	ssion	Exi	sting		Din	nuthu	
GWL	is g : Gr	given ( ound V	not N- Vater	value) Level obser	ved inside	the		W - Wate WS-Wgre	er Sample ey Sample			G - Gra SG -Spa	ain Size An ecific Grav	alysis ity Test		CU - Co UU-Un	onsolidate consolida	d Undrai ed Undra	ned ained	grour	d leve	el Sup	ervised l	<u>By:</u>	
1	Во	rehole	, after	the saturat	ion	-		UD- Undi	isturbed Sam	nple		B - Bul	lk Density	,		pH - Ch	nemical			cons	idered		5.M.D	Saman	tha
NE HB	Not l -Ha	Encou mmer	ntered Bound	ce				CS- Core Cr - Core	Sample Recoverv (	(%)		V - Va	ne Shear To	est		O - Org SO. <sup>2-</sup>	anic cont	ent Content		le	vel	Dril	led By:		
FD	- Fr	ee Do	wn					RQD-Roc	k Quality D	Designati	on (%)					CI - Cl	oride Con	tent				╞	W.L.	Nimal	
$\otimes$	Ma	de C	Brour	ıd	*****	Silt		ໍຈິຈິ	Gravel				Laterite	e Nod	ules	<u> </u>	1 C	omplet	ely Wea	thered l	Rock	6	$\bowtie$		
	Cla	ıy				San	d		Organic	Matte	er	x X	Silty Sa	and		Š	- High	ıly We	athered	Rock			Fresh	Roc	k

Project         Cevere hareal Investigation for National Transmission and Distribution         National Transmission and Distribution           Notice Charge Construction for National Transmission and Distribution         Notice Construction for National Transmission and Distribution           Notice Construction for National Transmission and Distribution           Notice Construction for National Transmission and Distribution           Notice Construction           State of District           Notice Function           State of District           Mode of District           Mode of District           State of District           Mode of District	(	Ŀ		El	NGIN	NEEF		G & LA SITE INV	ABORAT	ORY	' SERV S DIVIS	ICES	PVI	[) L'	ГD.	N	O 62/3 Katu	8, Neela Iwawal	ummal a, Sri 4 200	hara F Lanka 404	₹oad, 1.	ļ	Form ELS-	at N -SI-0	o: 12
Client         Ms. Takys Electric Power Service Cn. Id         Sheet         1 st         1 st<	Pro	jec	et			Geote	echni	ical Inve	stigation for	or Nati	ional Tr	ansmissi	on an t Proi	d Di	stribi II)	utior	L E	Boreh	ole N	494 Jo	Τ	A	P-32	2	
Description         Sampoor         Direct of Survey         List of Survey         Conditionates         B*21*13598*N           Date of Survey         16 01 2015         Chaing Dameter [20mm]         Elevation (m)         Conditionates         B*21*13598*N           Date of Survey         Sign 2         <	Cli	ent				M/s.	Toky	o Electri	ic Power S	ervice	s Co. Lt	d	LIIU	eti (	11)		S	heet			1		of		1
Date of Finished       Cosing Date of Finished       Coordinates       87 = 21 + 58 M = 87 + 28 + 72 + 50 M = 87 + 27 + 52 M = 72 + 50 M = 87 + 27 + 52 M = 72 + 50 M = 100 + 1000 + 100 + 100 + 1000 + 100 + 100 + 100 + 100 + 100 + 100 + 100 +	Loca	atio	n		_	Samp	oor	0	Rig	<u>UI</u>	Joy	Core	Diam	eter	54m	m	Ĩ	Gro	und	Wate	er lev	vel	1.	.151	m
Date of Function         Casting Diameter [76mm]         Elevation (m)         Constraint         Constraint         Pice 38, 72, 83, 73, 84, 73, 86, 75, 75, 75, 75, 75, 75, 75, 75, 75, 75	Date	e of	Sta	rted		16.01	.201.	5	Drilling N	1ethod	Wash	Casir	ig dep	oth	6.0n	1		Coo	-dina	tag	8	° 21'	45.9	<del>)</del> 8"]	N
Image: state of the s	Date	of	Fin	ishe	d				Casing Di	ameter	<sup>.</sup> 76mm	Eleva	tion (	(m)				000	uma	lies	8	1° 2'	38.7	72"!	Ē
and and a second level       and a	G					G	[	ſ	_	_	_	_	F	ield I	Recor	ds			Mois	ture C	Conter	nt - %	. 2		_
Set Diff       Set Diff <th< td=""><td>th (r</td><td>Conc</td><td></td><td>ype</td><td>ced</td><td>th (r</td><td>pue</td><td>1</td><td>Soil I</td><td>Descrip</td><td>otion</td><td></td><td></td><td>(S</td><td>PT)</td><td></td><td>10</td><td>20 Unc</td><td>rainec</td><td>d Shea</td><td>ar Stre</td><td>ength -</td><td>t/m<sup>-</sup></td><td>90</td><td>_</td></th<>	th (r	Conc		ype	ced	th (r	pue	1	Soil I	Descrip	otion			(S	PT)		10	20 Unc	rainec	d Shea	ar Stre	ength -	t/m <sup>-</sup>	90	_
Def       D	Dep	Sa. (	ša.N	Sa.T	Redu level	Depi	Lege	1					Е	È	Ę	-	10	20 S	PT Re	esistar	nce - F	Blows/	ft		
Image: Construction of the proving find the proving	0.00	v.		<b>.</b>	<u> </u>	<u> </u>			Gr	ound lev	/el		15ci	15ci	15ci	z	5	10	15	20 2	25 3	30 35	40	45	5
100         100 <td>F</td> <td><math>\bigtriangledown</math></td> <td>D1</td> <td>DS</td> <td></td> <td>0.00</td> <td>—</td> <td></td> <td><math>\top</math></td> <td><math>\top</math></td> <td></td>	F	$\bigtriangledown$	D1	DS		0.00	—																$\top$	$\top$	
100       1		$\bigtriangleup$					—	Brown, f	fine to coar	se CLA	AYEY S	AND wit	h						+				1	-	
100       101       102       102       100       1       100       1       <	-						• • • •	fir	ne gravels v	with roo	ot fragm	ents							-				-	+	
200       Vors       100       1<	1.00							l	e		-								+				-	+	
200       WS       Image: Signal of the second seco	-	$ \forall $	D2	SS	▼	1.00	<u> </u>						3	3	3	6			+				+	+	
2.00       Diss       Sister and Sister		Ň			C WI		<u> -</u> -								-		4	6	+				+	+	
200       ns       ns       1.5m       i       Firm to stiff, fine to coarse SANDY CLAY       4       6       9       15 <t< td=""><td>F</td><td>Γ</td><td></td><td>ws</td><td>G.W.L at</td><td></td><td><u> </u></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td><math>\setminus</math></td><td></td><td></td><td></td><td>-</td><td>-</td><td>+</td><td></td></t<>	F	Γ		ws	G.W.L at		<u> </u>											$\setminus$				-	-	+	
200       Dol SS       100 <t< td=""><td>2 00</td><td></td><td></td><td></td><td>1.15m</td><td></td><td>÷ -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td><math>\rightarrow</math></td><td></td><td></td><td></td><td></td><td>+</td><td>+</td><td>-</td></t<>	2 00				1.15m		÷ -											$\rightarrow$					+	+	-
100       1	2.00	$ \vdash $	50	SS				Firm to	stiff, fine to	o coars	se SAND	OY CLAY		6	9	15		+	+		$\square$	+	+	+	-
100       1		IΧ	55	00			<u> </u>						7	0	>	15				5				+	-
10       10       10       14       24       24         400       WS       1       1       1       1         400       WS       1       1       1       1         500       D5       SS       1       1       1       1         500       D5       SS       1       1       1       1       1         600       D5       SS       1       1       1       1       1       1         600       D6       SS       1 </td <td>┝</td> <td>ľ</td> <td></td> <td>WS</td> <td></td> <td></td> <td>÷ -</td> <td></td> <td>+</td> <td><math>\square</math></td> <td><math>\square</math></td> <td></td> <td>+</td> <td>+</td> <td>- </td>	┝	ľ		WS			÷ -												+	$\square$	$\square$		+	+	-
100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       14       24         100       15       25         100       15       25         100       15       25         100       15       25         100       15       25         100       15       25         100       15       25         100       15       25         100       15       15         100       15       15         100       15       15         100       15       15         100       15       15         100 <t< td=""><td>2.00</td><td></td><td></td><td>W 5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>+</td><td></td><td></td><td></td><td>_</td><td>+</td><td>- </td></t<>	2.00			W 5															+				_	+	-
101       SS       3.00       2.4       1       2.4       1       2.4       1       1       2.4       1	3.00	k-	54				÷						$\neg$	1.0						$\mathbb{H}$	$ \rightarrow $		+	+	-
4.00       WS       Image: Set of the s		IΧ	D4	SS		3.00							8	10	14	24					24		+	_	
400       WS       Image: Construction base to be analysis         500       D6       SS       Image: Construction base to be analysis         600       D6       SS       Image: Construction base to be analysis         7.00       F       Ware full 0.300 generation base to be analysis       Image: Construction base to be analysis       Image:	L	<u> </u>																		ļŢ	24			_	
400       WS       -							ΞĴ																	_	-
500       105       555       1 </td <td>4.00</td> <td></td> <td></td> <td>WS</td> <td></td>	4.00			WS																					
500       D5       SS       Image: Solution of the construction of t							: -																		
5.00       DS       SS       SS       Image: SADE SS       ImageesS       ImageesS       Ima	L						÷ ,																		
5.00       Image: Service of the service of the service of the number of blows for the queded perturbation in grave law water Sample       Image: Service of the service of the service of the service of the number of blows for the queded perturbation is graved at the range of the number of blows for the queded perturbation is graved water and water Sample       Image: Service of the service of the service of the service of the number of blows for the queded perturbation is graved water and water Sample       Image: Service of the serv	Γ	$\nabla$	D5	SS			<u> </u>						4	9	16	25									
600       D6       SS       CLAY with fine to medium gravels       6       10       15       25       1 <td>5.00</td> <td><math>\bigtriangleup</math></td> <td></td> <td></td> <td></td> <td></td> <td><u> </u></td> <td>Very sti</td> <td>iff, brown,</td> <td>fine to</td> <td>medium</td> <td>SANDY</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>25</td> <td>)</td> <td></td> <td></td> <td></td>	5.00	$\bigtriangleup$					<u> </u>	Very sti	iff, brown,	fine to	medium	SANDY									25	)			
6.00       NB       1 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>÷ .</td> <td>CLA</td> <td>AY with fir</td> <td>ne to m</td> <td>edium g</td> <td>ravels</td> <td></td>							÷ .	CLA	AY with fir	ne to m	edium g	ravels													
6.00       D6       SS       Image: Construction of the service of t				ws			<u></u>												1						
6.00       D6       SS       Image: SS in the standard standar	F						<u> </u>												-						
2.1.       2.5.       3.0.       3.0.       A.1.	6.00						÷ź												+				+	+	
7.00       Image: Construct of the structure of the	F	$ \forall $	D6	SS			÷ -						6	10	15	25			-				-	-	
7.00       Image: Construction of the state of the quoted potentiation is given (not N-value)       Image: Construction of the state of the quoted potentiation is given (not N-value)       Image: Construction of the construction		M																			25	,	+	+	
7.00       Image: Section of the standard sample       No. Natural Moisture Content is given (not N-value)       No. Natural Moisture Content is S-SPT Sample       So. Specific Content is S-SPT Sample       No. Natural Moisture Content is S-SPT Sample       So. Specific Content is S-SPT Sample       So. Specific Content is S-SPT Sample       So. Specific Content is S-SPT Sample       No. Natural Moisture Content is S-SPT Sample       So. Specific Content is S-SPT Sampl	┠						÷Ż												+		$\neg$	-	+	+	
7.00       Image: Construction of the source o	7.00																							+	-
8.00       7.30       END OF THE BOREHOLE ATT 7.30m         9.00       0 <td>7.00</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td>ROC</td> <td>W LEV</td> <td>VEI</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>+-</td> <td><math>\left  \right </math></td> <td></td> <td></td> <td>+</td> <td>+</td> <td>-</td>	7.00						-		ROC	W LEV	VEI								+-	$\left  \right $			+	+	-
8.00       7.30       END OF THE BOREHOLE ATT 7.30H         DEPTH       DEPTH         9.00       9.00         9.00       9.00         10.00       Sample Key / Tet Key         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted ponetration is given (not N-value)       D         GWL       Group due the saturation       D         W. Vater Sample       S.S. SPT Sample         W. Vater Sample       S.S. Second Carriery Test         B. Balk Density       V. Vater Shear Test         Sorgenic Content       Sorgenic Content         C. Core Socialated Undrained prive Content       Sorgenic Content         C. Core Recovery (%)       ROD-Rock Quality Designation (%)         Made Ground       Sorgenic Gravel         Made Ground       Sorgenic Gravel         Made Ground       Sorgenic Gravel         Made Ground						7 20	<u> </u>			VE DE .	VEE OFEAT	T 7 20m	_										_	+	-
8.00 9.00 9.00 9.00 9.00 10.00 SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-alue) SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-alue) SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-alue) SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-alue) SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-alue) SPT Not Encountered Borehole, after the saturation NE Not Encountered HB -Hammer Bounce FD - Free Down Made Ground Tarsa Silt Silt Solt are all and a blow and a blow all and a blow all a blows all and a blow all a blows all and a blow all a blows all all a blows all all a blows all all all a blows all all all all all a blows all all all all all all all all all al	┠					1.50			Л	VEDTH		1 7.5011											_	+	
8.00       9.00         9.00       9.00         9.00       9.00         9.00       9.00         10.00       10.00         Sample Key / Test Key         Remarks         Sample Key / Test Key         V         Nor Enconfined Compression CU - Consolidated Undrained Br - Balk Density         O : Organic content So 4 <sup>2</sup> - Sulphate Content         Sulpate Content Cr - Core Recovery (%) RDD-Rock Quality Designation (%)         Made Ground X X X X         Conspletely Weathered Rock	0.00							1	L		1										$\square$			+	-
9.00 9.00 9.00 9.00 9.00 9.00 9.00 9.00	8.00							1													$\square$		_	+	-
9.00 9.00 9.00 10.00 Sample Key / Test Key SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value) GWL : Ground Water Level observed inside the Borchole, after the saturation NE Not Encountered HB -Hammer Bounce FD - Free Down Made Ground X***X Made Ground X***X Made Ground X***X Made Ground X***X Mater Main Mathematical Content C - Consolidated Undrained UD- Undisturbed Sample CS- Core Sample								1															_	+	-
9.00 9.00	┝							1												$\left  - \right $	$ \rightarrow $		+	+	-
9.00       Image: Construction of the saturation       Sample Key / Test Key         10.00       Image: Consolidation of the saturation       Image: Consolidation of the saturation         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       Image: Consolidation of the saturation       Image: Consolidation of the saturation       Image: Consolidation of the saturation       Image: Consolidated Undrained UD-Undisturbed Sample       Image: Consolidated UD-Undisturbed Sample       Image: Consolidated UD-Un								1															_	+	
Interview       Sample Key / Test Key       N - Natural Moisture Content       C - Consolidation       Existing         GWL       Ground Water Level observed inside the Borehole, after the saturation       D - Disturbed Sample       N - Natural Moisture Content       C - Consolidated Undrained       Existing       ground level         NE<	9.00							l													$\square$		_	+	
In 0.00       Sample Key / Test Key       Network       Remarks       Logged By :         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test Borehole, after the saturation       C - Consolidation UCT-Unconfined Compression CU - Consolidated Undrained pH - Chemical       Existing ground level considered as the zero level       Supervised By: S.M.DSamantha         NE       Not Encountered       Cs - Core Sample CT - Core Recovery (%) FD - Free Down       Cs - Core Recovery (%) RQD-Rock Quality Designation (%)       Network Content CT - Cloride Content CT - Cloride Content       Supervised By: S.M.DSamantha         Made Ground       Image: Silt       Image: Silt       Group Create Create       Create Create       Create Create       Completely Weathered Rock         Made Ground       Image: Silt       Image: Group Create       Create       Completely Weathered Rock       Image: Completely Weathered Rock								1																_	
In 0.00         Sample Key / Test Key         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test G - Grain Size Analysis       C - Consolidation UCT-Unconfined Compression UCT-Unconfined Compression UCT-Unconstituted Undrained UD-Undisturbed Sample       Supervised By:         GWL       : Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       SG - Specific Gravity Test UD- Undisturbed Sample       C - Consolidated Undrained UD- Undisturbed Sample       Supervised By:         NE       Not Encountered       CS - Core Sample       V - Vane Shear Test       O - Organic content SO,2 <sup>-</sup> - Sulphate Content       S.M.DSamantha as the zero level         HB       -Hammer Bounce       Cr - Core Recovery (%) RQD-Rock Quality Designation (%)       NAME       Laterite Nodules       Cr - Cloride Content CT - Cloride Content       W.L.Nimal         W.L.Nimal       Solid       Solid       Gravel       Mate Ground       Total to the solid	_							1																	
10.00       Sample Key / Test Key       Remarks       Logged By :         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation       Existing UCT-Unconfined Compression       Existing ground level         GWL       Ground Water Level observed inside the Borehole, after the saturation       W- Water Sample       S - Specific Gravity Test       U- Consolidated Undrained UU-Unconsolidated Undrained UU-Undisturbed Sample       Supervised By:         NE       Not Encountered       CS- Core Sample       V - Vane Shear Test       0 - Organic content SO <sub>2</sub> <sup>2</sup> - Sulphate Content CT - Core Recovery (%) RQD-Rock Quality Designation (%)       Not Laterite Nodules       Supervised By:       SM.DSamantha         Made Ground       X * * * X X * * X Silt       Soft Gravel       Made Laterite Nodules       C- Completely Weathered Rock       W.L.Nimal																								_	
Sample Key / Test Key         SPT       Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)       D - Disturbed Sample       N - Natural Moisture Content L - Atterberg Limit Test       C - Consolidation UCT-Unconfined Compression CU - Consolidated Undrained Borehole, after the saturation       Existing Supervised By:         GWL       : Ground Water Level observed inside the Borehole, after the saturation       W - Water Sample       S - SPT Sample       C - Consolidated Undrained UU-Unconsolidated Undrained UD-Undisturbed Sample       B - Bulk Density       pH - Chemical       Existing ground level       Supervised By:         NE       Not Encountered       CS - Core Sample       V - Vane Shear Test       0 - Organic content SO <sub>4</sub> <sup>2</sup> - Sulphate Content       as the zero level       S.M.DSamantha         FD       - Free Down       RQD-Rock Quality Designation (%)       Gravel       MAM       Laterite Nodules       C - Completely Weathered Rock       W.L.Nimal	10.00																								
the number of blows for the quoted penetration is given (not N-value) GWL : Ground Water Level observed inside the Borehole, after the saturation NE Not Encountered HB - Hammer Bounce FD - Free Down Made Ground <b>x</b> * * * Silt Supervised By: SS - SPT Sample W - Water Sample UD- Undisturbed Sample CS - Core Samp	SPT	Whe	e full	0 3m r	penetration	has not be	en achie	ved	D - Disturbed S:	: Key / Test ample	t Key	N - Natural M	oisture Co	ontent	C - Cor	nsolidati	on		+	Rema	rks	Logged	By :	—	_
is given (not N-value) W - Water Sample G - Grain Size Analysis CU - Consolidated Undrained UD-Unconsolidated Undrained Borehole, after the saturation UD- Undisturbed Sample B - Bulk Density PH - Chemical as the zero HBB - Hammer Bounce CS - Core Sample C - Core Recovery (%) C - Core Recovery (%) RQD-Rock Quality Designation (%) C - Consolidated Undrained C - Cloride Content C - Cloride C -	5.1	the	numb	er of b	lows for th	ne quoted p	enetratio	n	SS -SPT Sample		1	L - Atterberg	limit Test	t	UCT-U	nconfin	ed Comp	ression		Exist	tino				
GWL     : Ground Water Level observed inside the Borehole, after the saturation     WS-Wgrey Sample     SG - Specific Gravity Test     UU-Unconsolidated Undrained pH - Chemical     considered as the zero Ievel     S.M.DSamantha       NE     Not Encountered     CS- Core Sample     V - Vane Shear Test     O - Organic content SG <sup>2</sup> - Sulphate Content     Drilled By:       HB     -Hammer Bounce     Cr - Core Recovery (%) RQD-Rock Quality Designation (%)     V - Vane Shear Test     O - Organic content SG <sup>2</sup> - Sulphate Content     Drilled By:       W.L.Nimal     W.L.Nimal     Completely Weathered Rock     W.L.Nimal		is g	iven (	not N-	value)				W - Water Samp	ole	(	G - Grain Size	Analysis		CU - C	onsolida	ted Undr	ained	g	round	level	Superv	ised By	<u>r</u>	
NE     Not Encountered     CS- Core Sample     V - Vane Shear Test     O - Organic content     as the zero level     Drilled By:       HB     -Hammer Bounce     Cr - Core Recovery (%) RQD-Rock Quality Designation (%)     V - Vane Shear Test     O - Organic content     as the zero level     Drilled By:       W.L.Nimal       Made Ground     X * * * X     Silt     Sologing Gravel     AAAA     Laterite Nodules     Cr - Completely Weathered Rock	GWL	: Gr	ound V rehole	Vater I after i	Level obset the saturat	ved inside	the		WS-Wgrey Samp UD- Undisturbed	ole I Sample		SG -Specific G B - Bulk Densi	avity Tes	t	UU-Un pH - Cl	consolic remical	ated Unc	lrained	ç	consid	lered	S N	AD Sa	amant	ha
HB     -Hammer Bounce     Cr - Core Recovery (%)     SO4 <sup>2-</sup> - Sulphate Content     level       FD     - Free Down     RQD-Rock Quality Designation (%)     CT - Cloride Content     W.L.Nimal       Made Ground     X X X X X     Silt     So of Gravel     AAAA     Laterite Nodules     Completely Weathered Rock	NE	Not I	Encou	ntered	the suturut	ion			CS- Core Sample	e	÷	V - Vane Shea	Test		O - Org	anic co	ntent		e	as the	zero	Drilled	By:		
RDD-Rock Quality Designation (%)     CT - Cloride Content     W.L.Nimal       Made Ground     Image: Arrow and the second sec	HB	-Ha	mmer	Bound	ce				Cr - Core Recove	ery (%)					SO4 <sup>2-</sup> -	Sulphat	e Conten	t		lev	el				
	FD XXX	- Fr	ee Do	vn	d	×××	Q;14		RQD-Rock Quali	ity Designa	ation (%)			1 1	CI - Cl	oride Co	ntent	4.1.33		1 D	1	$\mathbf{h}$	W.L.N	imal	
	×××		de C	roun	a	×* <u>*</u> *×	] 5m	1				Late	The Not	dules	<u>}</u>	딑	Comple	etely W	eather	red Ro	)CK		4	<b>D</b> 1	

(	b		E	NGIN	NEEF	SING S	G & LA site inv	BORATOR /ESTIGATIO	Y SERV	ICES (I	PVT	<b>[])</b> L <sup>*</sup>	ГD.	N	NO 62 Ka	2/3, N atuwa Tel·	Veelam wala, 1	maha Sri La	ra R inka	oad,	Τ	For EL	mat N S-SI-	No: 02
Pro	ojeo	et			Geoto Netw	echni ork ]	ical Inves Developn	tigation for National Action	ational Tra ency Impr	ansmissio ovement	n an Proj	d Dis ect (	stribı II)	utio	n	Bo	rehole	e No	7 <del>4</del>		A	P-36	5A	
Cli	ent				<b>M/s</b> . '	<u>.</u> Foky	o Electri	c Power Servio	ces Co. Lto	1		•••				She	et			1		of		1
Loc	atio	n			Samp	oor	·	Rig	Joy	Core I	Diam	eter	54m	m		~ (	Grour	nd W	/ate	r lev	vel	(	0.60	)m
Date	e of	Sta	rted		25.01	.201.	3	Drilling Metho	od Wash	Casing	g dep	th	3.50	m		C	'oord	inoto	20	8	° 25	' 58	.86'	'N
Date	e of	Fin	ishe	d	25.01	.201.	3	Casing Diamet	er 76mm	Elevat	ion (	m)	1				.0010	mate	s	8	1° 6	.49'	46'	Έ
(					()						F	ield F	ecor	ds			М	loistu	re C	onten	1t - %	0		
ı (m	ond		pe	ed	u (m	р		Soil Desc	rintion		1.		DT)	us			Undrai	ined S	Shea	r Stre	ength	- t/m	2 1	
eptł	Ŭ	NO.	ı. Ty	educ vel	eptł	eger		Son Dese	inpuloii			(5)	- 1)		10	0 20	) 30 CDT	40	50	) 60	) 7(	) 80	9	0
	ů.	Se	ŝ	R. le	Д	Ĺ		Cround	laval		5cm	5cm	5cm	z		<i>c</i> 1	SPI	Resi	stand	ce - B	Slows	3/ft		
0.00	$\vdash$	DI	DC		0.00			Giouna	level		-	-	-			5 1	10 15	20	2:	5 30	0 3	5 4	<u> </u>	45
	IX	DI	DS		0.00														_					
_	Р			_																				
1.00																								
Γ	$\nabla$	D2	SS	G.W.L							4	3	3	6										
	$\wedge$			at 0.011		:•:•:										<b>A</b> 6	>							
-			ws				Loose, bi	rown, fine to med	ium SAND	with some						$\uparrow$								
2 00								clay and g	gravels									_	-					
2.00	-	DA	00										-			$\left  \right $			_					
	IX	D3	88								3	4	5	9			a							
_	Р																$\sim$							
			WS			• • • • • •																		
3.00																						_		
	$\nabla$	D4	SS								нв			>50									$\overline{}$	
	$\bigtriangleup$							ROCK L	EVEL												-		>50	
-					3 50		END	OF THE BORE	HOLE AT	3 50m														
1.00					5.50		LIND	DED1		5.5011														
4.00								DEFI	11															
5.00																								
_																								
																			-				_	
┢																								
6.00																			-	-+	-	$\rightarrow$	-	
6.00																			_					
7.00																								
																							-	
┢																								
0.00																				-+		$\rightarrow$	-	
8.00																			_					
L																								
9.00																								
																					-	-		
┢																								
10.00																								
10.00	1			<u> </u>	<u> </u>		[	Sample Key / 7	lest Kev		<u> </u>	<u> </u>	I					<u>م</u>	Remar		Log	red By		
SPT	When	e full	0.3m J	penetration	has not be	en achie	ved	D - Disturbed Sample	N	- Natural Mois	sture Co	ntent	C - Cor	nsolidat	ion				al		1 <u>-088</u>	. y Li w	<u> </u>	
	the	numb	er of b	lows for th	e quoted p	enetratic	on	SS -SPT Sample	L	- Atterberg Lin	mit Test		UCT-U	nconfir	ned Cor	npress	ion	F	xisti	ing	L	Nish	antha	
<b></b>	is g	iven (	not N-	value)				W - Water Sample	C	- Grain Size A	nalysis		CU - C	onsolid	ated U	ndraine	ed .	gro	und	level	Supe	rvised	By:	
GWL	: Gr	ound V	Nater 1	Level obset	ved inside	the		WS-Wgrey Sample	S	G -Specific Grav	vity Tes	t	UU-Un nH - Cl	consoli 1emical	dated U	Jndrain	ied	col	nside	ered		Ιa	hiru	
NE	Not I	Encou	, aner ntered	une saturat	1011			CS- Core Sample	- E	- Vane Shear T	ſest		O - Org	anic co	ontent			as	the 2	zero	Drill	ed By:	u	
нв	-Ha	mmer	Bound	e				Cr - Core Recovery (%)					SO4 <sup>2-</sup> -	Sulpha	te Cont	tent			leve	el.	F	<u> </u>		
FD	- Fr	ee Do	wn					RQD-Rock Quality Desi	ignation (%)				Cl - Cl	oride C	ontent						╞	Sur	anga	
$\bigotimes$	Ma	de C	Broun	ıd	<u>x×*×*</u>	Silt		Gravel	Ž	Lateri	te Noc	lules	<u> </u>	-1	Comj	pletel	y Wea	thereo	d Ro	ck		$\mathbf{z}$		
	Cla	ıy			:•:•:•:	San	d	Organic M	latter	Silty S	and		5	Hi	ghly	Weat	hered l	Rock			1	Fresh	Roc	k

e	b	1	El	NGIN	IEER	RING	G & LA SITE INV	BOR	RAT( IGAT	ORY	SER S DIVIS	VIC SION	ES (P	VT	') <b>L</b> '	ΓD.	N	NO 62 Ka	2/3, Ne tuwav Tel: 0	eelamm wala, Sr	ahara i Lank 9 494	Road, a.	,	For EL	mat l S-SI-	No: 02
Pro	jec	et			Geote	echni ork l	ical Inves	stigati	on fo nd Fi	or Nati fficien	ional T	rans	missio	n an Proi	d Dis ect ()	stribı II)	utio	n	Bore	ehole ]	No		1	AP-3	38	
Clie	nt				M/s.	<u>Fokv</u>	o Electri	ic Pow	er Se	ervices	s Co. Li	td	ment	IIUJ		11)			Shee	et		1		of		1
Loca	atio	n			Samp	oor		Rig			TD	1	Core D	iame	eter	54m	m		G	round	Wat	er le	vel		1.40	)m
Date	e of	Sta	rted		23.01	.2015	5	Drilli	ng M	ethod	Wash	(	Casing	dep	th	7.50	m		C	oordin	atec	8	s° 25	5' 43	.01'	'N
Date	e of	Fin	ishe	d	14.01	.2015	5	Casin	ıg Dia	ameter	76mm		Elevati	on (1	m)	-				Jorum	ates	8	1° 1	2'1	3.96	Ъ́Е
(in	p				(u									Fi	eld F	Recor	ds			Moi	sture (	Conte	nt - %	6	2	-
th (r	Con	0.	ype	lced	th (r	end		S	Soil D	Descrip	otion				(SI	PT)		10	) 20	Jndraine 30	40 She	50 6	engti	1 - t/n	1 0 9	0
Dep	Sa. (	Sa.N	Sa.T	Redu level	Dep	Leg								Е	Ē	Ē	I			SPT R	esista	nce -	Blow	/s/ft		
0.00									Gro	ound lev	el			15c	15c	15c	Z		5 10	) 15	20	25	30	35 4	0	45
	$\nabla$	D1	DS		0.00	<u> </u>																				
	$\bigtriangleup$					· .																				
						<u> </u>	G4:66	1	. c		. 1: C		W													
1.00						-	Sun,	CLAN	1, 111¢ 7:41			ANI Ma	JY	4	5	9	14									
Γ	$\bigtriangledown$	D2	SS	_		÷ ,		ULA I	witt	11001	nagmei	its														
	$\bigtriangleup$			_		- T														<b>1</b>	4					
-			WS	G.W.L		÷. ·																				
2.00				at 1.40m	1.00	:.:.:								4	8	9	17									
-	$\bigtriangledown$	D3	SS			:::::																				
	$\bigtriangleup$					:														_ Ì	17					
F			ws																							
3.00													c	8	8	8	16									
-	$\bigtriangledown$	D4	SS				Medium	1 dense	e, yell	lowish	brown	, gray	y, fine													
	$\bigtriangleup$							to	o med	lium S	AND										16					
-																				7						
4.00			ws			: : : :														/						
						:													1							
																			7							
-	$\bigtriangledown$	D5	SS		4.50	_								1	2	1	3								-	
5.00	$\bigtriangleup$					_ *	2											4	2							
-																			J							
			ws			— "												$\top$								
F						-2												T								
6.00						<b>9</b>	Ve	ry soft	, blac	k, gra	y, amor	phou	S	FD	FD	FD	0									
F	$\bigtriangledown$	D6	ss				ORGA	VIC CI	LAY	with f	ine to c	oarse	e sand													
	$\bigtriangleup$					- ~	-										4									
-						¥																				
7.00			ws			- *													$\mathbf{N}$							
F																										
						<b>9</b>	1																			
Γ	$\nabla$	D7	SS		7.50	()	Creation	h ~	£	to a -	****	di-	h fire -	15	8	16	24									
8.00	$\triangle$					() 	Greenis	n gray	, iine	to coa	use san	u wit	ii rine								X	24				
F						んご			g	avels																
1			ws			へい	COMI	PLETE	ELY V	WEAT	HERE	D RC	OCK													
Γ						$\mathbb{C}$		I	ROCI	K LEV	VEL															
9.00					0 00	<u> </u>	END			ODEU		тос	20m													
Г					0.80		END	UF IF	ים ים דר	UKEH	ULE A	1 8.8	SOIII													
1									D	Dr I H	L															
10.00																										
SPT	When	re full	0 3m n	enetration	has not be	en achie	ved	D - Distu	Sample I urbed Sam	Key / Test	Key	N - Nº	atural Moist	ure Cor	ntent	C - Cor	nsolidat	ion			Rem	arks	Log	ged By		
	the	numb	er of b	lows for th	e quoted p	enetratio	n	SS -SPT	Sample			L - At	tterberg Lin	nit Test		UCT-U	nconfir	ned Con	npressio	on	Exis	sting	1	N.A.C 1	vishsha	inka
CUL	is g	given (	not N-	value)	· · · ·	a		W - Wat	er Sampl	le		G - Gr	ain Size An	alysis		CU - C	onsolid	ated Un	drained		ground	d leve	1 Sup	ervised	By:	
GWL	: Gro Bo	ound V rehole	vater I after t	evel obser. he saturati	ved inside on	the		wS-Wgre UD- Undi	ey Sample isturbed S	ie Sample		SG -Sp B - Bu	ecitic Grav ilk Densitv	ity Test		∪U-Un pH - Cl	consoli 1emical	aated U	ndraine	a	consi	dered	R	.M.B.S	andaru	iwan
NE	Not I	Encou	ntered					CS- Core	Sample	¥ •		V - Va	ine Shear T	est		O - Org	anic co	ontent			as the	e zero	Dril	led By:		
HB FD	-Ha	immer	Bounc	e				Cr - Core	Recover	ry (%) ty Design-	tion (%)					SO <sub>4</sub> <sup>2-</sup> -	Sulpha	te Cont	ent		lev	vel		Sum	athinal	a
***	Ma	ide G	roun	d	××××.	Silt			Grave	el	шон (70 <b>)</b>	<u>A A A A</u>	Laterit	e Nod	ules			Comr	letelv	Weath	ered R	lock		$\overline{\mathbf{\nabla}}$	pau	
× × ×	Cla	iv			. <u></u>	San	d		Organ	nic Mat	ter	× ×	Silty Se	and		ぼ		ghlv V	Weath	ered Ro	ck	r	ŕ	Fres <sup>1</sup>	1 Roc	k
		2				1			0				.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			r N	4	~ /								

(	B	ļ	E	NGIN	NEEF	RING	G & LA SITE INV	BORAT	ORY TIONS	SER S DIVIS	VIC SION	CES (F N	PVT	[]) L]	ΓD.	N	10 6 K	2/3, N atuwa Tel: (	eelamn wala, S 0114 30	nahara ri Lanl 9 494	Road, ta.		For EL	mat N S-SI-(	lo: 02
Pro	ojeo	et			Geote Netw	echni ork l	ical Inves Developn	stigation fo nent and E	or Nati Efficien	ional T icy Imp	rans prove	missio ement l	n an Proj	d Dis ect (1	stribı II)	itioi	1	Bor	ehole	No		Ι	3H-3	39	
Cli	ent				<b>M/s.</b> '	Toky	o Electri	c Power S	ervices	5 Co. L	td							She	et		1		of		4
Loca	atio	n			Samp	oor	_	Rig	<u> </u>	Joy		Core D	Diam	eter	54m	m		(	Ground	l Wa	ter le	vel		1.60	m
Date	e of	Sta	rted		16.01	.201:	5	Drilling M	1ethod	Wash		Casing	dep	th	40.0	0m		С	oordii	nates	2	3° 2:	<u>5'7.</u>	.77"	N
Date	e of	Fin	ishe	d	22.01	.201:	5	Casing Di	ameter	/6mm		Elevati	on (1	m)	<u>i</u>		1		M		810	13	49.	16.2	7″E
ਜ	ч				я)								Fi	ield F	Recor	ds			MC	isture	Conter	nt - %	0	2	-
th (1	Con	Ö	ype	ced	th (1	pua		Soil I	Descrip	otion				(SI	PT)		- 1	0 20		40 ed She	$\frac{50}{50}$	engtr	1 - t/m	1 ) 90	)
Depi	Sa. (	sa.N	Sa. T	kedu evel	Depi	Lege							я	Ŕ	Ē		-	20	SPT I	Resista	nce - I	Blow	s/ft	· ,	
0.00	•1	01	•1	нц	-			Gr	ound lev	el			15cr	15cr	15cr	z		5 1	0 15	20	25 3	30 3	35 4	0 4	5
-	$\nabla$	D1	DS		0.00	<u>-</u> ,																			
	Ŵ					<u> </u>																			
-		l				: ~														_					_
1.00						÷ -	Stiff	hrown fin	a ta ma	dium 6	י א אדו	DV								_					_
1.00	$\vdash$	Da					Sun,	biown, im		earum e	AN	DI		-	_					_					
	IX	D2	88			÷			CLAY				2	5	7	12			A 12	_					
L	$\vdash$			▼															<b>T</b> 12	·					
			WS																	_					
2.00				GWI		— · ·																			
	$\mathbb{N}$	D3	SS	at1.6m	2.00								17	6	6	12									
	$\bigtriangleup$					:::::													12						
-			ws			:::::																			
3 00																									
-	$\nabla$	D4	ss				Medii	14	5	6	11														
	IX	21	55				Wieda	14	5	0	11			11	-					_					
-		Î													_										
						:-:-:							-/												
4.00			WS												_										
																		/							
_	$\nabla$	D5	SS		4.50	:-:-:	Washed	sample;					8	2	2	4		I							
5.00	$\bigtriangleup$													No S	ample	-	4	4							
-							· ·	c,							1										
			ws				Loose, b	rown, fine	to coai	rse sanc	i wit	h mica													
-									traces											-					
6.00						:														_					
6.00	$\vdash$	D			6.00								1	~	2	_				_					
	IX	D6	55		6.00								1	2	3	5		5		_					
_	$\vdash$																	Τ'		_					
						₹.																			
7.00			WS			- *																			
						≆	Soft, bla	ack, amorp	hous O	RGAN	IC C	CLAY													
Г	$\nabla$	D7	SS				with fir	ne to coarse	e sand a	and son	ne gr	avels	2	2	1	3									
8.00	$\square$					⊢ _								1	1		<b>A</b>	3							
F	1					*																			
			ws																						
F	1													1	1		$\vdash$								
0.00	1					<b>.</b>								1	1		$\vdash$								
9.00	$\vdash$		00		0.00	<u></u>								1		•	+			_					
1	IX	D8	55		9.00		* 7	,	,	,	c		1	1	1	2		,		_					
L	$\vdash$					: <u> </u>	Very	loose, blac	ck, amo	orphous	, fine	e to					T	<u> </u>							
Í	1					<b></b>	coars	se, CLAYE	Y OR	JANIC	SAN	ND		1	1		$\square$								
10.00			WS											<u> </u>											
SPT	Wha	re fi-li	0.3m -	enetratio-	has not h-	en achi-	ved	Sample	Key / Test	Kev	N N	atural Mai-	ure Ca	ntept	C Car	solidat	ior			Ren	ark <u>s</u>	Log	ged By		
Sr1	w ne the	numb	o.5m p er of b	lows for th	nas not be ne quoted b	en acme	n	SS -SPT Sample	unpie		n - N L - A	aturai Moisi tterberg Lin	nit Test	ment	UCT-U	nconfin	ion ied Co	mpressi	on	E	tine		Nisl	hantha	
	is g	given (	not N-	value)	F			W - Water Samp	ole		G - G	rain Size Ar	alysis		CU - C	onsolida	ated U	Indraine	d	EXI	sung d level	Supe	ervised	By:	
GWL	: Gr	ound V	Water 1	Level obser	ved inside	the		WS-Wgrey Samp	ole		SG -Sp	pecific Grav	ity Test	t	UU-Un	consoli	dated	Undrain	ed	consi	dered			1 ''	
NE	Bo	rehole Encour	, after	the saturat	ion			UD- Undisturbed CS- Core Sample	sample		B - Bu V - V	11k Density ane Shear T	est		pH - Ch O - Ore	anic co	ontent			as th	e zero	Drill	Ine led Bv:	aunıl	
HB	-Ha	immer	Bound	e				Cr - Core Recove	ery (%)		''				SO4 <sup>2-</sup> -	Sulphat	te Cor	itent		le	vel				-
FD	- Fi	ee Do	wn			-		RQD-Rock Qual	ity Designa	tion (%)		-			CI - Cle	oride C	ontent						Suma	athipala	
$\approx$	Ma	ide C	Broun	d	*****	Silt		Grav	/el			Laterit	e Nod	lules	1	-	Com	pletel	y Weath	ered F	lock		$\mathbf{S}$	_	
	Cla	Clay Organic Matter Sand Organic Matter							Silty S	and		う	Hi	ghly	Weatl	nered R	ock			Fresh	n Rocl	k			

E	b	I	El	NGIN	NEEF	RINO S	G & LA SITE IN	ABORATO VESTIGATIO	CES (F N	PVT	[]) L	TD.	1	NO 6 K	2/3, N atuwa Tel:	Veelamn wala, S 0114 30	nahara ri Lanl )9 494	Road, ka.	,	For EL	mat l S-SI-	No: •02		
Pro	jec	et			Geote Netw	echni ork l	cal Inve Developi	stigation for I ment and Effi	National T ciency Imp	'rans prove	missio ement	n an Proj	d Di ect (	istrib (II)	utio	n	Bo	rehole	No		]	BH-:	39	
Clie	ent				<b>M/s.</b> ′	Toky	o Electr	ic Power Serv	vices Co. L	td							She	eet		2		of		4
Loca	tio	n			Samp	oor		Rig	Joy		Core D	Diamo	eter	54m	n		(	Groun	d Wa	ter le	vel			
Date	of	Sta	rted		16.01	.201:	5	Drilling Meth	nod Wash		Casing	, dep	th	40.00	0m		C	Coordii	nates		8° 2	5'7	.77"	N
Date	of	Fin	ishe	d	22.01	.2015	5	Casing Diam	eter 76mm	1	Elevati	ion (1	m)	<u> </u>		1				81	13	<u> 49.</u>	16.2	27″E
я)	q				я (							Fi	ield I	Recor	ds			MC	1 sture	Conte	nt - 9	70 1. (/)	2	-
h (r	Con	Ö.	ype	ced	h (r	pua		Soil Des	cription				(S	PT)			0 20		and Sho	ear Str	engt	h - t/n	1 <sup>-</sup>	•
Jept	a. (	a.N(	a.T	edu	Jept	ege						-	(~ 	/	I	-	10 20	SPT	40 Resists	ance -	Blow	vs/ft	<u> </u>	
10.00	0	s	S	R	Ц	Г		Continue f	rom Page 1			15cn	15cn	5cn	z		5	0 15	20	25	30	35 4	0	45
						÷		e ontinue n	ioni i ugo i				-										1	
						¥.	1	Same as previo	ous descript	tion						$\square$	-		_					
-		,	00		10.50	::÷						4.							_					
	Х	D9	SS		10.50							1	2	2	4				_					
11.00		•															4							
			WS			· · · · ·																		
-						· · · · ·																		
12.00							Loose	black fine to	coarse SA	ND .	with						-			+				_
12.00		D10					Loose	ll amount of (			v	1	1	2		$\vdash$			_				_	
	Х	D10	55			:-:-:	SIIIc		KUANIC	ULA	. 1	1	1	2	3		3		_					
_																								
13.00			ws			· · · · ·											V							
-																	1							
																			-				_	
-		D11	00		12.50	<u> </u>	2		_		1		_	+										
	Х	DH	55															7	_					
14.00																	T	ľ						
			ws			<u> </u>																		
-				55 Firm, black, amorphous ORGANIC fine 3																				
15.00																			-	++			_	_
15.00		, D12	00											~					_				_	
	Х	DIZ	55				FIIII,	black, amorph	OUS OKGA	INIC	Inne	3	3	5	8			8						
_		•				,¥⊂		SANDY	CLAY								T	0						
16.00																								
_			ws			-14																		
															-	+								
-																			_	+			_	
																			_					
17.00												4										$ \longrightarrow $		
	Х	D13	SS		17.00							2	3	3	6									
	$\square$																							
18.00						_	<b>D</b> : 1		ODGU															
-			ws			_ *	Firm, b	lack, amorpho	us ORGAN	VIC C	CLAY						1			+				
						_ ~											-						_	_
F															1	$\vdash$	-		_		<u> </u>			
															1		-		_	$\downarrow$				
19.00												ļ			1									
	$\nabla$	D14	SS		19.00	<b>3</b> 2.						3	2	3	5									
	$\triangle$						Firm, b	lack, amorpho	us ORGAN	VIC C	CLAY				1		<b>∮</b> 5							
						⊢‴	, -	with some	fine sand						1					+				
20.00															1	$\vdash$				+				
_0.00			L			-		Sample Kev	/ Test Kev			I	I	I	<u>I</u>	1			Ren	narks	Los	gged Bv	:	
SPT	When	re full	0.3m p	enetration	has not be	en achie	ved	D - Disturbed Sample		N - Na	atural Mois	ture Co	ntent	C - Con	solidatio	on					1	<u>,</u>		
	the	numb	er of b	lows for th	ne quoted p	enetratio	n	SS -SPT Sample		L - A	tterberg Lir	nit Test		UCT-Ur	nconfine	ed Cor	npressio	on	Exi	sting		Nis	hantha	
CWI	is g	given (	not N-	value)		41		W - Water Sample		G - Gi	rain Size Ar	nalysis		CU - Co	nsolida	ted Ur	ndrained	l 	groun	d leve	1 Sup	ervised	By:	
GWL	. Gro Bei	ound V	vater I after i	Level obset	iveu inside	une		UD- Undisturbed Sam	ple	50-Sр В - Вг	Jecuic Grav alk Density	ny rest	L	pH - Ch	onsolid emical	ated (	nuraine	u	cons	idered		In	dunil	
NE	Not I	Encour	ntered	uidt				CS- Core Sample	•	V - Va	ane Shear T	est		O - Orga	anic cor	itent			as th	e zero	Dri	lled By:		
нв	-Ha	mmer	Bounc	e				Cr - Core Recovery (	%)					SO4 <sup>2-</sup> - S	Sulphate	e Cont	ent		le	vel				
FD	- Fr	ee Do	wn			-		RQD-Rock Quality D	esignation (%)	<b>.</b>	1			Cl' - Clo	ride Co	ntent						Sum	athipal	a
$\approx$	Ma	de G	iroun	d	×****	Silt		Gravel			Laterite	e Nod	ules	1-1-	-1	Com	pletel	y Weath	nered F	Rock	6	$\leq$		
	Cla	ıy			• • • •	San	1	Organic	Matter	* *	Silty S	and		Ń	Hi	ghly	Weat	hered R	ock			Fresh	n Roc	k

E	b		EI	NGIN	EER	RING SI	& LA	BOR 'ESTI	ATO GATI	RY S	SERV DIVIS	ICES ( ION	PVT	') L'	ГD.	N	O 62 Ka	2/3, N tuwa Tel: (	eelami wala, S )114 3	mahara Sri Lani 09 494	Road, ka.		Form ELS	nat N S-SI-0	o: 2
Pro	jeo	et			Geot	echni ork F	cal Inves Developm	stigati nent a	on for nd Eff	Natio	onal Tr	ansmissi	ion ar t Pro	nd Di iect (	istrik (II)	outio	n	Bor	ehole	No		Е	8H-3	9	
Clie	ent				M/s.	Toky	o Electri	c Pow	ver Ser	vices	Co. Lt	d	<u>t I I U</u>		(11)			She	et		3		of		4
Loca	tio	n			Samp	oor		Rig		İ	Joy	Core	Diam	eter	54m	m		C	broun	d Wa	ter le	vel			
Date	of	Star	rted		16.01	.2015		Drilli	ng Met	thod	Wash	Casir	1g dep	oth	40.0	00m		С	oordi	nates	8	8° 25	577.2	77"N	1
Date	of	Fin	ishe	d	22.01	.2015		Casin	g Dian	neter	76mm	Eleva	ation (	(m)				U	oorui	indico	81°	<u>, 13, 13, 13, 13, 13, 13, 13, 13, 13, 13</u>	49.1	16.2	7"E
(n	ч				(F								Fi	ield I	Reco	rds			M	oisture	Conte	nt - %	,	2	
th (r	Con	О.	ype	lced	th (r	end		5	Soil De	script	tion			(S	PT)		10	20	Jndrai 30	40	50 6	ength	- t/m	- - 	-•
Depi	Sa. (	Sa.N	Sa.T	Redu evel	Depi	Lege							E	Ē	É	1		20	SPT	Resista	ance - !	Blow	s/ft		•
20.00	• 1	<b>9</b> 1	•1					С	ontinue	from P	age 1		15cı	15cı	15cı	z		5 10	) 15	20	25 3	30 3	5 40	) 4:	;
Γ			WS			_																			
						_ *	C				. ,.														
							2	same a	s previ	ous d	escripti	on													
21.00						_																			-
		D15	SS		21.00	- *							1	2	1	3	+								_
	Х	010	~~		21.00	. –							-	-	-		3							_	_
F																	+					$\left  - \right $			_
22.00																	+			_					
22.00			IL C			 											+			_	—	$ \vdash $	$\vdash$		
			ws														$\vdash$								
L						-											1								
						¥.														_	_				
23.00						<u> </u>	Very s	oft, bl	ack, an	norph	ous OR	GANIC											$\square$		
	X	D16	SS			-		fin	e SAN	DY C	CLAY														
L	$\sim$					÷ ,							1	FD	FD	0	Ľ								
						<u> </u>								No S	ample	.									
24.00						<u> </u>																			
Γ			ws			<u> 1</u>											Τ								
						<u> </u>																			
						<u> </u>																			
25.00																									
F		D17	ss		25.00								3	3 2	3	5	-1								_
	Ň					—											5	4							-
F																									_
26.00																		<b>1</b>							_
																		+							-
			we			-												+						_	_
⊢			w 5			—												+		_				_	_
																		-				$\left  - \right $			_
27.00		DIO	00												-			_		_		$ \rightarrow $	$ \rightarrow $	_	_
	X	D18	55				Loos	e, brov	wnish t	black,	fine to	coarse	e	9 4	. /	11		п				$\left  - \right $			
L							CLA	YEY S	SAND	with f	fine to n	nedium							$\mathbf{A}$						
									gra	vels									$\rightarrow$	_					
28.00						_			-										`	$\setminus \vdash$		$\left  - \right $	$ \rightarrow $	_	
						—														$\rightarrow$					
F														1						-					
1																				_ <b>`</b>	$\checkmark$				
29.00			ws			—																			
						_																			
						_																			
Г																						$  \rangle$			
30.00						_																			
<b>GD</b>								<u>;</u>	Sample Key	/ Test K	ey				a -					Rer	narks	Logg	ed By :		
SPT	When	e full	0.3m p er of b	enetration lows for th	has not be e quoted n	en achieve enetration	ed	D - Distu SS -SPT	irbed Samp Sample	le	1	N - Natural M	oisture Co Limit Tee	ontent t	C - Co UCT-I	nsolidati Inconfin	on ed Cor	nnrecci	on	<b>.</b>			Nish	antha	
1	is g	given (1	not N-	value)				W - Wat	er Sample		(	G - Grain Size	Analysis		CU - C	onsolida	ited Ur	drained	1	Exi	sting	Supe	rvised F	<u>3y:</u>	
GWL	: Gr	ound V	Vater I	evel obser	ved inside	the		WS-Wgre	ey Sample	1	2	SG -Specific G	ravity Tes	ŧ	UU-Un	consolid	lated U	Indraine	ed	cons	idered				
NE	Bo Not I	rehole, Encour	atter t	the saturati	on			UD- Undi CS- Core	sturbed Sar Sample	mple	]	B - Bulk Densi V - Vane Shea	ıty r Test		рн - С О - Ог	nemical ganic co	ntent			as th	e zero	Drill	Ind ed Bv <sup>.</sup>	unií	
нв	-Ha	mmer	Bounc	e				Cr - Core	Recovery	(%)		. une oned			SO4 <sup>2-</sup> -	Sulphat	e Cont	ent		le	vel	22. 110			
FD	- Fr	ee Dov	vn			-		RQD-Roo	ck Quality	Designati	ion (%)				CI - CI	oride Co	ontent					╞	Sumat	thipala	
$\sim \sim \sim$	Ma	de G	roun	d	<u> </u>	Silt		°°°°	Gravel			Later	rite Noc	lules	$\leq$	<u>-1</u> (	Comp	letely	Weat	hered I	₹ock		5		
	Cla	ıy			:·:·:	· Sand			Organi	c Matte	er	* Kilty	Sand		ゞ	- Hig	ghly V	Weath	ered F	Rock		]	Fresh	Rock	

F	ļ		E	NGIN	NEEF	RING	G & LA	BORA	VICE	S (P	VT	) L'	TD.	NO	) 62/3 Katu	, Neelan wawala,	nmaha , Sri La	ra Roa anka.	ıd,	Fo E	ormat l LS-SI-	No: -02		
Pro	iec	et			Geote	echni	ical Inves	tigation	for Nation	onal Tr	ansmi	ssion	and	l Dis	stribu	ition	Te	l: 0114 Boreho	309 49 le No	)4		BH	-39	-
Clie	nt	-			Netw M/s	ork I Toky	Developn o Electri	<u>nent and</u>	Efficien Services	cy Imp Co Lt	rovem d	ent P	roje	ect (]	II)			heet		+	4	of		4
Loca	tio	n			Samp	oor	0 Electri	Rig	Services	Joy	Co	ore Di	iame	eter	54mı	n	2	Grou	nd W	ater	level			· ·
Date	of	Stai	ted		16.01	.2015	5	Drilling	Method	Wash	Ca	asing o	dept	h	40.00	)m		Coord	linate		8°	25' ′	7.77"	'N
Date	of	Fin	ishe	d	22.01	.2015	5	Casing I	Diameter	76mm	El	evatic	on (r	n)				COUR		<u>~ 8</u>	1° 1	3' 49	).16.2	27"E
(m)	pu		Э	_	(n)								Fi	eld l	Recor	ds		Undi	Moist	Ire Co Shear	ntent	- %	$t/m^2$	-
pth (	Cor	V	Typ	luced	pth (	gend		Soi	l Descrip	otion				(S	PT)		10	20 30	40	50	60	70 8	0 90	
De	Sa.	Sa.]	Sa.	Red leve	De	Lei							cm	scm	scm	z		SI	PT Res	istance	e - Bl	ows/f	<b>A</b>	\
30.00								Conti	inue from I	Page 1			12	15	15	-	5	10 1	5 20	25	30	35 4	0 45	
	Х	D19	SS		30.00	—							12	17	22	39				$\vdash$	$\rightarrow$	39	-	
-						_														$\vdash$	$\rightarrow$		$\rightarrow$	
						—	Dener		.1. 1	£										$\vdash$	$\rightarrow$		$\rightarrow$	
31.00			we				Dense	, yenowis	VEV S	I, IIIIe IC	mean	.111					$\vdash$			$\vdash$	$\rightarrow$		+	$\setminus$
			ws					CLF	ALL I SI												+		_	$\mathbf{h}$
-																				$\vdash$	+		_	+
32.00						-														$\vdash$	+	_	_	+
		D20	SS		32.00								18	22	29	>50	$\vdash$				+	_	-	
	Х	D20	00		52.00					10	22	2)	-20					+	-		50			
-																					-			
33.00							Verv d	ense vell	owish br	own gr	av fin	e to									-		+	
_			ws					co	arse SAl	ND											+		+	
																					-		-	
-																					-		-	
34.00																					+	-	+-	
_	$\bigtriangledown$	D21	SS		34.00		*** 1 1						16	23	25	48					+		+	$\pm$
	Δ						Washed	sample cl	hanged to	0;				No s	ample						+	-	48	
-							4					i			Ĺ						+			
35.00																					+	-	-	
-			ws				1														-		+	$\top$
							]														+		-	
-							]																	
36.00																								
-	$\bigtriangledown$	D22	SS										12	19	25	44								
	Δ																					4	4	
_							1																	
37.00						: : : :	Dense	, brown, g	gray, fine	to med	ium saı	nd												
			ws				]	wit	h mica tr	aces														
38.00																								
	V	D23	SS			::::	1						24	28	24	52				$ \square $	$\square$			
_	$\square$					: : : :														$ \square $	$\square$			
							]													$\vdash$	_		5	52
39.00							}													$\vdash$	$\perp$			
																				$\vdash$	$\rightarrow$		_	
_																				$\vdash$	$\rightarrow$			
							END (	OF THE I	BOREHO	DLE AI	Г 40.00	m								$\vdash$	$\rightarrow$			
40.00						••••		Same	DEPTH	Kov										omorke		aged Di		
SPT	When	re full	0.3m j	penetration	has not be	en achie	ved	D - Disturbed	Sample	nty	N - Natura	al Moistu	re Con	tent	C - Cons	olidation	1		<u></u>	CHIATKS	1.0	5ged By	-	
	the	numb	er of b	lows for th	e quoted p	enetratio	n	SS -SPT Samp	le		L - Atterb	berg Limit	t Test		UCT-Un	confined	Compre	ssion	E	xisting	, <u> </u>	N	ishantha	
GWL	is g : Gro	given ( ound V	not N- Vater I	vatue) Level obse	rved inside	the		w - Water Sa WS-Wash San	mpie nple		G - Grain SG -Specif	Size Ana fic Gravit	iiysis y Test		CU - Co UU-Unc	nsolidate onsolida	:a ∪ndra ted Undr	inea ained	grou	and lev	vel Su	pervised	<u>. By:</u>	
	Bo	rehole	after	the saturat	ion			UD- Undisturb	ed Sample		B - Bulk I	Density			pH - Ch	emical			cor	isidere			Indunil	
NE HB	Not I -Ha	Encour mmer	ntered Bound	e				CS- Core Sam Cr - Core Reco	ple overy (%)		V - Vane S	Shear Tes	st		O - Orga	ulphoto	Content		as	level	Dr	illed By	<u>.</u>	
FD	- Fre	ee Dov	vn	-				RQD-Rock Qu	ality Designa	tion (%)					Cl' - Clo	ride Con	tent					Sw	mathipal	a
$\times$	Ma	de C	rour	nd	******	Silt		°°°° GI	ravel		t 🎎	aterite	Nodu	ıles	:-:-	C C	omple	tely We	athered	d Rocl	< E	$\mathfrak{A}$		
	Cla	ıy	Sand Organic Matter								* <b>*</b> S	Silty Sa	nd			Hig	ghly W	eathere	d Rock	c		Fre	sh Roc	k

(	Ŀ		E	NGI	NEER	RIN	G & LA site inv	BORATORY	SERVI	CES (F	VT	') L'I	ГD.	N	O 62/ Kat	3, Neel uwawa	amma la, Sri 4 309	hara l Lank	Road, a.	,	For EI	rmat _S-SI	No: -02
Pro	ojeo	et			Geote	echni	ical Inves	stigation for Nat	ional Tran	ismissio	n an Desi	d Dis	stribu	ıtior	1	Boreh	ole l	No			AP-	44	
CI	-				Netw M/a	OFK I Folw	Developii	a Dowon Somuioo	<u>icy impro</u>	vement	гој	eci (1	11)		_	01 4			1		of		1
	ent atio	n			Samn	oor	0 Electri	Rio	<u>s Co. Liu</u> !Iov	Core F	liame	eter	5/m	m		Sneet Gro	und	Wat	er le	vel	01	1 30	0m
Date		Sta	rted		27 01	201	5	Drilling Method	Wash	Casing	dent	th	2.0n	<u>ווו</u> ז		OIC	una	mut	1 8	20 27	7,17	$\frac{1.5}{7.13}$	"N
Date	$\frac{1}{2}$ of	Fin	ishe	d	27.01	201	5	Casing Diameter	· 76mm	Elevati	$\frac{uep}{on(1)}$	m)	2.011	1		Coo	rdina	ates	8	101	8'2	8 90	)"E
Duit		1 111	15110	u l	27.01	.201.		Cubing Diameter	/ 011111	210 / 40			I				Mois	sture (	Conte	nt - 9	<u>~</u>	0.7 (	
(II)	pu		e	σ	(m)			G. I.D.			F1	eld F	Recor	ds		Unc	Iraine	d She	ar Str	rengtl	h - t/r	n <sup>2</sup>	
pth	õ	ŇO.	Typ	luce	pth	gene		Soil Descrip	otion			(SI	PT)		10	20	30	40	50 6	50 7	70 8	30	90
De	Sa.	Sa.]	Sa.	Red	De	Leg					m	m	cm	-		S	PT R	esista	nce -	Blow	/s/ft		<u>هــــــــــــــــــــــــــــــــــــ</u>
0.00								Ground lev	/el		150	150	150	Z	5	10	15	20	25	30	35	40	45
	$\mathbb{N}$	D1	DS		0.00	$\sim$	Brown	, light brown, fin	e sand with	n mica													
	$\bigtriangleup$					$\mathbb{N}^{+}$		traces and root f	ragments														
-						$\left[ \right]$	COMI	PLETELY WEAT	THERED R	ROCK								-					
1.00						$\sim$	00111				2	4	6	10									
1.00		D				いし					2	-	0	10								<u> </u>	
	IX	D2	55			へい	(1.00-]	1.45)m sample ch	anged to; b	orown,						-	10					<u> </u>	
_	P			G.W.L		1.1	black, si	lty, fine to mediu	m, sand wi	th mica							~			<u> </u>	<u> </u>		
			WS	at 1.20m		$\sim$	, í	traces	,														
2.00				1.50m		$\mathbb{C}^{\prime}$		liuces												$\sim$			
Г	$\nabla$	D3	SS								14	17	HB	>50								$\sim$	
	$\bigtriangleup$					[\`]	COMI	PLETELY WEAT	THERED R	ROCK												>5	0
-						N.,		ROCK LEV	VEL								-						
3 00					2.80	~	END	OF THE BOREH	OLE AT 2	2.80m							_						
5.00					2.00		LIND	DEPTH														<u> </u>	
								DEI III	L													<u> </u>	
<b>–</b>																						<u> </u>	
																						<u> </u>	
4.00																					<u> </u>		
5.00																							
-																							
																		-					
-																						<u> </u>	
6.00																							
0.00																						<u> </u>	
																						<u> </u>	
-																		_				<u> </u>	
																				<u> </u>	<u> </u>		
7.00																							
L																							
8.00																							
F	1																+				<u> </u>		
9.00	1																+					<u> </u>	
-																							
																		-				<u> </u>	
-																						<u> </u>	
10.00	1																					<u> </u>	$\left  - \right $
10.00	<u> </u>							Sample Key / Tes	t Kev				<u> </u>				<u> </u>	Rem	arks	Los	ged By	<u> </u>	
SPT	When	e full	0.3m p	enetration	has not be	en achie	wed	D - Disturbed Sample	N -	Natural Moist	ure Cor	ntent	C - Cor	isolidati	on		+			1	(		
	the	numb	er of b	lows for th	e quoted p	enetratio	on	SS -SPT Sample	L -	Atterberg Lin	nit Test		UCT-U	nconfin	ed Com	pression		Exis	ting		Di	muthu	
GWL	IS §	given (	not N- Vater I	value) evel obse	ved inside	the		w - Water Sample WS-Wgrey Sample	G - 80	Grain Size Ar Specific Grav	alysis itv Test		CU - Co UU-Um	onsolida	ited Und	trained	g	ground	l leve	1 Sup	ervised	<u>ı By:</u>	
L	Bo	rehole	after	the saturat	ion			UD- Undisturbed Sample	В-	Bulk Density	, 1001		pH - Cł	nemical				consi	dered		Ir	ndunil	
NE	Not I	Encou	ntered					CS- Core Sample	V -	Vane Shear T	est		O - Org	anic co	ntent			as the	zero	Dril	lled By		
HB FD	-Ha	mmer ee Do	Bound	e				Cr - Core Recovery (%)	ation (%)				$SO_4^{2-}$ -	Sulphat	e Conte	nt		iev	01		Sur	athing	la
XXX	Ma	de C	iroun	d	× × × ×	Silt		Gravel	AA	A Latorit	e Nod	ulec			nuent	etelv u	/eath-	red P	ock	1	$\nabla$	pa	
× × ×	Cla	.v	- 5 411		· · · · ·	San	d	Organic Mat	ter	Silty S	and		F		zhlv W	leathere	ed Ro	ck	JUN	É	Fres	h Ro	ck

(	b		El	NGIN	NEEF	RINO	G & LA SITE INV	BOR	RATOR	Y SER	VIC SIOI	CES (F	PVT	') <b>L</b> ]	ΓD.	N	IO 62/3 Katu Te	, Neel wawa	amma la, Sri 4 309	hara I Lanka 494	Road, a.	Τ	For EL	mat l .S-SI-	No: •02
Pro	jec	et			Geote	echni ork I	cal Inves	stigati	on for Na	tional T	'rans	missio	n an Droi	d Dis	stribu	itior	B	oreh	ole N	Jo		 	ГТ-(	)2	
CE	- nt				Netw	OFK I Folyv	o Flootri	o Dou	na Emici on Somio	ency Imp	prove td	ement	РГОЈ	ect (I	11)		G	haat			1		of		1
	atio	n			Samn	oor	0 Electri	Rig		Lov	lu	Core D	Diame	eter	54m	m	0	Gro	ound	Wat	er le	vel	01	NI	- I
Date		Sta	ted		25 01	$\frac{001}{201}$	5	Drilli	ng Metho	d Wash		Casing	dept	th	2.0n	<u>ווו</u> ו		-		··· ac	1 8	;° 28	3' 25	5.59	''N
Date	e of	Fin	ishe	d	25.01	.2015	5	Casin	g Diamet	er 76mm	1	Elevati	on (1	m)	2.011	-		Coo	rdina	ites	8	1° 1	8' 5	5.61	"Е
-					-				0				E:		laaar	da			Mois	sture (	Conte	nt - %	6	,	
u (D	puc		pe	eq	(U	р			Soil Desci	intion			I.I	רוט ד רוט ר	DT)	us		Uno	draine	d She	ar Str	ength	1 - t/n	n <sup>2</sup>	
epth	Ŭ	NO.	ı. Ty	sduc vel	epth	eger				iption				(51	(1)		10	20	30	40 5	50 6	0 7	0 8	0 9	0
0	š	Sa	S	Ré	D	Ľ			Cround 1	aval			5cm	5cm	5cm	z	~	10	SPT Re	esistai	nce -	Blow	s/ft	40	45
0.00		DI	DC		0.00	$\sim$			Giouna i	evel			1	1	-			10	15	20	25 .	50	55 4		45
	IX	DI	105		0.00	いし	I	Black,	dark brov	vn, fine s	and								_						
_	$\vdash$					うい																			
						$\sim$	COMI	'LETE	ELY WEA	THERE	DRO	JCK							_						
1.00							(1.00-	1.45)r	n sample o	changed t	to; bl	lack,													
	IV	D2	SS			~	yello	wish l	prown, of	fwhite, fi	ne sa	und	8	8	HB	>50								~ = (	
L	$\sim$					へい	COMI	PLETH	ELY WEA	THERE	D R(	ЭСК												>5(	
			WS			1.	(2.00-	2.45)n	n sample o	changed t	to; bl	lack,													
2.00						$\sim$	li	ight gr	een, sligh	tly silty s	and														
	$\nabla$	D3	SS				COMI	PLETE	ELY WEA	THERE	D R(	ЭСК	2	16	HB	>50									
	$\bigtriangleup$					うじ			ROCK LI	EVEL														>50	
-			ws			<u>``</u> ,	ENIE			HOLE	-	<u> </u>													
3.00					2.60		END	OF TH	IE BORE	HOLE A	T 2.0	60m													
-									DEPT	Η										-					
																			-	-					
-																									
4.00																			-						
4.00																				-					
																			_						
-																		_	_						
																			_						
5.00																			_						
																			_						
_																			_						
6.00																			_						
																			_						
L																			_						
7.00																									
L																									
8.00																									
Í																									
L																									
9.00																									
Г																									
L																									
Г																									
10.00																									
SPT	W/1	a 6.11	0.2	anatro:-	has not 1	an cal-i	ved	D D:	Sample Key / T	'est Key	N N	atural M-:	ure C-	tart	C C	eolid-	on			Rema	arks	Log	ged By	_	
Srl	w ner	e iuil numb	er of b	lows for th	nas not be	enetratio	n	SS -SPT	Sample		IN - IN L - A	aturai Moisi Atterberg Lin	ure Cor nit Test	nent	UCT-U	nconfin	on ed Compr	ession		E.	tine		Di	muthu	
	is g	given (	not N-	value)	r			W - Wat	er Sample		G - G	rain Size Ar	alysis		CU - C	onsolida	ited Undra	ined	σ	EXIS TOUN	ung Heve	1 Sup	ervised	By:	
GWL	: Gr	ound V	Vater I	evel obser	ved inside	the		WS-Wgr	ey Sample		SG -SJ	pecific Grav	ity Test		UU-Un	consolic	lated Und	rained	5	consid	dered		T	dur:1	
NE	Bo Not I	enole. Encou	arter f ntered	ne saturat	ion			CS- Core	Sample		в - Ві V - V	ик Density ane Shear T	est		pri - Ch O - Org	anic co	ntent			as the	zero	Dril	In led By:	dunii	
нв	-Ha	mmer	Bound	e				Cr - Core	Recovery (%)		1				SO4 <sup>2-</sup> -	Sulphat	e Content			lev	rel	F			
FD	- Fr	ee Do	vn		X *	. ev:		RQD-Ro	ck Quality Desi	gnation (%)		A	_		Cl - Cl	oride Co	ontent					╞	Sum	athipal	a
$\propto$	j Ma	de G	roun	d	<u>x×*×x</u>	Silt		ଌୖୖୢୖୖ୶	Gravel			Laterit	e Nod	ules	<u> </u>	1	Comple	tely W	Veathe	red R	ock		$\boldsymbol{\boldsymbol{\boxtimes}}$		
	Cla	ıy				Sand	1	1.11	Organic M	atter	× . ×	Silty S	and		Š	- Hig	ghly We	eather	ed Roc	ck		1	Fresh	1 Roc	k
Annexure II: Field Photographs

Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)







Annexure III: Borehole Locations

Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Engineering & Laboratory Services (Pvt) Ltd.

Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Client: Tokyo Electric Power Services Co. Ltd. (TEPSCO)



Engineering & Laboratory Services (Pvt) Ltd.

Loss Reduction Calculation of the 400kV Sampoor - New Habarana T/L

Year         Generation at P         Operato (T, T)         Land ff         Energy iv s, S, T, T, Li         Sending (S, S, T, T, Li         Load (of S, H) T, T, Li         Load (of S, H) S, S, T, T, T, Li         Sending (S, S, T, T, T, Li         Load (of S, H) S, S, T, T, T, Li         Load (of S, H) S, S, T, T, T, Li         Sending (S, S, T, T, T, Li         Load (of S, H) S, S, T, T, T, Li         Sending (S, S, T, T, T, Li         Load (of S, H) S, S, T, T, T, Li         Sending (S, S, T, T, S, S, T, T, S, S, T, T, Li         Load (of S, H) S, S, T, T, Li         Load (of S, H) S, S, T, T, Li         Sending (S, S, T, T, S, S, T, T, S, S, T, T, Li         Load (of S, H) S, S, T, T, Li         Load (of S, H) S, S, T, T, Li         Sending (S, S, T, T, S, S, T, T, S, S, T, T, Li         Load (of S, H) S, S, T, T, S, S, T, T, Li         Annual (S, S, T, T, S, S, S, T, T, S, S, T, T, S, S, T, T, S, S, T, T, S, S, S, T, T, S, S, T, T, S, S, T, T, S, S, T, T, S, S, S, T, T, S, S, T, T, S, S, T, T, S, S, T, T, S, S, T, T	Power factor 0.85 Load factor of 220kV 0.582 Conductor Resistance - ACSR Zebra 0.0814 Ohm/km at 63 - LL-ACSR/AC 550 0.0621 Ohm/km at 61 Bundle 4 bundle Length of S-H T/L 91.2 km							Construction cost of 400kV Sampoor - New Habarana-ACSR Zebra9284 M Rs-LL-ACSR/AW 55010029 M Rs-Cost Difference745 M RsRate0.87 LKRs/yen										
C(SWb)         (LV)         (LWb)         (CWb)         (CWb)         (LWb)         (LWb) <th< td=""><td></td><td>Year</td><td>Generation at Sampoor</td><td>Operatio n Voltage of S-H T/L</td><td>Load of Kapparut lai</td><td>Energy to S-K T/L</td><td>Energy to S-H T/L</td><td>Sending per 1cct of S-H T/L</td><td>Load factor of S-H T/L</td><td>Load Loss Factor of S-H T/L</td><td>Current per conducto r</td><td>Annual losses on Zebra per cct</td><td>Annual losses on LL per cct</td><td>Annual loss reduction per cct</td><td>Annual loss reduction</td><td>Tariff</td><td>Loss reduction benefits equivalen t Sales</td><td>Sum of Annual Benefit Amouints</td></th<>		Year	Generation at Sampoor	Operatio n Voltage of S-H T/L	Load of Kapparut lai	Energy to S-K T/L	Energy to S-H T/L	Sending per 1cct of S-H T/L	Load factor of S-H T/L	Load Loss Factor of S-H T/L	Current per conducto r	Annual losses on Zebra per cct	Annual losses on LL per cct	Annual loss reduction per cct	Annual loss reduction	Tariff	Loss reduction benefits equivalen t Sales	Sum of Annual Benefit Amouints
1         2017         -        -         -			(GWh)	(kV)	(MW)	(GWh)	(GWh)	(MW)			(A)	(MWh/k m)	(MWh/k m)	(MWh/km )	(MWh)	(kWh/Y)	(M JPY)	(M JPY)
2         2018         -        -         -	1	2017																
4         2020         3380         222         852         1444         1943         08594         7722         14997         1445         1112         2448         1582         19917         9917         9917         9917         9917         9917         9917         9917         9917         9917         9917         9923         9233         9343         400         114         5912         2733         9425         9176         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11562         91763         11662         9223         911         10074         11562         9223         911         10074         11562         9223         11693 <t< td=""><td>2</td><td>2018</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	2	2018																
S       2021       3381       220       852       444.9       945.0       977.9       149.97       147.7       113.4       35.3       642.99       15.62       110.44       119.91         7       2023       8055       400       88       448.7       674.3       452.9       0.6397       192.27       22.3       154.4       48.0       875.53       156.2       178.55       534.24         8       2024       9343       400       114       581.2       876.16       708.8       0.7046       0.5380       301.3       416.0       318.9       991.1       18078.4       156.2       222.38       158.138       156.2       222.38       158.318       156.2       222.38       158.318       156.2       222.38       158.318       140.0       318.9       991.1       18078.4       156.2       222.38       158.318       168.376       156.2       222.38       158.318       156.2       156.2       156.2       222.38       159.411       130.209       9343       400       114       581.2       8761.8       708.8       0.7046       0.5380       30.33       418.0       318.9       991.1       16078.4       156.2       222.28       257.332.8       156.2	4	2019	3360	220	85.2	434.4	2925.6	194.3	0.8594	0.7628	149.97	146.8	112.0	34.8	6348.8	15.62	99.17	99.17
6       20:2       6621       40:0       88       44.8       704:3       452.9       702:3       72:02:1       72:03       15:62       17:05       534:44         8       20:25       89:33       40:0       114       58:12       77:16       70:08       0:70:46       0:53:0       20:13       15:62       17:05       534:44         9       20:25       39:33       40:0       114       58:12       77:16       70:08       0:70:46       0:53:0       30:13       41:10       31:8.9       99:11       160:76:4       15:62       22:23:8       169:31:0         112       20:25       39:33       40:0       114       58:12       87:16       70:08       0:70:46       0:53:80       30:13:3       41:60       31:8.9       99:11       160:76:4       15:62       22:23:8       169:31:16         12       20:25       39:35       40:0       114       58:12       87:16:7       70:80:0       0:70:46       0:53:80       30:13:3       41:80       31:89       99:11       160:76:4       15:62       22:22:82       27:32:30:15:62       17:52:31:15:62       17:52:31:15:62       17:52:31:15:62       17:52:31:15:62       17:52:31:15:62       16:52:31:15:52:10:15:51:15:51:15:51:15:51:1	5	2021	3381	220	85.2	434.4	2946.6	194.3	0.8656	0.7725	149.97	148.7	113.4	35.3	6429.9	15.62	100.44	199.61
1         0000         000         00000         0000         0000         00	6	2022	6621	400	88	448.7	6172.3	452.9	0.7779	0.6397	192.27	202.3	154.4	48.0	8750.3	15.62	136.68	336.29
9         2025         9343         400         114         5812         8761.6         7028         0.7046         0.5380         301.33         418.0         315.9         991.1         1078.4         15.62         282.38         1.031.33           11         2027         9343         400         114         5812         8761.6         708.8         0.7046         0.5380         301.33         418.0         315.9         991.1         1078.4         15.62         282.33         168.3           12         2028         9343         400         114         5812         8761.5         708.8         0.7046         0.5380         301.33         418.0         315.9         991.1         16078.4         15.62         282.38         2.2510.20           12         3013         944.4         400         114         581.2         6716.8         0.7046         0.5380         301.33         416.0         316.9         991         18078.4         15.62         282.38         3.035.6           12         2031         9344         400         114         581.2         6716.8         0.7046         0.5380         301.33         416.0         316.8         991         18078.4         15.6	8	2023	9343	400	114	581.2	8761.8	709.8	0.3384	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	816.62
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	9	2025	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	1,099.00
11       1202       3943       400       114       5012       7003       7003       7003       7003       7003       7003       7003       7004 <td< td=""><td>10</td><td>2026</td><td>9343</td><td>400</td><td>114</td><td>581.2</td><td>8761.8</td><td>709.8</td><td>0.7046</td><td>0.5380</td><td>301.33</td><td>418.0</td><td>318.9</td><td>99.1</td><td>18078.4</td><td>15.62</td><td>282.38</td><td>1,381.38</td></td<>	10	2026	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	1,381.38
13       2029       3343       400       114       591.8       709.8       0.7046       0.5380       301.33       416.0       318.9       991.1       1807.84       116.2       222.85.2       220.85.2       273.28       222.85.2       250.10       313.4       416.0       318.9       991.1       1807.84       116.2       222.85.2       250.10       313.4       416.0       318.9       991.1       1807.84       116.2       222.85.2       307.56.0       313.3       418.0       318.9       991.1       1807.84       15.62       222.38.3       307.56.0       307.33       418.0       318.9       991.1       1807.84       15.62       222.38.3       307.56.0       307.44       0.5380.301.33       418.0       318.9       991.1       1807.84       15.62       222.38.3       307.66.0       307.44       0.5380.301.33       418.0       318.9       991.1       1807.84       15.62       223.83       307.66.0       307.44       18.80       918.1807.84       15.62       223.84       420.518       220.218       307.34       418.0       318.9       991.1807.84       15.62       223.84       420.518       220.218       43.43       400.114       146.12       8761.8       7098.0       70.46       5.530	12	2027	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	1,946.14
14       2030       9343       400       114       5512       877.6       709.8       0.7046       0.5380       301.33       416.0       318.9       99.1       1807.84       15.62       222.38       2.510.90         15       2013       9343       400       114       551.2       877.18       709.8       0.7046       0.5380       301.33       416.0       318.9       99.1       1807.84       15.62       222.38       3.384.04         17       2033       9343       400       114       551.2       877.18       709.8       0.7046       0.5380       301.33       416.0       318.9       99.1       1807.84       15.62       222.38       3.382.44         19       2035       9343       400       114       561.2       876.18       709.8       0.7046       0.5380       301.33       416.0       318.9       99.1       1807.84       15.62       222.38       4.205.18         21       2035       9343       400       114       561.2       876.18       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       1807.84       15.62       223.84       4.497.66       22.201.8       8343       400 <td>13</td> <td>2029</td> <td>9343</td> <td>400</td> <td>114</td> <td>581.2</td> <td>8761.8</td> <td>709.8</td> <td>0.7046</td> <td>0.5380</td> <td>301.33</td> <td>418.0</td> <td>318.9</td> <td>99.1</td> <td>18078.4</td> <td>15.62</td> <td>282.38</td> <td>2,228.52</td>	13	2029	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	2,228.52
15       2031       3943       400       114       5612       27618       7098       0.7046       0.5380       301.33       418.0       316.9       991.1       1807.4       1562       222.38       3.075.66         112       2033       9343       400       114       561.2       8761.8       7098       0.7046       0.5380       301.33       418.0       316.9       991.1       18078.4       1562       222.38       3.386.04         18       2043       400       114       561.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       316.9       991.1       18078.4       1562       222.38       3.922.40         12       2037       9343       400       114       561.2       6761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       991.1       18078.4       1562       222.38       4.467.56         21       2037       9343       400       114       561.2       6761.8       7098.0       0.7046       0.5380       301.33       418.0       318.9       991.1       18078.4       1562       222.38       4.662.4       22.38       5.662.42       22.38       5.662.4	14	2030	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	2,510.90
117       2033       8345       400       114       5812       87618       709.8       0.7046       0.5380       301.35       418.0       318.5       99.1       10078.4       15.62       282.28       3.355.04         18       2034       9343       400       114       5612       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.5       99.1       18078.4       15.62       282.28       3.355.04         19       2035       9343       400       114       5612       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.2.38       4.4205.16         12       2037       9343       400       114       5812       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.23       5.637.00         22       2040       9343       400       114       5812       87618       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.23       5.637.00       12.2.2.2.2.2.2.2.2.2.35       5.479.8	15	2031	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0 418.0	318.9	99.1	18078.4	15.62	282.38	2,793.28
18       2034       9043       400       114       5812       87618       7098       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.83       3.640.42         20       2036       9345       400       114       5812       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.83       8.4205.18         21       2037       9343       400       114       5812       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.83       4.429.56         21       2039       9343       400       114       5812       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       5.617.03         22       2044       9343       400       114       5812       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       5.819.40       22.23       5.819.40       114	17	2032	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	3,358.04
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	18	2034	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	3,640.42
22       2030       3933       400       114       5612       07046       0.7368       0.7046       0.5380       301.33       418.0       318.9       991       18078.4       15.62       282.38       4.4407.56         22       2033       9343       400       114       581.2       8761.8       708.8       0.7046       0.5380       301.33       418.0       318.9       991       18078.4       15.62       282.38       4.769.94         23       2039       9343       400       114       581.2       8761.8       708.8       0.7046       0.5380       301.33       418.0       318.9       991.1       18078.4       15.62       282.38       5.052.32         24       2040       9343       400       114       581.2       8761.8       708.8       0.7046       0.5380       301.33       418.0       318.9       991.1       18078.4       15.62       282.38       5.617.08         22       2043       9343       400       114       581.2       8761.8       708.8       0.7046       0.5380       301.33       418.0       318.9       991.1       18078.4       15.62       282.38       6.464.22         2044       9343	19	2035	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	3,922.80
22         2038         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         4,769.94           22         2040         9343         400         114         561.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         5,602.32           24         2040         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         5,899.46           2         2043         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         6,464.22           29         2044         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9 <t< td=""><td>20</td><td>2030</td><td>9343</td><td>400</td><td>114</td><td>581.2</td><td>8761.8</td><td>709.8</td><td>0.7046</td><td>0.5380</td><td>301.33</td><td>418.0</td><td>318.9</td><td>99.1</td><td>18078.4</td><td>15.62</td><td>282.38</td><td>4,205.18</td></t<>	20	2030	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	4,205.18
23         2039         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         5.052.32           24         2040         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         5.617.08           25         2041         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         6.819.44           2044         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         6.474.20           2044         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4	22	2038	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	4,769.94
24       9443       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       222.38       5.517.08         26       2042       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       5.838.7.0         2043       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       6.746.0         29       2044       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       6.746.00         30       2046       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.781.42         31       2044       9343       400	23	2039	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	5,052.32
26         2042         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         5.899.46           27         2043         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         6.181.84           28         2044         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         6.464.22           2045         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         7.7311.36           31         2047         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1	24	2040	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	5,334.70
27       2043       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       6.161.84         28       2044       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       6.646.22         30       2046       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.028.98         31       2047       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.976.12         32       2049       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8.165.50         32       0051	26	2042	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	5,899.46
28       2044       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       1562       282.38       6.746.60         29       2045       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       1562       282.38       6.746.60         31       2047       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       1562       282.38       7,931.136         32       2049       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       1562       282.38       7,876.12         34       2050       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       1562       282.38       8.440.88       36       2052       9343	27	2043	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	6,181.84
20       2045       3043       400       114       5012       20103       61050       30133       418.0       318.3       92.1       18078.4       15.62       222.38       7.028.98         31       2047       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.028.98         32       2048       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.593.74         33       2049       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7.876.12         34       2050       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,723.26         37       2053       9343       400	28	2044	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	6,464.22
31       2047       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7,311.36         32       2048       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7,593.74         33       2049       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7,593.74         34       2050       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,723.26         35       2051       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,723.26         37       2055	30	2045	9343	400	114	581.2	8761.8	709.8	0.7040	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	7,028.98
32       2048       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7,876.12         33       2049       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       7,876.12         34       2050       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,158.50         35       2051       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,723.26         36       2052       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9,025.64         39       2055	31	2047	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	7,311.36
33       2049       3943       400       114       381.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,158.50         34       2050       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,158.50         35       2051       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       8,723.26         37       2053       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9,0265.64         38       2054       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9,570.40         40       2056	32	2048	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	7,593.74
35         2051         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         8.440.88           36         2052         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         8.723.26           37         2053         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.0265.64           38         2055         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.0265           3943         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4	34	2049	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	8.158.50
36         2052         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         8,723.26           37         2053         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.0265.4           39         2055         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.0265.6           39         2055         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.052.78           41         2057         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         <	35	2051	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	8,440.88
37       2055       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9.0265.64         38       2055       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9.028.02         39       2055       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9.055.78         40       2056       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       9.052.78         41       2057       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.0417.54         43       2059	36	2052	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	8,723.26
39         2055         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.570.40           40         2056         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.557.40           41         2057         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.417.54           42         2058         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.417.54           43         2059         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9	38	2053	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	9,005.64
40         2056         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         9.852.78           41         2057         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.135.16           42         2058         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.417.54           43         2059         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.982.30           44         2060         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9	39	2055	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	9,570.40
41       2057       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.135.16         42       2058       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.147.54         43       2059       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.417.54         44       2060       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.982.30         45       2061       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11.547.66         47       2063 <td>40</td> <td>2056</td> <td>9343</td> <td>400</td> <td>114</td> <td>581.2</td> <td>8761.8</td> <td>709.8</td> <td>0.7046</td> <td>0.5380</td> <td>301.33</td> <td>418.0</td> <td>318.9</td> <td>99.1</td> <td>18078.4</td> <td>15.62</td> <td>282.38</td> <td>9,852.78</td>	40	2056	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	9,852.78
43       2059       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.689.92         44       2060       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.689.92         44       2060       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       10.982.30         45       2061       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11.547.66         47       2063       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11.547.06         47       2063 <td>41</td> <td>2057</td> <td>9343</td> <td>400</td> <td>114</td> <td>581.2</td> <td>8/61.8</td> <td>709.8</td> <td>0.7046</td> <td>0.5380</td> <td>301.33</td> <td>418.0</td> <td>318.9</td> <td>99.1</td> <td>18078.4</td> <td>15.62</td> <td>282.38</td> <td>10,135.16</td>	41	2057	9343	400	114	581.2	8/61.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	10,135.16
44         2060         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         10.982.30           45         2061         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         11.984.68           46         2062         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         11.944.68           47         2063         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         11.829.44           48         2064         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9	43	2059	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	10,699.92
45       2061       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11,264.68         46       2062       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11,264.68         47       2063       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11,246.48         47       2063       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       11,224.48         48       2064       9343       400       114       581.2       8761.8       709.8       0.7046       0.5380       301.33       418.0       318.9       99.1       18078.4       15.62       282.38       12,111.82         49       2065 <td>44</td> <td>2060</td> <td>9343</td> <td>400</td> <td>114</td> <td>581.2</td> <td>8761.8</td> <td>709.8</td> <td>0.7046</td> <td>0.5380</td> <td>301.33</td> <td>418.0</td> <td>318.9</td> <td>99.1</td> <td>18078.4</td> <td>15.62</td> <td>282.38</td> <td>10,982.30</td>	44	2060	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	10,982.30
TO         LOC         SOTA         TOO         111         SOTA         TOO         111         SOTA         TOO         111         SOTA         TOO         111         SOTA         TOO         1130         ZZZZZ         TOO         111         SOTA         TOO         111         SOTA         TOO         1130         ZZZZZ         TOO         111         SOTA         TOO         1130         ZZZZZZ         TOO         TOO <thtoo< th=""> <thtoo< th=""> <thtoo< th=""></thtoo<></thtoo<></thtoo<>	45	2061	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	11,264.68
48         2064         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         12,111.82           49         2065         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         12,111.82           49         2065         9343         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         12,394.20           50         2066         9242         400         114         581.2         8761.8         709.8         0.7046         0.5380         301.33         418.0         318.9         99.1         18078.4         15.62         282.38         12,394.20         14.67.6         180.78         15.62         282.38         12,394.20         14.67.6         180.78         15.62         282.38         12,394.20         14.67.75         14.67.75         14.67.75	40	2062	9343	400	114	581.2	8761.8	709.8	0.7040	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	11,829.44
49 2065 9343 400 114 581.2 8761.8 709.8 0.7046 0.5380 301.33 418.0 318.9 99.1 18078.4 15.62 282.38 12,394.20	48	2064	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	12,111.82
	49	2065	9343	400	114	581.2	8761.8	709.8	0.7046	0.5380	301.33	418.0	318.9	99.1	18078.4	15.62	282.38	12,394.20

Loss Reduction Calculation of the 220kV Sampoor - Kappalturai  $T\!/\!L$ 

	Power fact Load facto	tor or of 220kV Resistance	/	0.85 0.582				Conductor	cost - ACSR Z	ebra R/AC 550	770 1 079	JPY/m .IPY/m	670 LKRs/m 939 LKRs/m		
	Conductor	- ACSR Z	ebra R/AC 550	0.0814	Ohm/km a	at 63 deg.		Cost Diffe	rence per k	cm	3,708,000	JPY/km	3,225,960	LKRs/km	
	Bundle	- LL-ACS	N/AC 550	0.0021	bundle	at of deg.		Rate			0.87				
	Length of	S-H T/L		45	km										
			Operation	Sanding	Load	Current	Annual	Annual	Annual				Loss	Sum of	
	37	Generatio	Voltage	per 1cct	Loss	per	losses on	losses on	Loss	Annual	Annual	T. :00	benefits	Annual	
	Y ear	n at Sampoor	of S-H	of S-K	Factor of	conducto	Zebra per	LL per	reduction	Loss	Loss reduction	Tariff	equivalent	Benefit	
		Sumpoor	T/L	T/L	S-K T/L	r	cct	cct	per cct	reaction	reauenon		Sales	Amouints	
		(GWh)	(kV)	(MW)		(A)	(MWh/k m)	(MWh/k m)	(MWh/k m)	(MWh/k m)	(MWh)	(kWh/Y)	(JPY/km)	(JPY/km)	
1	2017						)	)	)						
2	2018														
3	2019	3360	220	39.3	0.3874	60.67	6.1	4.7	1.4	2.9	130.2	15.62	45.184	45.184	
5	2021	3381	220	39.3	0.3874	60.67	6.1	4.7	1.4	2.9	130.2	15.62	45,184	90,368	
6	2022	6621	220	44.1	0.3874	68.08	7.7	5.9	1.8	3.6	163.9	15.62	56,895	147,263	
7	2023	8053	220	44.1	0.3874	68.08 88.15	7.7	5.9	1.8	3.6	163.9	15.62	56,895 95 382	204,158	
9	2024	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	394,922	
10	2026	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	490,304	
11	2027	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	585,686	
12	2028	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	681,068 776 450	
13	2029	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	871,832	
15	2031	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	967,214	
16	2032	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,062,596	
17	2033	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,157,978	
19	2035	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,348,742	
20	2036	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,444,124	
21	2037	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,539,506	
22	2030	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,730,270	
24	2040	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,825,652	
25	2041	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	1,921,034	
20	2042	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,010,410	
28	2044	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,207,180	
29	2045	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,302,562	
30	2046	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382 95,382	2,397,944	
32	2048	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,588,708	
33	2049	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,684,090	
34	2050	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,779,472	
36	2051	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	2,970,236	
37	2053	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,065,618	
38	2054	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,161,000	
39 40	2055	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,256,382	
41	2057	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,447,146	
42	2058	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,542,528	
43	2059	9343	220	57.1	0.3874	88.15	12.9	9.8 a o	3.1	6.1	274.8	15.62	95,382	3,637,910	
45	2000	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,828,674	
46	2062	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	3,924,056	
47	2063	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	4,019,438	
48	2064	9343	220	57.1	0.3874	88 15	12.9	9.8 9.8	3.1	6.1	274.8	15.62	95,382	4,114,820	
50	2066	9343	220	57.1	0.3874	88.15	12.9	9.8	3.1	6.1	274.8	15.62	95,382	4,305,584	





Annex 5.3-1



Annex 5.3-2



## Annex 5.3-3

SL-SP SS-SD-002 :Station Service Circuit Diagram for the Sampoor 220 kV Switching Station

3. ON RESTORATION OF MAIN SUPPLY 3.1 CIRCUIT BREAKER G1 SHALL BE OPENED WITH A TIME DELAY. 3.2 CIRCUIT BREAKER T1 OR T2, & S1 SHALL BE CLOSED 4. AUTO CHANGE OVER FACILITY SHALL BE PROVIDED WITH GENERATOR SUPPLY & 33 kV LINE SUPPLIES.

2. LOSS OF SUPPLY FROM 33 kV LINE SHALL AUTOMATICALLY INITIATE THE FOLLOWING OPERATIONS: 2.1 AFTER A SHORT TIME DELAY, THE DIESEL GENERATOR SHALL START. 2.2 CIRCUIT BREAKER G1 SHALL CLOSE AFTER THE GENERATOR VOLTAGE IS REACHED. CIRCUIT BREAKER T1, T2 AND S1 WILL BE OPENED SIMULTANEOUSLY DEFORE CLO GOED.

5. INTERLOCKING REQUIREMENTS. ONLY ONE OF THE BREAKERS G1, T1 AND T2 CAN BE IN CLOSED POSITION AT A TIME FOR ALL OPERATING CONDITIONS.

Note NOLE. THE MAIN SUPPLY IS TO BE AUTOMATICALLY SELECTED & INTERLOCKED TO PREVENT PARALLELING OF THE TWP SUPPLY & TP TO ALWAYS SUPPLY TJE ESSENTIAL SERVICES 1. UNDER NORMAL OPERATING CONDITIONS: 1.1 CIRCUIT BREAKER 11 OR 12 WILL BE CLOSED. 1.2 CIRCUIT BREAKER G2 WILL BE OPENED.

BEFORE G1 CLOSED.



SL-SP SS-SD-003 :Supervisory Control System for the Sampoor 220 kV Switching Station

Annex 5.3-4







SECTION X-X

SL-SP SS-LY-002 : Control Building Layout for the Sampoor 220 kV SS



SECTION Y-Y SCALE B

Annex 5.3–5



Phase 1:

# Layout for the Sampoor 220 kV Switching Station Annex 5.4-1



Annex 5.4-2





Annex 5.4-4





Phase 1 : Layout for the New Habara

Layout for the New Habarana 220 KV Grid Substation Annex 5.4-6



Phase 2 : Preceding Constructi

Preceding Construction for the 400 kV Grid Substation Annex 5.4-7



400 KV and 220kV OVERHEAD T/L

Layout for the 400 kV Grid Substation (1 cct)

Layout for the New Habarana 220 KV Grid Substation (1 cct) Annex 5.4-8



400 KV OVERHEAD T/L (2 CCT)

Layout for the New Habarana 400 KV Grid Substation (2 cct) Annex 5.4-9

Phase 4 : Lavout for the New Habara



**Final Phase** 

Layout for the New Habarana 400 KV Grid Substation (2 cct) Annex 5.4-10

## Terms of Reference for Supervision Consultant for the works under National Transmission and Distribution Network Development and Efficiency Improvement Project (II)

## in Democratic Socialist Republic of Sri Lanka (Draft)

#### Chapter 1. Background

- (1) Sri Lanka has 2,970 MW electric power supply capability (2012) and 2,146 MW electricity peak demand (2012), and its power system is stable comparing with other South Asian countries However, the economy has had the annual average growth rate of 7%, and the economic growth has caused electricity demand increase at the annual average rate of 5-6% Therefore, Government of Sri Lanka promotes the construction of in recent years. large-scale coal-fired power plants based on the long term generation expansion plan in order to meet the rapid expansion of electricity demand and decrease the generation cost. On the other hand, transmission and distribution system loss rate is improved year by year (12.0% as of 2012). However, it is necessary to reduce the transmission and distribution system loss rate more and more by the introduction of high voltage transmission system, low-loss conductor, etc. in order to meet the power demand expansion. Ministry of Power and Energy (MOPE) published the electrical policy for steady power supply and energy efficiency as one of the important policies in national energy policy (2006), and considered to introduce high voltage transmission systems which had enough transmission capacity in parallel with the construction of the large-scale power station. In addition, introduction of low-loss conductor is promoted from the point of view of transmission loss reduction Component of "National Transmission and Distribution Network simultaneously. Development and Efficiency Improvement Project (II) (hereinafter referred to as 'the Project')" is to construct transmission lines from Sampoor coal-fired power plant (250 MW x 2) to New Habarana Substation (which locates between Sampoor coal-fired power plant and Colombo area) and Kappalturai substation in order to evacuate the electric power from Sampoor coal-fired power plant constructed by Trincomalee Power Company Limited (TPCL: special-purpose company by the co-funding of National Thermal Power Corporation (NTPC) in India and Ceylon Electricity Board (CEB)). In addition, related switching station/ substation are also included in the Project for the stable power supply. Another purpose of the Project is energy efficiency by the introduction of extra high voltage (400 kV) transmission facilities for the first time and low-loss conductor.
- (2) Based on the above background, the Government of Sri Lank requested to receive a loan from the Japan International Cooperation Agency (hereinafter referred to as "JICA") to

finance the National Transmission and Distribution Network Development and Efficiency Improvement Project (II) which is to enhance transmission network system in Sri Lanka.

- (3) The Project consists of the following components:
  - a) Construction of 400 kV designed Sampoor New Habarana TL (220 kV operation)
  - b) Construction of 220 kV Sampoor Kappalturai TL
  - c) Construction of 220 kV GIS at Sampoor SS
- (4) The Government of Sri Lanka intends to use part of the proceeds of the loan for eligible payments for consulting services for which this ToR is issued.
- (5) The Project is expected to be completed by the end of 2018.
- (6) Location of the Project: See (3) of this Chapter
- (7) Executing Agency: CEB (Ceylon Electricity Board)

## Chapter 2. Objectives of Consulting Services

The consulting services shall be provided by an international consulting firm (or any other relevant entity) (hereinafter referred to as "the Consultant") selected in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012.

The services to be rendered by the Consultant will cover construction supervision partially. Expected consulting services period is approximately 14 months.

## Chapter 3. Scope of Consulting Services

## 3.1 Project Implementation Stage

The Consultant shall perform his duties during the construction period in accordance with the contracts to be executed between the Employer and the Contractors. FIDIC Plant and Design Build First Edition (1999) will be applied to the works of the Project.

The Consultant is requested to be (behave) "advisor".

In addition to roles of "Engineer" above, the Consultant shall also carry out the followings:

- To assist in review of the detailed design documents of 400 kV transmission line and 220 kV GIS prepared by the Contractors
- To assist in carrying out construction supervision of 400 kV transmission line and 220 kV GIS in view of quality control and scheduling control
- To assist in inspection of manufacturing and fabrications of 400 kV transmission line and 220 kV GIS at the site
- To assist in review and approval for testing procedure prepared by Contractors.
- To witness the testing and commissioning at site as well as factory acceptance tests.
- To check the as-built drawings and operation & maintenance manuals prepared by the Contractors.

### 3.2 Co-ordination

The Consultant will assist CEB to maintain proper co-ordination and communication between CEB/JICA and CEB/Contractors.

#### Chapter 4. Expected Time Schedule

The total duration of consulting services will be 24 months. The implementation schedule expected is as shown in Table 1.

Key activities	Data (FY)	Expected		
		Duration in		
		Months		
Commencement of construction	January 2017	24		
End of construction	December 2018			
Termination of Consulting Services	December 2018	24		

Table 1: Implementation Schedule Tentative

## Chapter 5. Staffing

Refer to the page \*\*.

2 of Professional (A) consultants will be engaged, over 24 month's duration of consulting services, for a total of 40.0 man-months for Professional (A).

A detailed schedule of consulting services of person-months is shown in Attachment xx.

The qualification of key Team Members is shown in Table 2.

Designation	Qualification
International Consultants (Pro-A)	
Transmission Line Engineer	Education:
	• Graduate in Electrical Engineering
	Experience:
	• In the power transmission system related field:
	15 years or more
	• In design and/or construction supervision for
	transmission line projects: 10 years or more
	• In design and/or supervision of installation
	works for transmission line projects: 2 projects
	or more
Substation Engineer	Education:
	• Graduate in Electrical Engineering
	Experience:
	• In the power transmission system related field:
	15 years or more
	• In design and/or construction supervision for
	substation (including GIS) projects: 10 years or
	more
	• In design and/or supervision of installation
	works for substation projects: 2 projects or more

Table 2: Qualification of Key Team Members

### Chapter 6. Meager Tasks and Duties of Team members

#### 6.1 Transmission Line Engineer

- Assist in review of the detailed design documents of 400 kV transmission line prepared by the Contractors.
- Assist in carrying out construction supervision of 400 kV transmission line in view of quality control and scheduling control.
- Assist in inspection of manufacturing and fabrications of 400 kV transmission line at the site.
- Assist in review and approval for testing procedure prepared by Contractors.
- Witness the testing and commissioning at site as well as factory acceptance tests.
- Check the as-built drawings and operation & maintenance manuals prepared by the Contractors.

### 6.2 Substation Engineer

- Assist in review of the detailed design documents of 220 kV GIS prepared by the Contractors
- Assist in carrying out construction supervision of 220 kV GIS in view of quality control and scheduling control
- Assist in inspection of manufacturing and fabrications of GIS at the site
- Assist in review and approval for testing procedure prepared by Contractors.
- Witness the testing and commissioning at site as well as factory acceptance tests.
- Check the as-built drawings and operation & maintenance manuals prepared by the Contractors.

## Chapter 7. Reports to be prepared by the Consultant

The Consultant shall prepare and submit to the Owner for the following reports:

■ Site Work Report

## Chapter 8. Obligation of the Executing Agency

The followings are assumed to be provided from the Executing Agency for the consulting services:

- To provide to the Consultants in an expeditious manner access to and copies of studies, plans, specifications, maps, drawings, criteria, and other information related to the Project, if available to CEB and necessary for the Consultants to perform the Services, at no expense to the Consultants.
- To assist the Consultants in obtaining customs clearance for materials or equipment brought into Sri Lanka for performance of the Services by the Consultants. CEB and/or

government of Sri Lanka shall directly pay the customs duties associated with materials or equipment reimbursable hereunder brought for the jobsite office only, which at completion of the Project will be delivered to CEB as CEB's property.

- To assist the Consultants, if required, in obtaining clearances, visas, and extensions; resident work permits; and any other documents relating to Expatriates of the Consultant, their accompanying dependents, and their personal effects assigned to perform the Services and shall use its best efforts to assist the Consultant, its Sub-consultants, and employees to obtain the benefit of all privileges, exemptions, and other favorable treatment, which are or may become lawfully available under any decisions, laws, regulations, or rules of Sri Lanka.
- To provide overall management, direction, and control of the Project. In addition, CEB intends to provide a dedicated CEB's team for the Project to coordinate with the Consultants' project team.
- To facilitate and expedite the Services, CEB shall approve or object to the Consultants' replies and/or recommendations within two weeks after receipt of such replies/recommendations made during the Project's implementation period and in accordance with the Project's milestone schedule. For the purposes of assuring continuity in the performance of the Consultants' Services, in the event approval or objection is not made within such two weeks period, the replies/recommendations shall be deemed approved unless otherwise agreed for a longer period.

#### Manning Schedule for the Consulting Services

	Position	Billin	g Rate	2015			1		20	16			2017					2018							
		F/C JPY	LC/ LKR	1 2 3	4 5 6	7 8 9	9 10 11 12	1 2	3 4	56	7 8 9	0 10 11	12 1	2 3	4 5	6 7 8	3 9 1	0 11 12	1 2	3 4	5 6	7 8	9 10	11 12	Total
	Engineering and Consulting Services																								
	International Consultants	C	0 0																						0
А	1 Transmission Line Engineer	2,895,000	0 0			ΙΙΙ				Ι			1	1 1	1 1	1	1 1	1 1	1	1 1	1	1 1	1 1	1 1	20
A	2 Substation Engineer	2,895,000	0 0											1 1	1 1	1 1	1 1	1	1 1	1 1	1	1 1	1 1	1 1	20
		C	0 0			II.I.																			0
		C	0 0																						0
	Local Consultants	C	0 0																						0
		C	0 0																						0
		C	0 0																						0
		C	0 0																						0
		C	0 0																						0
	[Total of Pro-A]				0				0					19				21				40			
	[Total of Pro-B]			0				0				0				0				0					
	[Total of Pro-A+Pro-B]				0		0				19				21				40						
	Total Cost of FC for Each Month(Pro-A)				0			0				55,005,000				60,795,000				115,800,000					
	Total Cost of FC for Each Month(Pro-B)				0	)			0				0				0				0				
	Total Cost of LC for Each Month(Pro-A)				0	)			0				0				0				0				
	Total Cost of LC for Each Month(Pro-B)				C	)		0					0					0				0			
		C	0 0					<b>.</b>																	0
С	1 Secretary	0	118,000										1	1 1	1 1	1 1	1 1	1 1 1	1 1	1 1	1  1	1 1	1 1	1  1	24
		C	0 0																<b>.</b>						0
		<u> </u>	0																		ļ			ļ	0
		0	0					<b>.</b>											<b>.</b>						0
		C	0					<b>.</b>																	0
		0	0																						0
		,, Ç	0 0					<b>.</b>											<b>.</b>						0
·····		<u> </u>	0 0					<b> </b>											<b>.</b>						0
		L	0													40									0
	Tetal Cast of L C for Each Marth (CC)					<u>,</u>	_			0		_	_	12				12				24			
	Ore ad Tatal					0									1,4	10,000			1,416,000				2,832,000		
	Grand Lotal	1		0											31					- 3	3			64	

Annex 10.2-1 Assumed Constructio	n Cost of Transmission Lines
----------------------------------	------------------------------

1. Assumed Construction Cost of 400 kV Sampoor - New Habarana Transmission Line

Rate= 130.2 LKR / USD

Item	Specification					Samp	oor - New Habaran	a		
		Linit M/HT	No. of	Tot M/Ht	FC [LKR]	LC [LKR]	Total [LKD]	FC [USD]	LC [USD]	Total [USD]
		Offic vvilij	Tower	TOL WILL	230,040 LKR/t	0 LKR/t	TOTAL			Total [03D]
Towers										
Suspension Tower (TDL)	Body extension +0m	49.1	22	1.080.2	248.489.208	0	248,489,208	1.908.519	0	1.908.519
Suspension Tower (TDL)	Body extension +3m	55.4	142	7,000.2	1 922 422 999	0	1 922 422 999	12 007 104	0	12 007 104
Suspension Tower (TDL)	Body extension +5m	04.4	145	7,322.2	65 147 229	0	65 147 229	500 264	0	13,337,104
Suspension Tower (TDL)	Body extension +6m	94.4	3	203.2	65,147,328	0	05,147,320	500,364	0	500,364
Suspension Tower (TDL)	Body extension +9m	61.8	1	61.8	14,216,472	0	14,216,472	109,190	0	109,190
Tension Tower 0-10 (TD1)	Body extension +0m	45.5	6	273.2	62,851,989	0	62,851,989	482,734	0	482,734
Tension Tower 0-10 (TD1)	Body extension +3m	47.6	2	95.2	21,888,767	0	21,888,767	168,117	0	168,117
Tension Tower 0-10 (TD1)	Body extension +6m	54.3	2	108.6	24,990,166	0	24,990,166	191,937	0	191,937
Tension Tower 0-10 (TD1)	Body extension +9m	60.1	0	0.0	0	0	0	0	0	0
Tension Tower 10-30 (TD3)	Body extension +0m	56.2	17	954.7	219,619,879	0	219,619,879	1,686,789	0	1,686,789
Tension Tower 10-30 (TD3)	Body extension +3m	58.8	3	176.5	40.612.872	0	40.612.872	311.927	0	311.927
Tension Tower 10-30 (TD3)	Body extension +6m	64.8	2	129.5	29.794.321	0	29,794,321	228.835	0	228.835
Tension Tower 10-30 (TD3)	Body extension +9m	72.2	0	0.0	0	0	0	0	0	0
Tension Tower 30-60 (TD6)	Body extension ±0m	67.7	10	677.3	155 812 994	0	155 812 004	1 196 720	0	1 196 720
Tension Tower 30 60 (TD6)	Body extension 12m	71.0	10	254.0	91 626 506	0	91 626 506	627,000	0	607,000
Tension Tower 30-60 (TD8)	Body extension +3m	71.0	5	354.9	81,030,390	0	81,030,390	627,009	0	627,009
Tension Tower 30-60 (TD6)	Body extension +6m	11.1	2	155.4	30,738,000	0	30,738,000	274,490	0	274,490
Tension Tower 30-60 (TD6)	Body extension +9m	85.6	0	0.0	0	0	0	0	0	0
Terminal Tower (TDT)	Body extension +0m	151.9	1	151.9	34,935,485	0	34,935,485	268,322	0	268,322
Terminal Tower (TDT)	Body extension +3m	167.3	5	836.4	192,406,607	0	192,406,607	1,477,777	0	1,477,777
Terminal Tower (TDT)	Body extension +6m	184.3	0	0.0	0	0	0	0	0	0
Terminal Tower (TDT)	Body extension +9m	194.4	0	0.0	0	0	0	0	0	0
Total Towe	er		224	13,261.0	3,050,564,127	0	3,050,564,127	23,429,832	0	23,429,832
		[Unit]	Qty	Unit Price	FC [LKR]	LC [LKR]	Total [LKR]	FC [USD]	LC [USD]	Total [USD]
Conductors			í							
LL-ACSR eq Zebra		[km]	0.0	1 079 000	0	0	0	0	0	0
Zebro/A R		[km]	2 400 0	770,000	1 695 376 000	0	1 695 376 000	12.044.516	0	12 044 516
Zebia/AS		ĮKIIJ	2,100.0	770,000	1,005,376,000	0	1,665,376,000	12,944,516	0	12,944,516
Total Conduct	0F		2,188.8		1,685,376,000	0	1,685,376,000	12,944,516	0	12,944,516
Earth Wires										
AS 110		[km]	91.2	243,000	22,161,600	0	22,161,600	170,212	0	170,212
OPGW 120		[km]	91.2	611,000	55,698,760	0	55,698,760	427,794	0	427,794
Total Earth wit	re		182.4		77,860,360	0	77,860,360	598,006	0	598,006
Insulators										
U160 BS	Suspension tower	[Nos.]	38,976	4,900	190,982,400	0	190,982,400	1,466,839	0	1,466,839
U160 BS	Tension tower	[Nos.]	54,432	4,900	266,716,800	0	266,716,800	2,048,516	0	2,048,516
U160 BLP (Anti-fog)	Suspension tower	[Nos.]	13.356	7.600	101.505.600	0	101.505.600	779.613	0	779.613
LI160 BLP (Anti-fog)	Tension tower	[Nos ]	11 592	7 600	88 099 200	0	88 099 200	676 645	0	676 645
		[Nos ]	1.008	2,400	2 419 200	0	2 419 200	18 581	0	18 581
UZORI R (Anti fog)		[Nos.]	1,000	4,700	1 194 400	0	1 194 400	0.007	0	0,007
UTUBLE (Anti-log)		[NUS.]	202	4,700	1,164,400	0	1,164,400	9,097	0	9,097
i otal insulato	rs		119,616		000,907,000	0	650,907,600	4,999,290	0	4,999,290
Spacer dumpers										
4 bundle spacer	LL-ACSR eq Zebra	[Nos.]	10,944	2,400	26,265,600	0	26,265,600	201,733	0	201,733
4-bundle jumper spacer	LL-ACSR eq Zebra	[Nos.]	330	2,400	792,000	0	792,000	6,083	0	6,083
Total Spacer dumper	rs		11,274		27,057,600	0	27,057,600	207,816	0	207,816
Insulator set										
Normal suspension insulator s	et double-strings	[Sets]	696	140,000	97,440,000	0	97,440,000	748,387	0	748,387
Anti-fog suspension insulator s	setdouble-strings	[Sets]	318	300,000	95,400,000	0	95,400,000	732,719	0	732,719
Normal tension insulator set	guad-strings	[Sets]	486	350.000	170.100.000	0	170,100,000	1.306.452	0	1.306.452
Anti-fog tension insulator set	quad-strings	[Sets]	138	800,000	110,400,000	0	110,400,000	847 926	0	847 926
Jumper euepeneien insulator set	as single string including	[Coto]	100	120,000	110,400,000	0	110,400,000	047,520	0	047,320
Sumper suspension insulation	se single-string including	[Sets]	0	120,000	0	0	0	0	0	0
Anti-rog Jumper suspension in	ist single-string	[Sets]	0	300,000	0	0	0	0	0	0
Inverted type tension insulator	s quad-strings	[Sets]	0	300,000	0	0	0	0	0	0
Inverted type anti-fog tension i	int quad-strings	[Sets]	0	800,000	0	0	0	0	0	0
Light duty tension insulator set	t single-string	[Sets]	36	150,000	5,400,000	0	5,400,000	41,475	0	41,475
Light duty anti-fog tension insu	lator set	[Sets]	12	320,000	3,840,000	0	3,840,000	29,493	0	29,493
Supension sets for earth wire	AS 110	[Sets]	169	5,000	845,000	0	845,000	6,490	0	6,490
Supension sets for earth wire	OPGW 120	[Sets]	169	6,400	1,081,600	0	1,081,600	8,307	0	8,307
Tension sets for earth wire	AS 110	[Sets]	112	4,100	459,200	0	459,200	3,527	0	3.527
Tension sets for earth wire	OPGW 120	[Sets]	112	6 000	672 000	0	672 000	5 161	0	5 161
Proformed amor red	Zohra og	[Sote]	4.056	3 600	14 601 600	0	14 601 600	112 147	0	112 147
	et at	[Jets]	4,000	3,000	500 220 400	0	500 330 400	2 842 005	0	112,147
otal insulator s	CI.				000,239,400	0	000,239,400	3,642,085	0	3,842,085
outer supply			· .	050 500 611	050 500 577		050 500	0 704 677		0.704
Other supply	o% of total cost above		1	359,520,305	359,520,305	0	359,520,305	2,761,293	0	2,761,293
A. Total Supp	ly		1		6,351,525,392	0	6,351,525,392	48,782,837	0	48,782,837

Item	[Unit]	Qty	Unit Price	FC [LKR]	LC [LKR]	Total [LKR]	FC [USD]	LC [USD]	Total [USD]	
Design and Drawings										
Design and liaison of works	[km]	91.2	180,000	0	16,416,000	16,416,000	0	126,083	126,083	
Drawings and Documentation required for works	[km]	91.2	180,000	0	16,416,000	16,416,000	0	126,083	126,083	
B. Total Design and Drawings				0	32,832,000	32,832,000	0	252,166	252,166	
Item	Specification	[Unit]	Qty	Unit Price	FC [LKR]	LC [LKR]	Total [LKR]	FC [USD]	LC [USD]	Total [USD]
---------------------------	------------------------------------	---------	------	-------------	----------	---------------	---------------	----------	------------	-------------
Foundation Work										
TDL Tower foundation	Pad and chimney	[Units]	162	6,471,000	0	1,048,302,000	1,048,302,000	0	8,051,475	8,051,475
TD1 Tower foundation	Pad and chimney	[Units]	10	6,886,000	0	68,860,000	68,860,000	0	528,879	528,879
TD3 Tower foundation	Pad and chimney	[Units]	22	7,566,000	0	166,452,000	166,452,000	0	1,278,433	1,278,433
TD6 Tower foundation	Pad and chimney	[Units]	17	17,853,000	0	303,501,000	303,501,000	0	2,331,037	2,331,037
TDT Tower foundation	Pad and chimney	[Units]	6	31,437,000	0	188,622,000	188,622,000	0	1,448,710	1,448,710
TDL Tower foundation	pile foundation	[Units]	7	12,942,000	0	90,594,000	90,594,000	0	695,806	695,806
TD1 Tower foundation	pile foundation	[Units]	0	13,772,000	0	0	0	0	0	0
TD3 Tower foundation	pile foundation	[Units]	0	15,132,000	0	0	0	0	0	0
TD6 Tower foundation	pile foundation	[Units]	0	35,706,000	0	0	0	0	0	0
TDT Tower foundation	pile foundation	[Units]	0	62,874,000	0	0	0	0	0	0
Total Foundation Work					0	1,866,331,000	1,866,331,000	0	14,334,340	14,334,340
Tower Erection										
Suspension Tower (TDL)	Body extension +0m	[Unit]	22	1,136,000	0	24,992,000	24,992,000	0	191,951	191,951
Suspension Tower (TDL)	Body extension +3m	[Unit]	143	1,281,000	0	183,183,000	183,183,000	0	1,406,935	1,406,935
Suspension Tower (TDL)	Body extension +6m	[Unit]	3	1,429,000	0	4,287,000	4,287,000	0	32,926	32,926
Suspension Tower (TDL)	Body extension +9m	[Unit]	1	2,183,000	0	2,183,000	2,183,000	0	16,767	16,767
Tension Tower 0-10 (TD1)	Body extension +0m	[Unit]	6	1,053,000	0	6,318,000	6,318,000	0	48,525	48,525
Tension Tower 0-10 (TD1)	Body extension +3m	[Unit]	2	1,101,000	0	2,202,000	2,202,000	0	16,912	16,912
Tension Tower 0-10 (TD1)	Body extension +6m	[Unit]	2	1,256,000	0	2,512,000	2,512,000	0	19,293	19,293
Tension Tower 0-10 (TD1)	Body extension +9m	[Unit]	0	1,391,000	0	0	0	0	0	0
Tension Tower 10-30 (TD3)	Body extension +0m	[Unit]	17	1,299,000	0	22,083,000	22,083,000	0	169,608	169,608
Tension Tower 10-30 (TD3)	Body extension +3m	[Unit]	3	1,361,000	0	4,083,000	4,083,000	0	31,359	31,359
Tension Tower 10-30 (TD3)	Body extension +6m	[Unit]	2	1,498,000	0	2,996,000	2,996,000	0	23,011	23,011
Tension Tower 10-30 (TD3)	Body extension +9m	[Unit]	0	1,669,000	0	0	0	0	0	0
Tension Tower 30-60 (TD6)	Body extension +0m	[Unit]	10	1,567,000	0	15,670,000	15,670,000	0	120,353	120,353
Tension Tower 30-60 (TD6)	Body extension +3m	[Unit]	5	1,642,000	0	8,210,000	8,210,000	0	63,057	63,057
Tension Tower 30-60 (TD6)	Body extension +6m	[Unit]	2	1,797,000	0	3,594,000	3,594,000	0	27,604	27,604
Tension Tower 30-60 (TD6)	Body extension +9m	[Unit]	0	1,979,000	0	0	0	0	0	0
Terminal Tower (TDT)	Body extension +0m	[Unit]	1	3,512,000	0	3,512,000	3,512,000	0	26,974	26,974
Terminal Tower (TDT)	Body extension +3m	[Unit]	5	3,868,000	0	19,340,000	19,340,000	0	148,541	148,541
Terminal Tower (TDT)	Body extension +6m	[Unit]	0	4,262,000	0	0	0	0	0	0
Terminal Tower (TDT)	Body extension +9m	[Unit]	0	4,495,000	0	0	0	0	0	0
Total Tower Erection					0	305,165,000	305,165,000	0	2,343,817	2,343,817
Stringing										
Stringing	includes installation of insulator	[km]	91.2	1,530,000	0	139,536,000	139,536,000	0	1,071,705	1,071,705
Total String					0	139,536,000	139,536,000	0	1,071,705	1,071,705
Other work										
Other work	10% of total cost above		1.0	231,103,200	0	231,103,200	231,103,200	0	1,774,986	1,774,986
C. Civil work					0	2,542,135,200	2,542,135,200	0	19,524,848	19,524,848

Item		[Unit]	Qty	Unit Price	FC [LKR]	LC [LKR]	Total [LKR]	FC [USD]	LC [USD]	Total [USD]
Other services										
Other services	4% of total other cost		1.0	357,059,704	0	357,059,704	357,059,704	0	2,742,394	2,742,394
D. Total Other	services				0	357,059,704	357,059,704	0	2,742,394	2,742,394

Cost estimate for 400kV Sanpo	oor - New Habarana Transmissi	on Lin						
	Item	F	C [LKR]	LC [LKR]	Total [LKR]	FC [USD]	LC [USD]	Total [USD]
A. Supply cost		6,3	51,525,392	0	6,351,525,392	48,782,837.30	0.00	48,782,837.30
B. Design and Drawing cost			0	32,832,000	32,832,000	0.00	252,165.90	252,165.90
C. Civil work cost			0	2,542,135,200	2,542,135,200	0.00	19,524,848.03	19,524,848.03
D. Other services cost			0	357,059,704	357,059,704	0.00	2,742,394.04	2,742,394.04
Total		6,3	51,525,392	2,932,026,904	9,283,552,296	48,782,837.30	22,519,407.97	71,302,245.27
Unit Price			69,643,919	32,149,418	101,793,337	LKR/km		781,822.86
								USD/km
				Rate	0.823	Yen/LKR		
	Item	F	C [Yen]	LC [Yen]	Total [Yen]			
Total in Yen		5,2	27,305,398	2,413,058,142	7,640,363,540			
Unit Price			57,316,945	26,458,971	83,775,917	Yen/km		
Length of Transmission Line		91.2 km						
Nos. of Tower	Suspension tower	169 towe	rs					
	Tension tower	49 towe	rs					
	Terminal Tower	6 towe	rs					
	Substation gantry	2 ganti	ys	Sampoor S/S, N	lew Habarana G/S			
Anti-fog insulator using Towe	Suspension tower	53 towe	rs	Anti-fog insulato	r will use the tower	that are within 10	0km from coast lin	
	Tension tower	11 towe	rs	(No.160 to No.2	24 Towers will use	anti-fog insulator		
	Terminal Tower	1 towe	rs					
	Substation gantry	1 ganti	v					
	· · ·	5						

2. Assumed Construction Cost of 220 kV Sampoor - Kappalutrai Transmission Line Escaretion rate Foreign = 0.02 Local = 0.038

	Foreign =	Foreign = 0.02 Local = 0.038				Rate:	0.823 Yen/LKR		
ſ	Voor	Longth (km)	Uni	it cost	Total	cost	Unit cost	Total cost	
	Teal	Lengin (kin	FC (MLKRs) LC (MLKRs)		FC (MLKRs)	LC (MLKRs)	M Yen/km	M Yen	
1	2013	45	39.10	15.72	1759.50	707.4	45.12	2030.26	
ľ	2014	45	39.88	16.32	1794.60	734.4	46.25	2081.37	
	CEB data base for construction	cost in 2013		1					

CEB data base for construction cost in 2010									
Transmission Line / Cable	Per km Co	ost (MLKR)							
	FC	LC							
220kV 2xZebra double cct TL	39.10	15.72							
400kV 4xZebra double cct TL	105.64	23.79							
220kV Cu(XLPE) 1600mm2 cab	289.80	32.20							
(Source:CEB database)									

## Cost Estimate for Dispute Board (Standing)

Construction Period	24 Months
Warranty Period	12 Months

Cost estimate for the regular Site visits is shown below:

Cost Category	1	For 1 DB member for calculation purpose							
		1 1							
Monthly Retainer Fee	Fee		Const Period		USD				
	3,000 USD	х	24 Months	=	72,000				
Monthly Retainer during DNP	Fee		Const Period		USD				
	2,000 USD	х	12 Months	=	24,000				
Daily fee for Site Visits	Fee		Const Period		USD				
1 day x 2 for travel)	3,000 USD	x	$5 \frac{\text{Days}}{(3+2)}$	x $6 \frac{\text{Times}}{(1\text{Nos}/4 \text{ months})} =$	90,000				
Site Visit Expenses	Fee		Const Period		USD				
accommodation, etc.)	1,000 USD	x	$6 \frac{\text{Times}}{(1\text{Nos}/4 \text{ months})}$	=	6,000				
Sub-Total (1)					192,000				

Cost estimate for the referrals is shown below:

Cost Category For 1 DB member for calculation purpose									
Additional Daily Fee at	Fee	Const Period			USD				
Regular Site visits	3,000 USD	x 1 Days	x 2 Times	=	6,000				
Reviewing Submission	Fee	Const Period			USD				
and Drafting Decision	3,000 USD	x $6 \frac{\text{Days}}{(3+3)}$	x 2 Times	=	36,000				
Sub-Total (2)					42,000				

Total 234,000		
	Total	234,000

# Cost Estimate for Dispute Board (Ad hoc)

Construction Period	24 Months
Warranty Period	12 Months

Cost estimate for the referrals is shown below:

Cost Category	For 1 DB member for calculation purpose						
Daily Fee at Regular Site Visits	Fee	v	Const Period	v	2 Times =	USD	
	3,000 USD	л	1 Days	л	2 1 miles =	0,000	
Reviewing Submission	Fee		Const Period			USD	
and Drafting Decision	3,000 USD	х	$6 \frac{\text{Days}}{(3+3)}$	x	2 Times =	36,000	
Total						42,000	

### Cost Breakdown for 220 kV Sampoor Switching Station

(1) Cost breakdown for "One-and-half circuit		US\$ 1 = US\$ 1 = LKR 1 =	107.10 130.2 0.823	JPY LKR JPY				
Itomo	Unit	Qty.	Unit	Price	Foreign Portion	Local Portion	Total	Total
Items	Unit		FC (JPY)	LC (LKR)	(JPY)	(LKR)	(JPY)	(USD)
1 GIS & Local control panel/cabinet	[bay]	1	230,000,000	12,980,000	230,000,000	12,980,000	240,682,540	2,247,269
2 Supervisory service	[bay]	1	5,000,000	0	5,000,000	0	5,000,000	46,685
3 Special tools	15,000,000	0	15,000,000	140,056				
Total					250.000.000	12.980.000	260.682.540	2.434.011

#### (2) Cost Breakdown for "Common Items - GIS"

Items		01	Unit I	Price	Foreign Portion	Local Portion	Total	Total
		Qty.	FC (JPY)	LC (LKR)	(JPY)	(LKR)	(JPY)	(USD)
1 LVAC – 400 V Panel	1 LVAC - 400 V Panel [panel]		2,698,938	151,650	10,795,752	606,600	11,294,984	105,462
2 Battery Charger and Distribution Boards	[panel]	2	10,535,590	530,780	21,071,180	1,061,560	21,944,844	204,901
3 Lightning Arrester (Outdoor)		12	499,182	78,020	5,990,184	936,240	6,760,710	63,125
4 Fiber Optic/SCADA	[unit]	1	17,932,920	606,610	17,932,920	606,610	18,432,160	172,102
5 Substation earthing	[lot]	1	10,904,059	1,516,520	10,904,059	1,516,520	12,152,155	113,465
6 Transformers (33/0.4-0.23 kV, 200 kVA)	[unit]	2	1,347,536	27,500	2,695,072	55,000	2,740,337	25,587
7 Cables and sealing ends	[lot]	1	122,655,260	14,739,660	122,655,260	14,739,660	134,786,000	1,258,506
8 Civil works	[lot]	1	18,143,015	212,549,014	18,143,015	212,549,014	193,070,853	1,802,716
9 Diesel Generator	[unit]	1	3,736,025	303,300	3,736,025	303,300	3,985,641	37,214
10 Digital Disturbance Recorder		1	15,691,305	1,668,170	15,691,305	1,668,170	17,064,209	159,330
Total					229,614,772	234,042,674	422,231,892	3,942,408
Total (Round)					229,610,000	234,040,000	422,230,000	3,940,000

#### Note:

Cost Breakdown of Common Items were calculates as the following rules: 1) The original data as at 2013 was received by CEB,

2)

3)

The original data as at 2013 was received by CEB. The original data was modified the one as of 2015 in cosideration with price escalation. The price of "4 Cables and seeling ends" was reviewd and modified in accordance with the length of cable estimated by basic drawings as follows: Total price for "4 Cables and seeling ends" calculated in 3) is distributed by the original ratio of FC and LC. 4)

#### A) Detail Breakdown for Cable price (incl. construction cost)

	Section		Qty.	Cable size	Unit Price Total Price (JPY) (JPY)		Remarks
1	220 kV GIS to Gantry structure for Kappalthurei G/S	[m]	60	800 sq	33,600	12,096,000	2cct, 3phase
2	220 kV GIS to Gantry structure for Sampoor CFPP	[m]	50	2000 sq	65,300	19,590,000	2cct, 3phase
3	220 kV GIS to Gantry structure for New Habarana ${ m G/S}$	[m]	200	1600 sq	60,800	72,960,000	2cct, 3phase
					Total	104,646,000	

#### B) Detail Breakdown for Cable sealing end (incl. construction cost)

	Section		Qty.	Cable size	Unit Price (JPY)	Total Price (JPY)	Remarks	
Cable Sealing End for AIS								
1	220 kV GIS to Gantry structure for Kappalthurei G/S	[set]	2	800 sq	1,960,000	3,920,000	2cct	
2	2 220 kV GIS to Gantry structure for Sampoor CFPP		2	2000 sq	3,330,000	6,660,000	2cct	
3	220 kV GIS to Gantry structure for New Habarana G/S	[set]	2	1600 sq	3,330,000	6,660,000	2cct	
Cable	Sealing End for GIS							
1	220 kV GIS to Gantry structure for Kappalthurei G/S	[set]	2	800 sq	1,510,000	3,020,000	2cct	
2	220 kV GIS to Gantry structure for Sampoor CFPP	[set]	2	2000 sq	2,470,000	4,940,000	2cct	
3	3 220 kV GIS to Gantry structure for New Habarana G/S		2	1600 sq	2,470,000	4,940,000	2cct	
					Total	30,140,000		

A+B 134,786,000 JPY

### (3) Cost Breakdown of "5 Civil Works"

lterre		11.3	0.5.1	Unit I	Price	Foreign Portion	Local Portion	Total	Total
	items	Unit	Gruy.	FC (JPY)	LC (LKR)	(JPY)	(LKR)	(JPY)	(USD)
1	Preliminary work	[lot]	1	145,227	61,037	145,227	610,368	647,560	6,046
2	Site Cleaning	[m2]	59,150	51	30	3,019,376	1,766,272	4,473,018	41,765
3	Site formation & up keeping	[m2]	59,150	0	387	0	22,891,050	18,839,334	175,904
4	Cable trenches duct	[m]	310	0	21,062	0	6,529,220	5,373,548	50,173
5	Galvanized steel structures	[unit]	6	1,552,265	880,182	9,313,591	5,281,092	13,659,930	127,544
6	Foundations for switchgear & take-off structu	[lot]	1	0	12,468,735	0	12,468,735	10,261,769	95,815
7	Lightning protection system	[lot]	1	871,361	366,221	871,361	366,221	1,172,761	10,950
8	Miscellaneous work								
8-1	Room for diesel generator	[lot]	1	0	1,460,303	0	1,460,303	1,201,829	11,222
8-2	Shed for car parking	[unit]	2	0	1,002,954	0	2,005,908	1,650,862	15,414
8-3	Guard room and watch tower	[lot]	1	0	4,156,866	0	4,156,866	3,421,101	31,943
9	Water aupply and drainage	[lot]	1	0	3,811,228	0	3,811,228	3,136,641	29,287
10	Construction & maintenance road								
10-1	Approach road	[m]	169	0	50,452	0	8,526,388	7,017,217	65,520
10-2	Structures for approach road	[m]	169	0	18,329	0	3,097,601	2,549,326	23,803
10-3	Access roads & structures	[m]	1070	0	10,666	0	11,412,620	9,392,586	87,699
11	Fence	[m]	843	0	13,172	0	11,103,996	9,138,589	85,328
12	Miscellaneous work	[lot]	1	455,944	1,916,272	455,944	1,916,272	2,033,036	18,983
13	Substation building								
13-1	Sub-structures	[m2]	1361.25	0	23,383	0	31,830,109	26,196,180	244,596
13-2	Super structures	[m2]	1361.25	0	35,111	0	47,794,849	39,335,161	367,275
13-3	Door & windows	[unit]	24	0	109,197	0	2,620,728	2,156,859	20,139
13-4	Roof & ceiling	[lot]	1	0	9,461,153	0	9,461,153	7,786,529	72,703
13-5	Floor & trenchs	[m2]	1739.25	0	5,852	0	10,178,091	8,376,569	78,213
13-6	Finishes & fittings	[lot]	1	0	8,774,622	0	8,774,622	7,221,514	67,428
13-7	Curtaining & funiture	[lot]	1	0	1,448,954	0	1,448,954	1,192,489	11,134
13-8	Supplying & erection crane	[unit]	1	4,337,516	2,635,186	4,337,516	2,635,186	6,506,274	60,750
13-9	Miscellaneous building works	[lot]	1	0	401,182	0	401,182	330,173	3,083
14	Supplying & installation services								
14-1	A/C ventilation system	[lot]	1	3,131,968	890,624	3,131,968	890,624	3,864,952	36,087
14-2	Fire protection & detecting system	[lot]	1	1,049,772	5,349,093	1,049,772	5,349,093	5,452,076	50,906
14-3	Lighting & small poert supply work	[lot]	1	8,337,376	8,014,813	8,337,376	8,014,813	14,933,567	139,436
	Total					18,143,015	212,549,014	193,070,853	1,802,716

## Cost Breakdown for the Consulting Services

					USD	= JPY	107.1
					LKR	= JPY	0.823
							Combined
			Foreign	Portion	Local P	ortion	Total
	l l	l T	(JF	γY)	LK	R	
	Unit	Qty.	Rate	Ámount	Rate	Amount	('000)
				('000)		('000)	JPY
A Remuneration							
1 Professional (A)	M/M	40	2,895,000	115,800	0	0	115,800
2 Professional (B)	M/M	0	0	0	0	0	0
3 Supporting Staffs	M/M	24	0	0	118,000	2,832	2,331
Subtotal of A				115,800		2,832	118,131
B Direct Cost	ļ!					ļ'	
1 International Airfare	ļ!	7	510,000	3,570		0	3,570
2 Domestic Airfare	<b> </b>	0		0		0	0
3 Domestic Travel		0		0		0	0
3 Accommodation Allowance (A)	Month	40	600,000	24,000		0	24,000
Accommodation Allowance (B)	Month	0		0	100,000	0	0
Accommodation Allowance (SS)	Month	24		0		0	0
4 Vehicle Rental	Month	40		0	280,000	11,200	9,218
5 Office Rental	M/M	0		0		0	0
6 International Communications	M/M	40	10,000	400		0	400
7 Domestic Communications	M/M	40		0	10,000	400	329
8 Office Supply	Set	1		0	100,000	100	82
9 Office Furniture and Equipment	M/M	0		0		0	0
10 Report Preparation	Set	1			20,000	20	16
	ļ!					I'	
						<b> </b> '	
	<b> </b>					<b> </b> '	
	<b> </b>					'	
	<b> </b>					<b> </b> '	
	<b> </b>					<b> </b> '	
						<b> </b> '	
						<b> </b> '	
		└────┤				I'	
	<b> </b>			07.070		44 700	07.040
Subtotal of B				27,970		11,/20	37,616
Total				143,770		14,552	155,746

A	nnual Fund Requirement															
	Base Year for Cost Estimation:	Apr, 2	2015				FC & Tota	al: millio	n JPY							
	Exchange Rates	LKR =	= JPY	0.823			LC	million	LKR							
	Price Escalation:	FC:	2.0%	LC:	3.8%											
	Physical Contingency	5%														
	Physical Contingency for Consultant	5%														
	Item		Total			2015			2016			2017			2018	
		FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
Α.	ELIGIBLE PORTION															
I)	Procurement / Construction	9,761	4,770	13,687	0	0	0	0	0	0	4,832	2,341	6,758	4,929	2,429	6,928
	Package 01: Construction of Transmission Line	7,747	3,847	10,913	0	0	0	0	0	0	3,873	1,923	5,456	3,873	1,923	5,456
	Package 02: Construction of Switching Station	1,100	291	1,339	0	0	0	0	0	0	550	145	670	550	145	670
	Base cost for JICA financing	8,847	4,138	12,252	0	0	0	0	0	0	4,423	2,069	6,126	4,423	2,069	6,126
	Price escalation	449	405	783	0	0	0	0	0	0	179	160	311	271	245	472
	Physical contingency	465	227	652	0	0	0	0	0	0	230	111	322	235	116	330
	Consulting services	159	17	173	0	0	0	0	0	0	75	8	81	84	9	91
	Base cost	144	15	156	0	0	0	0	0	0	68	7	74	75	8	82
	Price escalation	7	1	9	0	0	0	0	0	0	3	1	3	5	1	5
	Physical contingency	8	1	8	0	0	0	0	0	0	4	0	4	4	0	4
Total (I + II)		9,920	4,787	13,859	0	0	0	0	0	0	4,907	2,348	6,839	5,013	2,438	7,020
<u>B.</u>	NON ELIGIBLE PORTION														<b>└───</b> ↓	
а	Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
															<b>└───</b> ┤	
	Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b	Land Acquisition	0	428	352	0	27	23	0	341	281	0	59	49	0	0	0
	Base cost	0	391	322	0	26	21	0	313	258	0	52	43	0	0	0
	Price escalation	0	16	13	0	0	0	0	12	10	0	4	3	0	0	0
	Physical contingency	0	20	17	0	1	1	0	16	13	0	3	2	0	0	0
С	Administration cost	0	863	711	0	1	1	0	17	14	0	418	344	0	426	351
d	VAI	0	2,021	1,663	0	0	0	0	0	0	0	997	821	0	1,024	842
e		0	844	694	0	0	0	0	0	0	0	417	343	0	426	351
I Ot	al (a+b+c+d+e)	0	4,155	3,420	0	29	24	0	358	295	0	1,892	1,557	0	1,876	1,544
10	IAL (A+B)	9,920	8,942	17,279	0	29	24	0	358	295	4,907	4,241	8,397	5,013	4,315	8,564
~		0.1	0	0.1	0											
C.	Interest during Construction	61	0	61	0	0	0	0	0	0	20	0	20	41	0	41
	Interest during Construction(Const.)	61	0	61	0	0	0	0	0	0	20	0	20	41	0	41
_	Interest during Construction (Consul.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D.	Front End Fee	28	0	28	28	0	28	0	0	0	0	0	0	0	0	0
GR	AND IOIAL (A+B+C+D)	10,009	8,942	17,368	28	29	51	0	358	295	4,927	4,241	8,417	5,054	4,315	8,605
															<b>⊢−−−</b> ∔	
E.	JICA finance portion incl. IDC (A + C + D)	10,009	4,787	13,948	28	0	28	0	0	0	4,927	2,348	6,860	5,054	2,438	7,061

Administration Cost =

5%12% of the expenditure in local currency of the eligible portion

VAT= Import Tax=

7%

Annex 10. 5-1