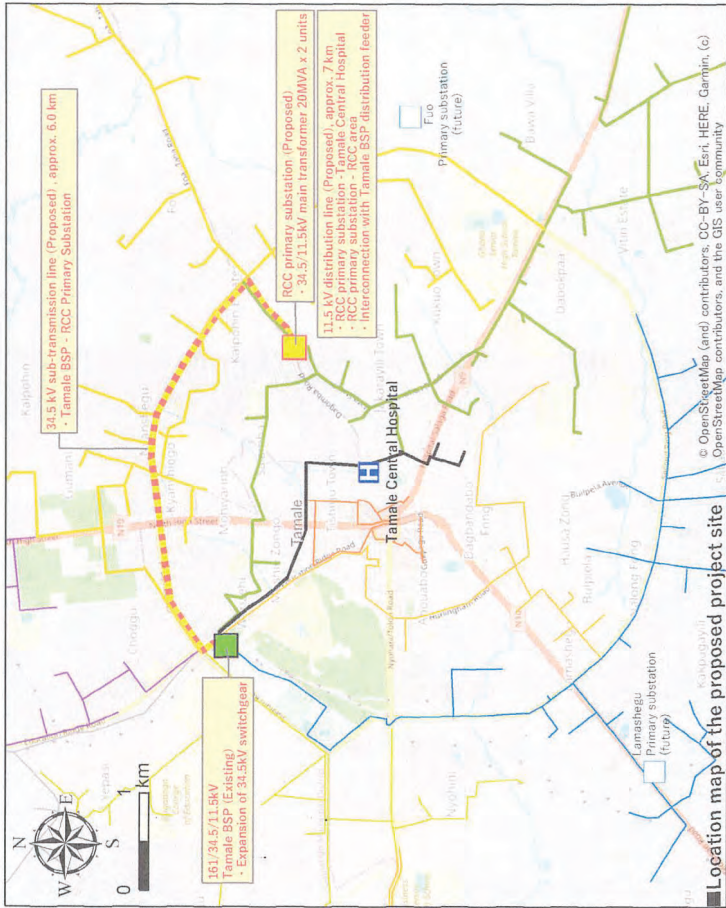
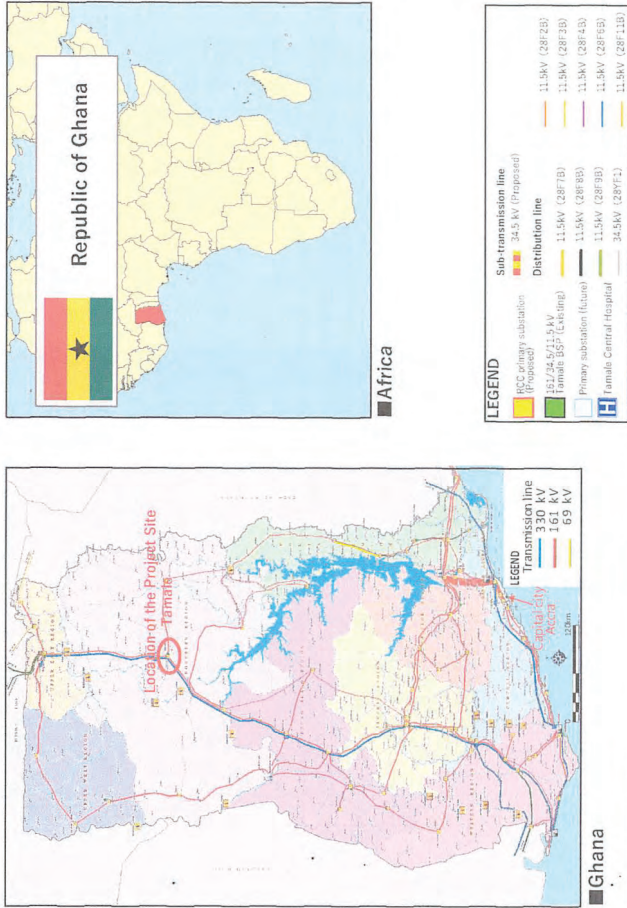


Drawing List

General	DWG No.	Title
	G-01	Location of the Project Site
Substation	DWG No.	Title
	SS-01	System Configuration of RCC primary substation
	SS-02	Single Line Diagram of RCC primary substation
	SS-03	Steps for 34.5 kV Cable connection at Tamale BSP substation
	SS-04	SCADA Signal List for RCC primary substation
	SS-05	Layout Drawing of Switchgear room and Control room in Tamale BSP substation
Architectural	DWG No.	Title
	A-01	Site Plan of RCC primary substation
	A-02	Plan of the Control Building for RCC primary substation
	A-03	Elevation and Section of the Control Building for RCC primary substation
Sub-Transmission and Distribution Lines	DWG No.	Title
	DL-01	34.5 kV Sub-transmission and Distribution Lines routes
	DL-02	Sub-transmission and Distribution Line Network Diagram
	DL-03	34.5kV Pole arrangement
	DL-04	11.5kV Pole arrangement

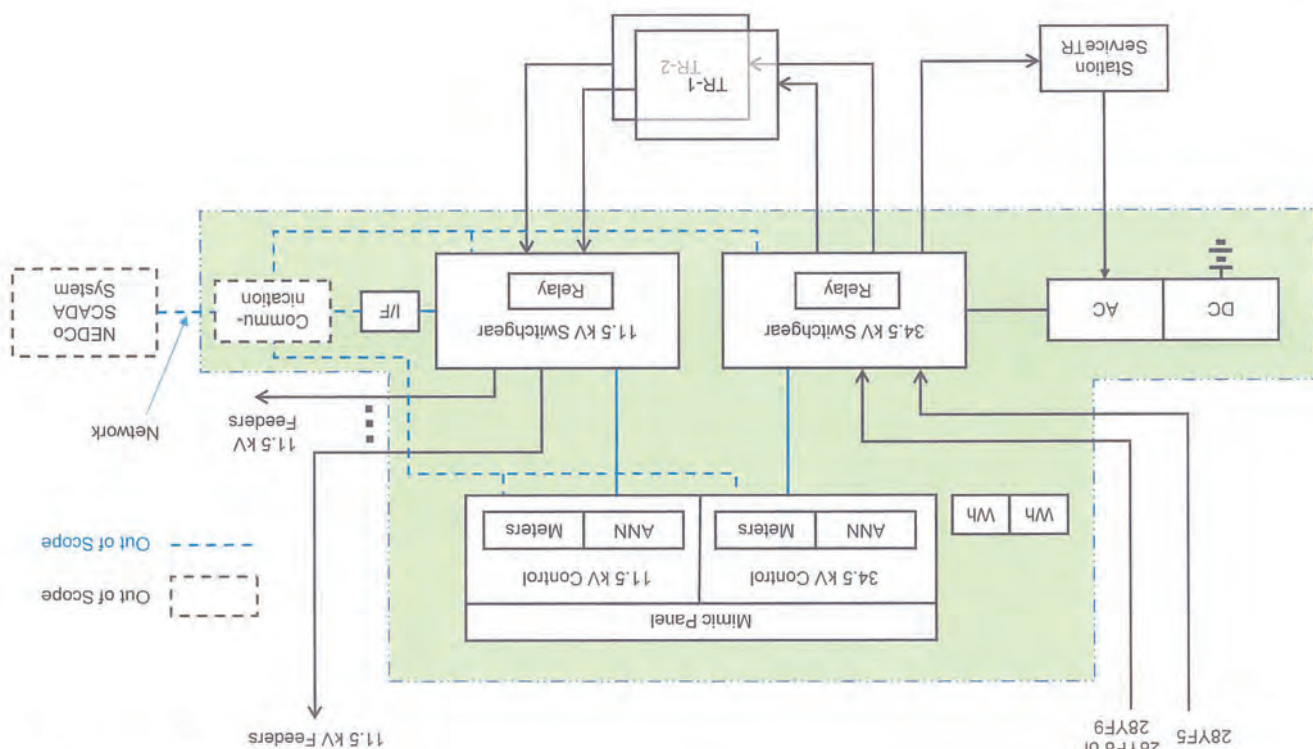


Handwritten mark

A6-3
A5-51

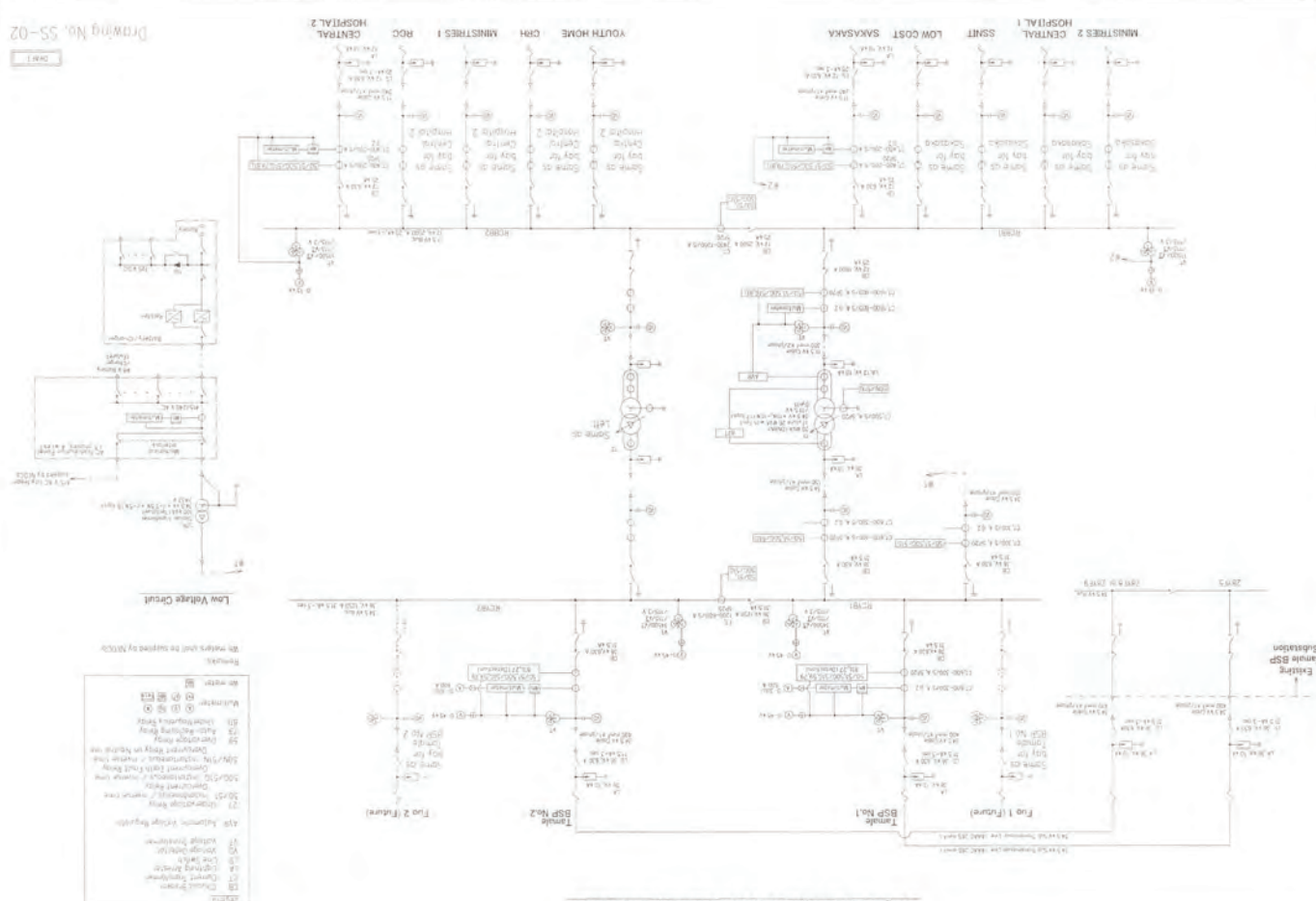
System Configuration of RCC Primary Substation

SS-01



A6-4
A5-52

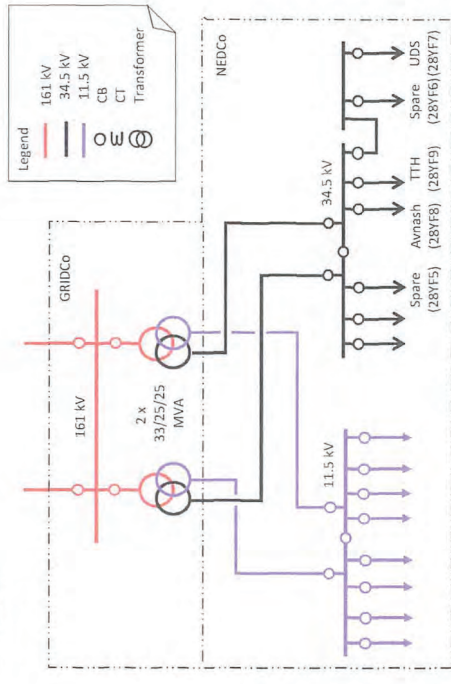
Single Line Diagram of RCC Primary Substation



Drawing No. SS-02

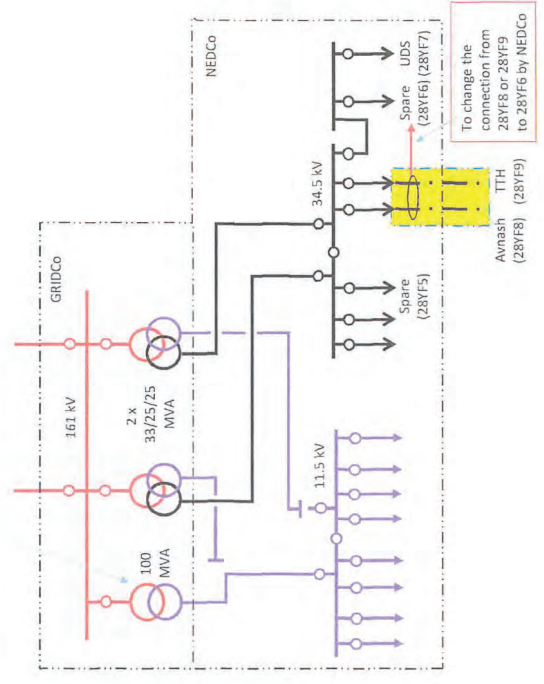
Steps for 34.5 kV Cable connection at Tamale BSP substation

Current Diagram

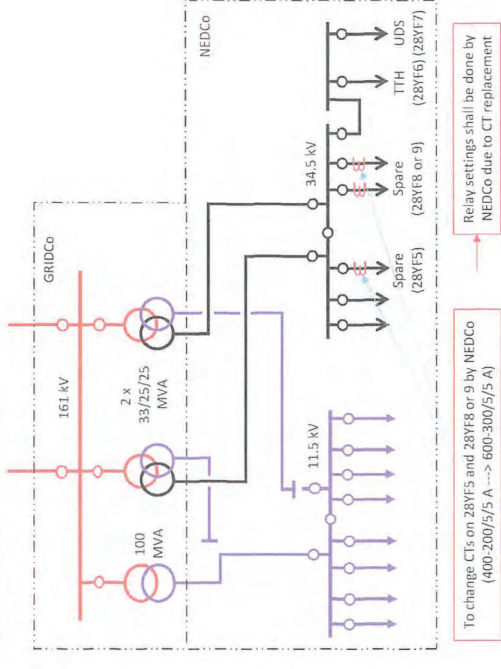


Step 1: Connection change of 34.5 kV feeder

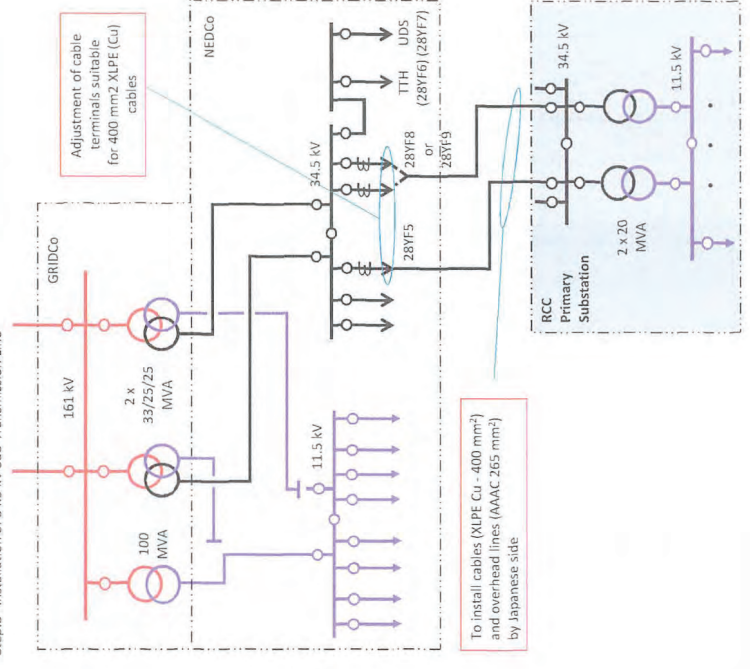
161/11.5 kVA, 100 MVA transformer will be installed around first quarter of 2023 and transfer all 11.5 kV load of 25 MVA transformers.



Step 2: CT change of 34.5 kV spare feeders



Step 3: Installation of 34.5 kV Sub-Transmission Line



To install cables (XLPE Cu - 400 mm²) and overhead lines (AAAC 265 mm²) by Japanese side

SCADA Signal List for RCC Primary Substation

Note: The interface with SCADA system should be basically done at "interface panels" in Control room. The interface of some points of the signals may be done at data ports of intelligent electronic devices suitable for IEC protocol.

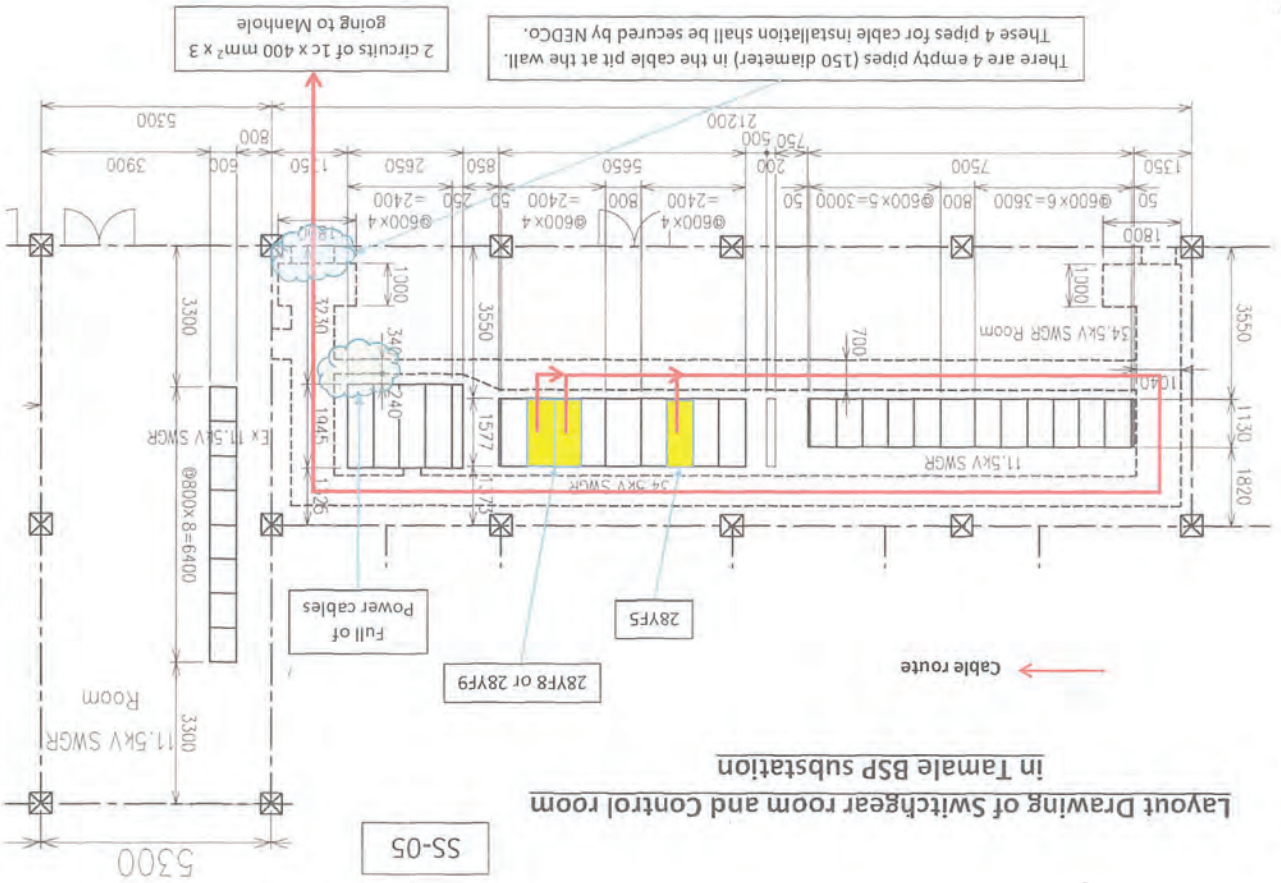
SS-04

Item No.	Description	Category			
		Analogue	Pulse	Double Command	Single Command
1.1	Current (34.5 kV Line) A	-	-	-	-
1.2	Current (34.5 kV Line) B	-	-	-	-
1.3	Current (34.5 kV Line) C	-	-	-	-
1.4	Voltage (34.5 kV Bus) A	-	-	-	-
1.5	Voltage (34.5 kV Bus) B	-	-	-	-
1.6	Voltage (34.5 kV Bus) C	-	-	-	-
1.7	Active Power (kW) (34.5 kV Line)	-	-	-	-
1.8	Reactive Power (kVAr) (34.5 kV Line)	-	-	-	-
1.9	Active Power (kW) (34.5 kV Line)	-	-	-	-
1.10	Current Breaker Open/Close	-	-	-	-
1.11	Current Breaker Open/Close	-	-	-	-
1.12	Current Breaker Open/Close	-	-	-	-
1.13	34.5 kV Feeder Burned	-	-	-	-
1.14	Selector Switch Local/Remote	-	-	-	-
1.15	125 V DC Supply	-	-	-	-
1.16	Main Protection Operated (50/51)	-	-	-	-
1.17	Backup Protection Operated (Others)	-	-	-	-
1.18	Protection DC Supply	-	-	-	-
1.19	Earthling Switch Close	-	-	-	-
1.20	Earthling Switch Open	-	-	-	-
1.21	Trap Circuit Supervision	-	-	-	-
1.22	Gas Pressure Low Alarm	-	-	-	-
1.23	Gas Pressure Low Lockout	-	-	-	-
2.1	Current (11.5 kV Line) A	-	-	-	-
2.2	Current (11.5 kV Line) B	-	-	-	-
2.3	Current (11.5 kV Line) C	-	-	-	-
2.4	Current (11.5 kV Line) A	-	-	-	-
2.5	Current (11.5 kV Line) B	-	-	-	-
2.6	Current (11.5 kV Line) C	-	-	-	-
2.7	Voltage (11.5 kV Bus) A	-	-	-	-
2.8	Voltage (11.5 kV Bus) B	-	-	-	-
2.9	Voltage (11.5 kV Bus) C	-	-	-	-
2.10	Active Power (kW) (11.5 kV Line)	-	-	-	-
2.11	Reactive Power (kVAr) (11.5 kV Line)	-	-	-	-
2.12	Active Power (kW) (11.5 kV Line)	-	-	-	-
2.13	Active Power (kW) (11.5 kV Line)	-	-	-	-
2.14	Reactive Power (kVAr) (11.5 kV Line)	-	-	-	-
2.15	Reactive Power (kVAr) (11.5 kV Line)	-	-	-	-
2.16	Current Breaker Open/Close	-	-	-	-
2.17	Current Breaker Open/Close	-	-	-	-
3.1	Selector Switch Local/Remote	-	-	-	-
3.2	Tap changer Lower	-	-	-	-
3.3	Tap changer Upper	-	-	-	-
3.4	Tap changer in progress	-	-	-	-
3.5	Tap change incomplete	-	-	-	-
3.6	AVR Manual control selected	-	-	-	-
3.7	Tap changer AVR selected	-	-	-	-
3.8	Tap changer Position selected	-	-	-	-
3.9	Tap changer Out of Step	-	-	-	-
3.10	Tap changer AVR failure	-	-	-	-
3.11	Tap changer AVR failure	-	-	-	-
3.12	Tap changer Motor failure	-	-	-	-
3.13	Main Protection Operated (87T, 26, 95-2)	-	-	-	-
3.14	Backup Protection Operated (Others)	-	-	-	-
3.15	Temperature Alarm	-	-	-	-
3.16	Busbar Alarm (96-1)	-	-	-	-
3.17	Oil Level Low Alarm	-	-	-	-
4.1	MCCB trip (AVC Distribution panel)	-	-	-	-
4.2	Charger failure	-	-	-	-
4.3	Battery failure	-	-	-	-
4.4	MCCB trip (CC Distribution panel)	-	-	-	-
5.1	Substation	-	-	-	-
5.2	Substation	-	-	-	-
5.3	Substation	-	-	-	-
5.4	Substation	-	-	-	-
5.5	Substation	-	-	-	-
5.6	Substation	-	-	-	-
5.7	Substation	-	-	-	-
5.8	Substation	-	-	-	-
5.9	Substation	-	-	-	-
5.10	Substation	-	-	-	-
5.11	Substation	-	-	-	-
5.12	Substation	-	-	-	-
5.13	Substation	-	-	-	-
5.14	Substation	-	-	-	-
5.15	Substation	-	-	-	-
5.16	Substation	-	-	-	-
5.17	Substation	-	-	-	-
5.18	Substation	-	-	-	-
5.19	Substation	-	-	-	-
5.20	Substation	-	-	-	-
5.21	Substation	-	-	-	-
5.22	Substation	-	-	-	-
5.23	Substation	-	-	-	-
5.24	Substation	-	-	-	-
5.25	Substation	-	-	-	-
5.26	Substation	-	-	-	-
5.27	Substation	-	-	-	-
5.28	Substation	-	-	-	-
5.29	Substation	-	-	-	-
5.30	Substation	-	-	-	-
5.31	Substation	-	-	-	-
5.32	Substation	-	-	-	-
5.33	Substation	-	-	-	-
5.34	Substation	-	-	-	-
5.35	Substation	-	-	-	-
5.36	Substation	-	-	-	-
5.37	Substation	-	-	-	-
5.38	Substation	-	-	-	-
5.39	Substation	-	-	-	-
5.40	Substation	-	-	-	-

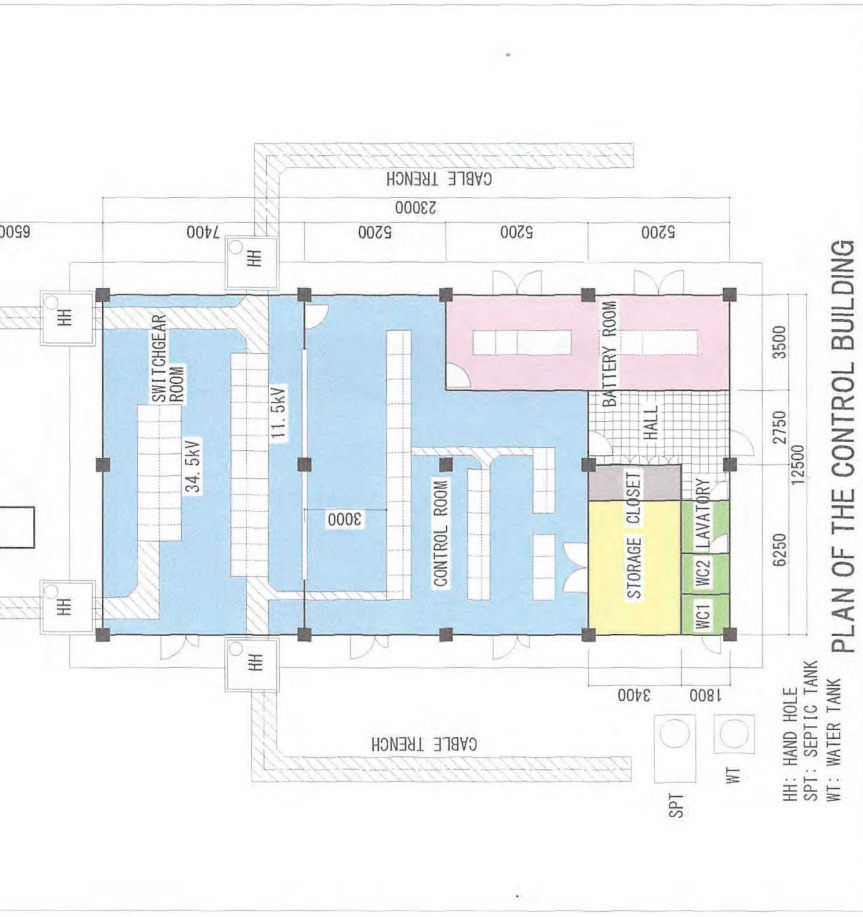
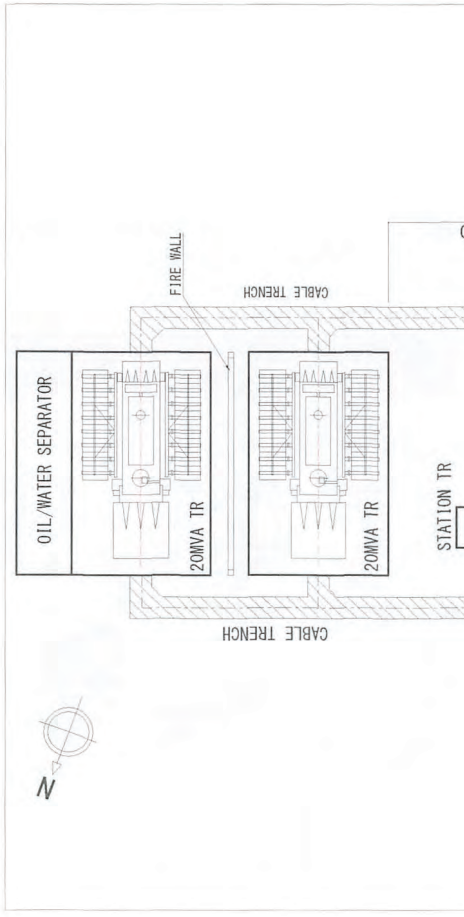
A6-7
A5-55

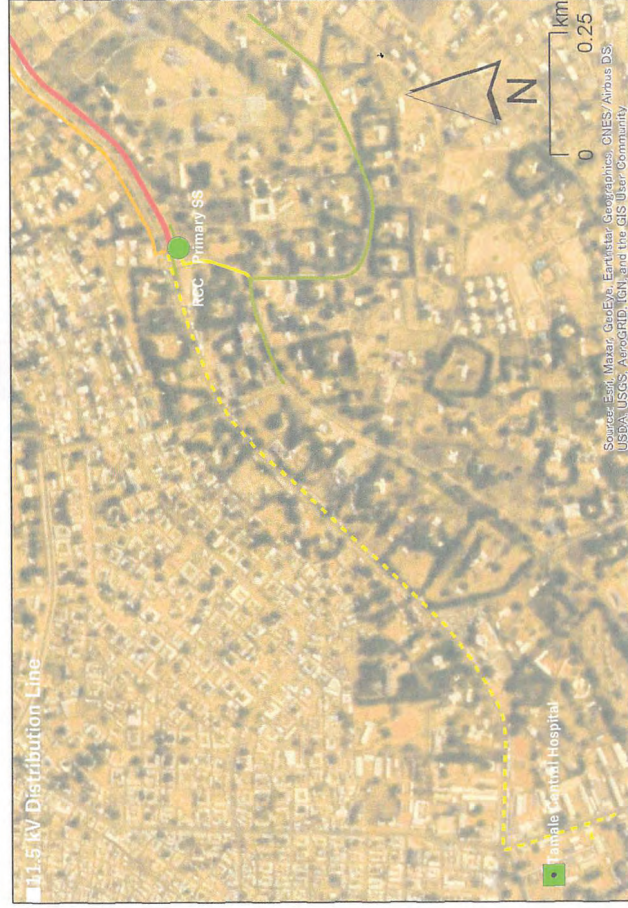
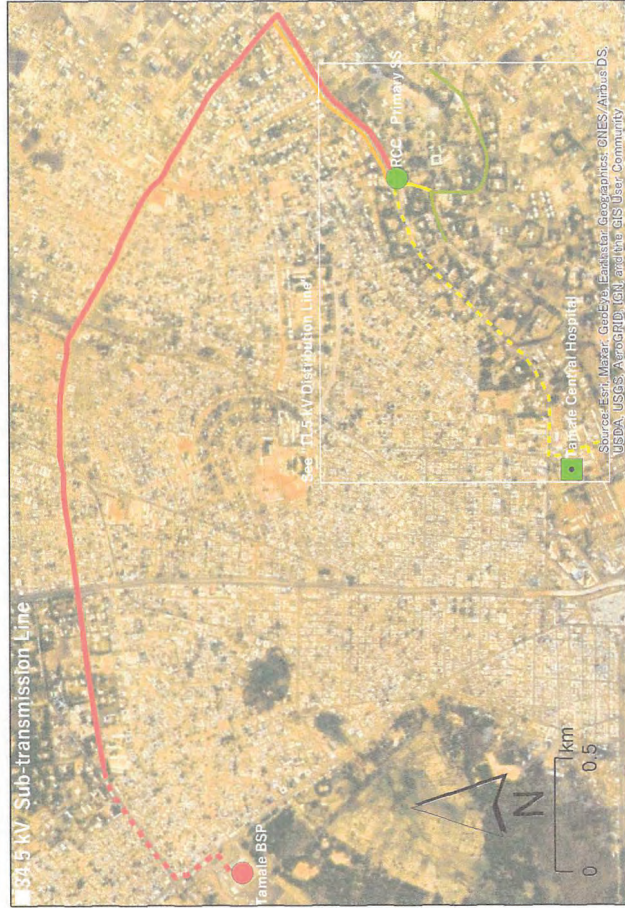
A6-8
A5-9A

Layout Drawing of Switchgear room and Control room in Tamsale BSP substation



A-02 Plan of the Control Building for RCC primary substation

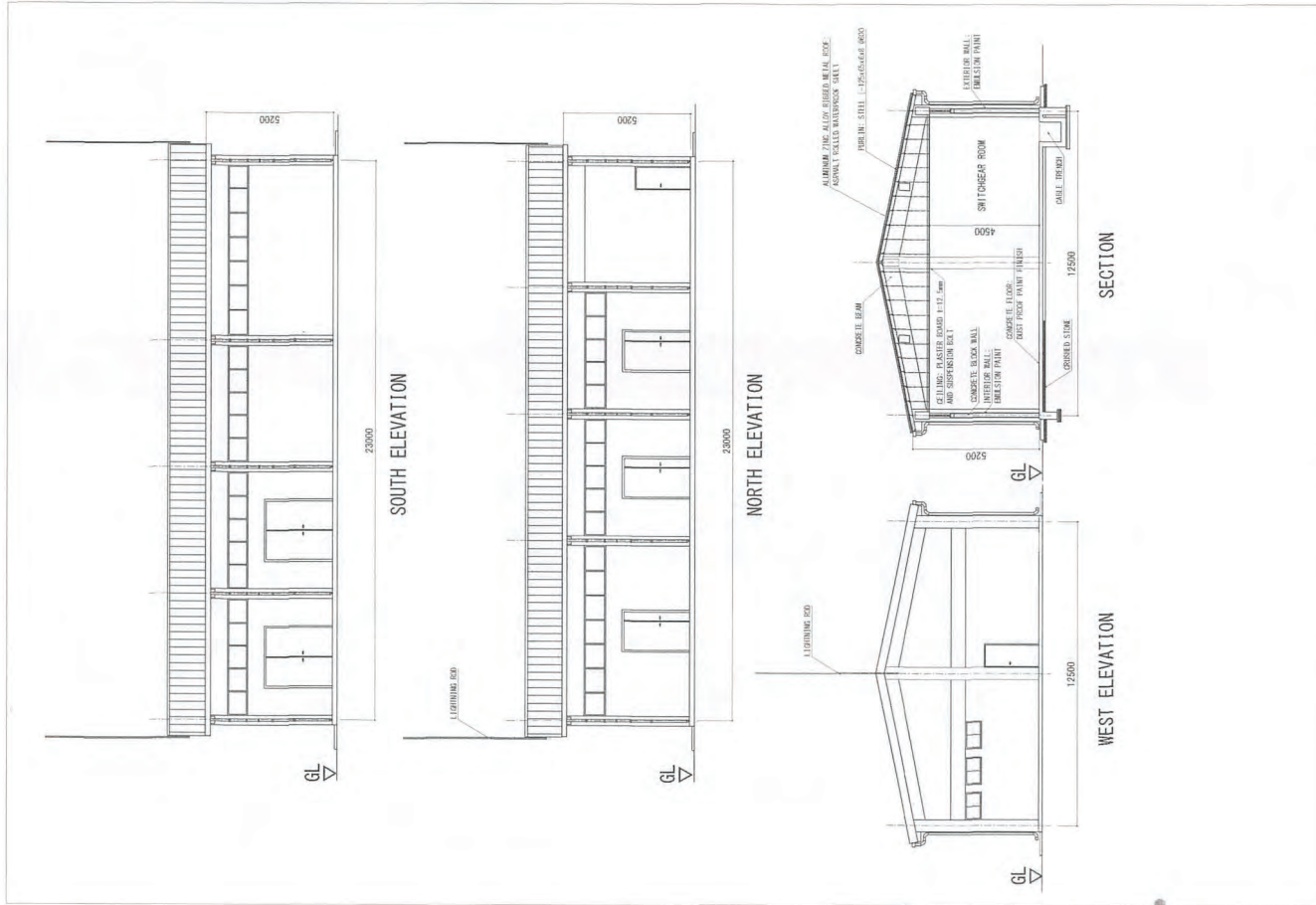




LEGEND		
--- 34.5kV XLPE Cu400mm ² x2	--- 11.5kV XLPE AL240mm ² x2	
--- 34.5kV AAAC 285mm ² x2	--- 11.5kV AAAC 120mm ² x2	
--- 11.5kV AAAC120mm ² x2	--- 11.5kV AAAC 120mm ² x1	

Drawing No. DL-01

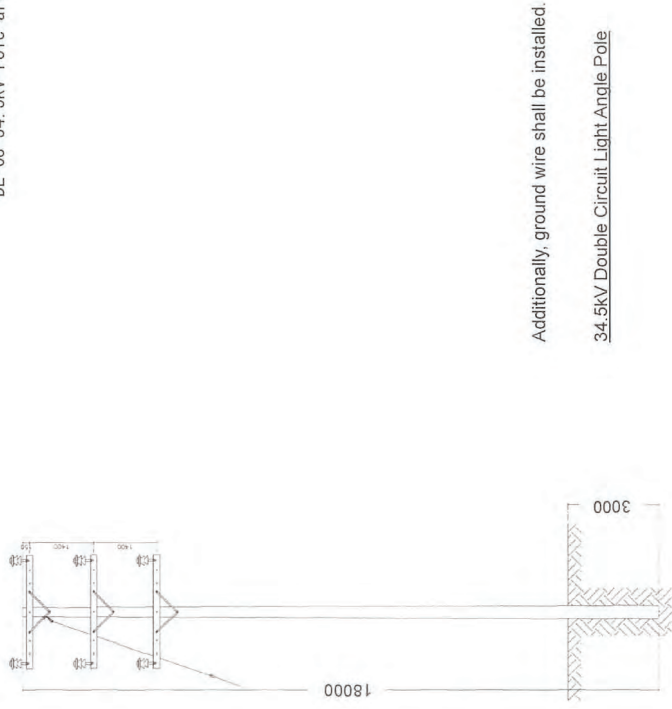
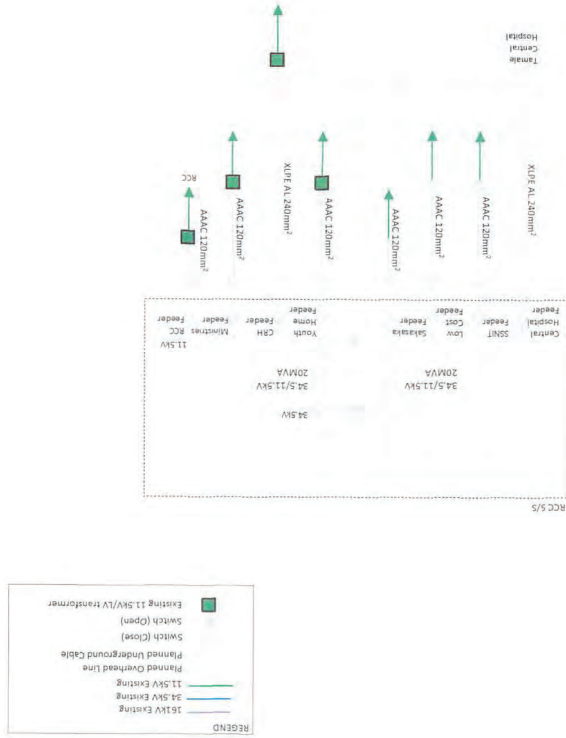
A-03 Elevation and Section of the Control Building for RCC primary substation



A6-11

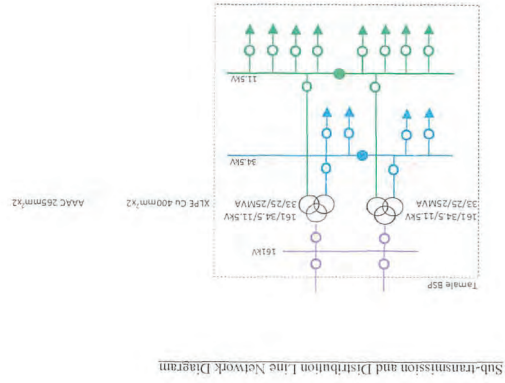
Drawing No. A-03

A5-59



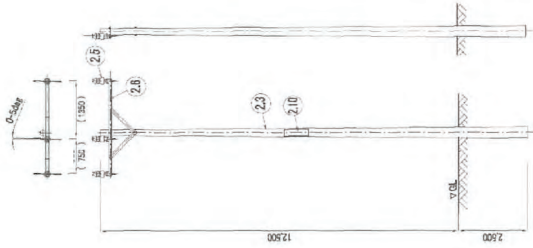
Additionally, ground wire shall be installed.

34.5kV Double Circuit Light Angle Pole



Additionally, ground wire shall be installed.

34.5kV Double Circuit Section Pole

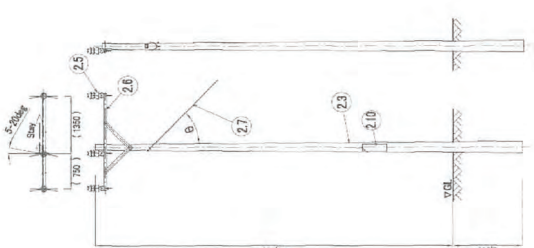


P.NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DTr)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Circuit Switch with Fuse	0
1.5	Lightning Arrester	0
1.6	Main Distribution Board (MDB)	0
2.1	Conductor (m)	0
2.2	Connector	0
2.3	Steel Pole (15m)	1
2.4	Strain Insulator Set	0
2.5	Pin Insulator set	3
2.6	Crossarm set	1
2.7	Stay Wire Set	0
2.8	Earth Wire Set	0
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.

Dwg.No.TPA-A

11.5kV 引通し柱 (0度~5度) (型番 1A)
11.5kV Intermediate Pole (Line Angle 0-5deg) [Type 1A]



P.NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DTr)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Circuit Switch with Fuse	0
1.5	Lightning Arrester	0
1.6	Main Distribution Board (MDB)	0
2.1	Conductor (m)	0
2.2	Connector	0
2.3	Steel Pole (15m)	1
2.4	Strain Insulator Set	0
2.5	Pin Insulator set	3
2.6	Crossarm set	1
2.7	Stay Wire Set	1
2.8	Earth Wire Set	0
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.

Preferable Stay Angle : 30° ≦ θ ≦ 45°

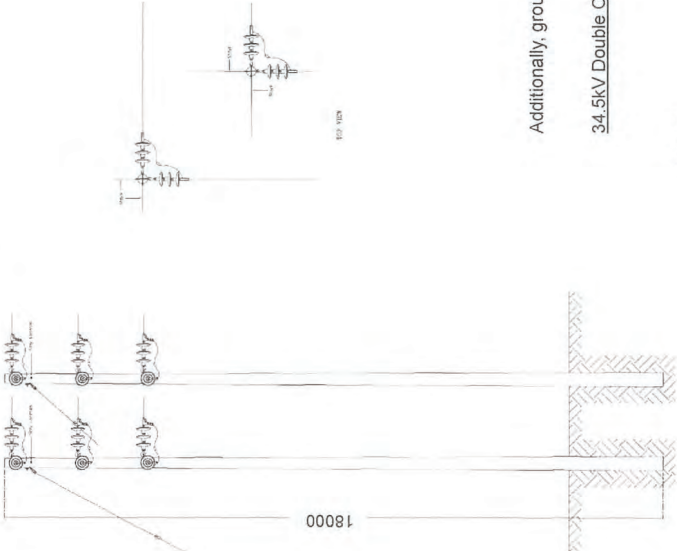
Dwg.No.TPA-B

11.5kV 斜角度柱 (5度~20度) (型番 1B)
11.5kV Light Angle Pole (Line Angle 5-20deg) [Type 1B]



Additionally, ground wire shall be installed.

34.5kV Double Circuit Terminal Pole



Additionally, ground wire shall be installed.

34.5kV Double Circuit Heavy Angle Pole

Drawing No. DL-03

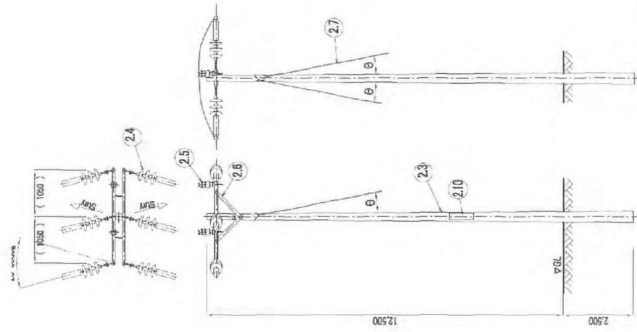
A6-15
A5-63

Dwg.No.TPA-B

11.5kV 斜角度柱 (5度~20度) (型番 1B)
11.5kV Light Angle Pole (Line Angle 5-20deg) [Type 1B]

A6-16
A5-64

Drawing No. DL-04



Dwg.No.TPA-C

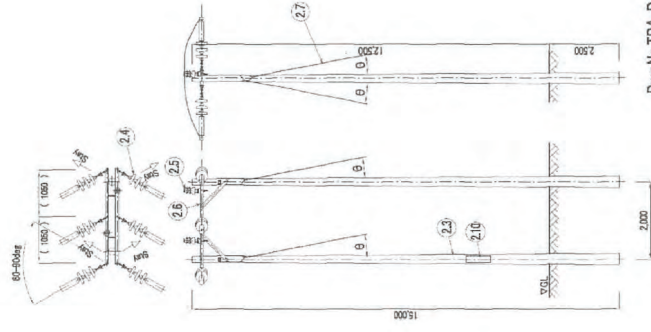
P NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DT)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Outout Switch with Fuse	0
1.5	Lighting Arrestor	0
1.6	Main Distribution Board(MDB)	0
2.1	Conductor (m)	0
2.2	Connector	0
2.3	Steel Pole (15m)	1
2.4	Strain Insulator Set	5
2.5	Pin Insulator set	2
2.6	Crossarm set	2
2.7	Stay Wire Set	2
2.8	Earth Wire Set	0
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.

The disk type insulator is 2pcs/phase for 11.5kV.

Preferable Stay Angle $30^\circ \leq \theta \leq 45^\circ$

11.5kV 中角度柱 (20度~60度) [型番 1C]
11.5kV Medium Angle Pole (Line Angle 20-60deg.) [Type 1C]



Dwg.No.TPA-D

P NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DT)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Outout Switch with Fuse	0
1.5	Lighting Arrestor	0
1.6	Main Distribution Board(MDB)	0
2.1	Conductor (m)	0
2.2	Connector	0
2.3	Steel Pole (15m)	2
2.4	Strain Insulator Set	6
2.5	Pin Insulator set	2
2.6	Crossarm set	2
2.7	Stay Wire Set	4
2.8	Earth Wire Set	0
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.

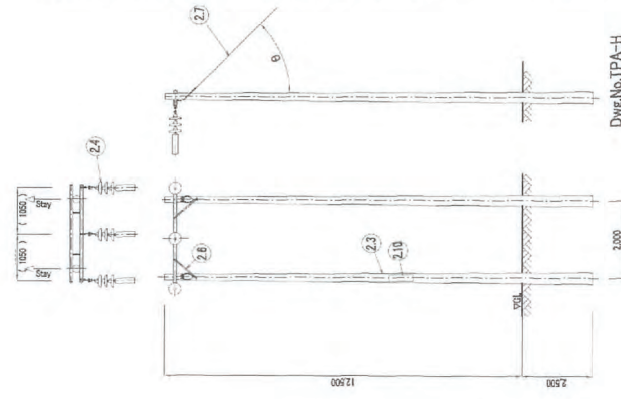
The disk type insulator is 2pcs/phase for 11.5kV.

Preferable Stay Angle $30^\circ \leq \theta \leq 45^\circ$

11.5kV 強角度柱 (60度~90度未満) [型番 1D]
11.5kV Heavy Angle Pole (Line Angle 60-90deg.) [Type 1D]

A6-17 Drawing No. DL-04

A5-65



Dwg.No.TPA-H

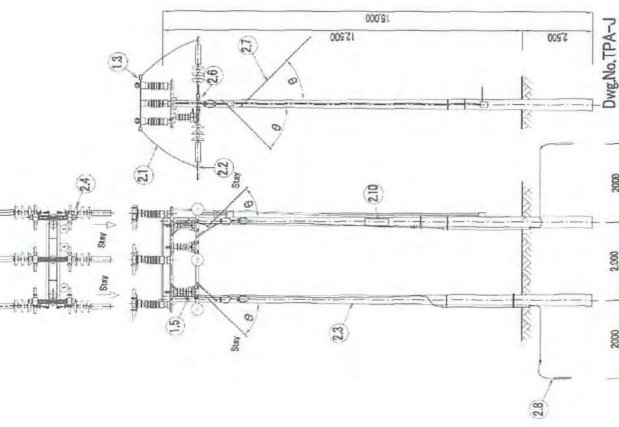
P NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DT)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Outout Switch with Fuse	0
1.5	Lighting Arrestor	0
1.6	Main Distribution Board(MDB)	0
2.1	Conductor (m)	0
2.2	Connector	0
2.3	Steel Pole (15m)	2
2.4	Strain Insulator Set	3
2.5	Pin Insulator set	0
2.6	Crossarm set	2
2.7	Stay Wire Set	2
2.8	Earth Wire Set	0
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.

The disk type insulator is 2pcs/phase for 11.5kV.

Preferable Stay Angle $30^\circ \leq \theta \leq 45^\circ$

11.5kV 終端柱 [型番 1H]
11.5kV Terminal Pole [Type 1H]



Dwg.No.TPA-J

P NO	DESCRIPTION	QTY
1.1	Distribution Transformer (DT)	0
1.2	Auto Recloser	0
1.3	Load Isolator	0
1.4	Outout Switch with Fuse	1
1.5	Lighting Arrestor	1
1.6	Main Distribution Board(MDB)	0
2.1	Conductor (m)	30
2.2	Connector	3
2.3	Steel Pole (15m)	2
2.4	Strain Insulator Set	6
2.5	Pin Insulator set	0
2.6	Crossarm set	2
2.7	Stay Wire Set	4
2.8	Earth Wire Set	3
2.9	LV Cabling Materials	0
2.10	Plate set	1

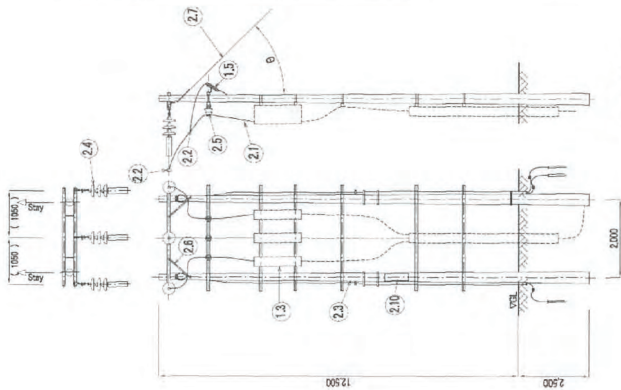
Additionally, ground wire shall be installed.

The disk type insulator is 2pcs/phase for 11.5kV.

11.5kV 断路器柱 (水平型) [型番 1J]
11.5kV Disconnecting Switch Pole (Horizontal Type) [Type 1J]

A6-18 Drawing No. DL-04

A5-66



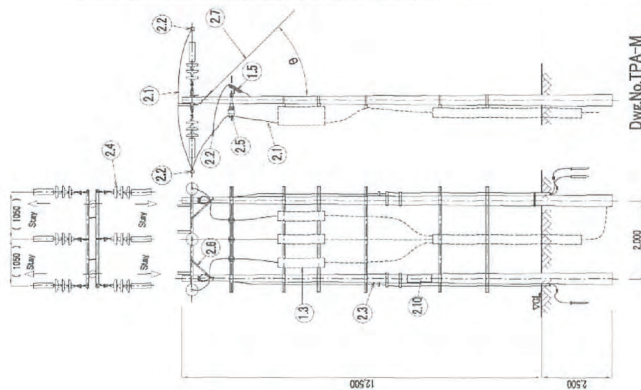
P. NO.	DESCRIPTION	Q. TY.
1.1	Distribution Transformer (DTr)	0
1.2	Auto Recloser	0
1.3	Disconnecting Switch	0
1.4	Outcut Switch with Fuse	1
1.5	Lightning Arrester	0
1.6	Main Distribution Board (MDB)	0
2.1	Conductor (m)	30
2.2	Connector	6
2.3	Steel Pole (15m)	2
2.4	Strain Insulator Set	3
2.5	Pin Insulator set	3
2.6	Crossarm set	8
2.7	Slay Wire Set	2
2.8	Earth Wire Set	3
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.
The disk type insulator is 2pcs/phase for 11.5kV.

Preferable Slay Angle: $30^\circ \leq \theta \leq 45^\circ$

Dwg.No.TPA-K

11.5kV 断路器柱(垂直片引型) [型番 1K]
11.5kV Disconnecting Switch Pole (Vertical Section Type) [Type 1K]



P. NO.	DESCRIPTION	Q. TY.
1.1	Distribution Transformer (DTr)	0
1.2	Auto Recloser	0
1.3	Disconnecting Switch	0
1.4	Outcut Switch with Fuse	1
1.5	Lightning Arrester	0
1.6	Main Distribution Board (MDB)	0
2.1	Conductor (m)	30
2.2	Connector	6
2.3	Steel Pole (15m)	2
2.4	Strain Insulator Set	3
2.5	Pin Insulator set	3
2.6	Crossarm set	8
2.7	Slay Wire Set	2
2.8	Earth Wire Set	3
2.9	LV Cabling Materials	0
2.10	Plate set	1

Additionally, ground wire shall be installed.
The disk type insulator is 2pcs/phase for 11.5kV.

Preferable Slay Angle: $30^\circ \leq \theta \leq 45^\circ$

Dwg.No.TPA-M

11.5kV 断路器柱(垂直面引型) [型番 1M]
11.5kV Disconnecting Switch Pole (Vertical Section Type) [Type 1M]

A6-19 Drawing No. DL-04

A5-67

A5-68

6. 概略設計図

6. 概略設計図

変電設備

図面番号	図面名称
SS-01	RCC 一次変電所 システム構成図
SS-02	RCC 一次変電所 単線結線図
SS-03	タマレ境界変電所 34.5 kV ケーブル接続ステップ図
SS-04	RCC 一次変電所 SCADA 信号一覧
SS-04-1	RCC 一次変電所 SCADA システム（将来）との取合い概念図
SS-05	タマレ境界変電所 配電盤室及び制御室配置図
SS-06	RCC 一次変電所 変電所監視制御盤 盤面図
SS-07	RCC 一次変電所 ケーブルトレンチ図
SS-08	RCC 一次変電所 NEDCo 既設低圧線取合図
SS-09	RCC 一次変電所 制御棟配置図
SS-10-1	RCC 一次変電所 11.5 kV 配電第1 柱周り取合図
SS-10-2	RCC 一次変電所 34.5 kV 配電第1 柱周り取合図

送配電設備

図面番号	図面名称
TDL-01	送配電線概略図
TDL-02	送配電線系統図
TDL-03	送配電線装柱図
TDL-04	地中ケーブル標準断面図
TDL-05	送配電線ルート図
TDL-06	機材一覧表

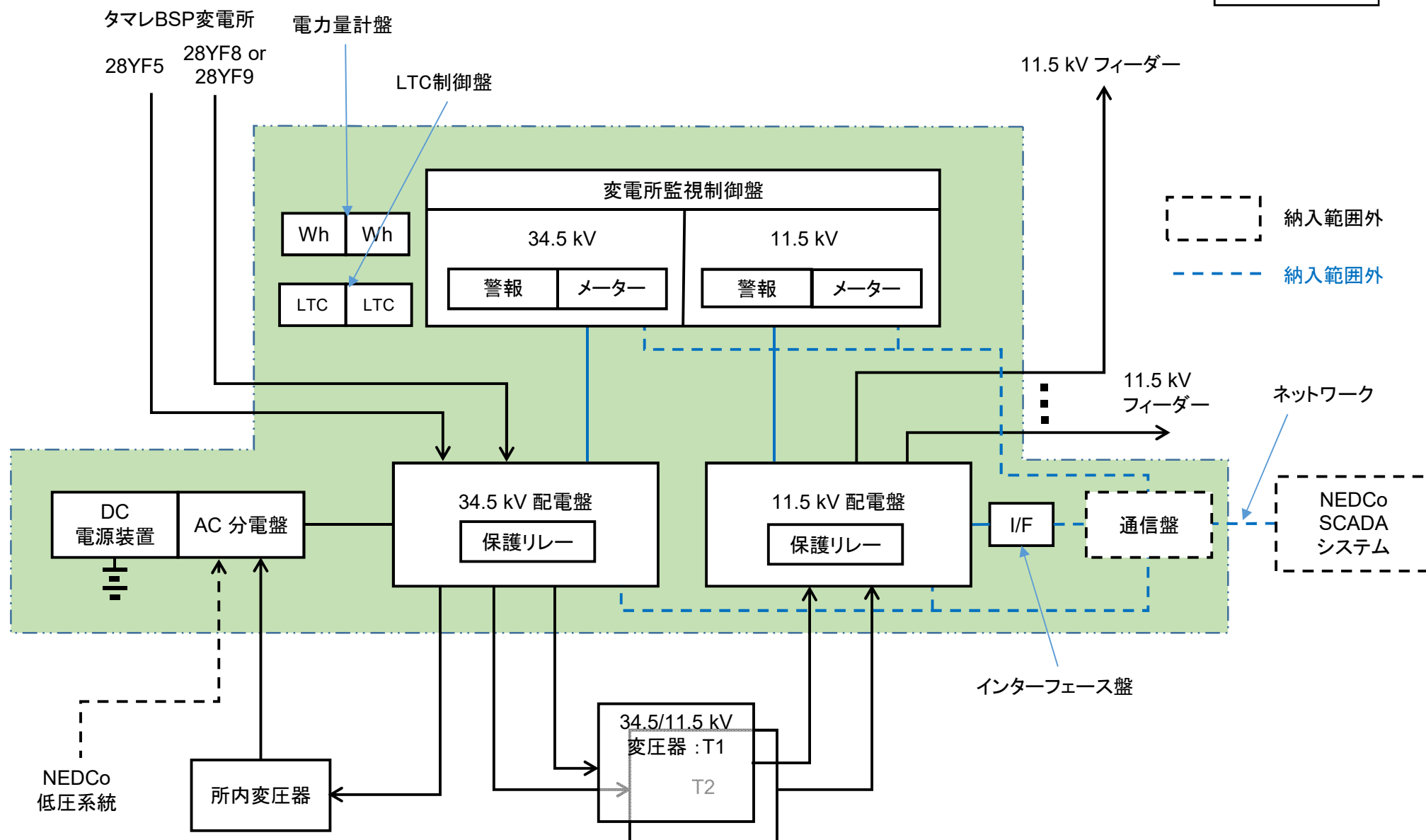
建築設備

図面番号	図面名称
A-01	測量図
A-02	変電所全体配置図
A-03	制御棟平面図/屋根平面図/仕上げ表
A-04	制御棟立面図/断面図
A-05	制御棟建具表
S-01	制御棟基礎伏図
S-02	制御棟屋根伏図
S-03	制御棟屋根母屋図
S-04	制御棟軸組図(1/2)
S-05	制御棟軸組図(2/2)
S-06	制御棟基礎配筋図

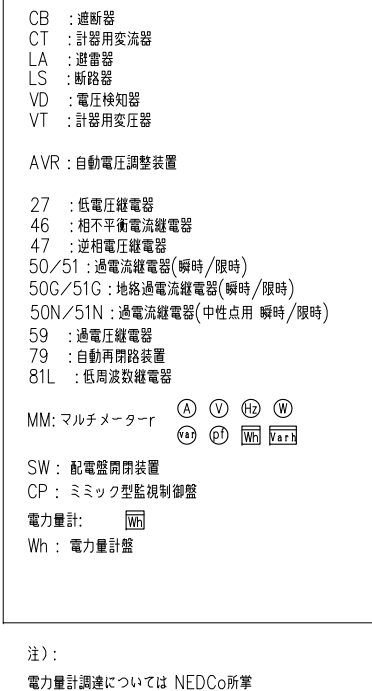
S-07	制御棟柱梁配筋図
S-08	変圧器基礎平面図/防火壁配筋図/油水分離槽配筋図
S-09	変圧器基礎配筋図
S-10	ケーブルトレンチ/ハンドホール配筋図
S-11	浄化槽配筋図/避雷針基礎配筋図/構内道路標準断面図
S-12	給水タンク基礎配筋図
M-01	制御棟空調機器機材リスト
M-02	制御棟空調システム図
M-03	制御棟配管機材リスト
M-04	制御棟屋外配管図
M-05	制御棟屋内配管図
E-01	制御棟凡例
E-02	例制御棟受電盤/照明機器リスト
E-03	制御棟電気配線図
E-04	制御棟照明機器配置図
E-05	制御棟屋外照明機器配置図
E-06	制御棟天井照明取り付け図
E-07	制御棟消防設備システムダイアグラム図
E-08	制御棟消防設備システム図
E-09	制御棟避雷設備機器図
E-10	制御棟避雷針取り付け立面図
E-11	制御棟避雷針取り付け平面図
E-12	制御棟屋根避雷針取り付け平面図

変電設備

RCC一次変電所 システム構成図



SS-02



※1

STR;
所内変圧器
100 kVA (暫定)
34.5 kV $\pm$ 2.5%, $\pm$ 5% (5タップ)
/ 433 V

415 V AC cityフィーダー
NEDCo所掌

機械式インターロック付き

交流分電盤
(三相4線式)

Wh Multimeter

415/240 V AC

48 V バッテリー
/ 雙流器 (有来)

整流器盤

No.1 No.2

125 V DC

SiD

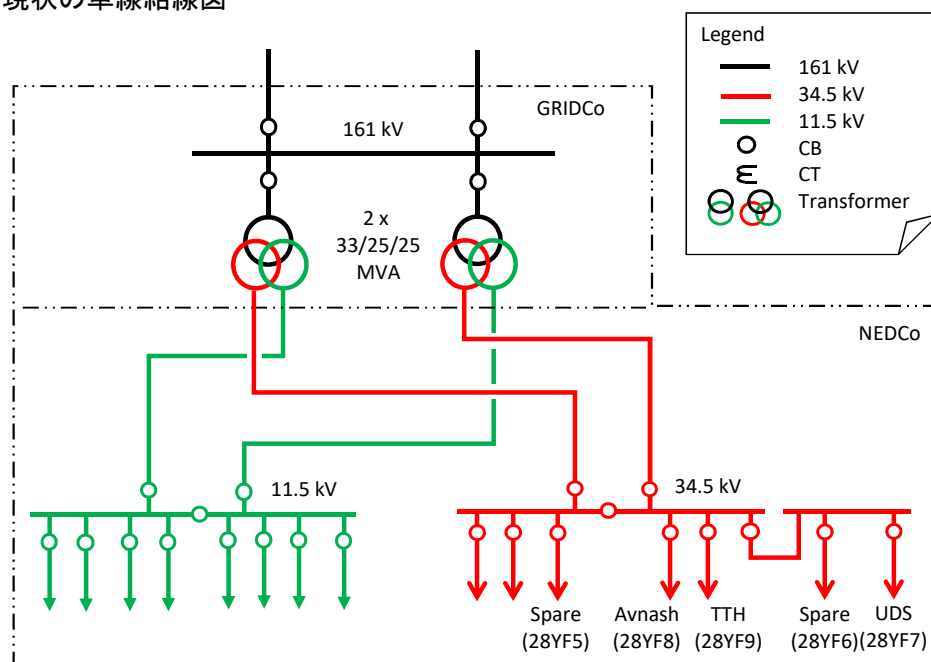
Battery

直流分電盤

125 V DC

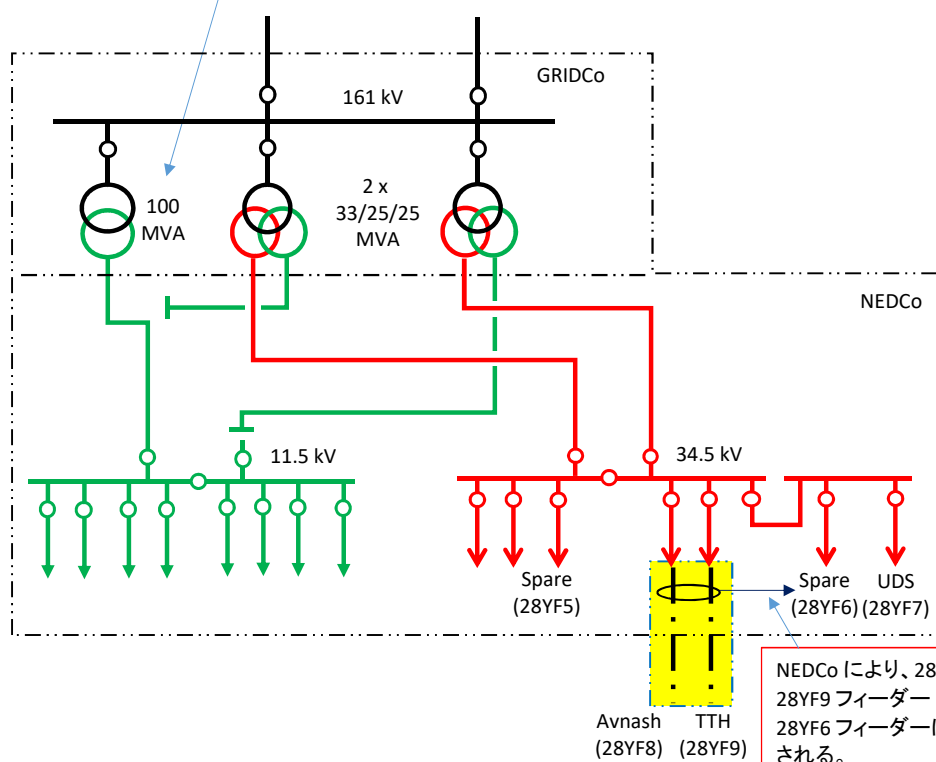
タマレBSP変電所 34.5 kVケーブル接続ステップ図

現状の単線結線図

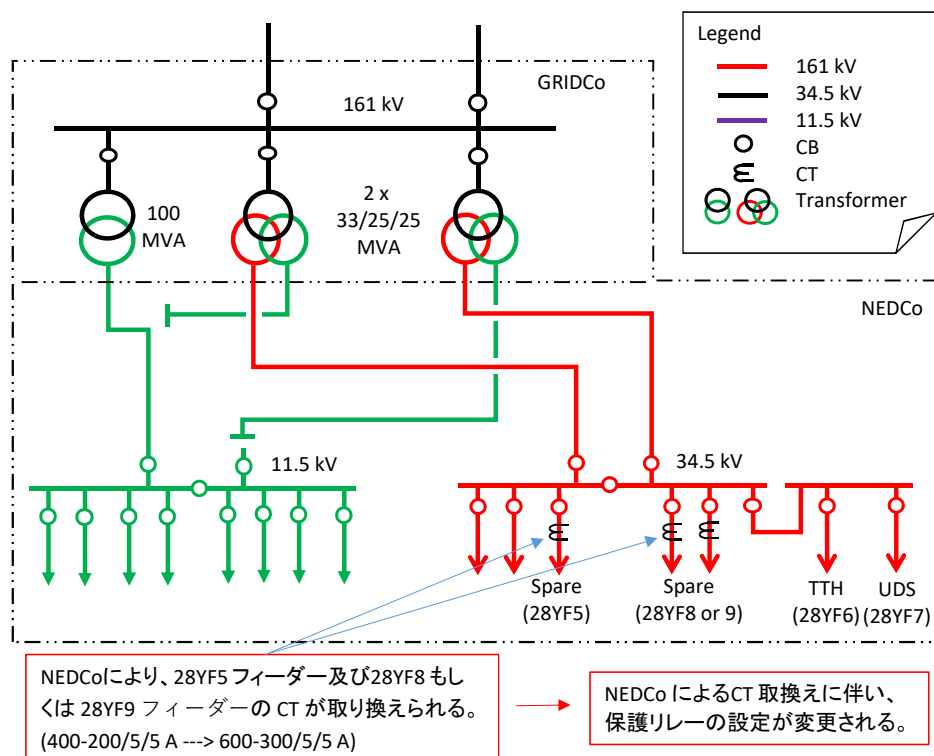


ステップ 1: 100 MVA 変圧器の設置 (GRIDCo) 及び34.5 kV 配電線用ケーブルの接続換え (NEDCo)

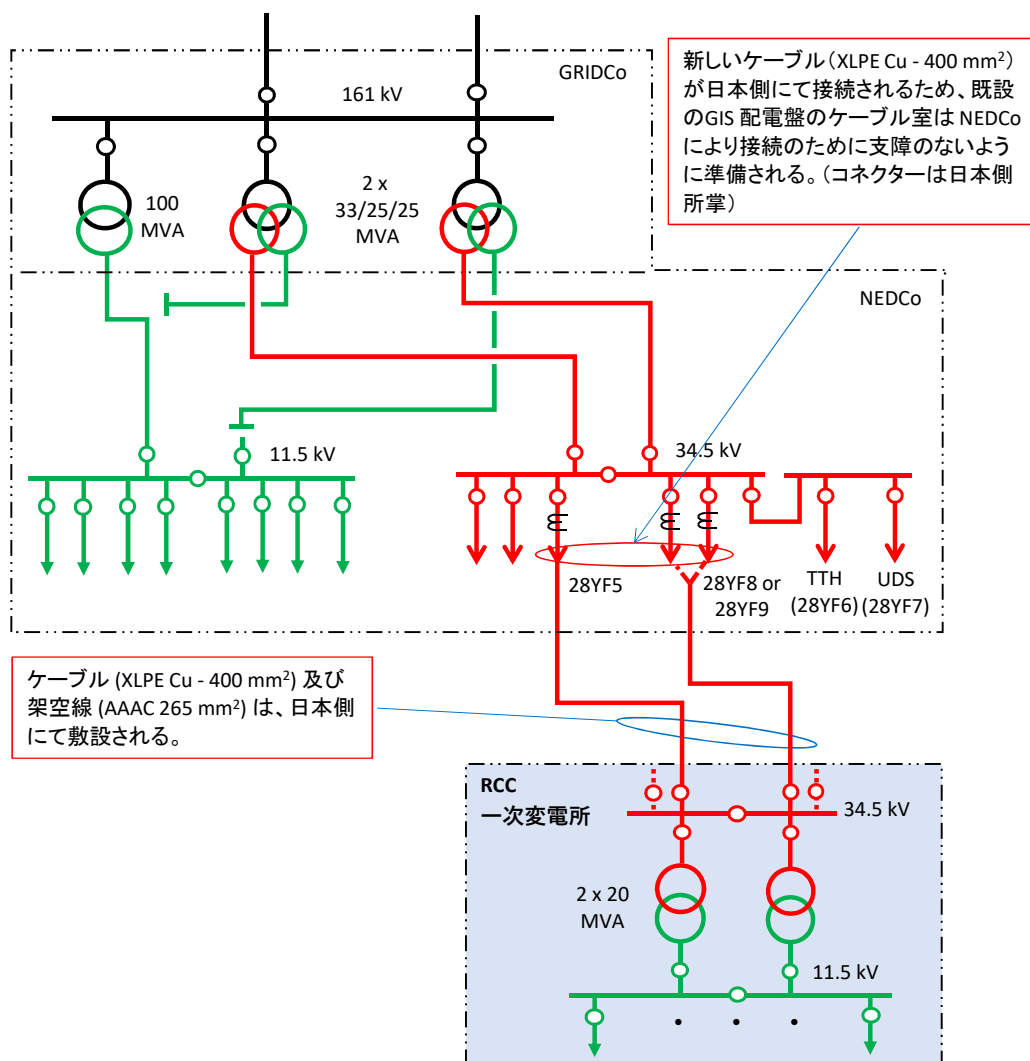
GRIDCo は 100 MVA、161/11.5 kV 変圧器を2023年第一四半期中に設置し、現在の33/25/25 MVA 変圧器の11.5 kV 負荷をこの100 MVA 変圧器に移行する予定である。



ステップ 2: 34.5 kV 予備フィーダーの変流器取換え (NEDCo)



ステップ 3: 34.5 kV 準送電線の敷設・接続



RCC一次変電所 SCADA信号一覧

SS-04

注) SCADAシステムとの取合いは基本的にインターフェース盤で行なう。

国際標準規格プロトコルに適合したインテリジェント電子装置等においてはその接続ポートを取合い点にしてもよい。

Item No.	Description	Category				
		Analogue Output	Pulse Output	Single Digital Output	Double Digital Output	Command Input
1.	34.5 kV Switchgear					
1.1	Current (34.5 kV Line) A	4	-	-	-	-
1.2	Current (34.5 kV Line) B	4	-	-	-	-
1.3	Current (34.5 kV Line) C	4	-	-	-	-
1.4	Voltage (34.5 kV Bus) A	2	-	-	-	-
1.5	Voltage (34.5 kV Bus) B	2	-	-	-	-
1.6	Voltage (34.5 kV Bus) C	2	-	-	-	-
1.7	Active Power (kW) (34.5 kV Line)	4	-	-	-	-
1.8	Reactive Power (kvar) (34.5 kV Line)	4	-	-	-	-
1.9	Active Energy (kWh) (34.5 kV Line)	-	4	-	-	-
1.10	Circuit Breaker Open/Close	-	-	-	8	-
1.11	Circuit Breaker Open	-	-	-	-	8
1.12	Circuit Breaker Close	-	-	-	-	8
1.13	Circuit Breaker Disconnected Position	-	-	8	-	-
1.14	Selector Switch Local/Remote	-	-	-	8	-
1.15	125 V DC Supply	-	-	8	-	-
1.16	Main Protection Operated (50/51)	-	-	8	-	-
1.17	Back-up Protection Operated (Others)	-	-	8	-	-
1.18	Protection DC Supply	-	-	8	-	-
1.19	Earthing Switch Open	-	-	7	-	-
1.20	Earthing Switch Close	-	-	7	-	-
1.21	Trip Circuit Supervision	-	-	8	-	-
	Subtotal	26	4	62	16	16

2.	11.5 kV Switchgear					
2.1	Current (11.5 kV Line) A	10	-	-	-	-
2.2	Current (11.5 kV Line) B	10	-	-	-	-
2.3	Current (11.5 kV Line) C	10	-	-	-	-
2.4	Current (Transformer feeder) A	2	-	-	-	-
2.5	Current (Transformer feeder) B	2	-	-	-	-
2.6	Current (Transformer feeder) C	2	-	-	-	-
2.7	Voltage (11.5 kV Bus) A	2	-	-	-	-
2.8	Voltage (11.5 kV Bus) B	2	-	-	-	-
2.9	Voltage (11.5 kV Bus) C	2	-	-	-	-
2.10	Active Power (kW) (11.5 kV Line)	10	-	-	-	-
2.11	Reactive Power (kW) (11.5 kV Line)	10	-	-	-	-
2.12	Active Energy (kWh) (34.5 kV Line)	-	10	-	-	-
2.13	Active Power (kW) (Transformer)	2	-	-	-	-
2.14	Reactive Power (kvar) (Transformer)	2	-	-	-	-
2.15	Circuit Breaker Open/Close	-	-	-	13	-
2.16	Circuit Breaker Open	-	-	-	-	13
2.17	Circuit Breaker Close	-	-	-	-	13

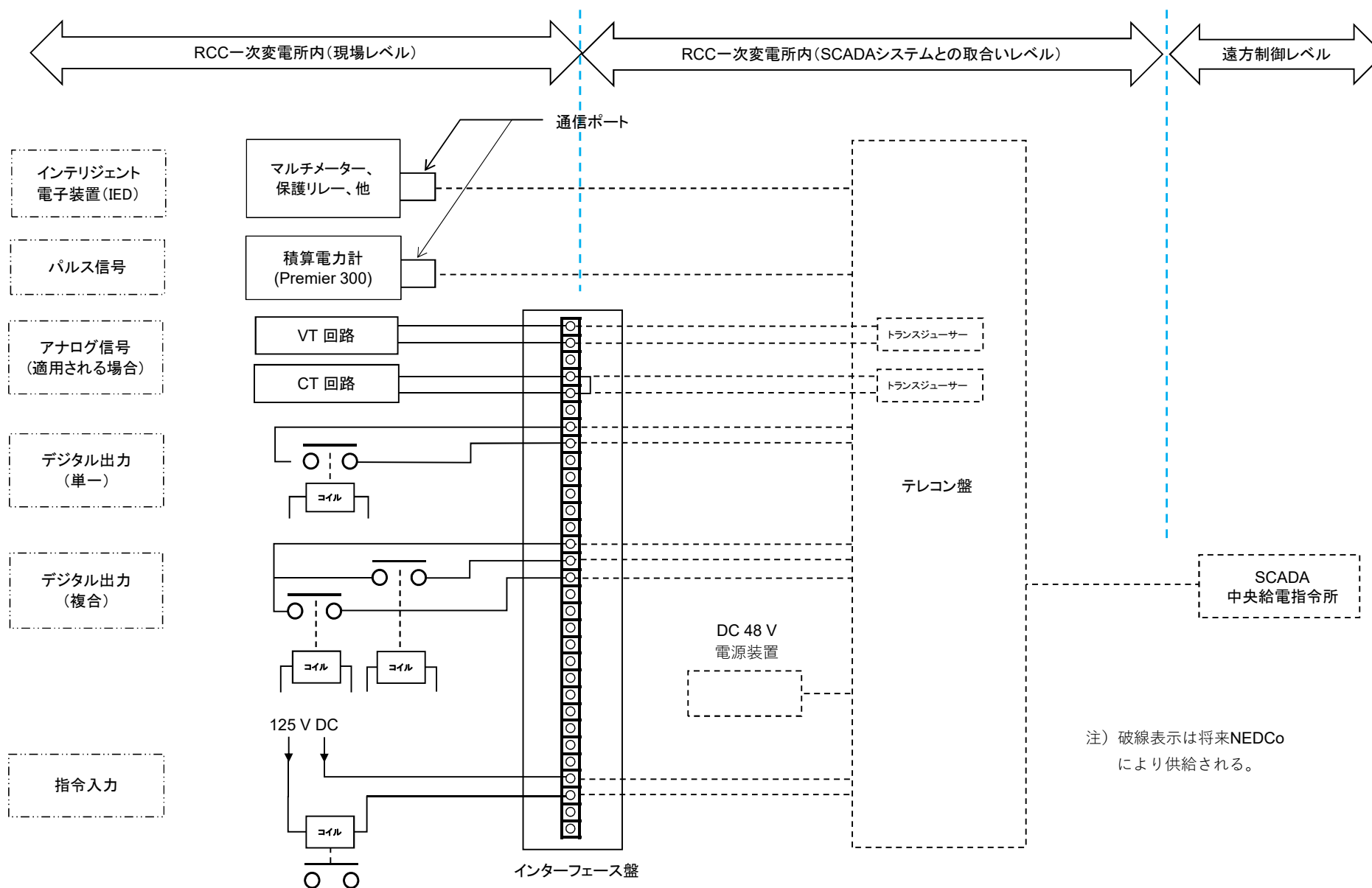
Item No.	Description	Category				
		Analogue Output	Pulse Output	Single Digital Output	Double Digital Output	Command Input
2.18	Circuit Breaker Disconnected Position	-	-	13	-	-
2.19	Selector Switch Local/Remote	-	-	-	13	-
2.20	125 V DC Supply	-	-	13	-	-
2.21	Main Protection Operated (50/51)	-	-	13	-	-
2.22	Back-up Protection Operated (Others)	-	-	13	-	-
2.23	Protection DC Supply	-	-	13	-	-
2.24	Earthing Switch Open	-	-	12	-	-
2.25	Earthing Switch Close	-	-	12	-	-
2.26	Trip Circuit Supervision	-	-	13	-	-
	Subtotal	66	10	102	26	26

3.	Main Transformer					
3.1	Selector Switch Local/Remote	-	-	-	2	-
3.2	Tap changer Raise	-	-	-	-	2
3.3	Tap changer Lower	-	-	-	-	2
3.4	Tap change in progress	-	-	2	-	-
3.5	Tap change incomplete	-	-	2	-	-
3.6	AVR/Manual control selected	-	-	-	2	-
3.7	Tap changer AVR selected	-	-	-	-	2
3.8	Tap changer Manual selected	-	-	-	-	2
3.9	Tap changer Position	-	-	2	-	-
3.10	Tap changer Out of Step	-	-	2	-	-
3.11	Tap changer AVR failure	-	-	2	-	-
3.12	Tap changer Motor failure	-	-	2	-	-
3.13	Main Protection Operated (87T, 26, 96-2)	-	-	2	-	-
3.14	Back-up Protection Operated (others)	-	-	2	-	-
3.15	Temperature Alarm	-	-	2	-	-
3.16	Buchholz Alarm (96-1)	-	-	2	-	-
3.17	Oil Level Low Alarm	-	-	2	-	-
	Subtotal	0	0	22	4	8

4.	Power supply					
4.1	MCCB trip (AC Distribution panel)	-	-	1	-	-
4.2	Charger failure	-	-	2	-	-
4.3	Battery failure	-	-	1	-	-
4.4	MCCB trip (DC Distribution panel)	-	-	1	-	-
	Subtotal	0	0	5	0	0
	Total	92	14	191	46	50

SCADA システム(将来)との取合い概念図

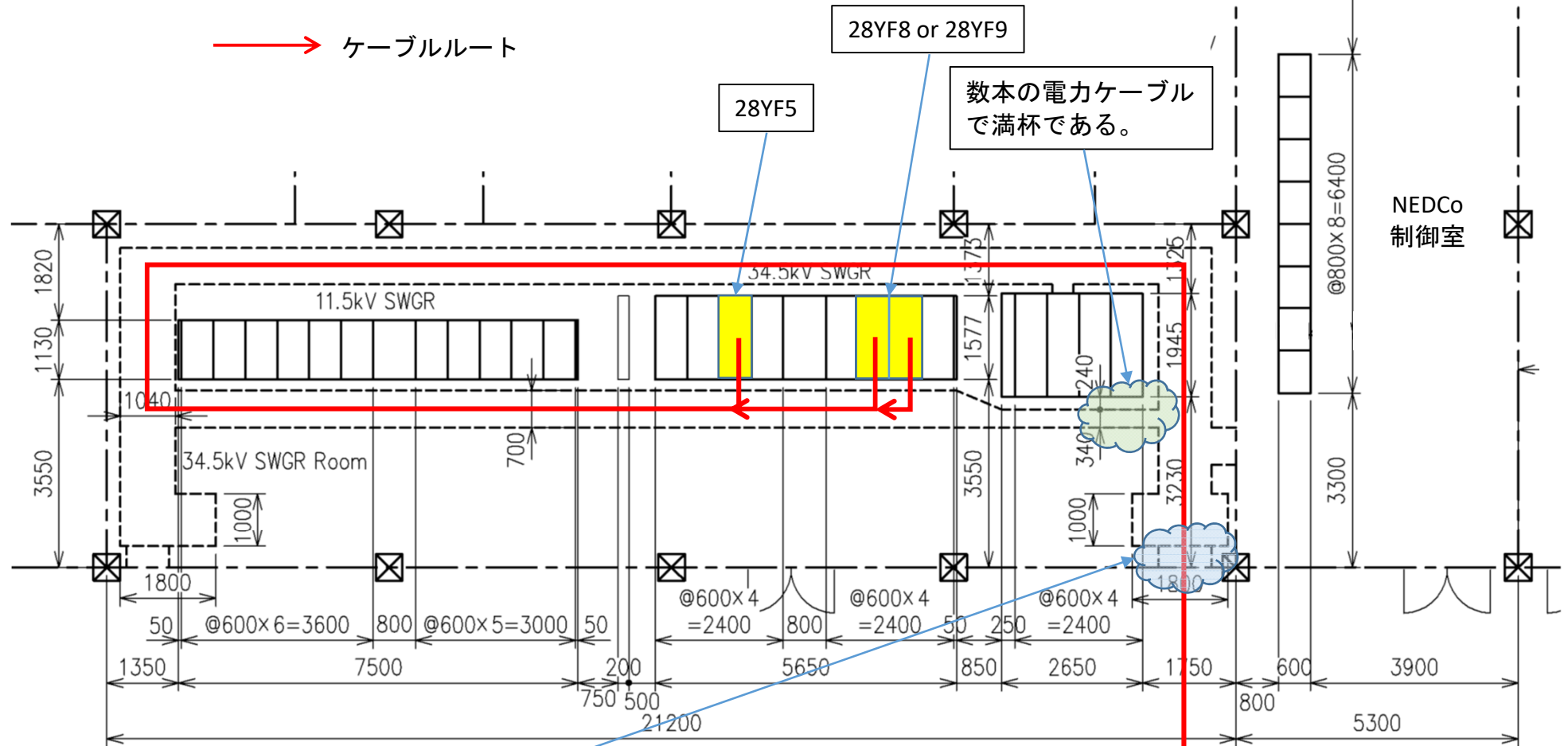
SS-04-1



タマレBSP変電所 配電盤室及び制御室配置図

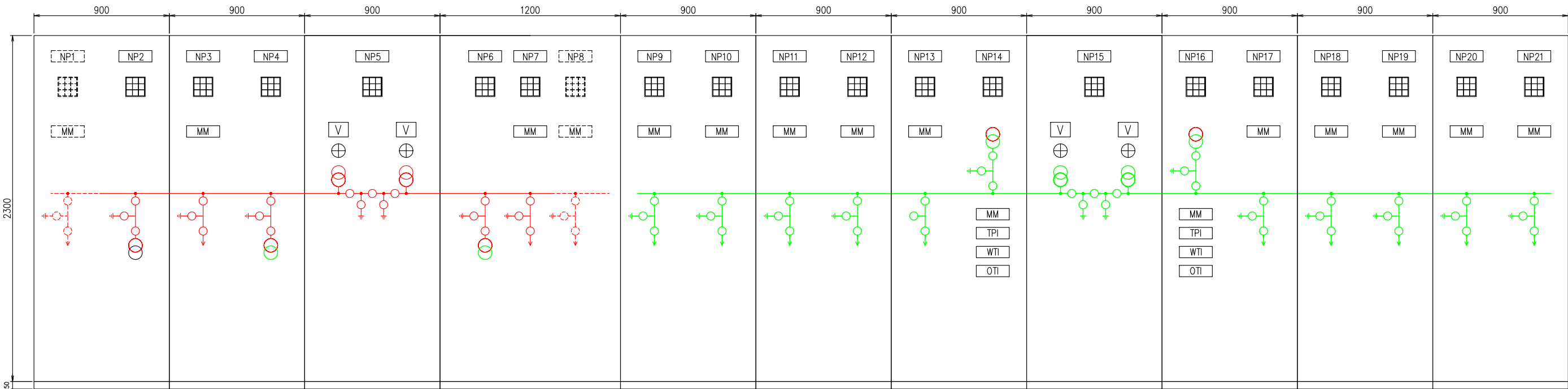
SS-05

→ ケーブルルート



壁側のケーブルピットに4個の空きパイプ（直径 150 mm）があるが、これらの4個のパイプはRCC一次変電所向け電力ケーブル用としてNEDCoにより確保されること。

2回線 x 3本 x 単芯400 mm² CV
ケーブル → 屋外マンホールへ



凡例

34.5kV

11.5kV

433V

開閉器、接地装置

変圧器

警報窓

MM

マルチメーター

TPI

変圧器タップ位置表示器

WTI

変圧器巻線温度計

OTI

変圧器絶縁油温度計

V

電圧計

⊕

相切替スイッチ

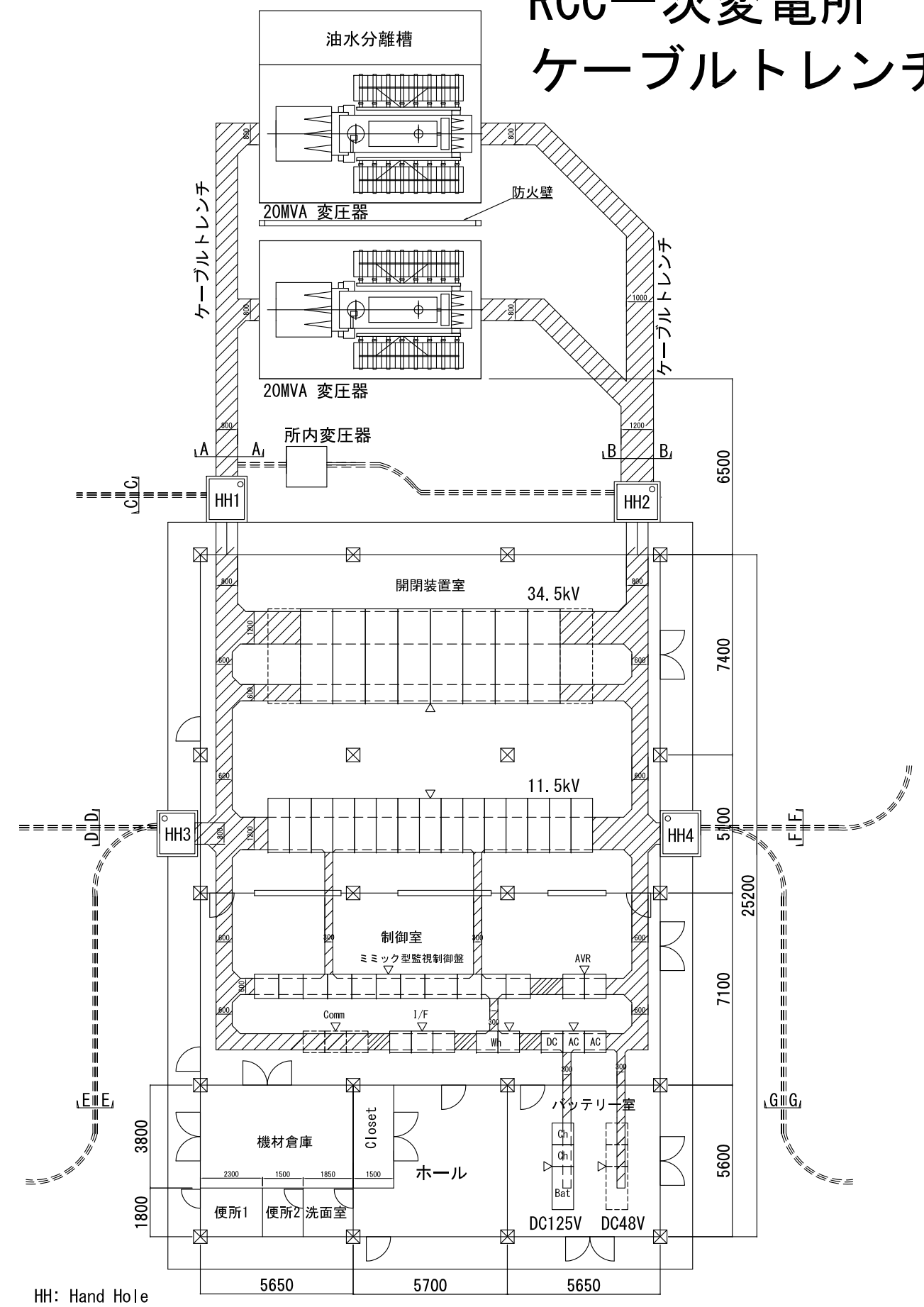
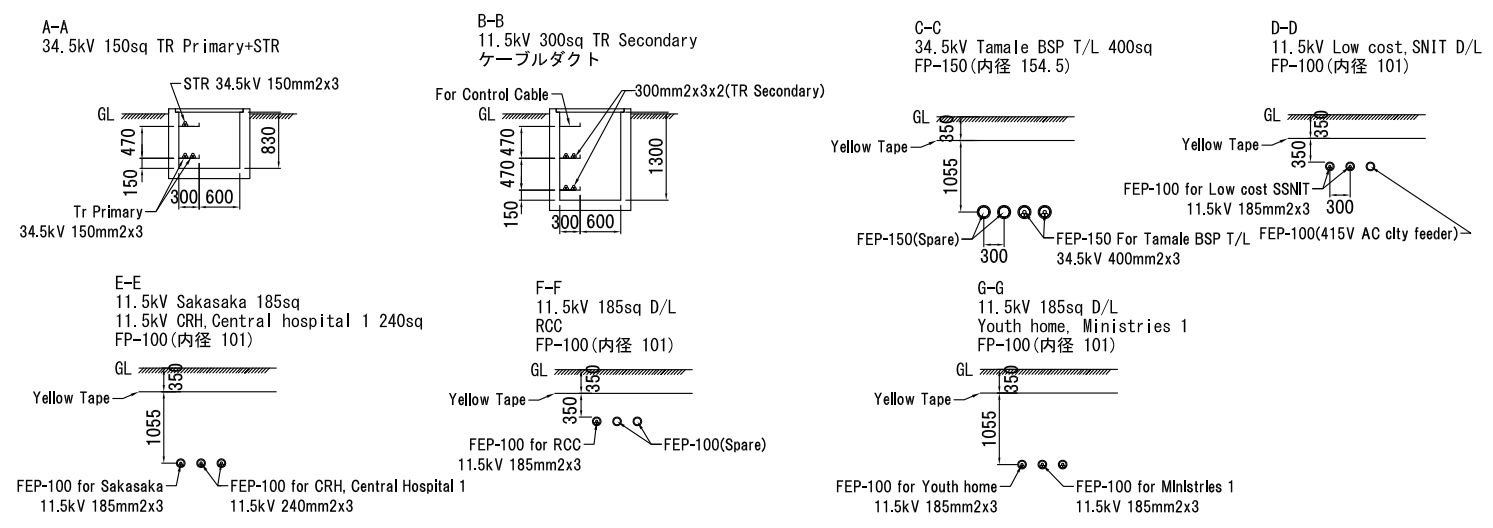
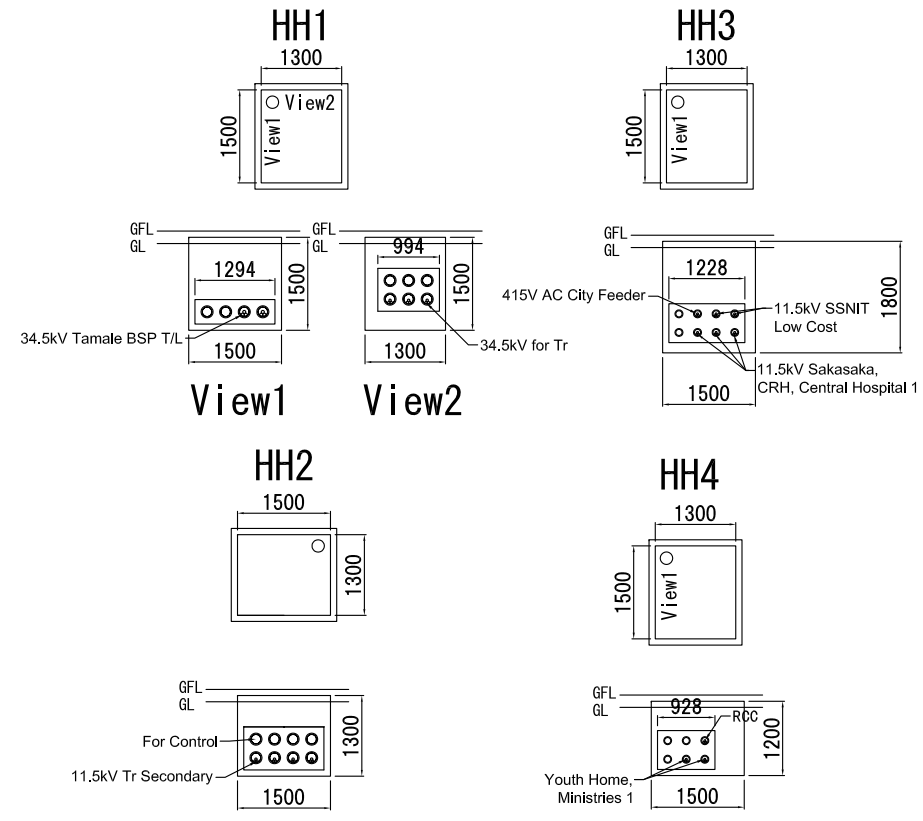
名称銘板

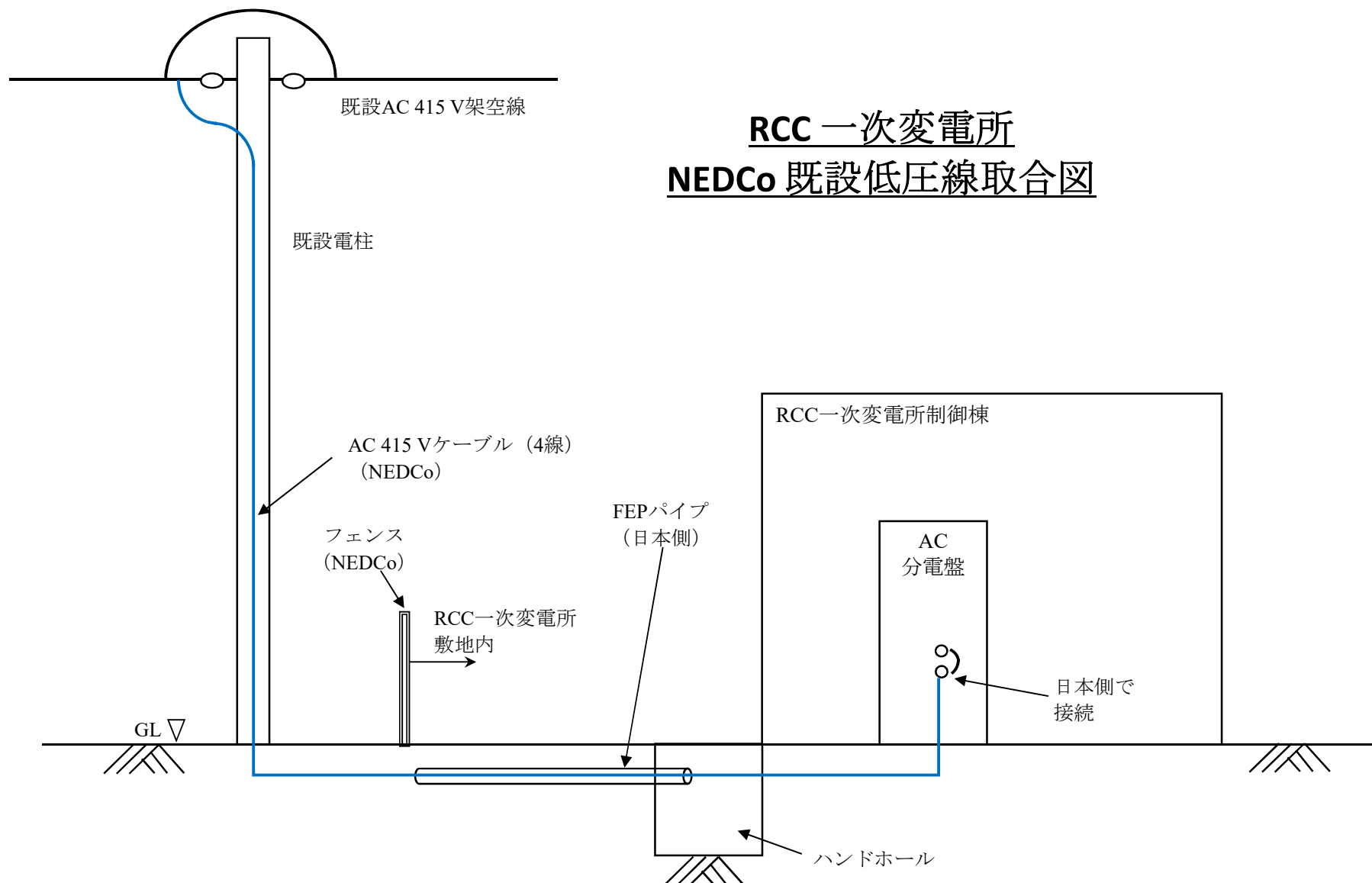
NP	名称	NP	名称
1	Future (Fuo No.1)	11	Ministries 1
2	Station Transformer	12	CRH
3	Tamale BSP No.1	13	Youth home
4	No.1 Transformer (Primary)	14	No.1 Transformer (Secondary)
5	Bus Tie (34.5kV)	15	Bus Tie (11.5kV)
6	No.2 Transformer (Primary)	16	No.2 Transformer (Secondary)
7	Tamale BSP No.2	17	Sakasaka
8	Future (Fuo No.2)	18	Low Cost
9	Central Hospital 2 (Spare)	19	SSNIT
10	RCC	20	Central Hospital 1
		21	Ministries 2 (Spare)

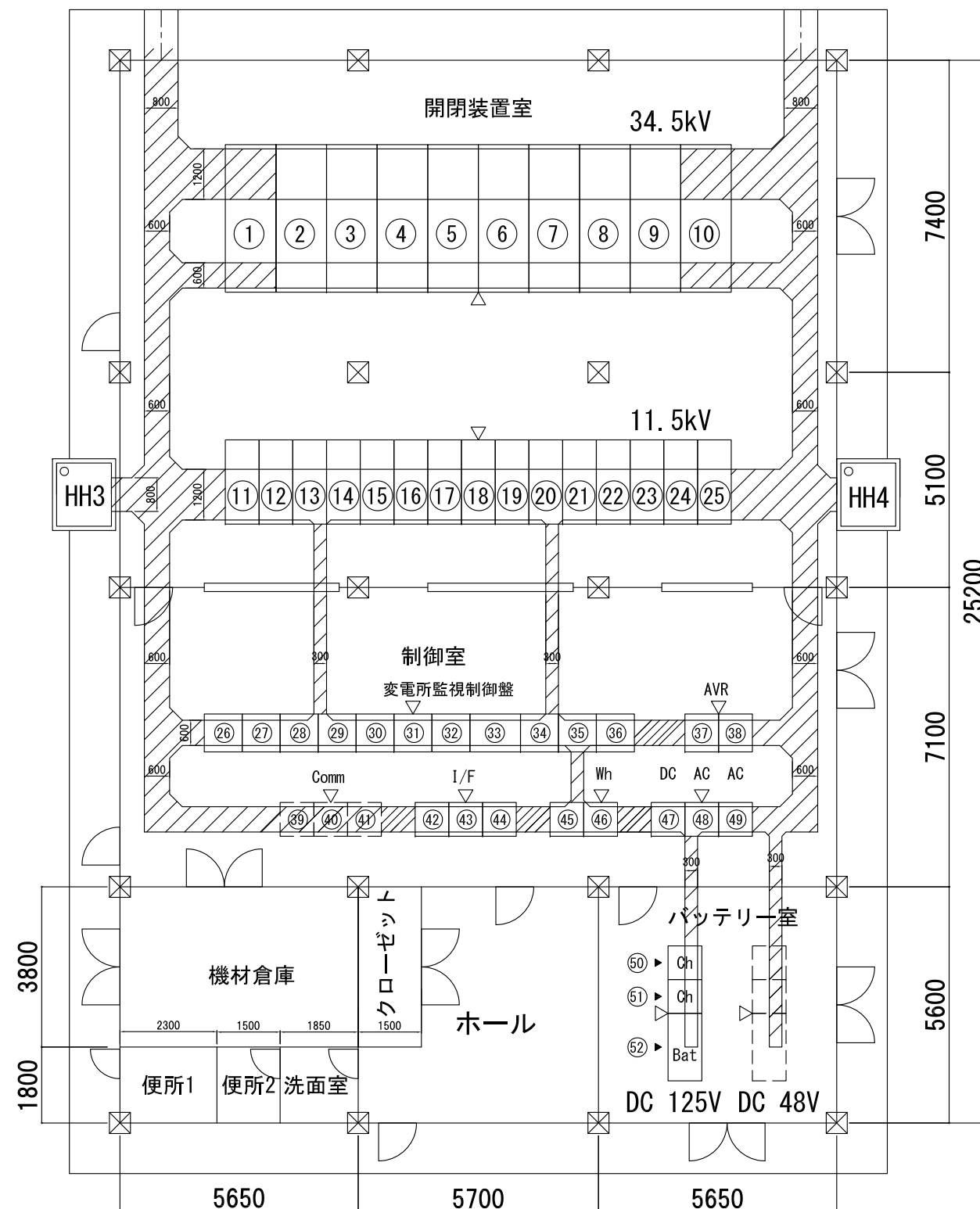
SS-06
変電所監視制御盤
盤面図

A6-11

SS-07 RCC一次変電所 ケーブルトレンチ図







34.5kV 開閉器盤

No	盤名称
1	Future (Fuo No.1)
2	Station Service Transformer
3	Tamale BSP No.1
4	No.1 Transformer (Pri)
5	VT-1
6	Bus Tie (34.5kV)
7	VT-2
8	No.2 Transformer (Pri)
9	Tamale BSP No.2
10	Future (Fuo No.2)

11.5kV 開閉器盤

No	盤名称	No	盤名称
11	Ministries 2 (Spare)	21	Youth Home
12	Central Hospital 1	22	CHR
13	SSNIT	23	Ministries 1
14	Low Cost	24	RCC
15	Sakasaka	25	Central Hospital 2 (Spare)
16	No.2 Transformer (Sec)		
17	VT-2		
18	Bus Tie (11.5kV)		
19	VT-1		
20	No.1 Transformer (Sec)		

変電所監視制御盤

No	盤名称
26	Central Hospital 1 / Ministries 2 (Spare)
27	Low Cost / SSNIT
28	No.2 Transformer (Sec) / Sakasaka
29	Bus Tie (11.5kV)
30	Youth Home / No.1 Transformer (Sec)
31	Ministries 1 / CRH
32	Central Hospital 2 (Spare) / RCC
33	No.2 Transformer (Pri) / Tamale BSP No2 / Future (Fuo No.2)
34	Bus Tie (34.5kV)
35	Tamale BSP No1 / No.1 Transformer (Pri)
36	Future (Fuo No.1) / Station Service Transformer

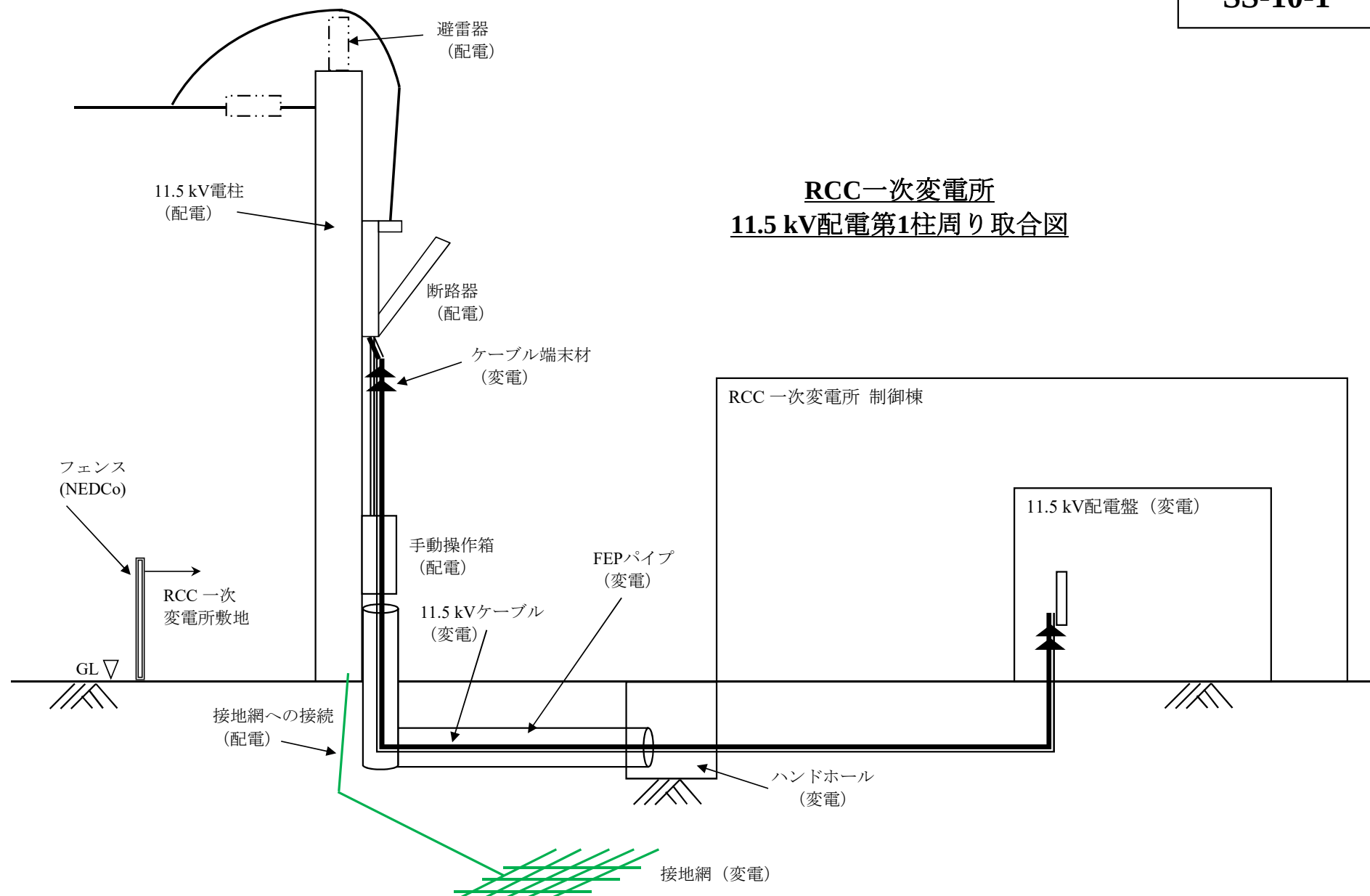
その他

No	盤名称	No	盤名称
37	AVR-2	47	DC Distribution Panel
38	AVR-1	48	AC Distribution Panel-2
39	将来用 (Communication-3)	49	AC Distribution Panel-1
40	将来用 (Communication-2)	50	DC Charger Panel-2
41	将来用 (Communication-1)	51	DC Charger Panel-1
42	Interface Panel-3	52	Battery Panel
43	Interface Panel-2		
44	Interface Panel-1		
45	Watthour Panel-2		
46	Watthour Panel-1		

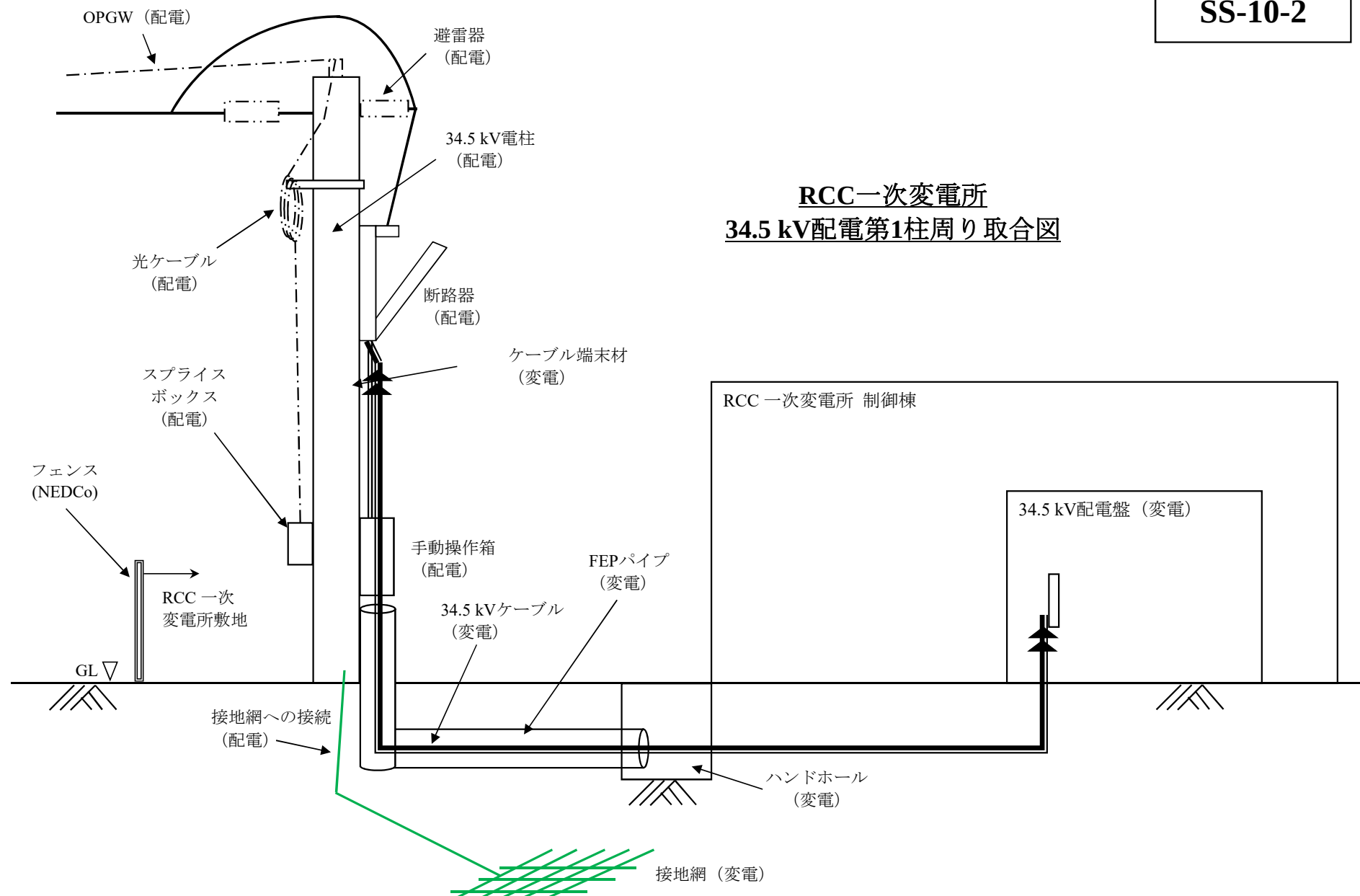
注) 盤面数については契約者の設計により変更となる。

SS-09
制御棟配置図

SS-10-1



SS-10-2

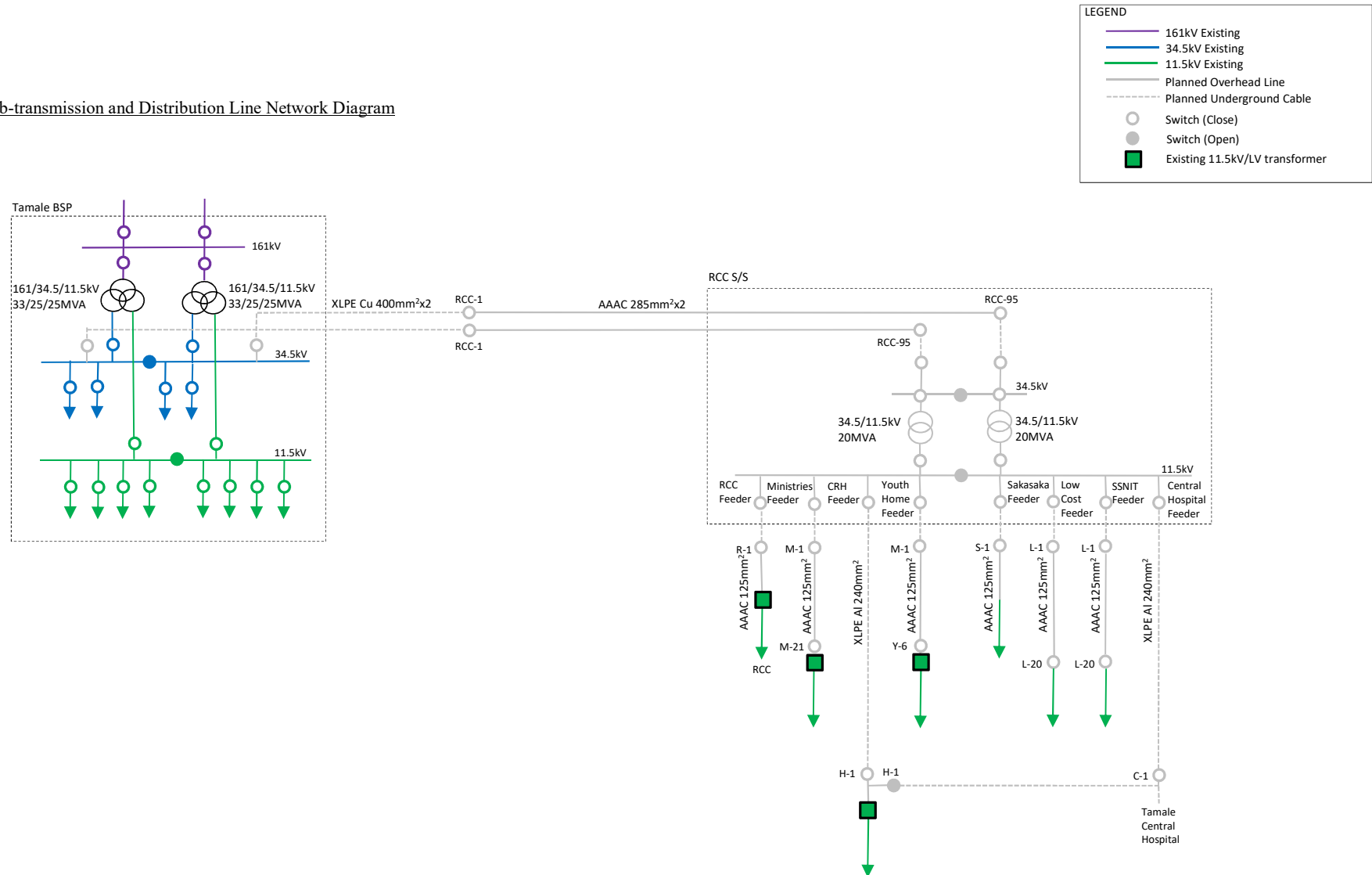


送配電設備

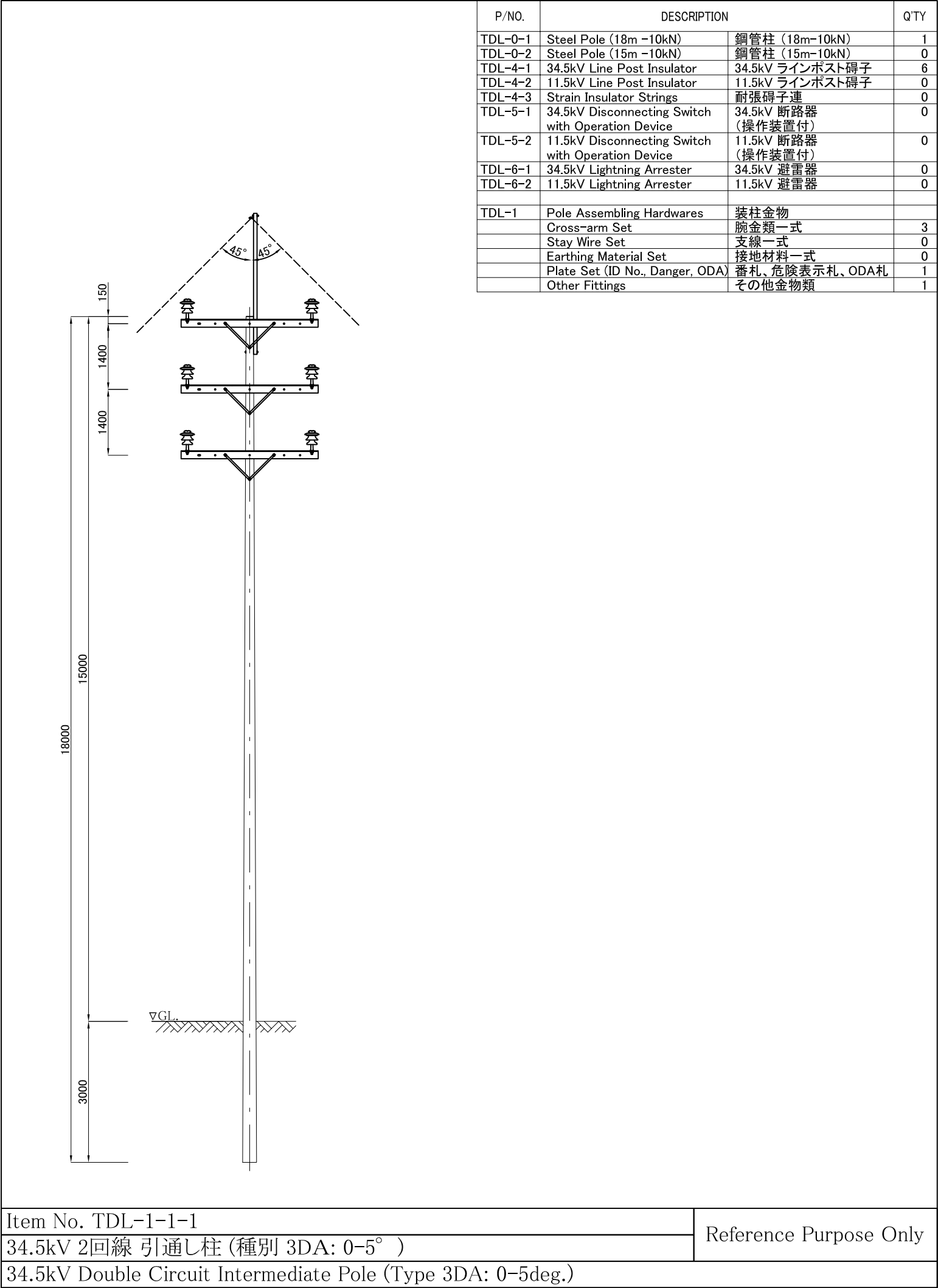


LEGEND							
架空線		34.5kV 2 回線	約4.64km	地中線		34.5kV 2 回線	約0.90km
		11.5kV 2 回線	約1.00km			11.5kV 2 回線	約1.80km
		11.5kV 1 回線	約1.26km			11.5kV 1 回線	約0.15km

Sub-transmission and Distribution Line Network Diagram



TDL-02 送配電線系統図



P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	6
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	1
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-1-2

34.5kV 2回線 軽角度柱 (種別 3DB: 5-20°)

34.5kV Double Circuit Light Angle Pole (Type 3DB: 5-20deg.)

Reference Purpose Only

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	4
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-1-3

34.5kV 2回線 中角度柱 (種別 3DC: 20-60°)

34.5kV Double Circuit Middle Angle Pole (Type 3DC: 20-60deg.)

Reference Purpose Only

P/NO.		DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)		2
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)		0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子		6
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子		0
TDL-4-3	Strain Insulator Strings	耐張碍子連		12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)		0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)		0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器		0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器		0
TDL-1		Pole Assembling Hardwares	装柱金物	
		Cross-arm Set	腕金類一式	6
		Stay Wire Set	支線一式	4
		Earthing Material Set	接地材料一式	0
		Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
		Other Fittings	その他金物類	1

Item No. TDL-1-1-4

34.5kV 2回線 両引留柱 (種別 3DE)

34.5kV Double Circuit Section Pole (Type 3DE)

Reference Purpose Only

18000

2999

∇GL

45° 45° 45° 45°

STAYS

TOP VIEW

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	2
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	0
	Stay Wire Set	支線一式	4
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
	Other Fittings	その他金物類	1

Item No. TDL-1-1-5

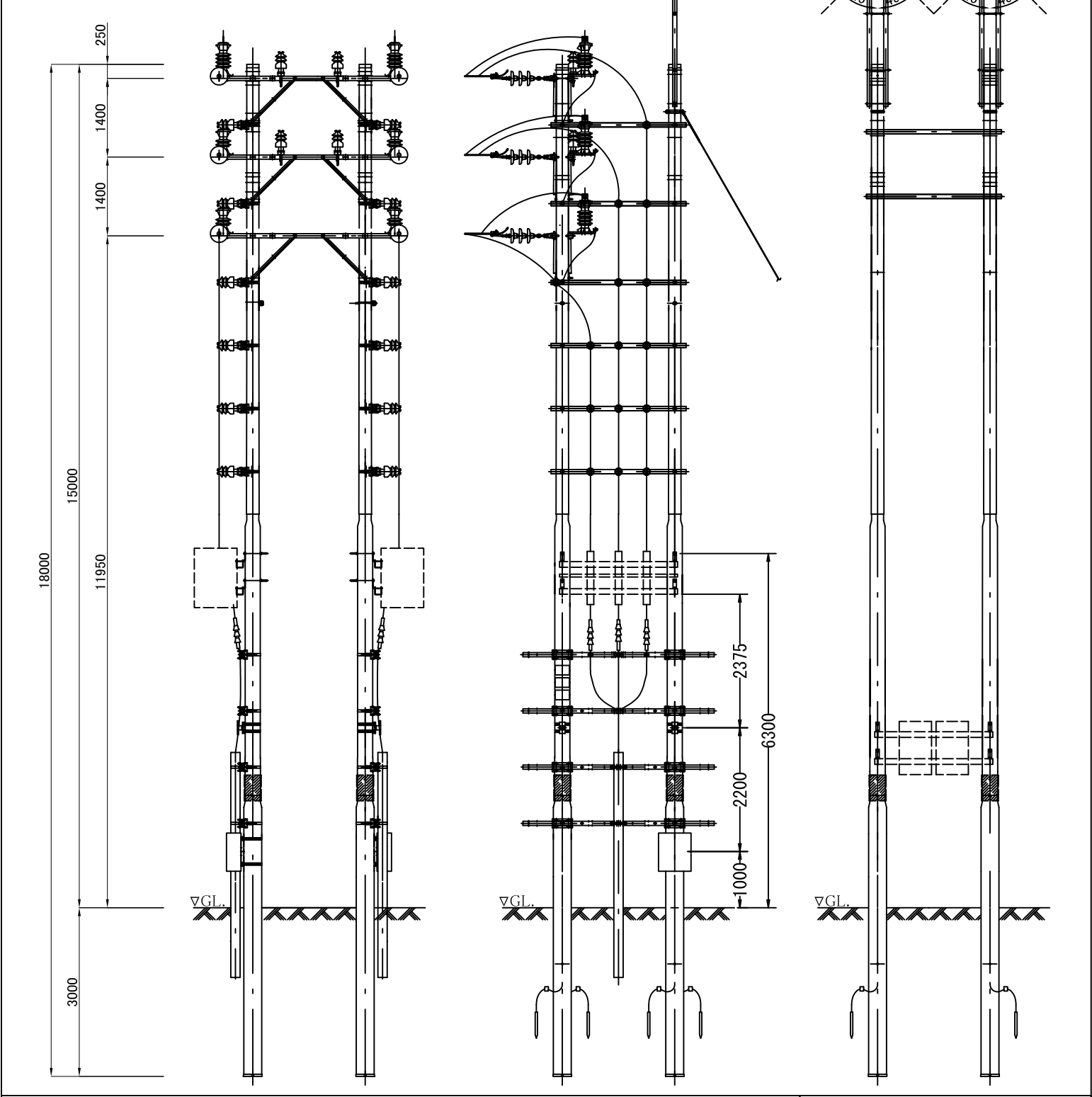
34.5kV 2回線 強角度柱 (種別 3DF: 60-90°)

34.5kV Double Circuit Heavy Angle Pole (Type 3DF: 60-90deg.)

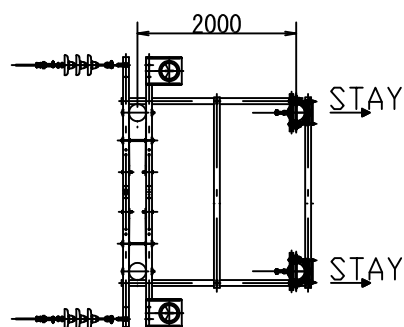
Reference Purpose Only

TDL-03 送配電線装柱図(6/22)

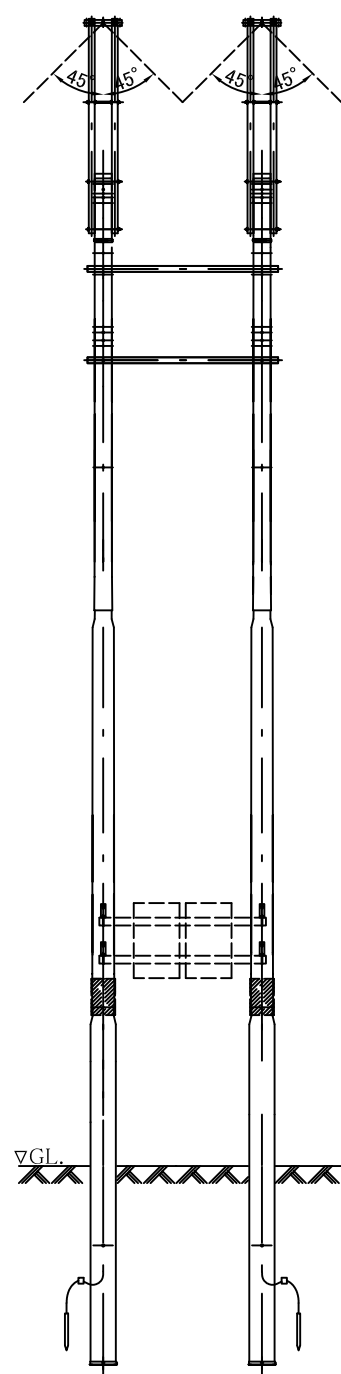
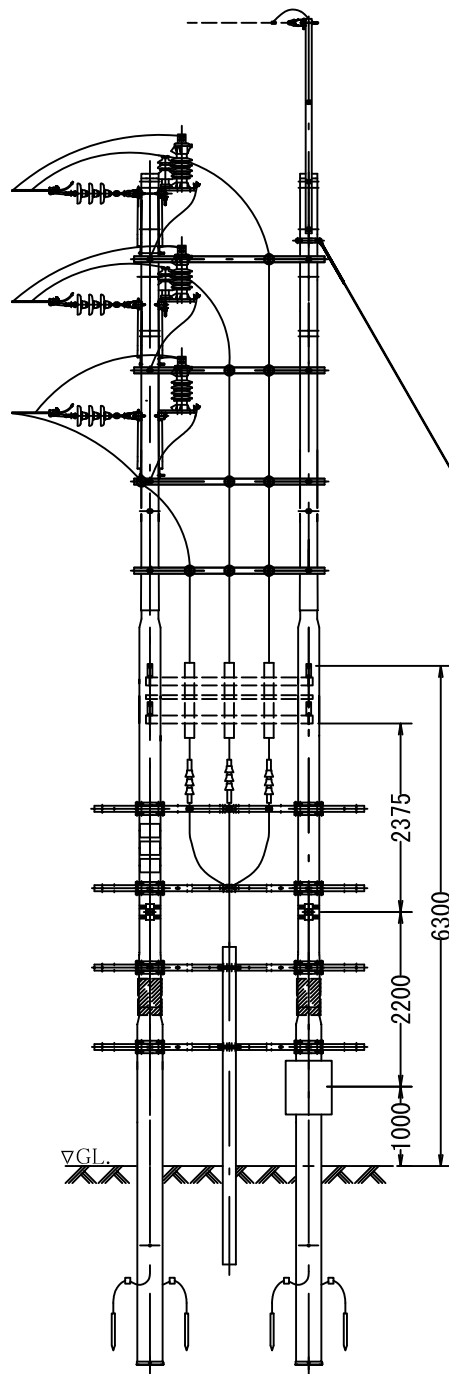
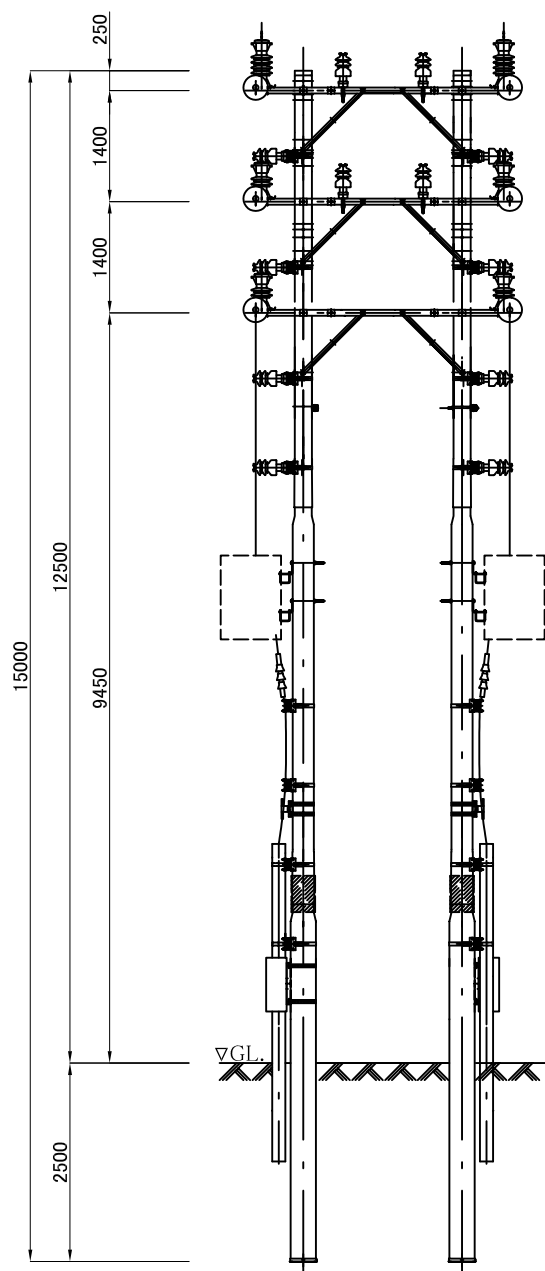
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	4
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	32
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	2
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	6
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	30
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	4
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	4
	Other Fittings	その他金物類	1



Item No. TDL-1-1-6	Reference Purpose Only
34.5kV 2回線 断路器・ケーブル立上柱 (種別 3DG)	
34.5kV Double Circuit 18m Disconnecting Switch & Cable Termination Pole (Type 3DG)	



P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	4
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	20
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	2
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	6
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardware	装柱金物	
	Cross-arm Set	腕金類一式	24
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	4
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	4
	Other Fittings	その他金物類	1



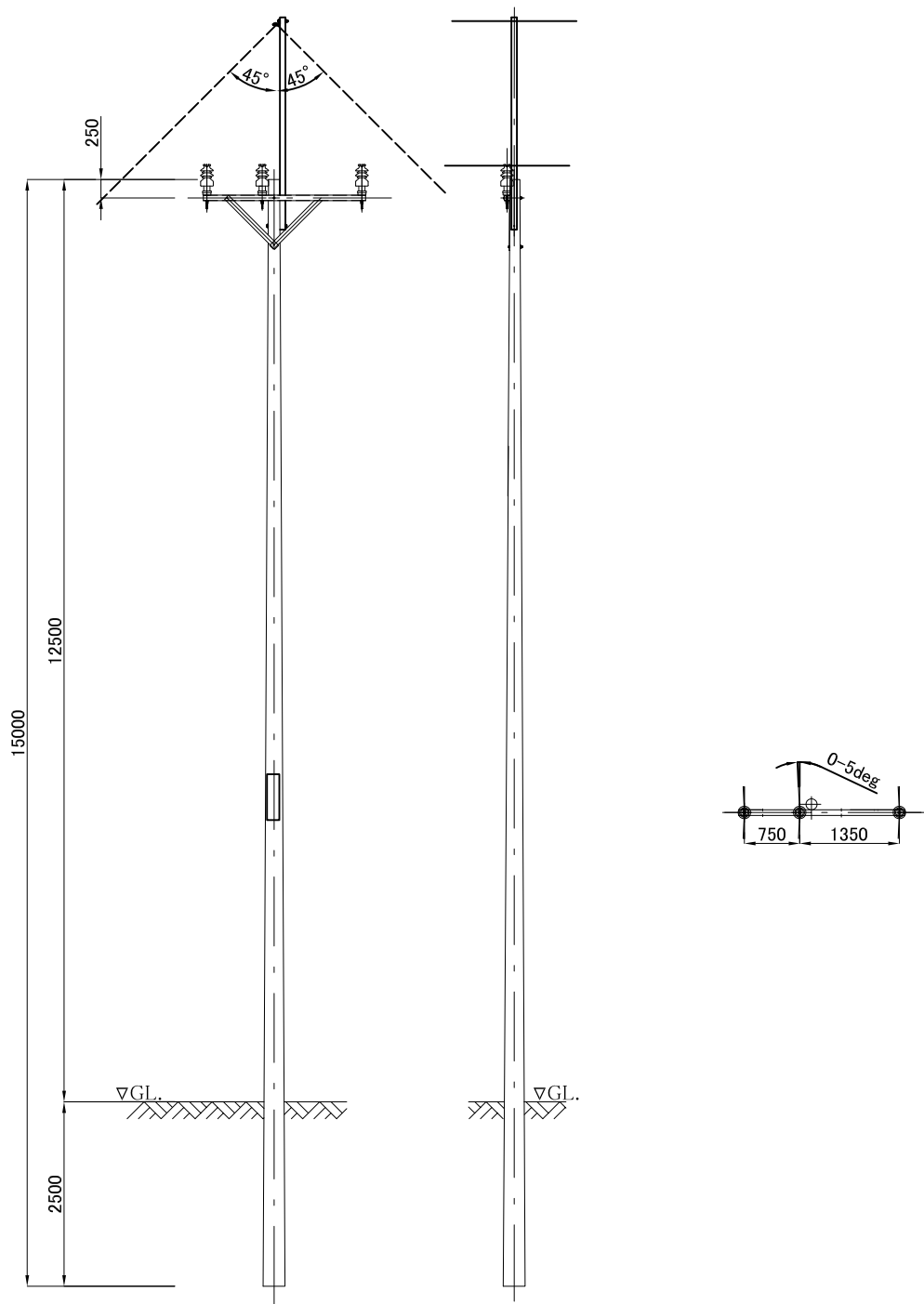
Item No. TDL-1-1-6

34.5kV 2回線 断路器・ケーブル立上柱 (種別 3DG)

Reference Purpose Only

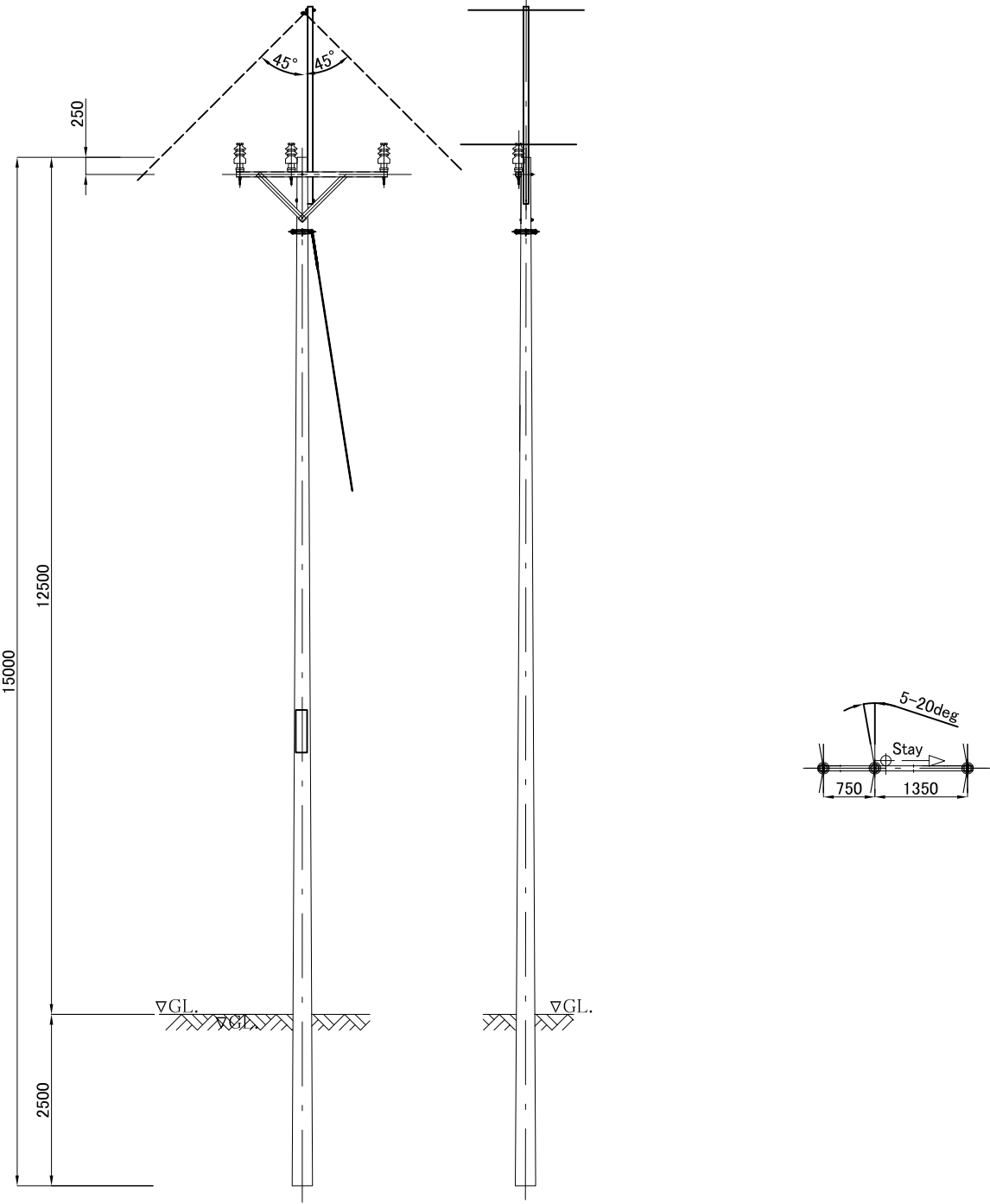
34.5kV Double Circuit 15m Disconnecting Switch & Cable Termination Pole (Type 3DG)

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	1
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	3
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	1
	Stay Wire Set	支線一式	0
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1



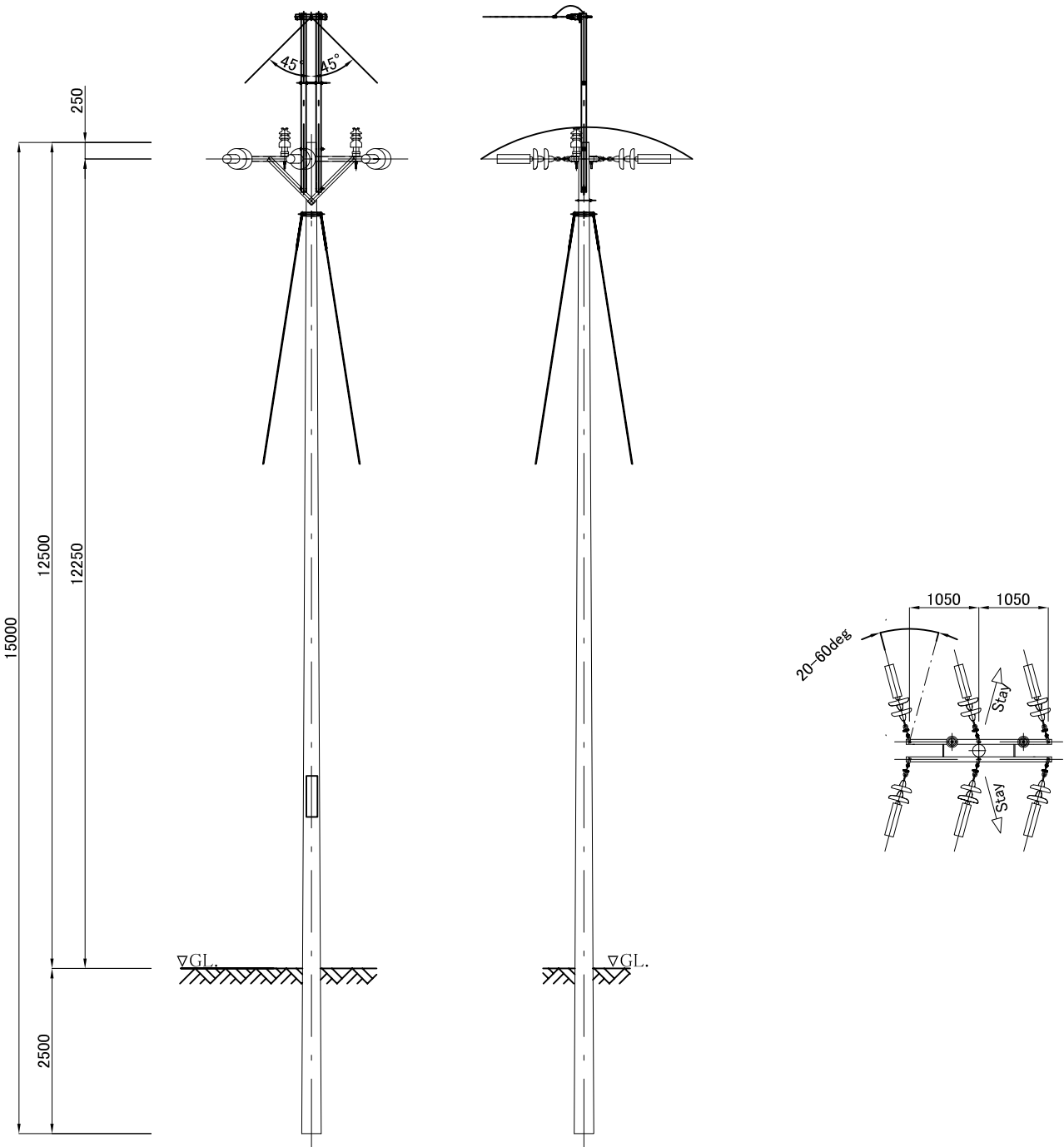
Item No. TDL-1-2-1	Reference Purpose Only
11.5kV 引通し柱 (種別 1A: 0-5°)	
11.5kV Intermediate Pole (Type 1A: Line Angle 0-5deg.)	

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	1
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	3
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	1
	Stay Wire Set	支線一式	1
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1



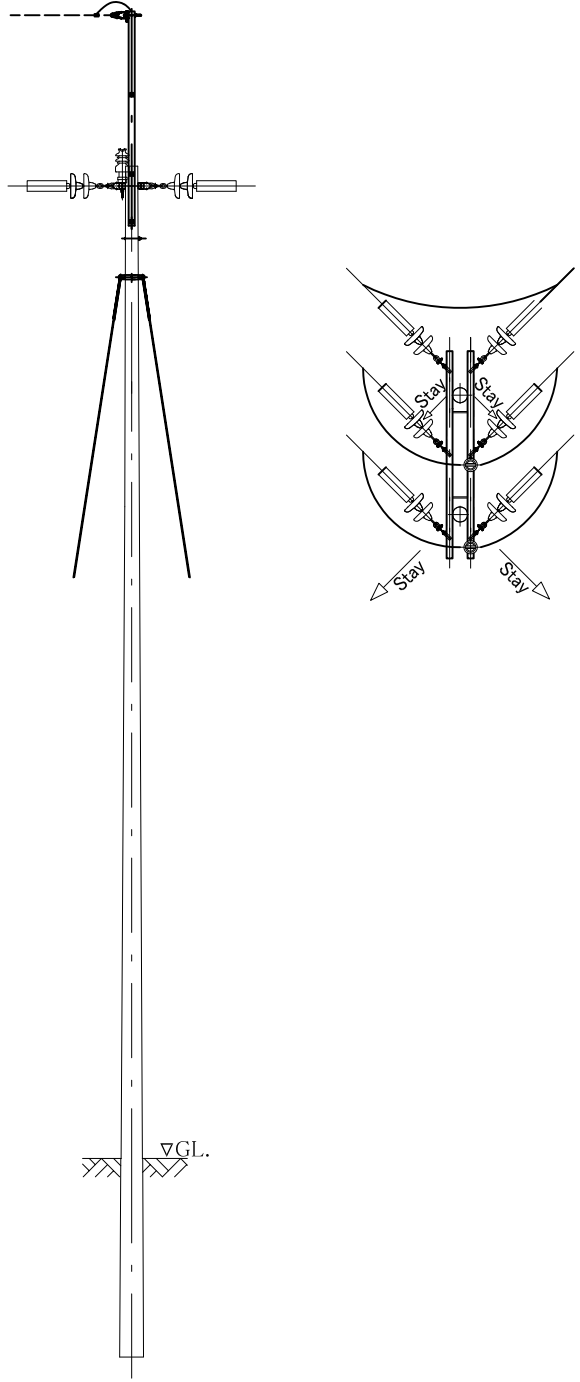
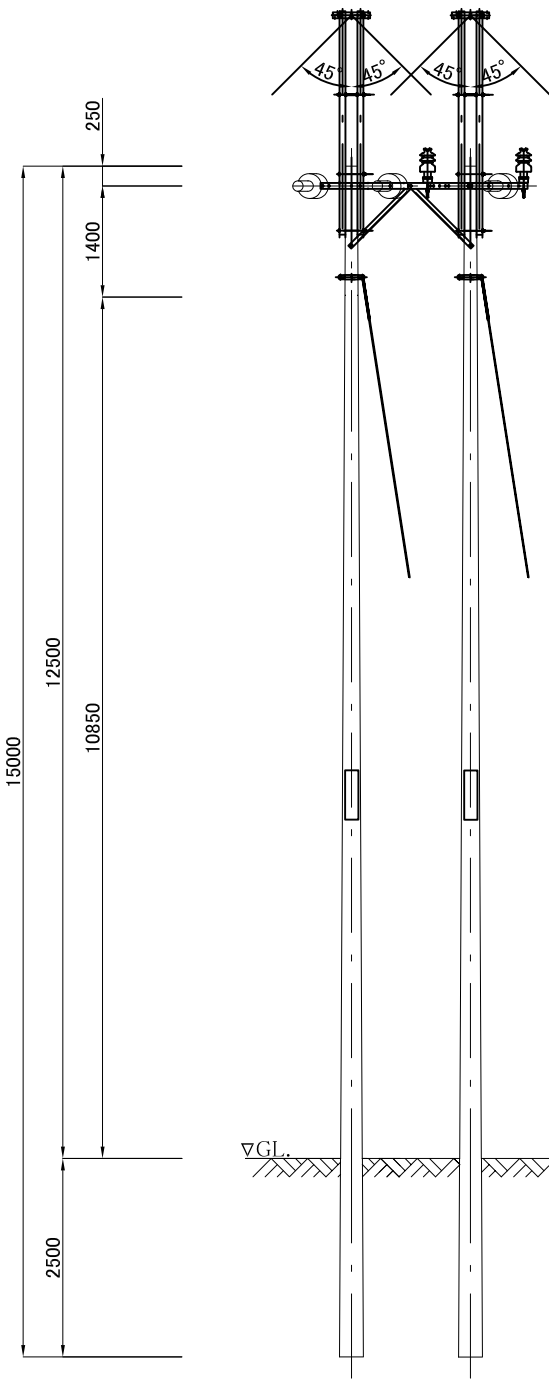
Item No. TDL-1-2-2	Reference Purpose Only
11.5kV 軽角度柱 (種別 1B: 5-20°)	
11.5kV Light Angle Pole (Type 1B: Line Angle 5-20deg.)	

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	1
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	2
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	2
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

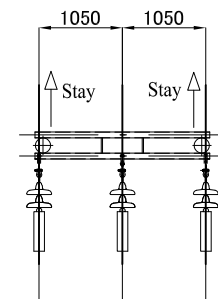
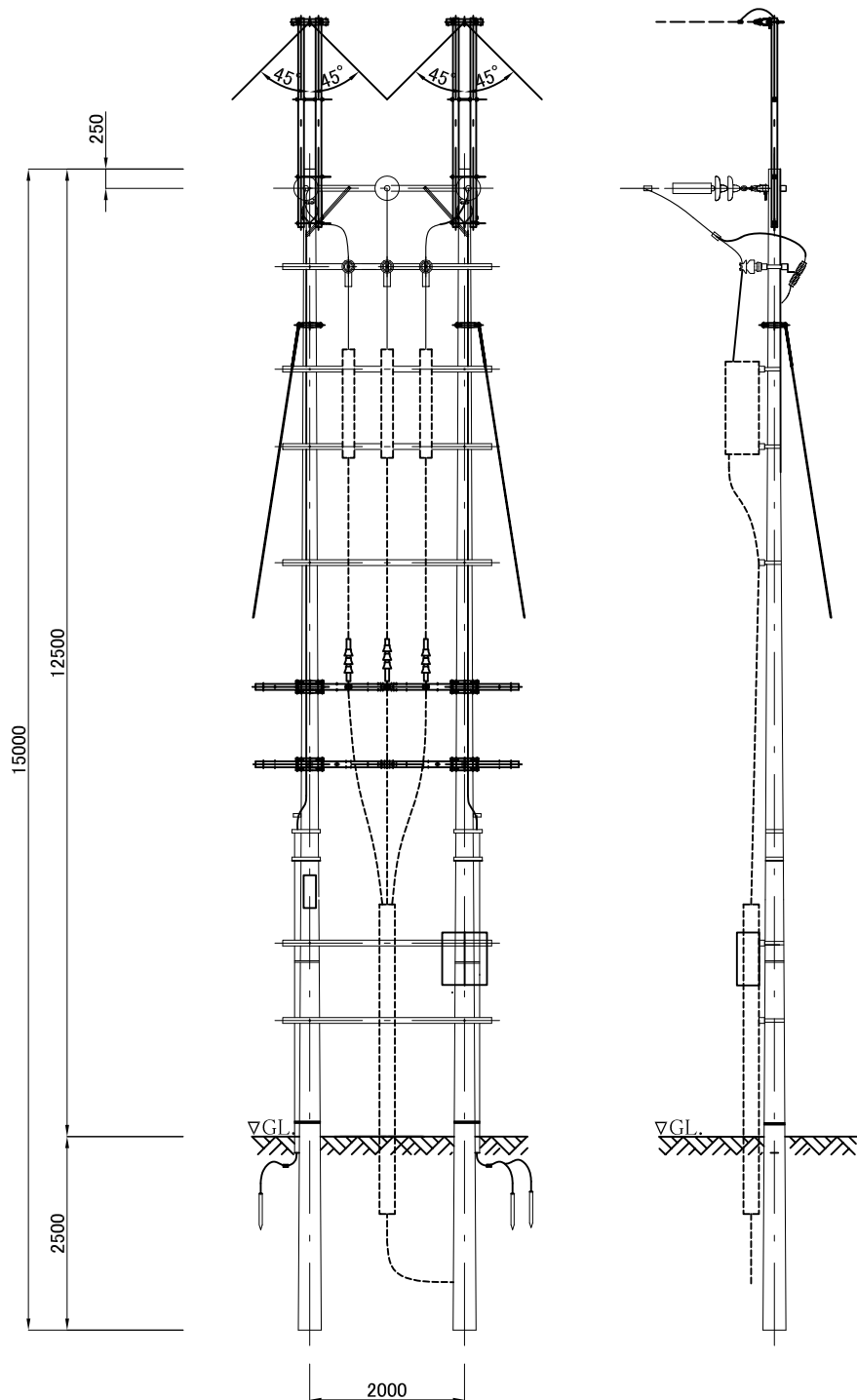


Item No. TDL-1-2-3	Reference Purpose Only
11.5kV 中角度柱 (種別 1C: 20-60°)	
11.5kV Middle Angle Pole (Type 1C: Line Angle 20-60deg.)	

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	2
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	2
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardware	装柱金物	
	Cross-arm Set	腕金類一式	2
	Stay Wire Set	支線一式	4
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
	Other Fittings	その他金物類	1



P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	2
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	3
TDL-4-3	Strain Insulator Strings	耐張碍子連	3
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	1
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	3
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	10
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	2
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
	Other Fittings	その他金物類	1



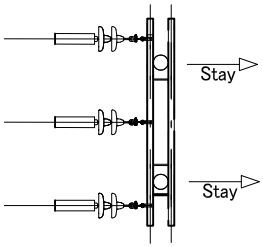
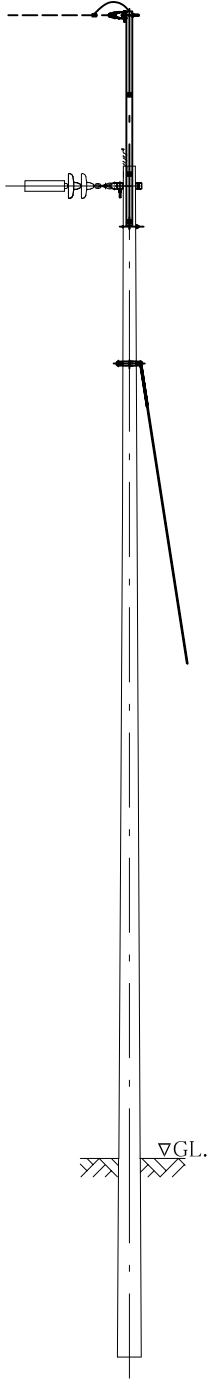
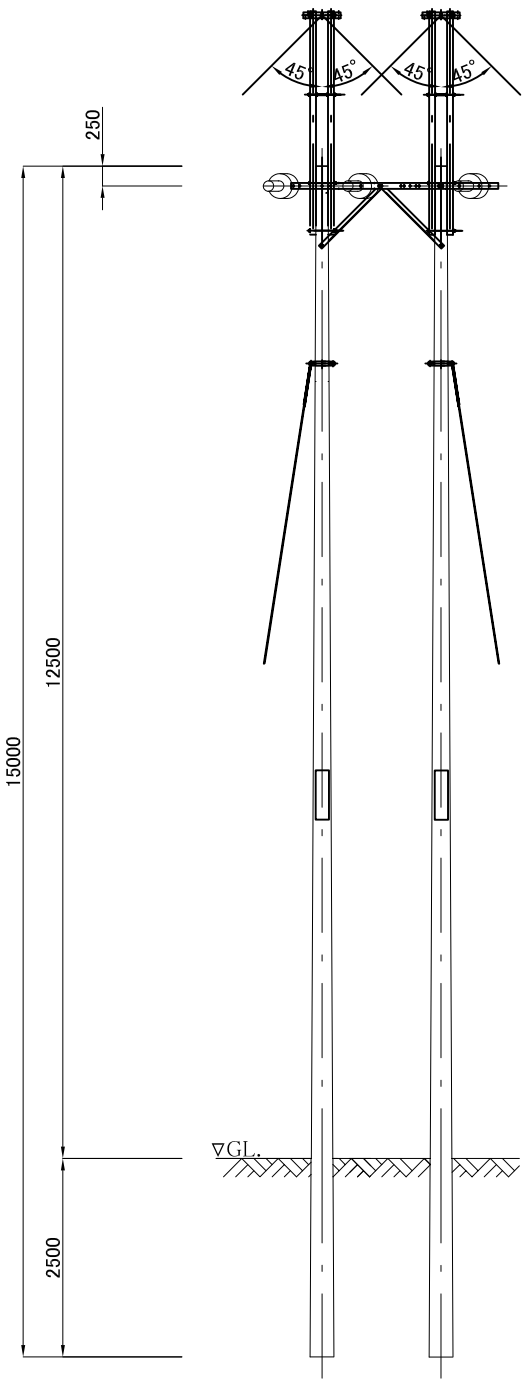
Item No. TDL-1-2-5

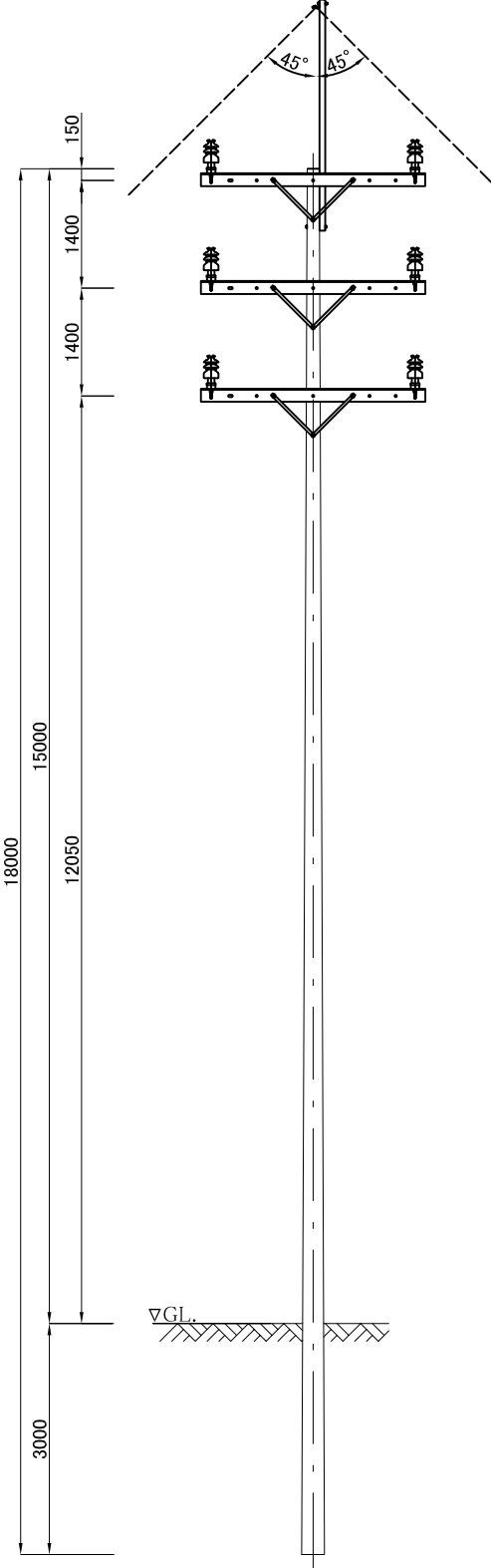
11.5kV 断路器・ケーブル立上柱 (種別 1G)

11.5kV Disconnecting Switch & Cable Termination Pole (Type 1G)

Reference Purpose Only

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	2
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	3
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	2
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
	Other Fittings	その他金物類	1





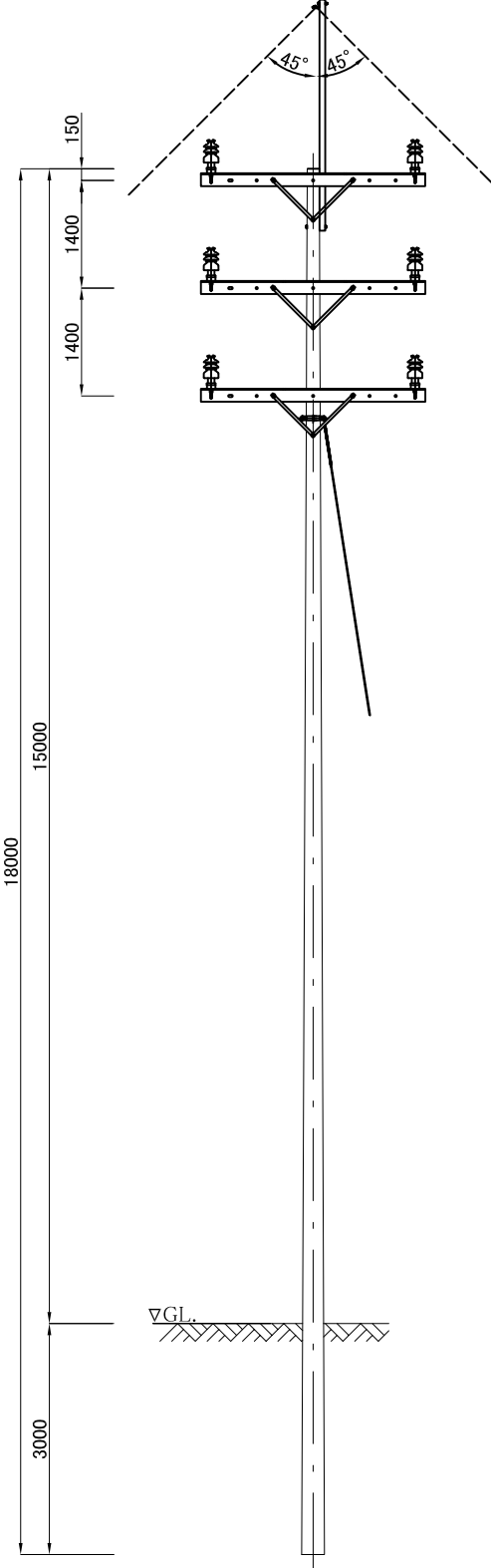
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	6
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardware	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	0
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-3-1

11.5kV 2回線 引通し柱 (種別 1DA: 0-5°)

11.5kV Double Circuit Intermediate Pole (Type 1DA: Line Angle 0-5deg.)

Reference Purpose Only



P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	6
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	1
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-3-2

11.5kV 2回線 軽角度柱 (種別 1DB: 5-20°)

11.5kV Double Circuit Light Angle Pole (Type 1DB: Line Angle 5-20deg.)

Reference Purpose Only

A6-34

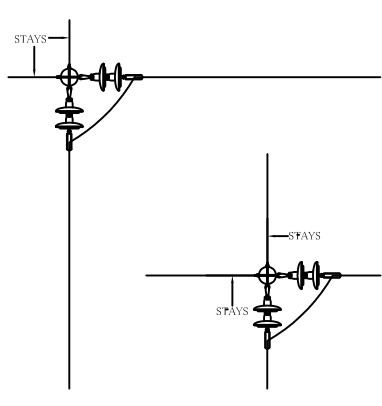
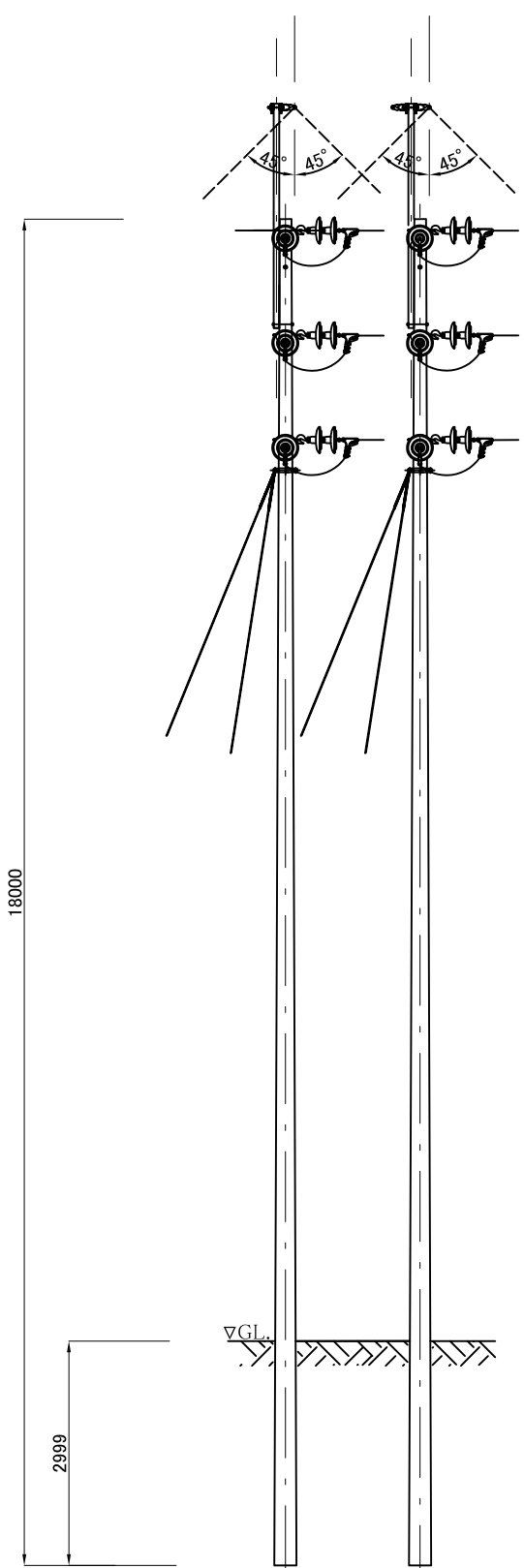
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	4
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-3-3

11.5kV 2回線 中角度柱 (種別 1DC: 20-60°)

11.5kV Double Circuit Middle Angle Pole (Type 1DC: Line Angle 20-60deg.)

Reference Purpose Only



TOP VIEW

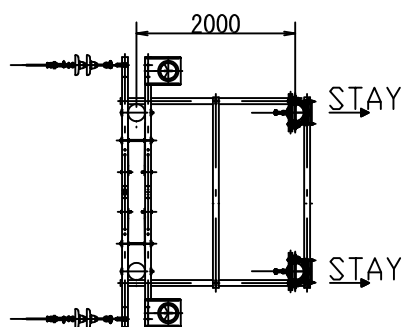
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	2
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	0
	Stay Wire Set	支線一式	4
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	2
	Other Fittings	その他金物類	1

Item No. TDL-1-3-4

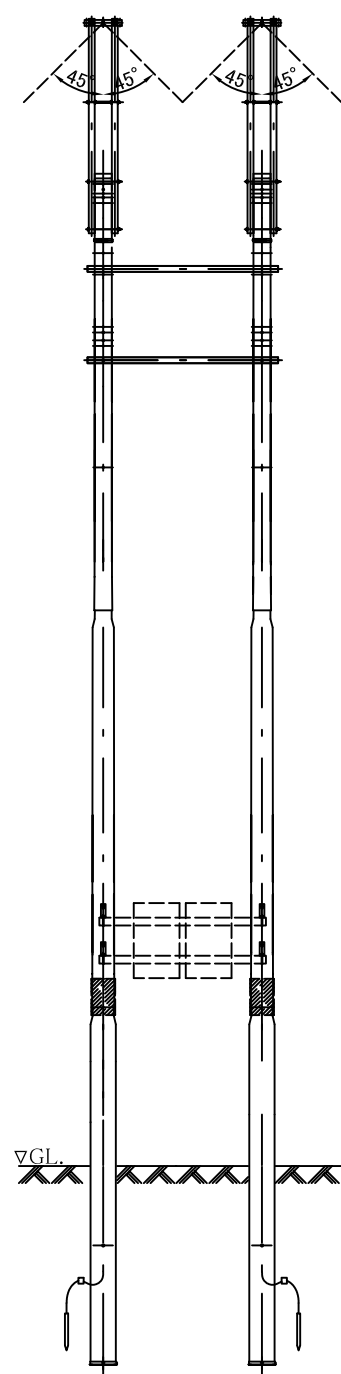
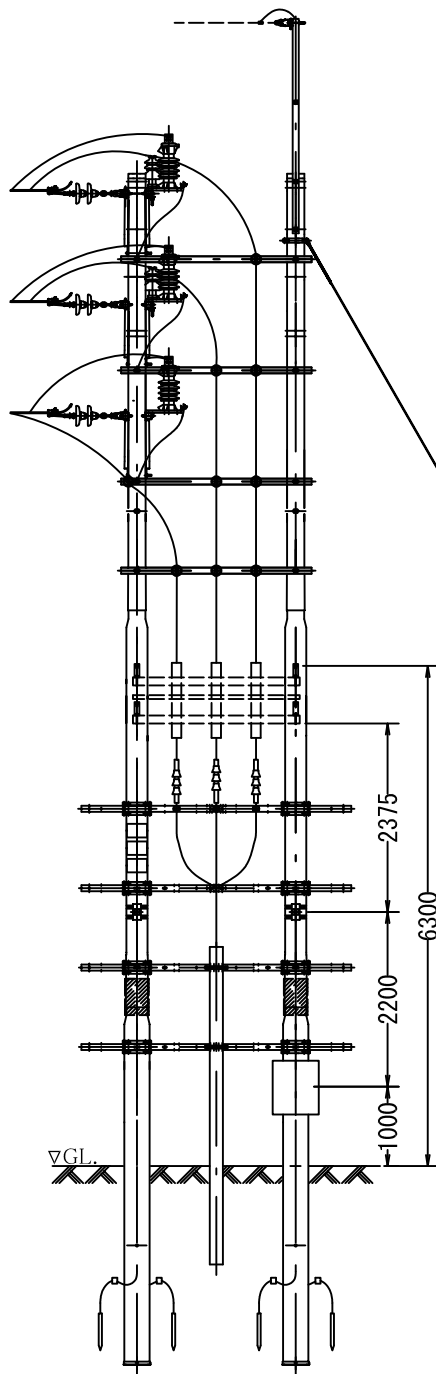
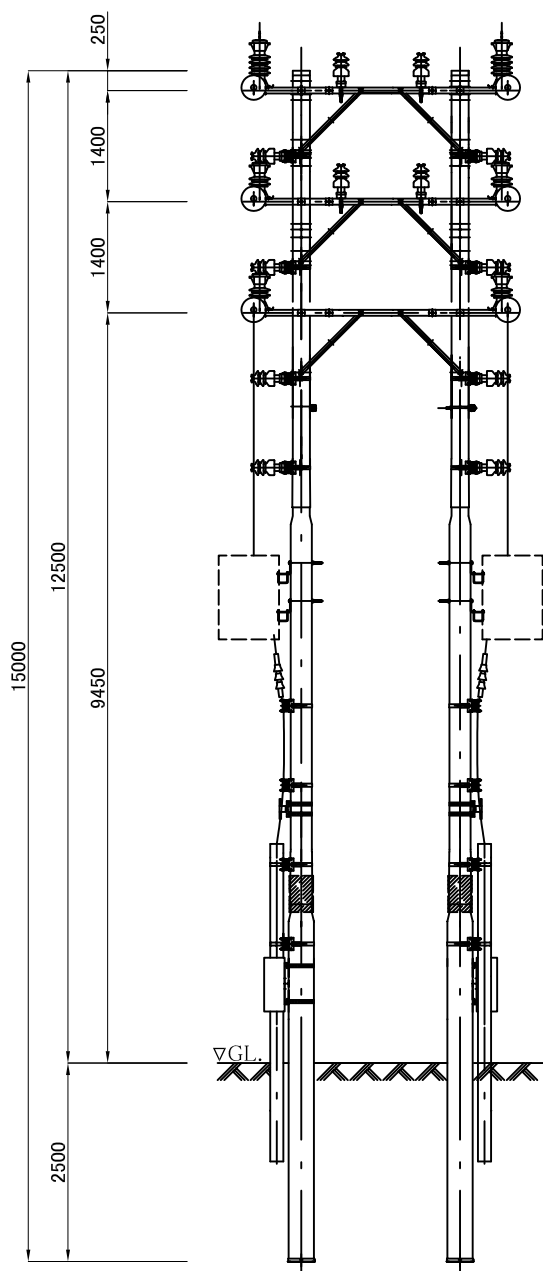
11.5kV 2回線 強角度柱 (種別 1DF: 60-90°)

11.5kV Double Circuit Heavy Angle Pole (Type 1DF: Line Angle 60-90deg.)

Reference Purpose Only



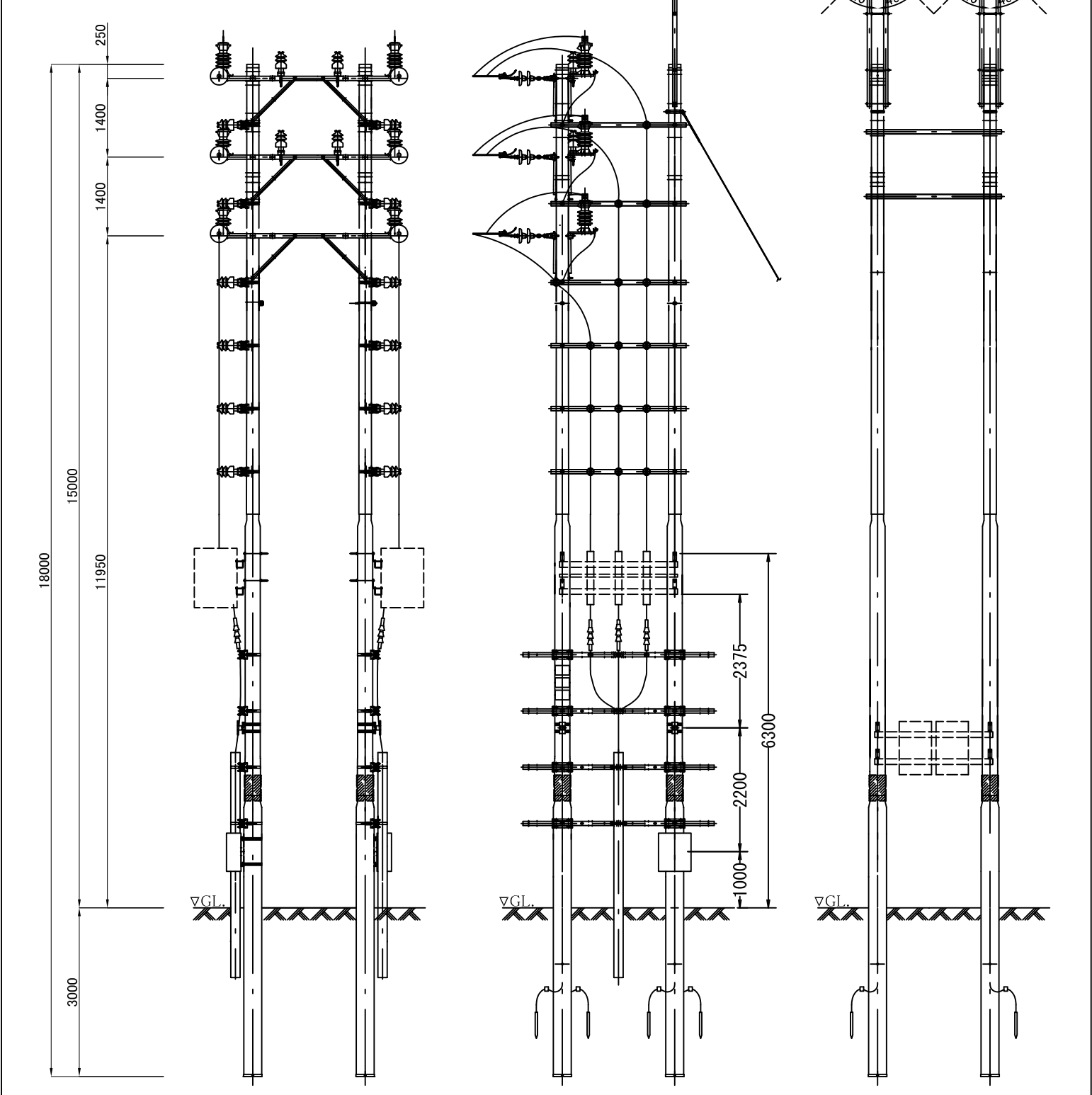
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	0
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	4
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	20
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	2
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	6
TDL-1	Pole Assembling Hardware	装柱金物	
	Cross-arm Set	腕金類一式	24
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	4
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	4
	Other Fittings	その他金物類	1



Item No. TDL-1-3-5	Reference Purpose Only
11.5kV 2回線 断路器・ケーブル立上柱（種別 1DG）	
11.5kV Double Circuit Disconnecting Switch & Cable Termination Pole (Type 1DG)	

TDL-03 送配電線装柱図(19/22)

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	4
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (5m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	32
TDL-4-3	Strain Insulator Strings	耐張碍子連	6
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	2
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	6
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	30
	Stay Wire Set	支線一式	2
	Earthing Material Set	接地材料一式	4
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	4
	Other Fittings	その他金物類	1



Item No. TDL-1-3-5	Reference Purpose Only
11.5kV 2回線 断路器・ケーブル立上柱 (種別 1DG)	
11.5kV Double Circuit Disconnecting Switch & Cable Termination Pole (Type 1DG)	

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	0
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	3
	Stay Wire Set	支線一式	4
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

Item No. TDL-1-3-6

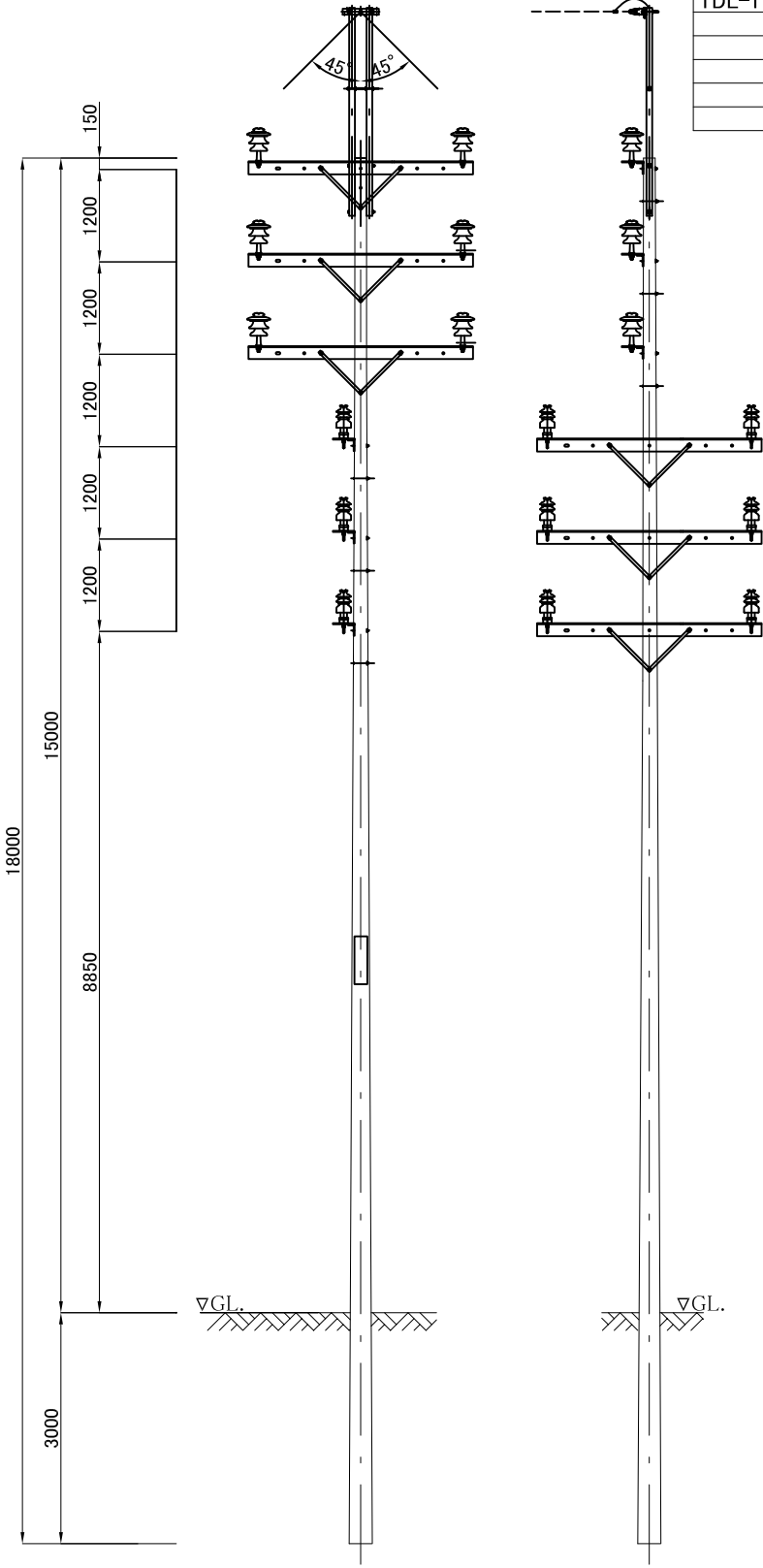
11.5kV 2回線 分岐柱 (種別 1DH)

11.5kV Double Circuit Branch Pole (Type 1DH)

Reference Purpose Only

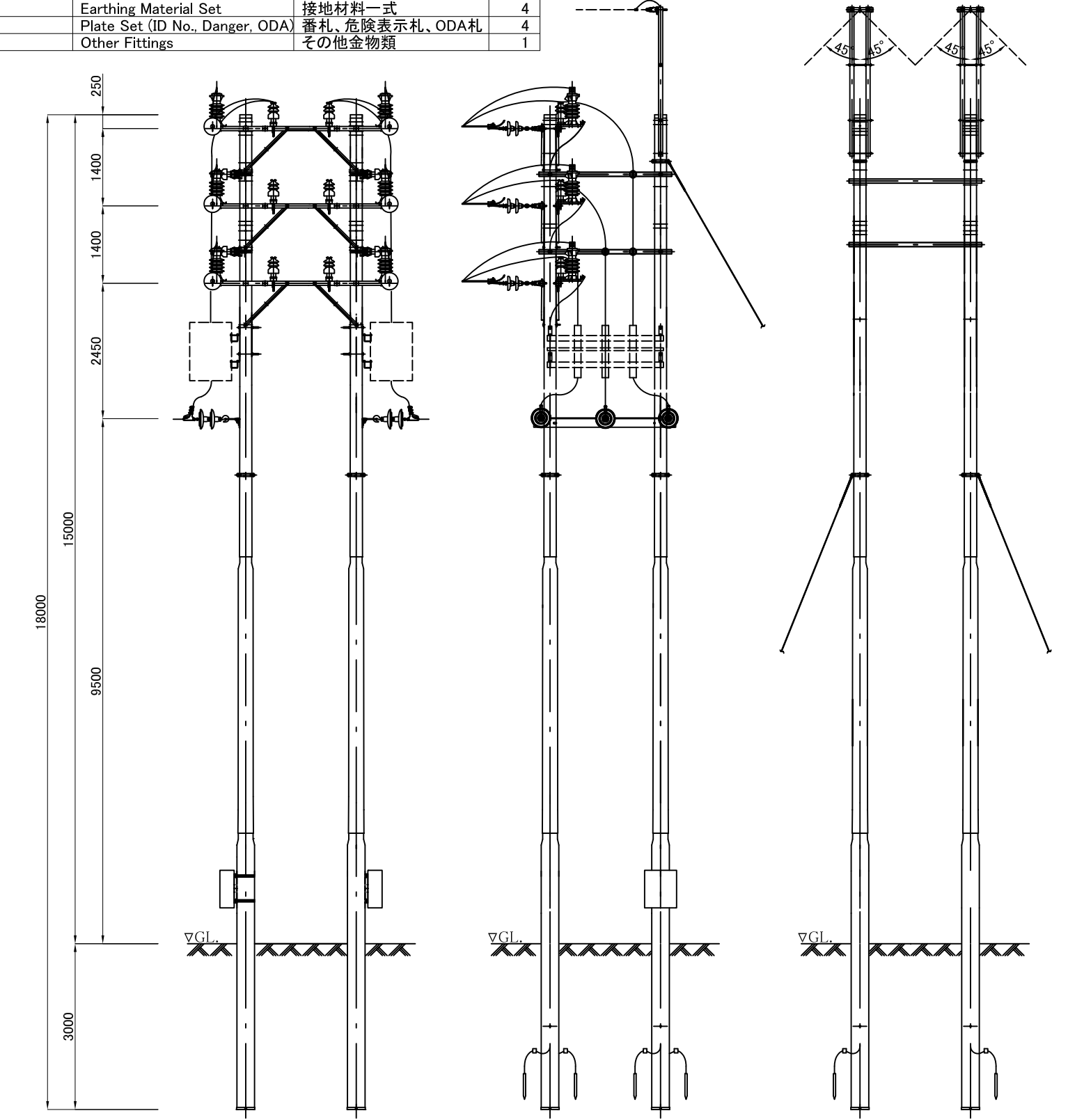
A6-39

P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	1
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	6
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	6
TDL-4-3	Strain Insulator Strings	耐張碍子連	0
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	0
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	0
TDL-1	Pole Assembling Hardwares	装柱金物	
	Cross-arm Set	腕金類一式	6
	Stay Wire Set	支線一式	0
	Earthing Material Set	接地材料一式	0
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	1
	Other Fittings	その他金物類	1

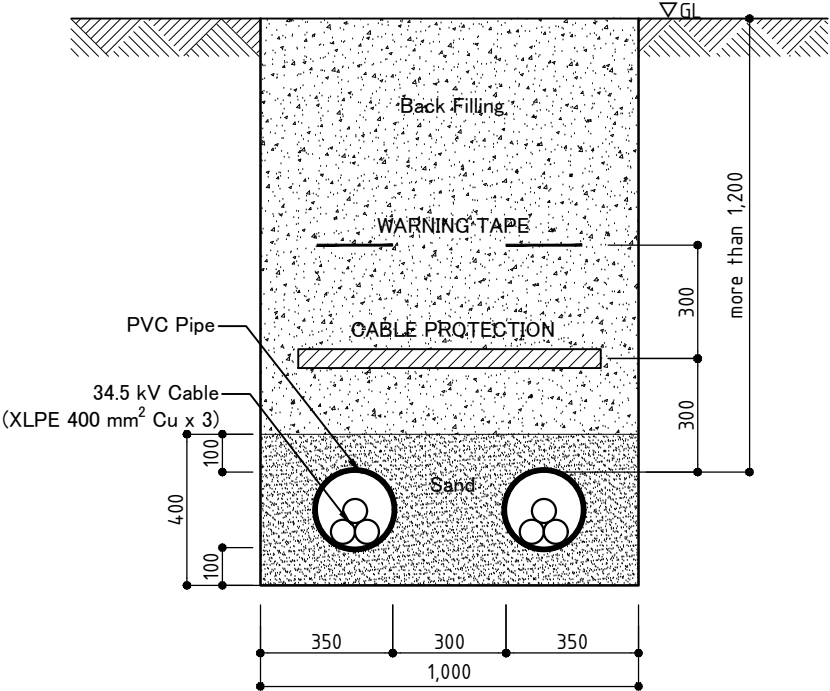


TDL-03 送配電線装柱図(22/22)

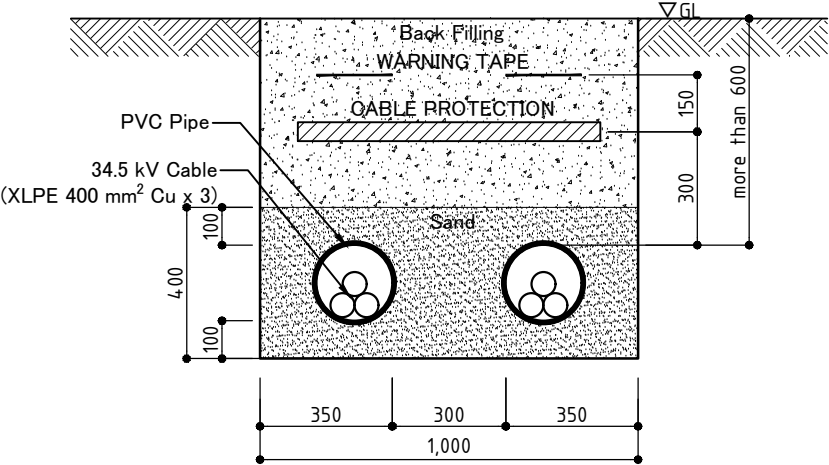
P/NO.	DESCRIPTION		Q'TY
TDL-0-1	Steel Pole (18m -10kN)	鋼管柱 (18m-10kN)	4
TDL-0-2	Steel Pole (15m -10kN)	鋼管柱 (15m-10kN)	0
TDL-4-1	34.5kV Line Post Insulator	34.5kV ラインポスト碍子	0
TDL-4-2	11.5kV Line Post Insulator	11.5kV ラインポスト碍子	12
TDL-4-3	Strain Insulator Strings	耐張碍子連	12
TDL-5-1	34.5kV Disconnecting Switch with Operation Device	34.5kV 断路器 (操作装置付)	0
TDL-5-2	11.5kV Disconnecting Switch with Operation Device	11.5kV 断路器 (操作装置付)	2
TDL-6-1	34.5kV Lightning Arrester	34.5kV 避雷器	0
TDL-6-2	11.5kV Lightning Arrester	11.5kV 避雷器	6
TDL-1	Pole Assembling Hardware	装柱金物	
	Cross-arm Set	腕金類一式	11
	Stay Wire Set	支線一式	6
	Earthing Material Set	接地材料一式	4
	Plate Set (ID No., Danger, ODA)	番札、危険表示札、ODA札	4
	Other Fittings	その他金物類	1



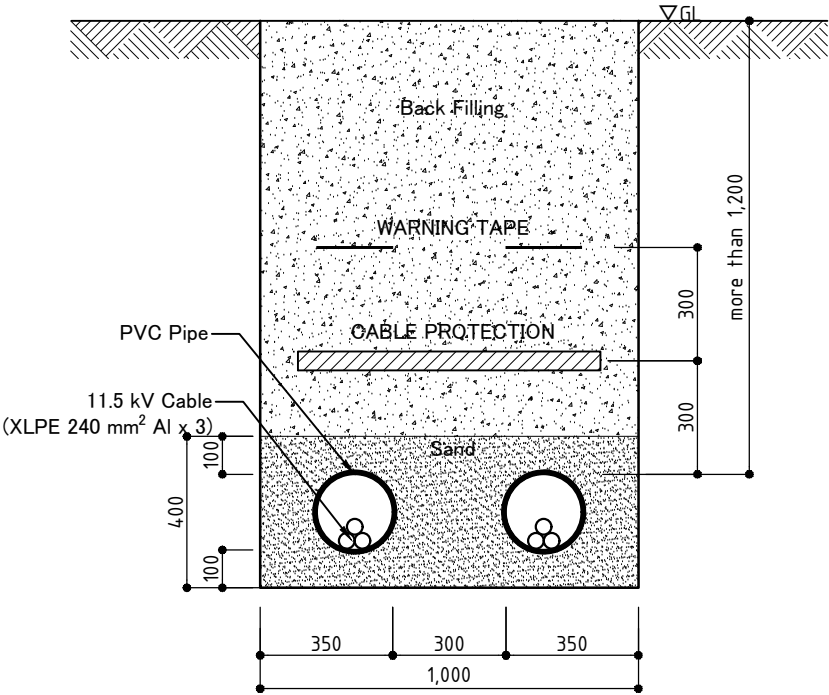
Item No. TDL-1-3-8	Reference Purpose Only
11.5kV 2回線 断路器・分岐柱 (種別 1DT)	
11.5kV Double Circuit Disconnecting Switch & Branch Pole (Type 1DT)	



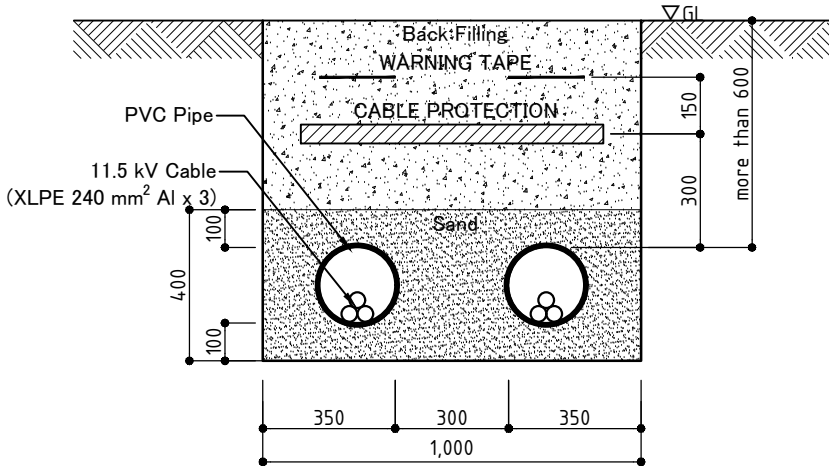
34.5 kV CABLE STANDARD LAYOUT PLAN
(UNDERGROUND CABLE AT THE ROAD CROSSING)



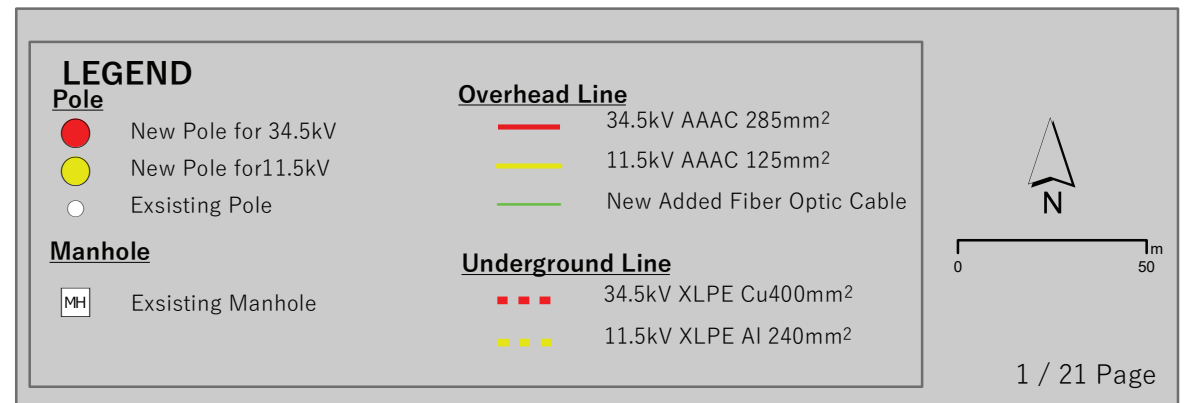
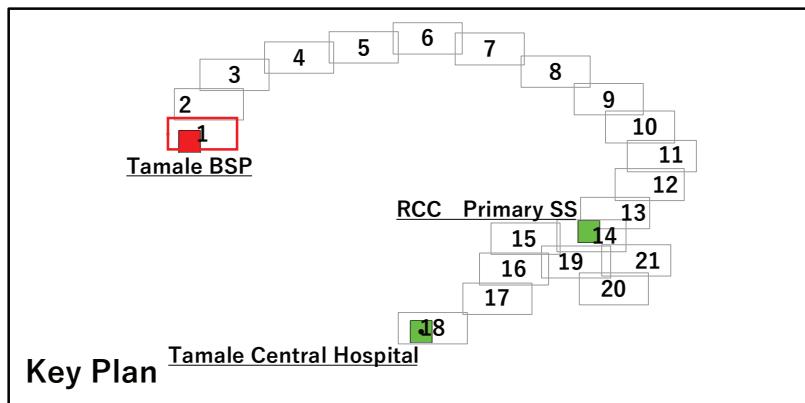
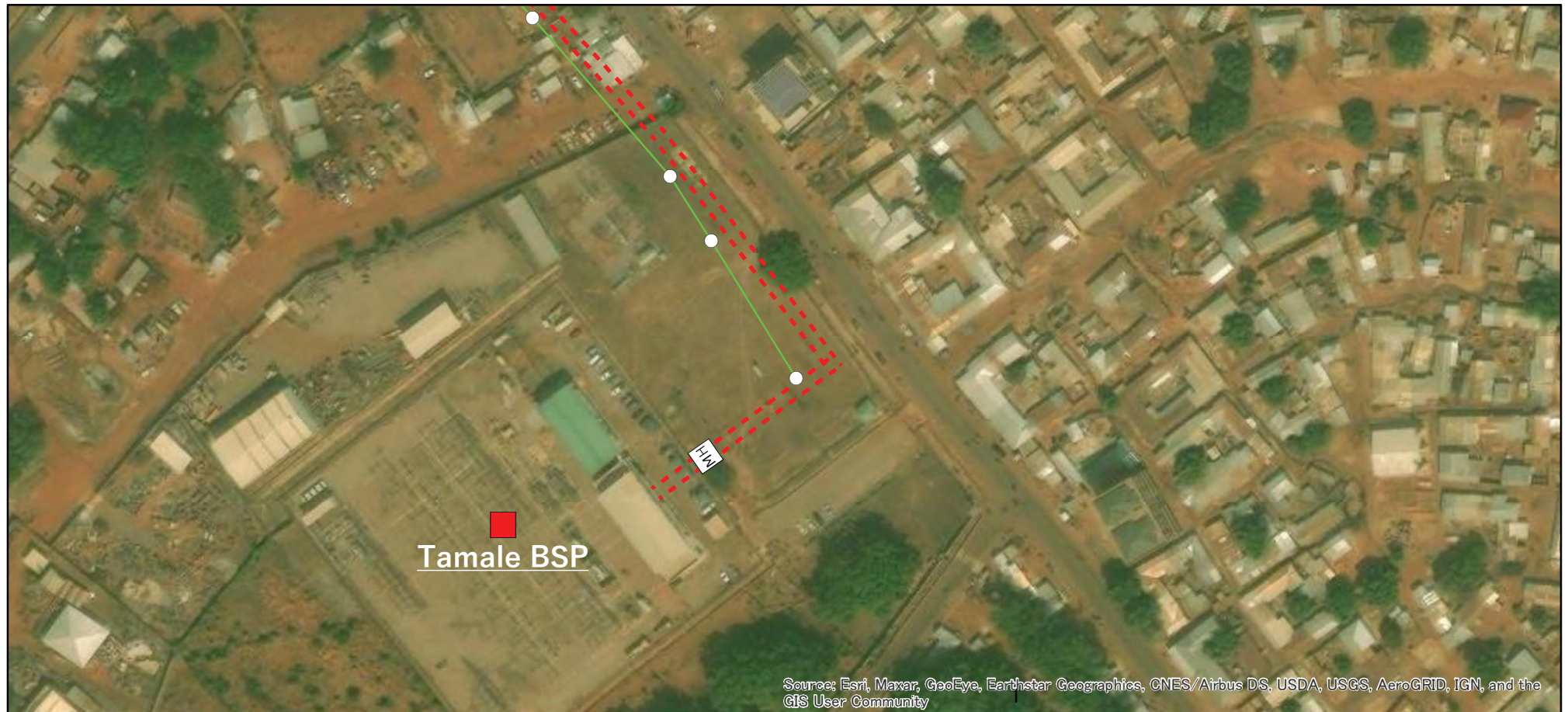
34.5 kV CABLE STANDARD LAYOUT PLAN
(UNDERGROUND CABLE AT NORMAL GROUND)



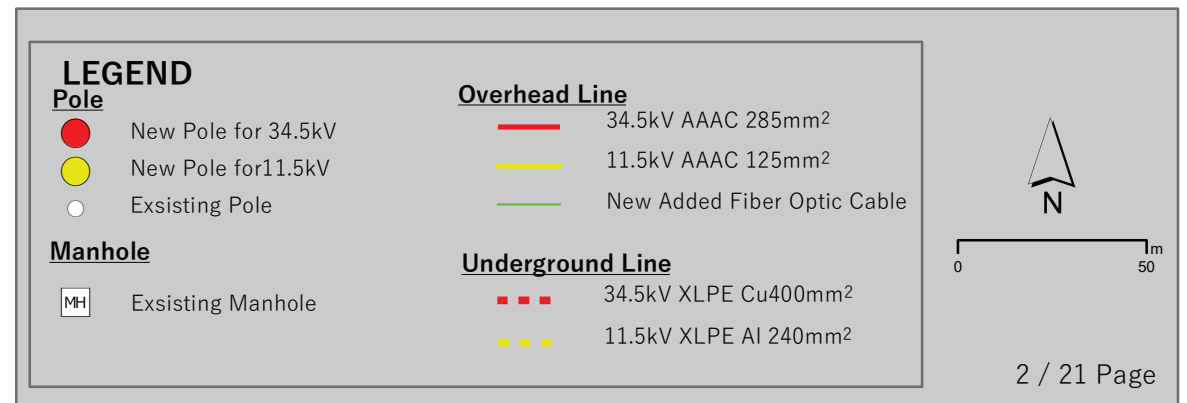
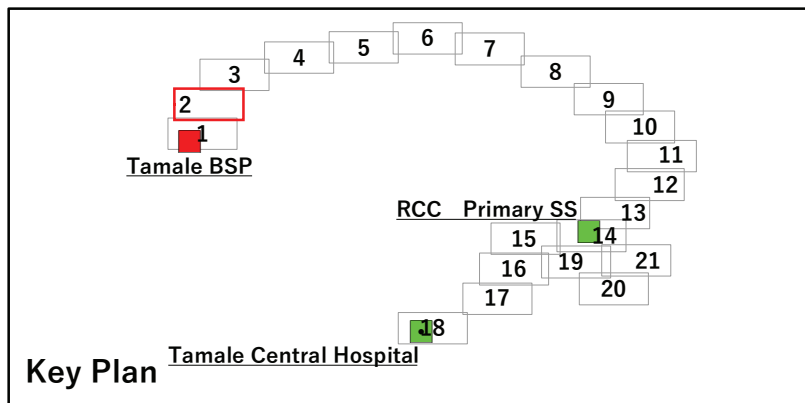
11.5 kV CABLE STANDARD LAYOUT PLAN
(UNDERGROUND CABLE AT THE ROAD CROSSING)

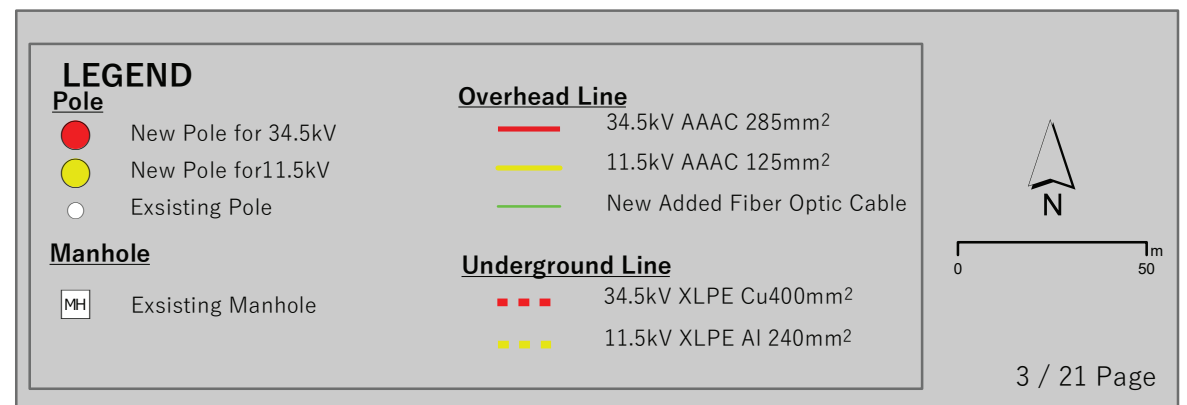
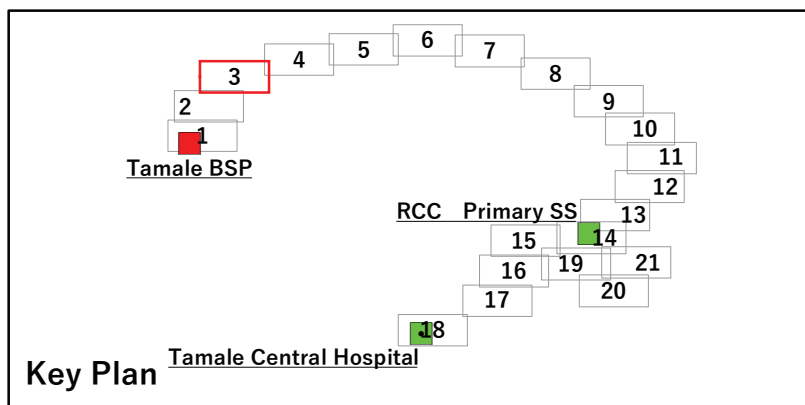


11.5 kV CABLE STANDARD LAYOUT PLAN
(UNDERGROUND CABLE AT NORMAL GROUND)

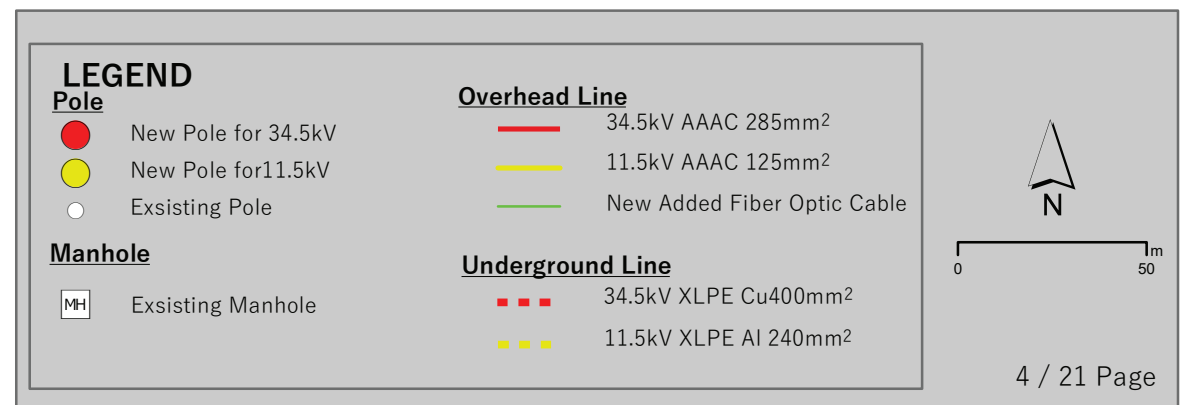
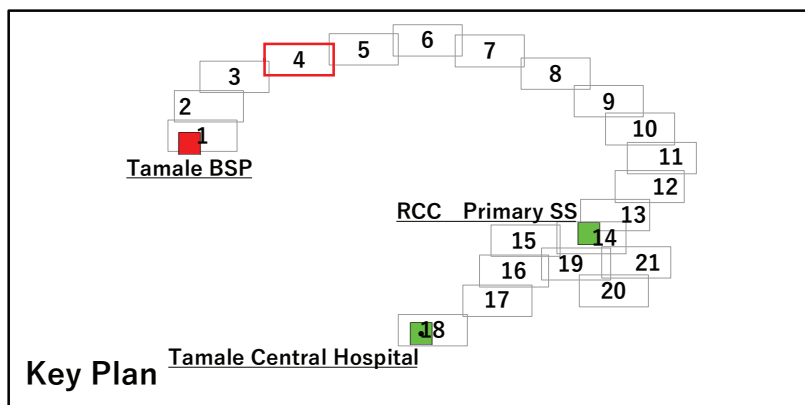


TDL-05 送配電線ルート図(2/21)

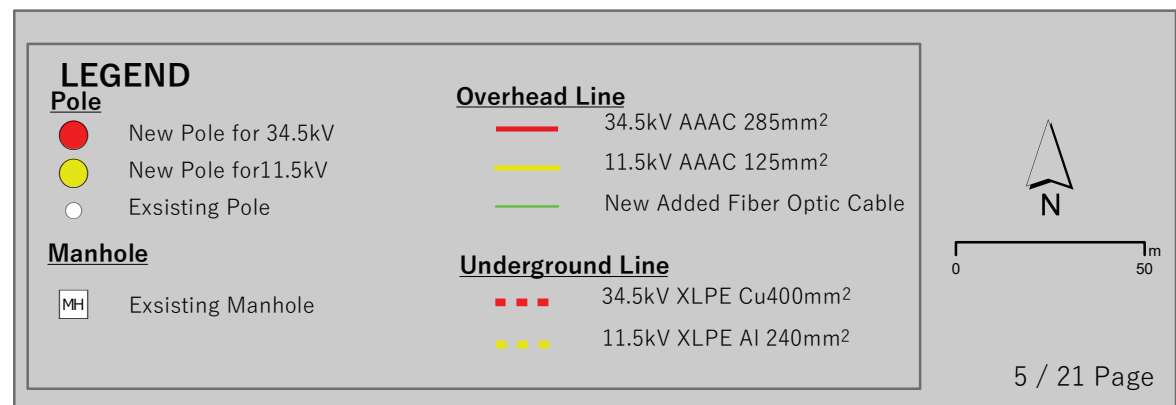
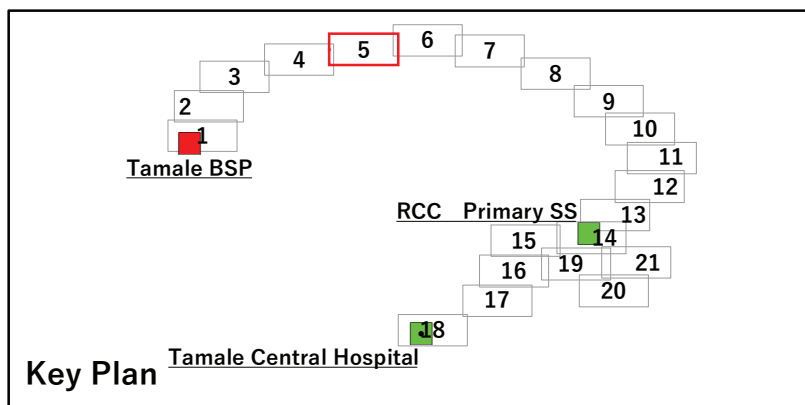
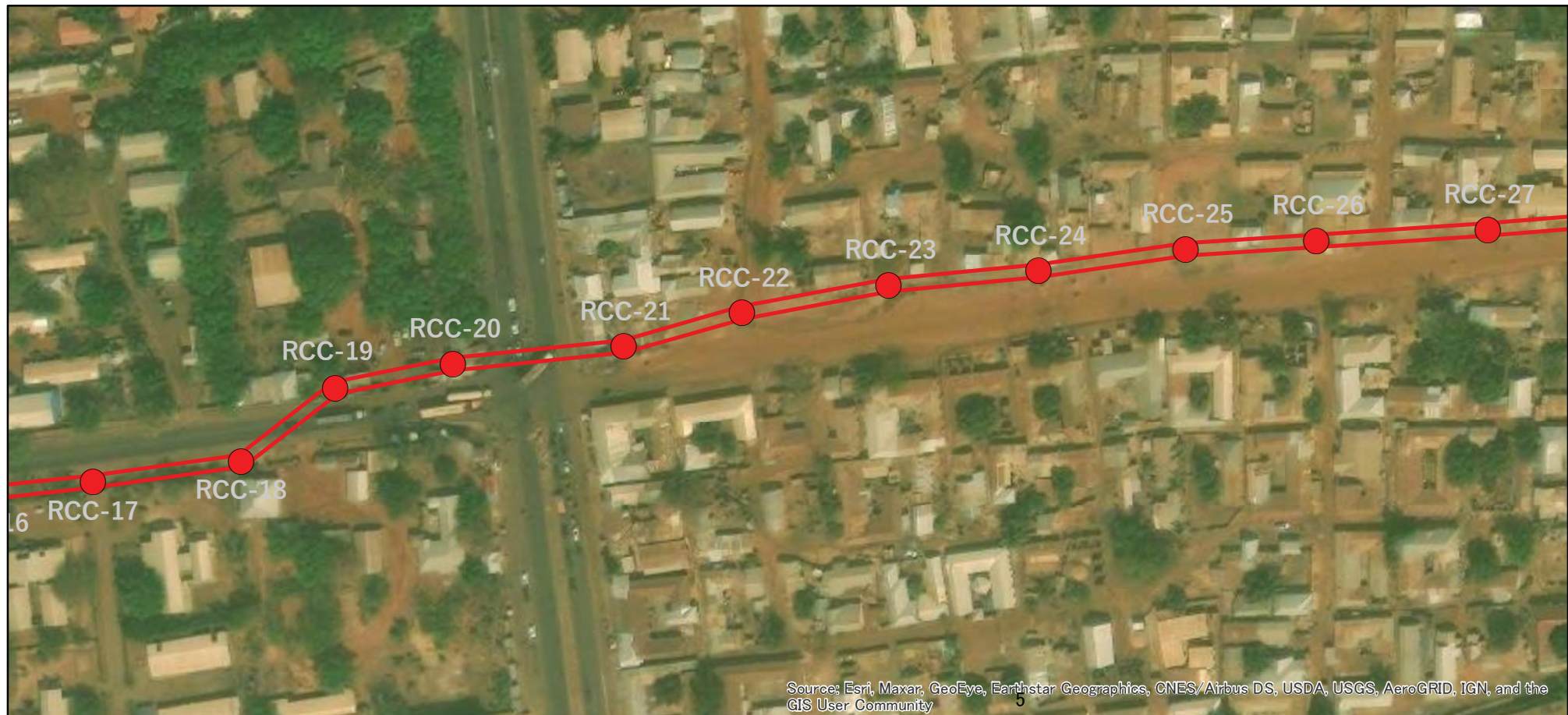


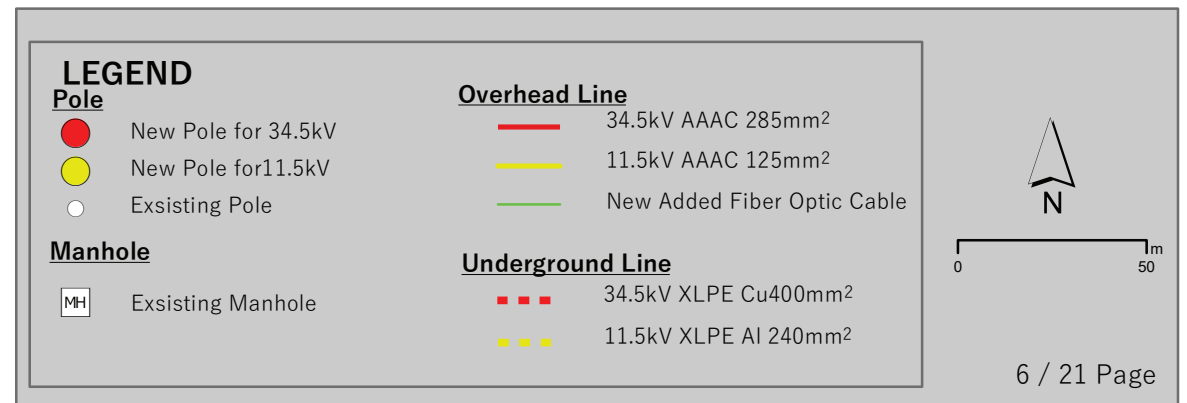
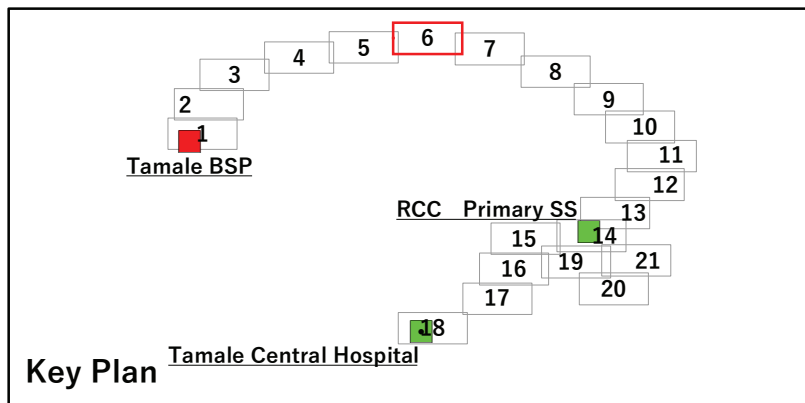


TDL-05 送配電線ルート図(4/21)

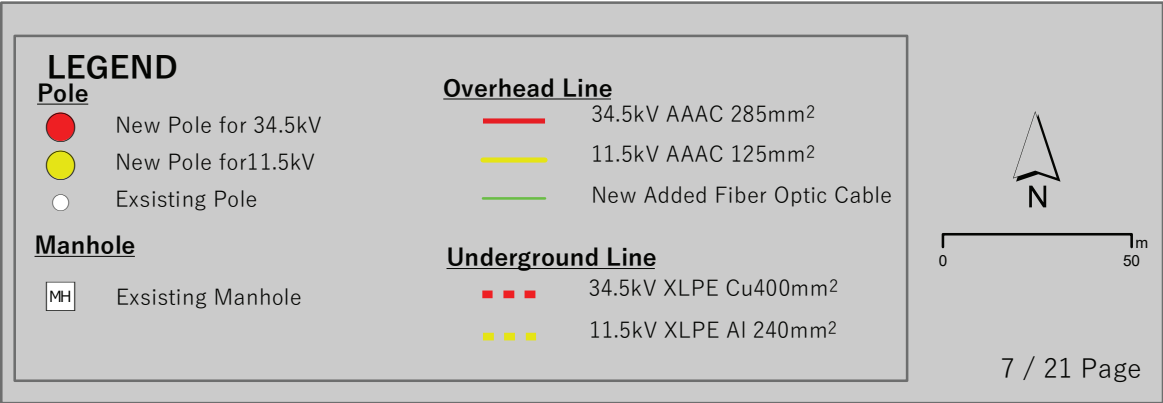
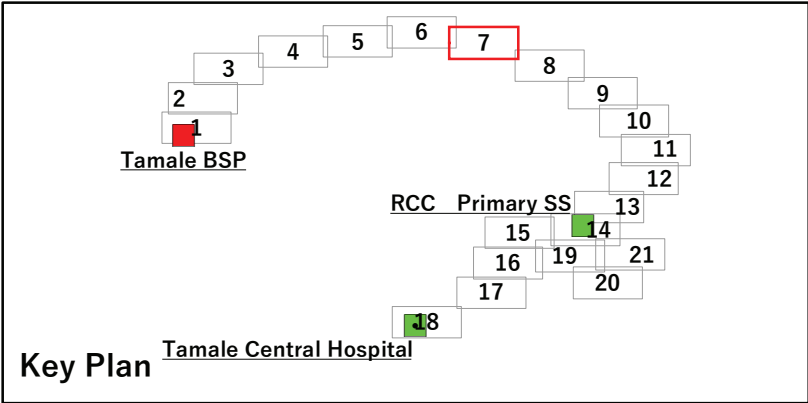


TDL-05 送配電線ルート図(5/21)

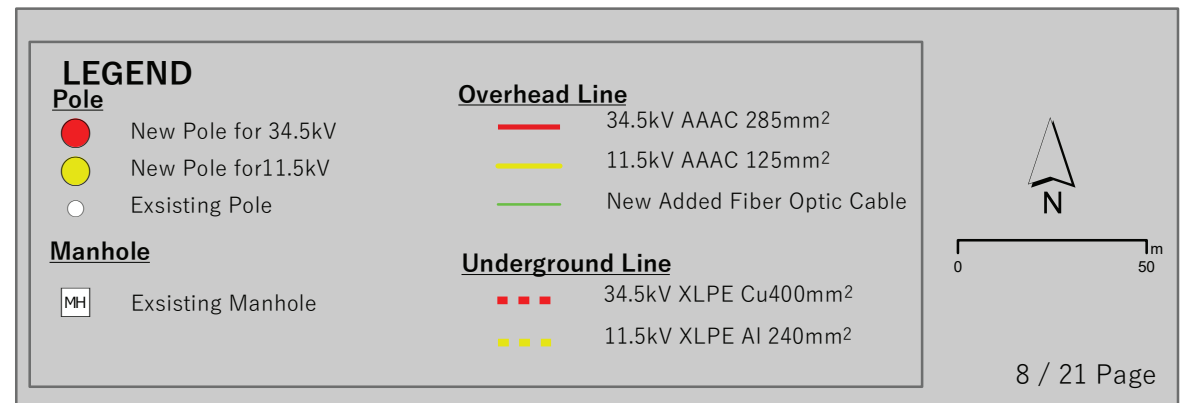
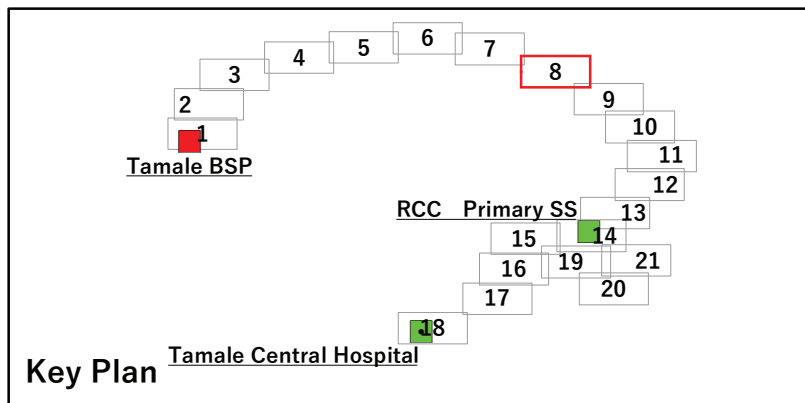




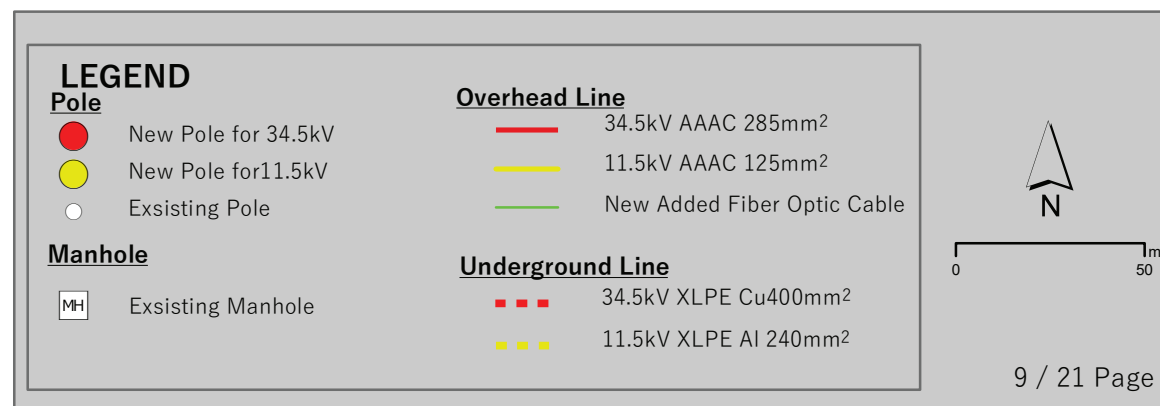
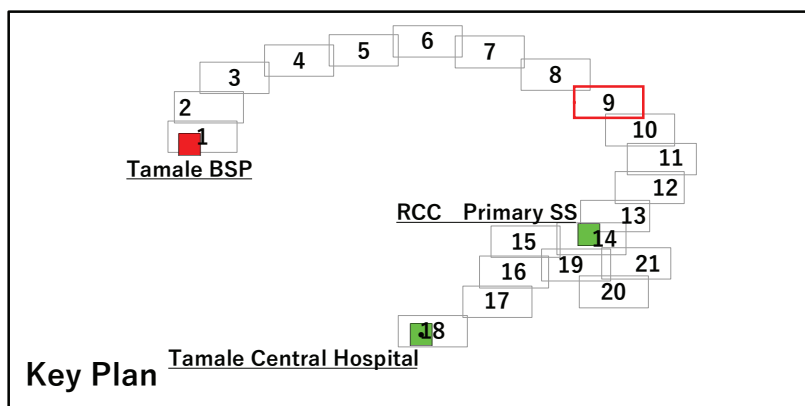
TDL-05 送配電線ルート図(7/21)



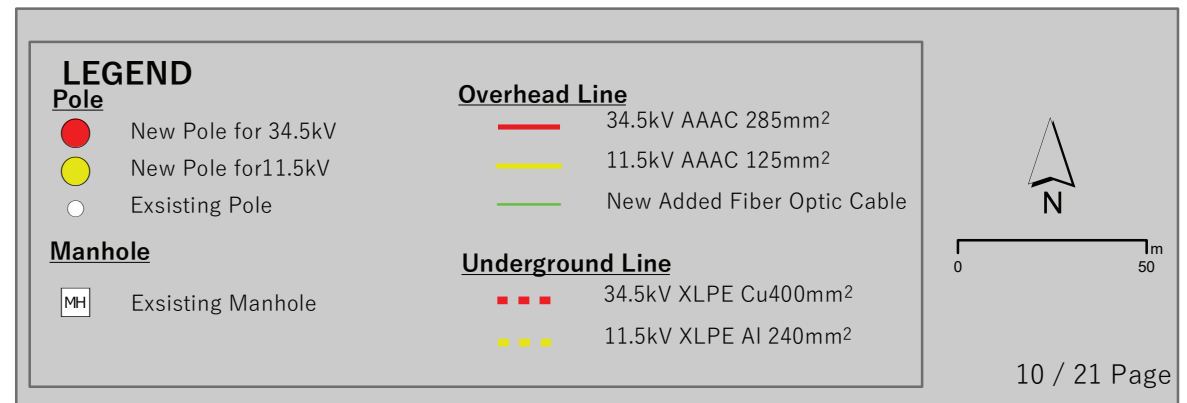
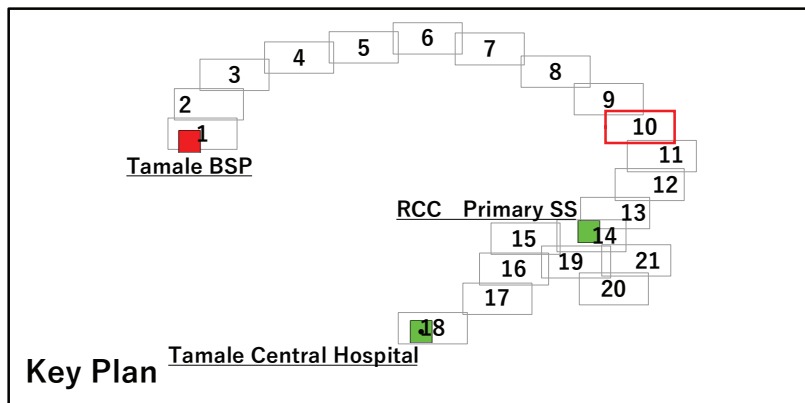
TDL-05 送配電線ルート図(8/21)



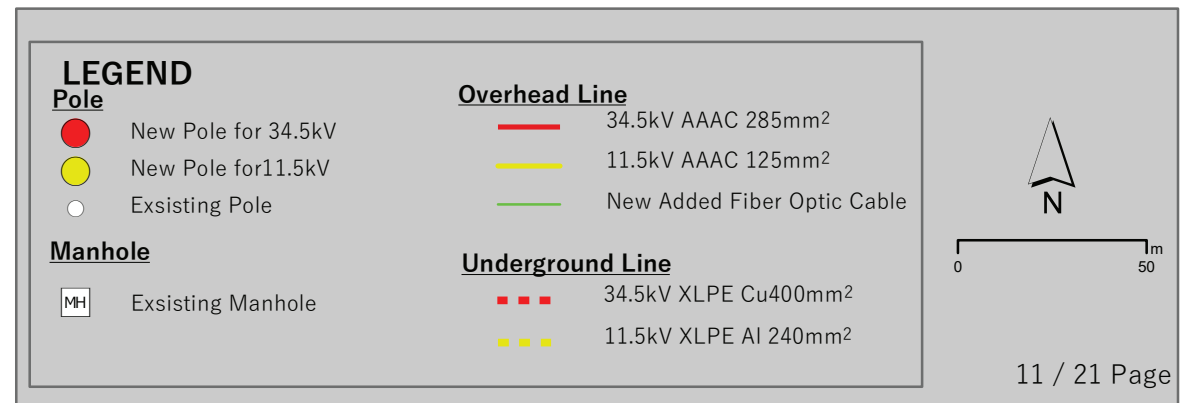
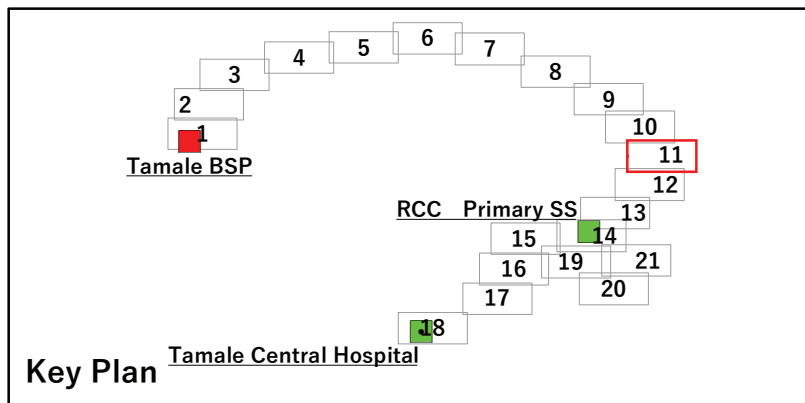
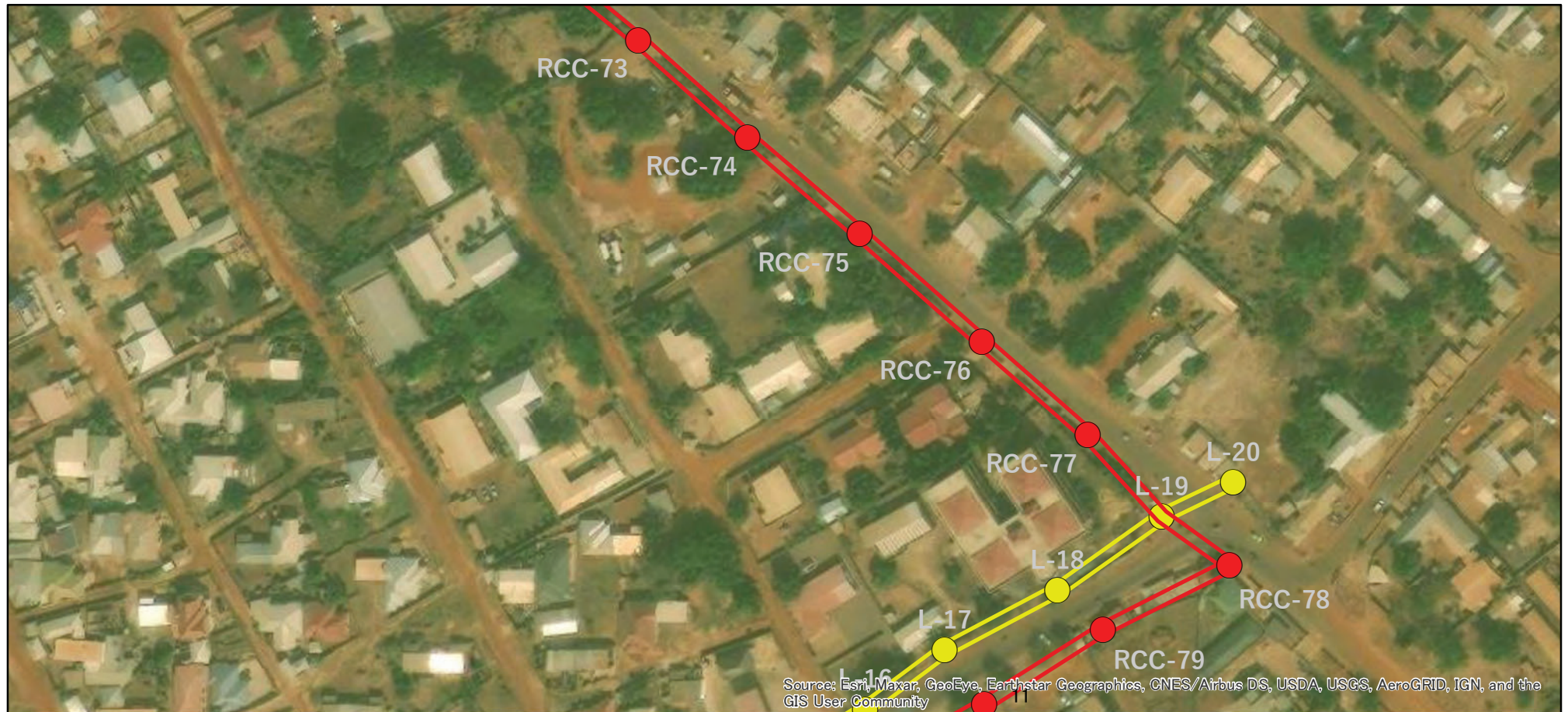
TDL-05 送配電線ルート図(9/21)



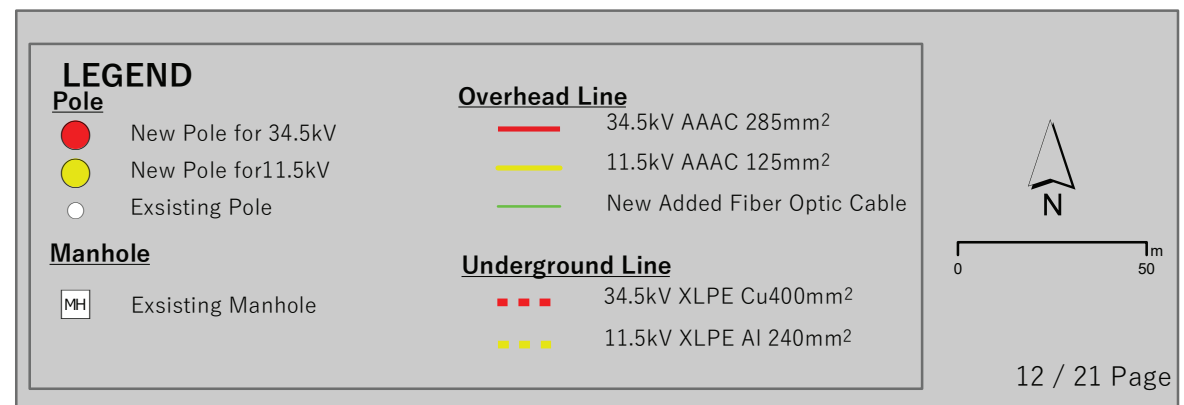
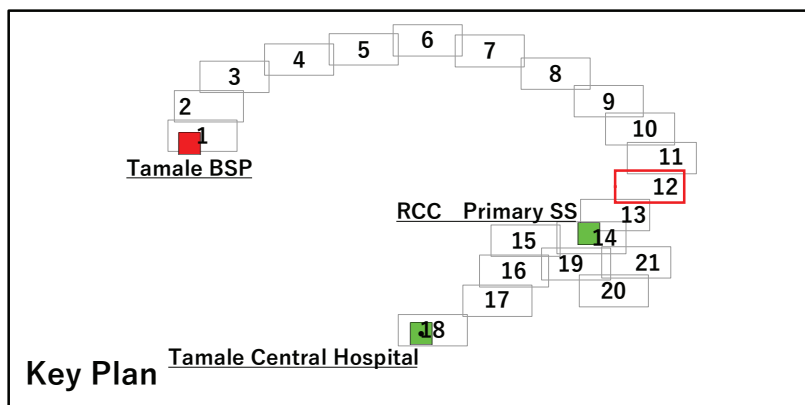
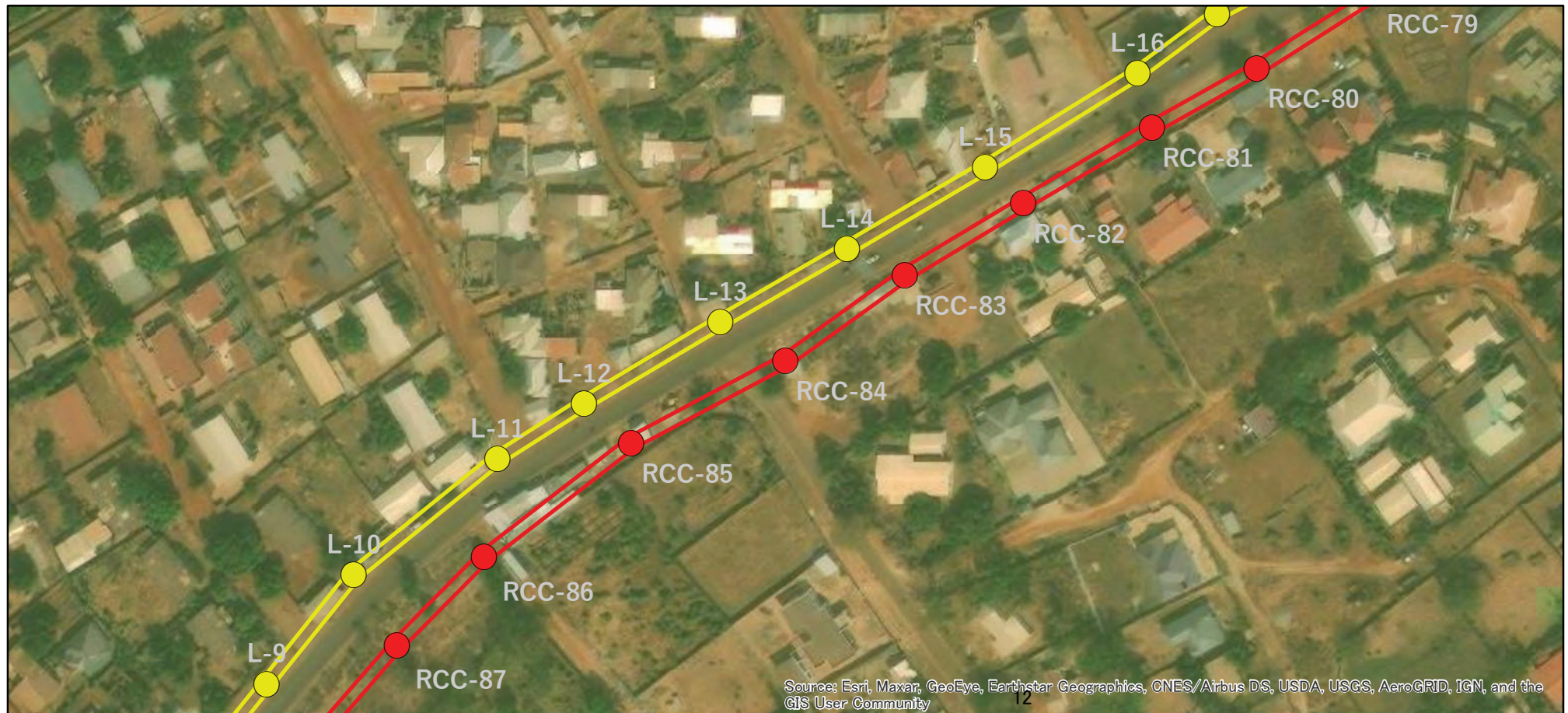
TDL-05 送配電線ルート図(10/21)

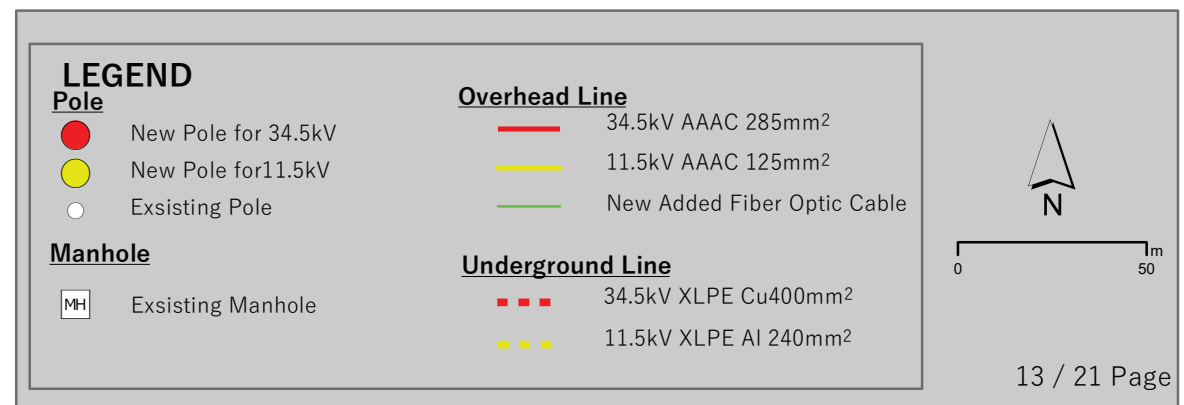
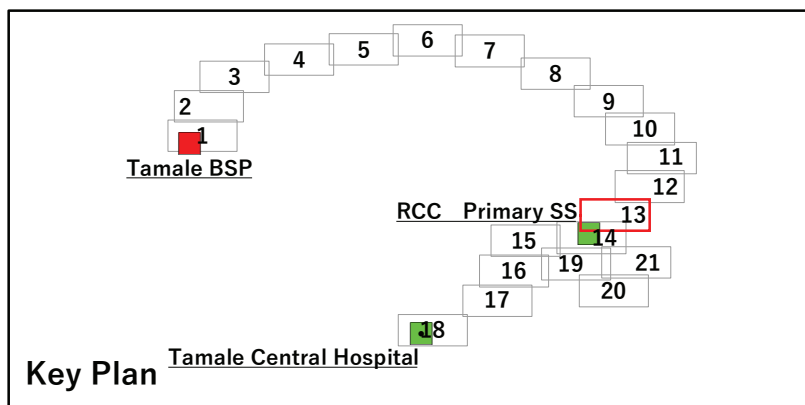
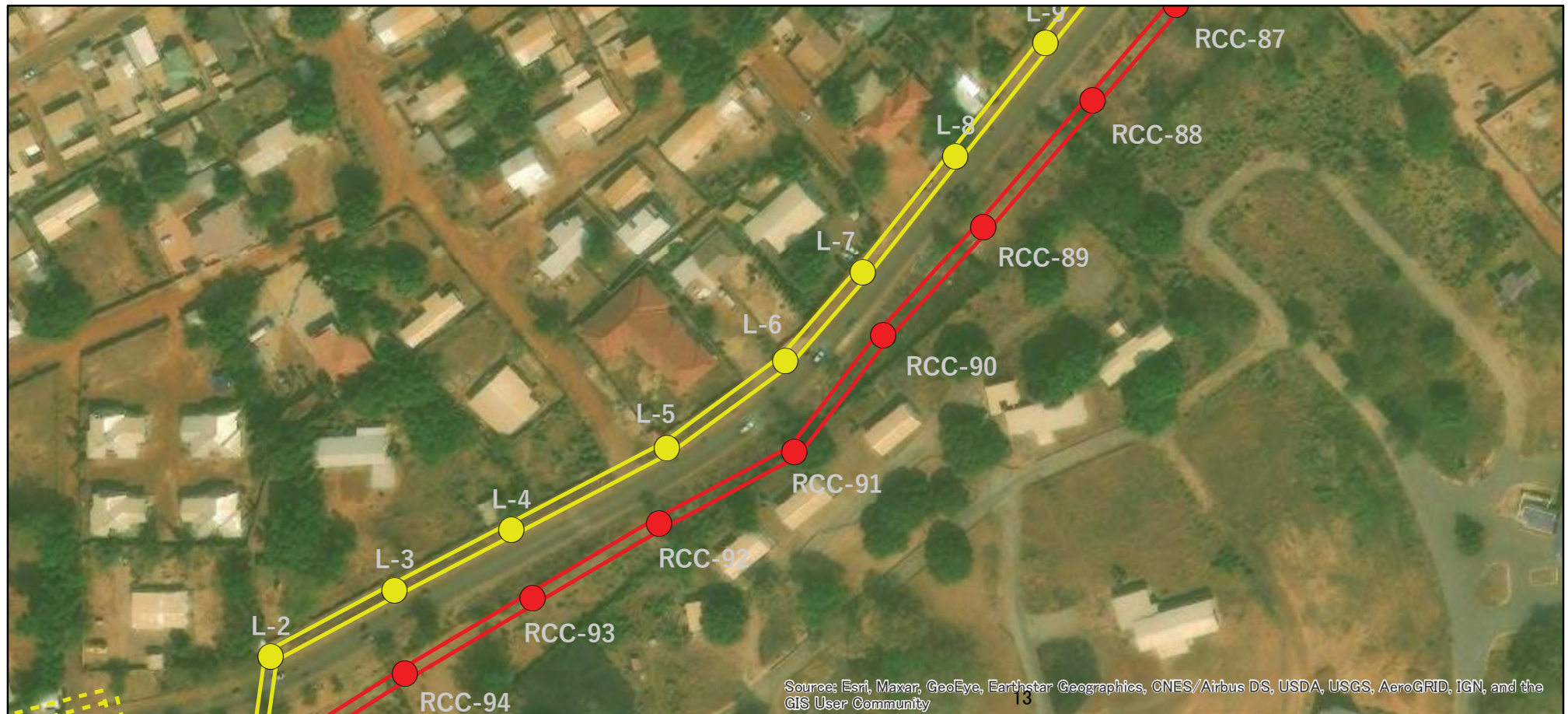


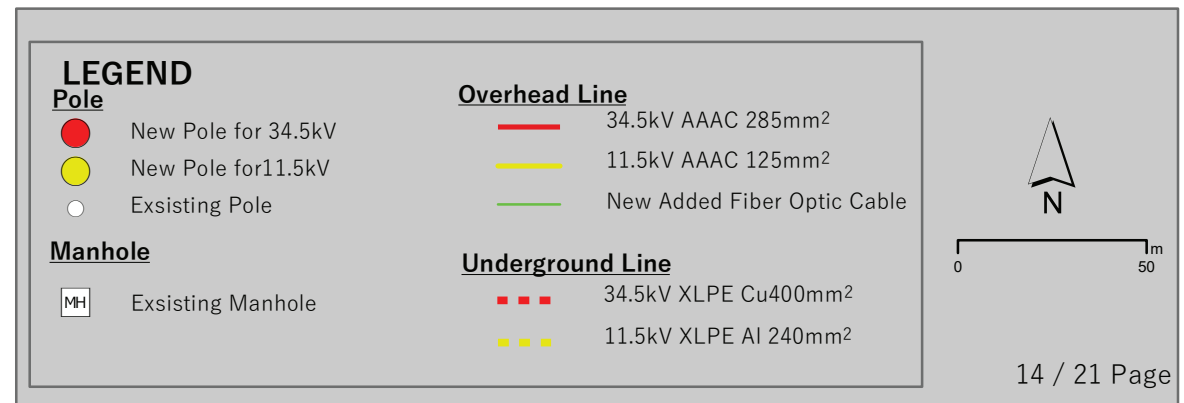
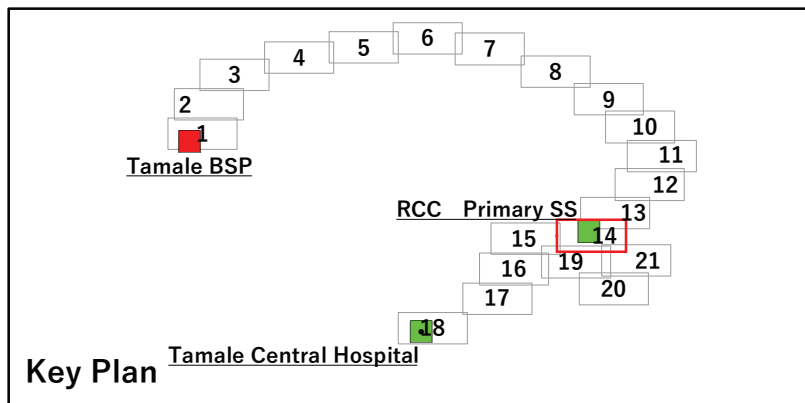
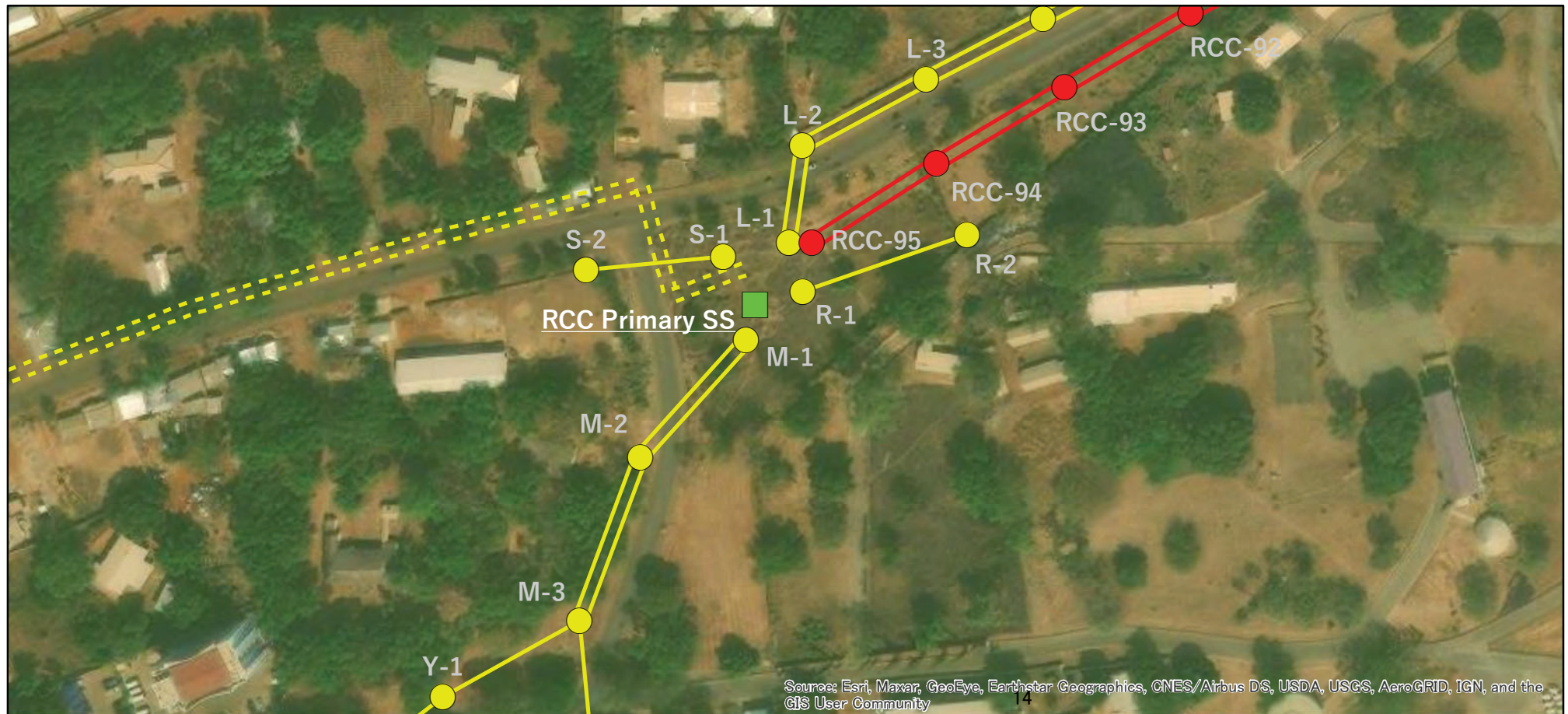
TDL-05 送配電線ルート図(11/21)

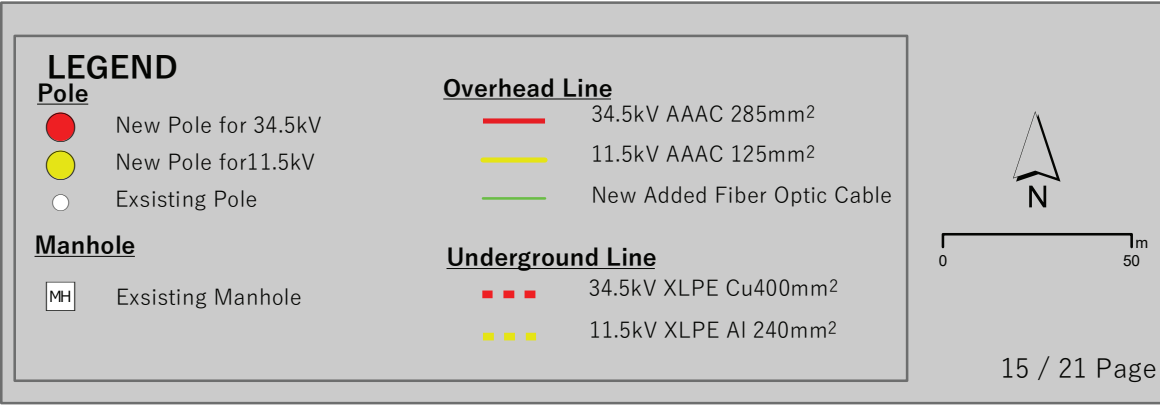
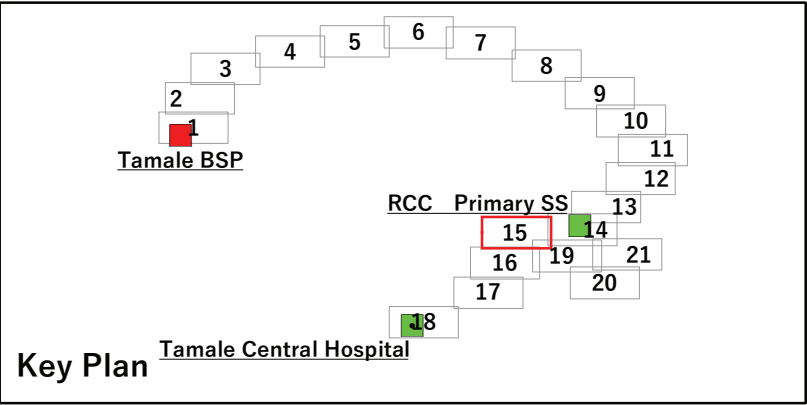


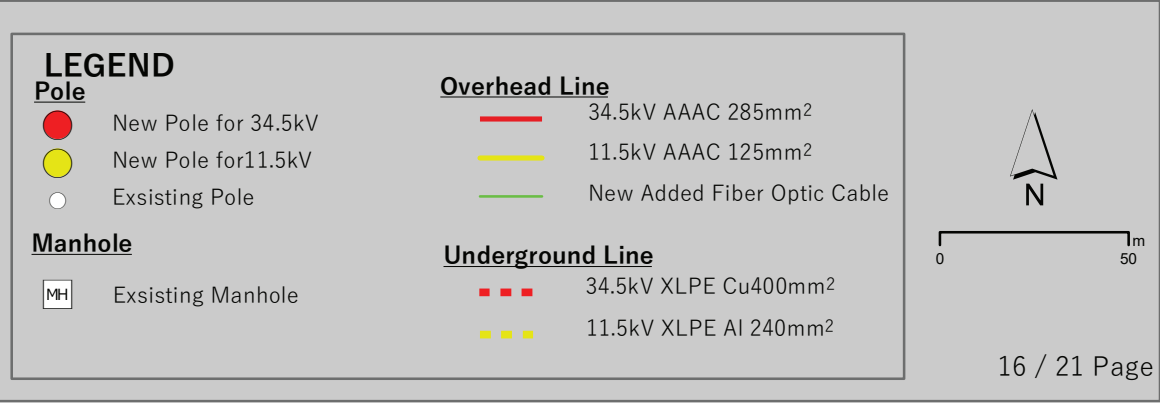
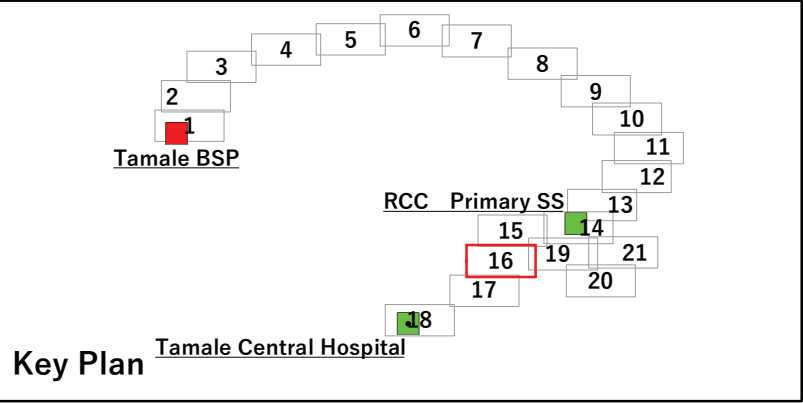
TDL-05 送配電線ルート図(12/21)

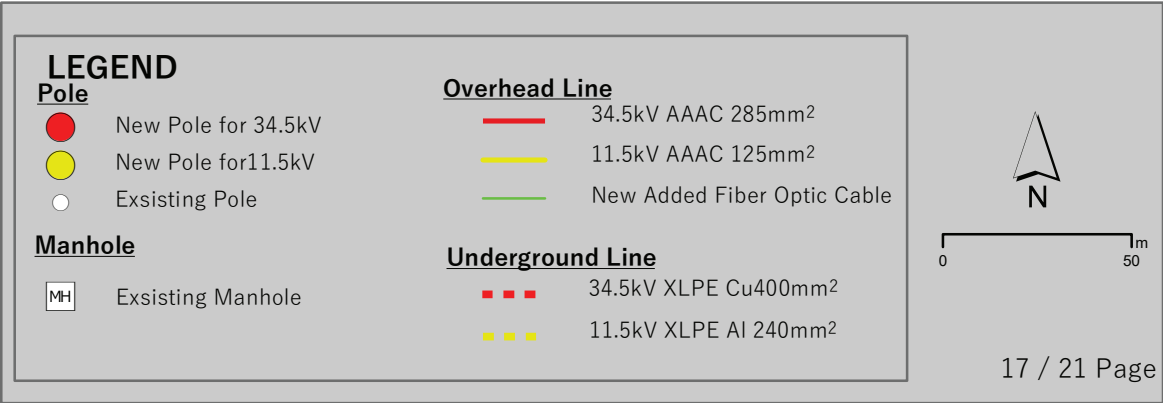
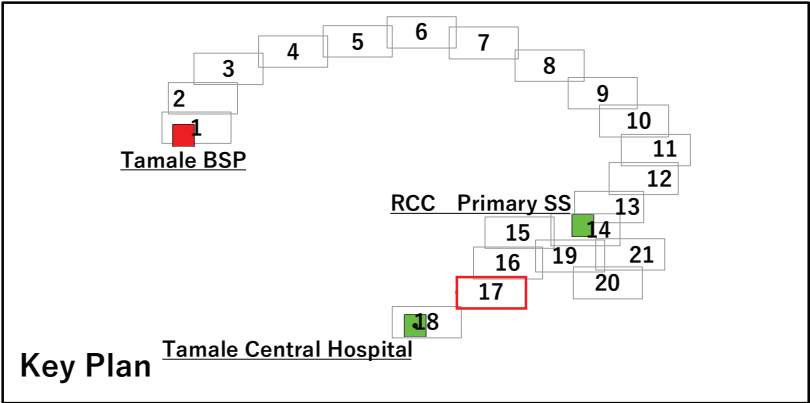


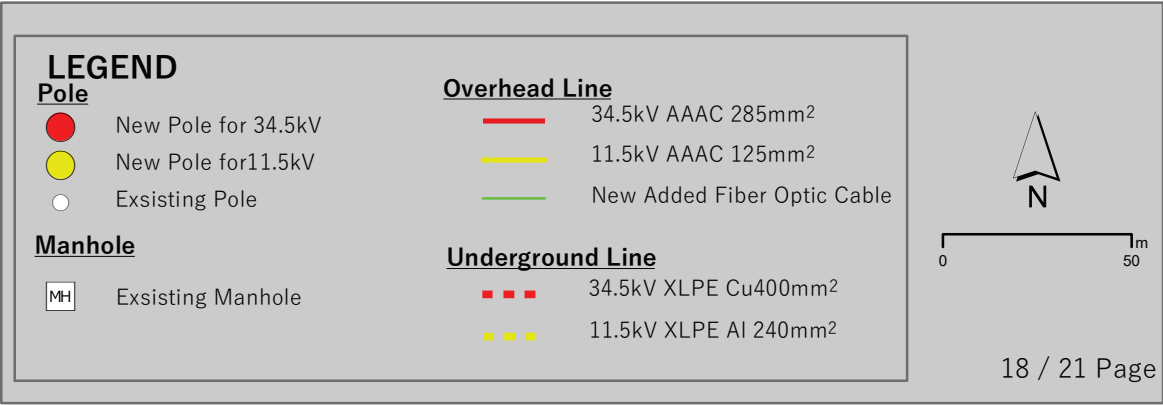
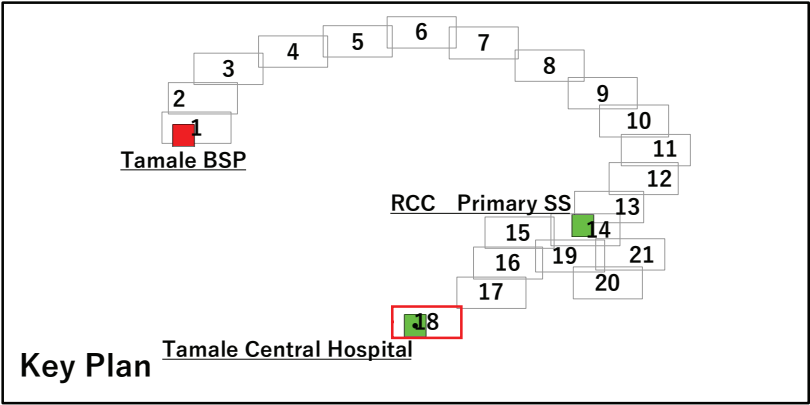




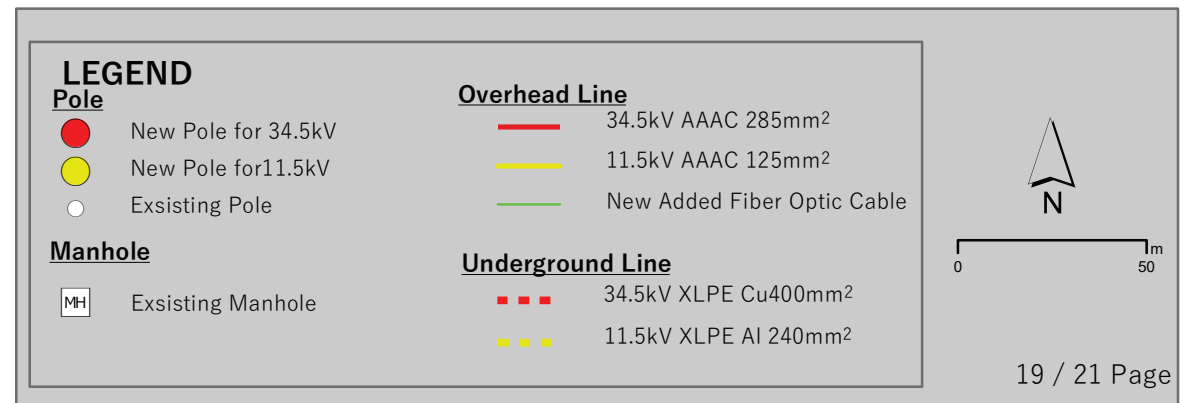
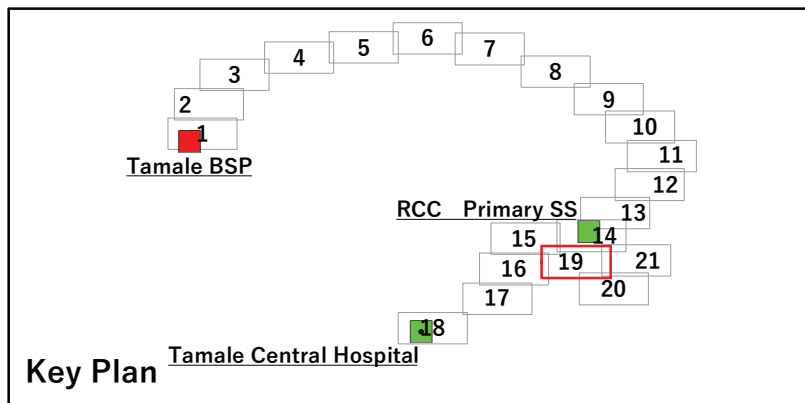




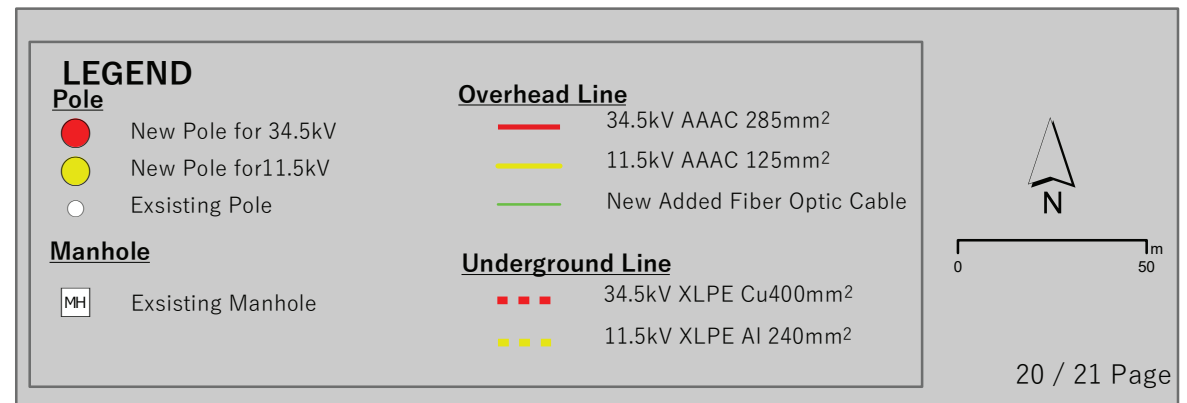
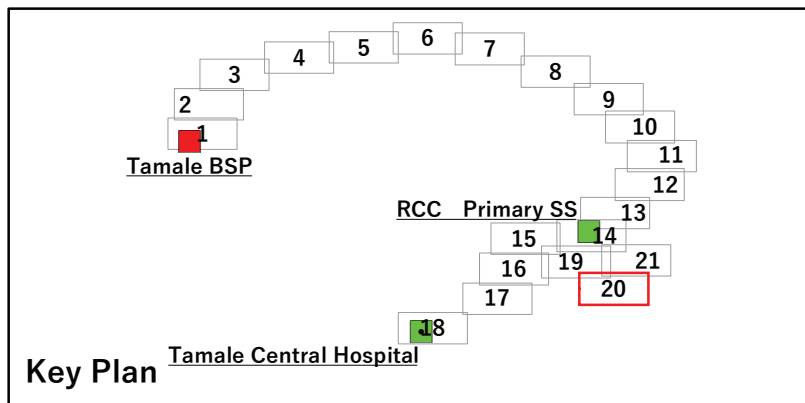
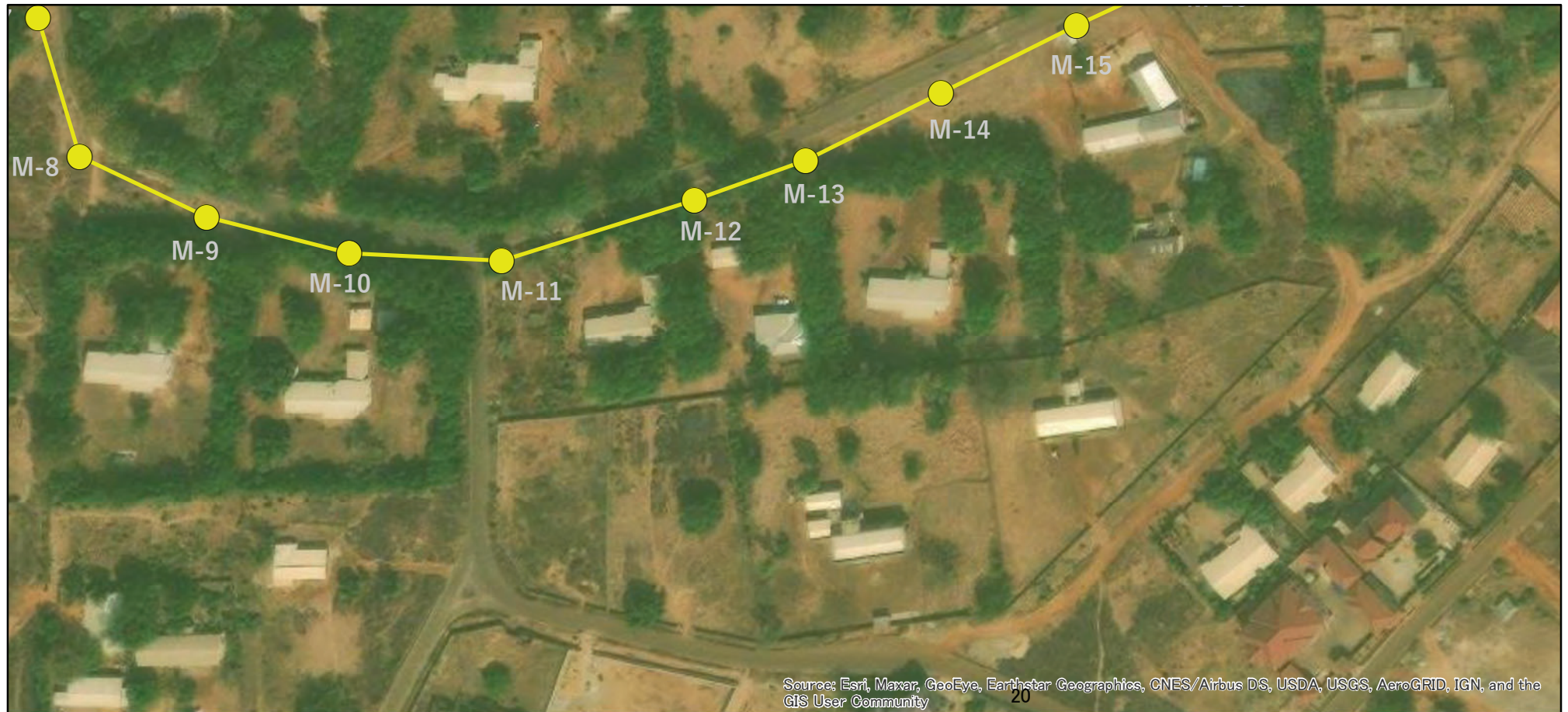


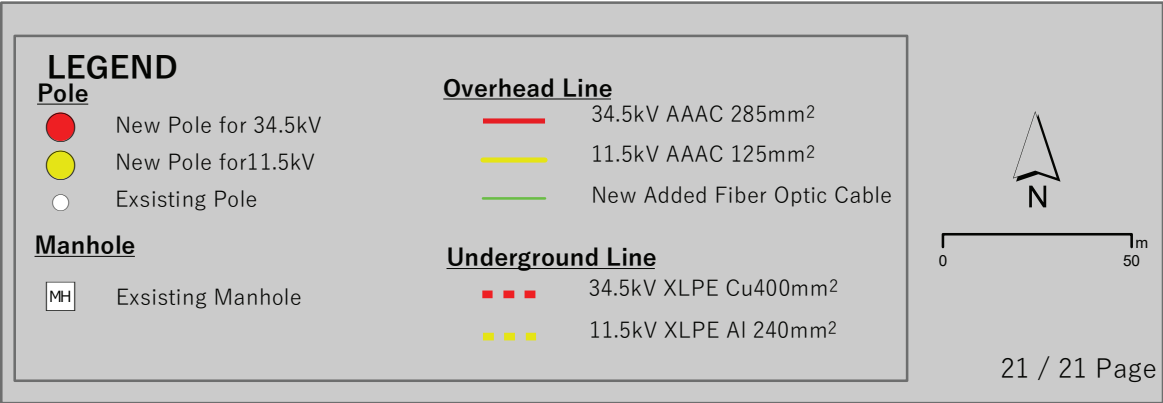
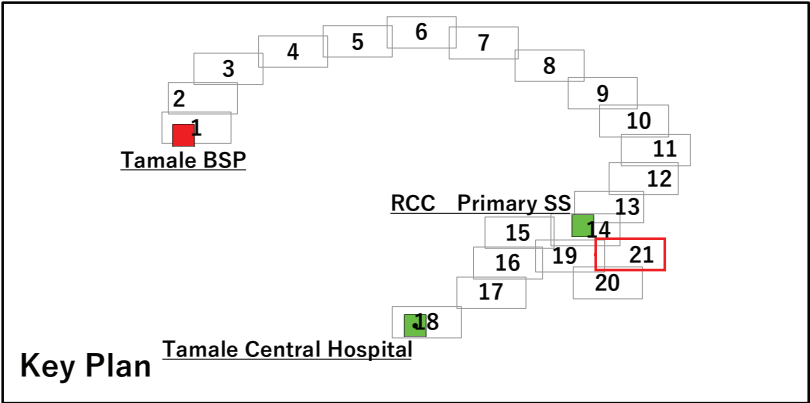


TDL-05 送配電線ルート図(19/21)



TDL-05 送配電線ルート図(20/21)



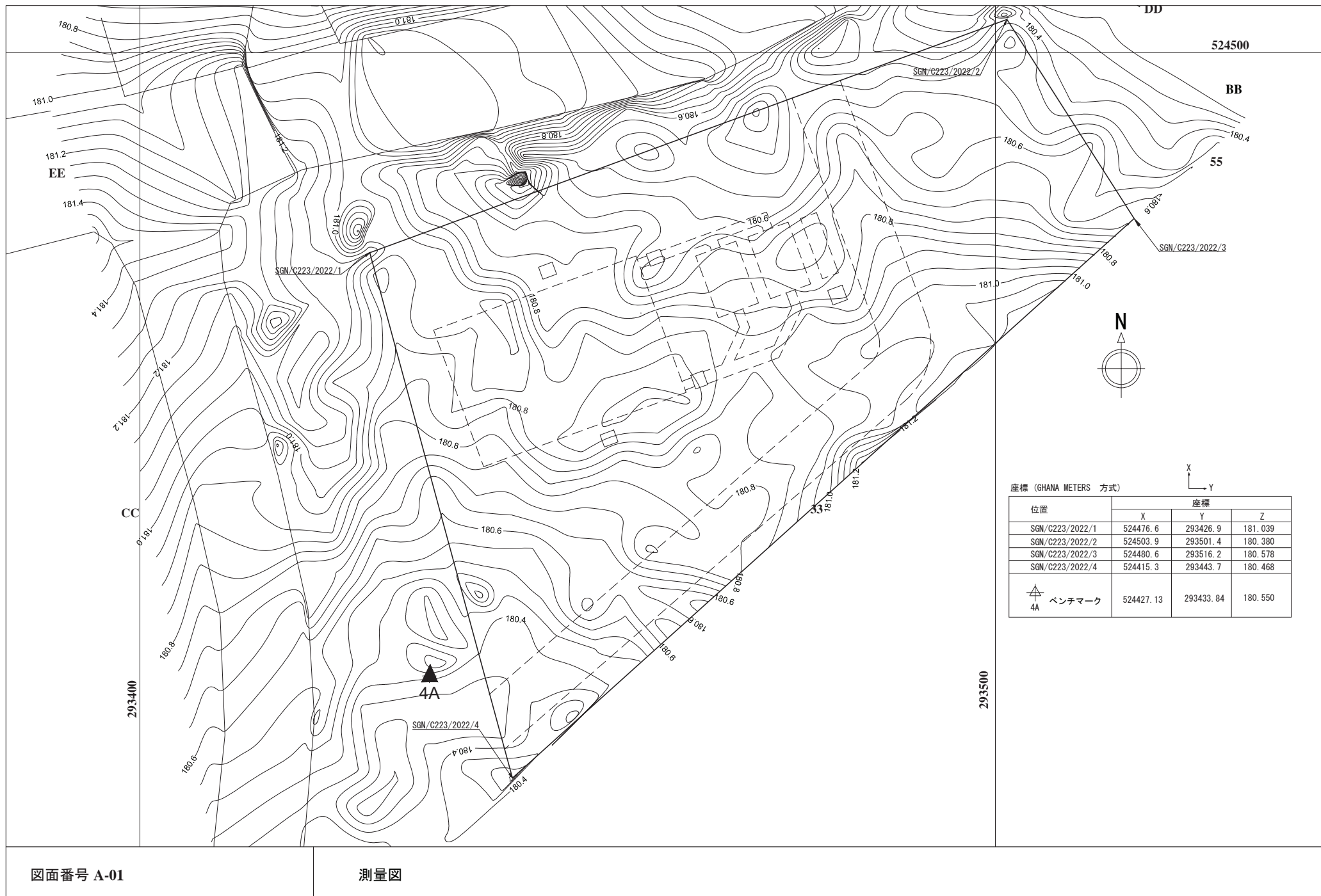


送配電設備

機材 番号	構成 機材 番号	機材名	単位	数 量	数量内訳				
					34.5kV	11.5kV			
TDL-0		電柱							
	TDL-0-1	鋼管柱 18M-10kN	基	136	103	33			
	TDL-0-2	鋼管柱 15M-10kN	基	46	4	42			
TDL-1		装柱金物							
	TDL-1-1-1	34.5kV 2回線 引通し柱 (種別 3DA : 0-5°)	基	56	56	0			
	TDL-1-1-2	34.5kV 2回線 軽角度柱 (種別 3DB : 5-20°)	基	22	22	0			
	TDL-1-1-3	34.5kV 2回線 中角度柱 (種別 3DC : 20-60°)	基	9	9	0			
	TDL-1-1-4	34.5kV 2回線 両引留柱 (種別 3DE)	基	5	5	0			
	TDL-1-1-5	34.5kV 2回線 強角度柱 (種別 3DF : 60-90°)	基	1	1	0			
	TDL-1-1-6	34.5kV 2回線 断路器・ケーブ立上柱 (種別 3DG)	基	2	2	0			
	TDL-1-2-1	11.5kV 引通し柱 (種別 1A : 0-5°)	基	7	0	7			
	TDL-1-2-2	11.5kV 軽角度柱 (種別 1B : 5-20°)	基	8	0	8			
	TDL-1-2-3	11.5kV 中角度柱 (種別 1C : 20-60°)	基	5	0	5			
	TDL-1-2-4	11.5kV 強角度柱 (種別 1F : 60-90°)	基	2	0	2			
	TDL-1-2-5	11.5kV 断路器・ケーブ立上柱 (種別 1G)	基	3	0	3			
	TDL-1-2-6	11.5kV 終端柱 (種別 1H)	基	4	0	4			
	TDL-1-3-1	11.5kV 2回線 引通し柱 (種別 1DA : 0-5°)	基	9	0	9			
	TDL-1-3-2	11.5kV 2回線 軽角度柱 (種別 1DB : 5-20°)	基	7	0	7			
	TDL-1-3-3	11.5kV 2回線 中角度柱 (種別 1DC : 20-60°)	基	1	0	1			
	TDL-1-3-4	11.5kV 2回線 強角度柱 (種別 1DF : 60-90°)	基	1	0	1			
	TDL-1-3-5	11.5kV 2回線 断路器・ケーブ立上柱 (種別 1DG)	基	3	0	3			
	TDL-1-3-6	11.5kV 2回線 分岐柱 (種別 1DH)	基	1	0	1			
	TDL-1-3-7	11.5kV 2回線 引通し柱 (34.5kV 交差) (種別 1DS)	基	1	0	1			
	TDL-1-3-8	11.5kV 2回線 断路器・分岐柱 (種別 1DT)	基	1	0	1			
TDL-2		電線設備							
	TDL-2-1	34.5kV 架空電線 AAAC 285mm ²	m	29,500	29,500	0			
	TDL-2-2	11.5kV 架空電線 AAAC 125mm ²	m	10,500	0	10,500			
	TDL-2-3	光ファイバ複合架空地線(OPGW) 48c 87mm ²	m	5,000	5,000	0			
	TDL-2-4	架空地線 AC 50mm ²	m	2,500	0	2,500			
TDL-3		電力ケーブ立							
	TDL-3-1	34.5kV 電力ケーブ立 XLPE Cu 400mm ²	m	6,000	6,000	0			
	TDL-3-2	11.5kV 電力ケーブ立 XLPE Al 240mm ²	m	12,000	0	12,000			
TDL-4		碍子							
	TDL-4-1	34.5kV ラインボスト碍子	個	601	595	6			
	TDL-4-2	11.5kV ラインボスト碍子	個	286	0	286			
	TDL-4-3	34.5kV 耐張碍子	個	192	192	0			
	TDL-4-4	11.5kV 耐張碍子	個	129	0	129			
TDL-5		断路器							
	TDL-5-1	34.5kV 断路器	台	4	4	0			
	TDL-5-2	11.5kV 断路器	台	11	0	11			
	TDL-5-3	11.5kV 断路器(水平型)	台	2	0	2			
TDL-6		避雷器							
	TDL-6-1	34.5kV 避雷器	個	12	12	0			
	TDL-6-2	11.5kV 避雷器	個	39	0	39			
TDL-7		根柵							
	TDL-7-1	根柵	個	12	12	0			
TDL-8		光ファイバケーブ立							
	TDL-8-1	光ファイバケーブ立 SM-48	m	900	900	0			

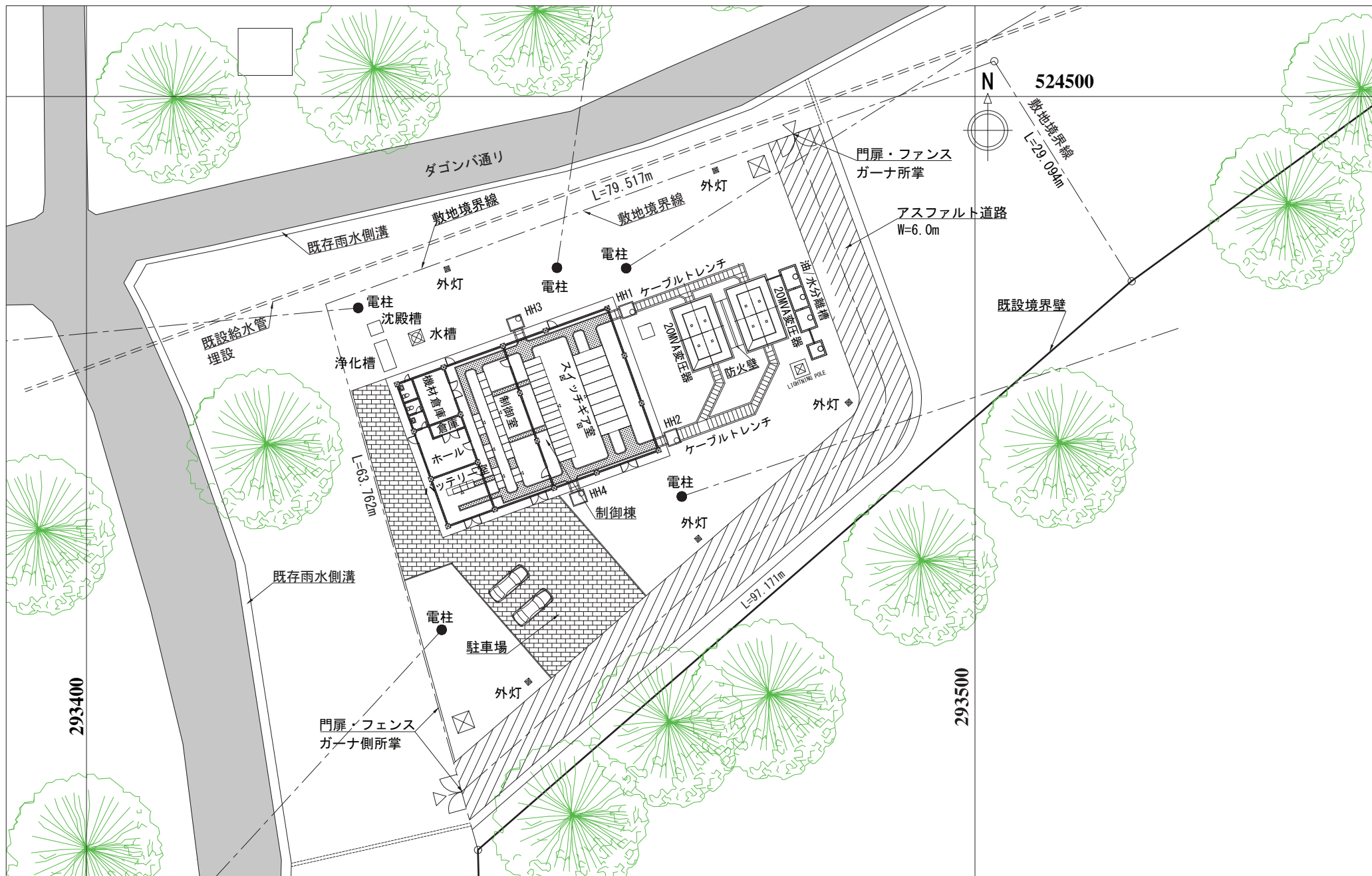
TDL-06 機材一覧表

建築設備



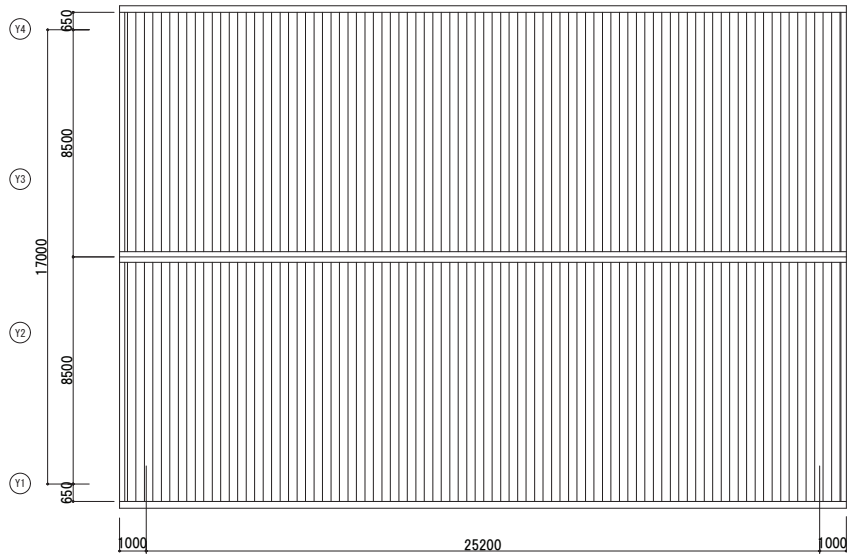
座標 (GHANA METERS 方式)

位置	座標		
	X	Y	Z
SGN/C223/2022/1	524476.6	293426.9	181.039
SGN/C223/2022/2	524503.9	293501.4	180.380
SGN/C223/2022/3	524480.6	293516.2	180.578
SGN/C223/2022/4	524415.3	293443.7	180.468
 4A ベンチマーク	524427.13	293433.84	180.550

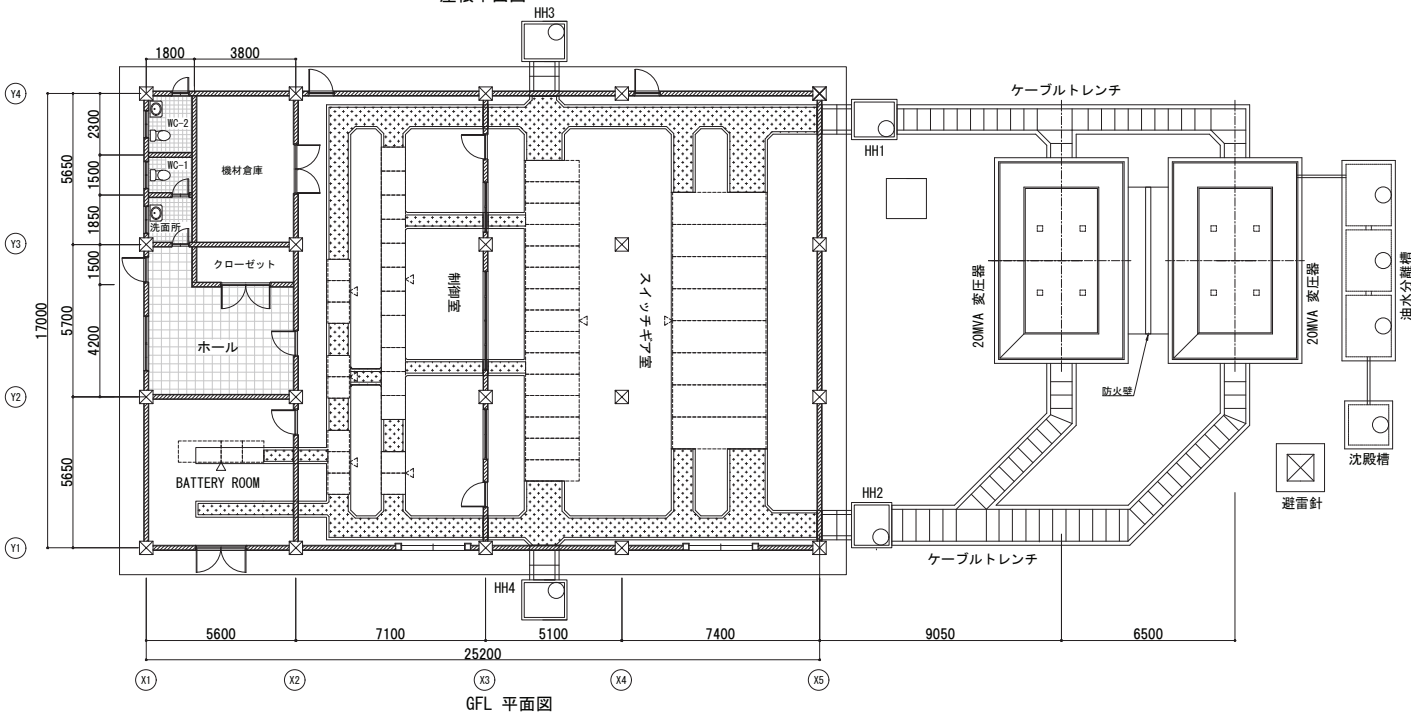


図面番号 A-02

変電所全体配置図



屋根平面図

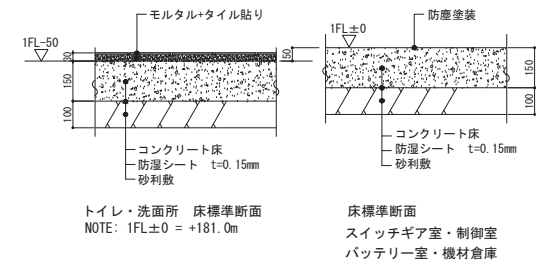


GFL 平面図



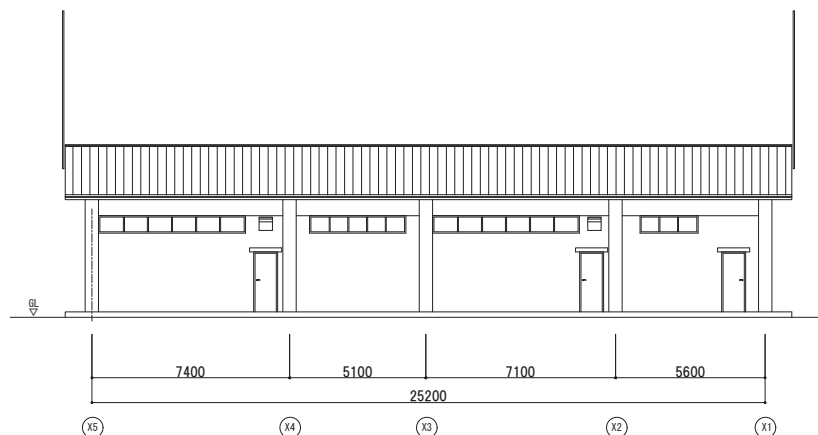
- * 建物概要 *
1. 構造及び階数：鉄筋コンクリート造、平屋建て
 2. 基礎型式：直接基礎
 3. 付帯設備：電気設備：受電盤・配電盤、照明 等
機械設備：給排水、換気、空調設備等

1. 一般事項		
敷地面積	3,954.0 m ²	
建物面積	287.5 m ²	
建物床面積	287.5 m ²	
基礎	鉄筋コンクリート造	
躯体	鉄筋コンクリート造	
2. 外部仕上		
屋根	金属折板 t=0.8mm + アスファルトルーフィング防水+構造合板 t=12mm	
外部壁	コンクリートブロック 厚さ150mm+モルタル20mm+エマルジョンペイント仕上	
3. 内部仕上		
項目	仕上 / 仕様	天井高さ
内壁	コンクリートブロック 厚さ150mm+モルタル20mm+エマルジョンペイント仕上	
スイッチギア室	床 コンクリートコテ仕上+防塵塗装	3,900mm
	壁 モルタル厚20mm+エマルジョン塗装	
	天井 プラスターボード+グラスウールt=100mm	
	巾木 モルタル巾木 25mm x 100mm +エマルジョン塗装	
制御室	FLOOR コンクリートコテ仕上+防塵塗装	3,900mm
	WALL モルタル厚20mm+エマルジョン塗装	
	CEILING プラスターボード+グラスウールt=100mm	
	BASEBOARD モルタル巾木 25mm x 100mm +エマルジョン塗装	
バッテリー室	FLOOR コンクリートコテ仕上+防塵塗装	3,900mm
	WALL モルタル厚20mm+エマルジョン塗装	
	CEILING プラスターボード+グラスウールt=100mm	
	BASEBOARD モルタル巾木 25mm x 100mm +エマルジョン塗装	
機材倉庫	FLOOR コンクリートコテ仕上+防塵塗装	3,000mm
	WALL モルタル厚20mm+エマルジョン塗装	
	CEILING プラスターボード+グラスウールt=100mm	
	BASEBOARD モルタル巾木 25mm x 100mm +エマルジョン塗装	
クローゼット	FLOOR コンクリートコテ仕上+防塵塗装	3,000mm
	WALL モルタル厚20mm+エマルジョン塗装	
	CEILING プラスターボード+グラスウールt=100mm	
	BASEBOARD モルタル巾木 25mm x 100mm +エマルジョン塗装	
トイレ・洗面所	FLOOR モルタル厚30mm+磁器質タイル 150 X 150 (ノンスリップタイプ)	2,500mm
	WALL セラミックタイル 150 X 150 (高さ2.0m以下の部分)	
	CEILING 石膏ボード	
	FLOOR モルタル厚30mm+磁器質タイル 300 X 300 (ノンスリップタイプ)	
ホール	WALL エマルジョン塗装	3,000mm
	CEILING プラスターボード+グラスウールt=100mm	
	BASEBOARD モルタル巾木 25mm x 100mm +エマルジョン塗装	

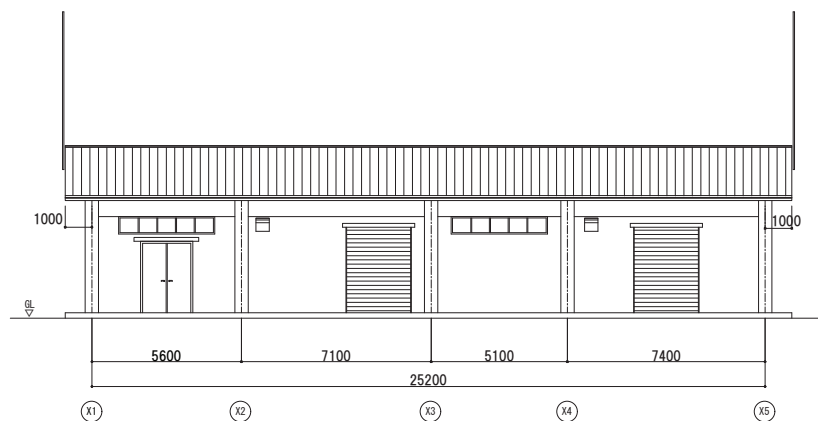


トイレ・洗面所 床標準断面
NOTE: 1FL±0 = +181.0m

床標準断面
スイッチギア室・制御室
バッテリー室・機材倉庫

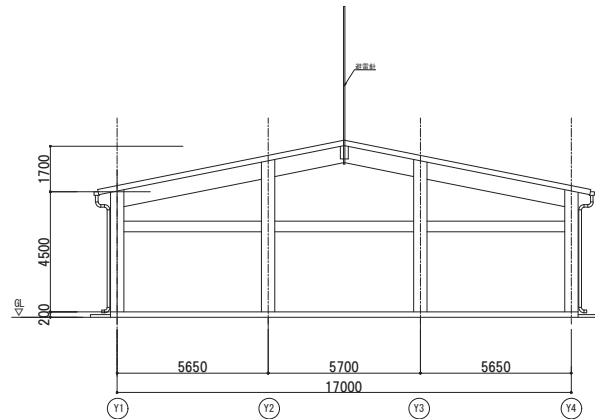
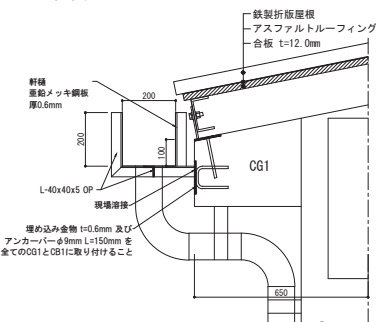


立面図 LINE-Y4

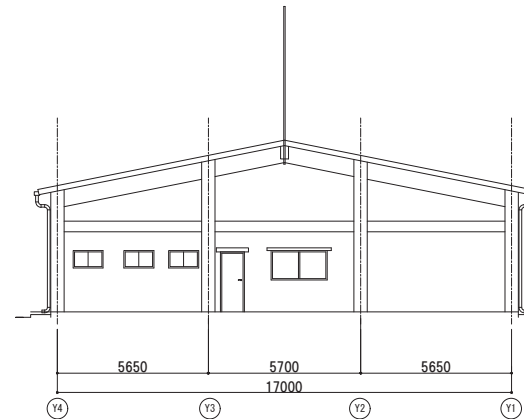


立面図 LINE-Y1

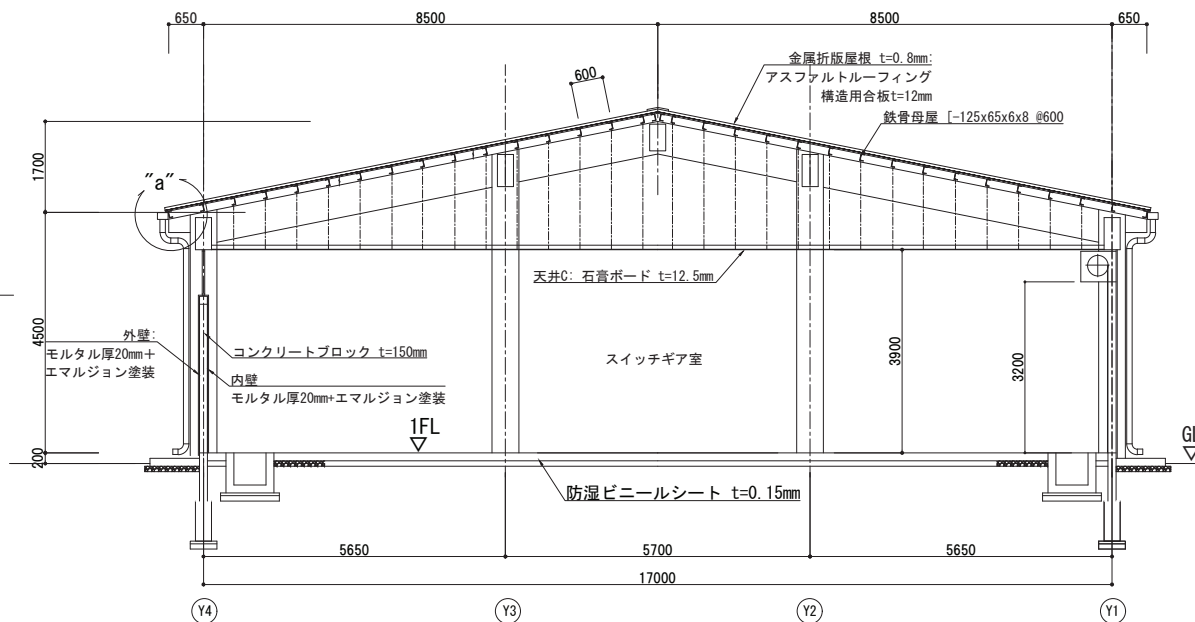
NOTE:
GL⇒+180.8m
1FL⇒+181.0m



立面図 LINE-X5



立面図 LINE-X1



スイッチギア室断面図

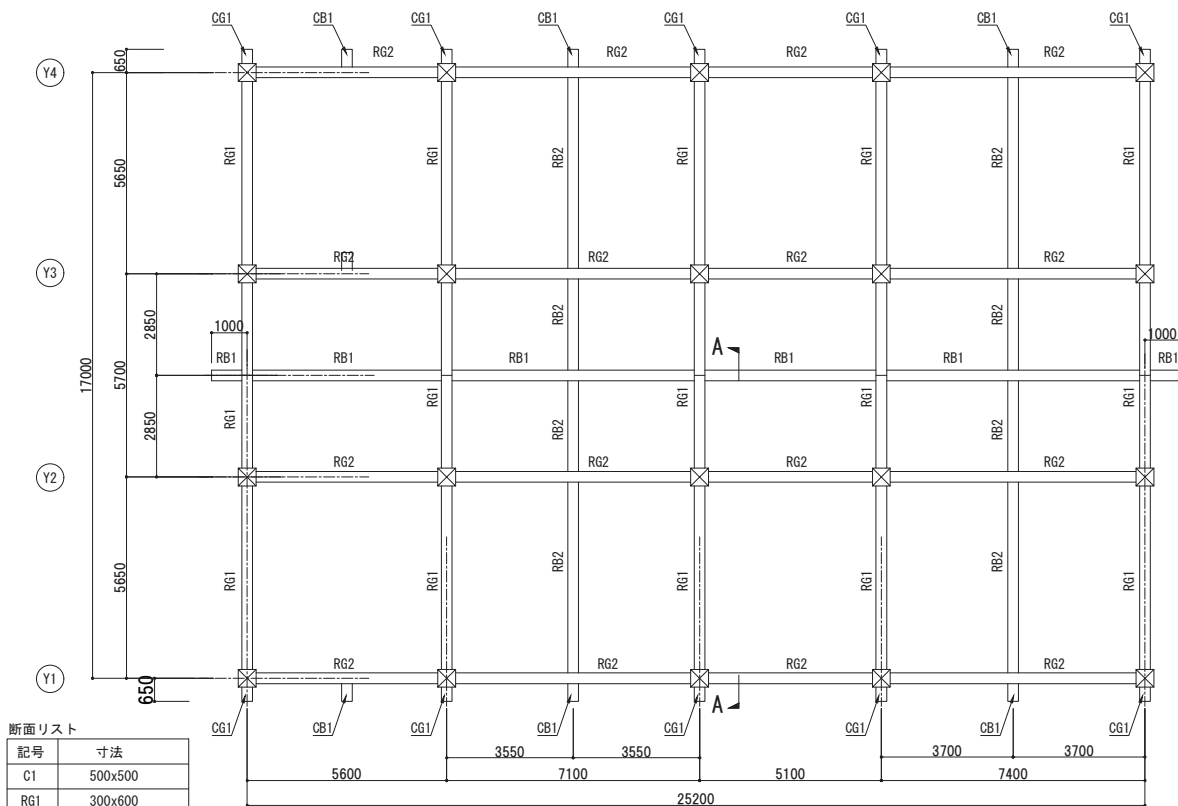
NOTE:
鳥・蚊類の侵入防止板をX1, X5 通り及び Y1, 5通りのコンクリート梁に設けること

記号	断面 2		断面 3		断面 1		断面 3		断面 1		断面 1		断面 2		防犯グリルの標準図		
断面																	
型式	固定窓		固定窓		固定窓		両開き窓		両開き窓				固定窓		固定窓		
材料 / 仕上げ	アルミニウム		アルミニウム		アルミニウム		アルミニウム		アルミニウム				鋼製 / 油性塗装仕上げ		鋼製 / 油性塗装仕上げ		
ガラス	透明ガラス 5.0mm		透明ガラス 5.0mm		透明ガラス 5.0mm		透明ガラス 5.0mm		透明ガラス 5.0mm				強化プラスチックガラス 厚6.0mm		強化プラスチックガラス 厚6.0mm		
金具類	クレセント		クレセント		クレセント		クレセント		クレセント								
注記	防犯グリル		防犯グリル		防犯グリル		防犯グリル		防犯グリル								

記号	断面 1		断面 2		断面 1		断面 1		断面 1		断面 4		断面 2		断面 1		断面 2		ドアプレートの標準図	
断面																				
型式	両開きドア		両開きドア		両開きドア		両開きドア		両開きドア		片開きドア		片開きドア		両開きドア		鋼製シャッター			
材料 / 仕上げ	鋼製・油性塗装仕上げ		鋼製・油性塗装仕上げ		鋼製・油性塗装仕上げ		鋼製・油性塗装仕上げ		鋼製・油性塗装仕上げ		鋼製・油性塗装仕上げ		木製・油性塗装仕上げ		木製・油性塗装仕上げ		木製・油性塗装仕上げ			
金具類	鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		鍵・レバーハンドル・センジ ドアストッパー・ドアクローザー (SUS)		電動式及び手動式			
注記			パニックレバーハンドル (SUS)										ドアグリル							

図面号 A-05

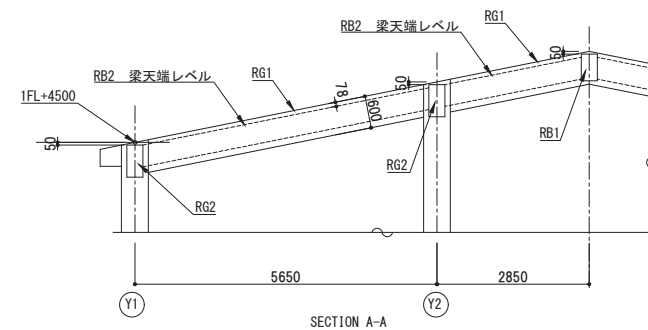
... /具

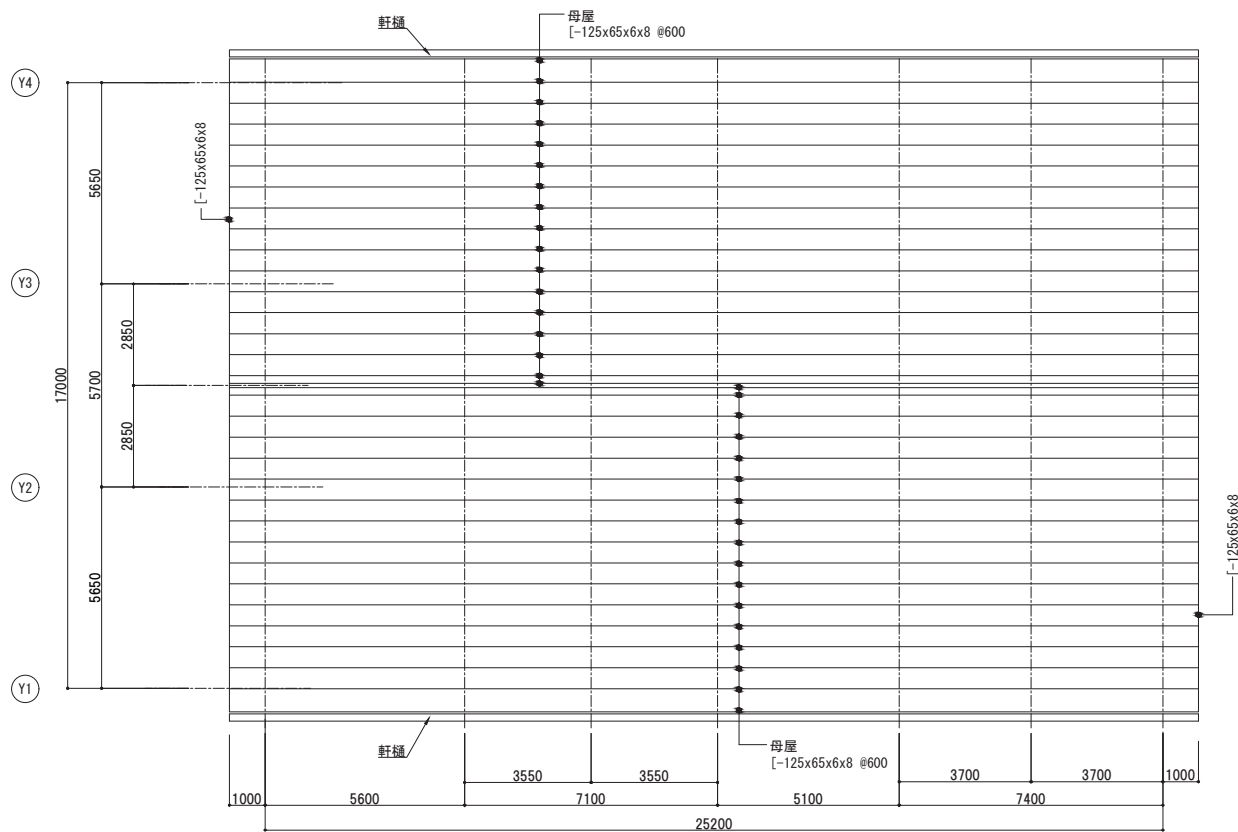


断面リスト

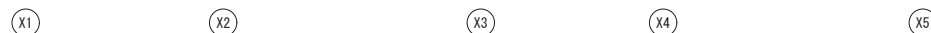
記号	寸法
C1	500x500
RG1	300x600
RG2	300x600
RB1	300x500
RB2	300x400
CG1	300x (320-400)
CB1	300x (250-330)

屋根梁 伏図

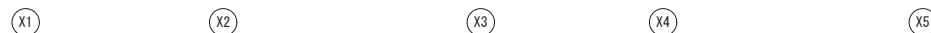




屋根 母屋伏図



Y3 軸組図



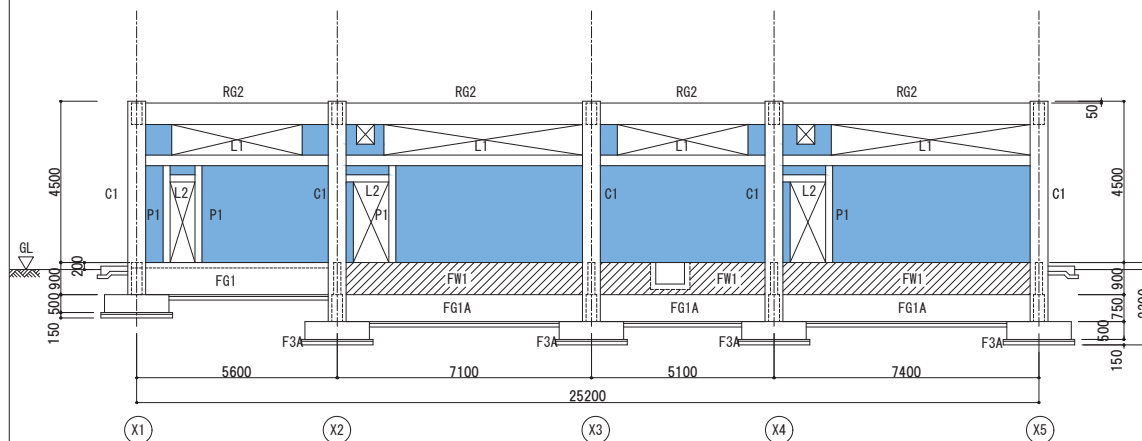
Y2 軸組図



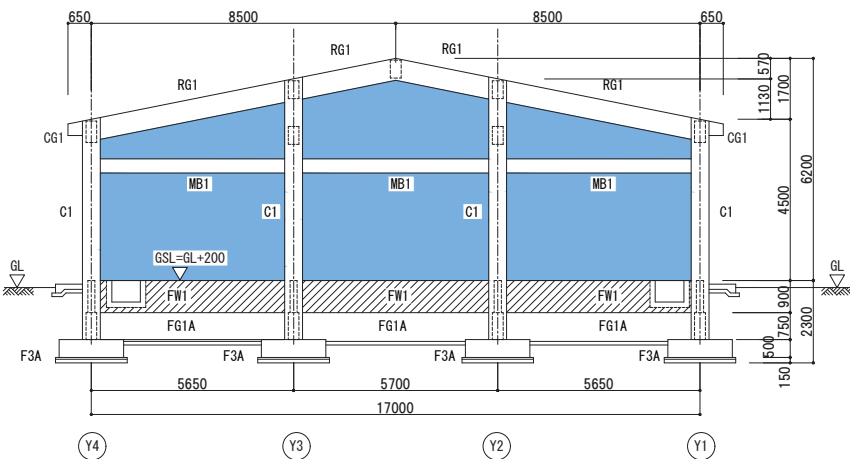
Y1 軸組図



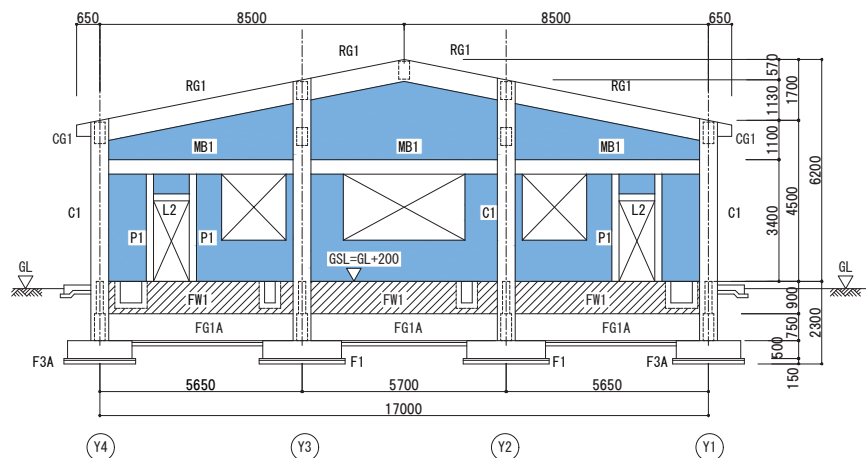
A6-75



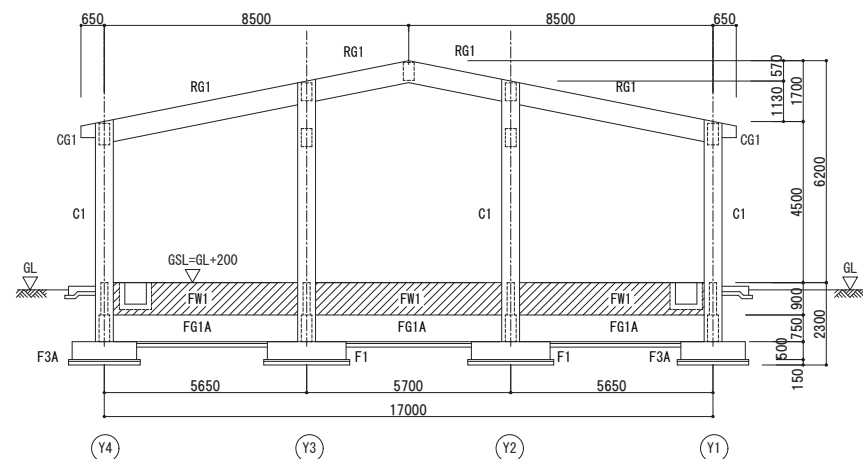
Y4 軸組図



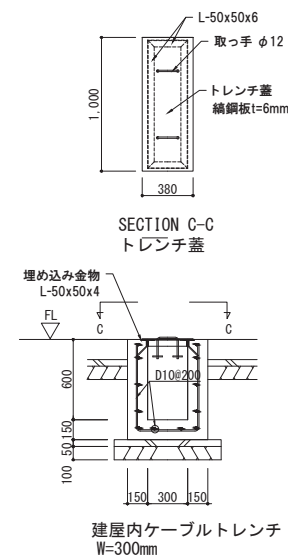
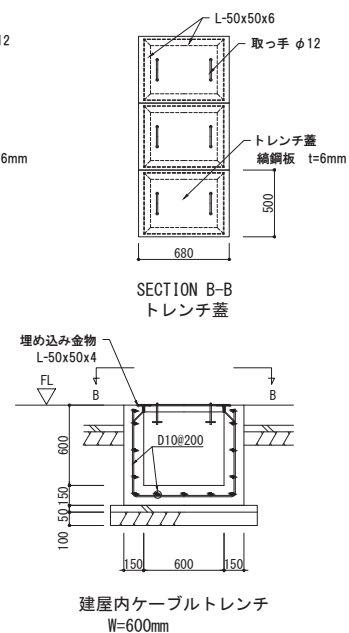
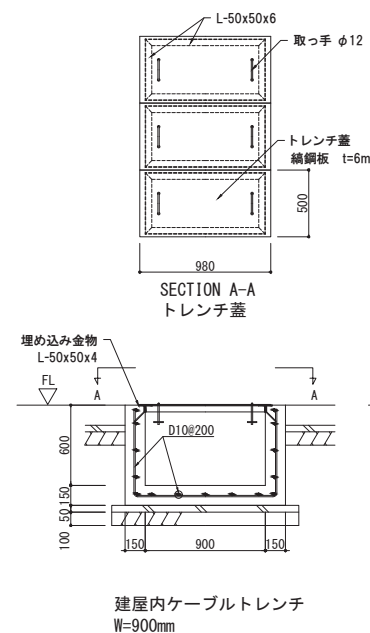
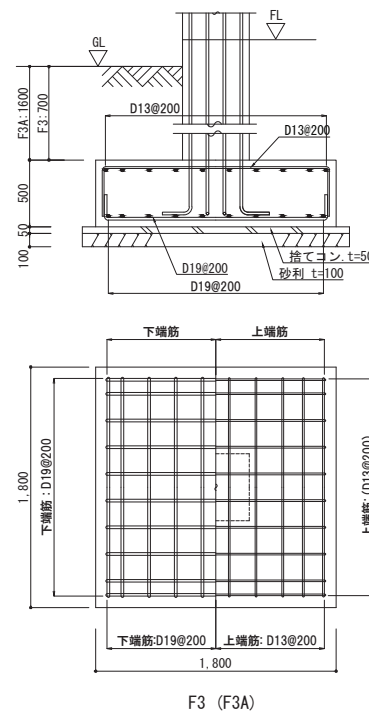
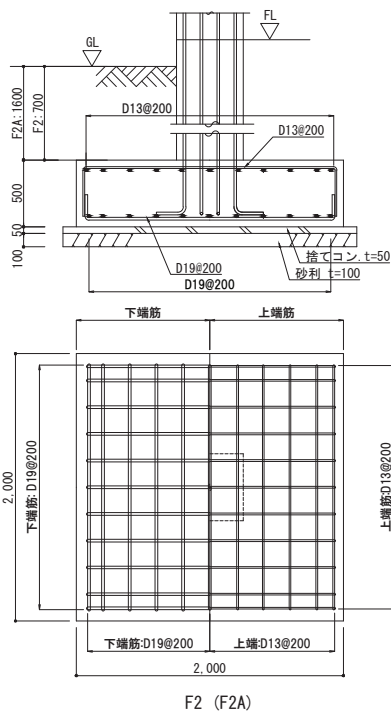
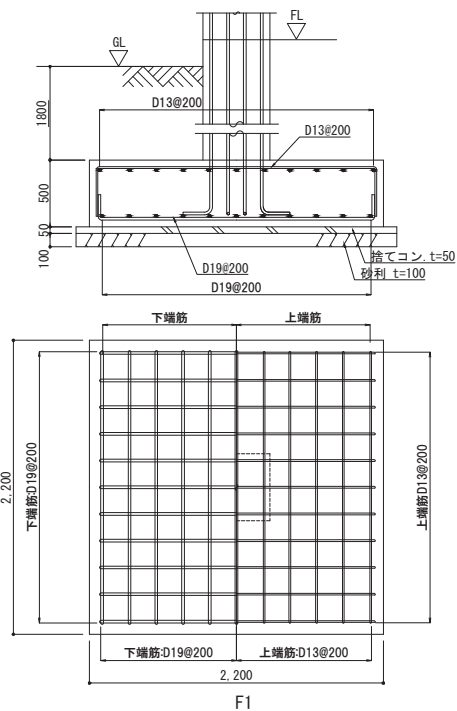
X5 軸組図



X3 軸組図



X4 軸組図

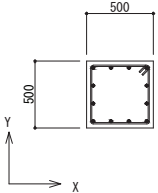
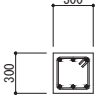


- NOTES:
- コンクリート強度
(1) 基礎用: $F_c=21\text{N/mm}^2$
(2) 躯体用: $F_c=21\text{N/mm}^2$
(3) 土間床用: $F_c=21\text{N/mm}^2$
(4) 間柱/臥梁用: $F_c=21\text{N/mm}^2$
(5) ケーブルトレンチ / ハンドホール用: $F_c=21\text{N/mm}^2$
(6) 捨てコンクリート用: $F_c=18\text{N/mm}^2$
 - 鉄筋
(1) 異形鉄筋: JIS-SD295A
又は同等品
(2) 丸鋼: JIS-SR235
又は同等品
 - 鋼材: JIS-SS400
又は同等品

大梁・小梁 断面図

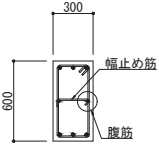
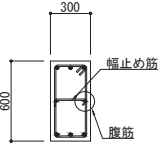
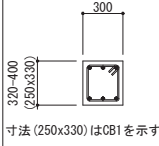
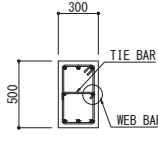
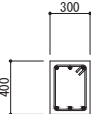
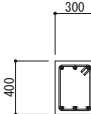
記号	FG1	FG1A	FB1	FW1	土間コンクリート
断面					
上端筋	3-D19	3-D19	3-D19	縦筋 D10@200	
下端筋	3-D19	3-D19	3-D19	横筋 D10@200	
せん断補強筋	D10@150	D10@150	D10@150		
幅止め筋	D10@1000	D10@1000	D10@1000		
腹筋	2x2-D10	2x2-D10	2-D10		

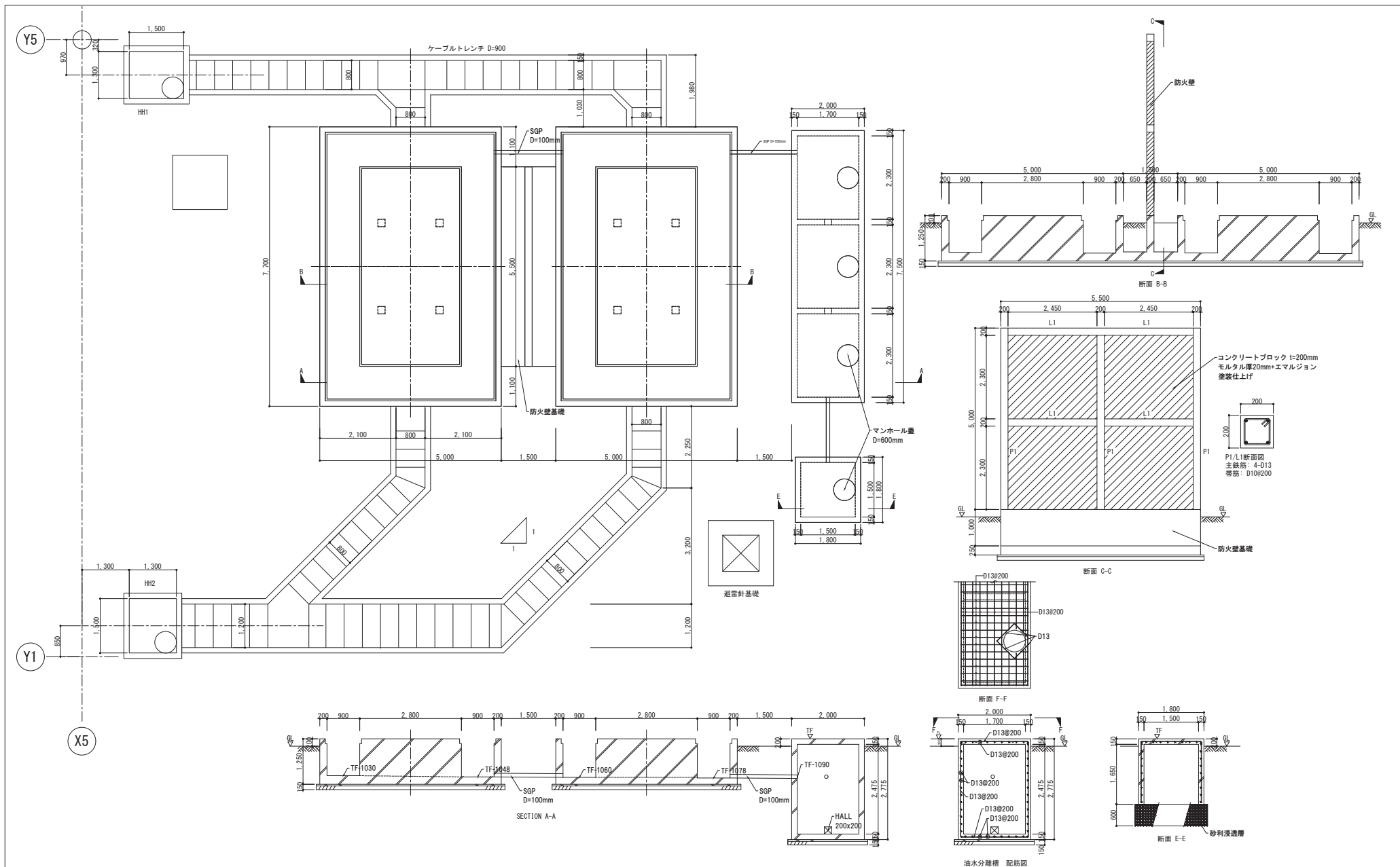
柱/間柱/臥梁 リスト

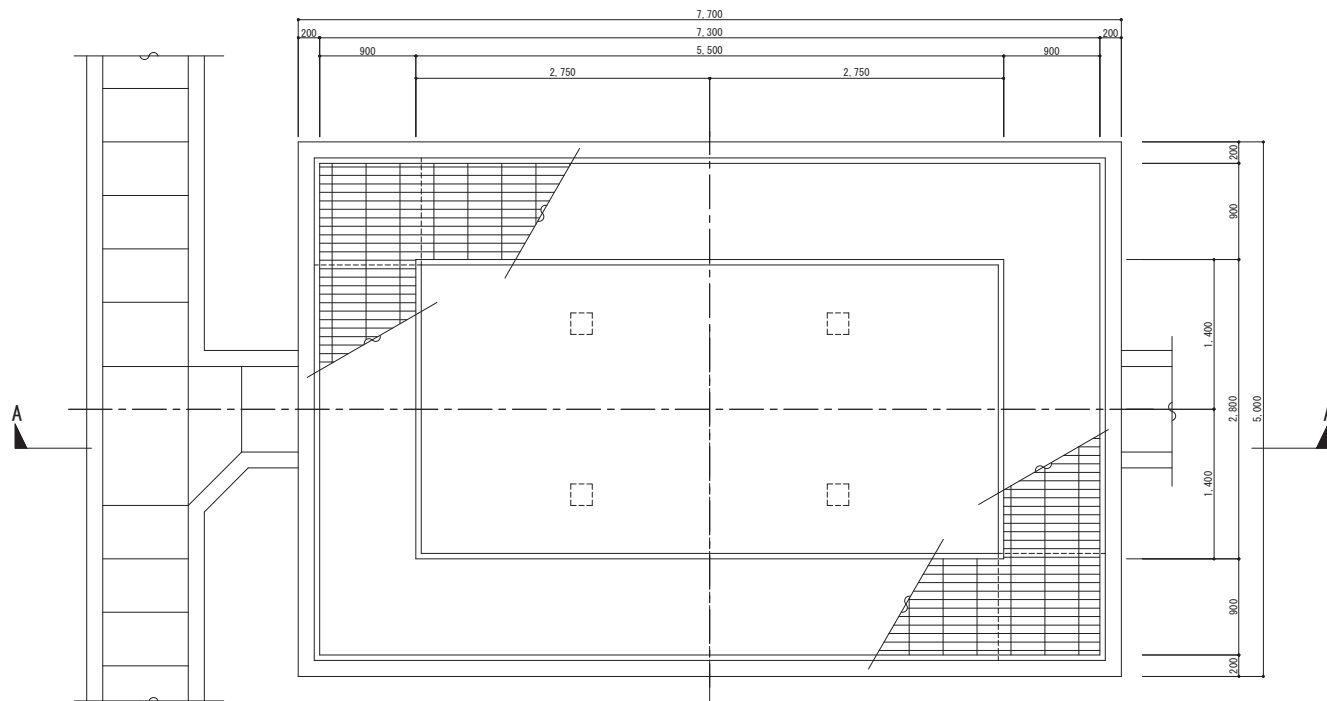
記号	C1	P1	P2	L1	L2	
断面						
主鉄筋	12-D19	2-D10	2-D10	3-D13	2-D10	
帯筋	D10@100	D10@200	D10@200	D10@200	D10@200	

- NOTES:
- コンクリート強度
(1) 基礎用: $F_c=21\text{N/mm}^2$
(2) 躯体用: $F_c=21\text{N/mm}^2$
(3) 土間床用: $F_c=21\text{N/mm}^2$
(4) 間柱/臥梁用: $F_c=21\text{N/mm}^2$
(5) ケーブルトレンチ / ハンドホール用: $F_c=21\text{N/mm}^2$
(6) 捨てコンクリート用: $F_c=18\text{N/mm}^2$
 - 鉄筋
(1) 異形鉄筋: JIS-SD295A
又は同等品
(2) 丸鋼: JIS-SR235
又は同等品
 - 鋼材: JIS-SS400
又は同等品

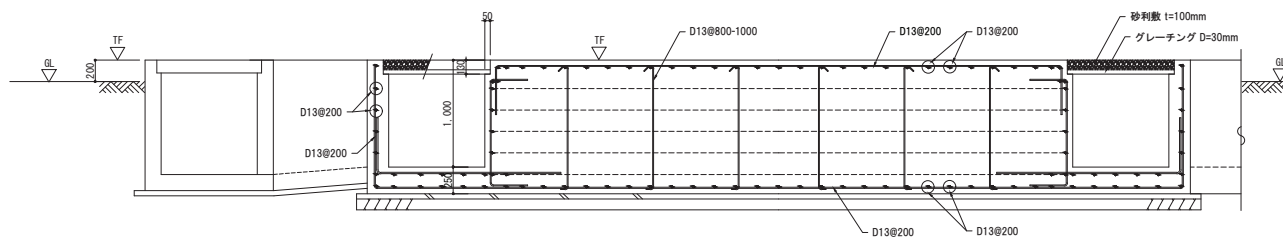
大梁/小梁 断面リスト

記号	RG1	RG2	CG1 (CB1)	RB1	RB2	MB1
断面						
上端筋	3-D19	3-D19	3-D19	3-D19	3-D19	3-D19
下端筋	3-D19	3-D19	3-D19	3-D19	3-D19	3-D19
せん断補強筋	D10@150	D10@150	D10@150	D10@150	D10@150	D10@150
幅止め筋	D10@1000	D10@1000		D10@1000	D10@1000	D10@1000
腹筋	2-D10	2-D10		2-D10	2-D10	2-D10

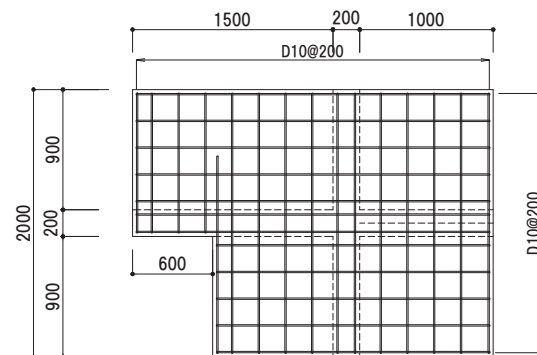
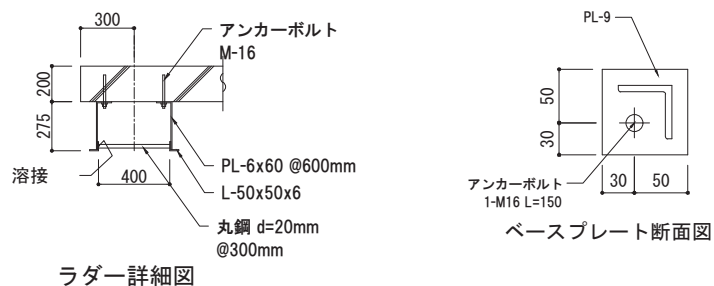
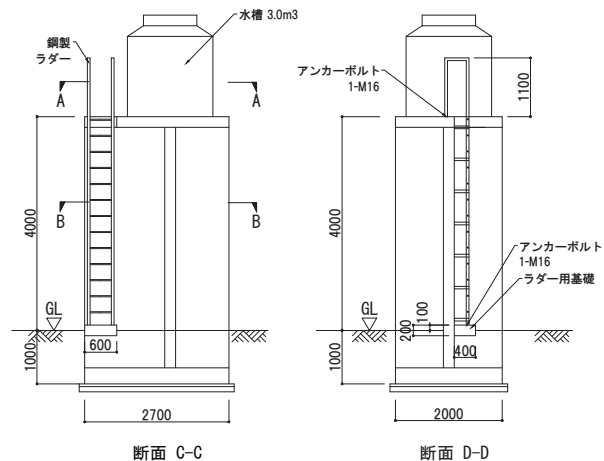
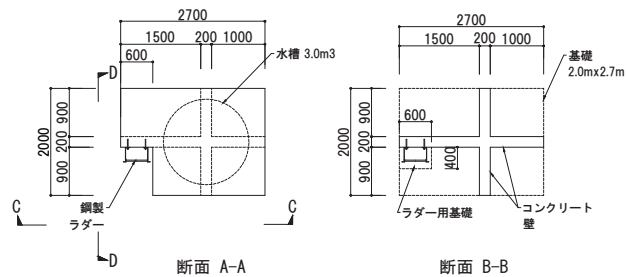




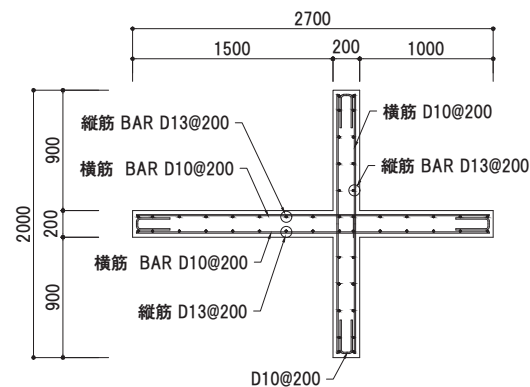
20MVA 変圧器平面図



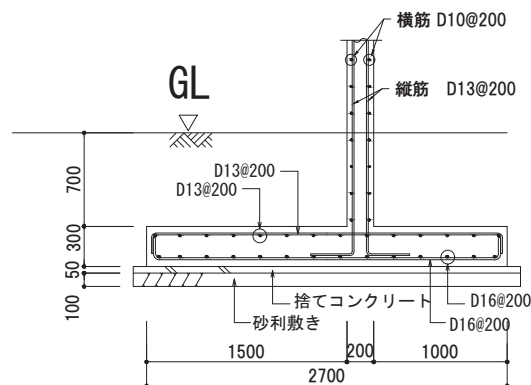
断面 A-A



水槽置き場 床配筋図



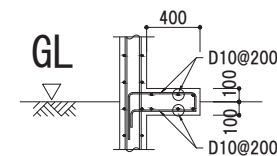
壁配筋図



基礎配筋図

NOTES:

- (1) コンクリート強度 $F_c=21\text{N/mm}^2$
- (2) 異形鉄筋: SD295A/SD345 又は同等品
- (3) 丸鋼: SS400 又は 同等品
- (4) ボルト: HIGH TENSION BOLT F10T 又は同等品
- (5) アンカーボルト: SR235 又は同等品
- (6) 鉄面は錆び止め塗装・2回塗りの上
SOP (合成樹脂塗装) 仕上げとする



ラダー基礎配筋図

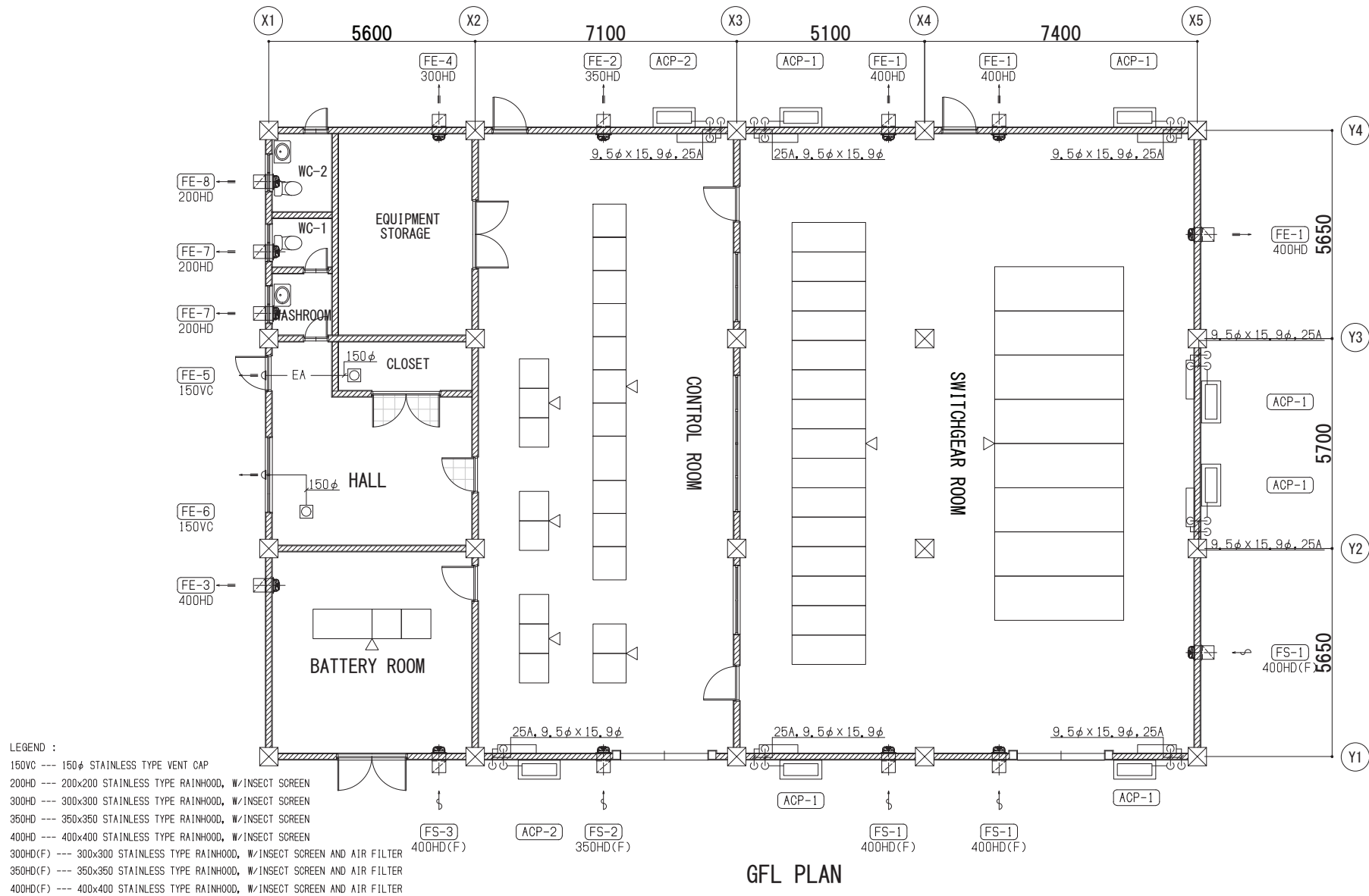
EQUIPMENT SCHEDULE

SYMBOL	DESCRIPTION	QTY	SPECIFICATION	LOCATION
ACP-1	WALL MOUNTED TYPE HEAT-PUMP SYSTEM AIR CONDITIONER	6	COOLING CAPACITY : 10.0 kW CONSUMPTION POWER : 2.75 kW COMPRESSOR POWER : 1.79 kW INDOOR FAN POWER : 26 W OUTDOOR FAN POWER : 94 W POWER : 3 PHASE - 230 V - 50 Hz	SWITCHGEAR ROOM
ACP-2	WALL MOUNTED TYPE HEAT-PUMP SYSTEM AIR CONDITIONER	2	COOLING CAPACITY : 10.0 kW CONSUMPTION POWER : 2.75 kW COMPRESSOR POWER : 1.79 kW INDOOR FAN POWER : 26 W OUTDOOR FAN POWER : 94 W POWER : 3 PHASE - 230 V - 50 Hz	CONTROL ROOM
FS-1	WALL MOUNTED TYPE PROPELLER SUPPLY FAN	3	CAPACITY : 400DIA x 2700m3/H x 50Pa x 200W POWER : 1 PHASE - 230 V - 50 Hz	SWITCHGEAR ROOM
FS-2	WALL MOUNTED TYPE PROPELLER SUPPLY FAN	1	CAPACITY : 350DIA x 1900m3/H x 50Pa x 150W POWER : 1 PHASE - 230 V - 50 Hz	CONTROL ROOM
FS-3	WALL MOUNTED TYPE PROPELLER SUPPLY FAN	1	CAPACITY : 400DIA x 3100m3/H x 50Pa x 200W POWER : 1 PHASE - 230 V - 50 Hz	BATTERY ROOM

SYMBOL	DESCRIPTION	QTY	SPECIFICATION	LOCATION
FE-1	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	3	CAPACITY : 400DIA x 2700m3/H x 50Pa x 200W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	SWITCHGEAR ROOM
FE-2	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	1	CAPACITY : 350DIA x 1900m3/H x 50Pa x 150W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	CONTROL ROOM
FE-3	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	1	CAPACITY : 400DIA x 3100m3/H x 50Pa x 200W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	BATTERY ROOM
FE-4	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	1	CAPACITY : 300DIA x 350m3/H x 50Pa x 50W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	EQUIPMENT STRAGE
FE-5	CEILING MOUNTED TYPE EXHAUST FAN	1	CAPACITY : 200m3/H x 50Pa x 25.5W POWER : 1 PHASE - 230 V - 50 Hz	CLOSET
FE-6	CEILING MOUNTED TYPE EXHAUST FAN	1	CAPACITY : 400m3/H x 54W POWER : 1 PHASE - 230 V - 50 Hz	HALL
FE-7	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	2	CAPACITY : 200DIA x 100m3/H x 13.5W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	WASHROOM WC-1
FE-8	WALL MOUNTED TYPE PROPELLER EXHAUST FAN	1	CAPACITY : 200DIA x 150m3/H x 13.5W POWER : 1 PHASE - 230 V - 50 Hz ASSEMBLY : WIND TYPE SHUTTER	WC-2

図面番号 M-01

制御棟/空調機器機材リスト



図面番号 M-02

制御棟/空調システム図

EQUIPMENT SCHEDULE

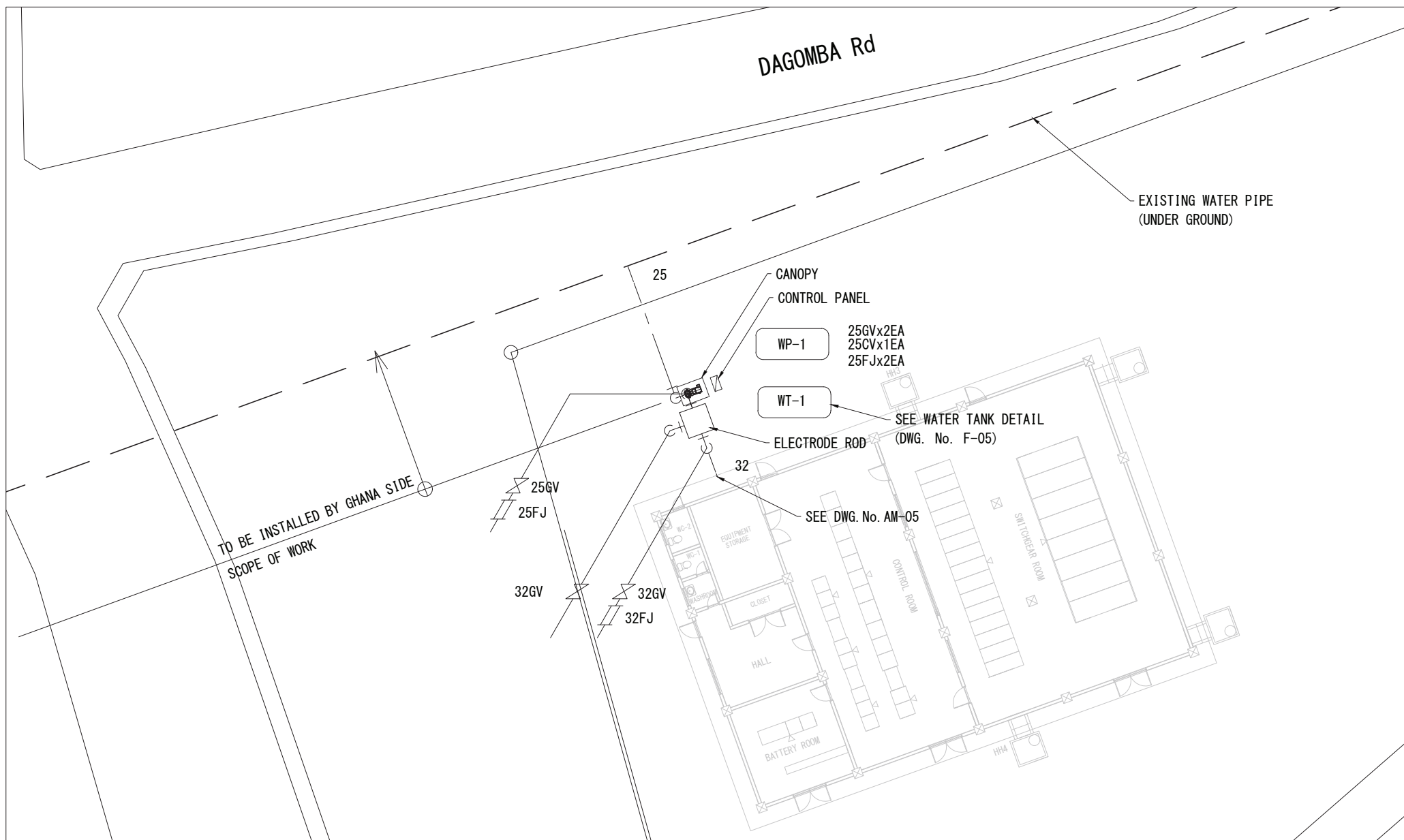
SYMBOL	DESCRIPTION	QTY	SPECIFICATION	LOCATION
WT-1	FIBER REINFORCED PLASTIC TYPE ELEVATED WATER TANK	1	CAPACITY : 3.0 m ³ WATER TANK BASE : GL + 4.0 m	OUTWARD
WP-1	WATER SUPPLY PUMPS OUTDOOR TYPE	1	CAPACITY : 25DIAx20 L/minx160 kPa x 0.4 kW POWER : 1 PHASE - 230V - 50Hz ASSEMBLY : VIBRATION ISOLATING BASE CONTROL PANEL, RAIN SHED	OUTWARD
AE-1	FIRE EXTINGUISHER	5	ABC DRY CHEMICAL EXTINGUISHER CAPACITY : 10 TYPE (APPROXIMATELY 3.0 kg) ACCESSORY : FLOOR MOUNTED STEEL BOX	SWITCHGEAR ROOM CONTROL ROOM BATTERY ROOM EQUIPMENT STRAGE HALL
CE-1	FIRE EXTINGUISHER	1	CARBON DIOXIDE FIRE EXTINGUISHER CAPACITY : 10 TYPE (APPROXIMATELY 4.6 kg) ACCESSORY : FLOOR MOUNTED STEEL BOX	CONTROL ROOM

PLUMBING FIXTURE SCHEDULE

SYMBOL	DESCRIPTION	QTY	SPECIFICATION	LOCATION
P-1	WATER CLOSET FLOOR MOUNTED	2	W/FLUSH TANK AND PAPER HOLDER	WC-1 WC-2
P-2	LAVATORY	2	W/MIRROR AND SOAP DISPENSER	WASHROOM WC-2

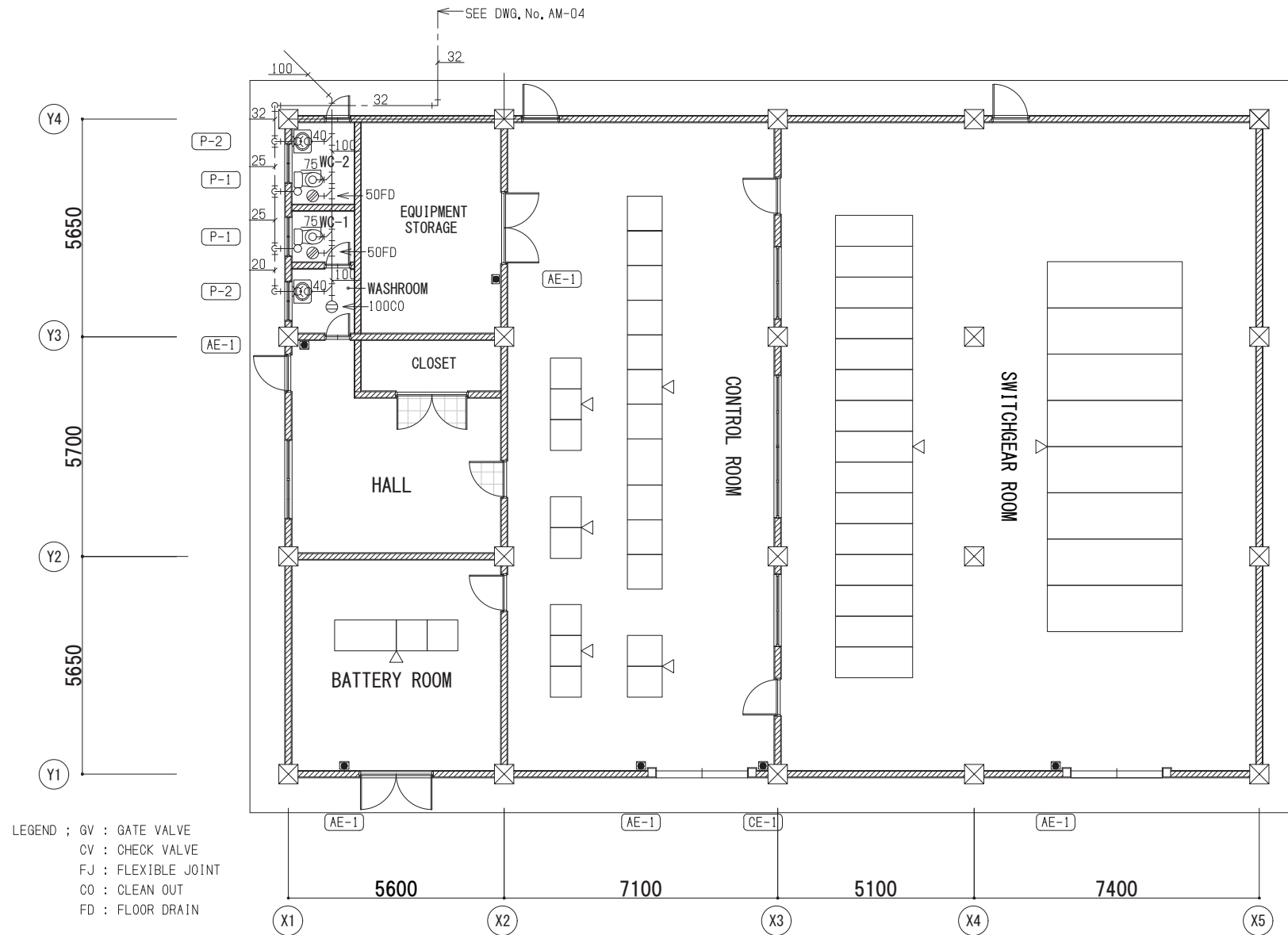
図面番号 M-03

制御棟/配管機材リスト



図面番号 E-04

制御棟/屋外配管図

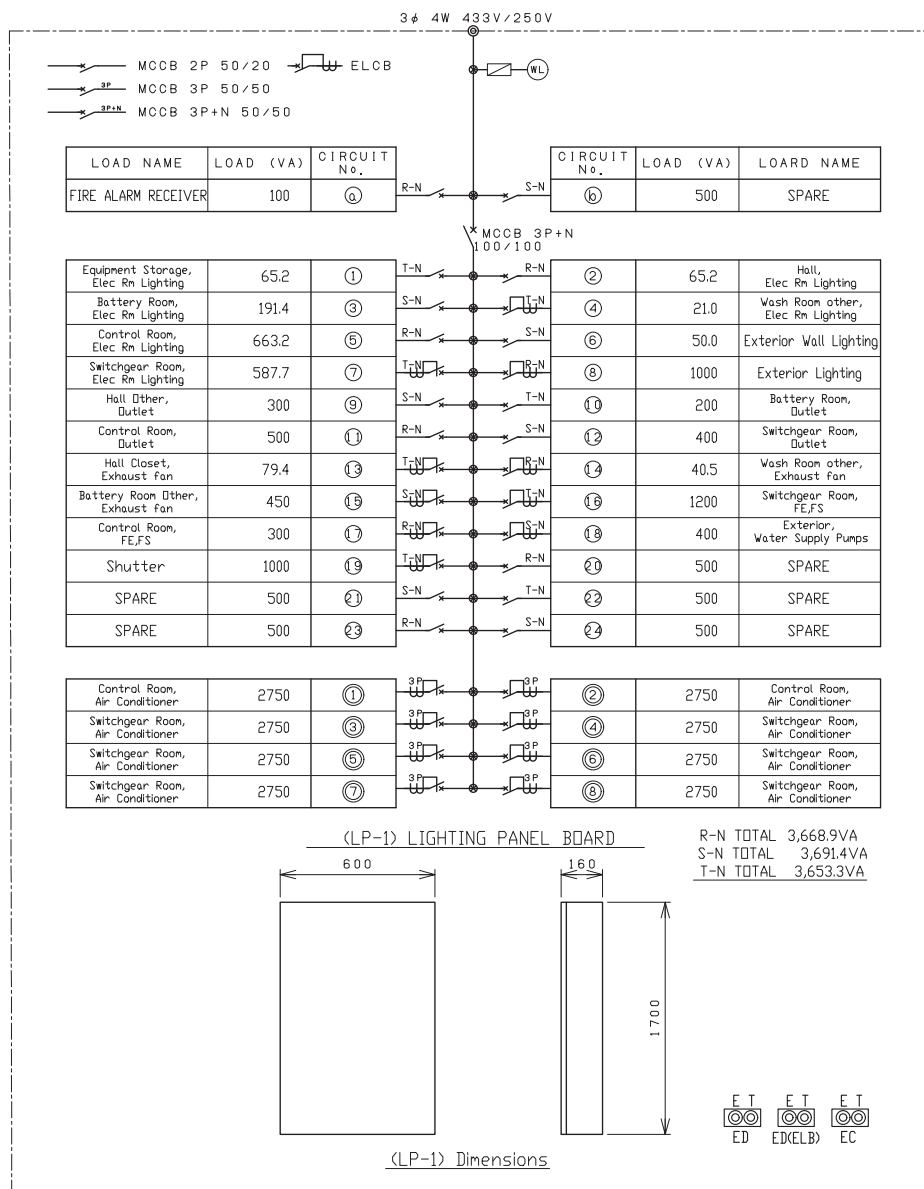


図面番号 E-05

制御棟/屋内配管図

MAIN FEEDER & POWER SYSTEM		SOCKET OUTLET SYSTEM	
	ELECTRIC LIGHTING POWER DISTRIBUTION PANEL		SOCKET OUTLET 2P+E 250v 15A/ 1-GANG (BS TYPE)
	CONTROL PANEL		SOCKET OUTLET 2P+E 250v 15A/ 2-GANG (BS TYPE)
LIGHTING SYSTEM			
	SURFACE MOUNT		ISOLATING SWICH (MCCB3P50/50NT) OUT DOOR WATERPROOF TYPE
	SURFACE MOUNT (EMERGENCY LIGHTING BUILT-CELL TYPE)		
	BRACKET TYPE, WATER PROOF		
	DOWN LIGHT		
	EXTERIOR LIGHTING		
	LIGHTING SWITCH 1P 15A 1-WAY		
	LIGHTING SWITCH 3W 15A 3-WAY		
	LIGHTING SWITCH 4W 15A 4-WAY		
	LIGHTING SWITCH 1P 15A 1-WAY WP		
	LIGHTING SWITCH 1P 15A 1-WAY (LED EDKING LUMP TYPE)		
	LIGHTING SWITCH 3W 15A 3-WAY (LED EDKING LUMP TYPE)		
			EXPOSED BOX
	SHUTTER POWER		JOINT BOX
			PULL BOX (w/DIMENSION) ø00xø00xc00
			PULL BOX (w/DIMENSION) 200x200x100 SUS,WP
			RISER WIRING, w/WIRE & CONDUIT SIZE
			BRING DOWN WIRING, w/WIRE & CONDUIT SIZE

WIRING	
	WIRING, CONCEALED IN CEILING OR WALL
	WIRING, CABLE
	WIRING, EXPOSED
	WIRING, EMBEDDED IN FLOOR SLAB
	WIRING, UNDER GROUND AREA
	VVF 2-2C (VE22)
	VVF 2-3C (VE22)
	VVF 2-2C+2 (VE22)
	VVF 2-3C (1CE) (VE22)
	VVF 2-3C (1CE) (G22)
	VVF 2-2C+2 (1CE) (VE22)
	CV35-3C (1CE) (FEP30)
	CV35-3C (1CE) (VE28)
	CV35-4C (1CE) (VE28)
	CV35-4C (1CE) (G28)



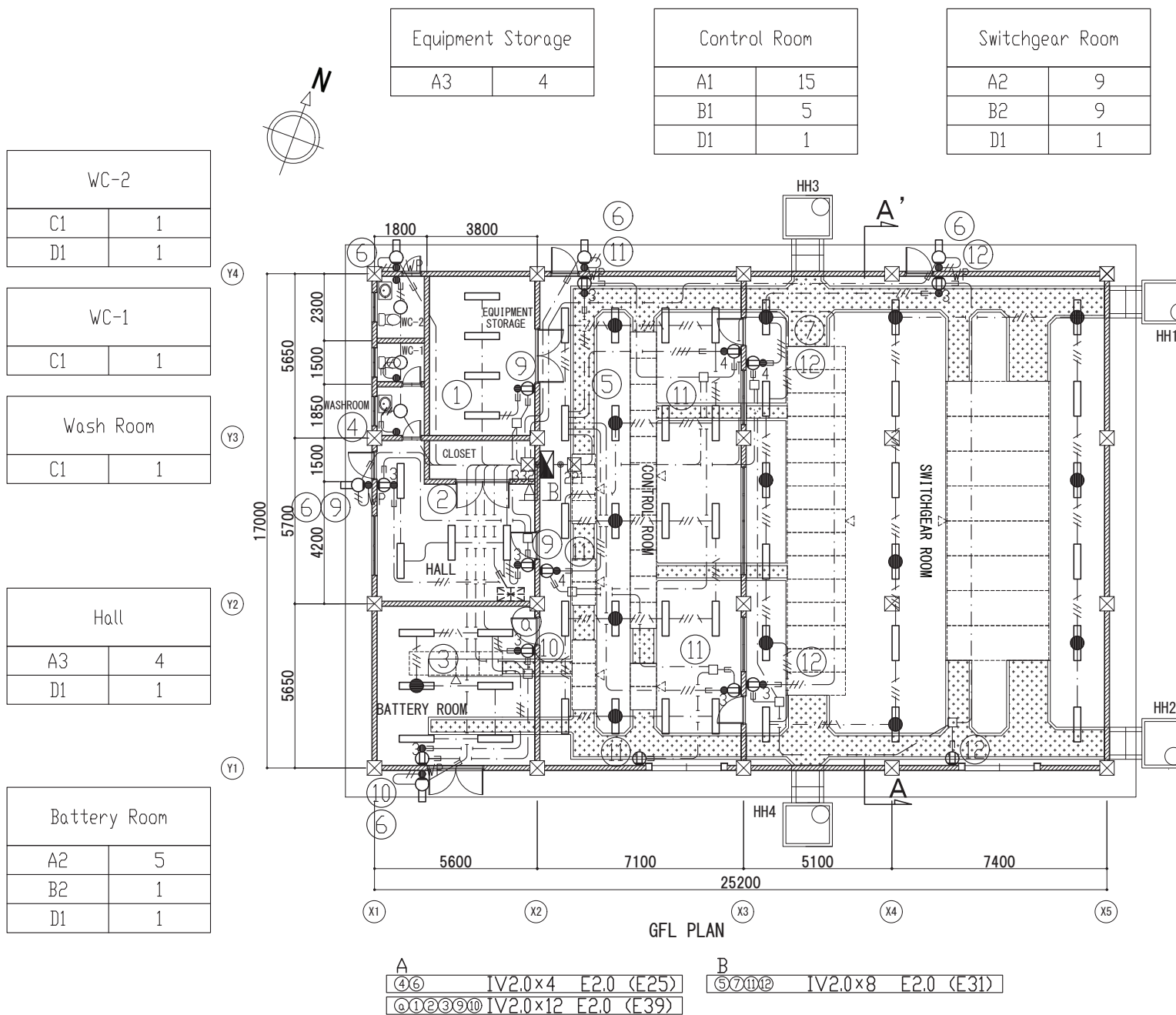
LIGHTING FIXTURE SCHEDULE

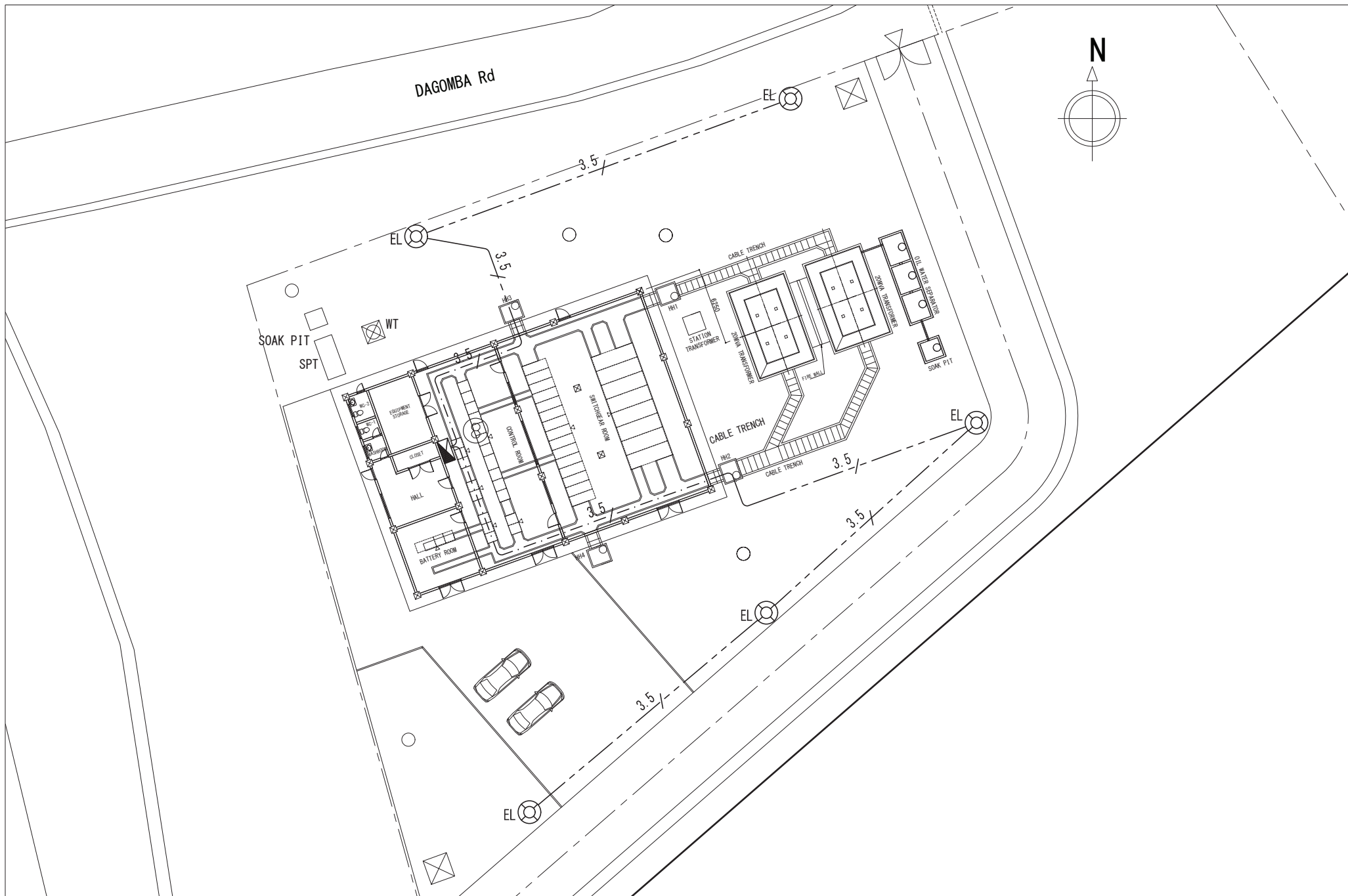
A	SURFACE MOUNTED TYPE		B		
A1	LED LSS9-4-65	6900 lm	B1	LED LSS9-4-65 EMERGENCY LIGHTING BUILT=CELL TYPE	6900 lm
A2	LED LSS9-4-48	5200 lm	B2	LED LSS9-4-48 EMERGENCY LIGHTING BUILT=CELL TYPE	5200 lm
A3	LED LSS9-4-23	2500 lm	B3	LED LSS9-4-23 EMERGENCY LIGHTING BUILT=CELL TYPE	2500 lm

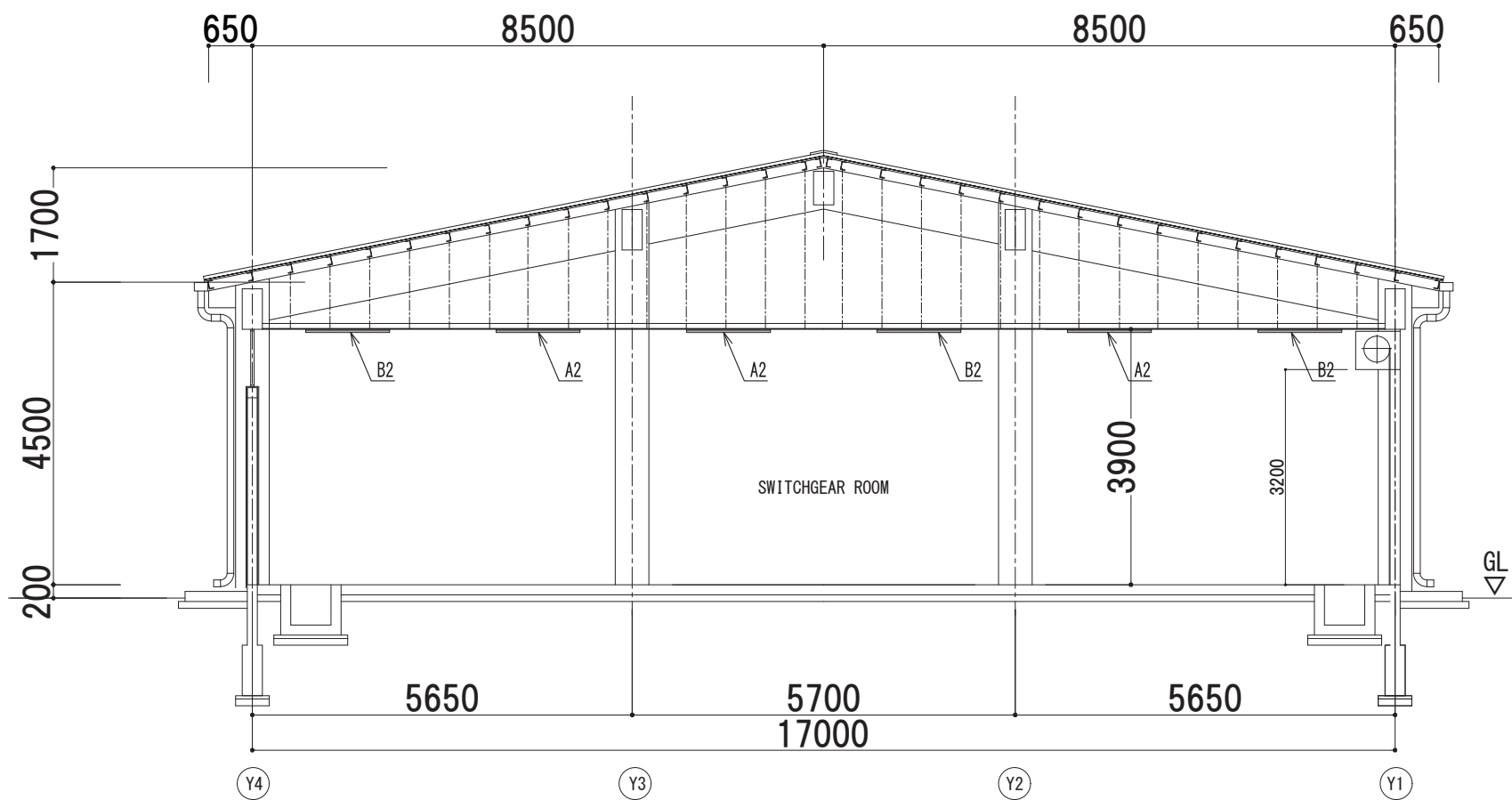
					
C	DOWN LIGHT		D	Bracket Type, Water Proof	
C1	LED LRS1-08	1045 lm	D1	LED LBF3MP/RP-2-06	1020 lm
					
			WALL MOUNTED TYPE		

LEGEND

1. RATED VOLTAGE : 1φ 250V-50Hz
2. STARTER (FLUORESCENT LAMP) : GLOW STARTER
3. POWER FACER : HIGH POWER FACTOR







SECTION A-A' OF SWITCHGEAR ROOM

LEGEND		
SYMBOL	NAME	SPECIFICATION
	FIRE ALARM RECEIVER	
	EQUIPMENT STORAGE BOX	BOX ,WITH CABLE TERMINAL
	P-TYPE MANUAL CALL POINT	P-TYPE CLASS 1 INDICATOR LIGHT (AC24V, LED)
	FIRE BELL	DC24V,10mA,LED
	THE TERMINATOR	FOR FIRE BELL(10KΩ)
	PHOTOELECTRIC SPOTTYPE SENSOR	CLASS 2
	WARNING AREA NUMBER	FOR FIRE DISPLAY
	WARNING AREA NUMBER	FOR FIRE DISPLAY(THE STAIRS)
	WARNING AREA LINE	
	PIPING WIRING	UNDERGROUND WIRING
	PIPING WIRING	EXPOSED WIRING
	PIPING WIRING	FLOOR EMBEDDED WIRING
	PIPING WIRING RISE AND FALL	
	JUNCTION BOX	
	JUNCTION BOX	WATERPROOF

〔CABLE LEGEND〕

	WIRING SPECIFICATION
A	HP0.9- 2C (PF16)・(E19)
B	HP0.9- 4C (PF16)・(E19)
C	HP0.9- 3P (PF16)・(E19)
D	HP0.9- 5P (PF22)・(E25)
E	HP0.9-10P (PF28)・(E31)
F	HP0.9-15P (PF28)・(E31)
G	AE0.9- 2C (PF16)・(E19)
H	AE0.9- 4C (PF16)・(E19)

〔 NOTE 〕

1.FIRE ALARM RECEIVER

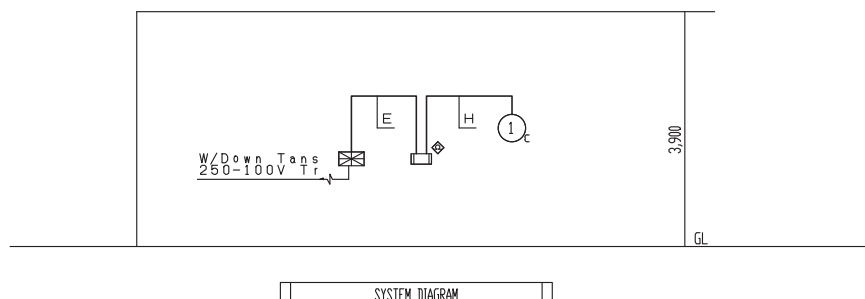
- 1) P-TYPE CLASS 1 WALL HANGING TYPE
ACCUMULATION TYPE,WITH AUTO DISCONNECTION ALARM FUNCTION
- 2) AUTOMATIC TEST FUNCTION
- 3) GROUND FAULT DETECTION FUNCTION
- 4) DISPLAY CONTENT

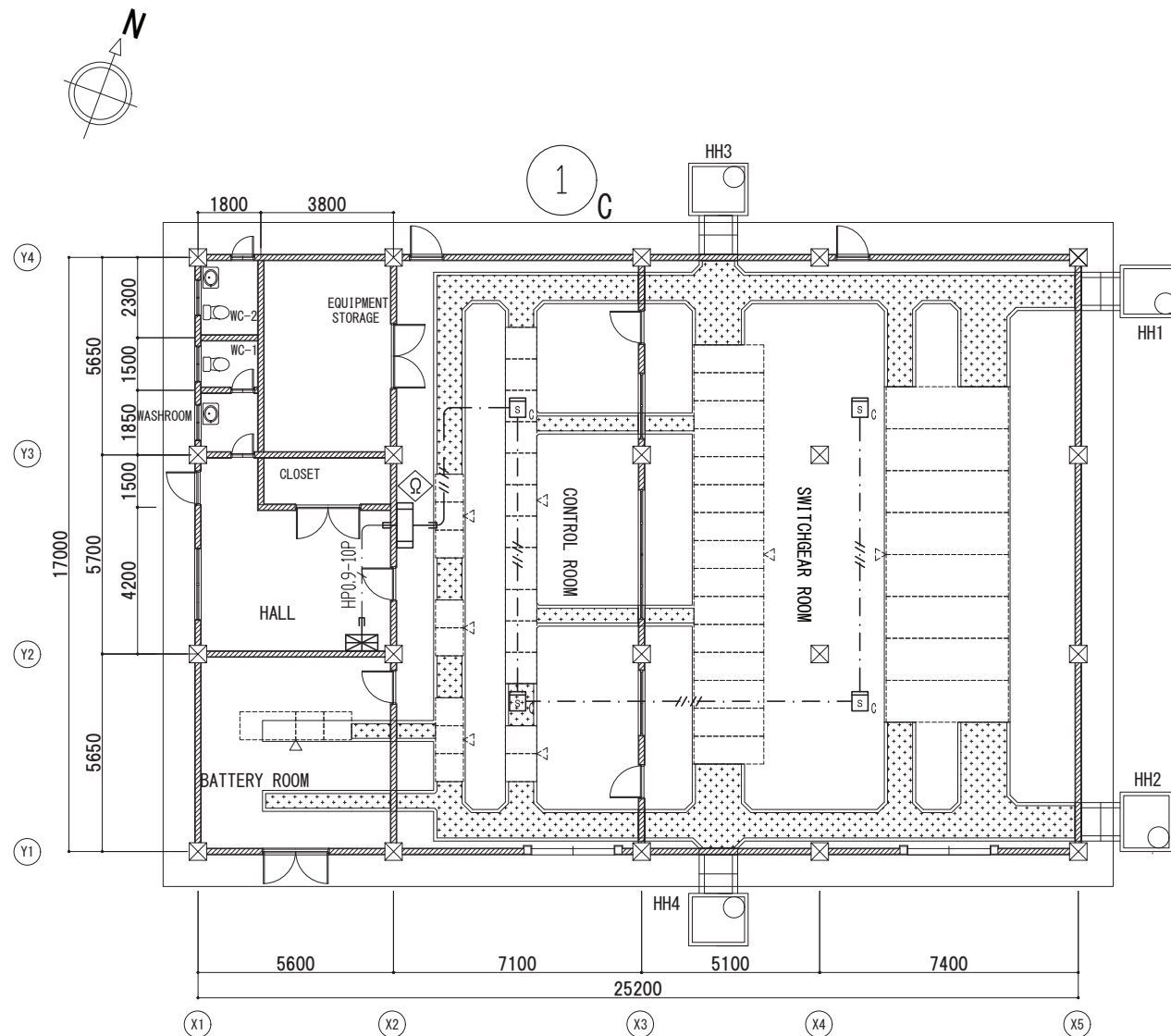
・FIRE INDICATION 1L
 } + 4L (SPARE) =5L

2.ALL SENSORS ARE WITH CONFIRMATION LIGHT

3. PIPING WIRING LEGEND EXPOSED WIRING

- · — · — AE0.9- 2C (PF16)
- · ~~///~~ · — AE0.9- 4C (PF16)
- ~~HP~~ · — HP0.9- 2C (PF16)



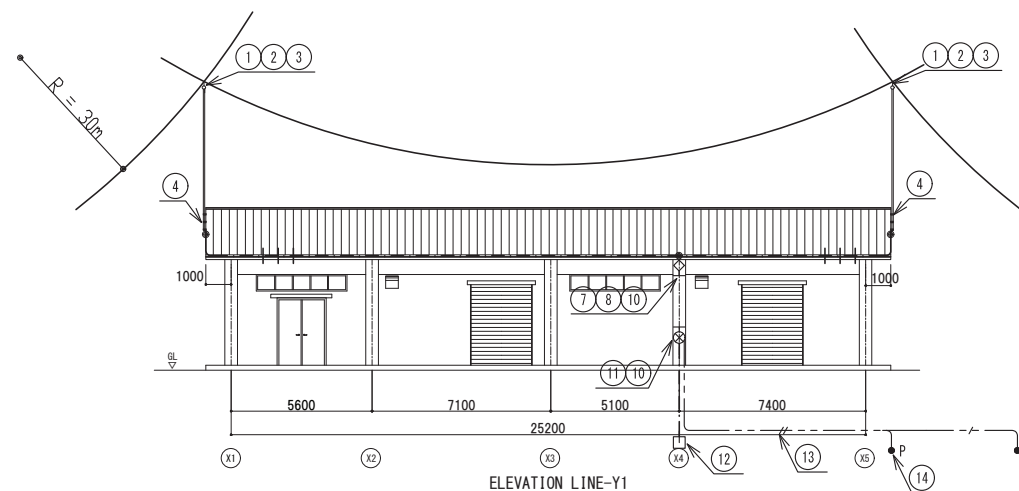
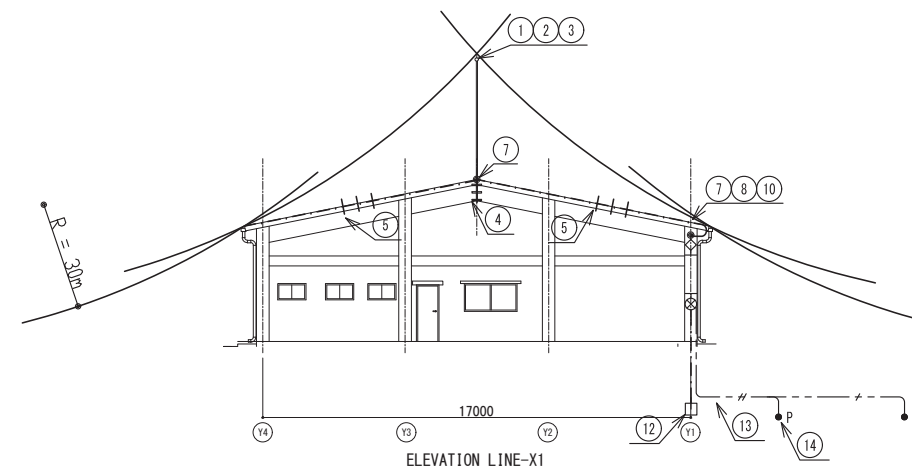


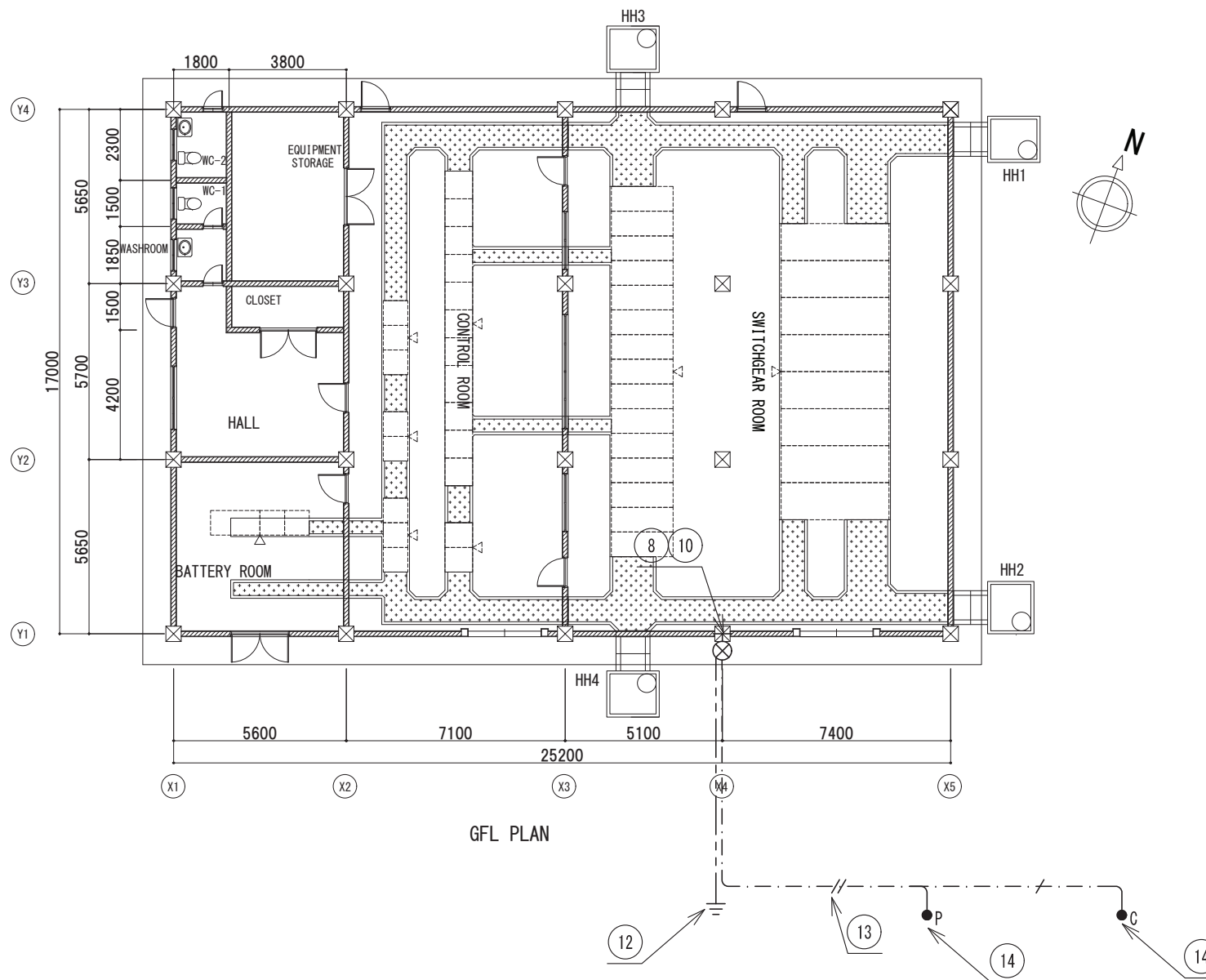
GFL PLAN

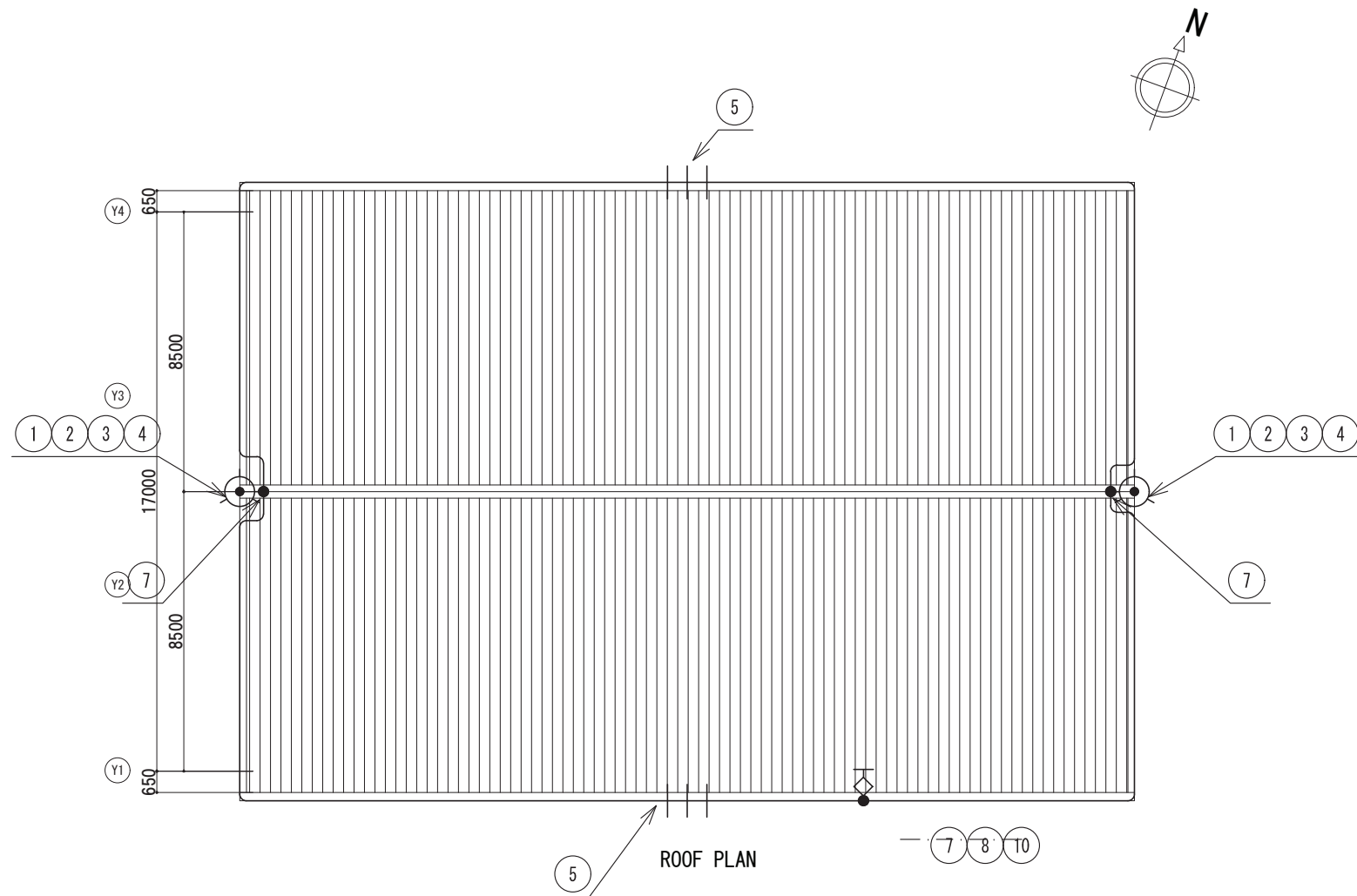
Aluminum wire mounting hardware (for bonding)	T type connection terminal	Drain terminal (one side aluminum wire terminal)
Connection terminal for steel frame	Terminal box for grounding measurement (for exposure SUS)	Grounded copper plate

Lightning protection equipment legend

NO	SYMBOL	NAME
1		Needle JIS Large (Copper) Chrome Plating
2		Die coupling (with brass row)
3		Support pipe A:STKW 48.6φ(3.2t) 5.5m Sidewall type
4		Support Pipe Mounting hardware (made of iron galvanizing) For light column
5		Exposed wiring Aluminum wire 2.0×19 pieces
		Wire mounting hardware (made of corrosion-resistant aluminum alloy) Horizontal = 600C/C Vertical 1000C/C
6		Connection terminals for lighting columns (Materials are supplied, installation is made for lighting column work)
7		T type connection terminal (made of corrosion-resistant aluminum alloy)
8		Water drain terminal (brass chrome plating, one side: aluminum)
9		Copper wire 2.0×13 (PF 22) Embedded piping
10		Connection terminal for steel frames (Plate materials are supplied, welding is done as construction work)
11		Terminal box embedded type for lightning protection ground (stainless steel) PC terminal and marking plate
12		Ground copper plate 1.5×900×900
13		Measuring lead wire IV 5.5φ
14		Measuring earth bar 1φ×300







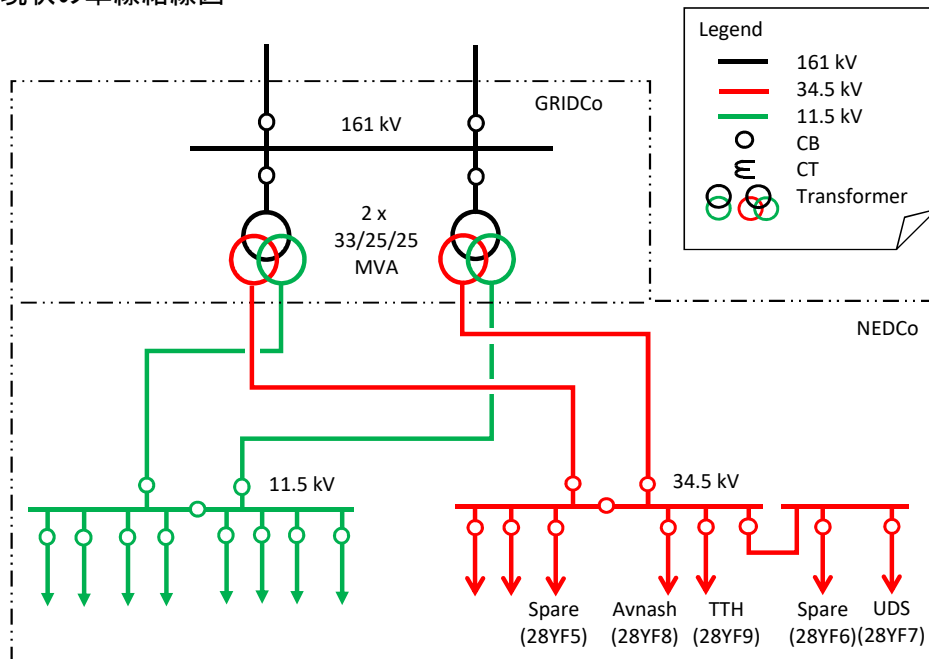
7. 変電所及び送配電線切替作業・手順（案）

7. 変電所及び送配電線切替作業・手順（案）

SS-03

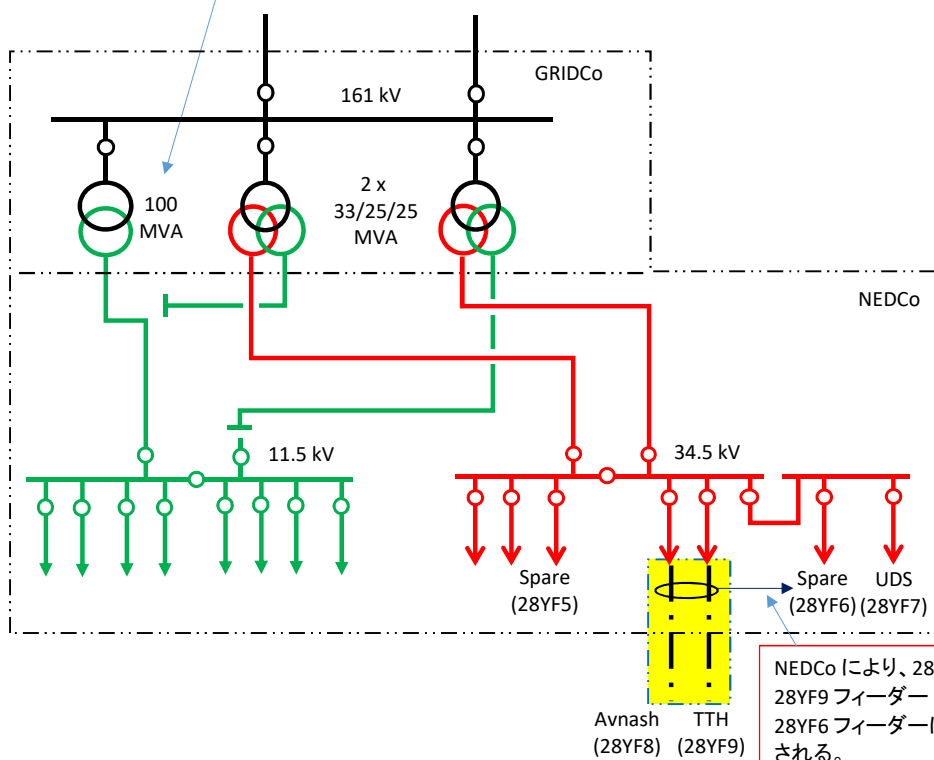
タマレBSP変電所 34.5 kVケーブル接続ステップ図

現状の単線結線図

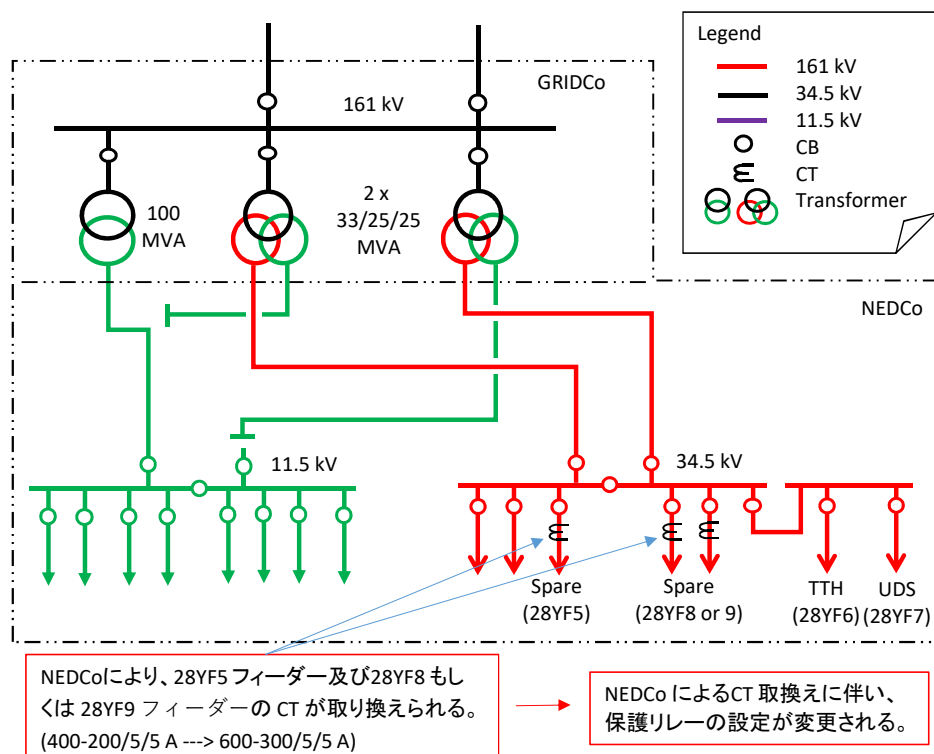


ステップ 1: 100 MVA 変圧器の設置 (GRIDCo) 及び34.5 kV 配電線用ケーブルの接続換え (NEDCo)

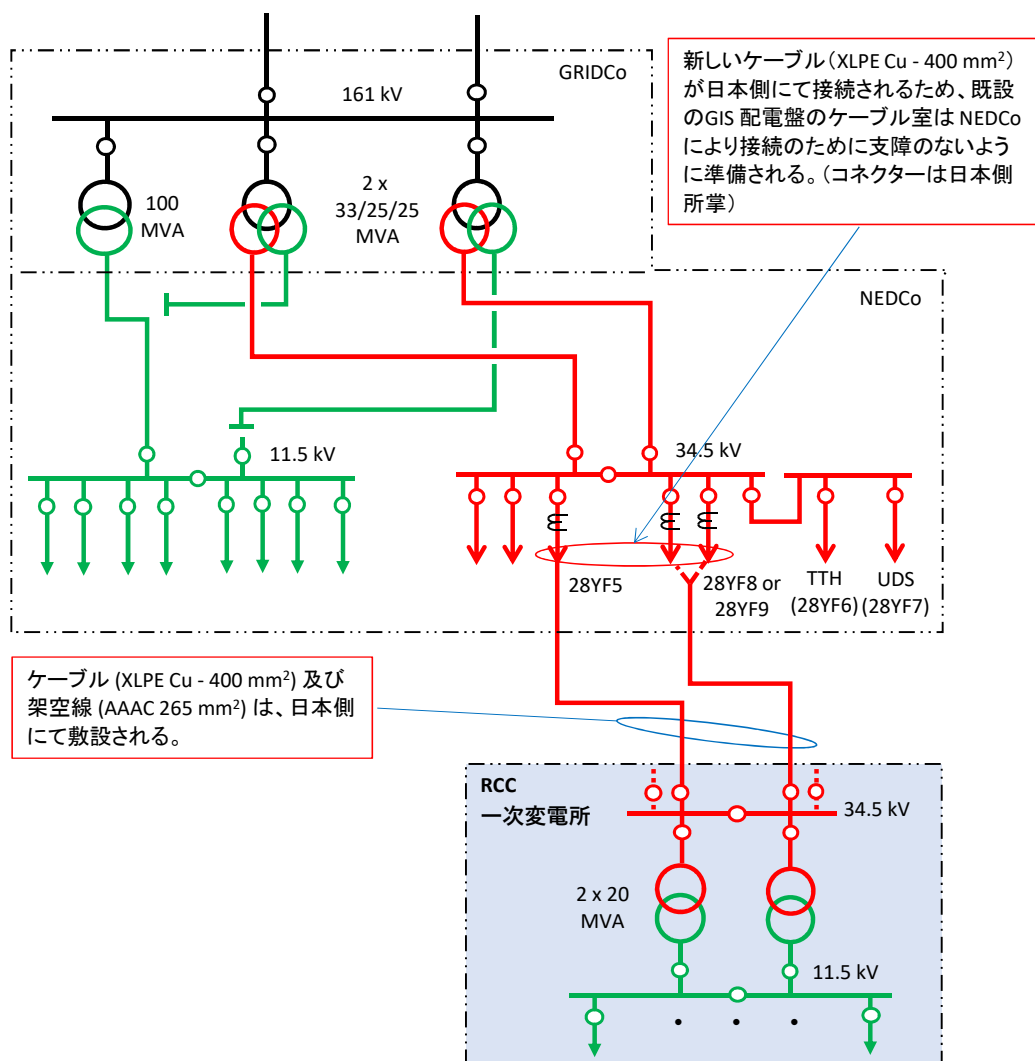
GRIDCo は 100 MVA、161/11.5 kV 変圧器を2023年第一四半期中に設置し、現在の33/25/25 MVA 変圧器の11.5 kV 負荷をこの100 MVA 変圧器に移行する予定である。



ステップ 2: 34.5 kV 予備フィーダーの変流器取換え (NEDCo)



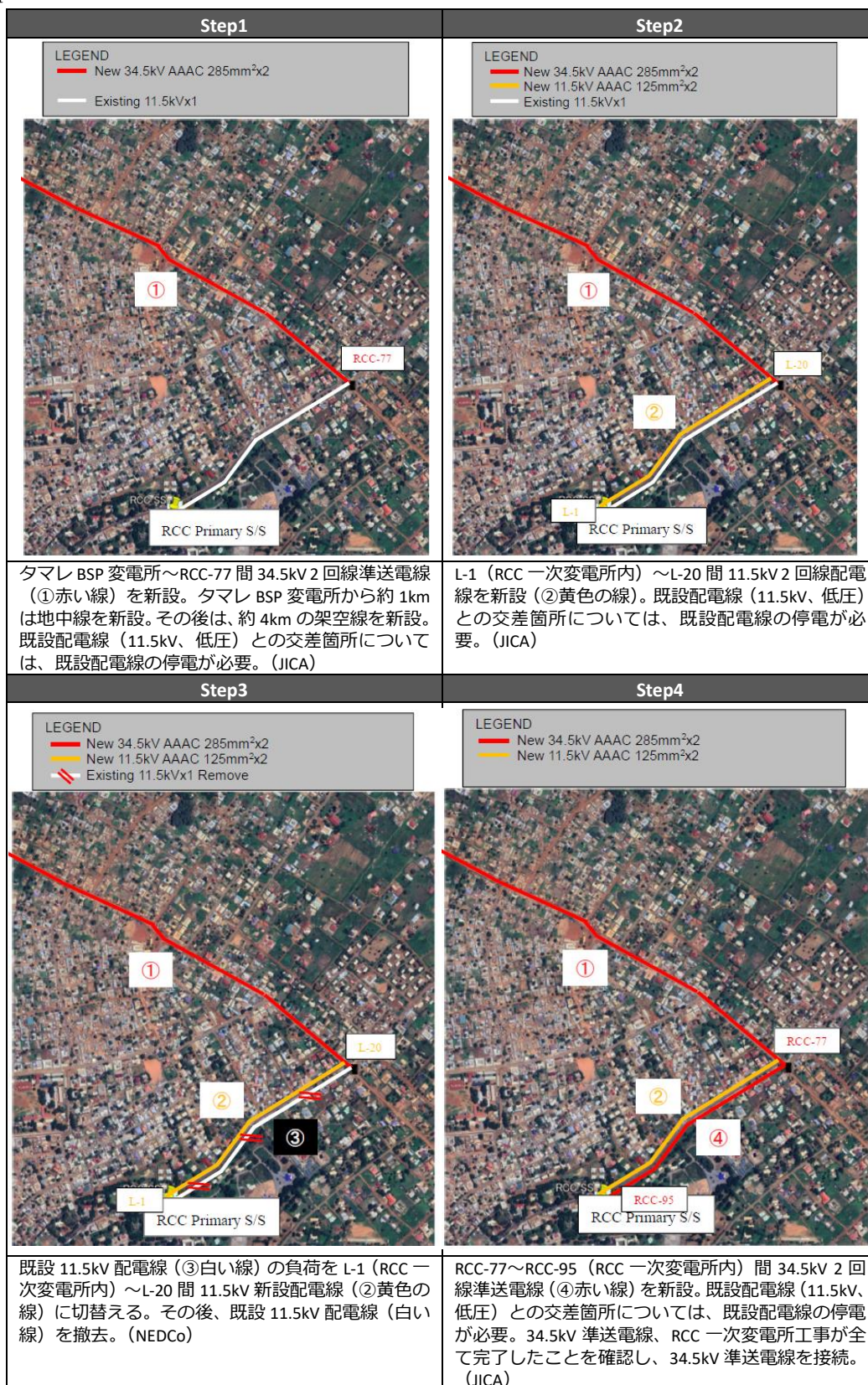
ステップ 3: 34.5 kV 準送電線の敷設・接続



34.5kV 準送電線及び 11.5kV 配電線の施工方法(案)

1. 34.5kV 準送電線工事

現地調査結果及び NEDCo との協議結果を踏まえて、34.5kV 準送電線工事について、下記 Step1～4 の手順で進める。



出典：調査団作成

図 34.5kV 準送電線工事の手順 (案)

(1)Step1

34.5kV 2 回線準送電線の新設にあたって、タマレ BSP 変電所から約 1km は地中線を新設する。地中線の設置箇所は ROW 範囲内であるが、一部の商店、建物がある箇所では工事の際に人が工事区間に立ち入らないよう十分な安全上の配慮が必要である。その後、架空線を約 4km 新設する。工事区間の十分な安全上の配慮に加えて、既設配電線（11.5kV、低圧）との交差箇所において既設配電線の停電が必要であり、主要な官公庁、学校、病院、ホテル、商店等との綿密な停電調整が必要である。

(2)Step2

RCC-77～RCC-95（RCC 一次変電所内）間の 34.5kV 2 回線準送電線の設置箇所には既設 11.5kV 配電線があるため、先行してこの既設配電線を撤去する必要がある。この既設配電線の負荷を切替えるため、L-1（RCC 一次変電所内）～L-20 間の 11.5kV 2 回線配電線を新設する。工事区間の十分な安全上の配慮に加えて、既設配電線（11.5kV、低圧）との交差箇所において既設配電線の停電が必要であり、主要な官公庁、学校、病院、ホテル、商店等との綿密な停電調整が必要である。

(3)Step3

L-1（RCC 一次変電所内）～L-20 間の 11.5kV 2 回線配電線を新設後、ガーナ側負担事項として、既設 11.5kV 配電線の負荷を新設 11.5kV 配電線に切替え、既設 11.5kV 配電線を撤去する。

(4)Step4

RCC-77～RCC-95（RCC 一次変電所内）間の 34.5kV 2 回線準送電線を新設する。工事区間の十分な安全上の配慮に加えて、既設配電線（11.5kV、低圧）との交差箇所において既設配電線の停電が必要であり、主要な官公庁、学校、病院、ホテル、商店等との綿密な停電調整が必要である。34.5kV 準送電線、RCC 一次変電所工事が全て完了したことを確認し、RCC 一次変電所で 34.5kV 準送電線を接続する。

2. 11.5kV 配電線工事

RCC 一次変電所からタマレ中央病院までの約 1.8km の 11.5kV 2 回線配電線は地中線を新設する。地中線の設置箇所は ROW 範囲内であるが、一部の商店、建物がある箇所では工事の際に人が工事区間に立ち入らないよう十分な安全上の配慮が必要である。

また、Central Hospital フィーダ及び CRH フィーダ以外の架空線の設置箇所（RCC フィーダ、Ministries フィーダ、Youth Home フィーダ、Sakasaka フィーダ、Low Cost フィーダ及び SSNIT フィーダの 6 フィーダ）では、工事区間の十分な安全上の配慮に加えて、これら 6 フィーダの既設配電線（11.5kV、低圧）との交差箇所において既設配電線の停電が必要であり、主要な官公庁、学校、病院、ホテル、商店等との綿密な停電調整が必要である。

各フィーダ末端から既設 11.5kV 配電線への接続はガーナ側負担事項であるが、その場合にも既設配電線の停電が必要であり、主要な官公庁、学校、病院、ホテル、商店等との綿密な停電調整が必要である。

11.5kV 配電線、RCC 一次変電所工事が全て完了したことを確認し、RCC 一次変電所で 11.5kV 配電線を接続する。

8. 電力供給信頼度の検討

8. 電力供給信頼度の向上効果の検討

電力供給信頼度の向上効果の検討として、需要家 1 軒当たりの平均停電時間（SAIDI: System Average Interruption Duration Index）と平均停電回数（SAIFI: System Average Interruption Frequency Index）に関し、本プロジェクトにて計画している設備を拡充することで、近年のこれらの指標の改善効果を検討した。

表 1 に近年の Tamale Metro（タマレ BSP 変電所から供給している 11.5kV 系統の合計）及び RCC 一次変電所からの電力供給を計画しているエリアの SAIDI、SAIFI の実績を示す。現状では、RCC 一次変電所計画エリアにはタマレ BSP 変電所の 11.5kV フィーダ（28BF7、28BF8、28BF9）から電力供給されている。2022 年はアドゥビリイ境界変電所（TM2）が建設され、仮設の 34.5/11.5kV 変圧器でタマレ市内 11.5kV 系統への電力供給が開始されたことで、タマレ市内の電力供給力が大きく改善され、SAIDI、SAIFI が減少した。本プロジェクトの効果としては、2022 年の実績を基に電力供給信頼度の向上効果を検討する。

本プロジェクトを実施した場合は、表 2 に示すように RCC 一次変電所から 8 フィーダで電力供給することにより停電時の影響範囲が縮小し、電力供給信頼度が向上する。

表 1 近年の SAIDI と SAIFI（タマレ BSP 変電所からの 11.5kV 系統）

信頼度指標	エリア	2020 年	2021 年	2022 年
SAIDI (時間／年・軒)	Tamale Metro	107.8	181.1	75.0
	RCC 一次変電所 計画エリア	94.6	201.7	71.0
SAIFI (回／年・軒)	Tamale Metro	95.8	116.0	46.0
	RCC 一次変電所 計画エリア	86.2	132.1	51.4

【出所】 NEDCo

表 2 タマレ BSP 変電所からの供給フィーダと RCC 一次変電所からの供給フィーダの需要家数

タマレ BSP 変電所からの供給フィーダ (2022 年)		RCC 一次変電所からの供給フィーダ (2028 年)	
フィーダ	需要家数 (契約口数)	フィーダ	需要家数 (契約口数)
28BF7	32,199	Ministries	8,950
		SSNIT	5,655
		Low Cost	23,841
28BF8	2,630	Central Hospital	1
		CRH	3,139
28BF9	29,937	Sakasaka	10,569
		RCC	1
		Youth Home	25,172
総計	64,766	総計	77,328

【出所】 NEDCo への調査結果を基に作成

1 フィーダ（需要家数： a ）が x フィーダ（需要家数： $c_1, c_2, \dots, c_x$ ）に分割された場合、需要家が均等分布していると仮定すると SAIDI、SAIFI の改善効果（改善前：SAIDI₁, SAIFI₁、改善後：SAIDI₂, SAIFI₂）については次式により求められる。また、以下の検討においてタマレ BSP 変電所から RCC 一次変電所までの 34.5kV 準送電線での停電はないものと仮定する。

$$\text{SAIDI}_2 = \frac{c_1^2 + c_2^2 + \dots + c_x^2}{a^2} \text{SAIDI}_1$$

$$\text{SAIFI}_2 = \frac{c_1^2 + c_2^2 + \dots + c_x^2}{a^2} \text{SAIFI}_1$$

(1) 28BF7

タマレ市街地北東部に電力供給しているフィーダであり、本プロジェクト実施後は RCC 一次変電所 Ministries、SSNIT、Low Cost フィーダから電力供給する。2022 年の SAIDI は 74.0（時間／年・軒）、SAIFI は 50.4（回／年・軒）である。停電は NEDCo 起因による事故停電、計画停電と上位系統である GRIDCo 起因による事故停電、計画停電に分けられる。GRIDCo 起因による停電については、本プロジェクトによる停電時間の改善は図れない。NEDCo 起因による SAIDI は 64.8（時間／年・軒）、SAIFI は 41.5（回／年・軒）である。上記の改善効果の算出式により NEDCo 起因による SAIDI は 29.8（時間／年・軒）、SAIFI は 19.1（回／年・軒）に改善される。これに GRIDCo 起因による SAIDI、SAIFI を加算すると、本プロジェクト実施後の SAIDI は 39.0（時間／年・軒）、SAIFI は 28.0（回／年・軒）となる。

(2) 28BF8

タマレ市街地中心部に電力供給しているフィーダであり、本プロジェクト実施後は RCC 一次変電所 Central Hospital、CRH フィーダから電力供給する。2022 年の SAIDI は 9.5（時間／年・軒）、SAIFI は 10.8（回／年・軒）である。NEDCo 起因による SAIDI は 1.1（時間／年・軒）、SAIFI は 2.0（回／年・軒）である。上記の改善効果の算出式により NEDCo 起因による SAIDI は 1.1（時間／年・軒）、SAIFI は 2.0（回／年・軒）となり、Central Hospital への電力供給信頼度は高くなるが、フィーダ分割による改善効果はない。これに GRIDCo 起因による SAIDI、SAIFI を加算すると、本プロジェクト実施後の SAIDI は 9.5（時間／年・軒）、SAIFI は 10.8（回／年・軒）となり、プロジェクト実施前と変わらない。

(3) 28BF9

タマレ市街地の中心部及び南東部に電力供給しているフィーダであり、本プロジェクト実施後は RCC 一次変電所 Sakasaka、RCC、Youth Home フィーダから電力供給する。2022 年の SAIDI は 73.1（時間／年・軒）、SAIFI は 56.1（回／年・軒）である。NEDCo 起因による SAIDI は 63.6（時間／年・軒）、SAIFI は 46.2（回／年・軒）である。上記の改善効果の算出式により NEDCo 起因による SAIDI は 37.1（時間／年・軒）、SAIFI は 27.0（回／年・軒）に改善される。これに GRIDCo 起因による SAIDI、SAIFI を加算すると、本プロジェクト実施後の SAIDI は 46.6（時間／年・軒）、SAIFI は 36.9（回／年・軒）となる。

表 3 に RCC 一次変電所計画エリア全体の SAIDI、SAIFI の改善効果を示す。2028 年の RCC 一次変電所計画エリアの SAIDI、SAIFI はプロジェクトを実施しない場合と比較して約 4 割減と大幅に改善され、電力供給信頼度が向上することが確認できる。なお、タマレ中央病院、州政府評議会（RCC：Regional Coordinating Council）にはそれぞれ専用フィーダで供給し、他の場所での停電の影響を受けないので、著しく電力供給信頼度が向上する。

表 3 本プロジェクトを実施した場合の RCC 一次変電所計画エリアの電力供給信頼度の向上効果

信頼度指標	実績 (2022 年)	SAIDI、SAIFI の削減効果	プロジェクトを実施し た場合の信頼度 (2028 年)
SAIDI (時間／年・軒)	71.0	29.7	41.3
SAIFI (回／年・軒)	51.4	20.0	31.4

〔出所〕 NEDCo への調査結果を基に作成

9. 社会経済調査アンケート質問事項

Social and Economic Survey for the Project of Enhancement of Power Supply Reliability in Tamale

I. Households

Q2. Number of family members: _____

☐ Farming ☐ Private company employee ☐ Government employee
☐ Private business ☐ Others ()

☐ Less than 50 ☐ 50~99 ☐ 100~149 ☐ 150~199 ☐ 200~249 ☐ More than 250

Q6. (If Q5 is yes,) how much do your family pay for electricity per month? (GHS/Month)

☐ Less than 10 ☐ 10~29 ☐ 30~49 ☐ 50~69 ☐ 70~89 ☐ 90~99 ☐ More than 100

Q8. What kind of electric appliance is your family using? (Multiple answers acceptable)

☐Lighting ☐Refrigerator ☐Cooking stove ☐TV set ☐Radio ☐Air conditioner ☐Electric fan
☐Mobile phone ☐PC ☐Electric Iron ☐Vacuum cleaner ☐Others

Q9. How often do you experience power outage?

☐ Very seldom ☐ Once or twice a week ☐ Three or Four times a week ☐ Almost everyday

Q10 Do your family own its own power generator? ☐Yes ☐No

Q11. (If Q10 is yes,) how many hours is the generator operated in average each time of power outage?

☐ Less than 1 hour ☐ 1 to 2 hours ☐ 3 to 4 hours ☐ More than 4 hours

Q12. (If Q10 is yes,) how much do your family pay for the generator fuel per month? (GHS/Month)

☐ Less than 25 ☐ 25~49 ☐ 50~99 ☐ 100~149 ☐ More than 150

Q13. How do you feel the present outage time level?

☐ Very bad ☐ Bad ☐ Not so bad ☐ Not bad at all (satisfied)

Q14 If the outage level is improved, how are your family benefited?

☐ Not so much benefited because the present outage level is acceptable.

☐ Benefited because ()

☐ Very much benefited because (

Q15. (If Q14 is "benefited" or "Very much benefited",) please state the reason.

Medical agencies (Hospitals, clinics, nursing facilities etc.)
Interviewee: Chief Administrator

Japan International Cooperation Agency (JICA)

Social and Economic Survey for the Project of **Enhancement of Power Supply Reliability in Tamale**

Introduction: Japan International Cooperation Agency (JICA) is conducting a preparatory survey for the Project of **Enhancement of Power Supply Reliability in Tamale, which is expected to improve daily lives and business & social activities of people in Tamale.** A consultant team is conducting a Social and Economic Survey with which results the consultant team estimates the effects of the Project implementation. The information collected from the Social and Economic Survey is used only for that purpose and individual data/information will not be released unless the data/information are processed as summary or average of a group.

II. Medical agencies (Hospitals, clinics, nursing facilities etc.)

Q1. Address and Name of the district: _____

Q2. Name/Phone# of agency: _____

Q3. Name/Title/Phone# of Interviewee: _____

Q4. Number of doctors: _____

Q5. Number of patients per day _____

Q6. Electricity connected? ☐Yes ☐No

Q7. (If Q6 is yes,) how much do your agency pay for electricity per month? (GHS/Month)

☐Less than 50 ☐50~99 ☐100~149 ☐150~199 ☐200~249 ☐More than 250

Q8. (If Q6 is No,) please state the reason.

Q9. What kind of electric appliance is your agency using? (Multiple answers acceptable)

☐Therapy equipment ☐Clinical test equipment ☐Vaccine Refrigerator ☐Lighting ☐Projector ☐Printer ☐
Copy machine ☐Electric fan ☐Refrigerator ☐Cooking stove ☐TV set ☐Radio ☐Air conditioner
☐Mobile phone ☐PC ☐Electric Iron ☐Elevator ☐Others

Q10. How often do you experience power outage?

☐Very seldom ☐Once or twice a week ☐Three or Four times a week ☐Almost everyday

Q11. Do your agency own its own power generator? ☐Yes ☐No

Q12. (If Q11 is yes,) how many hours is the generator operated in average each time of power outage?

☐Less than 1 hour ☐1 to 2 hours ☐3 to 4 hours ☐More than 4 hours

Q13. (If Q11 is yes,) how much do your agency pay for the generator fuel per month? (GHS/Month)

☐Less than 25 ☐25~49 ☐50~99 ☐100~149 ☐More than 150

Q14. How do you feel the present outage time level?

☐Very bad ☐Bad ☐Not so bad ☐Not bad at all (satisfied)

Q15. If the outage level is improved, how are your agency benefited?

☐Not so much benefited because the present outage level is acceptable.

☐Benefited because (_____)

☐Very much benefited because (_____)

Q16. (If Q15 is "benefited" or "Very much benefited",) please state the reason.

Schools (Universities, high schools, middle schools, elementary schools, etc.)

Interviewee: Chief Administrator or Principal

Japan International Cooperation Agency (JICA)

Social and Economic Survey for the Project of **Enhancement of Power Supply Reliability in Tamale**

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III. Schools (Universities, high schools, middle schools, elementary schools, etc.)

Q1. Address and Name of the district: _____

Q2. Name/Phone# of school: _____

Q3. Name/Title/Phone# of Interviewee: _____

Q4. Number of teachers: _____

Q5. Number of students _____

Q6. Electricity connected? ☐Yes ☐No

Q7. (If Q6 is yes,) how much do your school pay for electricity per month? (GHS/Month)

☐Less than 50 ☐50~99 ☐100~149 ☐150~199 ☐200~249 ☐More than 250

Q8. (If Q6 is No,) please state the reason.

Q9. What kind of electric appliance is your agency using? (Multiple answers acceptable)

☐Lighting ☐PC ☐Projector ☐Printer ☐Copy machine ☐Electric fan ☐Refrigerator ☐Cooking stove ☐TV set ☐Radio ☐Air conditioner ☐Mobile phone ☐Electric Iron ☐Elevator ☐Others

Q10. How often do you experience power outage?

☐Very seldom ☐Once or twice a week ☐Three or Four times a week ☐Almost everyday

Q11. Do your school own its own power generator? ☐Yes ☐No

Q12. (If Q11 is yes,) how many hours is the generator operated in average each time of power outage?

☐Less than 1 hour ☐1 to 2 hours ☐3 to 4 hours ☐More than 4 hours

Q13. (If Q11 is yes,) how much do your agency pay for the generator fuel per month? (GHS/Month)

☐Less than 25 ☐25~49 ☐50~99 ☐100~149 ☐More than 150

Q14. How do you feel the present outage time level?

☐Very bad ☐Bad ☐Not so bad ☐Not bad at all (satisfied)

Q15. If the outage level is improved, how are your agency benefited?

☐Not so much benefited because the present outage level is acceptable.

☐Benefited because (_____)

☐Very much benefited because (_____)

Q16. (If Q15 is "benefited" or "Very much benefited",) please state the reason.

Business establishments (Factories, stores/shops, business offices, farming companies, etc.)

Interviewee: Chief Representative

Japan International Cooperation Agency (JICA)

Social and Economic Survey for the Project of **Enhancement of Power Supply Reliability in Tamale**

Introduction: Japan International Cooperation Agency (JICA) is conducting a preparatory survey for the Project of **Enhancement of Power Supply Reliability in Tamale, which is expected to improve daily lives and business & social activities of people in Tamale.** A consultant team is conducting a Social and Economic Survey with which results the consultant team estimates the effects of the Project implementation. The information collected from the Social and Economic Survey is used only for that purpose and individual data/information will not be released unless the data/information are processed as summary or average of a group.

IV. Business establishments (Factories, stores/shops, business offices, farming companies, etc.)

Q1. Address and Name of the district: _____

Q2. Name/Phone# of establishment: _____

Q3. Name/Title/Phone# of Interviewee: _____

Q4. Kind of business: _____

Q5. Number of employees _____

Q6. Electricity connected? ☐ Yes ☐ No

Q7. (If Q6 is yes,) how much do your agency pay for electricity per month? (GHS/Month)

☐ Less than 50 ☐ 50~99 ☐ 100~149 ☐ 150~199 ☐ 200~249 ☐ More than 250

Q8. (If Q6 is No,) please state the reason.

Q9. What kind of electric appliance is your agency using? (Multiple answers acceptable)

☐ Lighting ☐ Neon sign ☐ Factory machine ☐ PC ☐ Projector ☐ Printer ☐ Copy machine ☐ Electric fan
☐ Refrigerator ☐ Cooking stove ☐ TV set ☐ Radio ☐ Air conditioner ☐ Mobile phone ☐ Electric
Iron ☐ Elevator ☐ Others

Q10. How often do you experience power outage?

☐ Very seldom ☐ Once or twice a week ☐ Three or Four times a week ☐ Almost everyday

Q11. Do your company own its own power generator? ☐ Yes ☐ No

Q12. (If Q11 is yes,) how many hours is the generator operated in average each time of power outage?

☐ Less than 1 hour ☐ 1 to 2 hours ☐ 3 to 4 hours ☐ More than 4 hours

Q13. (If Q11 is yes,) how much do your agency pay for the generator fuel per month? (GHS/Month)

☐ Less than 25 ☐ 25~49 ☐ 50~99 ☐ 100~149 ☐ More than 150

Q14. How do you feel the present outage time level?

☐ Very bad ☐ Bad ☐ Not so bad ☐ Not bad at all (satisfied)

Q15. If the outage level is improved, how are your agency benefited?

☐ Not so much benefited because the present outage level is acceptable.

☐ Benefited because (_____)

☐ Very much benefited because (_____)

Q16. (If Q15 is "benefited" or "Very much benefited",) please state the reason.

Public-sector organizations (Municipal offices, police stations, fire stations, water supply stations, etc.)

Interviewee: Chief Administrator

Japan International Cooperation Agency (JICA)

Social and Economic Survey for the Project of **Enhancement of Power Supply Reliability in Tamale**

Introduction: Japan International Cooperation Agency (JICA) is conducting a preparatory survey for the Project of **Enhancement of Power Supply Reliability in Tamale, which is expected to improve daily lives and business & social activities of people in Tamale.** A consultant team is conducting a Social and Economic Survey with which results the consultant team estimates the effects of the Project implementation. The information collected from the Social and Economic Survey is used only for that purpose and individual data/information will not be released unless the data/information are processed as summary or average of a group.

V. Public-sector organizations (Municipal offices, police stations, fire stations, water supply stations, etc.)

Q1. Address and Name of the district: _____

Q2. Name/Phone# of organization _____

Q3. Name/Title/Phone# of Interviewee: _____

Q4. Kind of services: _____

Q5. Number of staff _____

Q6. Electricity connected? ☐ Yes ☐ No

Q7. (If Q6 is yes,) how much do your school pay for electricity per month? (GHS/Month)

☐ Less than 50 ☐ 50~99 ☐ 100~149 ☐ 150~199 ☐ 200~249 ☐ More than 250

Q8. (If Q6 is No,) please state the reason.

Q9. What kind of electric appliance is your agency using? (Multiple answers acceptable)

☐ Lighting ☐ Neon sign ☐ PC ☐ Projector ☐ Printer ☐ Copy machine ☐ Electric fan ☐ Refrigerator

☐ Cooking stove ☐ TV set ☐ Radio ☐ Air conditioner ☐ Mobile phone ☐ Electric Iron ☐ Special machine necessary for your service ()

☐ Elevator ☐ Others

Q10. (If Q9 is "Special machine necessary for your service",) please explain the detail.

Q11. How often do you experience power outage?

☐ Very seldom ☐ Once or twice a week ☐ Three or Four times a week ☐ Almost everyday

Q12. Do your school own its own power generator? ☐ Yes ☐ No

Q13. (If Q12 is yes,) how many hours is the generator operated in average each time of power outage?

☐ Less than 1 hour ☐ 1 to 2 hours ☐ 3 to 4 hours ☐ More than 4 hours

Q14. (If Q12 is yes,) how much do your agency pay for the generator fuel per month? (GHS/Month)

☐ Less than 25 ☐ 25~49 ☐ 50~99 ☐ 100~149 ☐ More than 150

Q15. How do you feel the present outage time level?

☐ Very bad ☐ Bad ☐ Not so bad ☐ Not bad at all (satisfied)

Q16. If the outage level is improved, how are your agency benefited?

☐ Not so much benefited because the present outage level is acceptable.

☐ Benefited because ()

☐ Very much benefited because ()

Q17. (If Q16 is "benefited" or "Very much benefited",) please state the reason.

10. EPA によるスクリーニング結果

10. EPAによるスクリーニング結果報告レター

Tel: (03720) 22294

Email: northern.region@epa.gov.gh

Website: <http://www.epa.gov.gh>



Environmental Protection Agency

P. O. Box TL 620

Tamale

Northern Region

EPA/NR/6/Vol. 20



7th December, 2022

The Director ✓
(Engineering Services)
NEDCO
Tamale
Northern Region

Attention: Ing. Gideon Otehere-Appiah
Manager, Design and Projects
(NEDCO), Tamale

Dear Sir,

REQUEST FOR CONDUCT OF A PRELIMINARY ENVIRONMENTAL REPORT FOR THE PROPOSED ENHANCEMENT OF POWER SUPPLY RELIABILITY PROJECT IN TAMALE METROPOLIS OF THE NORTHERN REGION

We officially acknowledge receipt of one (1) completed EA2 form submitted to the Agency for the purpose of obtaining an Environmental Permit for implementation of an Enhanced Power Supply Reliability Project in selected areas of Tamale in Tamale Metropolis of the Northern Region.

We are glad to inform you that initial review of your application is in progress.

Further review of your application in line with Section 8(1) of Ghana Environmental Assessment regulations LI 1652 of 1999 reveals that your project is classified under the projects for which a Preliminary Environmental Report (PER) is required.

You are by this letter required to prepare and submit eight (8) copies of Preliminary Environmental Reports (PER) to EPA to enable the Agency make an informed technical decision in respect of your Environmental Assessment received by the EPA application.

Additionally, you are required to pay an initial non-refundable Environmental Assessment Processing fee of twenty thousand Ghana cedis (GH¢20,000.00) to Environmental Protection Agency.

You are by this letter required to contact EPA Tamale office to collect an official invoice to enable your Institution pay the above non-refundable Processing fee into EPA's Ghana Commercial Bank (GCB) or Consolidated Bank Ghana (CBG) or National Investment Bank (NIB) account.

Please note that if your application is approved, you will be required to pay an Environmental Assessment Permit fee before an Environmental Permit is finally issued to your organization to implement the protect.

Kindly find attached an outline for the conduct of a Preliminary Environmental Report (PER).

Please do not hesitate to contact EPA Tamale office for any assistance you may require in this regard.

Thanks.

Yours faithfully,

A handwritten signature in blue ink, appearing to be 'Abu Iddrisu', with a circular stamp or seal partially visible underneath.

Abu Iddrisu
(Regional Director)
Fore: Executive Director

CC: The Director, EIA Department, EPA Headquarters, Accra.

FORMAT FOR PRELIMINARY ENVIRONMENTAL REPORT

1. Non-Technical Executive Summary

- Brief description of the project and the environment
- Brief description of the main impacts and mitigation measures to be undertaken

2. Introduction

- Description of the purpose and objectives of the undertaking
- Overview of relevant policy, legislative and regulatory framework

3. Description of the Undertaking

- Description of the nature scope and scale of the development
- Detailed description of the project components and stages including description of production processes where applicable with flow diagrams.
- Description of the nature and duration of construction and operational phase activities.
- Estimation of the number of workers and materials required for various stages of the project and their sources.
- Other relevant information provided.

4. Baseline Information

- Description of the proposed site including the immediate adjoining land uses and zoning status
- Definition of land area taken by the development (provide site plan/map)
- Description of the allocation of different activities/uses to which the proposed land would be put (this must be presented in a clearly labelled block plan)
- Description of the relevant baseline environmental quality information (e.g. air quality, water quality, noise, traffic, services, socio-economic information etc.).
- Alternative sites considered and evaluated and the main reasons for the selection of the preferred option.
- Other relevant information.

5. Identification, Analysis and Evaluation of Impacts

- Description of the potential impacts of the proposed undertaking including the methodology used for impacts identification (e.g. checklists, matrices, impact networks etc.). Impacts must be described in terms of their nature (Direct and indirect, positive, negative), duration (short, medium, long term), magnitude, areal extent, frequency etc.) and categorized into all phases of project (pre-construction, construction, operation and decommissioning).
- Occupational Health and Safety Risks
- Other Risks and Hazards

6. Mitigation Measures

- Description of mitigation measures for significant impacts Measures must be defined in practical terms (e.g. costs, manpower, equipment, technology needs etc.).

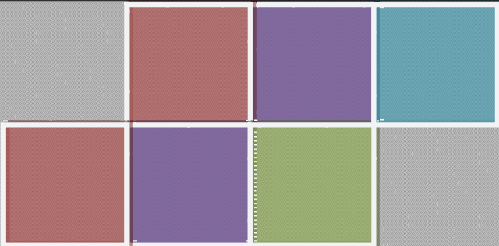
7. Environmental Monitoring Plan

- Environmental Monitoring Plan including parameters to be monitored, frequency of monitoring reporting etc.

8. Consultations

9. Conclusions.

11. 予備環境報告書 (PER)





**YACHIYO ENGINEERING
CO., LTD.**

**ENHANCEMENT OF POWER SUPPLY IN
TAMALE**

**PRELIMINARY
ENVIRONMENTAL REPORT**

SAL Consult Limited, P O Box GP20200, Accra
September, 2023



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ACRONYMS AND ABBREVIATIONS

AIS	Air Insulated Switchgear
BSP	Bulk Supply Point
CBD	Central Business District
CBS	Community Based Surveillance
EPA	Environmental Protection Agency
FRM	Federal Reference Method
GDP	Gross Domestic Product
GIS	Gas insulated switchgear
GRIDCO	Ghana Grid Company
GSA	Ghana Standards Authority
GSS	Ghana Statistical Service
IEC	International Electrotechnical Commission
JICA	Japan International Cooperation Agency
MED	Metropolitan Education Directorate
MoE	Ministry of Energy
MTDPs	Medium Term Development Plans
NCCP	The National Climate Change Policy
NEDCo	Northern Electricity Distribution Company
PAPs	Project Affected Persons
PEA	Preliminary Environmental Assessment
PER	Preliminary Environmental Report
PHC	Population and Housing Census
PPE	Personal Protective Equipment
PURC	Public Utilities and Regulatory Commission
RCC	Regional Coordinating Council
Row	Right of Way
SDHMT	Sub-district Health Management Team
TAMA	Tamale Metropolitan Assembly
TBAS	Traditional Birth Attendants
TCH	Tamale Central Hospital
UNICEF	United Nations International Children's Emergency Fund

NON-TECHNICAL EXECUTIVE SUMMARY

0.1 Introduction

The Japan International Cooperation Agency (JICA) in collaboration with the Northern Electricity Distribution Company (NEDCo) is providing funding for the Enhancement of Power Supply Project at Tamale in the Northern Region of Ghana. The project comprises of the construction of a primary substation at the Regional Coordinating Council (RCC) as well as transmission and distribution lines. The project aims to guarantee and improve the basic quality of life for the residents of Tamale and its environs through a stable power supply for crucial services such as health and water supply in the Tamale metropolis and surroundings, as well as to increase the available power supply for new customers. The project is expected to ultimately contribute to loss reduction and revenue growth as well.

The RCC primary substation will serve as the main power source for the Tamale Central Hospital (TCH), which is the second-largest hospital in the region. The hospital, which currently delivers healthcare to about 300–500 outpatients daily in Tamale, would be guaranteed a continued power supply. Additionally, it will also provide reliable power to businesses and residences such as SSNIT, Sakasaka, the Regional Coordination Council, and Vittin. Due to its strategic location, not far from the center of town, the substation is expected to create new business opportunities for residents through the additional capacity to connect customers at the Central Business District (CBD) of Tamale City.

0.2 Objective of Project

This project aims to improve distribution reliability, increase electricity access rates in the Tamale metropolis, and reduce distribution losses on the feeders related to this project. It also aims to guarantee and improve the basic quality of life for the residents of Tamale by providing a reliable electric power supply to Tamale Central Hospital and new customers in and around Tamale.

0.3 Components of the Project

The main components of the Project will comprise:

- Construction of RCC primary substation
- Construction of 34.5 kV sub-transmission line between the existing Tamale BSP and RCC primary substation. (Approx. 6.0 km, RoW is 10 m)
- Construction of 11.5 kV distribution line between RCC primary substation and Tamale Central Hospital. (Approx. 8.0 km RoW is 10 m)

The width of the Right of Way (RoW) for electrical lines (34.5 kV and 11.5 kV) is 10 m which is 5m on either side of the centerline.

0.4 Environmental and Social Baseline Conditions

The Tamale Metropolis lies within the Savannah Woodland Region of the country. The trees in this part of the country are short, scattered wood lots. Major tree types are the Shea, Dawadawa, Nim, Acacia, Mahogany, Baobab among others.

The area is characterized by two main seasons, the dry and the raining seasons with an annual average rainfall of 1,200 mm. The dry season starts from late October to early May followed by the raining season from late May to early October. The dry season is noted for hunting and burning of bushes for game with some fire disasters occurring during this period. Also, dry harmattan winds from the Sahara are experienced during the months of November to February. The coldest nights in the year are experienced in the months of December, January and February, while the hottest nights are experienced in the months of March, April and May. Farming activities noted for this period are harvesting of rice, cassava, yam, drying of foodstuffs, preparation of farmlands and raising of yam mounds.

The rainy season is characterized by inaccessibility of some parts of the Metropolis due to bad roads. This period, June to early August, is also associated with lean or food shortage. Cultivation and sowing are also done during this period.

The area is generally flat with gentle undulating low relief and altitude ranging from 400 to 800 ft. above sea level. The area has relatively few seasonal water bodies that dry up in the dry season. The only natural water systems are a few seasonal streams which have water during the rainy season and dry up during the dry season. All these streams have their headwaters from Tamale which is situated on a higher ground. The Metropolis has sandstone, gravel, mudstone and shale weathered into different soil grades as its major soil types. Owing to seasonal erosion, soil types resulting from this phenomenon are sand, clay, and laterite ochrosols the availability of the various soil types has aided rapid real estate development such as river sand, gravel, and clay being used by developers especially in urban areas.

0.5 Potential Impacts and Mitigation

This study has identified potential positive impact of the project on healthcare delivery, boost in economic activities and employment creation as well as effective functioning of institutions within the metropolis. Despite these positive potential impacts, there are minor negative impacts the project is anticipated to pose to the project construction areas. These minor negative impacts and proposed mitigation measures for the preparatory, construction and operation phases of the project have been captured in the table below.

Potential Impact during preparatory/construction phase	Mitigation Measures
Occupational health and safety	- Health and safety induction will be provided for all workers - The contractor should carry along a well stuffed First Aid Box for the construction site and transmission lines installation - The contractor should identify and provide appropriate PPE that will offer protection to workers in all areas of operation (e.g. overalls, safety boots, hand gloves etc.) - Cautionary or warning signs and notices should be boldly posted at potentially dangerous or hazardous areas. - Fire-fighting equipment such as fire extinguishers should be provided at construction site - All incidents/accidents should be recorded, investigated and preventive measures put in place to avoid re-occurrence. - The contractor should ensure that its workers are enrolled on the National Health Insurance Scheme
Air quality deterioration	- The contractor will use dust control methods such as water suppression and/or application of biodegradable dust suppressants on untarred access roads and at the project site to reduce dust generation. - The contractor will as much as possible minimize dust generating activities during windy periods. - The contractor will only use machinery and trucks in good condition for the project. All machinery and trucks will also be regularly serviced to prevent excessive generation of exhaust fumes. - Vehicle speed, particularly on untarred roads will be strictly controlled to minimize dust generation.
Noise Nuisance	- The contractor will select equipment with lower sound power levels for use. - The contractor will install suitable mufflers on engine exhausts and compressor components. - The contractor will schedule construction works to ensure noise generating activities are carried out during less sensitive periods, such as during active working hours where most residents will be at work and not at home. - The contractor will only use good condition machinery and equipment for the construction work. These will be regularly serviced and maintained to reduce noise generation.

	The contractor will educate machine operators and truck drivers to avoid unnecessary honking, reduce revving of engines to the barest minimum and not to leave idle engines on.
Waste generation and disposal	- The contractor will adopt efficient construction methods and re-use of construction materials to minimize the waste to be generated from the construction works. Excavated soil material will be re-used in backfilling and leveling as much as possible at the substation site and for the trenches for the power evacuation route. - The contractors will implement a waste management plan that includes provision of temporary storage bins at construction sites and disposal of waste at Metropolitan Assembly's approved sites - Metal scraps will be given to scrap dealers for recycling. - The contractor will provide mobile toilet facilities or identify community toilet facilities for use by construction workers
Public safety and traffic issues	- The project site will be cordoned off and strict security measures enforced to prevent entry of unauthorized persons to the site. - Warning signs will be used at vantage points to warn the public against dangers. - Any broken-down vehicles will be immediately removed off the road. - The contractor will adjust material/equipment delivery times to avoid peak traffic periods and periods where school children are commuting to and from school. - Officials of the Motor Traffic and Transport Directorate (MTTD) of the Ghana Police Service will be engaged where necessary to direct traffic to reduce traffic congestions. - Thrust-boring will be used at road crossings to minimize traffic impacts. - All trenches will be covered immediately after laying of cables. - The contractor will develop and implement an effective grievance redress mechanism to address public complaints. - Red bands or reflective materials should be tied on protruding poles out of bands during transport of poles to site. - As a policy, the contractor should ban free range defecation by workers and offenders should be punish to serve as a deterrent
Displacement of persons and properties on Row	- The contractor in conjunction with local authorities will educate and sensitise the communities prior to site clearing and excavation on project site - The contractor will educate its workers to ensure that only areas required for pole installation and for limited movement required by line workers are excavated

	Invite the Land Valuation Division, the government body responsible for enumeration, valuation and compensation arrangement, to take inventory of affected persons and properties and apply official procedures to provide realistic compensation payments to affected persons
Vegetation loss	- Felling of any tree without any justified reason linked to project activity should be prohibited and be made punishable. - Tree planting should be implemented as a compensatory measure for trees cut down. (1 tree planted for every 1 tree cut)

Potential Impact of Operation phase	Mitigation Measures
Occupational health and safety	- VRA-NEDCo will provide training for their workers on safety and standard operational procedures - Working on live lines should be discouraged. Confirmation of power outage should be done before work commences. - Proper PPEs should be provided for line maintenance workers - Well stuffed first aid box should be made available to line maintenance workers and should include medication for snake/insect bites and stings - All incidents/accidents should be recorded, investigated and preventive measures put in place to avoid re-occurrence
Soil contamination	VRA-NEDCo should develop waste oil management plan in consultation with the EPA and agree to the proper disposal of transformer oil with the EPA.
Noise Nuisance	Carry out scheduled maintenance on transformers
Waste generation and disposal	- Adequate waste bins will be provided for frequent collection and disposal of waste generated. This will include scrap metal and waste oils which will be sold to licensed recyclers. - A licensed waste management company will be contracted to collect and dispose waste from the facility - A hazardous waste management plan will be developed or adopted to manage hazardous waste from broken down/obsolete equipment such as transformers.
Risk of fires and explosions	- Machines and equipment will be regularly serviced and maintained to avoid any fires and explosions. - Security at the facility will be strictly enforced to prevent any sabotage from the public. - Firefighting equipment such as fire hydrants and fire extinguishers will be installed at vantage points. - A Fire Management Program will be developed and implemented. This will include: - Training on fire prevention, firefighting and rescue; - Fire drills; and - Emergency response plan; etc.
Public health and safety issues	- Caution/warning tapes and tiles will be used to indicate the presence of underground electricity lines to warn the public. - Caution and warning signs will be used at the substation to warn the public of any danger

	• The project should educate local communities on dangers associated with coming into contact with exposed wires. • An emergency contact line should be made known to the public or local communities to enable faults or fallen lines or poles to be reported for quick action to be taken • Poles should be properly installed during the construction phase to prevent easy falling during storm events • Poles installed near road sides should be painted in appropriate reflective colours so that they become very visible at night to prevent vehicles from crashing into them. • Maintenance workers should be educated to avoid open defecation and encouraged to identify and use local community toilet facilities
Interruption and disruption in power supply	• NEDCo should adequately inform the local communities prior to disconnection for maintenance or repair works, indicating how long it will take for power to be restored

1.0 INTRODUCTION

1.1 Background

The Northern Electricity Distribution Company (NEDCo) through Japan International Cooperation Agency (JICA) funding is implementing a Power Supply Enhancement Project in Tamale. The project comprises among others, building a 34.5kV sub-transmission line (approximately 6km) from the GRIDCo Bulk Supply Point in Tamale to a new substation to be built at the Watherston residential area herein referred to as the RCC primary sub-station.

The purpose of the Project is to improve stability and efficiency of power supply in and around Tamale city by constructing new substation, sub-transmission and distribution lines.

In keeping with the legal requirements of the country, NEDCo registered the proposed project with the Environmental Protection Agency (EPA). In response to the project registration the EPA, requested the preparation of a Preliminary Environmental Report for the proposed project as per the provisions of the Environmental Assessment Regulations 1999, LI 1652.

1.2 Objective of Study

The objective of the environmental assessment is to assist Northern Electricity Distribution Company (NEDCo) to obtain an Environmental Permit for the development of the proposed Enhancement of Power Supply to Tamale Project within the Tamale Metropolis in the Northern Region. The specific objectives of the Preliminary Environmental Assessment (PEA) study include the following:

- Identification of possible direct and indirect significant adverse impacts associated with the implementation of the project on the physical and social environment;
- Assessment and evaluation of potential impacts of the project on the environment and community/worker health and safety;
- Provision of practical, socially acceptable, technically and economically feasible and environmentally sustainable measures to address the potential adverse impacts;
- Satisfying legal obligations given under the Environmental Assessment Regulations 1999, LI 1652; and
- Document all findings and recommendations in a PER to guide project execution.

1.3 Approach and Methodology for the Study and Reporting

The approach and methodology adopted for the study included:

- Survey of project sites;
- Relevant stakeholder consultations;
- Review of available literature;
- Collection of baseline data;
- Data analysis; and
- Reporting.

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1.3.1 Site Visits <u>Site Surveys</u> Site surveys and inspection of the project site as well as its area of influence were undertaken to confirm relevant environmental baseline and socio-economic conditions and issues likely to develop from implementation of the proposed project. Nearby communities and the project area of influence were visited to confirm relevant socio-economic and cultural conditions/facilities existing within the communities, which are likely to be affected or influenced by the project.	1.3.2 Review of Available Literature The major documents reviewed include: • Documents from the project implementers on scope of the project; • Regulations governing the construction and operation of power substation, transmission and distribution lines from bodies such as the VRA, NEDCo, Ghana Grid Company Limited (GRIDCo) and the EPA; • Medium Term Development Reports from the Tamale Metropolitan Assembly (TaMA); and • Information from some relevant environmental reports relating to the construction and operation of power substation and transmission in the country and elsewhere.	1.3.3 Relevant Stakeholder Consultations Consultations have been held with various stakeholders, regulatory agencies, interested parties and traditional authorities. The details of the consultations are provided in Chapter 8. The following institutions and groups were consulted: • Environmental Protection Agency; • Northern Electricity Distribution Company; • Ghana National Fire Service, Regional Office; • Tamale Metropolitan Assembly (TaMA); • Ghana Highways Authority, Regional Office; • Department of Urban Roads, Regional Office; • Ghana Police Service, Regional Office; • Ghana Water Company Limited, Regional Office; • MTN Office, Tamale Main; • Vodafone Ghana, Tamale; • Tamale Central Hospital; • GRIDCo, Tamale; • Lands Commission, Regional Head of Valuation Department, Tamale; • St Paul's Roman Catholic Junior High School, Tamale; and • Traditional Authority, Tamale
1.3.4 Baseline Data Collection Secondary information was obtained from various sources especially from the Medium-Term Development Plans (MTDPs) obtained from the Tamale Metropolitan Assembly. As part of the baseline data collection, the following activities were carried out: • Elevated air quality and noise nuisances were determined to be potential sources of impact of the project on some receptors (residential areas, schools) within the project area. The current levels were measured as part of the baseline study. • Flora and fauna conditions were obtained from field inspections and desk studies as well as land use activities; and • Socio- economic activities within the project corridor were observed and recorded. Potential impact on local water resources was deemed to be minimal and therefore not investigated further as part of this assessment.	1.3.5 Data Analysis and Reporting The results of the PEA study have been analysed and presented in this Preliminary Environmental Report (PER) following the format issued by the EPA. Major headings of the report include the following: a) Non-Technical Executive Summary; b) Introduction; c) Description of Proposed Power Enhancement Project; d) Environmental Baseline Information; e) Impact Identification and Assessment; f) Mitigation Measures; g) Environmental Monitoring Plan; h) Decommissioning; i) Stakeholder Consultations; and j) Conclusion.	1.3.6 Data Collection and Reporting The results of the PEA study have been analysed and presented in this Preliminary Environmental Report (PER) following the format issued by the EPA. Major headings of the report include the following: a) Non-Technical Executive Summary; b) Introduction; c) Description of Proposed Power Enhancement Project; d) Environmental Baseline Information; e) Impact Identification and Assessment; f) Mitigation Measures; g) Environmental Monitoring Plan; h) Decommissioning; i) Stakeholder Consultations; and j) Conclusion.
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2.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK OF THE PROJECT

The relevant Ghanaian environmental and other statutory laws and regulations to guide NEDCo from conceptualisation of the proposed project to implementation and monitoring as well as decommissioning are described with respect to the Environmental Policy and Regulatory frameworks.

2.1 Environmental Policy Framework

National Energy Policy, 2012

The energy sector goals of the National Energy Policy include ensuring “that Energy is produced and supplied in a form that conforms to acceptable international practice with regards to their health and environmental impact”. The specific objectives of the policy are the minimization of “environmental impacts of energy supply and consumption through increased renewable energy and efficient energy delivery”. The government will ensure effective disposal of all hazardous substances and materials associated with the production, transportation, and use of energy.

National Environmental Policy, 2012

The main aim of this national policy is to effectively and efficiently exploit, use natural resources and to maintain the environment in a friendly manner not only for the current generation but also for the existence of future generations. Hence, the policy aims to achieve the triple-bottom-line objectives of sustainable development: social, economic, and the environment. Specifically, to maintain essential ecological processes, check pollution, encourage environmentally sound development and ensure public participation in environmental decision-making.

Ghana National Climate Change Policy/Action Plan 2013

The National Climate Change Policy (NCCP) is Ghana's integrated response to climate change concerns. The policy aims at ensuring a climate-resilient and climate-compatible economy, while pursuing sustainable development agenda through equitable low-carbon economic growth for Ghana. The policy areas have been subdivided into programme areas which will improve food security, increase the resilience of infrastructure and communities, improve environmental management practices and ecosystems for greater biodiversity and carbon sequestration, optimize key socio-economic factors, and achieve more efficient systems for improved economic growth

National Health Policy, 2020

The National Health Policy document which aims at creating wealth through health, among other things places emphasis on improvements in personal hygiene, immunisation of mothers and children, the practice of safe sex and the prevention of injuries at both work places and on the road. The National Health Policy also argues that a healthy population could only be achieved if there were improvements in environmental hygiene and sanitation, proper housing and town planning, provision of safe water, safe food and nutrition and encouragement of regular physical exercise.

National Land Policy, 1999

The Land Policy of Ghana aims at the judicious use of the nation's land and all its natural resources by all sections of the Ghanaian society in support of various socio-economic activities undertaken in accordance with sustainable resource management principles and in maintaining viable ecosystems. The specific objectives of this policy include:

- Ensure that Ghana's international boundaries are maintained at all times and cross border activities are managed jointly.
- Ensure that shared water bodies are utilised to the mutual benefit of all stakeholder countries.
- Ensure that every socio-economic activity is consistent with sound land use through sustainable land use planning in the long-term national interest.
- Protect the rights of landowners and their descendants from becoming landless or tenants on their own lands.
- Ensure the payment, within reasonable time, of fair and adequate compensation for land acquired by government from stool, skin or traditional council, clan, family and individuals.
- Instil order and discipline into the land market to curb the incidence of land encroachment, unapproved development schemes, multiple or illegal land sales, land speculation and other forms of land racketeering.
- Minimise, and eliminate, where possible, the sources of protracted land boundary disputes, conflicts and litigations in order to bring their associated economic costs and socio-political upheavals under control.
- Create and maintain effective institutional capacity and capability at the national, regional, district, and where appropriate, community levels for land service delivery.
- Promote community participation and public awareness at all levels in sustainable land management and development practices to ensure the highest and best use of land, and thereby guarantee optimum returns on land.
- Promote research into all aspects of land ownership, tenure and the operations of the land market and the land development process.
- Ensure continuous education of the general public on land matters.

Legal and Regulatory Framework for Resettlement and Compensation

In Ghana, the legal provisions governing land acquisition and resettlement for public-purpose projects such as JICA Enhancement of Power Supply in Tamale include the;

- Relevant sections of the Constitution of Ghana (1992),
- State Lands Act (Act 125 of 1962) as amended,
- Lands (Statutory Wayleaves) Act (Act 186 of 1963), and
- National Land Policy, 1999

Section 18 of the Constitution guarantees the right of individuals or groups to own and dispose property, including land and structures. This right is fundamentally protected by the constitution. Notwithstanding, the Constitution establishes the circumstances and the procedures with which the state can acquire privately-owned land and property for public purposes. Article (18) of the constitution clearly stipulate that “no person shall be subjected to interference with the privacy of his home, property, correspondence,

or communication except in accordance with law and as may be necessary...for public safety or the economic well-being of the country, for the protection of the rights and freedom to others.”

For public purposes, the state may acquire land and properties owned by individuals or groups either by negotiation or through compulsory acquisition. The right of the state to acquire private property is vested in the President, and can only be exercised if the “taking of possession or acquisition is necessary in the interest of defense, public safety, public order, public morality, public health, town and country planning or the development or utilization of property in such a manner as to promote the public benefit”. When private properties become subjects of compulsory acquisition or expropriation, “the necessity for the acquisition” must be clearly stated and “is such as to provide reasonable justification for causing any hardship that may result to any person who has interest in or right over the property.”

In such instances, the constitution also provides remedies for offsetting the impacts and hardships resulting from compulsory acquisition. These remedies include cash compensation, resettlement assistance, or both. Article (20) requires that the state makes “sufficient provision...for the prompt payment of fair and adequate compensation”. It also expressly stipulates that where the compulsory acquisition involves the displacement of any inhabitants, the state shall resettle them on suitable alternative site, having regard to their Socio-cultural values and economic well-being and social and cultural values”. Costs of disturbance and incidental expenses or other damage suffered are to be considered in the award of compensation.

2.2 Legal/Regulatory Framework

Constitution of the Republic of Ghana, 1992

The Constitution of the Republic of Ghana 1992, makes provisions that protect the right to private property and sets principles under which citizens may be deprived of their property in the interest of the public.

Environmental Protection Agency Act 1994 (Act 490)

The Environmental Protection Agency Act 1994 (Act 490) gave mandate to the Agency to ensure compliance of all investments and undertakings with laid down Environmental Assessment (EA) procedures in the planning and execution of development projects, including compliance in respect of existing ones.

Environmental Assessment Regulations 1999, LI 1652

The Environmental Assessment Regulations 1999, LI 1652 enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to commencement of the project.

Land Use and Spatial Planning Act, 2016 (Act 925)

The Land Use and Spatial Planning Act, 2016 (Act 925) regulates land use through a decentralised planning system to ensure judicious use of land in order to improve quality of life, promote health and safety in respect of human settlements and generally provide for spatial aspects of socio-economic development and related matters.

Energy Commission Act, 1997 (Act 541)

The Energy Commission was established by the Act which also provides for its functions relating to the regulation, management, development and utilization of energy resources in Ghana; granting of licenses for the transmission, wholesale supply, distribution and sale of electricity and natural gas; refining, storage, bulk distribution, marketing and sale of petroleum products and related matters.

Electricity Supply and Distribution (Standards of Performance) Regulations, 2008 (LI 1935)

The Electricity Supply and Distribution (Standards of Performance) Regulations, 2008 (LI 1935) provide for performance benchmarks for electricity supply and distribution in conformity with the provisions of Electricity Supply and Distribution (Technical and Operational) Rules, 2005 (LI 1816). It provides the standards within which electricity may be supplied to a customer and the penalty if the distribution utilities fail to perform up to the desired standard. It applies to electricity supply and distribution utilities licensed by the Energy Commission.

Electricity Regulations, 2008 (LI 1937)

The Electricity Regulations, 2008 (LI 1937) provide for:

- The planning, expansion, safety criteria, reliability and cost effectiveness of the national interconnected transmission system;
- The market and technical operations of the electricity transmission utility;
- Minimum standards and procedures for the construction and maintenance of facilities and installations;
- The protection of the mains and electrical installations and services; and
- The protection of life and property, and the general safety of the public in respect of electricity services.

Fees and Charges (Miscellaneous Provisions) 2022, Act 1080

The Fees and Charges (Miscellaneous Provisions) 2022, Act 1080 replaces the Fees and Charges (Amendment) Instrument 2019 (L.I. 2386). The law provides a comprehensive rate, fees and charges collectable by Ministries, Department and Agencies (MDAs) for goods and services delivered to the public. The Instrument stipulates the fees and charges to be paid by proponents with respect to processing, environmental permits and certificates.

The Local Government Act 1993 (Act 462)

The Local Government Act 1993 (Act 462) empowers the Metropolitan/Municipal/District Assemblies to establish Waste Management Departments to be responsible for the development and management of waste disposal sites within their areas of jurisdiction.

Local Governance Act, 2016 (Act 936)

This Act establishes and regulates the local government system and gives authority to the RCC and the District Assembly to exercise political and administrative power in the regions and districts respectively.

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This includes initiation of development programmes as well as development, improvement and management of human settlements and the environment through departments such as the Urban/Feeder Roads and Physical Planning Departments <u>Fire Precaution (Premises) Regulations 2003 (LI 1724)</u> The Fire Precaution (Premises) Regulations 2003 (LI 1724) requires all premises intended for commercial and industrial use to have Fire Certificates. <u>The Public Health Act, 2012 (Act 851)</u> The Public Health Act, 2012 (Act 851) is an Act to revise and consolidate the law relating to public health to prevent disease, promote, safeguard, maintain and protect the health of humans and animals and to provide for related matters. <u>The Persons with Disability Act 2006. (Act 715)</u> An Act to provide for persons with disability, to establish a National Council on Persons with Disability and to provide for related matters. Provisions include the right to a family life and participation in social, creative or recreational activities; the prohibition of differential treatment for residential purposes, the right to the same living conditions as persons without disability when persons with disability are placed in special institutions. No exploitation, abuse, discrimination or disrespect to persons with disability, appropriate facilities when involved in court proceedings; and access to public places. <u>Factories, Offices and Shops Act, 1970 (Act 328)</u> The Act requires all proponents to register every factory/workplace with the Chief Inspector of Factories Inspectorate Division (FID), report accidents, dangerous occurrences and industrial diseases, post in a prominent position in every factory the prescribed abstract of the Act and other notices and documentations, as well as outlines the regulations to safeguard the health and safety of workers. <u>Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917)</u> The Hazardous and Electronic Waste and Control Act 2016 (Act 917) provides list of hazardous and other waste. It also provides control, management and disposal of electrical and electronic waste. Hazardous waste generally refers to waste with properties that makes it potentially dangerous or harmful to human health or the environment and they include liquids, solids or gases which cannot be treated or disposed of by common means. <u>Hazardous, Electronic and Other Wastes (Classification) Regulations, 2016 (LI2250)</u> The purpose of these Regulations is to (a) regulate the classification, control and management of waste: (b) establish a mechanism and procedure for the listing of waste management activities that do not require a Waste Management Permit; (c) prescribe requirements for the establishment of take-back systems, (d) prescribe requirements and timeframes for the management of wastes listed in the First	Schedule; (e) prescribe general duties of waste generators, waste transporters and waste managers; and (f) prescribe requirements for the disposal of wastes. <u>Ghana Standard for Environmental Protection - Requirements for Effluent Discharge (GS1212, 2019)</u> Ghana Standard for Environmental Protection - Requirements for Effluent Discharge (GS1212, 2019); specifies requirements for sector specific effluent quality and also gives guideline discharge into the environment. <u>Ghana Standards for Environment and Health Protection - Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236, 2019)</u> Ghana Standards for Environment and Health Protection - Requirements for Ambient Air Quality and Point Source/Stack Emissions (GS 1236, 2019) specifies the requirements and methods of analysis for ambient air. It also specifies the requirements and test methods for point source or stack emissions based on the sources of energy. <u>Ghana Standards for Health Protection - Requirements for Ambient Noise Control (GS 1222, 2018)</u> Ghana Standards for Health Protection - Requirements for Ambient Noise Control (GS 1222, 2018) specifies the requirements for acceptable ambient noise levels within categorized locations. According to the Standards, the test method should be in accordance with the relevant test methods given in GS 1253:2018 (Acoustics- Guide for the measurement of outdoor A-weighted sound levels. <u>Ghana Standards for Environment and Health Protection - Requirements for Motor Vehicle Emissions (GS1219, 2018)</u> Ghana Standards for Environment and Health Protection - Requirements for Motor Vehicle Emissions specifies the requirements for exhaust emissions of motor vehicles as well as tractors, farm equipment (such as combine harvester, etc.), mobile industrial / construction machines (such as excavators).

Table 2- 1: Environment and Health Protection Requirements for Ambient Air Quality and Point Sources/Stack Emissions

No.	Air Quality Parameter	Maximum Limits	Averaging Time
1	Carbon Monoxide, µg/m³	100	15 minutes
		60	30 minutes
		30	1 hour
		10	8 hours
2	Sulphur Dioxide (SO ₂), µg/m³	150	24hours
3	Nitrogen Oxides (measured as NO ₂), µg/m³	150	24hours
4	Total Suspended Particulate, µg/m³	150	24hours
		100	1 year
5	PM ₁₀ , µg/m³	70	24hours
6	PM _{2.5} , µg/m³	70	1 year
		35	24hours

Source: GSA, 2019

Noise Requirements for Ambient Noise Control of the Ghana Standards Authority. These standards are provided in the table 2-2 below.

Table 2- 2: Health Protection Requirements for Ambient Noise Control (GS 1222:2018)

Zone	Description Area of Noise Reception	Noise Level, dB(A)	
		Day (06:00-22:00)	Night (22:00-06:00)
A	Residential Areas	55	48
B	Educational (School) and health (hospital, clinic) facilities, office and law courts	55	50
C	Mixed used (Residential areas with some commercial or light industrial activities)	60	55
D	Areas with some light industry, places of entertainment or public assembly and places of worship	65	60
E	Commercial areas	75	65
F	Light industrial areas	70	60
G	Heavy industrial areas	70	70
Shaded row shows applicable guidelines to this study			

Source: GSA, 2018

Table 2- 3: Gaps between Ghana Laws/Rules/Guidelines and JICA Guidelines

Item	Ghanaian legislation requirement	JICA Guidelines (2022)	Gaps
Basic Principles	The EPA Act 1994 (Act 490) and Environmental Regulations 1999 (LI 1652) enjoins any proponent or person to register an undertaking with the Agency and obtain an Environmental Permit prior to the commencement of the project. This regulation allows the EPA to place proposed undertakings at the appropriate level of environmental assessment. The LI 1652 seeks to ensure that development is undertaken in a sustainable environment.	Environmental and social impacts caused by projects must be assessed and examined at the earliest possible planning stage. Alternatives or mitigation measures must be examined, in order to avoid such impacts as much as possible, and to minimize, reduce or mitigate them when such avoidance is impossible. The result of the examinations must be reflected into the project plan.	No gaps identified
Examination of Measures	Environmental Assessment Regulations 1999 (LI 1652) outlines the impact assessment procedures and the necessary measures to be taken in particular situations	Multiple alternatives must be examined in order to avoid or minimize adverse impacts by the project and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts. When this is not possible, minimization, reduction, and then mitigation of the impacts must be considered, in accordance with the mitigation hierarchy. Compensation measures must be examined only when significant impacts still remain even with the aforementioned measures.	No gaps identified
Information Disclosure	EPA Act 1994 (Act 490) and EAR 1999 (LI 1652) provides for public participation and information disclosure at various stages of the impact assessment process. The RTI Act (Act 989) guarantees the General Public access to Information from public institutions and relevant private bodies The Data Protection Act, 2012 (Act 843) protects individual privacy and personal data by regulating the collection, use, and disclosure of personal data and by providing procedures for the processing of personal data originating in Ghana.	Require proactive disclosure of information on JICA's website and other platforms, as well as reactive disclosure upon request from stakeholders. Respect the privacy and confidentiality of personal data of individuals involved in its development assistance activities, and only disclose such data with their consent or when required by law.	No gaps identified

Item	Ghanaian legislation requirement	JICA Guidelines (2022)	Gaps
Social Acceptability	The Ghanaian Environmental Protection Agency (EPA) regulations require that project is acceptable by all stakeholders including local authorities, communities and civil society organizations. It further requires active engagement of stakeholders and the provision of 21 days of public notice to receive concerns at different stages of the assessment process.	Projects must be adequately coordinated so that they are accepted in a socially appropriate manner for the countries and areas where the projects are planned. For Projects with potentially significant environmental and social impacts, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans are examined. The outcome of such consultations must be incorporated into the project plans.	No gaps identified
Scope of Impacts to be Assessed	Ghana's EA regulations require the assessment of direct and indirect impacts on the biophysical and socio-economic environment, as well as cumulative impacts.	The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water use, climate change, biodiversity, and ecosystem services, including trans-boundary or global scale impacts. These also include social considerations such as: Migration of population including involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor peoples and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.	There is no explicit mention of transboundary impacts or human rights issues in the regulations.
Monitoring	Ghana's EA regulations require monitoring hence the incorporation of monitoring plans into environmental impact statement documents prepared for projects.	During the project implementation, project proponents monitor whether any unforeseeable situations occur, and the performance and effectiveness of the planned mitigation measures. Project proponents take appropriate	No gaps identified

A11-25

Item	Ghanaian legislation requirement	JICA Guidelines (2022)	Gaps
Grievance Redress Mechanism	The 1992 Constitution of Ghana, (Article 20) provides access to the Court of Law to seek redress. Also, Ghanaian law provides for various forms of Alternative Dispute Resolution (ADR) Act 2010 (Act 798), such as arbitration, mediation, conciliation, and customary arbitration.	A mechanism for handling concerns and grievances from people and communities affected by the project's environmental and social impacts must be in place. The grievance redress mechanism needs to be easily accessible for the project affected people and communities. Project proponents disseminate the information about the grievance redress mechanism through consultations with local stakeholders. Project proponents should make efforts to respond promptly to the grievances they receive, taking into account the concerns and needs of the project affected people and communities.	ADR systems exist but there are no clear rules or procedures for their application and enforcement in different sectors and contexts.
Biodiversity	The Ghana Forest and Wildlife Policy 2012, National Biodiversity Strategy and Action Plan (NBSAP) that was updated in 2016, Wildlife Conservation Act, covers the laws, institutions, systems, organizations and individuals and how they interact for the conservation and sustainable development of forest and wildlife resources.	Illegal logging of forests must be avoided. Project proponents need to obtain logging permits from regulatory agencies, and are encouraged to obtain forest certifications for forestry projects, in order to ensure the prevention of illegal logging.	No gaps identified
Involuntary Resettlement and Loss of Livelihood	The 1992 Constitution and Lands Statutory Weyleave Regulation 1964 (LI 334) provide the modalities and procedures for the acquisition of the Statutory right of ways. Thus, the mechanism for entry for survey works and construction has been spelt out. In the event where inhabitants have to be physically displaced, the State/Project proponent is to resettle them on "suitable land with due regard for their economic well-being and social and cultural values"	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. If avoidance is not possible even after such examination, effective measures to minimize impacts and to compensate for losses must be taken upon agreement with the affected people.	There are no clear provisions on fair and adequate compensation, no provision for squatters, and vulnerable groups.
Indigenous Peoples	Ghana does not have a specific law or policy that recognizes and protects the rights of Indigenous People	Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by	N/A

A11-26

Item	Ghanaian legislation requirement	JICA Guidelines (2022)	Gaps
	because there are no recognized indigenous people in Ghana However, the 1992 Constitution of Ghana, guarantees the fundamental human rights and freedoms of all persons, regardless of their ethnic origin, culture, language, or religion.	exploring all viable alternatives, if avoidance is not possible even after such examination, effective measures for indigenous peoples must be taken to minimize the impacts and to compensate for the losses.	

2.4 Institutional Framework

Northern Electricity Distribution Company (NEDCo)
Northern Electricity Distribution Company (NEDCo) was formed out of the Northern Electricity Department (NED) of the Volta River Authority (VRA). NEDCo is an electricity distribution utility company in Ghana. The company is a subsidiary of the Volta River Authority, the main electricity generation company in the country. The company is the sole supplier of electricity to the Northern Regions of Ghana: Northern Region, Upper East Region, North East, Savannah Region and Upper West Region, Bono, Bono East, Ahafo Regions and part of the Ashanti and Volta Regions.

Energy Commission

The Energy Commission and the Public Utilities regulate the electricity supply industry. The Energy Commission, in addition to being responsible for technical regulations in the power sector, also advises the Minister for Energy on matters relating to energy planning and policy.

Public Utilities and Regulatory Commission (PURC)

The Public Utilities Regulatory Commission of Ghana is an independent body set up to regulate and oversee the provision of the highest quality of electricity and water services to consumers. The PURC is responsible for the economic regulation of the power sector with the mandate to approve rates for electricity sold by electricity distribution utilities.

In summary, PURC's key tasks include:

- Provide guidelines for rates to be charged for the provision of utility services.
- Examine and approve water and electricity rates;
- Protect the interest of consumers and provides of utility services;
- Monitor and enforce standards of performance for provision of utility services;
- Promote fair competition among public utilities; and
- Receive and investigate complaints and settle disputes between consumers and public utility.

Ghana Grid Company (GRIDCo)

The National Interconnected Transmission System (NITS) for electricity is owned and operated by the Ghana Grid Company (GRIDCo). GRIDCo is a state-owned company.

Environmental Protection Agency

The EPA is the body responsible for regulating the environment and ensuring the implementation of government policies on the environment. The Agency ensures that Environmental Impact Assessment is carried out for developments with potential adverse environmental impacts and mitigation measures instituted to respond to potential impacts. The functions of the Agency include:

- ensuring compliance with any laid down environmental impact assessment procedures in the planning and execution of development projects; including compliance in the respect of existing projects;
- promoting effective planning in the management of the environment;
- imposing and collecting environmental protection levies in accordance with the Environmental Protection Agency Act 1994, Act 490 or regulations made under the Act; and
- acting in liaison and co-operation with government agencies, District Assemblies and other bodies and institutions to control pollution and generally protect the environment.

Lands Commission

The Lands Commission was established by Article 258 of the 1992 Constitution and the Lands Commission Act, 2008 (Act 767). The functions of the Lands Commission include amongst others;

- advise the Government, local authorities and traditional authorities on the policy framework for the development of particular areas of the country to ensure that the development of individual pieces of land is coordinated with the relevant development plan for the area concerned;
- ensure that through sound, sustainable land use planning, socio-economic activities are consistent with sound land use through sustainable land use planning in the long-term national development goals; and
- promote community participation and public awareness at all levels in sustainable land management and development practices to ensure the highest and best use of land.

3.0 DESCRIPTION OF THE UNDERTAKING

The aim of the project is to guarantee and improve the basic quality of life for the residents of Tamale and its environs through a stable power supply for crucial services such as health and water supply in the Tamale metropolis and surrounding areas, as well as to increase the available power supply for new customers. The project is expected to ultimately contribute to loss reduction and revenue growth as well.

The RCC primary substation will serve as the main power source for the Tamale Central Hospital (TCH), which is the second-biggest hospital in the region. The hospital, which currently delivers healthcare to about 300–500 outpatients daily in Tamale, would be guaranteed a continued power supply. Additionally, it will also provide reliable power to businesses and residences such as SSNIT, Sakasaka, the Regional Coordination Council, and Vittin. Due to its strategic location, not far from the center of town, the substation is expected to create new business opportunities for residents through the additional capacity to connect customers at the Central Business District (CBD) of Tamale City.

3.1 Project Components

The main components of the Project are, (see Figure 3 -1 and 3-2):

- a. Construction of 34.5kV sub transmission line between the existing Tamale BSP and RCC primary substation. (Approx. 6.0 km, ROW is 10m)
- b. Construction of 11.5kV distribution line between RCC primary substation and Tamale Central Hospital. (Approx. 8.0km, ROW is 10m)
- d. The width of the Right of Way (ROW) for electrical lines (34.5 kV and 11.5 kV) is 10m which is 5m on either side of the centreline.

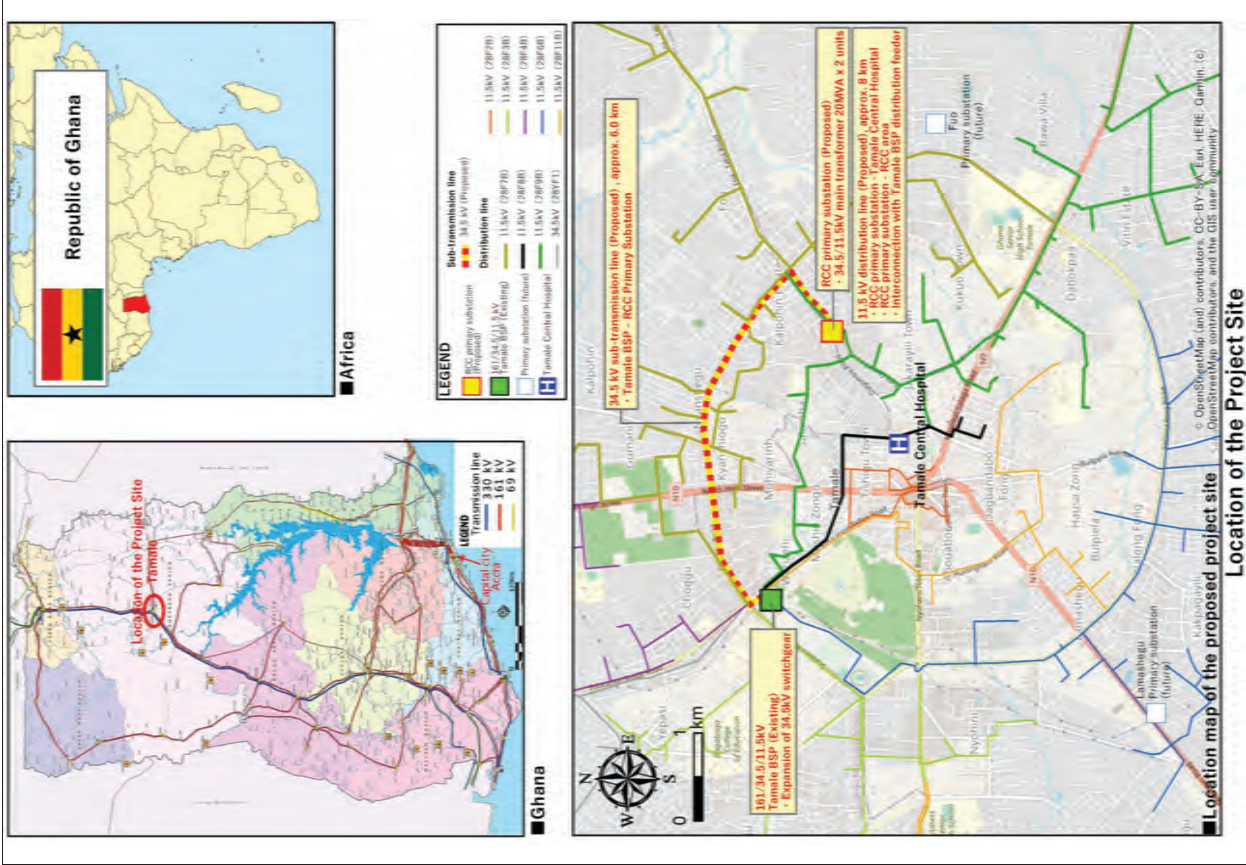


Figure 3- 1: Location and Site Map
Source: JICA Survey Team

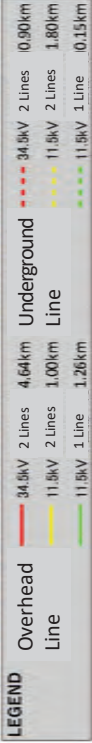


Figure 3-2: Detailed project map
Source: JICA Survey Team

3.1.1 Project Technical Specifications

The Project design, unless otherwise specified, will comply with relevant international standards such as IEC, ISO and Japanese standards. These standards will be applied to the major functions of equipment and facilities in conformity with the existing electrical equipment and facilities in the Republic of Ghana. For the system of units, the International System of Units (SI) is applied.

Tables 3-1 shows the list of codes and standards for the project.

Table 3-1: Relevant Codes and Standards		
Codes and Standards		Applications
a.	JIS (Japan Industrial Standards)	Industrial products in general
b.	JEC (Japanese Electro-technical Committee)	Electrical products in general
c.	JEM (Standards of Japan Electrical Manufacturer's Association)	Electrical products in general
d.	JCS (Japan Cable Maker's Association Standards)	Electrical wires and cable
e.	Technical standards on Electrical Installation	Electrical work in general
f.	IEC (International Electro-technical Commission)	Major functions of electrical products in general
g.	ISO (International Organization for Standardization)	Performance evaluation of industrial products in general
h.	JEAC (Japan Electric Association Code)	Electrical products in general
i.	JEAG (Japan Electric Association Guide)	Electrical products in general
j.	Relevant standards and specifications of Ghana	Mainly applicable to construction and its related matters
k.	Technical Specifications of NEDCo	Electrical products in general

Source: JICA Survey Team

3.1.2 System Electrical Parameters

The electrical parameters for the system used by the project are shown in Table 3-2 below.

Table 3- 2: System Electrical Parameters for substation and distribution lines

Items	Design Values
System Voltage	
- Nominal state	
34.5 kV system	34.5 kV+/-5% (32.775 - 34.5 - 36.225 kV)
11.5 kV system	11.5 kV+/-5% (10.925 - 11.5 - 12.075 kV)
- Alert state	
34.5 kV system	34.5 kV+/-10% (31.05 - 34.5 - 37.95 kV)
11.5 kV system	11.5 kV+/-10% (10.35 - 11.5 - 12.65 kV)
System Frequency	
- Nominal state	
- Alert state	50 Hz+/- 0.2Hz (49.8 - 50 - 50.2 Hz)
	50 Hz+/- 1.0Hz (49.0 – 50 - 51.0 Hz)
System Short Circuit Current	
34.5 kV system	31.5 kA - 3 sec.
11.5 kV system	25 kA - 3 sec.
Ground System	
34.5 kV system	Non-grounding
11.5 kV system	Solidly grounding
Ground Resistance	The Supplier shall propose the ground resistance with calculation sheet in accordance with the indicated standard. (IEEE std. 80 - 2000)
Site Pollution Severity Class	
Outdoor	Heavy (Class d of IEC-60815-2008)
Indoor	Light (Class b of IEC-60815-2008)

3.1.3 Substation Installations

RCC Primary Substation

The substation site is about 3km from the Tamale Central Hospital. The Tamale Central Hospital is a government hospital in the Tamale metropolis, among other hospitals like the Tamale Teaching Hospital and the Tamale West Hospital. The hospital is in the heart of the city. The construction of the substations will include the construction of 34.5kV interconnecting lines to the substations, 2x20MVA transformers, and new 11kV feeders from the substations to the adjoining distribution system feeders (with two dedicated feeders to the hospital). There would be tied line requirements that are estimated to be 7km of 34.5 kV lines and 5km of 11 kV lines, all of which can be built on existing line alignments. The substation has Indoor AIS (Air Insulated Switchgear) with building.

Installation

- ✓ All substation equipment except transformers shall be installed inside the newly constructed control building.
- ✓ Both 34.5 kV and 11.5 kV switchgear shall be of indoor type, air-insulated switchgear.
- ✓ The space shall be secured in the 34.5 kV switchgear for the planned two future panels for No. 1 and No. 2 lines.
- ✓ The space shall also be secured for Communication panel(s) in the control room and 48 V DC power supply system in the battery room for future Supervisory Control and Data Acquisition System (SCADA) system.
- ✓ A lightning mast shall be installed to protect the outdoor equipment from lightning.

Transformer

- ✓ The two main transformers shall have a capacity of 20 MVA each oil-natural, air-natural cooling (ONAN) and be capable of parallel operation.
- ✓ The main transformers shall be designed to be able to operate in oil-natural, air-forced cooling (ONAF) mode with a fan on the radiators for future capacity increases of 26 MVA.
- ✓ A local control panel shall be mounted on each main transformer and the space for fan control circuits shall be secured in the panels.
- ✓ The following facilities shall be installed.
 - An oil pit with the capacity of 50% of the total oil volume of the transformer shall be designed under each transformer.
 - An oil-water separator for two main transformers
 - A firewall between main transformers

Control and Protection

- ✓ Protection relays shall be mounted on the switchgear.
- ✓ Substation control panels with mimic busbars (called as Mimic control panel) shall be installed in the control room so that the circuit breakers can be operated on this panel. (Mimic busbars: Orange colour for 34.5 kV system and Green colour for 11.5 kV system)
- ✓ Multimeters and annunciators shall be mounted on the Mimic control panels, and the substation monitoring shall also be done on this panel.

It shall be noted that annunciators for common system (AC/DC power supply, etc.) shall be mounted on the 34.5 kV Bus section control panel.
- ✓ The dedicated watt-hour meter panels shall be installed in the control room; one panel for the 34.5 kV feeders and the other for the 11.5 kV feeders. The watt-hour meter is the Buyer-designated model and shall be supplied by the Buyer on site and be installed by the Supplier on site. The panel for 34.5 kV feeders shall include the future planned Fuo feeder (2 lines), and blind plates shall be fitted at this time. The watt-hour meter shall also be installed on the incoming circuit of the AC distribution panel.
- ✓ Interface panel(s) shall be installed in the control room in order to interface with future SCADA system. For devices such as Intelligent Electronic Devices (IEDs, multimeters, etc.) that are equipped with ports (Ethernet, Modbus, etc.), complied with international standards, the appropriate ports may be

used as the interface points.

Others

The AC incoming circuit for the substation use shall be two circuits, one is from the Station service transformer and the other is from the NEDCo low-voltage system.

3.1.4 34.5kV Sub-transmission Line

Double circuit 34.5kV sub-transmission lines of about 6.0km in length (approximately 0.9 km being underground cable and 4.6 km being an overhead line) will be constructed between the Tamale BSP and the RCC Primary Substation. As the Tamale BSP Substation is located in an urban area, the new sub-transmission line will use underground cabling near the Tamale BSP Substation to avoid the need for the resettlement of residents. The underground line will become an overhead line at the end of the urban area.

The conductor size of a 34.5kV feeder line will be All Aluminium Alloy Conductors (AAAC) 285mm². The conductor size of the copper cable will be 400mm². The underground cables and overhead lines will be two lines operating at all times, with sufficient capacity to enable power supply to each of the 20 MVA transformer of the RCC primary substation with one (1) line. In addition, even if one (1) line loses power due to an accident, the other has the capacity to supply power to the two (2) transformers of 40 MVA capacity at the RCC primary substation for a short time.

3.1.5 11.5kV Distribution Line

A total of eight (8) 11.5kV overhead distribution lines will be installed. In order to improve the reliability of supply to the Tamale Central Hospital and avoid relocation of residents and cutting of trees, the two lines of the Central Hospital feeder and CRH feeder will use the existing underground line with other distribution lines being overhead lines. The conductor size of the 11.5kV feeder line will be AAAC 125mm². The conductor size of the aluminum cable will be 240mm². The sizes of underground cables and overhead lines will conform to NEDCo standards.

Table 3- 3: 11.5kV distribution feeders from RCC primary substation

No.	Feeder	Distribution line
1	Central Hospital	Underground cable: approx. 1.8km
2	CRH	Underground cable: approx. 1.8km
3	SSNIT	Overhead line: approx. 0.9km, Underground cable: approx. 30m (in the RCC primary substation)
4	Low cost	Overhead line: approx. 0.9km, Underground cable: approx. 30m (in the RCC primary substation)
5	Sakasaka	Overhead line: approx. 0.1km, Underground cable: approx. 30m (in the RCC primary substation)
6	RCC	Overhead line: approx. 0.1km, Underground cable: approx. 30m

		(in the RCC primary substation)
7	Youth Home	Overhead line: approx. 0.4km, Underground cable: approx. 30m (in the RCC primary substation)
8	Ministries	Overhead line: approx. 1.0km, Underground cable: approx. 30m (in the RCC primary substation)

Source: JICA Survey Team

3.1.6 Pole Specifications

The support structure for the 34.5kV overhead sub-transmission line shall be steel pole types to prevent burnout and protect the urban landscape. In order to ensure the workability of double circuit poles, two lines will be arranged on the left and right. The poles will be 18 meters long to allow them to pass over the existing 11.5 kV distribution line with vertical arrangements and to ensure sufficient ground clearance on the road. There is sufficient ground strength as foundation for poles, but as a precaution, under bracings will be installed at 10 poles around a drainage and a water body.

The support structure of the 11.5kV overhead distribution line shall be steel poles which are fire-resistant. In the case of single circuit, the length of the pole shall be 15 m in order to pass over the existing 11.5 kV distribution line with a horizontal arrangement pole. In the case of a double circuit, as with the 34.5 kV sub-transmission line, two lines will be arranged on the left and right to ensure the workability of the double circuit poles.

3.2 Proposed Project Activities

3.2.1 Preparatory/Planning/Mobilization Phase Activities

Pre-construction phase activities include among others:

- Survey and selection of the substation site and line routes;
- Preparation and approval of designs;
- Preparation of Preliminary Environmental Assessment report;
- Acquisition of Right of Way (RoW);
- Compensation of Project Affected People (PAP),
- Sourcing of materials and;
- Mobilisation of construction staff and equipment.

Survey and selection of the substation site and line route

The substation site and the power line routes will be surveyed for suitability. The power line routes will be restricted to the outside edges of the road reserves as a way of mitigating wayleave issues.

Preparation and approval of designs

Detailed designs will be prepared based on the survey of the site for the substation and power line routes and submitted to NEDCo and JICA for approval. Approval for survey drawing will be obtained from the relevant authorities before project implementation.

Acquisition of Right of Way (RoW)

The RoW required is relatively small, 10 m width i.e. 5 meter on both sides from the centre line of the power lines will be carefully selected. The Government of Ghana through NEDCo and the TMA will be responsible for the RoW acquisition as well as compensation, when required.

Preparation of Preliminary Environmental Assessment Report (PER)

An environmental assessment report, as required by law i.e. Environmental Assessment Regulations, 1999 (LI 1652), will be prepared to obtain environmental approval for the execution of the project. In this case, a Preliminary Environmental Report (PER) is required.

Sourcing of Materials

Materials and equipment produced locally for construction of electrical networks would be sourced locally, legally and documented. Cement, sand, concrete aggregate, concrete roadblocks, brick, rebar, wood, gasoline, diesel, construction vehicles, cranes, trailers and other temporary work equipment/materials will be sourced be from permitted producers and copies of permits will be obtained before procurement. Materials and equipment not available locally would be sourced abroad.

Mobilisation of construction staff

Construction activities will employ approximately one hundred (100) workers. It is expected that majority of the workforce at this phase of the project implementation will be mobilized from the project beneficiary communities.

3.2.2 Construction Phase Activities

The construction phase will last over a period of eighteen (18) months starting from September 2024. Activities will include among others:

- Building and civil works for substation
- Line clearance
- Excavation and trenching
- Erection of poles
- Stringing of conductors and installation of hardware

Building and civil works for substation

A one-story concrete control building is planned (floor area of about 430m²) for the operation and protection of the substation equipment from external effects. Construction activities will be mainly excavation, civil works for the control room, support structure, steel gantry etc. and installation of the substation equipment. On the exterior, a fence wall and drains will be constructed to manage stormwater.

Power Line Clearance

The line clearance will be guided by approved survey drawings. The clearance shall be done up to a distance of 5m on either side of the centre line with branches of tall trees (>3m) close to the line trimmed.

Excavation and trenching

Pits/holes for planting poles will be excavated manually to the required depth of 1.5 – 2.0m except for rocky areas where a compressor will be used for excavation.

Erection of Poles

The steel poles will be dressed with the necessary hardware and planted into the hole manually. The number of persons that will carry the pole during planting will be determined by a safe load assessment. Poles will be fitted properly and aligned with steel wire stays supported by stay blocks used to ensure firmness of poles. For marshy areas, poles will be specially rammed and if necessary foundations reinforced with appropriate sizes of boulders.

Stringing of Conductors and Installation of Pole-top Hardware

Stringing of the AAAC conductors will be done by tensioning with the help of a winch and a bullwheel tensioner. The conductor reel attached to the bullwheel tensioner will be pulled through the stringing sheaves until the end reaches the winch. The tension maintained between the bullwheel tensioner and the winch keeps the conductor clear of the ground and other obstructions that could cause damage.

Galvanized steel wires will be used for the stay assembly. Transformers and other LV structures will be earthed and appropriate protective equipment, such as Surge Diverters and Drop-Out Fuse Gear will be installed on the power lines.

3.2.3 Operation/Power Supply Phase Activities

Operation phase activities include among others:

- RoW vegetation cover management; and
- Maintenance of substation, sub-transmission and distribution lines.

Management of Vegetation Cover on RoW

Trees and crops exceeding a height of 3m within the RoW will be cleared. Also, branches will be trimmed for trees located beyond the 5m RoW but close to the lines. The minimum vertical conductors to ground clearances to be maintained will be based on the minimum clearance generally applied for overhead distribution lines by NEDCo.

Maintenance of Substation, Sub-transmission and Distribution Lines

Proper Operation and Maintenance (O&M) for the transmission, distribution and substation facilities, as well as preservation of their surrounding environments, are essential to improving consumer trust in power supply in the project area and steady power supply management. As such, appropriate preventative maintenance is recommended to reduce the rate of facility accidents and improve trust, safety and efficiency levels. The basic concepts for transmission, distribution and substation facility maintenance are shown in Figure 3-2. Prevention must be the focus for maintenance of equipment and facilities procured, installed and built for the Project.

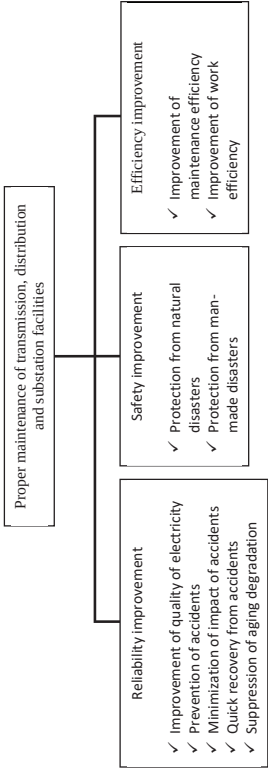


Figure 3- 3: Basic Concepts for Transmission, Distribution and Substation Facility Maintenance

Routine Inspection for Substation Facilities and Periodic Inspection Items

The standard regular inspections for the substation facilities are classified as follows;

- 1) Daily inspections, which involve a sensory check to detect abnormal heat, sounds and smells from the equipment,
- 2) Regular inspections, which check equipment for loose bolts, surface dirt or damage on insulation and other energized parts, not checked on daily inspections, and
- 3) Detailed inspections, which include functional checks of interlock mechanisms between devices, and precision maintenance of instrumentation.

In general, regular inspections are conducted once every one to two years, and detailed inspections are conducted once every four years. Internal fuses, metering, relays and other components with deteriorating performance, reduced insulation, contact wear or characteristic changes in Switchgear, Mimic control panels and other panels, should be replaced as appropriate on regular and detailed inspections upon confirming component qualities and frequency of use.

Table 3- 4: Inspection Items for Substation Facility Equipment

Inspection Items	Details of Inspection (Method)	Daily	Regular	Detailed
Visual Inspection	Condition of Switches, Indicators and Display lamps	o	o	
	Abnormal noise and/or smells	o	o	
	Overheat and discoloration of terminals		o	
	Cracks, damage or stain of bushings and porcelain	o	o	
	Rust on transformers tanks, panels, supporting structures, etc.	o	o	
	Temperature of transformer oil and windings (by OTI & WTI)	o	o	
	Oil level of transformers			
	Silica gel color on Dehydrating breathers on transformers			
	Tightening condition of terminals (mechanically)		o	
	Display condition on measuring instruments	o	o	o
	Indication on operation counters (LA)		o	o
	Wetness, rust or stain in switchgear and panels		o	o
	Refilling oil, cleaning	o	o	o
	Clamping of distributing terminals	o	o	o
	Confirmation of switching display status		o	o
Switchgear, Mimic control panels and other panels	Air or oil leaks		o	o
	Confirmation of pressures (air, etc.) before/after operation		o	o
	Confirmation of number of operation (Circuit breakers)	o	o	o
	Rust, deformation and/or damage on springs	o	o	o
	Abnormalities of tightening pins, if any		o	o
	Inspection and maintenance of auxiliary switches and relays		o	o
	Inspection of DC/AC control power source	o		
	Measurement of insulating resistance		o	o
	Measurement of contact resistance			o
	Condition of heater wires		o	o
Measureme nt and Test	Operation test of relays		o	o

Source: JICA Survey Team

Routine Inspection and Periodical Inspection for Sub-transmission and Distribution Lines

The maintenance and management of the 34.5 kV sub-transmission and 11.5 kV distribution lines is the most important service to be provided to customers. In addition, when ground fault accidents due to contact with trees on sub-transmission and distribution lines are expected, it is necessary to take preventive measures such as cutting down trees in advance. The following are the main items to be inspected during daily patrols.

Table 3- 5: Inspection Items for Sub-transmission and Distribution Lines

Equipment		Inspection Items
Support	Concrete pole	No cracks, breaks, bends, or tilts
	Guy wire	No corrosion, breakage, looseness
Crossarm		No curvature, inclination, rusting, or corrosion
Insulator		No cracks, damage, or staining
		Bindings not detached or broken
Electric wire		Whether or not the conductor is damaged
		Proximity between dissimilar wires, arms, etc.
Disconnecting Switch		Disconnection of lead wire
		Contact with trees, etc.
Cable		No rusting or corrosion of the case
		Whether the bushing is cracked, damaged, or stained
	Cable Pipeline	Whether the cable exterior is damaged or deteriorated
Manhole		Whether the protection pipe is damaged, deformed, rusted, or corroded
		Disconnect the cap of the rising protection pipe.
	Cable Head	Discoloration or deformation of terminal cover due to heating
Manhole		Deterioration or damage to triggers
		Damage or staining of bushings
		Check for shifting or rattling of the iron cover
Manhole		Presence of cracks or damage to the iron cover
		Whether there is a gap between the cover and the road surface

Source: JICA Survey Team

3.3 Expected outcome

The project would offer many benefits to the residents of Tamale through the enhancement of power supply to the Tamale Central Hospital, Tamale city, and surroundings. The hospital, which currently delivers health care to about 300–500 people per day in Tamale, would be guaranteed an improved power supply.

Increased reliability: There will be increased reliability of the electricity supply as the construction of the substation will introduce an acceptable degree of redundancy in the network. The new substation will receive its power supply from the GRIDCo BSP at Choggu. It will relieve a great deal of load from the current power transformers at the first Tamale Bulk Supply Point (BSP).

Increased installed capacity: There will be adequate capacity in the Tamale metropolis to take care of additional load growth. The underground cable currently supplying power to the TCH is a 95mm² copper cable that was installed about 30 years ago. This cable has run out of capacity and is unable to meet the

demand of the hospital and its environs. The cable will be upgraded under the project to enhance its capacity.

Improved voltage quality: The voltage profile in the Tamale metropolis will be improved as a result of the shortening of the 11kV distribution line lengths.

Increased revenue: The above-mentioned benefits will ultimately result in an increase in revenue as it will increase the amount of energy delivered to customers.

3.5 Analysis of Alternatives

Options for Consideration of sub-transmission and distribution lines

The proposed project considered some feasible options in respect of their potential environmental and social impacts. These are analysed in Table 3-6 and include:

- Pole type/tower options;
- Line stringing options; and
- No option.

Table 3- 6: Analysis of Alternative Project Options of sub-transmission and distribution lines

Option/ Method of Deployment	Potential Environmental, Social, Technological and Economic Implications		Preferred Option
Pole type option			
1. Wooden Pole	Advantages 1. Work well for bending; 2. Cost of poles and installation is lower, 3. Allow joint suspension of lines and streetlights; and 4. Have a much higher level of isolation due to the absence of leakage currents.	Disadvantages 1. Low strength; 2. Susceptible to fire 3. Low life span if not adequately treated (average life of wood pole is 25 years while that of steel poles ranges from 35-50 years); 4. Difficulty to source 10m and 11m locally due to government regulations to conserve nature in certain jurisdictions; and 5. Engineering challenges as wood is a natural product unlike steel which could be produced to meet certain technical specification. 6. Poor fire resistance.	Option 2, Steel pole is the preferred option for the project as the advantages of steel pole outweigh the wooden pole and steel tower.
2. Steel Pole	Advantages 1. Lighter than wood 2. Less bulky and easier and faster to transport 3. Can be pre-drilled to specifications for all the holes needed, making site installation quicker;	Disadvantages 1. Initial Capital Cost, as well as maintenance cost of a steel structure is high 2. Steel cannot not be moulded in any direction you want; and	

Option/ Method of Deployment	Potential Environmental, Social, Technological and Economic Implications		Preferred Option
	4. Fire-resistant and 5. Reliability and consistency of material compared to wooden poles.	3. The chances of brittle fractures increase if steel poles lose ductility.	
3. Steel Tower	Advantages 1. It is a four-legged type of steel tower that can be assembled from below almost entirely by hand, requiring no special equipment or heavy machinery. 2. Fire-resistant	Disadvantages 1. Costs are incurred for the tower foundation and the tower itself, resulting in higher maintenance costs. 2. The area of the steel tower foundation is large, and it is not easy to acquire land for the foundation construction area.	
Line stringing option			
1. Overhead system	Advantages 1. Components can be easily shifted to meet changes in load conditions 2. Makes for easy fault location, maintenance and repairs 3. Overhead distribution conductor has a considerably higher current carrying capacity 4. It is relatively less expensive 5. Distribution conductor has a considerably higher current carrying capacity	Disadvantages 1. Poses a higher public safety risk because of exposed distribution wiring 2. Faults are frequent as cables are open to harsh conditions 3. Visual intrusion effects are higher as distribution network is visible 4. Overhead system may have a lower useful life (about 25 years) 5. Trees will need to be cut down in areas with trees.	Option 3, the hybrid system, is the preferred choice because it combines the advantages of both overhead and underground systems.
2. Underground system	Advantages 1. Minimizes system high winds, hailstorms and falling trees 2. Aesthetically appealing as electric wires are buried 3. Low EMF, no corona discharge, no bush fire problems with 4. Minimal lightning problems and a high level of personnel and public safety	Disadvantages 1. Prone to damage from flood, rodents and human vandalism 2. More expensive due to the high cost of trenching, conduits, cables, manholes and other special equipment 3. System not flexible as manholes, duct lines etc., are permanently placed once	

Option/ Method of Deployment	Potential Environmental, Social, Technological and Economic Implications		Preferred Option
	5. General appearance of system is better as all the distribution lines are invisible 6. Root cutting is anticipated in some areas, but tree cutting is not required	installed and the load expansion can only be met by laying new lines 4. Fault location and maintenance is difficult	
3. Hybrid system (underground + overhead)	1. Provides the option of choosing between the underground or overhead system where necessary for operational efficiency.	1. Expertise is required for both overhead and underground systems.	
Project Implementation Option			
No project	Advantages	Disadvantages	Option 2 is preferable
	1. Funds for the project implementation could be used for solving other development problems, albeit less dire 2. No tree cutting, no impact on the landscape, no impact on residents due to construction	1. Non implementation of the project will continue to deprive most communities and institutions of access to reliable electricity and disrupt GoG target of 100% electricity access for all 2. Government's drive to industrialize the economy will be slowed	
Project implementation	Advantages	Disadvantages	
	1. Increased reliability of the electricity supply 2. Adequate installed capacity 3. Improved voltage quality 4. Increased revenue for service provider 5. Enhanced socio-economic activities in beneficiary communities	1. Initial investment could be deterrent	

Wooden poles are inferior to utility poles in terms of durability and strength, and steel towers require more space for their foundations, which may have an impact on the social environment in terms of acquisition of land and resettlement of residents, as well as increase costs for the foundations and steel tower itself. On the other hand, poles are easier to install on site, more durable, and less expensive than steel towers, and therefore steel towers will be used in this project.

For underground cables, the effects of high winds and necessary tree cutting will be minimized. In addition, even if there is an existing overhead line, the cable can be laid along the same route as the overhead line by burying the cable underground. It is also possible to combine poles and underground cables, with some sections using overhead and some sections using underground cables. This allows the introduction of underground cables in sections where existing overhead lines exist or where consideration must be given to the natural environment, such as sections with many trees, and the introduction of overhead lines using utility poles in other sections, thereby reducing the impact on both the social and natural environment.

Overhead lines are easy to maintain and repair, but there are concerns about increased risk of failure and tree cutting. Underground cables have less impact on the landscape, and even when there are existing overhead lines, the cables can be laid along the same route as the overhead lines by being buried underground. On the other hand, the need for excavation increases the impact on facilities and residents in the affected area, and the cost tends to be higher than for overhead lines.

It is also possible to combine poles and underground cables, with some sections using poles and some sections using underground cables. This makes it possible to reduce the impact on both the social and natural environment by using underground cables in sections where there are existing overhead lines or where consideration must be given to the natural environment, such as sections with many trees, and by introducing overhead lines using utility poles in other sections.

The proposal not to implement the project subject to cooperation will have no impact on the social and natural environment, such as construction impact on residents and tree cutting. On the other hand, the power transmission and distribution facilities that will support the power supply in Tamale will not be renovated, and a stable power supply is not expected in the future.

Options for Consideration of RCC primary substation

Some feasible options were considered in respect of their impacts.

The following four options were considered for the design of the RCC primary substation.

- Option A: Case with outdoor Air insulated switchgear (AIS) with no building (proposed by the survey team)
- Option B: Outdoor AIS with a control building (control and operation at the control room in the building)
- Option C: Indoor Gas insulated switchgear (GIS) with a control building (Ditto)
- Option D: Indoor AIS with a control building (Ditto)

These are analysed in **Table 3-7**.

Table 3- 7: Analysis of Alternative Project Options of RCC primary substation

Comparison items	Option A		Option B		Option C		Option D		Remarks
	Outdoor AIS (No building)	Outdoor AIS (with building)	Outdoor AIS (No building)	Outdoor AIS (with building)	Indoor GIS (with building)	Indoor GIS (with building)	Indoor AIS (with building)	Indoor AIS (with building)	
1 NEDCo's request	-		✓		✓		✓		
2 Mode of Operation	unmanned	manned	✓	manned	✓	manned	✓	manned	
3 Existing substation type	There is no Outdoor AIS in NEDCo system.				Indoor GIS in Tamale BSP Substation		Indoor AIS in UDS Primary Substation		UDS primary substation was constructed under previous Japanese grant aid project.
4 Relay panel (Relays shall be installed indoor due to electronic equipment)	Option A does not comply with NEDCo's requirement due to no building.	Necessary Relay panels shall be installed inside the building due to outdoor switchgear			Not Necessary		The relays can be installed on the indoor switchgear.		The relay panels shall be of 11 panels (as same as control panels) to avoid misunderstanding of operators.
5 Cost of Switchgear	To reduce the risk, such as high temperature, high humidity etc., it is necessary for outdoor AIS to consider the steel plate material, additional protective structure, special coating, etc. Thus, The cost of outdoor AIS would be almost same as indoor GIS.				Most expensive		Least expensive		
6 Maintain-ability									
6-1 Periodic inspection (Visual inspection)	Once a year	Preventive maintenance can be done through periodic inspections (patrols, etc.).			Once every 3 years		Once a year		Basically, gas filling section is maintenance free.
6-2 Detailed inspection	Once every 3 years				once every 6 years		Once every 3 years		Visual inspection (Building maintenance required)
6-3 Switchgear cubicles (Painting)	Once every 10 years						Same as left		
7 Building area	-		Approx. 202.5 m ²		Approx. 287.5 m ²		Approx. 453.6 m ²		

Comparison items	Option A		Option B		Option C		Option D		Remarks
	Outdoor AIS (No building)	Outdoor AIS (with building)	Outdoor AIS (No building)	Outdoor AIS (with building)	Indoor GIS (with building)	Indoor GIS (with building)	Indoor AIS (with building)	Indoor AIS (with building)	
8 Building and civil cost including equipment foundation		Although the building area is the smallest among options, there are many cable trenches and outdoor equipment foundations.			The size of building is smaller than option D due to Indoor GIS.	The size of the building is the largest among the options due to Indoor AIS.			
9 Emergency repair in case of failure		Maintenance and emergency restoration/repair can be done by the user if there are spare parts for regular use. (provided that on-the-job training is required.)			In many cases, the complete panel has to be replaced when the failure occurs. Thus, there is a risk of longer outage than other options.	Same as Option A & B			
10 Environmental Impact	No building, so the possibility of leaching of hazardous substances due to rainfall is increased.	No significant impact			No significant impact	No significant impact			
Evaluation	Bad	Not good	good	Very good					

Option A (outdoor AIS with no building)

- Cost reduction can be achieved by not constructing a building (control building).
- There is no unmanned substation in NEDCo system and does not conform to NEDCo's management system, which applies a manned management system.

Option B (outdoor AIS with a control building)

- There is no unmanned substation in NEDCo system
 - The control/operation system can be done at the control room in the building and meets NEDCo's requirements.
 - Substation monitoring/control panels are required, and from the viewpoint of preventing incorrect operation, it is recommended that the panel should be configured with maximum two feeders per one panel (monitoring and operation units for two feeders are placed on one panel), and at least 11 panels are required.
- Relay units, which are electronic devices, shall be installed indoors, and from the standpoint of preventing accidental misunderstandings, it is also recommended that they be configured with maximum two feeders per one panel, as same as philosophy of the control panels.

- d. Since AIS type allows the cubicle to be open in air, in the event of a failure, the user can replace it if he or she has spare parts. (provided that a certain amount of on-the-job training is required)

Option C (Indoor GIS with a control building)

- a. NEDCo has experience with existing substation facilities. (In Tamale BSP substation, original indoor AIS was replaced with indoor GIS in 2014, and is currently in operation.)
- b. The control/operation of the equipment can be done at the control room in the building and meets NEDCo's requirements.
- c. 11 panels of Substation monitoring/control panels are required, as same as Option B. On the other hand, relays can be installed on GIS cubicles, so that 11 panels of relay panel are not necessary.
- d. If a failure occurs in the gas filling section, which is sealed because it is gas-insulated, it is often necessary to be replaced with the complete panel. If a manufacturer's supervisor is required to be replaced with the cubicles, there is a risk of a longer power outage.

Option D (Indoor AIS with a control building)

- a. UDS primary substation constructed under previous Japanese grant aid project is of this type and is currently in operation without any problems.
- b. The control/operation system can be done at the control room in the building and meets NEDCo's requirements.
- c. As well as Option B & C, substation monitoring/control panels are required, while the relays can be installed on AIS cubicles (Relay panels are not required).
- d. As well as Option B, the switchgear cubicles can be opened in air because it is air-insulated, and in the event of a failure, the user can replace the switchgear if he or she has spare parts.

Validation

Option A, AIS type, does not have a building, which reduces the initial cost, but it does not meet NEDCo's requirements because "all existing substation facilities are manned management systems with buildings" and "the buildings are different from NEDCo's requirements.

Regarding Option B, NEDCo has no experience with outdoor AIS, and although it has a building, the switchgear is an outdoor type, which requires additional relay panels in the building with more space in the control room. Thus, it is reasonable to adopt Option C or D.

For Option C, which uses GIS with the most compact switchgear, the building area can be made smaller than option D, and NEDCo already has experience, operating GIS at Tamale BSP substation as of today. On the other hand, however, taking into account the location of the installation in Africa in the event of a major accident such as a gas leakage, it is expected that the outage time, including the arrival time of the manufacturer's supervisor, would be prolonged. While in the case of AIS, if replacement parts are owned, they can be restored with their replacement, which is more advantageous than in the case of GIS.

From the above consideration, it is concluded that although the building area will be larger, it is preferable to select Option D, which employs an AIS that can be expected to be restored quickly in the event of an accident or other incident. Accordingly, the plan is to proceed with construction under Option D.

4.0 BASELINE INFORMATION

4.1 Introduction

This section describes the existing physical, socio-economic and cultural conditions pertaining to the project site as well as the area of influence. The project falls within the Tamale Metropolitan Area. The data and information presented here highlights baseline parameters to be assessed to determine the capacity of the site to accommodate any environmental stresses, risks and hazards resulting from the proposed project and for which mitigation measures should be provided.

4.2 Project Location

4.2.1 Direct influence area of the project: Tamale Metro District

The Tamale Metropolitan Assembly, is one of the country's six Metropolitan Assemblies and the only Metropolis in the five regions of the north, namely the Upper East, Upper West, Northern, North East, and Savannah. Tamale is both the metropolitan and regional capital of the Northern Region. It is located in the central part of the Region and is bounded to the north-west by Sagnarigu Municipality, to the east by Milon District, to the south by East Gonja, and to the south-west by Central Gonja. The Metropolis has a total estimated land size of 454 km² and located between latitudes 9°16 and 9° 34 North and longitudes 0° 36 and 0° 57 West (**Figure 4-1**).

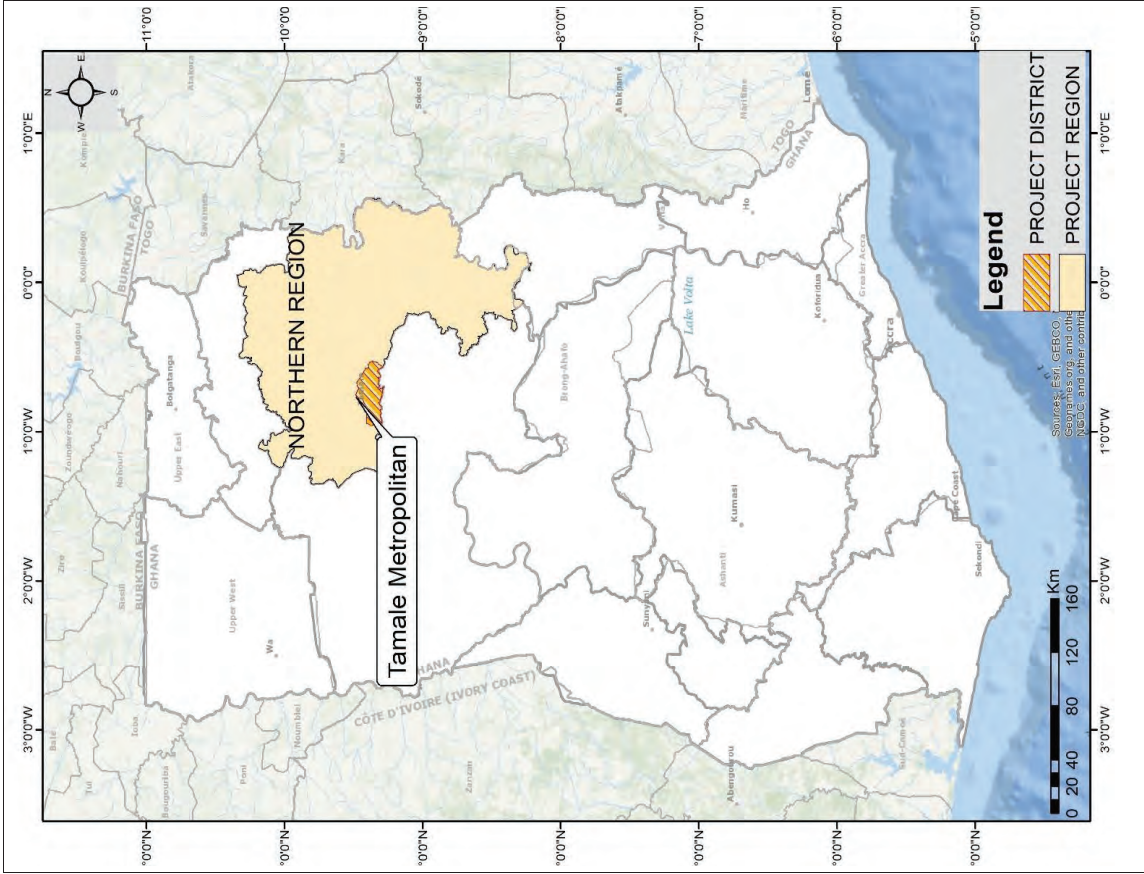


Figure 4. 1: Map of Ghana showing the Tamale Metropolitan Assembly

4.3 Physical Environment

4.3.1 Climate

The area is characterized by two main seasons, the dry and the raining seasons with an annual average rainfall of 1,200mm. The dry season starts from late October to early May followed by the raining season from late May to early October. The dry season is noted for hunting and burning of bushes for game with some fire disasters occurring during this period. Also, dry harmattan winds from the Sahara Desert are experienced during the months of November to February. The coldest nights in the year are experienced in the months of December, January and February, while the hottest nights are experienced in the months of March, April and May. Farming activities noted for this period are harvesting of rice, cassava, yam, drying of foodstuffs, preparation of farmlands and raising of yam mounds.

The rainy season is characterized by inaccessibility of some parts of the Metropolis due to bad roads. This period, June to early August, is also associated with lean or food shortage. Cultivation and sowing are also done during this period.

4.3.2 Topography and Drainage

The area is generally flat with gentle undulating low relief and altitude ranging from 400 to 800 meters above sea level. The area has relatively few seasonal water bodies that dry up in the dry season. The only natural water systems are a few seasonal streams which have water during the rainy season and dry up during the dry season. All these streams have their headwaters from Tamale which is situated on a higher ground.

Also, some artificial dams and dugouts have been constructed either by communities or Non-Governmental Organizations in the Metropolis to serve as water sources for animals as well as for domestic purposes. Two of such dams are the Datoiyili and water works dams. Despite this poor drainage situation, the Metropolis still has the potential for irrigation schemes. For instance, the Pagazaa stream has a potential that could serve as irrigation for agricultural purposes.

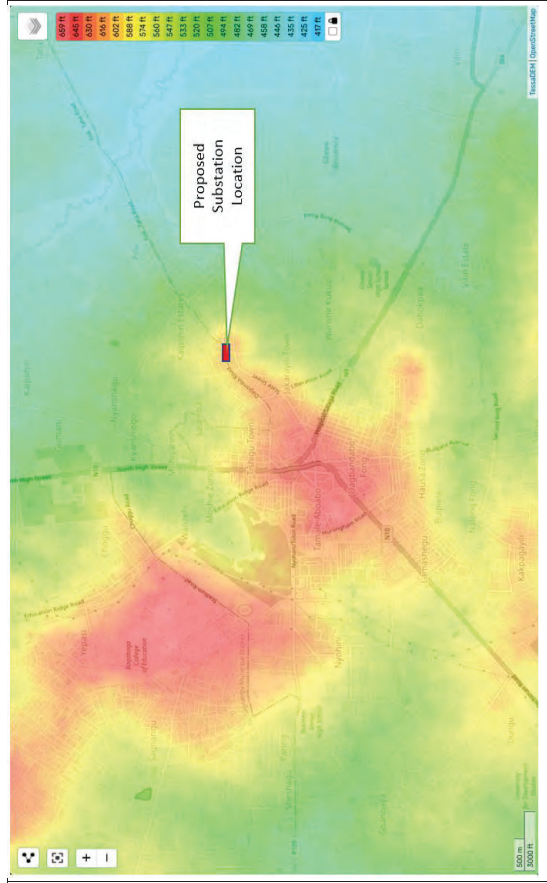


Figure 4-2: Topographic Map of Tamsale
Source: Topographic.maps.com

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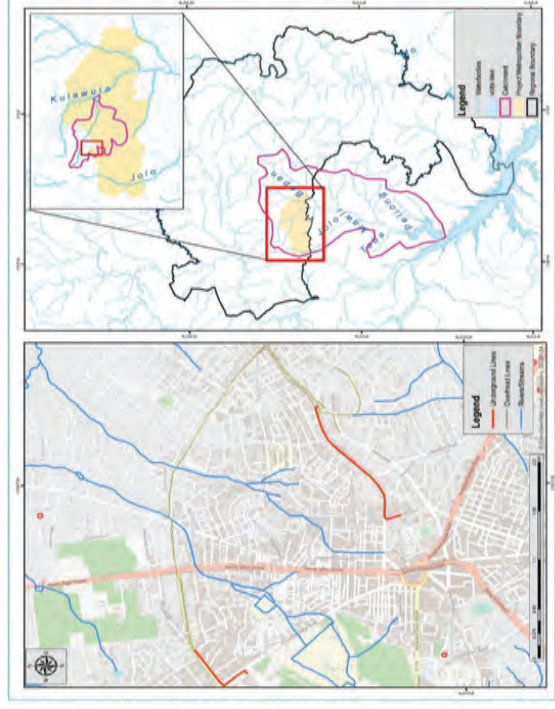
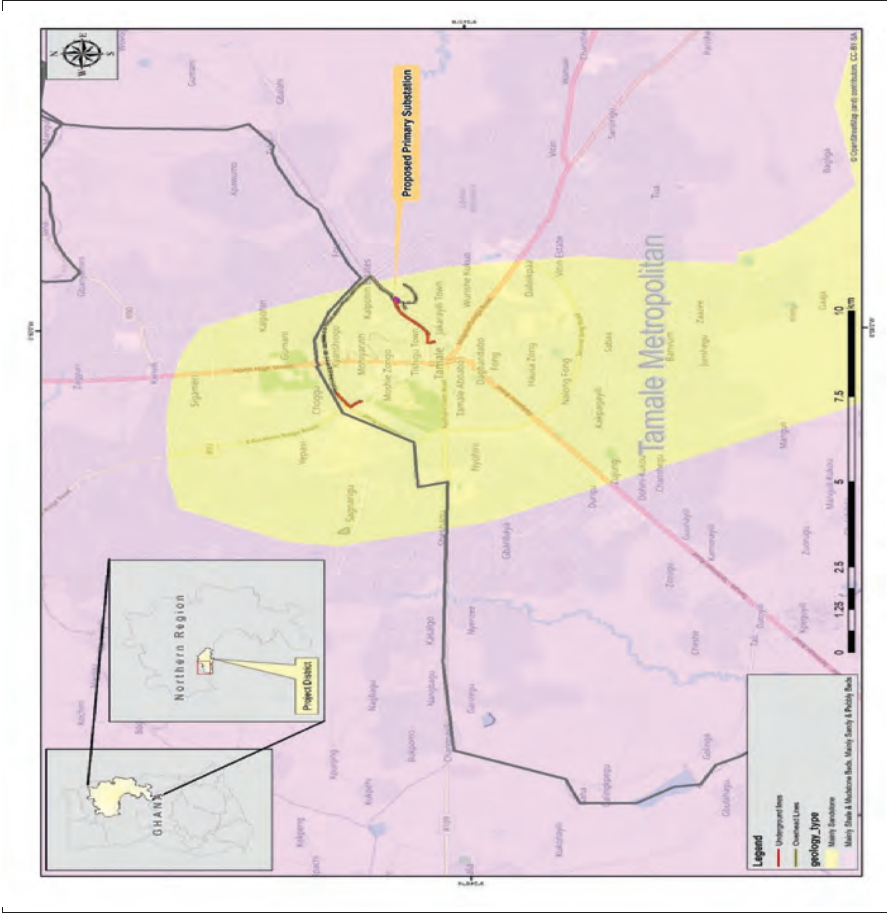


Figure 4-3: Drainage Map of Tamsale
Source: SAL Consult, 2023

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4.3.3 Geology and Soils

The Metropolis has sandstone, gravel, mudstone and shale weathered into different soil grades as its major soil types. Owing to seasonal erosion, soil types resulting from this phenomenon are sand, clay, and laterite ochrosols the availability of the various soil types has aided rapid real estate development such as river sand, gravel, and clay being used by developers especially in urban areas. In the rural parts, the soil type is sandy loam and it is suitable for growing crops such as millet, maize, guinea corn, groundnuts, yam, and beans.



Source: SAL Consult, 2023
Figure 4- 4: Geological Map of Tamale

4.3.4 Ambient Air Quality

As part of the primary data collection, ambient air quality was measured at a total of four (4) locations as shown in Figure 4-5 below. The data gathered provides useful information to help the project monitor its operational impacts on the environment, health and safety of its employees and surrounding neighbors.

These selection of monitoring sites was based mainly on proximity to project site and proposed project activities including the laying of underground cables.

The selected sites include:

- The Project site (new substation site)
- St Paul's Primary and JSS School, within the project corridor
- Gumbhini Community, within the project corridor, and
- Tamale Central Hospital (project site)

SAL Consult Ltd

YEC



Figure 4- 5: Location Map showing Project Sampling locations

Methodology

The Concentrations of Particulate matter (2.5 and 10) were sampled using the ARA N-FRM Air Sampler and Aeroqual's Portable Air Quality Monitor 500 (A-S500).

The ARA N-FRM Sampler is a portable, battery-powered particulate sampler that establishes a new class of air sampler called "Near FRM". It delivers Federal Reference Method (FRM) level of performance and integrates many additional functions for unmatched versatility. The compact-sized sampler collects PM₁₀, or PM_{2.5} filter samples and can simultaneously measure local meteorological parameters. The ARA N-FRM air sampler is equipped with an RTP profiler, which uses a Plantower light-scattering sensor to provide real-time data for two size ranges approximating PM₁₀ and PM_{2.5}. It shows trends during the sample run.

The ambient concentrations were recorded for every minute, for a 24-hr period from which hourly concentrations were calculated and mean concentrations determined. The particulate matter concentrations logged by the instrument were automatically saved in high-capacity internal flash memory built in the instrument. The results of the measurement were then transferred to a computer via a pen drive, where it was managed and reports created.

Photos of ARA NFRM equipment mounted at the selected locations for Particulate matter monitoring is shown as **Plate 4-1 to Plate 4-4** below.



Plate 4- 1: Particulate Matter monitoring at Gumbihini community



Plate 4- 2: Particulate Matter monitoring at St. Paul's Primary and JSS school



Plate 4- 3: Particulate Matter monitoring at new Substation



Plate 4- 4: Particulate Matter monitoring at Tamale Central Hospital

Photos of Aeroqual Series 500(A-S500) Gas Meter being used at the selected locations for CO, NO₂, and SO₂ monitoring is shown as **Plate 4- 5 and Plate 4-6** below.

At each selected location, measurements of CO, NO₂, and SO₂ levels were recorded for every 2-hrs over a period of 24hrs. These recorded measurements were then used to calculate concentrations and determine the average concentrations.



Plate 4- 5: NO_x, SO₂ and CO monitoring at the Tamale Central Hospital (left) and St. Paul's Primary and JHS (right)



Plate 4- 6: NO_x, SO₂ and CO monitoring at Gumbihini Community (left) and Tamale Central Hospital (right)

Results of Air Quality Monitoring

Particulate Matter (PM_{2.5}, PM₁₀)

The Particulate Matter (PM_{2.5}) concentrations recorded were are given in the Table – below. These fell within the Ghana Standard (GS 1239:2019) permissible values of 35 µg/m³ for PM_{2.5}. Likewise, for the Particulate Matter (PM₁₀) concentrations which were also within the Ghana Standard (GS 1239:2019) permissible values of 70 µg/m³ for PM₁₀.

Gases (NO_x, SO₂, CO)

Apart from the CO concentration of 200 µg/m³ recorded at the proposed Substation area, all the others fell within the Ghana Standards Authority (GSA) Standard values. The high concentration at this area may be attributed to the heavy traffic observed during the monitoring period.

Table 4- 1: Concentrations of Particulate matter at the various sampling sites

Location		Sample ID	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)
Project Site	New Substation	AQNS	3.639	16.014
Nearest Sensitive Receptors	St. Paul's Primary and JHS	AQSP	9.250	22.986
	Gumbihini community	AQGC	14.487	27.605
	Tamale Central Hospital	AQTH	6.069	18.347
Ghana Standards (GS 1236:2019) value for 24-hour ambient air quality for PM ₁₀ and PM _{2.5}			35	70
Sampling dates: 18 th to 21 st March, 2023				

* Values highlighted in green fall within both GSA and WHO requirements for Ambient Air Quality.

Table 4- 2: NO_x, SO₂ and CO Results Measured at selected sites

Location		NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (µg/m ³)
Project Site	New Substation	51.0	0	200
Nearest Sensitive Receptors	St. Paul's Primary and JHS	39.0	0	0
	Gumbihini community	31.0	0	0
	Tamale Central Hospital	36.0	0	100
Ghana Standards (GS 1236:2019) value for ambient air quality for Nitrogen Oxides (measured as NO2), Sulphur Dioxide (SO2) and Carbon Mono oxide (CO).		150	150	100
Sampling dates: 18 th to 21 st March, 2023				

* Values highlighted in red exceed the GSA requirements for ambient air quality, while values in green fall within the GSA requirements.

4.3.5 Ambient Noise levels

The data gathered will provide useful information to help the project monitor its operational impacts on the environment, health and safety of its employees and surrounding neighbors.

Noise Assessment was conducted at selected locations based on their proximity to the proposed new substation and proposed underground cables and stringing activities as shown in Figure 3-1 and coincided with the same locations carried out for air quality, namely:

- The Project site (new substation site)
- St Paul's Primary and JSS School, within the project corridor
- Gumbihini Community, within the project corridor, and
- Tamale Central Hospital (project site)

Methodology

According to IFC, noise monitoring is carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility. Noise monitoring should be carried out over a minimum period of 24-48 hours using a Type 1 or 2 sound level meter meeting International Electrotechnical Commission (IEC) 61672 standard¹.

Noise measurements/recordings were taken with a High Precision TSI Quest Sound Level Meter, Model Type 1. The sound level meter has an in-built calibrator, and was calibrated before each measurement/recording was taken. The noise meter was calibrated at 114 dB (A) prior to the measurement.

The following statistical indices were computed:

- L_{max} or maximum sound level, descriptor is the highest sound level measured during a single noise event (such as a vehicle pass by), in which the sound level changes value as time goes on. The maximum sound level is important in judging the interference caused by a noise event with common activities. L_{max} ignores the number and duration of these events, and cannot be totaled into a one-hour or a 24-hour cumulative measure of impact.
- L_{min} is the lowest time-weighted sound level measured by the meter over a given period of time.
- L_{eq} is the equivalent continuous sound level and represents sound exposure over an elapsed period of time.
- L_{10} is the level exceeded for 10% of the time. For 10% of the time, the sound or noise has a sound pressure level above L_{10} . For the rest of the time, the sound or noise has a sound pressure level at or below L_{10} . These higher sound pressure levels are probably due to sporadic or intermittent events.
- L_{50} is the level exceeded for 50% of the time. It is statistically the mid-point of the noise readings. It represents the median of the fluctuating noise levels.
- L_{90} is the level exceeded for 90% of the time. For 90% of the time, the noise level is above this level. It is generally considered to be representing the background or ambient level of a noise environment.

Photos of Noise meter mounted at the selected locations for noise monitoring is provided in **Plates 4-6 to Plate 4-11** below.

¹ IEC 61672 Electroacoustics - Sound level meters

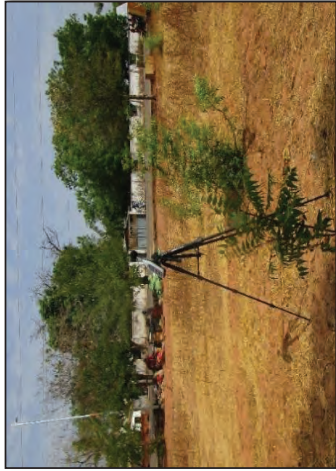


Plate 4- 7: Daytime Noise monitoring at New Substation



Plate 4- 8: Daytime Noise monitoring at St. Paul's Primary and JHS



Plate 4- 9: Daytime Noise monitoring at Gumbihini Community



Plate 4- 10: Daytime Noise monitoring at Tamale Central Hospital

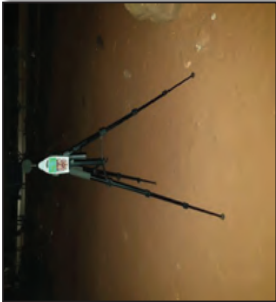


Plate 4- 11: Night time Noise monitoring at New Substation (left) and St. Paul's Primary and JHS (right)

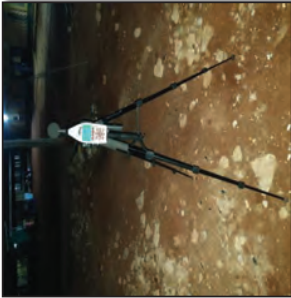
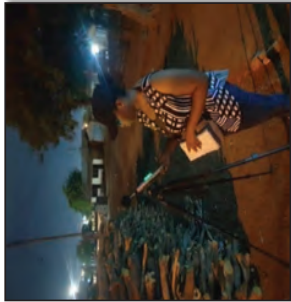


Plate 4- 12: Night time Noise Monitoring at Gumbihini Community (left) and Tamale Central Hospital (right)

Results of Noise Monitoring

The ambient noise levels (L_{eq} values) recorded was compared to the Ghana Standard (GS 1222:2018) zone B (Educational (School) and health (hospital, clinic) facilities, office and law courts) daytime and nighttime standards of 55 and 50 dBA respectively.

Daytime noise levels recorded as L_{eq} were all above the standard of 55dBA, Table 4-3 below. The sources of high daytime noise levels at the proposed new substation and Gumbihini community could be attributed to traffic and the call to prayer from speaker phones used by mosques within the community. At St. Paul's Primary and JHS, the main source of noise was from children shouting whilst playing within the school premises.

Night time noise levels were all below above the GSA standards of 50dBA. The observed sources of night time noise were from the rustling of leaves and loud constant chirping from crickets.

Table 4- 3: Day Ambient Noise levels (dBA) recorded at the various locations

Location	SAMPLE CODE	L_{eq}	L_{10}	L_{50}	L_{90}	L_{max}
Project Site	New Substation	NANS	57.7	60.0	55.7	51.7
Nearest Sensitive Receptors	St. Paul's Primary and JHS	NASP	69.0	72.0	65.8	61.3
	Gumbihini Community	NAGC	59.5	61.5	55.0	49.8
	Tamale Central Hospital	NATCH	57.4	59.2	55.9	53.2
Ghana Standards for Ambient Noise Control (GS 1222:2018), Zone B (Educational (School) and health (hospital, clinic) facilities, office and law courts)						
Daytime is from 06:00-22:00 GMT						
Sampling dates: 18 th to 21 st March, 2023						

*Values highlighted in red exceed both the GSA requirements for daytime ambient noise levels.

Table 4- 4: Nighttime Ambient Noise levels (dBA) recorded at the various locations

Location	SAMPLE CODE	L_{eq}	L_{10}	L_{50}	L_{90}	L_{max}
Project Site	New Substation	NANS	47.3	60.5	55.1	48.4
Nearest Sensitive Receptors	St. Paul's Primary and JHS	NASP	46.9	59.7	53.6	48.0
	Gumbihini Community	NAGC	47.8	59.6	54.3	49.7
	Tamale Central Hospital	NATCH	44.9	57.5	52.8	49.1
Ghana Standards for Ambient Noise Control (GS 1222:2018), Zone B (Educational (School) and health (hospital, clinic) facilities, office and law courts)						
Night time is from 22:00-06:00 GMT						
Sampling dates: 18 th to 21 st March, 2023						

*Values highlighted in red exceed the GSA requirements and values highlighted green are within the GSA requirements for daytime ambient noise levels.

4.4 Biological Environment
4.4.1 Vegetation

The Metropolis lies within the Savannah Woodland Region of the country. The natural vegetation is predominantly typical Guinea Savannah woodland with widely spaced trees up to about 9m tall and shrubs, and an under growth of coarse tussock grasses and herbs that ensure that the soil is fairly well covered. There are however, patches where the soil is much shallower and lateritic, where the vegetation is much more open with smaller trees and shrubs.

Common tree species include various species of Acacia, Afzelia africana, Afrosia laxiflora, Anogeisus leucarpus, Vatelaria paradoxa, Khaya senegalensis, Detarium species and Pterocarpus ernaceous. Along the banks of streams and in low lying seasonally flooded marshy areas, the riparian woodland is denser, with a characteristic two-storey structure with several species of tall grasses. The ground cover contains a lot of woody shrubs and creepers. Woody tree species include Mitrigyna inermis, Vitex doniana, Nauclea latifolia, Terminalia macroptera, Entanda abyssinica, Pseudocedrela kotschy, Daniell oliver, Gardinea ternifolia and Anchomanes deformis. Trees here may reach heights of up to 12m.

The Tamale Metropolitan Area has four (4) forest reserves. These are the Tamale Fuelwood plantation or Agric (0.34km²), Kworgni plantation (0.45km²), Tamale water works or Nyohini (0.23km²) and the Sinsalegbini (72.52km²). These forest reserves are exploited for fuelwood by the inhabitants of the Tamale Metropolitan area.

The governance of Ghana's forest reserves is a product of long history of statutory laws, and policies. Ghana's forestry policies and laws reposed total control and management responsibilities to the Forestry Commission of Ghana (FC) to safeguard Ghana's forest reserves and resources. The responsibilities of the forestry Commission are captured in the Forests Act 1927 (Cap 157); Forest Protection Act, 1974; Forest Protection (Amendment) Act 2002; 1999 Forestry Commission Act 571 and the Forest and Wildlife Policy 2012.

Despite the existence of these laws and policies to safeguard the reserves, they are being encroached upon by private developers (restaurants, petty traders, and other businesses) with other portions used for open defecation. There are naturally grown tall grasses during the rainy season that are woven into a mat called "Zanamat", (a type of local mat for roofing and for fencing). Biodiversity (Flora and fauna including habitats) within the project area is very limited due to extensive urbanization.

However, NEDCo Construction Standard NCS-301 states that "Trees in excess of 2 meters in the ROW shall be cut down to 25 cm or less." It is assumed that trees will need to be cut down or branches and leaves will need to be cut down in the overhead line sections of the quasi-transmission and distribution lines. Table shows the main tree species that could be cut down. Although the teak is listed as EN (Endangered) in the IUCN Red List Categories, it does not fall under critical habitat in Ghana, as it is a globally widespread species, mainly in South Asia and Southeast Asia.

Table 4- 5 Major Tree Types with Possibility for Cutting

No.	English name	Technical name	IUCN red list category
1	Neem.	<i>Azadirachta indica</i>	LC (Least Concern)
2	Mango	<i>Mangifera indica</i> L.	DD (Data Deficient)
3	Kapok	<i>Ceiba pentandra</i>	LC (Least Concern)
4	Teak	<i>Tectona grandis</i>	EN (Endangered)
5	African Baobab	<i>Adansonia digitata</i>	-

Source: JICA Survey Team

4.5 Socio-Economic Environment

4.5.1 Demography

The Metropolis has a total population of 374,744 comprising 185,051 (49.4%) males and 189,693 (50.6%) females. This is about 16.2% and 1.2% of the regional and national population respectively. The population density is 825 per km² with a total of 89,011 households and a household size of 4.1 persons per household which is lower than the regional average of 5.2.

Table 4- 6 Population and number of Households in Tamale Metropolis

Year	Population		Households	Persons per household
	Male	Female	Total	
2010	111,009	112,143	223,252	35,408
2021	185,051	189,693	374,744	89,011
				4.2

Source: GSS, 2010, 2021.

There are four main types of dwelling units in the Metropolis. These are the separate isolated houses (Self Contained), the semi-detached houses, separate room (s) within a compound usually with common cooking and toilet facilities, and several huts or buildings within a common compound. These dwellings are identical of certain communities in the Metropolis.

According to the 2021 Population and Housing Census, all the people in the metropolis live in urban areas as compared to 80.8% in 2010. This makes the metropolis one of only two entirely urban districts in the region with the second being Tamale South.

The Metropolis is occupied by diverse ethnic and tribal groups with Dagombas being the traditional occupants of this area (more than 80%). Other tribal groups include the Gonja, Mamprusi, Nanumba, Konkomba, Asantes, Ewes, Hausa and some other minorities. This composition is important for inter-tribal cooperation which is required for peace and development in the Metropolis.

Majority (90.5%) of the population in the Metropolis is Muslim and followed by Christians. About (0.2%) has no religious affiliation. Among the Christians, the Catholics have the highest proportion of 3.0%, followed by Pentecostal/Charismatic (2.4%) and Protestants (2.4%). The proportion of traditionalist in the Metropolis is (0.3%).

4.5.2 Education and Literacy

According to the 2010 Population and Housing Census, 60.1% of those aged 11 and up were literate with 39.9% being illiterate. About 27.2% were literate only in English, 9.4% in a Ghanaian language, and 61.8% in both English and a Ghanaian language. Less than 1% of the population was literate in English and French (0.4%) and for all the three languages (English, French and a Ghanaian language) the proportion was 1.1%. The number of female illiterates was higher than males.

Around 81.5% attend primary schools (Nursery, kindergarten, primary, JSS/JHS), 11.6% attend secondary/senior high schools, 0.7 percent attend vocational/technical/commercial schools, and 4.6% attend tertiary institutions. The majority of people who previously attended school (43.0%) completed at least the primary level. The primary level had the highest proportion of students attending school (Ghana Statistical Service, 2010).

The Metro Education Directorate (MED) is headed by the Metropolitan Director of Education. This Directorate has the oversight responsibility of providing relevant education to all humans living in the Metropolis and to develop their potential to be productive, facilitate poverty reduction and promote socio-economic growth and development.

All the public Basic Schools are distributed among educational circuits in the Metropolis (Figure 4-3). The school system is run in three terms in an academic year beginning August/September. There are a number of Circuit Supervisors who inspect, supervise and monitor teaching/ learning activities within that circuit.

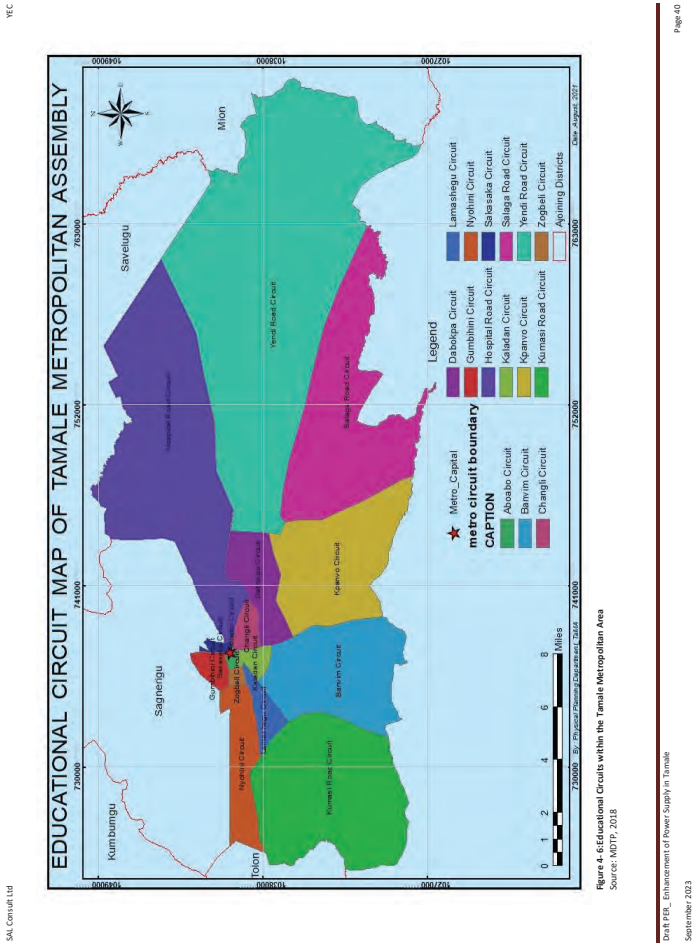


Figure 4-6 Educational Circuits within the Tamale Metropolitan Area

Draft PER_ Enhancement of Power Supply in Tamale
September 2023

4.5.3 Economic Activities

Agriculture is an important sector of Ghana's economy, employing about 60.0% of the economically active population of the nation (GSS, 2010). The sector is critical to the national economy, contributing 21.3% to the Gross domestic product (GDP) in 2013 (MOFEP, 2013). The 2010 Population and Housing Census (PHC) Report revealed that more than half (56.3%) of the population in the urban areas are engaged in agriculture, whereas less than half (43.3%) of the population in the rural areas are also engaged in agriculture. The main types of farming activities considered in the 2010 population and housing census in Ghana are crop farming (excluding gardening), tree growing, livestock rearing, and fishing. Crop farming is one of the most dominant in the Metropolis as a whole accounting for more than half (52.9%) of the population in the urban areas while less than half (43.3%) of them are also in the rural areas. Livestock rearing accounts for 49.8% and 50.2% of urban and rural households respectively. Fish farming is virtually nonexistent in the Metropolis and this may be attributed to the lack of water bodies suitable for that purpose. There is more livestock rearing in the rural areas (50.2%) as compared to the urban areas (49.8%). Livestock such as chicken, goat and sheep have large numbers of keepers but relatively small holdings. This perhaps explains the subsistence nature of farming in the Metropolis. The dove has the highest holding (28 per farmer) followed by cattle (26 per keeper). Beehives has the least holding (zero) which has no average keeper in the Metropolis. This implies that there is little or no bee keeping in the metropolises.

There are five functional markets in the Metropolis namely: the Tamale Central Market, Aboabo, Lamashegu, Kakpagyili, and Kukuo markets. There are however other satellite markets in other communities. The Central Business District (CBD) is also fast developing with the springing up of modern super market activities. There is however an uncompleted modern super market block that was under construction during the 1970s. It is still under construction. This facility when completed would provide space for offices, stores and shopping space for businesses. This would also assist in taking most of the traders off the street and other open spaces in the CBD area of the Metropolis. Fortunately, Government of Ghana has made provisions for funds for the completion of this market. Other structures would be constructed as part of this project to provide more stores for the traders.

4.5.4 Utilities and Services

Energy

Light is a very essential utility for all dwelling units. The sources of lighting for dwelling units in the metropolises include electricity, kerosene lamp, solar energy, firewood and flashlight or torch. About 82.2% of households in the Metropolis have access to electricity from the main grid. The proportion of households connected to the main grid in the urban areas is 90.5% while 42.2% are connected in the rural areas. About 11.6% of dwelling units use kerosene as their main source of lighting. The proportion for the rural areas is (36.4%) while that of the urban areas is (6.4%), indicating that more kerosene is being used in rural areas than the urban areas. Access to electricity from the main grid is heavily skewed towards the urban areas (GSS, 2010). All other sources of lighting except flashlight/torch account for less than 1.0% of dwelling units. The Metropolis enjoys electricity supply from the National Grid and about 70% of the communities are connected. Electricity supply has been fairly stable. This could be an

advantage to heavy industrial development that would depend mostly on energy for production. With the expansion of electricity in the Metropolis, there is also an expansion of the Small and Medium Scale Enterprise businesses in the area.

Water

Most households in the metropolis depend on either pipe-borne water outside their dwelling or pipe-borne water inside their dwelling (representing 41.4% and 39.8% respectively). The main water system in the Metropolis is pipe borne water from the Dalun and the Nawuni Water Treatment Plants which is rationed and managed by the Ghana Water Company Limited in urban Tamale. Some urban communities have difficulty with water supply due to old pipeline structure or their location, i.e., high land areas. The Ghana Water Company Limited supplies over 45,000 cubic meters daily. Sachet water firms have therefore taken advantage of this opportunity to establish plants to utilize this resource in the area which is also creating employment opportunities for the youth. Other water facilities are town water systems, mechanized boreholes and wells.

Sanitation and Waste Management

The most widely used method of solid waste disposal is by public dump (container) accounting for 98.3% households. About 72.5% of households have their solid waste collected with the remaining households resorting to indiscriminate dumping.

Solid waste generated daily in the metropolis is managed mostly by dumping at the landfill with about 250 tons of waste disposed of in landfills daily. The landfill site at Gbalahi has a huge potential for the generation of not only biogas but also for generation of fertilizer which could be very useful to farmers but the challenge is that the waste is not segregated. The Assembly in collaboration with the United Nations International Children's Emergency Fund (UNICEF) is trying to develop a system that could separate liquid and solid wastes to ensure full utilization of the waste.

The commonest toilet facility is used by 56.2% of households in the metropolis and that is public toilet (WC/KVIP/Pit latrine/pan). The use of KVIP is the second commonest used by just 7.1% of households. As much as 26.1% of households in the district has no toilet facility. The commonest bath facility for most households (39.3%) in the metropolis is shared separate bathrooms in the same house. Only 24.6% of households own bathrooms for their exclusive use (GSS, 2010). For grey liquid waste disposal, most households throw onto the street/outside, into gutters or storm drains.

Communication

The TaMA also enjoys telecommunication services with an increase in telecommunication service providers such as Airtel-Tigo, Vodafone, and MTN. Broadband service in the Metropolis is also encouraging which links the Assembly to the worldwide web. This has ensured competitive service delivery in the area. Besides, business activities are done with partners on a faster schedule globally.

Media activities are now vibrant with an increase in radio stations, television stations and newspaper supply vendors. The Media houses are avenues for organizing educative programmes especially on government policies in the illiterate population in the local languages. The major problem with the newspapers is that they arrive in the Metropolis very late and as such the public cannot afford to read current news items. With technological advancement there would be the need for a newspaper printing press located in the Metropolis to serve the three Northern Regions of the country.

Health

The health services in the Metropolis are managed at three (3) levels namely: Metro Health Administration level, Sub-district level and the Community level. The Metropolis is sub-demarcated into sub-districts each with a management team known as the Sub-district Health Management Team (SDHMT). The sub-districts are:

- Bulipela Sub-district
- Tamale Central Sub-district
- Vittin Sub-district

The SDHMTs are responsible for programme planning and implementation of health activities in their various sub-districts, some of them include:

- Conduct integrated static and outreach activities such as immunization, reproductive health, disease control, growth monitoring, health education/promotion and clinical care
- Training and supervision of community -based health workers such as traditional birth attendants (TBAs), Community Based Surveillance (CBS) volunteers, village Health Committees.

Health services are provided at the community level by sub-districts staff supported by TBAs, CBS volunteers.

Transportation

The major transport services in the area are taxi cabs with a main taxi station at the Central Business District (CBD). There is also an enormous usage of motorbikes and tricycles within the metropolis which is the main source of affordable transport for both males and females. State bus services such as the State Transport Company and Metro Mass Transit, and other private bus services like OA Transport link the Metropolis with other cities and towns in the country.

For easy transport of goods and services, EMS, FEDEX, DHL and others offer fast and reliable express services from the Metropolis to other places. There is a National Airport located at Mile 9. Major airlines such as Africa World Airlines and Passion Air offer domestic air services to customers in and around the Northern part of the country.

The roads in the Metropolis are fairly good especially those that link the Metropolis to other district capitals. The tarred roads in the area facilitate easy commuting from one place to the other. There is no traffic congestion. Most of the farming and the Peri-urban communities are linked to the marketing

centers by feeder roads. The availability of access roads linking farming communities is an incentive to the farmers since postharvest losses is reduced. Although most of the roads are tarred, some linking the regional capital to the remotest of areas are yet to be tarred. Others have been graveled but yet to be tarred.

4.5.5 Governance Structure

The General Assembly of the Metropolis stands at a total of 62 members. Out of this number, 41 are elected, 18 appointed, 2 Members of Parliament and the Metropolitan Chief Executive. For effective implementation of policies in the Assembly, the Metropolitan Authority has the following Sub-Committee: The Development Planning Sub-Committee, Works Sub-Committee, Social Services Sub-Committee, Revenue Sub-Committee, Education Sub-Committee, Environment and Sanitation Sub-Committee, Finance and Administration Sub-Committee, Justice and Security Sub-Committee.

Apart from the main Assembly, there are two sub-district councils; that is Tamale South and Central Sub district councils popularly called Sub-Metros that work to achieve development at the grassroots level. The main assignment of the Sub-Metro structures is to facilitate participatory decision making, community participation in project planning and implementation. They are also expected to design pragmatic ways of generating revenue for the Sub-Metro and the Assembly in general.

There are paramount and sub-chiefs who provide leadership at the local level and promote peace, stability, and development. Key traditional rulers include the Dakpema, the Gulkpe Naa, the Lamashe Naa and the Banvim Lana. Also supporting local development efforts at that level are the Assembly members, NGOs, Women groups, and other identifiable groups.

4.6 Land Ownership/Tenure

Land ownership follows a patrilineal system with regards to land inheritance. Accordingly, inheritances can go to the male's sons or brothers.

Where royal land is involved, as in the case of chieftains, land and right to chieftaincy may be passed on from a father to his sons, who are wards of the father's brother on the understanding that the right to the land and chieftaincy should rotate among the sons of the father and the father's brother.

Land ownership in traditional society tends to be acknowledged by communal recognition and observation, or that of the ruling traditional elder. Deeds or papers are not usually involved, nor are lawyers. The existence of deeds or papers usually indicates a previous dispute over the land which was taken to the court system. When a conflict emerges the traditional avenue for resolution is to have the traditional elder arbitrate. However, this process usually only works when both parties respect the traditional elder. If one or both parties lack confidence in the traditional elder, local politicians are frequently asked to arbitrate.

Land disputes may be taken to the court system, but these are costly, and, in the case of royal land, they can drag on as each party seeks to appeal every judgement that goes against it. In some areas, recourse to the courts is less likely because of the costs involved and less acceptance of that system as a dispute settling mechanism.

Nevertheless, even if a case goes before the courts, the land may still be used and/or occupied by the disputants since it often is the source of livelihood of the disputants. Force may be used to settle cases where traditional authority is ineffective.

The project is designed to acquire a 0.97 acre of government land at RCC for the construction of a substation. Construction of transmission and distribution lines will pass through Right-of-Ways for which there would be no need for land acquisition as RoWs are reserved lands for such projects.

5.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACT AND EVALUATION

5.1 Introduction

Environmental impact assessment is a formal process used to study and predict the environmental effects, both positive and negative of any development project. The process thus aims to prevent, reduce and offset potential problems at an early stage in the project planning and design.

Environmental assessment is taken up in the construction of the substation and transmission lines as a technique for determining the current status of the environment and identifying the impact of critical activities on environmental and social parameters. Based on this analysis, an environmental management system can be drawn up that will ensure impact mitigation and monitoring planning.

5.2 Project Area of Influence

Project description and extensive consultations in the field have helped in identifying potential environmental impacts associated with the proposed project. The perceived impacts will affect the geographical area within which the project is located.

Geographical Area of Influence

The immediate geographical area of influence of the proposed project is the 0.97acre land for the construction of the RCC substation and a 6km transmission line from the GRIDCO Bulk Supply Point in Tamale to the substation and its surroundings, especially the Watherston residential area and the communities through which the transmission line will traverse.

Institutional and Organizational Influence

The institutions and organisations to be affected by the proposed project include among others the following:

- Ghana Grid Company (GRIDCo);
- St Paul's Catholic Junior High School; and
- Physical Planning Department

Physical Environmental Media Influence

The physical environmental media to be potentially influenced by the activities of the proposed project are land (landscape) and air quality and noise.

Socio- economic influence

The construction of the RCC Power Sub-station as well as transmission and distribution lines will have significant bearing on the economic, socio-cultural conditions in the Tamale Metropolis and its surrounding environs.

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5.3 Project Activities of environmental concern The specific project activities that may create environmental, socio-economic, safety and health concerns are grouped into: • Preparatory phase; • Constructional Phase; and • Operational and maintenance Phase. <u>Preparatory Phase Activities</u> Preliminary activities to be carried out prior to the implementation of the proposed project include: • Permit and license acquisition • Survey works to determine the geomatic characteristics and the exact boundaries of the sub-station • Survey works to determine the Right-of-Way (RoW) and other suitable installation sites • Land acquisition and • Consultations with relevant stakeholders. <u>Constructional Phase Activities</u> Project activities to impact on the environment during constructional phase will include: • Land preparation and management (Site clearing) • Earth and civil works; • Trenching/Excavation/Thrust boring • Planting of poles • Stringing of overhead conductor lines • Installation of equipment at sub-station • Disposal of construction debris <u>Operational and Maintenance Phase Activities</u> Operational activities to potentially impact on the environment include: • Maintenance of project facilities (sub-station and transmission lines) • Waste disposal from operations; and • Implementation of emergency response systems. 5.4 Categories of Impact Rating Rating of significant impact depends on factors which include the following: • Impact magnitude; • Sensitivity and value of the receptor; • Extent and duration of impact; • Reversibility; • Compliance with relevant laws, regulations and standards; • Concerns and views of stakeholders; and • Likelihood of an occurrence.	The impact ratings are categorized as follows: • Negligible or nil • Minor significance; • Moderate significance; and • Major significance. <u>Negligible or nil</u> A “negligible or nil impact” or an impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels <u>Minor Significance</u> An impact of minor significance, hereafter referred to as a “minor impact” is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. These impacts can be prevented or mitigated against by the use of standard engineering procedures or the provision of adequate Personal Protective Equipment (PPE). <u>Moderate Significance</u> An impact of moderate significance hereafter referred to as a “moderate impact”, will be within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching an established (legal) limit. <u>Major Significance</u> An impact of major significance, hereafter referred to as a “major impact” is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. 5.5 Assessment and Evaluation of Potential Impacts 5.5.1 Evaluation of Impacts Associated with Preparatory Phase Activities Potential environmental issues which could arise from preparatory phase activities include: • Land acquisition and compensation; and • Occupational Health & Safety Issues <u>Land acquisition and Compensation:</u> The site for the proposed substation at RCC, Watherston is a government land which is in the process of being acquired by NEDCo through Certificate of Allocation to be issued by the Lands Commission in Tamale. NEDCo paid the Lands Commission on 23rd November, 2022, an administration and processing fee of Gh¢ 15,000.00 to acquire the certification.	YEC	YEC
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There are no farming activities on the proposed project site and its surroundings as it is a designated residential area. Survey works have been undertaken to establish the Row for the proposed 34.5KV sub-transmission line between existing Tamale BSP and RCC primary substation which is Approximately 6.0 km with a 10m ROW. Also, survey works have been done to establish the Row for the proposed construction of 11.5 KV distribution line between RCC primary substation and Tamale Central Hospital which is Approximately 8.0 km with a 10m ROW. The impacts from land acquisition and compensation for project are minor. <u>Occupational Health & Safety Issues</u> Pre-constructional activities such as surveying is expected to pose no occupational health and safety hazards at the proposed substation site and proposed routes for the construction of transmission lines. The use of standard engineering procedures will however ensure the safety of the workers as well as persons around the project area. This impact is of minor significance.	Revenue will accrue to the State through levies and taxes and contractor fees. Some government agencies such as the EPA and the District Assembly will charge fees which will increase the revenue base of the institutions. This impact is of moderate significance. <u>Potential Adverse Impacts</u> The potential adverse impacts from the construction phase activities include: • Influx of Migrants; • Impact on flora and fauna; • Visual Intrusion; • Air quality deterioration/ Vibration and noise nuisance; • Occupational Health and Safety; • Traffic Nuisance and Public/Community safety; • Solid waste management; and • Impacts to soil and sediment transport.
5.5.2 Evaluation of Potential Constructional Phase Impacts <u>Potential positive impacts</u> Potential benefits from the construction phase include: • Employment opportunities for the local residents; • Improved Local Economy; and • Improved institutional and national revenue. <i>Employment Opportunities</i> The project will employ the services of a number local people for excavation works during the construction of the substation and transmission lines. These people who may hitherto be unemployed will be gainfully employed and will earn some income during the period. The employment opportunity will boost the socioeconomic wellbeing of these individuals and their respective families. This impact is of moderate significance. <i>Improved Local Economy</i> The presence of workers in the area will provide a boost to the local commercial activities. Their purchasing power will be enhanced and members of the community will be in a better position to plan their personal and family lives better. This impact is of moderate significance. <i>Improved Institutional/National Revenue</i>	<i>Influx of Migrants</i> The influx of people to the construction sites is a common feature of construction activities in the country. This usually leads to social problems like prostitution, drug abuse, crime and economic pressures like competition for food/accommodation, local inflation, and sanitation problems. The relatively small size of the workforce required for the proposed construction activities coupled with the need for less unskilled labour will however reduce this effect. <i>Impact on Flora and Fauna</i> The project will clear sections of the 0.97 acre of grassland during the construction of the substation to make way for the installation of the proposed facilities. Disturbance from the presence of people, noise and vibration from the construction activities may scare away fauna (birds that may come to the area) from the project area. The flora and fauna studies involved reconnaissance walk along access routes where the transmission line would be constructed as well as the site of the proposed substation. This involved criss-crossing the study area and along the external boundaries to obtain an overview, the extent, topography and the nature and composition of the vegetation through observation in terms of available floral and fauna species. A study of the flora of the proposed site revealed that the vegetation at the proposed substation site is made of continuous grassy ground layer. As such, the substation project site and sections of the routes of the transmission lines are covered with grass. Although the land clearance and excavation to plant poles would lead to displacement of floral species (grassland) and some trees along the Row, impacts would be very minimal. But, tree trimming or cutting of branches and leaves may occur in some areas where overhead lines are installed. For fauna species, no animals have been identified at the proposed project
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site as well as transmission route lines. There will therefore be no impact on fauna species due to construction activities. The environmental significance of the loss of grass and impacts to fauna is minor. <i>Visual Intrusion</i> Visual effects of the construction activities and equipment may be uncomplimentary to what locals are used to. Poor housekeeping practices at the site may also reduce the aesthetic value of the proposed site and transmission routes. The proposed substation project is located at a section of the Watherston away from immediate settlements and therefore secured from the view of most residents. The impact is therefore of minor environmental significance. <i>Air Quality Deterioration/ Vibration and Noise Nuisance</i> The air quality within the immediate area of construction of the substation and transmission lines is not expected to deteriorate. The construction activities are not expected to result in any increase in the concentrations of airborne particulates and noxious gases in the ambient air. No temporal or permanent air emission sources will be created by the proposed project construction. Noise levels within the immediate project area are expected to increase occasionally due to the construction activities such as excavation and installation of equipment. The location of the proposed substation site will ensure the effect if these impacts is minimal on residents. This impact is of minor significance. <i>Occupational Health & Safety Issues</i> Construction workers will be exposed to work-place hazards from the handling of construction equipment and installation of substation equipment. They may also be exposed to minor hazards resulting from noise and dust emissions. There is also the risk of accidents from construction activities such as excavation or digging equipment. This potential impact is of minor significance. <i>Traffic Nuisance and Public/Community Health and Safety</i> The construction of the substation and transmission lines is not expected to cause any traffic situation within the project area. Construction and installation activities is also not expected to cause any community health and safety issues. This impact is of minor environmental significance. <i>Sanitation and Waste Disposal</i>	serious sanitation and health problems are not anticipated from substation site and transmission lines routes. The disposal of waste must be planned to avoid any negative impacts. The main waste to be generated include excavation spoil, left over foods/food wrappers, metal pieces from cut transmission lines, polythene bags, used iced water sachets, empty cans, pieces of papers. These wastes would have to be disposed of appropriately at the Metropolitan Assembly's designated waste collection sites as well as waste disposal bins to be sited at the substation construction site. This impact is of minor significance. <i>Impacts to Soil and Sediment Transport</i> Most construction and clearance activities will inevitably result in some disturbance to the soil. Whether through grassland clearance, earthworks, site grading and vehicle/worker movements, the soil can undergo a range of impacts, albeit minor. There could be soil erosion, soil mixing, compaction, topsoil loss. In most cases, disturbance to soil cannot be altogether avoided and therefore it is important to manage the potential impacts such that the potential for mitigation and restoration is maximised. The impact on soil and sediment transport is minor.
5.5.3 Evaluation of Impacts Associated with Operational Phase Activities Potential Positive Impact The potential positive impacts from the operational phase activities include the following: • Increase in local commercial activity; • Increased power supply; • Increase in Institutional and National Revenue; and <i>Increase in Local Commercial Activity</i> The enhancement of power supply will stabilise power within the metropolis and its environs. This will boost local commercial activities since electricity is used to undertake different forms of commercial activities across diverse sectors of the local economy. This will support economic development in the metropolis and the region as a whole. <i>Increased and stable power supply</i> The proposed project will result in the construction of RCC primary substation; construction of 34.5KV sub transmission line between the existing Tamale BSP and RCC primary substation; and the construction of 11.5KV distribution line between RCC primary substation and Tamale Central Hospital. This will lead to increased and stable power supply within the metropolis for institutions and individuals as well as businesses. <i>Increase in Institutional and National Revenue</i>	5.5.3 Evaluation of Impacts Associated with Operational Phase Activities Potential Positive Impact The potential positive impacts from the operational phase activities include the following: • Increase in local commercial activity; • Increased power supply; • Increase in Institutional and National Revenue; and <i>Increase in Local Commercial Activity</i> The enhancement of power supply will stabilise power within the metropolis and its environs. This will boost local commercial activities since electricity is used to undertake different forms of commercial activities across diverse sectors of the local economy. This will support economic development in the metropolis and the region as a whole. <i>Increased and stable power supply</i> The proposed project will result in the construction of RCC primary substation; construction of 34.5KV sub transmission line between the existing Tamale BSP and RCC primary substation; and the construction of 11.5KV distribution line between RCC primary substation and Tamale Central Hospital. This will lead to increased and stable power supply within the metropolis for institutions and individuals as well as businesses. <i>Increase in Institutional and National Revenue</i>
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Revenue will accrue to the State in the form of tax deductions from wages of workers. Government agencies e.g., EPA and Fire Service will charge processing and permit/certification fees for, which will increase the revenue base of these institutions.

Potential Negative Impact

The potential adverse environmental consequences during the operational phase will include the following:

- Occupational health & safety issues
- Noise nuisance
- Risk of fire and explosion
- Public and Community health and safety issues
- Waste generation and management

Occupational health & safety issues

Occupational health and safety issues associated with the operational phase include the following:

- Exposure to live power lines, electric and magnetic fields, and electrical hazards from use of machinery and tools.
- Working in confined spaces.
- Exposure to noise, hazardous materials and chemicals.
- Risk of accidents and injury from use of heavy machinery/ equipment and cranes.
- Risk of fires and explosions.
- Risk of working at height and along active roads during maintenance works on power transmission and distribution lines.

The impact on occupational health and safety is moderate

Noise nuisance

Noise from the operation of the substation will be from buzzing or humming from transformers or high voltage power lines producing corona. Transformers may also produce ozone which is a colorless gas with a pungent odor. Other sources of noise will be from the movement of vehicles to and from the substation.

The impact on noise nuisance is minor

Risk of fire and explosion

There is a risk of fire outbreak and explosion at the BSP if adequate safety measures and standard operation procedures are not followed. Engineering protection measures such as the use of relays are used to de-energize/isolate faulty equipment to prevent any fires/explosions. The risk of fires/explosions, though exists, is very low. Any occurrence of fires/explosions could be catastrophic and compromise public safety. Additional hazard prevention and control methods will be required to prevent any occurrence.

The impact on risk of fire and explosion is moderate

Public and Community health and safety issues

Public and community health and safety issues associated with the operation of the substation are related to the following:

- Electrocution;
- Electromagnetic emission;
- Visual intrusion;
- Fires and explosion; and
- Noise nuisance and ozone emission.

Electrocution may occur from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. The other public health and safety risks associated with the operation of the substation electromagnetic emission, visual intrusion, fires and explosions, noise nuisance and ozone emission)

The impact on public and community health and safety is moderate

Waste generation and management

Waste to be generated during operation and maintenance works at the BSP include domestic waste and hazardous waste. Domestic waste includes, food waste, packaging material and human waste. The hazardous waste will include retired/ replaced transformers and other equipment, faulty electrical parts, scrap metal, waste oil and containers for fuels/oils/lubricants.

The impact on waste generation and management is minor

5.5.4 Evaluation of Impacts Associated with Decommissioning Phase Activities

Power distribution substations and networks are designed to have long lifespans when the appropriate maintenance practices are undertaken. The expectation is that the substation and network will be regularly maintained to ensure smooth supply. The system elements may be upgraded and/or renewed based on cost/benefit analysis and new technologies.

The decommissioning activities described in this report is therefore limited to demobilization from site on completion of the project. The main activities will involve:

- Waste disposal
- Health and safety management

All solid waste resulting from the decommissioning process will be disposed of as follows:

- Damaged conductors and equipment will either be returned to NEDCo for proper disposal or sent to recyclers; and
 - Other solid wastes would be evacuated by handlers commissioned by the Tamale Metropolitan Assembly's Solid Waste Department.
- Construction workers will be exposed to hazards from the handling of construction equipment. They may also be exposed to minor hazards resulting from noise and dust emissions. There is also the risk of accidents from demobilization of equipment.

This potential impact is of minor significance.

6.0 MITIGATION MEASURES

The proposed mitigation options and interventions are to avoid, minimise and reduce the negative environmental and social impacts identified in the previous chapter and to ensure smooth and sustainable implementation of project and minimize conflicts or disputes. These are provided in the Tables 6-1 and 6-2 below.

Table 6- 1: Proposed Mitigation Measures for Preparatory/Construction Phase

Potential Impact	Mitigation Measures
Occupational health and safety	• Health and safety induction will be provided for all workers • The contractor should carry along a well stuffed First Aid Box for the construction site and transmission lines installation • The contractor should identify and provide appropriate PPE that will offer protection to workers in all areas of operation (e.g. overalls, safety boots, hand gloves etc.) • Cautionary or warning signs and notices should be boldly posted at potentially dangerous or hazardous areas. • Fire- fighting equipment such as fire extinguishers should be provided at construction site • All incidents/accidents should be recorded, investigated and preventive measures put in place to avoid re-occurrence. • The contractor should ensure that its workers are enrolled on the National Health Insurance Scheme
Air quality deterioration	• The contractor will use dust control methods such as water suppression and/or application of biodegradable dust suppressants on untarred access roads and at the project site to reduce dust generation. • The contractor will as much as possible minimize dust generating activities during windy periods. • The contractor will only use machinery and trucks in good condition for the project. All machinery and trucks will also be regularly serviced to prevent excessive generation of exhaust fumes. • Vehicle speed, particularly on untarred roads will be strictly controlled to minimize dust generation.
Noise Nuisance	• The contractor will select equipment with lower sound power levels for use. • The contractor will install suitable mufflers on engine exhausts and compressor components. • The contractor will schedule construction works to ensure noise generating activities are carried out during less sensitive periods, such as during active working hours where most residents will be at work and not at home.

	- The contractor will only use good condition machinery and equipment for the construction work. These will be regularly serviced and maintained to reduce noise generation. - The contractor will educate machine operators and truck drivers to avoid unnecessary honking, reduce revving of engines to the barest minimum and not to leave idle engines on. - The contractor will adopt efficient construction methods and re-use of construction materials to minimize the waste to be generated from the construction works. Excavated soil material will be re-used in backfilling and levelling as much as possible at the substation site and for the trenches for the power evacuation route. - The contractors should implement a waste management plan that includes provision of temporary storage bins at construction sites and disposal of waste at Metropolitan Assembly's approved sites - Metal scraps should be given to scrap dealers for recycling. - The contractor should provide mobile toilet facilities or identify community toilet facilities for use by construction workers
Waste generation and disposal	
Public safety and traffic issues	- The project site will be cordoned off and strict security measures enforced to prevent entry of unauthorized persons to the site. - Warning signs will be used at vantage points to warn the public against dangers. - Stringing of overhead lines will be done in sections/short distances to minimize nuisance to the public and disruption of commercial/other activities by the public - Stringing equipment such as tensioners, pullers, reel winders etc. will be used instead of manual methods to reduce stringing times and minimize nuisance to the public - Any broken-down vehicles will be immediately removed off the road. - The contractor will adjust material/equipment delivery times to avoid peak traffic periods and periods where school children are commuting to and from school. - Officials of the Motor Traffic and Transport Directorate (MTTD) of the Ghana Police Service will be engaged where necessary to direct traffic to reduce traffic congestions. - Thrust-boring will be used at road crossings to minimize traffic impacts. - All trenches will be covered immediately after laying of cables. - The contractor will develop and implement an effective grievance redress mechanism to address public complaints.

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	- Red bands or reflective materials should be tied on protruding poles out of trucks during transport of poles to site. - As a policy, the contractor will prohibit open defecation by workers and offenders will be punished to serve as a deterrent
Displacement of persons and properties on RoW	- The contractor in conjunction with local authorities should educate and sensitize the communities prior to site clearing and excavation on project site - The contractor should educate its workers to ensure that only areas required for pole installation and for limited movement required by line workers are excavated - Invite the Land Valuation Division, the government body responsible for enumeration, valuation and compensation arrangement, to take inventory of affected persons and properties and apply official procedures to provide realistic compensation payments to affected persons (Described in Annex 1)
Vegetation loss	- Felling of any tree without any justified reason linked to project activity should be prohibited and be made punishable. - Tree planting should be implemented as a compensatory measure for trees cut down. (1 tree planted for every 1 tree cut)

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Table 6-2: Proposed Mitigation Measures for the Operation/Power Supply Phase

Potential Impact	Mitigation Measures
Occupational health and safety	- NEDCo will provide training for their workers on safety and standard operational procedures - Working on live lines should be discouraged. Confirmation of power outage should be done before work commences. - Proper PPEs should be provided for line maintenance workers - Well stuffed first aid box should be made available to line maintenance workers and should include medication for snake/insect bites and stings - All incidents/accidents should be recorded, investigated and preventive measures put in place to avoid re-occurrence - VRA-NEDCo should develop waste oil management plan in consultation with the EPA and agree to the proper disposal of transformer oil with the EPA. - Carry out scheduled maintenance on transformers - Adequate waste bins will be provided for frequent collection and disposal of waste generated. This will include scrap metal and waste oils which will be sold to licensed recyclers. - A licensed waste management company will be contracted to collect and dispose waste from the facility - A hazardous waste management plan will be developed or adopted to manage hazardous waste from broken down/obsolete equipment such as transformers.
Risk of fires and explosions	- Machines and equipment will be regularly serviced and maintained to avoid any fires and explosions. - Security at the facility will be strictly enforced to prevent any sabotage from the public. - Firefighting equipment such as fire hydrants and fire extinguishers will be installed at vantage points. - A Fire Management Program will be developed and implemented. This will include: - Training on fire prevention, firefighting and rescue; - Fire drills; and - Emergency response plan; etc.
Public health and safety issues	- Caution/warning tapes and tiles will be used to indicate the presence of underground electricity lines to warn the public. - Caution and warning signs will be used at the substation to warn the public of any danger - The project should educate local communities on dangers associated with coming into contact with exposed wires.

- An emergency contact line should be made known to the public or local communities to enable faults or fallen lines or poles to be reported for quick action to be taken - Poles should be properly installed during the construction phase to prevent easy falling during storm events - Poles installed near road sides should be painted in appropriate reflective colours so that they become very visible at night to prevent vehicles from crushing into them. - Maintenance workers should be educated to avoid open defecation and encouraged to identify and use local community toilet facilities	
NEDCo should adequately inform the local communities prior to disconnection for maintenance or repair works, indicating how long it will take for power to be restored	Interruption and power supply disruption in power supply

7.0 ENVIRONMENTAL MONITORING PLAN

Monitoring will be done at the sub-project implementation stage to ascertain the effectiveness of the management of minor impacts identified, including the degree of success in implementing mitigation measures. During construction works, checks, reviews and inspections will be carried out to assess compliance with permit conditions. Monitoring will be done by NEDCo, JICA and other public institutions. Reports of monitoring activities on the project will be prepared by the sub-contractor and submitted to NEDCo, JICA, Tamale Metropolitan Assembly (TaMA) and EPA (Regional Office). A monitoring report must be submitted every three months during construction and every six months when the building is in operation (for three years after service). The monitoring reports will serve as the basis for EPA's compliance monitoring in line with the permit conditions, and verification of other environmental and social safeguard commitments. A completion of construction report will be prepared for the project to the EPA Regional Office, NEDCo and TaMA. The report will be a compilation of outcomes of the monitoring activities, in compliance with EPA's permit conditions and for the records of the TaMA. The completion report will form the basis for EPA's final monitoring for project completion and closure.

A summary of impacts, mitigation, management and monitoring measures to be implemented is captured in Table 7-1. As a guide for the construction works and operation of project.

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Table 7-1: Environmental Monitoring Plan and Reporting

Potential Environmental Issue	Anticipated Environmental and Social Impact	Proposed mitigation measures	Monitoring and reporting	Frequency/Duration	Management	Responsible Institution/Person	Cost (US\$)
Preparatory/Construction Phase							
RoW Acquisition and Compensation	Anxiety from potential loss of livelihood/ assets shelter/ or relocation	- Sensitization on scope and impact of projects for locals - Ensure all grievances/concerns of locals are resolved prior to construction - Adequate compensation for loss	- Minutes of awareness creation meetings - Records of complaints/grievances received and status (resolved/ unresolved) - Evidence of acceptable compensation paid	Weekly	Contractor's Community Liaison, Assembly/Unit committee members and chiefs TaMA Physical Planning/ Finance Officers	Assembly members and chiefs TaMA Physical Planning/ Finance Officers	TBC
Air quality	Air quality deterioration	- Suppress dust generation at sites - Purchase equipment in good condition and maintain regularly - Use good quality fuel and lubricants;	- Records of complaints/grievances resolved/ unresolved - Maintenance status of vehicles and heavy equipment - Measurement of air pollutants (SO₂, NO₂, PM₁₀, PM_{2.5}, CO)	Weekly 1 time/4 month	Contractor	Supervising Consultant TaMA Environmental Health Unit EPA	18,000
Public/community health and safety	Public health and safety issues/concerns	Red bands or reflective materials should be tied on protruding poles out of trucks during transport of poles to site.	- Records of complaints/grievances resolved/ unresolved - Warning and directional signs mounted	Daily	Contractor's HES officer	Supervising Consultant TaMA Environmental Health Unit	50,000

Potential Environmental Issue	Anticipated Environmental and Social Impact	Proposed mitigation measures	Monitoring and reporting	Frequency/ Duration	Management	Responsible Institution/ Person	Cost (US\$)
		Regular maintenance of all vehicles and trucks should be carried out in line with the manufacturer's manual					
Vegetation loss	Tree Cutting	Tree planting should be implemented as a compensatory measure for trees cut down	- Tree cutting records - Confirmation of growth of planted trees	Daily Weekly	Contractor NEDCO	Supervising Consultant TaMA Environmental Health Unit	5,000
Conveyance of construction materials	Traffic	- Provide warning signs at junctions to Project sites to indicate the approach of trucks - Transport materials during off-peak periods. - Use DWA certified vehicles and drivers - Liaise with the Departments of Urban Roads and the Police Motor Transport and Traffic Division (MTTD) for traffic control assurance.	- Change in condition of roads to project site - Availability and use of diversion/road signs or trained persons directing traffic. - Records of accident occurrence involving truck drivers	Daily	Contractor	Roads Department, MTTD Assembly/Members Supervising Consultant, Urban roads department	5,000

Potential Environmental Issue	Anticipated Environmental and Social Impact	Proposed mitigation measures	Monitoring and reporting	Frequency/Duration	Management	Responsible Institution/ Person	Cost (US\$)
Noise	Noise nuisance	Excavation equipment that generates some level of noise should be operated during day time to minimize its effect. And minimize noise generation during classes in close location to the school	- Use of ear muffs - Records of complaints/grievances resolved/ unresolved - Maintenance status of vehicles and heavy equipment - Measurement of environmental noise levels (RCC site) - Noise Level Measurement	Daily	Contractor's HES officer	Supervising Consultant TaMA Environmental Health Unit	12,000

Potential Environmental Issue	Anticipated Environmental and Social Impact	Proposed mitigation measures	Monitoring and reporting	Frequency/Duration	Management	Responsible Institution/Person	Cost (US\$)
Construction Waste	Generation and disposal of waste	- Enforce speed limits of between 40-50 km/hour within communities - The contractors should implement a waste management plan that includes provision of temporary storage bins at construction sites and disposal of waste at Metropolitan Assembly's approved sites - Metal scraps should be given to scrap dealers for recycling - The contractor should provide mobile toilet facilities or identify community toilet facilities for use by construction workers	- Availability and use of bins - Records on frequency and location of waste disposal site of domestic construction waste - Records on training	Daily Weekly	Contractor's HES officer	Supervising Consultant TaMA Waste Management Department	10,000
Construction related occupational health and safety	Occupational Health and Safety Issues/Concerns	Active construction areas to be marked with high-visibility tape	Workers' awareness of Contractor's health and safety policy	Daily	Contractor's HES officer	Supervising Consultant	40,000

Potential Environmental Issue	Anticipated Environmental and Social Impact	Proposed mitigation measures	Monitoring and reporting	Frequency/Duration	Management	Responsible Institution/Person	Cost (US\$)
Operation Phase Noise	Noise from transformer	- Backfill and secure trenches and excavated areas - Provide suitable PPEs for construction workers - Provide adequate sanitary facilities - Train workers on site rules/regulations, safe methods of work, first aid, hygiene	- Availability and proper use of PPEs - Availability and proper use of warning signs - Availability of first aid kit - Records on frequency, type and source of illness/accident/injury - Records on non-compliance	Weekly	NEDCo	MoE, EPA, DA Environmental Health Unit (EHU)	2,000 per quarter (24,000 for 3 years)
All project operations	Waste generation, management and disposal	Keep hazardous waste (e.g. spent oils) onsite before proper disposal	Records of oil storage conditions	Weekly	NEDCo	MoE, EPA, DA Environmental Health Unit (EHU)	20,000 per quarter (240,000 for 3 years)

8.0 CONSULTATIONS

8.1 Introduction

Consultations were held with stakeholders including local communities and other interested groups and institutions. This was aimed at gathering relevant information and discussing issues of environmental and social concern that may arise from implementing the project.

Local communities, their representatives and government institutions all contributed immensely during the consultative process and dialogues were directed at identifying and resolving key project-related issues.

The stakeholder consultation has been a two-way flow of information and dialogue between project proponents and stakeholders, which is specifically aimed at developing ideas that can help shape project design, resolve conflicts at an early stage, assist in implementing solutions and monitor ongoing activities.

8.2 Objectives of the Consultations

The main objective of consultations with stakeholders is to discuss and provide relevant information on the project. Specifically, to achieve the following objectives:

- Provide some information about the proposed project;
- Provide opportunities for stakeholders to discuss their opinions and concerns;
- Provide and discuss with stakeholders, alternatives considered to reduce anticipated impacts;
- Identify and verify significance of environmental, social and health impacts; and
- Inform the process of developing appropriate mitigation and management guidelines.

The consultations carried out so far indicates an overwhelming support for the project by all the stakeholders as well as other interested groups and the concerns have generally been on the prompt implementation of the project and payment of compensation to project affected persons.

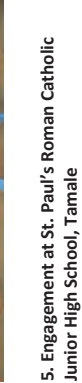
8.3 Stakeholders Identified

As part of the information gathering process, consultations were held with various stakeholders for their concerns to be incorporated in the environmental assessment. The following groups have been contacted and consulted:

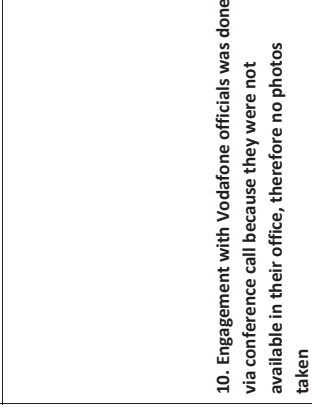
Table 8- 1: Stakeholders List

No.	Stakeholders	Date of Consultation
1	Tamale Metropolitan Assembly (TaMA)	09/03/2023
2	Ghana Highways Authority, Regional Office	09/03/2023
3	Department of Urban Roads	09/03/2023
4	Lands Commission, Regional Head of Valuation Department, Tamale;	10/03/2023
5	St Paul's Roman Catholic Junior High School, Tamale	10/03/2023
6	Tamale Central Hospital	10/03/2023
7	Ghana Water Company Limited, Regional Office	10/03/2023
8	Ghana Police Service, Regional Office	09/03/2023
9	MTN Office, Tamale Main	10/03/2023
10	Vodafone Ghana, Tamale	10/03/2023
11	Ghana National Fire Service, Regional Office	09/03/2023
12	Ghana Grid Company (GRIDCo), Tamale	10/03/2023
13	Northern Electricity Distribution Company (NEDCo)	09/03/2023
14	Environmental Protection Agency (EPA), Regional Office	30/11/2022
15	Traditional Authority, Tamale	30/03/2023
16	Project affected persons	31/03/2023 – 05/04/2023

The Table 8-2 below summarises the stakeholder and community concerns raised and discussed. Evidence (pictures) of the consultations is provided below and attendance sheets presented in **Annex 2**.

		1. Engagement at Tamale Metropolitan Assembly
		3. Engagement with the Regional Director, Department of Urban Roads, Tamale
		4. Engagement with the Regional Lands Valuation Division of the Lands Commission Tamale
		5. Engagement at St. Paul's Roman Catholic Junior High School, Tamale

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		6. Engagement with officials at Tamale Central Hospital
		7. Engagement with the Regional Distribution Manager, Ghana Water Company Ltd, Tamale
		9. Engagement with the Deputy Regional Commander of Ghana Police Service, Northern Region, Tamale.
		10. Engagement with Vodafone officials was done via conference call because they were not available in their office, therefore no photos taken
		11. Engagement at the Regional Office, Ghana National Fire Service (GNFS) Tamale

A11-102



Plate 8-1: Picture evidence of stakeholder engagements

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Table 8- 2: Summary of Stakeholder and Community Concerns

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
1. Tamale Metropolitan Assembly				
Ibrahim Mustapha	Tamale Metropolitan Assembly	Metropolitan Development Planning Officer		Certification and Other Permitting requirement - The Metropolitan Assembly provides extensive services to the community including issuance of permits. The Assembly will determine the types of permits required by the project after reviewing the project design. - The client is expected to share 3 nos. project designs with the Metropolis Engineer for necessary permitting obligations. - Construction and development permit will be acquired from the Assembly for the substation. - Environmental permit should be acquired from the Environmental Protection Agency (EPA) of Ghana. - The locality name for the proposed substation is Watherston.
Martin Ahorlu	Tamale Metropolitan Assembly	Metropolitan Waste Management Director		
Sadisu Sadique	Tamale Metropolitan Assembly	Head of Physical Planning Department		
James Nunoo	Tamale Metropolitan Assembly	Works Engineer		Project Zoning Status - The proposed primary substation area has been redeveloped to capture the newly built structures. - The proposed substation area is earmarked for civic and cultural use. The zoning scheme has to be changed to Light Industrial to suit the current use. - The proposed substation area is classified as a High-Class Residential area. - The Regional Coordinating Council (RCC) released the land at the proposed substation area to NEDCo. - The client is possessing evidence of land ownership which the Certificate of Allocation from Lands Commission.

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				Project Implementation and its impact on development in the metropolis - There are no established conflicts in the metropolis to impede work progress. - No bye-laws will affect the project. - Installation of transmission and distribution lines will not affect vegetation cover as the lines will pass through areas without vegetation. - The power supply enhancement will reduce the load on existing power lines. - The transmission lines should be erected high to prevent contact with vehicles crossing the facility especially around the Agriculture Junction area. - The project will affect livelihood as underground lines may pass through properties such as supermarkets, hairdressing shops, mechanic shops etc. - Greenhouse gases emission from project activities polluting the environment. - Impact on biodiversity by removing the top soil around the proposed substation area. Mitigation measures for the project - Regular maintenance of machinery and vehicles to reduce emission on site. - The valuation team will assess affected properties and corresponding compensations will be paid to project affected persons. - The project area should be barricaded with appropriate signage to prevent unauthorized access to site. Awareness and Opinions of about the project

A11-105

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- The communities along the transmission lines route should be engaged earlier enough to create awareness about the project. - Electricity is essential in all aspect of human endeavours. Improving the power supply in Tamale will enhance effectiveness and efficiency in the service delivery of the assembly. - Enough buffer land should be allocated between the residents and the substation. - Prompt backfilling of excavated trenches should be encouraged. - Collection of construction debris should be done regularly to ensure that the city is clean at all times. - The project is a good one and the assembly is delighted to have it in its jurisdiction.
2. Ghana Highways Authority, Northern Region, Tamale				
Victor Aman	Regional Office, Tamale	Regional Director		Plans for Expansion - There are plans to expand major road networks in the region - Plans underway to dualise Agriculture Junction Savelugu to Walewale road - Project would not negatively impact on road expansion plans Impact of Project - There is no anticipated potential damage to existing road infrastructure based on the project details shared - Agriculture junction across N10 transmission lines if done as overhead lines may not be the best for safety reasons if the lines are not high enough - There may be possible diversion of roads around the project area during construction and installation of lines
Francis Agbenyo	Regional Office, Tamale	Regional Quantity Surveyor		

A11-106

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- There may be disruptions to traffic flow around the project area during construction and installation of lines - Utility lines for water and telecommunications may be affected during construction - Potential noise and dust pollution in project areas - Destruction and disturbance of flora and fauna on project sites/areas, especially the sub-station construction site Mitigation Measures - If possible, Agriculture junction across N10 transmission lines should be underground to ensure maximum safety of road users - Construction team should liaise with utility service providers to identify service lines and installations to prevent/limit potential damages - On possible road diversions and disruptions to traffic flow, advanced notices should be given to motorists on routes to use with warning and cautions signs - Dumping of water to reduce dust pollution during construction - If underground transmission lines would be laid, thrust boring should be done to prevent damages to road infrastructure - Destruction and disturbance of flora and fauna species should be reduced as much as possible - Residents in the project areas should be well informed about the project and its related activities
3. Department of Urban Roads, Northern Region, Tamale				
Ing. Kwasi A. Darko	Northern Regional Office, Tamale	Regional Director		Plans for Expansion - There are plans to expand road infrastructure in the metropolis - Plans of expansion would not be negatively impacted by the project

A11-107

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- Road reservations are incorporated into the road constructions Impact of Project - Water works and N10 roads fall within the project areas - There may be road diversions during construction and installations of power transmission and distributions lines - There are existing utility lines installed by GWC and Telcos in the project areas - Any possible impact of project on existing road infrastructure would only be determined, upon the submission of project route map and what construction activity to be carried-out in specific project areas Mitigation Measures - Provisions would be made for road diversions during construction when necessary - Overhead transmission lines that would pass across roads should be high enough so it does not pose safety challenges to vehicles and motorists Other Concerns - The project is a positive one and should be followed through to completion - Request for the submission of project route map so they know the specific routes of the project and what arrangements to make
4. Lands Commission, Regional Land Valuation Department, Tamale				
Abdul-Razak Abdul-Mushin	Regional Office, Tamale	Assistant Land Officer		Status of Proposed Sub-Station Site The proposed land for the siting of the RCC sub-station is a government owned land

A11-108

SAL Consult Ltd		YEC	
Contact Person(s)	Location/District	Role	Contact No.
Issah Abdulai	Regional Tamale	Assistant Land Officer	
Nowie Abdul-Majeed	Regional Tamale	Land Administration Technician	
Issues/Concerns Raised and Information Received - The area where the sub-station would be sited is designated as a residential area (Watherston) Land Registration Processes - The land registration process to be undertaken is Certificate of Allocation - Because the proposed sub-station site land is owned by government, the proposed land must be formally transferred to NEDCO which is a government institution - Certificate of Allocation would be given to NEDCO by Lands Commission - NEDCO has paid the Lands Commission, an administration and processing fee of GH¢15,000.00 to formally acquire the Certificate of Allocation - There is no assigned time limit as to the usage of the land - In cases where the purpose for which the land was acquired is no longer in force, the land would be transferred back to government as the original owner Compensation Process - Compensation is based on the advice of Lands Commission after valuation of the land/properties Impact of Project - Project would significantly improve power situation within the metropolis - Improvement in power supply would enhance the operations of the commission which are mostly computer-based			

A11-109

SAL Consult Ltd		YEC	
Contact Person(s)	Location/District	Role	Contact No.
5. St. Paul's Roman Catholic Junior High School 'B', Tamale	Tamale	Head Teacher	
Rev. Christiana Noegaaba	Tamale	P.T.A. Secretary	
Other Concerns - Compensations to project affected persons must be adequate and paid on time Current Power Situation - Current power situation is good as the school does not operate gadgets and do not depend on power to teach the pupils - Outages that affect the school is general and is what pertains in the community. Impact of Project - Trees that provide shade to the pupils would be felled and this may affect children's play time - Food vendors that sell cooked food to the pupils under the shade provided by the trees would be displaced - The removal of trees that serve as boundaries may bring encroachers unto the school land - Digging of trenches may pose challenges to pupils during play time if not well monitored Mitigation Measures - Erection of shed for food vendors who would be displaced due to the felling of trees - Poles should be mounted immediately after digging holes - The areas to be dug should be cordoned-off to prevent entry. Other concerns - Provision of ICT Lab and tools such as computers and accessories would improve the learning experience of pupils			

A11-110

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received	YEC	
6. Tamale Central Hospital						
Ibrahim Mugsu	Tamale	Estate Manager		- Provision of Teachers Common Room would be greatly appreciated. Current Power Situation - Current power situation is very erratic - About three major outages are recorded every week - Major power outages averagely take about three hours before power is restored - Some departments such as surgical department are not able to function in times of power outages - Erratic power affects emergency care services - Some medical gadgets malfunction due to intermittent power supply Impact of Project - Project would impact tremendously on power stability in the hospital - Hospital would be able to operate optimally in all departments - Medical gadgets malfunctioning due to intermittent power supply would be reduced or eliminated all together - Services such as surgeries that are postponed due to power challenges would be always be in operation - Revenue generated in the hospital would increase due to power stability which could be used to improve services Other Concerns - Provision of dedicated power transmission line to the hospital should be followed through		
Bodza Yohanes Yao	Tamale	Health Senior Administrator				
Fuseini Alhasan Napari	Tamale	Artisan				
7. Ghana Water Company Limited, Regional Office, Tamale						

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
John-Paul Dinge	Regional Tamale	Regional Distribution Manager		Current Situation - There are five GWC water hydrants in the metropolis with four activated and one yet to be activated - None of the hydrants would be affected by the project due to their location - There are water utility lines at the project area - GWC request the submission of project route map so it can be imposed on the GWC route lines to confirm supply lines and specific locations to be affected by the project Impact of Project - Project would improve services at the regional office with regards to administrative duties - The project would not impact negatively on water supply in terms of distribution, however, if supply lines are damaged during construction, water provision especially to households would be disrupted because water is rationed - Excavation that would be carried-out may expose illegal water connections which would be taken-off Plans for Expansion - There are plans to expand water supply in the metropolis and its environs - Plans of expansion would not be negatively impacted by the project because water utilities are catered for in the Right of Way (RoW) Mitigation Measures - East and South-West GWC District Managers would be assigned to construction team to prevent damages

A11-111

A11-112

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Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- Officials of GWC would identify and inform contractors of the specific areas where water supply lines are located - There would be stand-by officials ready to undertake repair works in case of damage to supply lines Grievance Redress Mechanism - In-case of damages to water supply lines, project client undertaking the construction bears the cost of repairs - In emergency cases where delay in repairs cannot be allowed, GWC undertakes the repairs and submit bill to project client to reimburse - Damages to supply lines should be reported immediately to GWC officials that would be assigned to construction team for redress. Below listed official should be contacted. 1. Mr. Agyee, East District Manager – 0207177774 2. Peter Azuri, South-West District Manager – 055359874) Other Concerns - Official letter should be presented to the regional office to formally inform the office and also indicate timelines for the project so the office can make arrangements regarding the project
8. Ghana Police Service, Regional Office, Tamale				
Theodore Kwaku Hlormenu	GPS Regional Office, Tamale	Assistant Commissioner (Deputy Regional Commander)		State of Security in Tamale and Project Site - The metropolis is generally peaceful and safe - Crime rate is low within the metropolis due to Police patrols and other security measures - The proposed sub-station construction site is particularly safe due to government institutions and security installations in the area Incident Reporting
James Owusu	Tamale Metropolitan Assembly	Staff Officer		

A11-113

SAL Consult Ltd		YEC		
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				• If any security issues or incidences of theft arise, report should be made to nearest Police Station • Permission for road blocks or diversions during construction should be sought from the Police Regional Command and Tamale Metropolitan Assembly • In the case of breaking of structures, there should be an order from the Court and the Regional Command and Tamale Metropolitan Assembly must be notified Impact of Project • Project would improve current power situation and lightning within the metropolis which would enhance safety and security • Security cameras installed in the metropolis would help to maintain and enhance security with improvement in power supply • If project leads to power outages during night time, visibility would be poor which criminals could take advantage of and this could potentially endanger lives Mitigation Measures • If outages would occur especially at night, there should be adequate notification by NEDCO • Police visibility would be increased in the night at sub-station construction site if prior notification is given before start of project Other Concerns • Project should be completed on schedule • There should be sensitization of persons in the project affected areas
9. MTN, Tamale Main				

A11-114

SAL Consult Ltd		YEC		
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
Mariam Abubakari	MTN, Tamale	Branch Head		Current Situation - There are underground cables installed in the proposed project route - MTN would assign a representative to the construction team to locate cable routes - A formal letter indicating project schedule and routes map should be submitted so that arrangements can be made with the project construction team prior to start of construction Impact of Project - Potentially, cables could be cut during construction - Enhanced power supply would improve service delivery to clients - Quality service delivery to clients facilitated by stable power supply would improve revenue and boost investment in service delivery by MTN - Use of fuel to run operations is expensive; improved power supply would make service provision less expensive Mitigation Measures - Time schedule should be given ahead of time to assign MTN representative to the construction team - Cable routes would be provided to the construction team to locate specific areas where cables are installed by assigned representative - Construction team must be cautious as possible during operation Incident Reporting - Any incident of cable cut should be reported immediately to the assigned MTN representative on the ground
Isaac Anaba	MTN, Tamale	Facility Officer		

A11-115

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YEC

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- The contractor on the ground would pay for cable cuts that would occur during construction if MTN is not properly involved in the operation to locate cables Other Concerns - Priority should be given to service companies during project implementation in case of power outages
10. Vodafone, Tamale				
Alhassan	Tamale Main	Regional Coordinator		Current Situation - There are installed underground cables in the proposed route designated for the project - There are plans for the expansion of service - Vodafone would assign a representative to the construction team to locate cable routes - A letter indicating project schedule and routes map should be submitted so that arrangements can be made with the project construction team prior to start of construction Impact of Project - If there are cable cuts during construction, it would affect network service provision - Improvement in power supply would enhance operations and service delivery Mitigation Measures - Vodafone would assign a representative to the construction team to provide guidance on cable routes and installations
Felix Kanton	Tamale Main	Head of Technology		
Osman Fuseini	Tamale Main	Engineer Network Planning		

A11-116

SAL Consult Ltd	YEC				
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received	
				- Construction team's communication with Vodafone officials and assigned representatives should be prompt and effective - There should be the exercise of caution during construction Incident Reporting - In case of cable cuts, notice should be given promptly to assigned Vodafone representative with the construction team - In case of power cuts, bill of quantity would be prepared by engineers to produce cost for contractor to bear	
11. Ghana National Fire Service					
Jemima Musah	Regional Office, Tamale	Officer in Charge, Safety		Fire Risks in the Project area - No history of fire incidents in the project area. Fire Prevention and Fire Fighting Equipment - A Fire Station is about 2km from the proposed substation with fire hydrant to combat fire in the event of an outbreak. - Fire tenders are available with water to fight fire any day. - The service has well trained and competent officers to fight fire in the metropolis. Certification and Permitting Requirement - As required by the Fire Precaution (Premises) Regulation 2003, Legislative Instrument 1724, the client should submit a site plan to the service for Fire Permit processing. - The Fire Service will carry out an inspection at the proposed substation area and issue fire permit prior to the construction phase.	
Yussif Alidu	Regional Office, Tamale	Dep. Officer in Charge, Safety			
Joshua Awreh	Regional Office, Tamale	Operation Officer			

A11-117

SAL Consult Ltd	YEC				
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received	
				- The fire permit is renewable every 12-months (1 year) upon site inspection by the GNFS - When fire precautions relating to project are satisfied, fire certificate is then issued by the Ghana National Fire Service for the operational phase. - The service will conduct regular inspections on the facility and make recommendations when necessary. Impact of Project on operations - The project will not impact the facility of the service and no foreseeable impacts on their operations. Awareness and Opinions about the project - The client is expected to incorporate fire precautions such as safe and effective means of escape, satisfactory fire detection and warning signs as well as presence of firefighting equipment into the project design. - Regular training should be conducted to workers to educate them on fire safety. - Firefighting equipment should be accessible on site at all times.	
12. Ghana Grid Company Ltd (GRIDCo)					
Nelson Awotwe	GRIDCo Tamale	Principal Engineer		Impact of Project on Service Delivery - The project will improve power supply in the Tamale Metropolis which will enhance economic activities of the citizen. - No significant impact on GRIDCo facility. Mitigation Measures - The Bulk Supply Point has two (2) transformers comprising of 35KV and 11KV.	

A11-118

SAL Consult Ltd		YEC		
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- A spare feeder is available and 11KV feeders will be freed off so there will be no significance impact on the infrastructure. - The project will not interrupt power supply as a transformer will always be active to ensure continuous power supply. - The contractor should present an Environmental Health and Safety Officer who will liaise with GRIDCO on operational standards - GRIDCO's Land Supervisor will supervise work on GRIDCO premises. The supervisor should be pre-informed about the work schedule to ensure his availability. - Excavated trenches should be backfilled and reinstated. Grievance Redress Mechanism - In event of incidences, GRIDCO's Area Manager (Mr. George Adune) should be contacted.
13. Northern Electricity Distribution Company (NEDCo)				
Tampuri M. Tayeb	Regional Office, Tamale	Manager Network Planning and Development Office.		Project Timelines - The estimated land size for the proposed substation is 0.97 Acres (0.39 Ha.) - Construction phase is expected to start in 2024 and run through 2026. Grievance Redress Mechanism - NEDCO has established incident reporting procedure and a dedicated unit will be assigned under the project to handle all project related grievances. Impact of Project on Service Delivery - The project will improve the quality of power supply to customers which will result in customer satisfaction.
Stephen Kpalega	Regional Office, Tamale	Geomatics Engineer		

A11-119

SAL Consult Ltd		YEC		
Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- Enhanced power supply in the metropolis will result in increase in revenue generation which could open new doors for investment opportunities. Other Concerns - Environmental Health and Safety department of Volta River Authority will ensure that contractors comply to the occupational health and safety standards on site. - EPA permit conditions will serve as guide or checklist for environmental assessment and appraisal.
14. Environmental Protection Agency, Regional Office – Tamale				
Abu Iddisu	Tamale Metropolis	EPA Regional Director, Northern Region		EPA Permit Requirement - Regional Director of EPA requested for the proposed layout and other necessary project documents for project registration at the EPA - The project registration document will guide the next step to take - The EPA will inform the client accordingly whether a full blown ESIA or PER will be required prior to issuance of EPA permit - EPA permit will be issued after approval of Environmental and Social Impact Assessment or Preliminary Environmental Report - The EPA promised to fast track the permitting process to prevent delays in executing the project Others - The EPA was pleased with the proposed project because it will enhance the power supply in the Tamale Metropolis and promote good business environment for the communities

A11-120

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- The Regional Director of EPA indicated that EPA was glad that SAL Consult was enrolled on board as consultant to the project since SAL is noted for such commitments - The EPA promised to collaborate with the various stakeholders to ensure the project is undertaken
15. Traditional Authority, Tamale				
Gukpe Naa	Tamale Metropolis	Paramount Chief of Tamale		Awareness about Project - The chiefs expressed little awareness of the project and they have been duly apprised extensively - The chiefs unanimously support the JICA power enhancement project and called for completion of the project when it commences Land Ownership - The chiefs indicated that they are custodians of lands in the project area, particularly, where the transmission and distribution lines will traverse - The land upon which the substation will be built is a government land under the RCC - Land is made available for community development projects when the need arises Impact of the project - Project will lead to improved electricity supply to the metropolis - Leads to significant reduction in the frequent power outages experienced by residents - Loss of income to shop owners during excavation works for transmission and distribution lines Mitigation measures
Choggu Naa		Chief of Choggu		
Gumbihini Naa		Chief of Gumbihini		
Nyanshe Naa		Chief of Nyanshegu		
Kalpohim Naa		Chief of Kalpohini		

A11-121

Contact Person(s)	Location/District	Role	Contact No.	Issues/Concerns Raised and Information Received
				- Provision of timely and adequate information on excavation works to residents along the routes - Excavation areas should be cordoned-off - Timely payment of compensation to project affected persons where necessary - Reinstatement of properties should be done as soon as possible to prevent inconveniences to residents and businesses Economic Activities and Social Infrastructure in project area - The major economic activity of people in the communities is largely trading - Some residents in the project area, particularly RCC, are high- and middle-income earners - There is access to social infrastructure such as housing, health care, education and potable water in the project communities
16. Project affected persons (PAPs)				
111 PAPs (53 Male 58 Female)	Tamale Metropolis (PAPs were rather engaged one-on-one (door to door visits))	Local residents	-	Improvement in power supply – - Almost all the PAPs indicated that they expect the power situation in the area to improve with the implementation of the project. Resettlement – - Majority of PAPs expect cash compensation for impacts from the implementation of the project. Some also prefer both cash compensation and provision of a new structure (replacement of their affected structure) at their old or alternative site/location.

A11-122

9.0 CONCLUSION

The proposed Enhancement of Power Supply Project at Tamale in the Northern Region of Ghana will be implemented by NEDCo and funded by the Japan International Cooperation Agency in accordance with relevant Ghanaian laws as well as best international practices.

Generally, the scope of the project will have minimal impact on the environment as good construction and traffic practices will be adopted. Minor occupational and public health safety issues and impacts will be properly managed to prevent any serious incident/accident or conflict.

Compensation issues will be minimised through community sensitisation and involvement of affected persons during installation of poles and transmission lines as well as the construction of substation. Adverse effects will be minimised with the implementation of the proposed mitigation measures and residual impacts contained and controlled by implementing environmental management plan included in this report.

Stakeholder concerns arising out of the public consultation and involvement process will be properly handled or addressed and further consultations will continue during the implementation stage. The project implementation will be beneficial to the entire Tamale Metropolis and its environs as they will have access to stable electricity for domestic, institutional, commercial and industrial use with jobs created temporarily for locals during the construction stage of the project. Stakeholders, especially the project proponents, are therefore encouraged to ensure the implementation of the project to the benefit of the Tamale Metropolis and its immediate communities.

12. RCC 一次変電所用地取得に係るレター



NORTHERN ELECTRICITY DISTRIBUTION COMPANY
VRA/NEDCo
MEMORANDUM

TO: Director

FROM: Estate Manager

DEPT. /LOC: Services H/O, Tamale

DEPT. /LOC: Services H/O, Tamale

DATE: November 14, 2022

FILE: NEDCo/006/4645/2022

SUBJECT:

REQUEST FOR PAYMENT FOR PROCESSING OF CERTIFICATE OF ALLOCATION: SITE FOR NEDCO AT WATHERSON, TAMALE (0.97 acres)

We refer to the attached letter dated 10th November, 2022 from Lands Commission and your minutes enfaced on and seek for your approval to pay an amount of Fifteen Thousand Ghana Cedis (GHS15,000) as administrative and processing charges for preparation of Certificate of allocation.

This is in response to our earlier application to the Commission to acquire a suitable site at Watherson in Tamale for construction of MVA34.5/11.5Kv Substation.

We further attached a copy of the site plan detailing the location of the proposed site.

Submitted for your review and approval please.


Duah Adjei

ESTATE MANAGER, NEDCo

cc. Director Engineering, Tamale.

 16/11

Sec
pls copy MNPAD
for his info
 16/11



LANDS COMMISSION

NORTHERN REGION
P.O.Box TL 164
Tamale, Ghana
Tel: 03720 23080
Fax: 03720 23080
Email: lcnr@lc.gov.gh
Web: www.lc.gov.gh

My Ref No:

NR/HIP/12/21/10

Your Ref No:

10TH NOVEMBER, 2022

**THE DIRECTOR OF SERVICES
NORTHERN ELECTRICITY DISTRIBUTION COMPANY (NEDCo)
P O. BOX TL 77
TAMALE, NORTHERN REGION**

**RE; SITE FOR NORTHERN ELECTRICITY DISTRIBUTION COMPANY (NEDCO)
AT WATHERSTON (0.97 acres)**

The Northern Regional Lands Commission at its 5th Regular meeting held on 13th October, 2022 approved your application for construction of 40MVA, 34.5/11.5Kv substation. It has been noted, however, that your institution being a State Institution would rather be given a certificate of allocation instead of a lease.

This would enable you utilize the land for the services for which the Institution was established.

It would be appreciated therefore if you could pay an Administrative Charge of Fifteen Thousand Ghana Cedis (GH¢15,000.00) to this office towards the preparation and processing of the certificate of allocation

Please treat as urgent

Yours faithfully,

**(AG. REGIONAL LANDS OFFICER)
SAMUEL ATTA GYARTENG**

49.0 41 68/51

PLAN OF LAND

for: *NORTHERN ELECTRICITY DISTRIBUTION COMPANY(NEDCO)*

— *Shewn Edged Pink* —

Scale 1 : 2500

Area = 0.97 Acre (0.39 Ha.)

LOCALITY
WATHERSTON

DISTRICT
TAMALE METRO

REGION
NORTHERN

1721500 N

962500 E

1721500 N

963500 E



Bearings referred to
Meridian 1° West,
National Grid.

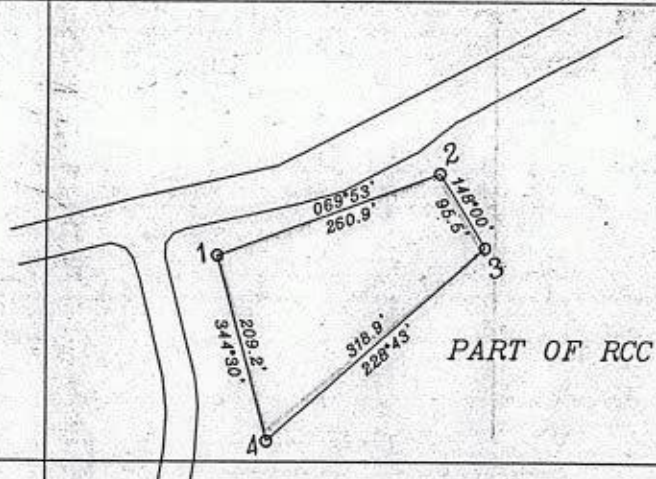
PILLARS NUMBERED 1 - 4 ON THIS PLAN
ARE PREFIXED BY SGN/C273/2022/

1721000 N

1721000 N

1720500 N

1720500 N



Beacon	Co-ordinates	
	X	Y
SGN/C273/2022/1	1720723.72	962686.48
SGN/C273/2022/2	1720813.47	962931.44
SGN/C273/2022/3	1720732.52	962982.02
SGN/C273/2022/4	1720522.14	962742.40

962500 E

963500 E

Approved By:

Surv. Robert Akutey Clotey
For Director, Survey & Mapping Division
Head, Survey & Mapping Division, N/R

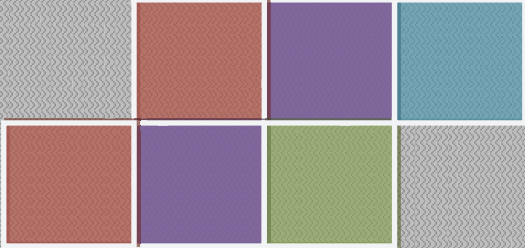
Date: 07/06/2022

HEAD
SURVEY & MAPPING DIVISION
NORTHERN REGION

Approved Seal

Approved Stamp

13. 簡易住民移転計画（ARAP）案





**YACHIYO
ENGINEERING CO.,
LTD.**

**ENHANCEMENT OF POWER SUPPLY IN
TAMALE**

**ABBREVIATED RESETTLEMENT ACTION
PLAN (ARAP)**

Prepared by:
SAL Consult Limited, P. O. Box GP20200, Accra, Ghana
September 2023



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ACRONYMS AND ABBREVIATIONS

ARAP	Abbreviated Resettlement Action Plan
DCF	Discounted Cash Flow
FGDs	Focus group discussions
FPIC	Free-prior- informed Consent
GC	Grievance Committee
GhIS	Ghana Institution of Surveyors
GRM	Grievance Redress Mechanism
KIIs	Key informant interviews
LVD	Land Valuation Division
MMDAs	Metropolitan, Municipal and District Assemblies
MoFA	Ministry of Food and Agriculture
NEDCo	Northern Electricity Distribution Company
NGO	Non-governmental organizations
OS	Operational Safeguard
PAPs	Project-affected-persons/Properties
PCU	Project Coordination Unit

COMPENSATION SUMMARY SHEET

#	Variables	Data
A. General		
1	Region ...	Northern Region
2	Municipality...	Tamale Metropolis Choggu, Gumbihini, Tshigu, Ward K, Agric Traffic Light, Regional Coordinating Council and Kalpohini Estate.
3	Communities ...	
4	Activity(ies) that trigger resettlement	
5	Project overall cost	Trenching and laying of transmission cables
6	Overall resettlement cost	-
7	Applied cut-off date (s)	GH¢ 670,017.18
8	Dates of consultation with the people affected by the project	15 th April 2023
9	Dates of the negotiations of the compensation rates / prices	30 th March - 4 th April 2023
B. Specific information		
10	Number of Structures affected by the project (PAP)	137
11	Number of Physically displaced	0
12	Temporary economic displacement (as a result of trenching of frontage of shop which is on the Right of Way). PAP cannot operate shop during trenching and will lose income).	76
13	Temporary inconvenience (due to trenching on bare ground/unpaved, only backfilling required)	37
14	Temporary inconvenience (due to damage to paved frontages of residence/ office/ shops, no displacement of PAP and business and offices can operate)	61
15	Number of females affected	56
16	Number of vulnerable affected	12
17	Number of major PAP	0
18	Number of total right-owners and beneficiaries	0
19	Number of households losing their shelters	0
20	Total area of lost arable/productive lands (ha)	0
21	Number of households losing their crops and/or revenues	0
22	Total areas of farmlands lost (ha)	0
23	Estimation of agricultural revenue lost (USD)	0
24	Number of building to demolish totally	0
25	Number of building to demolish totally at 50%	0
26	Number of building to demolish totally at 25%	0
27	Number of tree-crops lost	0
28	Number of commercial kiosks to demolish	0
29	Number of ambulant/street sailors affected	0
30	Number of community-level service infrastructures disrupted or dismantled	0
31	Number of households whose livelihood restoration is at risk	0

EXECUTIVE SUMMARY

0.1 Introduction and Project Intervention

The Japan International Cooperation Agency (JICA) in collaboration with the Northern Electricity Distribution Company (NEDCo) is providing funding for the Enhancement of Power Supply Project in Tamale in the Northern Region of Ghana. The project comprises the construction of a primary substation at the Regional Coordinating Council (RCC) as well as installation of transmission and distribution lines.

The project aims to guarantee and improve the basic quality of life for the residents of Tamale and its environs through a stable power supply for crucial services such as health and water supply in the Tamale metropolis and surroundings, as well as to increase the available power supply for new customers. This report represents the Abbreviated Resettlement Action Plan (ARAP) for the Project.

0.2 Legislative framework

This ARAP has been developed in line with the requirements of the Japanese International Cooperation Agency (JICA) Environmental and Social Consideration guidelines on Land Acquisition and Involuntary Resettlement and relevant and applicable national laws and regulations for resettlement planning and implementation of activities. These include the following:

- JICA ESC guidelines
- 1992 Constitution of Ghana
- State Lands Act of 1962 (Act 125)
- Lands (Statutory Wayleaves) Act of 1963 (Act 186)
- Ghana Land Policy of 1999
- Administration of Lands Act 1962, Act 123
- Environmental and Social Laws and Regulations

0.3 Category of Resettlement Impacts and Measures to minimise Impacts

The impact categories identified include:

- PAPs to be Temporarily Inconvenienced
- PAPs impacted by Temporary Economic Displacement
 - Temporary relocation (with or without loss of income); and
 - Temporary loss of income (i.e. no relocation)
- PAPs to suffer Permanent Economic Displacement
- PAPs to lose crop/use right of the property

0.4 Measures to minimize resettlement impacts

Recommendations from the design review to minimise resettlement impacts include:

- The contractor digging and laying cables alongside to minimise impact on businesses/commercial facilities whose frontages will be impacted.
- The contractor to include in its work plan, working at night for areas with heavy traffic congestion and commercial activities in order to minimise impacts on businesses and traffic.

Other measures include:

- Engaging inconvenienced persons not due compensations (who are not entitled to compensation) on how the impacts of the project on their activities could be managed;
- Ensuring timely backfilling of driveways/entrances and reinstatement of demolished paved surfaces of affected persons and organisations as a result of project activities; and
- Provision of wooden planks/steel plates or other suitable and safe measures to enable access over open trenches.

0.5 Census/Socioeconomic Survey and Valuation Exercise

Census and socioeconomic survey of all persons likely to be affected by the project was conducted from 5th December to 8th December 2023. An estimated 9 institutions and 165 individual PAPs were identified to be potentially affected directly by the implementation of the project.

During the valuation exercise, which was conducted from 10th April to 14th April 2023, 174 properties were captured. The Cut-Off date for the completion of census, socio-economic survey and asset inventory was April 15, 2023. The cut-off date has been communicated to all Project Affected Persons (PAPs) during the census/socioeconomic survey period. The census and socioeconomic data will be updated and reconciled with the valuation data as part of ARAP monitoring and evaluation.

The estimated total cash compensation payable to the PAPs (i.e. for affected properties, loss of income, relocation/disturbance, loss of standing crops and use right of land) under this ARAP is Five Hundred and Seventy-Six Thousand, Two Hundred and Six Cedis, Eighty-Four Pesewas (GH¢ 576,206.84) as at the final date of valuation of 14th April, 2023, and is based on the information available at the time of writing the report.

Compensation will be paid where necessary and the project sites and corridors handed over to the Works Contractors to commence works.

0.6 Institutional Arrangement

In terms of institutional responsibilities and monitoring implementation of the ARAP, recommendations are made in the table below:

No.	Institution	Role/Responsibility Description
1	JICA	• Will carry out external supervision for satisfactory ARAP implementation and provide support role throughout project implementation and monitor progress of project implementation.
2	NEDCo	• Responsible for the successful implementation of the project by engaging appropriate contractors and consultants for the execution of the project. • Has the oversight responsibility for the implementation of the ARAP.
3	ARAP Consultant	• Responsible for the preparation of the ARAP and Communication and Outreach Plan. • Responsible for ensuring that impacts are properly assessed and all PAPs are identified and their affected assets recorded and valued for adequate compensation. • Responsible for consultations with the PAPs and providing feedback on project/RAP implementation to the PAPs, NEDCo and JICA.

4	MMDAs	The relevant MMDA, Tamale Metropolitan Assembly, is the beneficiary local government authority where the project is being implemented. TaMA will be directly involved in the RAP implementation and will have representations on the Grievance Committee as well as the Monitoring and Evaluation Committee
5	Lands Commission (Land Valuation Division, LVD)	LVD will be invited to review and confirm values of affected properties and confirmation of land/property values when the need arises, especially during disputes or grievance redress issues concerning project affected persons.
6	PAPs	The PAPs will be required to select representatives to the grievance committee at the Assembly/Submetro level.

0.5 Grievance Redress Mechanism

The objective of the Grievance Redress Mechanism (GRM) is to provide an effective, transparent and timely system that would give aggrieved persons redress and avoid litigation, minimize bad publicity, avoid/minimize delays in execution of the project, and ensure sustainability of the Project.

The proposed GRM will consist of a three-tier resolution arrangement as follows:

- Local (project site) level;
- Grievance Committee Level (MMDA); and
- National legal level.

Regular monitoring and reporting are central to, and required for, effective management and implementation of the resettlement process. Resettlement monitoring and evaluation will focus mainly on the implementation of resettlement (i.e., compensation for displacement).

The ARAP monitoring will have two components, and these include:

- ✓ Process monitoring (internal); and
- ✓ Independent performance monitoring (external).

The ARAP Consultant will prepare and submit monthly and quarterly reports and a close-out report.

0.6 ARAP Implementation Plan

The implementation plan provides for indicative timelines for implementation of the ARAP as outlined below.

Main tasks	Specific tasks	Timelines/ Period	Comments
Stakeholder engagement	Meetings with stakeholders i.e. one-on-one, key informant interviews, focus group discussions	December –April 2023	Completed
Preparation of draft RAP	Census of affected persons	December - March 2022	Completed but monitoring required
	Socio-economic survey of PAPs	March 2023	Completed but monitoring required
	Field valuation of properties and reporting	April 2023	Completed

Main tasks	Specific tasks	Timelines/ Period	Comments
	Writing of draft ARAP report	May 2023	Completed
Revision and Finalization of draft Report	Review of draft ARAP	June 2023	Completed
	Revised ARAP preparation	August 2023	-
	Finalization of ARAP	September 2023	-
	Approval and clearance of ARAP	October 2023	-
Disclosure of Report	Disclose ARAP at the relevant MMDAs and on JICA website	October 2023	-
	Disclosure of compensation proposal/ figures to PAPs	October 2023	-
Formation of Grievance Committee	Grievance Committee	November 2023	-
Compensation payment	Compensation disbursement to PAPs	From December 2023	To be paid prior to commencement of subproject activity
Grievance Redress	Resolution of all disputes/ complaints	Project duration	-
Internal Monitoring and Evaluation	Monitor implementation of resettlement/ compensation activities	Project duration.	-
Reporting	Prepare Quarterly Progress Report	Every quarter during construction period	-
	Prepare ARAP Closeout Report after construction phase	One (1) month after construction phase	-

0.7 ARAP Implementation Budget

The cost estimates for the implementation of the RAP including direct compensation payments to PAPs, and contingency issues is **Gh¢ 670,017.18**.

0.8 Conclusion

This ARAP covers the seven identified project communities, Choggu, Gumbihini, Tshigu, Ward K, Agric Traffic light, Regional Council and Kalpohini Estate all within the Tamale Metropolis. A total of One Hundred and Thirty-Seven (137) permanent structures and Thirteen-Seven (37) Temporary structures were identified to be affected. Out of this, Ninety-Seven (97) PAPs would be temporarily inconvenienced (reinstatement of property/back filling required), Seventy-Six (76) PAPs would be temporarily displaced economically (cut through business structure which is on the RoW because it cannot be moved or easily moved), One (1) PAP would completely lose property.

Compensation will be duly paid from project funds to the project affected persons from an estimated budget of Six Hundred and Seventy Thousand, and Seventeen Cedis, Eighteen Pesewas (GHC 670,017.18). Also, concerns of PAPs, community members or any other persons will be adequately addressed by the Grievance Redress Mechanism proposed in this report. Sufficient provisions have been made for PAPs to receive their compensation and any necessary assistance.

1.0 INTRODUCTION

The Japan International Cooperation Agency (JICA) in collaboration with the Northern Electricity Distribution Company (NEDCo) is providing funding for the Enhancement of Power Supply Project in Tamale in the Northern Region of Ghana. The project comprises the construction of a primary substation at the Regional Coordinating Council (RCC) as well as transmission and distribution lines. The project aims to guarantee and improve the basic quality of life for the residents of Tamale and its environs through a stable power supply for crucial services such as health and water supply in the Tamale metropolis and surroundings, as well as to increase the available power supply for new customers. Also, the project is expected to ultimately contribute to loss reduction and revenue growth.

The RCC primary substation will serve as the main power source for the Tamale Central Hospital (TCH), which is the second-biggest hospital in the region. The hospital, which currently delivers healthcare to about 300–500 outpatients daily in Tamale, would be guaranteed a continued power supply. Additionally, it will also provide reliable power to businesses and residences in areas such as SSNIT, Sakasaka, the Regional Coordination Council, and Vittin. Due to its strategic location, not far from the center of town, the substation is expected to create new business opportunities for residents through the additional capacity to connect customers in the Central Business District (CBD) of Tamale City.

This report is the Abbreviated Resettlement Action Plan (ARAP) for the implementation of the Enhancement of Power Supply Project which includes the construction of a primary substation at the Regional Coordinating Council (RCC) as well as installation of transmission and distribution lines within the Tamale Metropolis. Per international best practice, when displacement impacts are not substantial, an Abbreviated Resettlement Action Plan (ARAP) is considered¹. A Preliminary Environmental Report (PER) has been prepared to take care of how to mitigate environmental/social impacts of the project hence that will not be addressed under this ARAP instrument.

1.1 Scope of Displacement and Involuntary Resettlement

The project is expected to mainly temporarily inconvenience PAPs who have structures along the RoW. However, project activities such as trenching could restrict locals/institutions access to their facilities. Dust is also an issue that will arise during the trenching, laying of cables and backfilling. The impact is local, and the displacement will be temporary as alternative sites exist. The impact is therefore considered moderately significant.

An assessment of the potential beneficiary communities, from December 5 to 8, 2022, showed that the affected number of structures/Persons (PAPs) within the Tamale Metropolis are one hundred and seventy-four (174). A total of One Hundred and Thirty-Seven (137) permanent structures and Thirteen-Seven (37) Temporary structures were identified to be affected. Out of this, Ninety-Seven (97) PAPs would be temporarily inconvenienced (reinstatement of property/back filling required), Seventy-Six (76) PAPs would be temporarily displaced economically (cut through business structure which is on the RoW because it cannot be moved or easily moved), One (1) PAP would completely lose property.

¹ When displacement impacts affect 200 PAPs or less, an Abbreviated Resettlement Action Plan is considered.

1.2 Purpose and Objectives of the Resettlement Action Plan

The purpose of the assignment is to conduct studies to prepare an ARAP of the proposed construction of a primary substation and installment of transmission and distribution lines within the Tamale Metropolis. The Project is committed to complying with the Japan International Cooperation Agency's (JICA) guidelines for Environment and Social Considerations, and World Bank's safeguards and national policies on involuntary resettlement.

The ARAP outlines the framework and principles for execution of the Project compensation/relocation/resettlement and livelihood related issues for project affected persons as early as possible in project development. This allows for early and effective disclosure to key stakeholders, and subsequent feedback and inputs. Despite the measures put in place to avoid livelihood displacement, a detailed resettlement action plan is required to mitigate any unforeseen eventualities.

The objectives of the assignment include the following:

1. Provide an understanding of what impact the project will have on persons living and operating in the project area.
2. Propose changes that aim at avoiding or minimizing livelihood disruption and involuntary resettlement impacts.
3. Ensure that impacts are properly assessed and all Project-affected-persons (PAPs) are identified and their assets that are affected are recorded and valued for adequate compensation.
4. Identified PAPs and valued affected assets, are provided with adequate compensation packages whether in cash or kind based on the extent of displacement.
5. Record grievances, and provide support for resolution of grievances.
6. Ensure stakeholders, including PAPs have been identified and engaged to ensure issues of concern to them are adequately addressed.

2.0 PRINCIPLES, POLICIES, LEGAL AND INSTITUTIONAL FRAMEWORK

This section provides an overview of Ghanaian national policy, legal and regulatory framework and international requirements related to acquisition of rights to land, resettlement and displacement. It summarizes the key national laws and policies that are relevant to project-related resettlement of structures and affected people.

2.1 Principles

The following principles based on the JICA ESC, have been applied in developing this ARAP:

- The ARAP should be based on a comprehensive social impact assessment that identifies the affected people, their assets, income sources, livelihoods, and needs.
- The ARAP should be prepared in consultation and participation with the affected people and other stakeholders, and reflect their views and preferences.
- The ARAP should provide adequate compensation and assistance to the affected people to restore their livelihoods and standards of living at least to pre-project levels.
- The ARAP should include not only cash payments but also other forms of assistance such as land-for-land exchange, income restoration programs, relocation assistance, and grievance mechanisms.
- The ARAP should be disclosed to the public and submitted to JICA for review and approval before the commencement of civil works or land acquisition that causes displacement or loss of income sources.

2.2 Legal and Regulatory Requirements

No.	Legal and Regulatory Requirement
1.	The Constitution of the Republic of Ghana, 1992 Article 20 of the Constitution of the Republic of Ghana (1992) concerns the protection from deprivation of property, and includes the following subsections: (2) Compulsory acquisition of property by the State shall only be made under a law which makes provision for: (a) The prompt payment of fair and adequate compensation; and (b) a right of access to the High Court by any person who has an interest in or right over the property whether direct or on appeal from any other authority, for the determination of his interest or right and amount of compensation to which he is entitled. (3) Where a compulsory acquisition or possession of land by the state ... involves displacement of any inhabitants, the State shall resettle the displaced inhabitants on suitable alternative land with due regard for their economic well-being and social and cultural values. (5) Any property compulsorily taken possession of or acquired in the public interest or for a public purpose shall be used only in the public interest or for the public purpose for which it was acquired.
2.	Ghana's National Land Policy, 1999 Ghana's Ministry of Lands and Forestry issued the National Land Policy in 1999. This policy provides the "framework and direction for dealing with the issues of land ownership, security of tenure, land use and development, and environmental conservation on a sustained basis" Policy guidelines include: (i) No interest in or right over any land belonging to an individual, family, clan, stool or skin can be compulsorily acquired without payment, in reasonable time, of fair and adequate compensation.

	(ii) Provided that payment of adequate compensation in reasonable time will be made, government may acquire land wherever and whenever appropriate to, among other things.... implement any rural or urban improvement programme provide social infrastructure
3.	The State Lands Act 1962, (Act 125) and the State Lands (Amendment) Act, 2000 (Act 586) This is the principal law under which lands can be compulsorily acquired in the public interest. The Act includes provision for the payment of compensation to those with a right or an interest in land acquired under the Act. The basis of the compensation includes the market value (also referred to as replacement value), and the cost of disturbance and damage. Community consultation and involvement during the resettlement process is not mandatory according to the Act.
4.	The Land Act, 2020 (Act 1036) The Act's stated object is to ensure sustainable land administration and management, and effective and efficient land tenure and it seeks to achieve this by, inter alia, establishing a broad-based framework for registering land rights and interests, a customary land rights framework and enhancing transparency and accountability in land governance institutions. Section 253 makes provision for the assessment and payment of compensation to project affected persons.
5.	The Office of the Administrator of Stool Lands Act, 1994 (Act 481) This Act puts in place a mechanism to ensure equal distribution of the benefits accruing from stool land resources. Stool lands include those belonging to, or are controlled by, a stool or skin and have allodial title for the benefit of members of that stool / skin or for the benefit of members of that community.
6.	The Administration of Lands Act, 1962 (Act 123) This Act relates to the administration of stool and other lands. Section 10 of the Act provides that "the President may authorise the occupation and use of a land to which this Act applies for a purpose which, in the opinion of the President is conducive to the public welfare or the interests of the State". It is a requirement that a public notice shall be published in the Gazette giving particulars of the lands to be taken and the use to which it will be put. Persons whose interests are affected by "reason of disturbance as a result of an authorisation" are entitled to be compensated.
7.	The Lands Commission Act, 2008 (Act 767) The Lands Commission Act, 2008 integrates four public sector agencies responsible for managing land: the Survey and Mapping Division; the Land Registration Division; the Land Valuation Division; and the Public and Vested Lands Management Division. The Commission's functions include: (i) managing public land on behalf of the government; (ii) advising the government, local authorities and traditional authorities on the policy framework for the development of land in accordance with relevant development plans; (iii) formulating and submitting to the Government recommendations on national policy with respect to land use suitability or capability; (iv) advising on, and assisting in the execution of, a comprehensive programme for the registration of title to land as well as registration of deeds and instruments affecting land throughout the country; (v) facilitating the acquisition of land on behalf of the Government; (vi) establishing standards to regulate survey and mapping of the country; (vii) undertaking land and land relative valuation services; and (viii) addressing protracted land boundary disputes, conflicts and litigations.

2.3 International standards

No.	International standard
1.	OECD Common Approaches The Organization for Economic Cooperation and Development Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence 2016 (the “OECD Common Approaches”) sets common approaches for undertaking environmental and social due diligence to identify, consider and address the potential environmental and social impacts and risks relating to applications for officially supported export credits by adherent organisations. They are applicable if an export credit agency that is an adherent to the OECD Common Approaches is involved in project financing. Of key relevance to managing Project-related resettlement, the OECD Common Approaches require that the project is reviewed against the IFC PS, including PS5 on involuntary resettlement.
2.	JICA Guidelines Applicability of JICA’s Guidelines for Environment and Social Considerations (hereinafter, ESC) is required if a project is funded by JICA. If a significantly adverse impact on the environment or society has been identified in JICA-assisted projects, the following has to be thoroughly considered and studied 1. ESC are pre-requisite a. JICA will take necessary measures to ensure that the appropriate ESC is given; b. When JICA reviews a project proposal and finds that the project could cause negative impacts on the environment or society, JICA advises the project proponents to provide appropriate ESC; c. If the negative impact of the project cannot be avoided or mitigated to an acceptable level, JICA will not support its implementation. 2. Respect human rights a. Development project should aim for fair distribution of its benefits and must not burden or exclude certain stakeholders for the sake of others; b. The project proponents must respect the rights of all people concerned, and pay special attention to vulnerable social groups such as women, elderly, the poor, people with disabilities, indigenous peoples, ethnic minorities, and other minority groups to ensure that they are involved in decision-making processes and that they benefit from the project; c. JICA’s ESC Guidelines defines ‘stakeholders’ as local residents including non-titleholders who are affected by the project as well as local NGOs. By involving local stakeholders from the early stage of the project, the project proponents can receive their inputs and plan appropriate measures to address their concerns, avoid conflict, and achieve higher results with their support. For this reason, the project proponents should conduct a series of consultations with local stakeholders in an interactive and meaningful manner. During this process, appropriate consideration must be given to socially vulnerable or different people such as women, children, the elderly and ethnic minorities. 3. Avoid adverse impacts a. Priority should be given to the avoidance of adverse impacts on the environment or society when a project is planned; b. Minimization or mitigation of impacts should be considered only if avoidance is not feasible and if the benefit of the project outweighs the cost of mitigation measures; c. The project proponents must assess the environmental and social impacts at the earliest possible stage of planning, and implement ESC measures in accordance with the ESC Guidelines.

4. Information on ESC must be disclosed to the public
 - a. Information disclosure is key in ESC. Project proponents must proactively release relevant information to the public;
 - b. Sharing information with a wide range of stakeholders from the early stage, the project proponents can utilize their feedback to improve the plan/project. In addition, the project proponents can ensure that unnecessary concerns and misunderstandings among the stakeholders are ameliorated.
5. Host country’s laws, standards, policies and plans

JICA-funded project must comply with the laws, standards, policies, and plans of the host country;

 - a. If the standard set by the host country differs from the international standard, the project proponents are advised to adopt international standard that better serves the purpose of attaining a higher level of ESC.

The World Bank’s Safeguard Policies

ESC in a JICA project must be in line with the World Bank’s Safeguard Policies including:

 - a. Operational Policy on Environmental Assessment (OP 4.01);
 - b. Natural Habitats (OP 4.04);
 - c. Involuntary Resettlement (OP 4.12);
 - d. Indigenous Peoples (OP 4.10) and other relevant policies.

2.4 Gap analysis of national law and international standards

A gap analysis of the requirements for resettlement under national law compared to the applicable international standards (JICA ESC), is provided in Table 1.

Table 1: Gap Analysis of the Resettlement Requirements under National Law and Applicable International Standards

Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Timing of compensation payment	Prompt payment of fair and adequate compensation. Compensation must be paid prior to any commencement of the development. The State shall resettle displaced inhabitants on suitable alternative land with due regard for their economic well-being, social and cultural values. Compensation for stool land to be paid to the traditional authority and not to those losing access to land.	The compensation should be paid before the commencement of civil works or land acquisition that causes displacement or loss of income sources. The compensation should: - be sufficient to restore the livelihoods and standards of living of the affected people at least to pre-project levels. - include not only cash payments but also other forms of assistance such as land-for-land exchange, income restoration programs, relocation assistance, and grievance mechanisms. - be based on a fair and transparent process that involves consultation and participation of the affected people and respects their rights and preferences	Certainty that compensation is provided prior to impacts occurring.	Compensation payments will be timed such that gaps in income and livelihood activity can be avoided. The Project will take responsibility for issuing compensation payments to have direct on-the-ground control over payments and ensure that payments are made before civil works commence.

Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Amount of compensation	Market value or replacement value and disturbance cost. There is no specific provision for assistance with relocation or transaction costs.	Compensations must be: - sufficient to restore the livelihoods and standards of living of the affected people at least to pre-project levels. - based on the replacement cost of the lost assets or income sources, without depreciation or deduction for taxes or fees. - include not only cash payments but also other forms of assistance such as land-for-land exchange, income restoration programs, relocation assistance, and grievance mechanisms. - take into account the needs and preferences of the affected people, especially vulnerable groups such as women, children, elderly, disabled, ethnic minorities, or indigenous peoples.	Compensation for loss of assets is not at full replacement cost. Therefore, requirement to validate that government valuation of affected assets reflects full replacement cost. There is no specific provision for other assistance for relocation or transaction costs associated with improving or restoring standards of living or livelihoods.	Project consultant will monitor compensation rates approved by Land Valuation Division (LVD) to verify that they reflect full replacement costs.

SAL Consult Limited		JICA/NEDCo/YEC		
Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Resettlement [Physical displacement]	Physically displaced inhabitants are to be resettled on suitable land with due regard for their economic well-being and social and cultural values.	The resettlement should be avoided or minimized as much as possible by exploring alternative project designs or locations. Resettlement should: - be planned and implemented with full consultation and participation of the affected people and other stakeholders. - Be based on a comprehensive social impact assessment and a resettlement action plan that address the needs and preferences of the affected people. - provide adequate compensation and assistance to the affected people to restore their livelihoods and standards of living at least to pre-project levels. - be monitored and evaluated by the project proponents and JICA to ensure its effectiveness and sustainability.	Requirement to provide a choice of options for compensation, including cash. Requirement to cover all costs for relocation assistance.	There is no physical displacement or land acquisition as the project is designed to minimize displacement.

SAL Consult Limited		JICA/NEDCo/YEC		
Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Squatters	No provisions. Squatters are deemed ineligible for compensation.	Squatters should be: - recognized as affected people and entitled to compensation and assistance for their lost assets or income sources unless there are compelling reasons to exclude them. - consulted and informed about their options and rights regarding resettlement or relocation. - provided with adequate alternative housing or land that is acceptable to them and that improves their living conditions. - given opportunities to participate in the planning and implementation of the resettlement or relocation program.	Requirement to recognise the eligibility of those without legally recognisable claims to land at the cut-off date.	All eligible owners of pre-cut off date assets (buildings, structures etc.) will be considered for compensation and treated equally regardless of legal tenure.

SAL Consult Limited		JICA/NEDCo/YEC		
Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Vulnerable Groups	No provision.	The protection of vulnerable groups should: - be based on a comprehensive assessment of their characteristics, needs, preferences, and potential impacts. - include measures to avoid or minimize adverse impacts, as well as to enhance positive impacts and opportunities for them. - ensure their meaningful consultation and participation in the project planning and implementation. - respect their human rights, dignity, culture, identity, and livelihoods. - be monitored and evaluated by the project proponents and JICA to ensure its effectiveness and sustainability.	Requirement to identify vulnerable persons and provide additional measures and supports for them as per the applicable standards.	Potentially vulnerable people have been identified. Additional support measures will be provided based on the specific vulnerabilities and may be in the form of financial or non-financial support.

SAL Consult Limited		JICA/NEDCo/YEC		
Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Livelihoods Restoration & Resettlement Assistance	No provision	The livelihood restoration should be based on a comprehensive assessment of the pre-project income sources, skills, and needs of the affected people. The livelihood restoration should: - provide adequate compensation and assistance to the affected people to restore their income sources and standards of living at least to pre-project levels. - include not only cash payments but also other forms of assistance such as vocational training, job placement, microfinance, or income-generating activities. - be planned and implemented with full consultation and participation of the affected people and other stakeholders. - be monitored and evaluated by the project proponents and JICA to ensure its effectiveness and sustainability	Requirement to support businesses financially and administratively to re-establish their business activities and restore livelihoods for business owners and employees.	For those that are eligible, livelihood restoration and assistance will include: - Moving allowances for structures and other assets; - Loss of earnings for business and employees during the transition period; and - Administrative support and fees for acquiring business permits.

Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Consultation and Information Disclosure	The owner/ tenants on the land must be formally notified at least a week in advance of the intent to enter and be given at least 24 hours' notice before actual entry.	The consultation and information disclosure should: - be conducted throughout the project cycle, from planning to implementation and post-evaluation. - be meaningful, timely, accessible, inclusive, and culturally appropriate. - provide relevant information on the project objectives, scope, impacts, mitigation measures, benefits, risks, and grievance mechanisms. - seek feedback and inputs from stakeholders, especially affected people and vulnerable groups, and reflect them in the project design and implementation. - be documented and reported by the project proponents and JICA to ensure transparency and accountability.	Requirement to provide advanced notice of requirements for displacement, and to disclose the proposed compensation and livelihood restoration packages.	Stakeholders will be continually engaged, given relevant project information and their opinions and concerns on the project solicited as indicated in the information disclosure section of this RAP. Further updates will be provided on planned activities and the processes for displacement, as well as disclosure of eligibility and entitlements including compensation and livelihood restoration packages.

Resettlement issue	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Grievances	Formal and informal mechanisms and formal access to court of law.	The grievance mechanism should: - be established and operated by the project proponents in consultation with the affected people and other stakeholders. - be accessible, transparent, fair, timely, culturally appropriate, and gender-sensitive. - provide information on how to file a complaint, how it will be handled, and what remedies are available. - should seek to resolve complaints through dialogue and mutual understanding, and avoid retaliation or intimidation against complainants. - be monitored and evaluated by the project proponents and JICA to ensure its effectiveness and responsiveness.	Requirement to establish and disclose a robust and transparent grievance mechanism.	A Grievance mechanism will be established to address any concerns relating to the project. This will be tiered to provide multiple opportunities for the prompt resolution of grievances.

3.0 BASELINE CHARACTERISTICS OF PROJECT AREA

3.1 Overview of the beneficiary metropolis

3.1.1 Demography

The Metropolis has a total population of 374,744 comprising 185,051 (49.4%) males and 189,693 (50.6%) females. This is about 16.2% and 1.2% of the regional and national population respectively. The population density is 825 per sqkm with a total of 89,011 households and a household size of 4.1 persons per household which is lower than the regional average of 5.2 (Population and Housing Census, 2021).

There are four main types of dwelling units in the Metropolis. These are the separate isolated houses (Self Contained), the semi-detached houses, separate room (s) within a compound usually with common cooking and toilet facilities, and several huts or buildings within a common compound. These dwellings are identical of certain communities in the Metropolis.

According to the 2021 Population and Housing Census, all the people in the metropolis (100%) live in urban areas as compared to 80.8% in 2010. This makes the metropolis one of only two entirely urban districts in the region with the second being Tamale South.

The Metropolis is occupied by diverse ethnic and tribal groups with Dagombas being the traditional occupants of this area (more than 80%). Other tribal groups include the Gonja, Mamprusi, Nanumba, Konkomba, Asantes, Ewes, Hausa and some other minorities. This composition is important for inter-tribal cooperation which is required for peace and development in the Metropolis.

Majority (90.5%) of the population in the Metropolis is Muslim and followed by Christians. About (0.2%) have no religious affiliation. Among the Christians, the Catholics have the highest proportion of 3.0%, followed by Pentecostal/Charismatic (2.4%) and Protestants (2.4%). The proportion of traditionalist in the Metropolis is only 0.3%.

3.1.2 Education

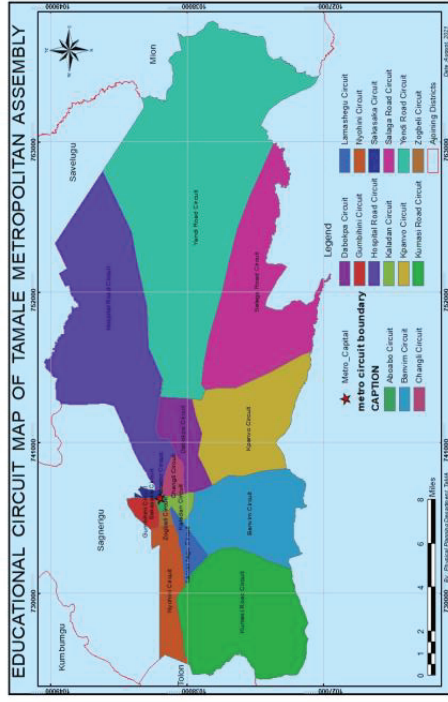
Currently, 60.1% of those aged 11 and up are literate, while 39.9% are illiterate. About 27.2% are literate only in English, 9.4% in a Ghanaian language, and 61.8% are literate in both English and a Ghanaian language. Less than 1% of the population is literate in English and French (0.4%) and for all the three languages (English, French and a Ghanaian language) the proportion is 1.1%. The number of female illiterates is higher than that of males.

Around 81.5% attend primary schools (Nursery, kindergarten, primary, JSS/JHS), 11.6% attend secondary/senior high schools, 0.7 percent attend vocational/technical/commercial schools, and 4.6% attend tertiary institutions. The majority of people who have previously attended school (43.0%) have completed at least the primary level. The primary level had the highest proportion of students attending school.

Resettlement & Evaluation	Ghanaian legislative requirement	Requirement under applicable JICA Environmental and Social Considerations (ESC) guidelines.	Potential gap	Gap closure
Monitoring & Evaluation	No provision.	Monitoring and evaluation should: - be conducted by the project proponents throughout the project cycle, from planning to implementation and post-evaluation. - collect and analyze relevant data and indicators on the environmental and social performance of the project, as well as the effectiveness and sustainability of the mitigation measures. - report and disclose the results and findings of the environmental and social assessment, consultation, grievance mechanism, and other related activities. - use feedback and lessons learned to improve the project design and implementation, as well as to inform future projects. - be supported and reviewed by JICA to ensure its quality and compliance with the ESC Guidelines.	Monitoring and evaluation of the ARAP implementation. Completion audit.	A monitoring and evaluation program is included as part of the ARAP implementation program and a completion audit will be undertaken.

The Metro Education Directorate (MED) is headed by the Metropolitan Director of Education. This Directorate has the oversight responsibility of providing relevant education to all humans living in the Metropolis and to develop their potential to be productive, facilitate poverty reduction and promote socio-economic growth and development.

All the public Basic Schools are distributed among educational circuits in the Metropolis (**Figure 1**). The school system is run in three terms in an academic year beginning August/September. There are a number of Circuit Supervisors who inspect, supervise and monitor teaching/ learning activities within that circuit.



Source: TaMA Medium Term Development Plan, 2021

Figure 1: Educational Circuits within the Tamale Metropolitan Area

3.1.3 Economic Activities

According to the 2010 Population and Housing Census, the occupation with the highest population in the Metropolis was service and sales work (33.0%). This was followed by those in the craft and related trades workers (21.5%). The proportion of the employed persons engaged in skilled agriculture, forestry and fishery was 17.6%. There were more males compared to females in almost all the occupations with the exception of service and sales (16.5% for males and a large proportion (50.3%) for females. Also there were more females (11.3%) than males (6.1%) in the elementary occupations.

In industry, wholesale and retail, repair of motor vehicles and motorcycles had the highest employed population (33.4%) with (22.1%) being male and (45.4%) female. Agriculture, forestry and fishing workers are the next major occupation in the Metropolis with a proportion of 18.2% of both sexes and with (24.4%) males and (11.8%) female. The next occupation that follows is manufacturing (12.5%), employing (12.1%) males and (12.9%) females. Wholesale, agriculture and retail and manufacturing account for 64.1% of the industrial base of the Metropolis.

Out of the total employed population, 11.3% are in public (government) sector while 83.2% are in private informal sector. A few persons are in NGOs (local and international) constituting 0.5 per cent. In the private informal sector, 76.5 per cent are males while 90.2% are females. Semi-public/parastatal has a negligible percentage of 0.1.

The 2010 PHC revealed that about half the population of the metropolis is engaged in agriculture. More than half (56.3%) of the population in the urban areas are engaged in agriculture whereas less than half (43.3%) of the population in the rural areas are also engaged in agriculture. Agricultural activities include crop farming (excluding gardening), tree growing, and livestock rearing. Crop farming is most dominant in the Metropolis as a whole accounting for more than half (52.9%) of the population in the urban areas while less than half (43.3%) of them are also in the rural areas. Livestock rearing accounted for 49.8% and 50.2% of urban and rural households respectively. There is more livestock rearing in the rural areas (50.2%) as compared to the urban areas (49.8%).

3.1.4 Utilities and Services

Energy

The three main sources of lighting for most households are electricity (main grid), constituting 82.2% of households, kerosene lamp (11.6%) and flashlight/torch (4.7%). Most households in the metropolis use two main sources of cooking fuel; charcoal, which is used by 94.3% of households, wood (52.9%) and gas (89.6%).

The Metropolis enjoys electricity supply from the National Grid and about 80% of the communities are connected. Electricity supply has been fairly stable. This could be an advantage to heavy industrial development that would depend mostly on energy for production. With the expansion of electricity in the Metropolis, there is also an expansion of the Small and Medium Scale Enterprise businesses in the area.

Water

Most households in the metropolis depend on either pipe-borne water outside their dwelling or pipe-borne water inside their dwelling (representing 41.4% and 39.8% respectively). The main water system in the Metropolis is pipe borne water from the Dalun and the Nawuni Water Treatment Plants which is rationed and managed by the Ghana Water Company Limited. Some communities have difficulty with water supply due to old pipe lines structure or their location i.e. high land areas. The Ghana Water Company Limited supplies over 45,000 cubic meters daily. Sachet water firms have therefore taken advantage of this opportunity to establish plants to utilize this resource in the area which is also creating employment opportunities for the youth. Other water facilities are town water systems, mechanized boreholes and wells.

Sanitation and Waste Management

The most widely used method of solid waste disposal is by public dump (container) accounting for 98.3% households. About 72.5% of households have their solid waste collected with the remaining households resorting to indiscriminate dumping.

Solid waste generated daily in the metropolis is managed mostly by dumping at the landfill with about 250 tons of waste disposed of in landfills daily. The landfill site at Gbalahi has a huge potential for the generation of not only bio-gas but also for generation of fertilizer which could be very useful to farmers but the challenge is that the waste is not segregated. The Assembly in collaboration with UNICEF is trying to develop a system that could separate liquid and solid wastes to ensure full utilization of the waste.

The commonest toilet facility is used by 56.2% of households in the metropolis and that is public toilet (WC/KVIP/Pit latrine/pan). The use of Kumasi Ventilated Improved Pit (KVIP) is the second commonest used by just 7.1% of households. As much as 26.1% of households in the district have no toilet facility. The commonest bath facility for most households (39.3%) in the metropolis is shared separate bathrooms in the same house. Only 24.6% of households own bathrooms for their exclusive use. For grey liquid waste disposal, most households throw onto the street/outside, into gutters or storm drains.

Communication

TaMA enjoys telecommunication services with an increase in telecommunication service providers such as Airtel-Tigo, Vodafone, Glo and MTN. RLG Limited has also sited their company in the metropolis which is serving as a source of employment for the youth. Broad band service in the Metropolis is also encouraging which links the Assembly to the worldwide web. This has ensured competitive service delivery in the area. Besides, business activities are done with partners on a faster schedule globally.

Media activities are now vibrant with an increase in radio stations, television stations and newspaper supply vendors. The Media houses are avenues for organizing educative programmes especially on government policies in the illiterate population in the local languages. The major problem with the newspapers is that, they arrive in the Metropolis very late and as such the public cannot afford to read current news items. With technological advancement there would be the need for a newspaper printing press located in the Metropolis to serve the three Northern Regions of the country.

Health

The Health services in the Metropolis are managed at three (3) levels namely: Metro. Health Administration level, Sub-district level and the Community level. The Metropolis is sub-demarcated into sub-districts each with a management team known as the Sub-district Health Management Team (SDHMT). The sub-districts are:

- Buipela Sub-district
- Tamale Central Sub-district
- Vitin Sub-district

The SDHMTs are responsible for programme planning and implementation of health activities in their various sub-districts, some of them include:

- Conduct integrated static and outreach activities such as immunization, reproductive health, disease control, growth monitoring, health education/promotion and clinical care

- Training and supervision of community-based health workers such as traditional birth attendants (TBAs), Community Based Surveillance (CBS) volunteers, village Health Committees.

Health services are provided at the community level by sub-districts staff supported by TBAs, CBS volunteers.

Transportation

The major transport services in the area are taxi cabs with a main taxi station at the Central Business District (CBD). There is also an enormous usage of motorbikes and tricycles within the metropolis which is the main source of affordable transport for both males and females. State bus services such as the State Transport Company and Metro Mass Transit, and other private bus services like OA Transport link the Metropolis with other cities and towns in the country.

For easy transport of goods and services, EMS, FEDEX, DHL and others offer fast and reliable express services from the Metropolis to other places. There is a National Airport located at Mile 9. Major airlines such as Africa World Airlines and Passion Air offer domestic air services to customers in and around the Northern part of the country.

The roads in the Metropolis are fairly good especially those that link the Metropolis to other district capitals. The tarred roads in the area facilitate easy commuting from one place to the other. There is no traffic congestion. Most of the farming communities are linked to the marketing centers by feeder roads. The availability of access roads linking farming communities is an incentive to the farmers since postharvest losses is reduced. Although most of the roads are tarred, some linking the regional capital to the remotest of areas are yet to be tarred. Others have been graveled but yet to be tarred.

3.1.5 Land Ownership/Tenure

Land ownership follows a patrilineal system with regards to land inheritance. Accordingly, inheritances can go to the male's sons or brothers. Where royal land is involved, as in the case of chieftains, land and right to chieftaincy may be passed on from a father to his sons, who are wards of the father's brother on the understanding that the right to the land and chieftaincy should rotate among the sons of the father and the father's brother.

Land ownership in traditional society tends to be acknowledged by communal recognition and observation, or that of the ruling traditional elder. Deeds or papers are not usually involved, nor are lawyers. The existence of deeds or papers usually indicates a previous dispute over the land which was taken to the court system. When a conflict emerges the traditional avenue for resolution is to have the traditional elder arbitrate. However, this process usually only works when both parties respect the traditional elder. If one or both parties lack confidence in the traditional elder, local politicians are frequently asked to arbitrate.

Land disputes may be taken to the court system, but these are costly, and, in the case of royal land, they can drag on as each party seeks to appeal every judgement that goes against it. In some areas, recourse to the courts is less likely because of the costs involved and less acceptance of that system as a dispute settling mechanism.

4.0 CENSUS AND SOCIOECONOMIC CONDITION OF PAPs

The census and socioeconomic condition of project affected persons (PAPs) is a crucial component of an ARAP. It provides a baseline data on the demographic, occupational, income, asset, and vulnerability status of the PAPs before the implementation of the project. The census and socioeconomic condition of PAPs also helps to identify the eligible beneficiaries for compensation, resettlement, and livelihood restoration measures. The census and socioeconomic condition of PAPs for this project was conducted in a participatory and transparent manner, involving the PAPs and other stakeholders. This section presents findings from data collected from 31st March to 4th April, 2023.

4.1 Methodology and Approach to Data collection

A mixed approach involving simple quantitative and qualitative methods were employed in gathering data and information to prepare this ARAP. An initial enumeration of the affected persons and properties was undertaken from 5th to 8th December, 2022 and confirmed from 31st March to 4th April, 2023 during the field survey exercises.

Data was obtained through direct primary and secondary sources. Primary data gathered were captured electronically using the Kobocollect tool and organized, using basic Microsoft Excel application. These helped to generate descriptive statistics in the form of graphical and tabular frequencies and percentages for quick comparisons and drawing of inferences about indicators selected.

One hundred and Seventy-four (174) PAPs from 7 communities were identified from the survey as shown in Table 2. These PAPs were identified along the route for underground transmission lines within the Tamale Metropolis.

Table 2: Project Beneficiary communities

No.	Community	Number of Affected Persons
1	Choggu	55
2	Gumbihini	3
3	Kalpohini Estate	25
4	Tishigu	28
5	Ward K	58
6	Agric Traffic Light	3
7	Regional Coordinating Council	2
	Total	174

4.2 PAPs Socioeconomic Baseline

Collection of primary baseline data was done through a socio-economic census survey targeting households identified as being impacted by the Project. A copy of the data collection instrument for the census and socio-economic survey is attached as Annex 2.

The socioeconomic baseline is presented in the following sections:

- Demographics
- Education and literacy
- Economic activity
- Employment
- Health
- Income and expenditure
- Vulnerability

4.2.1 Demographics

Quantitative demographic data, asset ownership, livelihood and vulnerability data among others were collected by administering a census questionnaire to Project Affected Persons (PAPs). Focus Group Discussions and Key Informant Interviews were used to identify persons that could potentially be affected.

Also, a field team assessed the project area and identified property owners. The survey was therefore administered to all available PAPs potentially losing assets or access to assets that leads to loss of income sources or means of livelihood as a result of the project.

A total of One hundred and seventy-four (174) PAPs were identified (which constitutes 74 PAPs and 38 Representatives of PAPs), out of which one hundred and twelve (112) respondents were interviewed. The remaining owners of the sixty-two (62) affected properties were not engaged due to the under listed factors:

- absence due to the unavailability of the PAP/ the property being uncompleted;
- non-cooperative PAPs; and
- untraceable PAPs for abandoned properties.

A summary of the number of PAPs and number of respondents is provided in the Table below.

Table 3: Number of PAPs and Respondents

Type of affected structure	Number of affected persons	Number of Respondents
Shops	148	108
Driveways/Walkways/Drain	13	0
Institution/Organization	9	0
Residential Building	4	4
TOTAL	174	112

The total number of occupants within the Four (4) no. residential buildings is Forty-five (45). There are 30 occupants in a compound house with multiple apartments. The other 3 residential buildings have five (5), three (3) and two (2) occupants each.

Sex

The Metropolis has a total population of 374,744 comprising 185,051 (49.4%) males and 189,693 (50.6%) females. The trend is similar with the number of respondents. Out of the total 112 respondents, 56 representing 50% were female and 56 representing 50% were male (**Figure 2**).

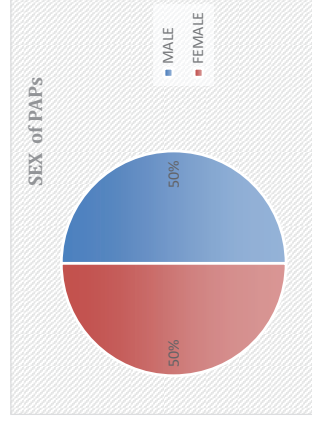


Figure 2: Sex of Respondents

Age

The metropolis has a very youthful population with about 80% below 60, according to the 2021 Population and Housing Census. In the project affected communities, the trend is similar as majority (81.0%) of the project affected household population was found to be below 60 (**Figure 3**).

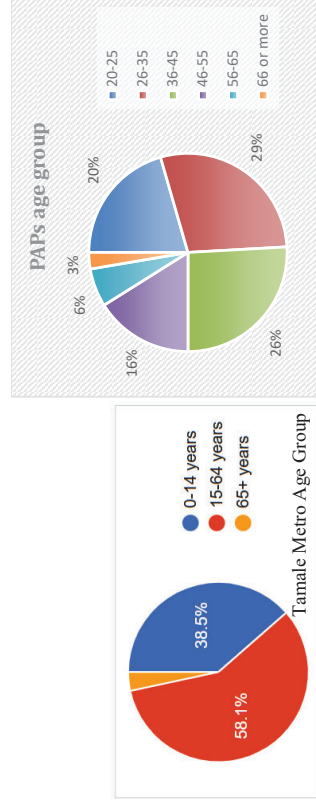


Figure 3: Age distribution of Tamale Metropolis(left) and Respondents (right)

Marital Status

Most (69%) of the respondents indicated that they are currently married, with 27% being single and 4% having lost their spouses (Table 3-4). Most of the respondents who have lost their spouses were females.

Table 4: Marital Status of Respondents

Marital Status	Total Number of Respondents	Percentage (%)
Married	77	69
Single	30	27
Widow/er	5	4
Total	112	100.0

Ethnicity

The Metropolis is occupied by diverse ethnic and tribal groups. The most prominent ethnic group is the Dagombas being the traditional occupants of this area (more than 80%). Other tribal groups include the Gonja, Mamprusi, Nanumba, Konkomba, Asantes, Ewes, Hausa and some other minorities.

Religion

Islam is the predominant religion with 88.3% of the interviewed PAPs being Moslems and 11.6% being Christians.

4.2.2 Education and Literacy

Out of the total number of 112 respondents, 18 (16.07%) have had no formal education whereas 94 (83.93%) have had some form of formal education with majority having their highest education as SHS. The proportion of the population who are literate in English only is higher among the younger ages (11-24 years) compared to the older cohorts. This pattern may reflect the impact of the policy increasing access to education at all levels. On the other hand, literacy in Ghanaian language only is more common among both male and female older cohorts of the population than the younger cohorts.

Table 5: Level of education of respondents

	Educational level					Total
	Never Attended	Primary	JHS	SHS	Tech/Vocational	
Number of PAPs	18	15	28	42	7	112

Source: Census Survey, March 2023, SAL Consult.

4.2.3 Economic activity

Artisanal works such as dressmaking, motor/car mechanic, auto electrician, electrical engineering, fridge and air-condition repair, rubber stamp making and sign post and bill boards making, vulcanizing, installation of satellite TV dishes, hair dressing salon and welding make up the majority of the main occupation of the respondents with 62 (55.4%) being Artisans (Figure 4).

Also, most (86.6%) respondents do not have a minor or secondary occupation. They heavily depend on their main occupation for livelihood (Figure 5).

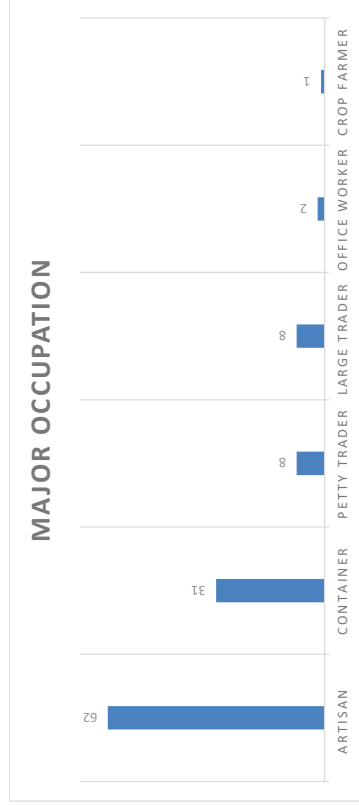


Figure 4: Main occupation of respondents



Figure 5: Minor Occupation of Respondents

4.2.4 Employment

Half (53%) of the interviewed persons indicated that they are self-employed, 24% were employed fulltime, 23% in temporary employment and none unemployed.

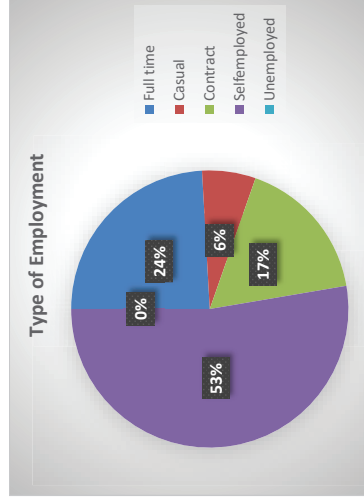


Figure 6: Type of employment of respondents

4.2.5 HealthCare

About 45 (40%) of the respondents affirmed that they had not experienced any form of sickness in their households in the past three (3) months, with the other 67 (60%) reporting the most common form of sickness as malaria/fever (68%), followed by diarrhea (13%), and Skin rashes/itches (11%). The Other sicknesses making up (8%) include sicknesses such as ulcer, headaches, body pains, arthritis and diabetes.

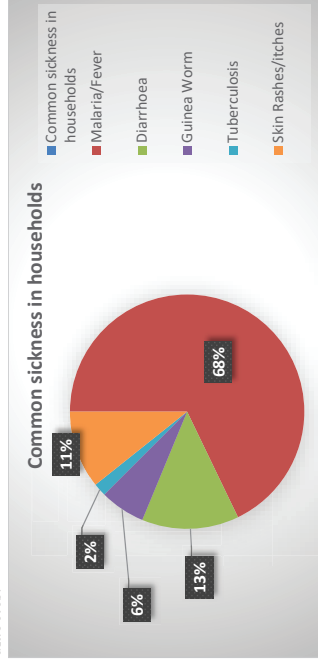


Figure 7: Common sicknesses in households

The most visited healthcare facilities are the traditional medicinal counters and the public hospitals making up a total of 67% of the healthcare coverage provided in the area. The main reasons given for choosing these type of healthcare facilities were their closeness to the houses of the respondents and the efficacy of the medication provided. Other reasons provided include low cost and religious and traditional beliefs.

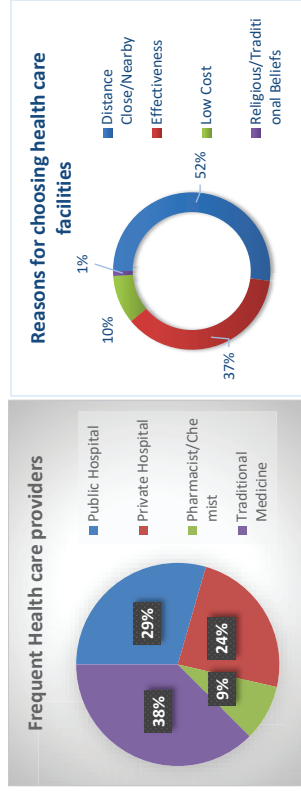


Figure 8: Types of healthcare services and reasons for visit

4.2.6 Income and expenditure

Income

The average monthly income for shops in Tamale Ghana depends on various factors, such as the type of shop, the location, the size, the products or services offered, and the customer base. Out of the total number of respondents who were asked about their average monthly income, majority (67%) which is 75 PAPs had their incomes to be within the 600gh - 1000gh range. 5% was above 1000gh and the remaining 28% had incomes below 500gh.

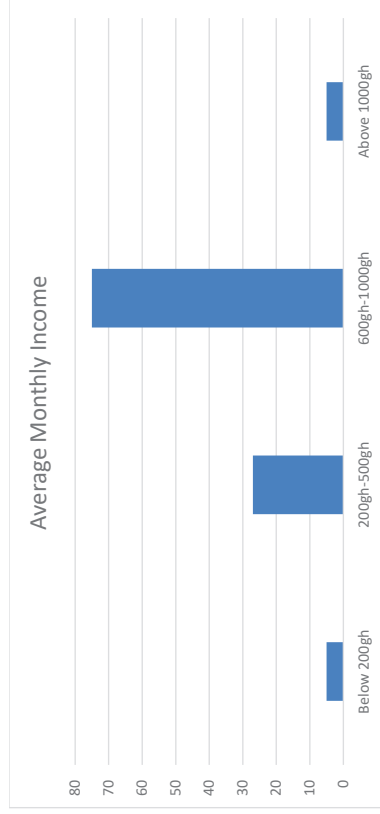


Figure 9: Major household expenditure

Expenditure

The respondents were asked about their major household expenditure items. A multiple response ranking placed food first with 60 and then education second with 37 respondents, Remittances

constituted the least expenditure with only 2 counts. The **OTHER** category consists of expenditures such as donations to church and charities and expenditure on recreation.

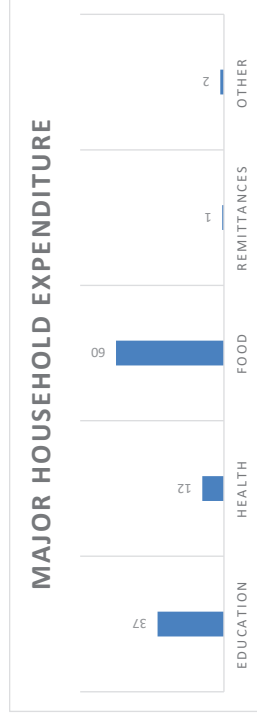


Figure 10: Major household expenditure

The breakdown of the most popular household expenditure food, healthcare, education, and remittances from the various households engaged in the interviews. The breakdown includes the average expenditure per day, week and month.

The average daily expenditure on education was Ghc 50.00 per household, on healthcare was Ghc 20.00 per household and on food was Ghc 65.00 per household. The average weekly expenditure on remittances was Ghc 120.00 per household.

4.2.7 Vulnerability

Vulnerable groups are those at risk of becoming more vulnerable due to impacts from project implementation. These vulnerable people include, but not limited to:

- disabled persons, whether mentally or physically challenged;
- the elderly, usually from 70 years and above;
- very sick and or physically weak individuals;
- people without formal land rights;
- women and female headed households; and
- children

Out of the 112 Respondents, based on the above mentioned criteria, 12 PAPs were identified to be vulnerable with nine (9) female heads of household, two (2) male head of household above 65 years and one (1) female head of household above 65 years.

Table 6: Vulnerable groups identified

Vulnerable Groups	Number of PAPs
Female headed households	9
Male head of household above 65 years	2
Female head of household above 65 years	1
Total	12

Members of vulnerable groups may require special or supplementary assistance because they are less able to cope with the physical and/or economic displacement than the affected population in general. Assistance to vulnerable people may take the following forms, depending upon vulnerable persons' requests and needs:

- Assistance in the compensation payment procedure (e.g. going to the bank with the person to cash the compensation check);
- Assistance in the post payment period to secure the compensation money and reduce risks of misuse/robbery;
- Reinstatement of damaged properties to be carried out by the contractor to take the burden of such work off the affected vulnerable person;
- Assistance in moving: providing vehicle, driver and assistance at the moving stage; and
- Health care if required at critical periods: moving and transition period.

4.3 Inventory of affected Persons and Properties

Tables 7 provides a summary of category of impacts of the affected properties. The categories of impacts are as follows:

Temporary Inconvenience

- Reinstatement of property required
- Bare ground/unpaved, only backfilling required
- PAP has no identifiable structure and needs information to temporarily leave area during construction

Temporary Economic Displacement

- Temporary relocation of affected business structure/property
- Cut through business structure which is on the right of way because it cannot be moved or easily moved
- Permanent relocation of business structure or person

Complete/Permanent loss of property or use right

- Affected property to be destroyed and cannot be reinstated due to project activity or PAP cannot use the site again due to project activity

4.4 Potential Negative Impacts on Assets, Livelihoods and Access Routes

The implementation of the Project will not directly affect any communal properties such as church buildings, mosque, school buildings etc., nor cultural sensitive sites such as cemeteries or shrines.

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Table 6: Summary of current uses of affected assets and category of impacts

No	Location/Community	Main Activities	Current use of affected assets	Category of Impacts	Land Acquisition	Crops	Livelihoods	Remarks
1	Choggu	• Laying of underground cables (Trenching)	✓ Business/Commercial Facility ✓ Serves as frontage of a business ✓ Driveway/Walkway ✓ Religious use	✓ Temporary inconvenience (reinstatement) back filling) ✓ Temporary economic displacement (Temporary relocation of affected business structure) ✓ Temporary economic displacement (Cut through structure within ROW)	No	No	Yes	-
2	Gumbhini	• Laying of underground cables (Trenching)	✓ Business/Commercial Facility ✓ Serves as frontage of a business ✓ Driveway/Walkway ✓ Religious use	✓ Temporary inconvenience (reinstatement) back filling) ✓ Temporary economic displacement (Cut through structure within ROW)	No	No	Yes	-
3	Kalpohini	• Laying of underground cables (Trenching) • Construction of Primary substation	✓ Business/Commercial Facility ✓ Serves as frontage of a business ✓ Driveway/Walkway ✓ Religious use	✓ Temporary inconvenience (reinstatement)	Yes	No	No	Land Acquisition for Primary Substation
4	Tishigu	• Laying of underground cables (Trenching)	✓ Business/Commercial Facility ✓ Serves as frontage of a business ✓ Driveway/Walkway ✓ Religious use	✓ Temporary inconvenience (reinstatement) back filling) ✓ Temporary economic displacement (Cut through structure within ROW)	No	No	Yes	-
5	Ward K	• Laying of underground cables (Trenching)	✓ Business/Commercial Facility ✓ Serves as frontage of a business ✓ Driveway/Walkway ✓ Religious use	✓ Temporary inconvenience (reinstatement) back filling) ✓ Temporary economic displacement (Cut through structure within ROW)	No	No	Yes	-

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5.0 STAKEHOLDER ENGAGEMENT

Consultations were held with stakeholders including local communities and other interested groups and institutions. This was aimed at gathering relevant information and discussing issues of environmental and social concern that may arise from implementing the project.

Local communities, their representatives and government institutions all contributed immensely during the consultative process as dialogues were directed at identifying and resolving key project-related issues. The stakeholder consultation has been a two-way flow of information. Dialogue between project proponents and stakeholders, aimed at developing ideas that can help shape project design, resolve conflicts at an early stage, assist in implementing solutions and monitor ongoing activities.

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No	Location/ Community	Main Activities	Current use of affected assets	Category of Impacts	Land Acquisition	Crops	Livelihoods	Remarks
6	Agric Traffic Light	Laying of underground cables (Trenching)	- Business/Commercial Facility - Serves as frontage of a business - Driveway/Walkway	- Temporary inconvenience (reinstatement) - Temporary economic displacement (Cut through structure within ROW)	No	No	Yes	-
7	Regional Coordination g Council	Laying of underground cables (Trenching)	- Business/Commercial Facility - Serves as frontage of a business - Driveway/Walkway	- Temporary inconvenience (reinstatement) - Temporary inconvenience (bare ground - backfilling)	No	No	Yes	-

The following under listed stakeholders were engaged.

1. Traditional Authority (Paramount/Divisional/Community Chiefs);
2. Tamale Metropolitan Assembly;
3. Ghana Highways Authority (Northern Region);
4. Department of Urban Roads (Northern Region);
5. Lands Commission, Regional Land Valuation Department;
6. St. Paul's Roman Catholic Junior High School "B", Tamale;
7. Tamale Central Hospital;
8. Ghana Water Company Limited, Regional Office, Tamale;
9. Ghana Police Service, Regional Office, Tamale;
10. Ghana National Fire Service;
11. MTN, Tamale main office;
12. Vodafone, Tamale main office;
13. Ghana Grid Company (GRIDCo); and
14. Northern Electricity Distribution Company (NEDCo);
15. Assembly members, opinion leaders, and community members including women, youth, persons with disability and project affected persons.

Records and pictures of Stakeholder Engagement is attached as Annex 5 and Annex 6 respectively.

6.0 COMPENSATION PLAN

6.1 Establishment and Communicating Cut-off-date

The objective of the cut-off date is to establish a deadline date for which project affected persons qualify for entitlement to compensation. Persons entering the project area after the Cut-Off Date are not eligible for compensation and/or resettlement assistance.

The consultant engaged the affected persons on the Project and the resettlement/compensation and grievance redress processes and solicited their concerns to inform the preparation of the ARAP. The engagement was through focus group meetings and one-on-one with the PAPs during the census and socioeconomic surveys.

Persons who encroach on the project areas after the final valuation exercise on April 15, 2023, are therefore not entitled to or expected to receive any form of compensation unless their claims are investigated and found justified by the Grievance Redress Process put in place as part of this Report.

6.2 Valuation Exercise

6.2.1 Purpose and Scope of Valuation

The purpose of the valuation exercise was to assess the overall Compensation Payable as part of the assessment of resettlement related issues under the proposed project. The scope of the valuation covered all affected properties, structures and crops/economic plants. Loss of income and disturbance are considered as far as it may be appropriate for payment of compensation.

6.2.2 Basis of Valuation

The basis of valuation is derived from the following documents:

- IFC PS5- Land Acquisition and Involuntary Resettlement ;
- Section 4(1) of the State Lands Act, 1962 (Act 125);
- Section 253 of the Land Act, 2020 (Act 1036); and
- Section 20 of the 1992 Fourth Republican Constitution of Ghana.

6.2.3 Valuation Process

The data gathering process involved:

- a) Taking inventory of secondary structures.
- b) Taking of pictures of identified project affected persons.

6.2.4 Valuation Method and Rates

Structures

The Replacement Cost Approach (RCA) was adopted for the valuation of the structures. The RCA is based on the assumption that cost and value are related. It involves finding the estimate of the gross replacement cost of a structure, which is the estimated cost of constructing a substitute structure, having the same gross area as that existing, at prices current at the relevant date. For the purpose of this valuation, the affected structures and development were not depreciated in line with the IFC requirements.

Disturbance Allowance

Disturbance is considered as a reasonable expenses incidental to any necessary change of residence or place of business by any person having a right or interest in the affected property. Cost of disturbance is one of the components to be considered when determining compensation for PAPs as provided in the State Lands Act 1962. As the replacement cost/reinstatement cost is the contractor's responsibility, no disturbance allowance was estimated on that. A disturbance allowance of 10% of the assessed compensation for businesses/structures or of the relocation cost/loss of income was applied and 20% for crops was applied as impact on crop is greater and no loss of income was estimated.

Loss of Income

A livelihood assistance or loss of income was determined for eligible PAPs. The estimation for loss of income or livelihood assistance for affected individuals is based on the estimated income or earnings of the individual. Income rates were deduced from field data (i.e. income ranges provided by PAPs during the census/socioeconomic survey) and the level of income expected to be earned monthly.

Estimation of Relocation /Transportation/Movement Cost

Relocation cost has been estimated to include the amount to be involved in the transportation of assets belonging to the project affected persons (PAPs) to a nearby location and back during the project period.

6.2.5 Description of compensation and assistance for different categories of PAPs

The description of compensation and assistance for different categories of PAPs are provided in the table 8 below.

Table 7: Compensation description for category of impact

No.	Category of Impact	Description of compensation and assistance	Remarks
1	Complete/permanent loss of property or use right.	1. Full replacement cost of property to be paid to PAP. 2. Disturbance allowance	-
2	Temporary inconvenience (PAPs have no identifiable structures and need information to move away to alternative sites).	No compensation required.	-
3	Temporary economic displacement (affected frontage of shop very close to shop or trenching to go through business structure fixed into concrete/ground, which is on the right of way. PAP cannot operate shop during trenching and will lose income).	1. Reinstatement of damaged frontage of shop by the Contractor 2. Loss of income as per construction duration of 5 days. 3. Disturbance allowance as a percentage (10%) of the loss of income/relocation	-Disturbance allowance is applied due to economic displacement. -The disturbance allowance estimation does not include the reinstatement component but only on the displacement/loss of income component
4	Temporary economic displacement (Temporary relocation of affected business structure/property).	1. Relocation cost of commercial structure/facilities to nearby area (before and after construction) 2. Loss of income as per construction duration of 3 days as appropriate	-Disturbance allowance is applied due to economic displacement. -The disturbance allowance estimation does not include

No.	Category of Impact	Description of compensation and assistance	Remarks
		3. Disturbance allowance	reinstatement component but only on the displacement/loss of income component. -If affected properties are to be moved slightly out of the right-of-way, such PAPs will not receive any compensation.
5	Temporary inconvenience (due to trenching on bare ground/unpaved, only backfilling required)	Reinstatement or backfilling by contractors	-
6	Temporary inconvenience (due to damage to paved frontages of residence/ office/ shops, no displacement of PAP and business and offices can operate)	Reinstatement of damaged frontage or parts by contractors	-

6.2.6 Valuation Opinion

Having taken cognisance of the relevant value indicators like type of property, category of impact, economic and institutional factors, and having conducted the appraisal in an objective manner in accordance with the Code of Professional Ethics of the Ghana Institution of Surveyors (GhIS), It is our considered opinion that the total heads of claim (i.e. estimated compensation payable to PAPs) for the resettlement of the affected PAPs is Five hundred and Seventy-Six Thousand, Two Hundred and Six Cedis, Eighty-Four Pesewas (GHC 576,206.84). This is the most accurate estimate of compensation payable to the PAPs based on the information available at the time of writing the report. The breakdown is provided in tables 9 and 10 below. Data on all Structures valued is attached as **Annex 8**.

Table 8: Valuation Summary by Category of Impact

No.	Category of Impact	Number of Affected Structures	Affected Livelihood	Compensation Amount (GHC)
1	Complete/permanent loss of property or use right.	0	0	0
2	Temporary inconvenience (PAPs have no identifiable structures and need information to move away to alternative sites).	0	0	0
3	Temporary economic displacement (as a result of trenching of frontage of shop which is on the Right of Way). PAP cannot operate shop during trenching and will lose income).	76	0	307,299.81
4	Temporary economic displacement (Temporary relocation of affected business structure/property).	0	0	0
5	Temporary inconvenience (due to trenching on bare ground/unpaved, only backfilling required)	0	37	22,258.50
6	Temporary inconvenience (due to damage to paved frontages of residence/ office/ shops, no displacement of PAP and business and offices can operate)	61	0	246,648.53
	Total	137	37	576,206.84

Table 9: Valuation Summary by Community

No.	Community	Affected Structures		Loss of Livelihood		Total	
		Number	Amount (GHC)	Number	Amount (GHC)	Number of PAPs	Compensation Amount (GHC)
1	Agric Traffic Light	2	7,659.30	1	165.00	3	7,824.30
2	Choggu	40	141,188.19	15	9,218.00	55	150,406.19
3	Gumbihini	3	8,250.00	-	-	3	8,250.00
4	Kalpohimi	21	131,881.75	4	3,234.00	25	135,115.75
5	Tishegu	26	132,541.75	2	1,166.00	28	133,707.75

No.	Community	Affected Structures		Loss of Livelihood		Total	
		Number	Amount (GHC)	Number	Amount (GHC)	Number of PAPs	Compensation Amount (GHC)
6	Ward K	43	123,775.85	15	8,475.50	58	132,251.35
7	Regional Coordinating Council	2	8,651.50	-	-	2	8,651.50
8	TOTAL	137	553,948.34	37	22,258.50	174	576,206.84

6.3 Compensation Disbursement Responsibility

The Northern Electricity Distribution Company (NEDCo) is responsible for compensation disbursement. A representative of the Municipal Assemblies or Sub metros or the local Assembly men/women will serve as a witness during the payment of compensation to PAPs, if necessary. NEDCo, with the support of the ARAP consultant, will ensure that all PAPs identified in the valuation report are paid their compensation due them excluding the reinstatement cost for affected structures/properties.

6.4 Compensation Payment Procedures

Cash compensation will be paid for temporary relocation of structures and for loss of income due to disruption of business.

Compensation will be paid prior to the affected person vacating the land, right-of-way (RoW) or property. Each eligible affected person will sign a compensation claim form (as shown in **Annex 3**) together with the authorized project representative. The compensation claim form clarifies mutual commitments as follows:

- On the project side: commitment to pay the agreed compensation, including all its components (relocation cost, livelihood/loss of income, disturbance); and
- On the affected person's side: commitment to vacate the land/RoW by the agreed date before the start of construction work.

6.5 Eligibility/Entitlement Matrix

The eligibility and entitlement matrix is provided in Table 10.

Table 10: Eligibility and Entitlement Matrix

Type of PAPs	Type of Structure	Type of Impact	Compensation for Loss of Land	Compensation for loss of structures and assets	Compensation for loss of income	Compensation for crop loss	Disturbance allowance
There will be a complete/permanent loss of property or use rights owned on the permitted land	Non-Shop	Loss of land + Permanent physical relocation	Full replacement cost of land	Full replacement cost of affected properties	N/A	N/A	Disturbance allowance (10%)
	Shops	Loss of land + Permanent physical relocation and economic displacement	Full replacement cost of land	Full replacement cost of affected properties	Loss of income as a result of the project	N/A	Disturbance allowance as a percentage (10%) of the loss of income/relocation
Owns the permitted land but not yet used	—	Loss of land	Full replacement cost of land	N/A	N/A	N/A	Disturbance allowance (10%)
There will be a complete/permanent loss of property or use rights owned on the non-permitted land	Non-Shop	Permanent physical relocation	N/A	Full replacement cost of affected properties	N/A	N/A	Disturbance allowance
	Shops	Permanent physical relocation and economic displacement	N/A	Full replacement cost of affected properties	Loss of income as a result of the project	N/A	Disturbance allowance as a percentage (10%) of the loss of income/relocation
Temporary relocation of owned property (immovable structure) will occur	Non-Shop	Temporary physical relocation	N/A	Relocation cost of facilities to nearby area (before and after construction)	N/A	N/A	N/A
	Shops	Temporary physical relocation and economic displacement	N/A	Relocation cost of commercial structure to nearby area before and after construction)	Loss of income as per construction duration	N/A	Disturbance allowance as a percentage (10%) of the loss of income/relocation
As a result of trenching of frontage of shop which is on the Right of Way, PAPs cannot operate/work shop during trenching and will lose income property	Shops	Temporary economic displacement	N/A	Reinstatement of damaged frontage or parts by contractors	Loss of income as per construction duration	N/A	Disturbance allowance as a percentage (10%) of the loss of income/relocation
	Any structures	Temporary inconvenience	N/A	Relocation cost of commercial	N/A	N/A	Disturbance allowance on

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Type of PAPs	Type of Structure	Type of Impact	Compensation for Loss of Land	Compensation for loss of structures and assets	Compensation for loss of income	Compensation for crop loss	Disturbance allowance
Due to damage to unpaved frontages of residence/ office/ shops, no displacement of PAPs and no impact for operation of business and offices	Any structures	Temporary inconvenience	N/A	Reinstatement or back-filling by contractors	N/A	N/A	N/A
Due to damage to paved frontages of residence/ office/ shops, no displacement of PAPs and no impact for operation of business and offices	Any structures	Temporary inconvenience	N/A	Reinstatement of damaged frontage or parts by contractors	N/A	N/A	N/A
PAPs have no identifiable structures and need information to move away to alternative sites	Any structures	Temporary inconvenience	N/A	N/A	N/A	N/A	N/A
Growing the affected crop/ economic plants (regardless of related plot ownership)	Crop/ Economic plants	Destruction of standing crops	N/A	N/A	N/A	Cash compensation for standing crops not harvested prior to land entry, counted at cut-off date and based on realistic crop rates, LYD rates	Disturbance allowance (20%)

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6.6 Assistance for Vulnerable Persons

Vulnerable PAPs were identified as part of the census and socioeconomic survey. Vulnerable PAPs may require special assistance because they are less able to cope with the physical and/or economic displacement and the temporary inconvenience to be experienced than the affected population in general. Assistance to vulnerable people may take the following forms, depending upon vulnerable persons' requests and needs:

- Assistance in the compensation payment procedure (e.g. going to the Bank with the person to cash the compensation cheque if required or requested).
- Prompt reinstatement of damaged properties and provision of access where necessary to be carried out by the contractor as soon as possible to minimise inconvenience and risk.
- Assistance in relocation of movable property to a convenient place by the contractor.

6.7 Disclosure

6.7.1 Disclosure of Compensation Proposals and Grievance Redress Sections of the ARAP to PAPs

As part of the disclosure process, the ARAP Consultant will disclose the compensation proposal/payable and the Grievance Redress section of the ARAP to the PAPs. A copy each of the PAPs compensation profile and the names and contacts of the ARAP Consultant team for grievance redress will be given and the necessary explanation and clarification provided to the PAPs. The PAPs will sign off if they agree to the compensation proposal and the relevant document received. All comments from the PAPs will be noted on the signed-off sheet. Each eligible PAP will be informed about the actual cash compensation amount to be paid to him or her.

6.7.2 ARAP Disclosure

NEDCo will submit copies of the final ARAP to JICA for clearance and disclosure of the cleared final ARAP on its website. NEDCo will also ensure that copies of the cleared ARAP or extracts of the cleared final ARAP (core report without valuation figures) are sent to the relevant MMDA to enable the PAPs, and other stakeholders such as Assemblymen and any interested Non-Governmental Organizations (NGO) in the project area access the document. A public notice of the ARAP disclosure will be placed at the Assembly premises and in the national dailies (e.g., Daily Graphic and Ghanaian Times) to notify the public/PAPs about where the ARAP documents can be accessed.

7.0 INSTITUTIONAL ARRANGEMENT

7.1 Relevant Institutions

The institutional arrangement identifies the relevant institutions involved with the implementation of the ARAP, their roles and responsibilities. The main institutions concerned with the implementation of the Project and the ARAP related activities including reinstatement works are provided in Table 12. The ARAP implementation activities will be under the overall guidance of NEDCo.

Table 11: Institutional Roles and Responsibilities

No.	Institution	Role/Responsibility Description
1	JICA	• Will carry out external supervision for satisfactory ARAP implementation and provide support role throughout project implementation and monitor progress of project implementation. • Will recommend additional measures for strengthening institutional capacity building measures as appropriate and implementation performance.
2	NEDCo	• Responsible for the successful implementation of the project by engaging appropriate contractors and consultants for the execution of the project. • Has the oversight responsibility for the implementation of the ARAP. • Responsible for providing funds for direct compensation payments to eligible PAPs who will be economically/physically displaced. • Responsible for compensation disbursement. • Have a representation in the ARAP Management Teams including the Grievance Committee and the Monitoring and Evaluation Committee. • Responsible for ensuring that environmental and social safeguard issues and documentations are taken care of under all the Project.
3	ARAP Consultant	• Responsible for the preparation of the ARAP and Communication and Outreach Plan. • Responsible for ensuring that impacts are properly assessed and all PAPs are identified and their affected assets recorded and valued for adequate compensation. • Responsible for ensuring that stakeholders including PAPs have been identified and engaged to ensure issues of concern to them are adequately addressed. • Responsible for consultations with the PAPs and providing feedback on project/RAP implementation to the PAPs and NEDCo. • Responsible for ensuring that all grievances are resolved, and feedback provided to the PAPs concerned.
4	MMDA	• The relevant MMDA, TaMA, is the beneficiary local government authority where the projects are being implemented. Will be directly involved with the RAP implementation and will have representations on the Grievance Committee and Monitoring and Evaluation Committee

5	Lands Commission (Land Valuation Division, LVD)	LVD will be invited to review and confirm value of affected properties and confirmation of land/property values when the need arises especially during disputes or grievance redress issues concerning project affected persons. The Grievance Redress Team may invite the LVD as expert to assist in resolving disputes requiring the expertise of the Valuation Division.
6	PAPs	The PAPs will be required to select representatives to the grievance committee at the Assembly/Submetro level. These representatives will be directly involved in activities of the Grievance Redress Mechanism (GRM) and serve as liaisons for all identified PAP groups.

8.0 GRIEVANCE REDRESS

Grievance redress mechanism (GRM) is the instruments, methods, and processes by which a resolution to a grievance is sought and provided.

8.1 Objective

The objective of the Grievance Redress Mechanism (GRM) is to provide an effective, transparent and timely system that would give aggrieved persons redress and avoid litigation, minimize bad publicity, avoid/minimize delays in execution of the project, and ensure sustainability of the Project. The GRM will provide all persons and groups affected by the project activities with avenues through which they can express their concerns and receive the needed corrective actions in an appropriate and timely manner.

8.2 Potential grievances/disputes

In practice, grievances and disputes that arise during the course of implementation of a resettlement/compensation program may be related to the following issues:

- Mistakes in inventorying/asset enumeration or valuation data;
- Disagreement on property boundaries, either between the affected person and the expropriation agency or between two neighbours;
- Disputed ownership of a given asset;
- Disagreement on asset valuation methods;
- Successions, divorces, and other family issues resulting in disputed ownership or disputed shares between inheritors or family members;
- Disagreement with the computation of the loss of income or relocation/transportation assistance; and
- Delays in construction and or reinstatement timelines.

8.3 Redress Process

The general steps of the grievance process will comprise:

- Registration of complaints;
- Determining and implementing the redress action (by any of the GRM tier levels as appropriate in consultation with the complainant);
- Verifying the redress action (by any of the GRM tier level as appropriate; and
- Signing of the grievance or closing out.
- To be signed off between the complainant and the GRM tier level as appropriate

Registration of complaints

Complaints can be lodged verbally or in writing or by phone call to the ARAP Consultant's field team members. The elected local Assemblyman/women for the area who receives complaints from PAPs (because the Assemblyman/woman lives within the community and some PAPs may prefer to route their complaints through the Assemblyman/woman) will be required to forward such complaints to the ARAP Consultant's contacts. All complaints will be registered using a grievance and resolution form, a sample is attached as **Annex 4**, or logged in a dedicated logbook for that purpose.

Determining and implementing the redress action

When a grievance/dispute is recorded as per above-mentioned registration procedures, the grievance will be resolved at the local (project site) level first and if not successful, referred to the next level as discussed extensively in the next subsection. Meeting(s) will be organized with interested parties. Minutes of meetings will be recorded if appropriate.

The grievance redress team will determine the redress action in consultation with the complainant, if necessary. Otherwise, the grievance redress team will communicate to the complainant on the acknowledgement of the grievance, the redress action proposed and the timeframe for implementation.

Verifying the redress action

The grievance redress team will visit the affected property site or get in touch with the complainant to confirm that the redress action is carried out. If the complainant is not satisfied with the outcome of the redress action, additional steps will be taken to resolve the issue or reach an amicable agreement, otherwise the complainant has the option to refer the matter to the next level for redress.

Signing of the grievance or closing out

If the complainant is satisfied with the redress action taken, he or she is required to sign off on the Grievance and Resolution Form and filed appropriately.

8.4 Redress Arrangement/Levels

The proposed GRM will consist of a three-tier resolution arrangement (Figure 10) as follows:

- Local (project site) level, to be handled by the ARAP Consultant in consultation with relevant parties e.g. NEDCo District Office to keep parties informed of all grievances, the management and resolution thereof at this level;
- Grievance Committee Level (Grievance committee to include Metropolitan Assembly representatives, PAP representatives from the affected community and other key stakeholders such as Land Valuation Division as and when appropriate); and
- National legal level (i.e., if the above three levels fail, the complainant is free to seek redress from the court of law).

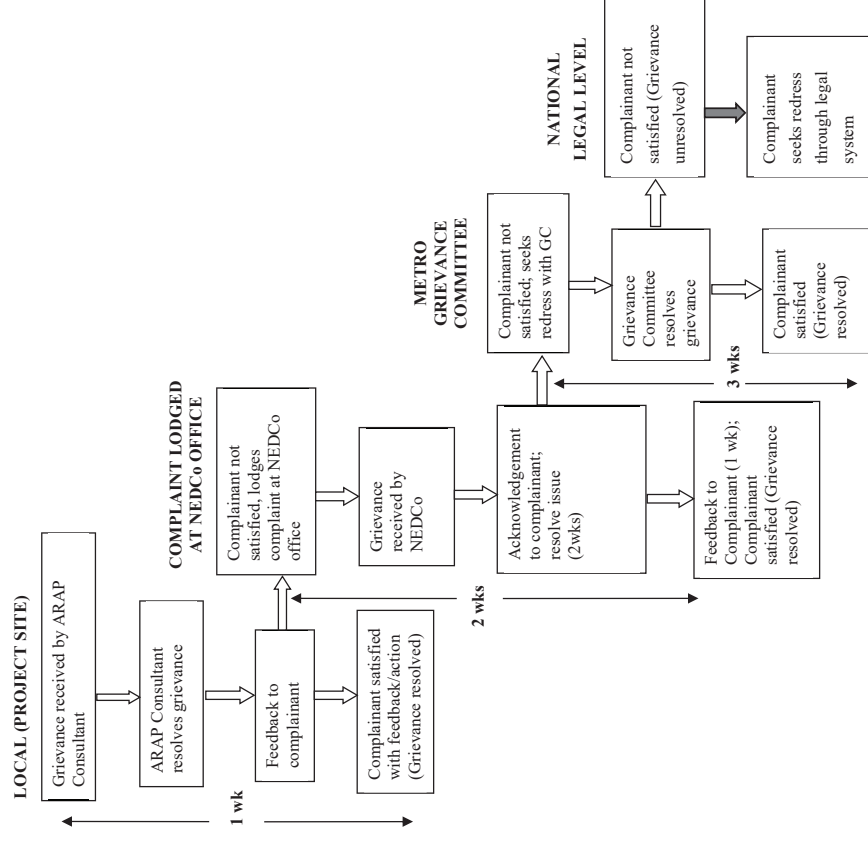


Figure 11: Grievance Redress Mechanism for Tamale Power Enhancement project

The levels of the GRM are explained as follows and summarized in **Figure 10**. The sensitization on the GRM will be done in the local languages of the area. This will ensure that approaches, ways and contact information for all stages of the GRM are clearly spelt out. Despite all efforts to inclusively and meaningfully engage PAPs/ stakeholders, grievances may arise. If not managed properly, even small complaints can escalate into conflict and even lawsuits. In order to forestall these tendencies, we shall as part of our instituted meetings with the affected people, allocate time to introduce and discuss the grievance redress mechanism. The possible grievance areas and steps for redress are highlighted in **Figure 10**.

8.4.1 Local (project site) Level

A complaint made at any project site shall be received by the ARAP Field Team member or an assigned officer from NEDCo. The procedure shall be as follows:

- A complaint form shall be filled out (see Annex 4), dated and signed, a copy of the same shall be kept by NEDCo office and a copy given to the complainant.

The ARAP Consultant will have focal persons who will receive complaints during the construction phase. However, complaints sent to the local Assembly members by PAPs shall be forwarded to the Consultant or ARAP Focal persons by the Assemblymen/women. The ARAP Consultant shall resolve the grievance or rectify the anomaly within one (1) week of receipt of complaint. The ARAP Consultant will also ensure that this information is made available by appropriate means including signboards, leaflets, community meetings, etc. The Consultant's progress report will contain the complaint, the solution proffered, and the results of follow-up to determine whether the complainant is satisfied with the outcome.

A complainant is also at liberty to lodge his/her complaint in a written form to NEDCo office. This shall be recorded, dated and signed to acknowledge receipt.

An acknowledgement of complaint form or grievance shall be sent to the complainant or emailed or delivered to the complainant directly as appropriate within one (1) week. NEDCo will make use of its internal dispute resolution system if necessary to have the issue(s) resolved within one week and shall inform the complainant verbally and/or in writing with the resolution. The solution proffered shall be recorded and dated. Follow up will be done to find out whether the complainant is satisfied, and the results of the follow-up recorded. If satisfied, the grievance shall be closed out by the signing of the appropriate section of the complaint form by NEDCo representative and the complainant.

8.4.2 Grievance Committee Level

For issues that could not be resolved directly by NEDCo, a project level Grievance Committee (GC) will be set up to handle such cases. The committee will be set up within the respective Metropolitan/Municipal Assemblies so that stakeholders do not have to travel long distances to attend committee meetings.

The GC will include the following:

- The Coordinating Director of the affected Metropolitan/Municipal/District Assembly/sub-metro;

- The local Assembly Man/Woman from the local community or electoral area where the complaint is coming from;
- The Regional Director of NEDCo (to chair the committee);
- The Chairman and Secretary of the PAPs Committee within the affected community; and
- The Regional Director of Land Valuation Division (if issue has to do with valuation, and compensations).

The GC will be chaired by the Regional Director of NEDCo. Membership of the GC will be made known to the public/stakeholders as part of the sensitization on the GRM. The GC shall provide a response within three (3) weeks of receiving formal notification of a grievance. In cases where further site visits, investigations or discussions with the aggrieved stakeholder are deemed necessary in order to arrive at an amicable resolution, a date shall be planned with the complainant for the follow-up visit which will fall within the mandated three (3) weeks.

8.4.3 National Legal Level

If the aggrieved stakeholder is not satisfied with the outcome of the Grievance Committee intervention in resolving the grievance, the stakeholder will be advised to seek redress through the appropriate legal system/law court.

8.5 Reimbursement of actual costs for Grievance Committee Activities

The cost of the Grievance Committee activities includes such incidental cost as transport allowance for the committee members (PAP representatives included), fuel or transport for field verification visits by the committee, and lunch for members for extended meeting hours and during field verifications. These incidental costs are captured in the implementation budget in Section 9 below.

8.6 Legal Claims and or Compensations from Grievance Resolutions

The Project will do all that it can to make use of the alternative dispute arrangement provided under this GRM in order to avoid or minimise litigation or court adjudication, which is very expensive and time consuming. However, complainants are at liberty to go to the law court to seek redress as enshrined in the Constitution of Ghana if not satisfied with the grievance process. NEDCo is responsible for payment of any legal claims and or compensation arising from a grievance resolution

9.0 MONITORING/EVALUATION AND REPORTING

Regular monitoring and reporting are central to, and required for, effective management and implementation of the resettlement process. Resettlement monitoring and evaluation will focus mainly on the implementation of resettlement (i.e., compensation for displacement).

The purpose of monitoring is to ensure that approaches mentioned in this plan are well implemented to make the project successful.

The ARAP monitoring will have two components, and these include:

- ◆ Process monitoring (internal); and
- ◆ Independent performance monitoring (external).

9.1 Process Monitoring (Internal)

The internal monitoring activities will focus on compliance with the Abbreviated Resettlement Action Plan (ARAP) and the updated stakeholder engagement, communication and outreach plan and to ensure that the objectives of these reports have been achieved.

9.1.1 Purpose and Responsibility

The internal process monitoring will be carried out by the ARAP Consultant during the ARAP/project implementation phase on behalf of NEDCo to track implementation activities, and be able to propose corrective measures expeditiously.

In addition to the above, the ARAP Consultant will

- Ensure compliance with the principles of the ARAP and that actions and commitments described in this ARAP are being implemented;
- Ensure that eligible people to be affected by the project receive their compensation promptly.
- Ensure that complaints and grievances lodged by PAPs are followed-up and resolved;
- Ensure that the contractors do not destroy properties beyond or above what has been compensated for or valued for compensation;
- Provide NEDCo with feedback on the resettlement/compensation implementation programme.

9.1.2 Monitoring Indicators for ARAP Implementation

The monitoring indicators will include but not limited to:

- Number of PAPs available and received or signed for the compensation amount;
- Number of Representatives of PAPs who received compensation on behalf of PAPs;
- Date of payment, and payee of the compensations;
- Number of grievances registered, number of grievances resolved and unresolved complaints; and
- Number of complaints resolved at the project site level, resolved by NEDCo, resolved by the Grievance Committee, and number sent to the law courts.

9.1.3 Monitoring of the Stakeholder Engagement, Communication and Outreach Plan

The process of monitoring the stakeholder engagement programme will aim to provide information such as whether:

- The activity is achieving the desired goals.
- The implementation is progressing towards the expected results.
- Complaints being received is due to lack of or inadequate project information dissemination or spread of inaccurate information or misinformation
- The time frame is respected.

9.1.4 Reporting

The ARAP Consultant will prepare and submit the following reports to NEDCo:

- Monthly Reports during construction – to provide account for all activities carried out within the specified month including challenges encountered. The monthly reports will provide NEDCo and other relevant stakeholders with information on ARAP implementation and issues of fresh compensation if any and grievances.
- Quarterly Progress Report during construction– to provide status of all activities carried out in the specified quarter including challenges and recommendations. The quarterly reports will enable NEDCo, and other relevant stakeholders to verify that resettlement measures including compensations identified in the ARAP were implemented and that construction and reinstatement works as well as actions prescribed in the ARAP and contractor work schedules are being implemented.
- ARAP Closeout Report – to provide a close out report on all resettlement and community engagement planning and implementation activities among others.

9.2 Independent Performance Monitoring (External)

An independent performance monitoring can be carried out by an external party (e.g., JICA) at structured intervals, e.g., mid-term monitoring and completion evaluation/audit. The completion evaluation/ audit is to determine whether the objectives of the ARAP have been achieved or otherwise and that compensation has been successfully completed in compliance with the ARAP. The completion evaluation/ audit should be undertaken after completion of construction activities including reinstatement works and submission of closeout report by the ARAP consultant.

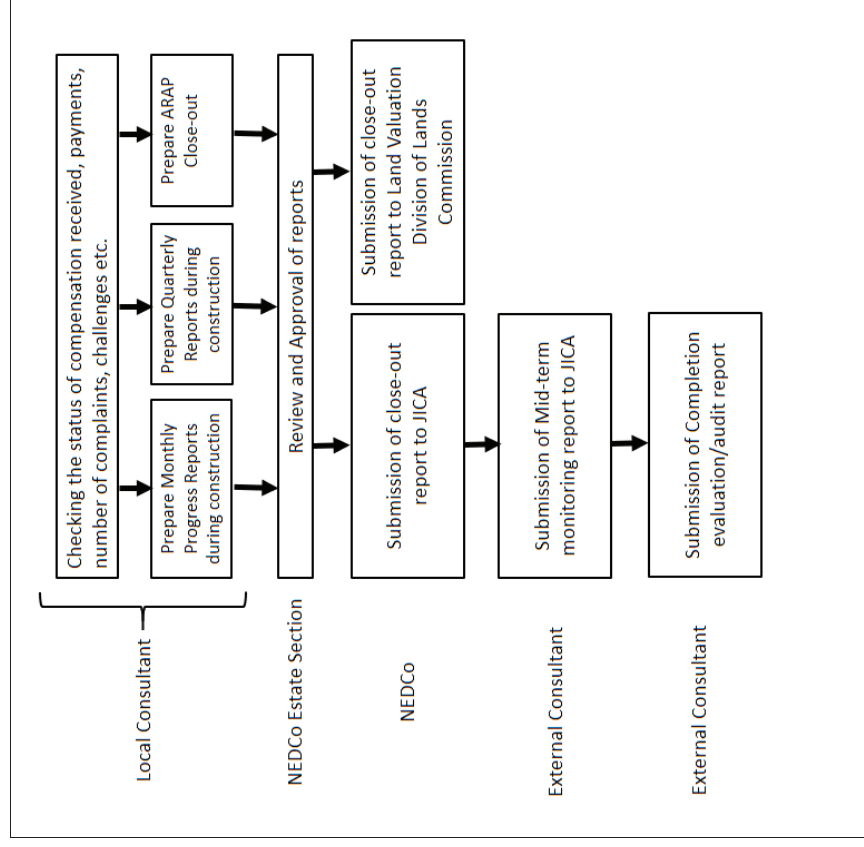


Figure 12: Flow chart for ARAP monitoring

10.0 IMPLEMENTATION PLAN

The implementation plan provides for indicative timelines for implementation of the ARAP. Table 13 below shows the general implementation plan for the various tasks identified under the resettlement related programme. The Implementation Plan will be updated periodically as and when changes occur in project/ARAP implementation timelines.

Table 12: ARAP Implementation Plan

Main tasks	Specific tasks	Timelines/ Period	Comments
Stakeholder engagement	Meetings with stakeholders i.e. one-on-one, key informant interviews, focus group discussions		Completed
Preparation of draft ARAP	Census of affected persons	March 2023	Completed but monitoring required
	Socio-economic survey of PAPs	March 2023	Completed but monitoring required
	Field valuation of properties and reporting	April 2023	Completed
Revision and Finalization of draft Report	Writing of draft ARAP report	April 2023	Completed
	Review of draft ARAP	June 2023	-
	Revised ARAP preparation	August 2023	-
	Finalization of ARAP	September 2023	-
Disclosure of Report	Approval and clearance of ARAP	October 2023	-
	Disclose ARAP at the relevant MMDAs and on JICA website	October 2023	-
	Disclosure of compensation proposal/ figures to PAPs	October 2023	-
Formation of Grievance Committee	Grievance Committee	November 2023	-
Compensation payment	Compensation disbursement to PAPs	From December 2023	To be paid prior to commencement of subproject activity
Grievance Redress Internal Monitoring and Evaluation Reporting	Resolution of all disputes/ complaints	Project duration	-
	Monitor implementation of resettlement/ compensation activities	Project duration.	-
	Prepare Quarterly Progress Report	Every quarter during construction period	-
	Prepare ARAP Closeout Report after construction phase	One (1) month after construction phase	-

11.0 COST AND BUDGET

11.1 Estimated Cost for ARAP Implementation

The cost estimates for the implementation of the ARAP including direct compensation payments to PAPs, and contingency issues is **ChF670,017.18**. The details are presented in the Table 14 below.

Table 13: Estimated cost for the implementation of the ARAP

No.	Item	Estimated Cost/ ChF	Remarks	Source of funds
1	Direct Cash Compensation to be paid to PAPs	576,206.84	Amount directly going to eligible PAPs due to economic displacement. To be provided and disbursed by NEDCo	Project funds
2	Subtotal	576,206.84		
3	External monitoring	20,000.00	Monitoring of ARAP implementation by external team e.g. JICA - Logistics during monitoring period - Accommodation during monitoring period - Transportation during monitoring period	Project funds
4	Audit of ARAP completion	10,000.00	Evaluation of ARAP implementation	Project funds
5	Cost for complaints redress	25,000.00	- Allowances for Assembly members/Grievance committee - Engaging PAPs with unresolved complaints - Hiring of tents and chairs at assembly points.	Project funds
6	Information and awareness campaign	10,000.00	Required for publicity and awareness creation including disclosure - Rental of public vans - Rental of PA Systems - Printing and sharing of tracts and booklets	Project funds
7	Subtotal	65,000.00		
8	Contingency (5% of No.2)	28,810.34	For unforeseen contingencies and incidental costs. To be provided by NEDCo	Project funds
9	Total for ARAP Implementation	670,017.18	Estimated cost for the implementation of the ARAP.	Project funds

12.0 CONCLUSION

This ARAP covers the seven identified project communities, Choggu, Gumbihini, Tshigu, Ward K, Agric Traffic light, Regional Council and Kalpohini Estate all within the Tamale Metropolis.

A total of One Hundred and Thirty-Seven (137) permanent structures and Thirteen-Seven (37) Temporary structures were identified to be affected. Out of this, Ninety-Eight (98) PAPs would be temporarily inconvenienced (reinstatement of property/back filling required), Seventy-Six (76) PAPs would be temporarily displaced economically (cut through business structure which is on the RoW because it cannot be moved or easily moved).

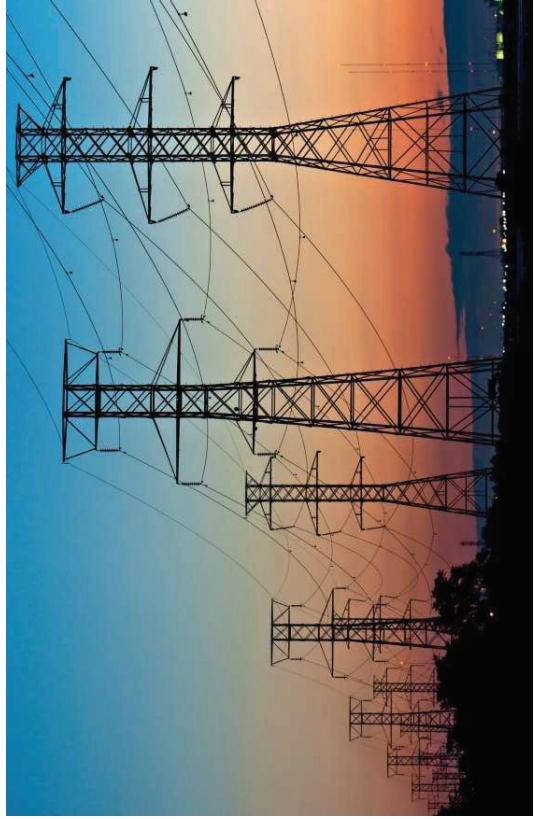
Compensation will be duly paid from project funds to the project affected persons from an estimated budget of Six Hundred and Seventy Thousand and Seventy Cedis, Eighteen Pesewas (GHC 670,017.18). Also, concerns of PAPs, community members or any other persons will be adequately addressed by the Grievance Redress Mechanism proposed in this report. Sufficient provisions have been made for PAPs to receive their compensation and any necessary assistance.

ANNEXES

- Annex 1 Location map of project communities showing proposed substation, transmission and distribution lines.
- Annex 2 Census survey instrument
- Annex 3 Compensation Claim and Agreement Form
- Annex 4 Grievance Redress Forms
- Annex 5 Record of meetings in with Stakeholders
- Annex 6 Pictures of Engagement
- Annex 7 List of interviewed Project Affected Persons (PAPs)
- Annex 8 Detailed Valuation Sheets

14. 地形地質測量結果報告書

PREPARATORY SURVEY FOR THE PROJECT OF ENHANCEMENT OF POWER SUPPLY RELIABILITY IN TAMALE.



TAMALE, GHANA **DECEMBER 2022**

**REPORT ON 34.5 KV, 11.5KV LINE ROUTE SURVEY AND
TOPOGRAPHICAL ON RCC SUBSTATION.**

Prepared by

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Preparatory survey for the project of Enhancement of
power supply Reliability in Tamale

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5.0 PICTURES OF REAL-TIME KINEMATICS(RTK) INSTRUMENT.	

1.0 INTRODUCTION

- 1.1 This report addresses the topographical survey at RCC substation located at regional coordinating council(RCC, Tamale) and 34.5kv, 11.5kv line route survey in tamale in the northern region. **YACHIYO ENGINEERING COMPANY LIMITED of Japan** contracted **KALYN SURVEYS AND SERVICES** to carried out Topographic survey and 34.5kv,11.5kv line route survey.

2.0 SCOPE OF WORK

- 2.1 The scope of the work entails survey and detail of object along 34.5kv and 11.5kv line route

- 2.2 To fix bench marks along the route

3.0 METHODOLOGY

Benchmarks were constructed and installed and the Universal Transverse Mercator (UTM WGS 84 30 N) was used to locate coordinates for the survey. Coordinates from existing poles, road edge, buildings along the line route were collected. The benchmarks were used with the Real-time kinematic were used to determine the topography and pole positions. Data from Universal Transverse Mercator (UTM WGS 84 30 N) were imported into the Arc GIS, Carlson survey and Auto CAD civil 3D to produce map locations for pole position along the 34.5kv RCC sub transmission line route from RCC substation to GRIDCO bulk supply station and the 11.5kv lines.

BENCHMARKS INSTALLED ON 34.5KV LINE ROUTE

Table 1: bench mark coordinates

NAME	NORTHERNS	EASTERNS	ELEVATION
JICA 34.5KV P24B	1042489.74	736060.83	180.12
JICA 34.5KV P24A	1042509.39	736099.94	179.62
JICA 34.5KV P25 A	1042451.4	736005.92	180.54
JICA 34.5KV P26 A	1042407.43	735942.51	181.81
JICA 34.5KV P27 A	1042235.97	735696.27	188.23
JICA 34.5 KV P29	1042198.58	735663.15	189.21
JICA 34.5 KV P30	1042126.88	735726.87	185.6
JICA 34.5 KV P31	1042084.08	735765.5	183.87
JICA 34.5KV P32	1041996.19	735833.16	180.29
JICA 34.5 KV P33	1041960.73	735793.09	181.37
JICA 34.5 KV P23A	1042522.32	736144.17	178.72
JICA 34.5 KV P22A	1042557.03	736308.26	174.35
JICA 34.5 KV P20 A	1042572.27	736405.09	170.94
JICA 34.5 KV P19 A	1042632.11	736844.19	161.15
JICA 34.5 KV P18 B	1042657.75	736886.37	160.81
JICA 34.5 KV P18 A	1042667.14	736933.43	160.39
JICA 34.5KV 17 A	1042670.16	736983.17	159.28
JICA 34.5 KV P16A	1042696.19	737103.74	156.49
JICA 34.5 KV P16B	1042708.12	737272.49	155.07
JICA 34.5 KV P16	1042716.79	737338.6	154.79
JICA 34.5 KV P15A	1042719.56	737487.49	153.96
JICA 34.5 KV P15B	1042719.08	737439.05	154.22
JICA 34.5 KV P15	1042717.25	737519.18	153.56
JICA 34.5KV P14	1042745.65	737558.08	153.6
JICA 34.5 KV P 13	1042749.33	737774.5	153.46
JICA 34.5KV P12	1042702.52	738062.12	153.48
JICA 34.5KV P11	1042588.32	738248.29	154.44
JICA 34.5 KV P10	1042360.29	738704.49	160.94
JICA 34.5 KV P9	1042304.11	738759.53	161.56
JICA 34.5 KV P8	104218.96	739069.1	158.19
JICA 34.5 KV P7	1042034.69	739196.49	157.25
JICA 34.5 KV P6	1041788.01	739486.47	156.85
JICA 34.5 KV P5	1041761.4	739476.96	157.74
JICA 34.5 KV P4	1041655.91	739298.79	162.01

JICA 34.5 KV P3A	1041601.54	739208.35	164.47
JICA 34.5 KV P3	1041543.97	739129.22	166.54
JICA 34.5 KV P2	1041363.33	738966.62	175.34
JICA 34.5 KV P6A	1041944.04	739301.92	156.759
JICA 34.5 KV P7A	1042083.6	739123.35	157.549
JICA 34.5 KV P8A	1042184.79	738947.11	160.093
JICA 34.5 KV P10A	1042402.52	738622.05	159.193
JICA 34.5 KV P10C	1042466.89	738481.44	157.212
JICA 34.5 KV P10B	1042523.42	738370.38	155.238
JICA 34.5 KV P12A	1042713	737991.46	158.703
JICA 34.5 KV P13A	1042745.56	737660.31	152.72
JICA 34.5 KV P16A	1042709.08	737273.59	154.937

Preparatory survey for the project of Enhancement of power supply Reliability in Tamale

Table 2: coordinates for pole position on 34.5KV route line

NAME	NORHINGS	EASTINGS	ELEVATION
RCC-1	1042482.66	736049.32	180.25
RCC-2	1042508.71	736098.58	179.63
RCC-3	1042522.63	736144.5	178.72
RCC-4	1042532.15	736188.8	178.87
RCC-5	1042541.54	736236.55	176.20
RCC-6	1042552	736288.67	174.87
RCC-7	1042561.51	736337.03	173.11
RCC-8	1042568.9	736383.47	171.52
RCC-9	1042576.9	736435.43	170.23
RCC-10	1042583.93	736486.11	168.85
RCC-11	1042607.24	736524.14	167.93
RCC-12	1042612.74	736565.35	167.02
RCC-13	1042599.89	736607.34	166.03
RCC-14	1042609.16	736673.71	164.55
RCC-15	1042615.1	736716.64	163.69
RCC-16	1042622.03	736766.98	162.67
RCC-17	1042626.01	736804.11	161.98
RCC-18	1042633.03	736854.51	161.05
RCC-19	1042657.77	736886.44	160.81
RCC-20	1042665.91	736926.55	160.47
RCC-21	1042671.89	736984.42	159.11
RCC-22	1042683.34	737024.49	157.85
RCC-23	1042692.68	737074.29	157.04
RCC-24	1042697.6	737125.3	156.25

RCC-25	1042704.88	737175.25	155.91
RCC-26	1042707.69	737219.57	155.50
RCC-27	1042711.59	737277.85	155.05
RCC-28	1042715.6	737325.72	154.87
RCC-29	1042715.69	737377.6	154.32
RCC-30	1042719.08	737439.05	154.47
RCC-31	1042709.73	737485.49	154.07
RCC-32	1042731.76	737517.85	153.65
RCC-33	1042745.65	737558.09	153.57
RCC-34	1042746.77	737616.56	153.12
RCC-35	1042747.1	737661.91	153.23
RCC-36	1042747.37	737712.51	153.11
RCC-37	1042747.56	737753.18	153.42
RCC-38	1042743.5	737808.63	153.48
RCC-39	1042737.62	737855.64	153.23
RCC-40	1042730.11	737906.51	153.36
RCC-41	1042720.67	737949.93	153.09
RCC-42	1042713.84	737996.29	153.13
RCC-43	1042708.8	738025.65	153.12
RCC-44	1042693.19	738077.22	153.75
RCC-45	1042673.05	738109.7	154.42
RCC-46	1042650.24	738145.99	154.68
RCC-47	1042623.24	738188.13	154.28
RCC-48	1042600.46	738230.91	154.46
RCC-49	1042574.15	738271.69	154.58
RCC-50	1042550.09	738315.76	154.74
RCC-51	1042525.65	738359.55	155.25
RCC-52	1042503.12	738404.16	156.45
RCC-53	1042483.12	738450.88	156.56
RCC-54	1042466.64	738486.28	157.19
RCC-55	1042436.21	738542.6	158.09
RCC-56	1042418.12	738588.72	158.57
RCC-57	1042397.69	738633.41	159.25
RCC-58	1042376.3	738677.64	160.06

RCC-59	1042343.76	738717.48	161.59
RCC-60	1042313.07	738748.35	160.78
RCC-61	1042258.79	738775.58	161.24
RCC-62	1042243.2	738823.38	161.52
RCC-63	1042218.75	738857.86	162.08
RCC-64	1042191.55	738908.56	159.75
RCC-65	1042164.82	738950.53	159.41
RCC-66	1042143.71	738984.61	159.15
RCC-67	1042113.77	739039.39	158.36
RCC-68	1042088.58	739083.17	158.64
RCC-69	1042066.27	739122.06	158.65
RCC-70	1042043.47	739156.04	158.14
RCC-71	1042012.76	739190.86	158.04
RCC-72	1041971.01	739238.1	157.86
RCC-73	1041940.44	739275.34	157.56
RCC-74	1041907.23	739312.56	157.69
RCC-75	1041874.42	739350.95	157.66
RCC-76	1041837.65	739392.46	157.62
RCC-77	1041805.82	739428.61	157.80
RCC-78	1041761.41	739477.1	157.78
RCC-79	1041739.59	739433.88	158.36
RCC-80	1041713.95	739393.35	159.41
RCC-81	1041693.81	739357.49	159.65
RCC-82	1041667.94	739313.65	161.25
RCC-83	1041643.65	739273.37	162.52
RCC-84	1041614.4	739232.71	163.92
RCC-85	1041586.44	739180.2	165.33
RCC-86	1041547.65	739130.07	166.49
RCC-87	1041517.62	739100.38	166.84
RCC-88	1041485	739072.12	168.96
RCC-89	1041442	739034.85	171.23
RCC-90	1041405.03	739000.78	173.42
RCC-91	1041365.45	738970.41	175.79
RCC-92	1041340.85	738924.39	177.14

RCC-93	1041315.51	738881.32	179.57
RCC-94	1041289.78	738837.86	180.16
RCC-95	1041262.64	738795.31	180.74

Preparatory survey for the project of Enhancement of power supply Reliability in Tamale

Table 3: Bench mark installed on 11.5kv route

NAME	NORTHERNS	EATERNS	ELEVATION
JICA 11.5 KV L1 P2	1041187.07	738739.78	180.26
JEICA 11.5 KV L1 P3	1041113.97	738713.67	179.32
JEICA 11.5 KV L1 P4	1041098.32	738626.27	179.47
JEICA 11.5 KV L1 P5	1041074.21	738556.23	179.37
JICA 11.5 KV L1 P6	1041044.53	738502.35	179.63
JEICA 11KV L1 P3A	1041064.08	738708.83	178.11
JEICA 11KV L1 P3B	1041014.05	738708.72	176.83
JEICA 11KV L1 P3C	1040923.25	738707.44	174.47
JEICA 11KV L1 P3D	1040884.31	738718.81	172.89
JICA 11KV L2 P3	1040864.90	738747.56	172.38
JICA 11KV L2 P3A	1040850.63	738809.80	172.74
JICA 11 KV L2 P4	1040847.20	738860.87	172.19
JICA 11KV L2 P5	1040880.54	738959.80	172.85
JICA 11KV L2 P6	1040970.26	739143.63	169.16
JICA 11KV L2 P7	1041091.93	739240.80	167.79
JICA 11KV L3 P1	1041292.41	738783.60	180.36
JICA 11KV L3 P1A	1041260.93	738663.84	180.46
JICA 11KV L3 P1B	1041237.92	738584.08	179.95
JICA 11 KV L3 P2	1041216.35	738523.32	179.81
JICA 11 KV L3 P3	1041196.43	738481.88	179.61
JICA 11 KV L3 P3A	1041166.03	738420.95	179.17
JICA 11 KV L3 P4	1041137.79	738387.13	179.02
JICA 11KV L3 P5	1041060.36	738303.33	179.64
JICA 11KV L3 P5A	1040933.54	738187.25	181.18
JICA 11 KV L3 P6	1040739.16	738002.65	184.41
JICA 11 KV L3 P6A	1040659.27	737894.99	184.71
JICA 11KV L3 P7	1040611.89	737806.25	185.28

JICA 11KV L3 P8	1040602.56	737739.14	186.12
JICA 11 KV L3 P9	1040605.19	737553.79	187.2
JICA 11 KV L3 P10	1040583.98	737532.37	188.54
JICA 11 KV L3 P11	1040444.15	737578.26	190.93
JICA 11KV L5 P1	1041382.07	738950.52	175.09
JICA 11KV L5 P2	1041408.50	738979.63	173.43
JICA 11KV L5 P3	1041513.84	739065.08	168.61
JICA 11KV L5 P3A	1041552.09	739095.57	167.26
JICA 11KV L5 P4	1041582.28	739135.45	166.05
JICA 11KV L5 P5	1041686.25	739310.47	161.15
JICA 11KV L5 P6	1041771.48	739450.69	157.93
JICA 11KV L1 P1	1041247.00	738731.91	181.67

Coordinates for pole position 11.5kv line route

Table 4:

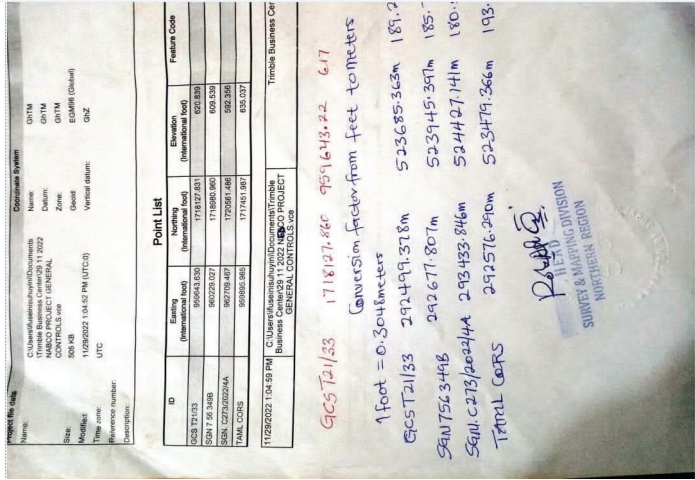
NAME	NORTHERNS	EATERNS	ELEVATION
C-1	1040439.01	737580.11	190.95
L-1	1041262.64	738787.51	180.61
L-2	1041295.76	738792.12	180.72
L-3	1041318.34	738834.3	179.70
L-4	1041338.97	738874.09	178.71
L-5	1041366.6	738927.07	176.07
L-6	1041396.29	738967.39	174.17
L-7	1041426.57	738993.82	172.42
L-8	1041466.07	739025.33	169.47
L-9	1041504.46	739056.01	168.63
L-10	1041541.42	739085.74	167.53
L-11	1041581.08	739134.66	166.04
L-12	1041599.81	739164.05	164.84
L-13	1041627.54	739210.5	163.41
L-14	1041652.54	739253.78	162.57
L-15	1041680.33	739300.88	161.40

L-16	1041712.29	739352.71	160.12
L-17	1041732.5	739379.8	159.16
L-18	1041752.81	739418.21	158.41
L-19	1041778.09	739453.89	157.67
L-20	1041789.78	739478.2	156.86
M-1	1041229.39	738772.93	180.71
M-2	1041189.61	738736.91	180.33
M-3	1041133.88	738716.16	179.25
M-4	1041084.82	738720.89	178.96
M-5	1041034.55	738708.71	177.35
M-6	1040978.49	738707.64	176.00
M-7	1040932.17	738702.22	174.53
M-8	1040884.94	738716.55	172.54
M-9	1040864.28	738759.82	172.18
M-10	1040851.89	738808.57	172.36
M-11	1040849.49	738860.42	172.39
M-12	1040870.05	738926.23	172.82
M-13	1040883.62	738964.11	173.35
M-14	1040906.65	739010.34	172.47
M-15	1040929.65	739056.57	171.54
M-16	1040950.31	739100.85	170.65

M-17	1040973.3	739143.53	169.14
M-18	1041015.1	739177.2	169.51
M-19	1041054.11	739209.4	168.14
M-20	1041093.98	739238.95	167.57
M-21	1041112.52	739220.58	168.36
R-1	1041246.13	738792.31	180.91
R-2	1041265.38	738848.12	180.53
S-1	1041257.99	738765.16	181.05
S-2	1041253.36	738718.46	181.55
Y-1	524326.762	293334.226	179.25
Y-2	524297.742	293296.074	178.88
Y-3	524277.105	293261.339	178.63
Y-4	524257.051	293224.114	178.57
Y-5	524242.871	293181.216	178.45
Y-6	524267.461	293158.595	179.92

4.0 conclusion

Topographical survey was based on the Data certified by the regional head, survey and mapping division northern region.



4.1 Data used for Topographical survey

NAME	NORTHERNS	EASTERNS	ELEVATION
ROAD	1041178.49	738751.68	180.193
ROAD	1041162.25	738746.88	179.989
ROAD	1041185.7	738753.05	180.31
ROAD	1041192.21	738753.81	180.385
ROAD	1041198.72	738754.38	180.481
ROAD	1041205.02	738754.64	180.52
ROAD	1041210.92	738754.5	180.576
ROAD	1041216.32	738753.87	180.607
ROAD	1041301.65	738839.03	179.876
ROAD	1041222.12	738753.54	180.742
ROAD	1041287.52	738817.6	180.599
ROAD	1041226.32	738752.41	180.91
ROAD	1041278.92	738800.44	180.904
ROAD	1041230.71	738751.39	180.916
ROAD	1041277.18	738793.35	180.948
ROAD	1041235.91	738750.75	180.788
ROAD	1041274.72	738783.46	181.066
ROAD	1041238.21	738749.15	180.988
ROAD	1041272.87	73875.36	181.14
ROAD	1041242.5	738748.02	181.019
ROAD	1041271.13	738767.97	181.13
ROAD	1041248.5	738746.18	181.078
ROAD	1041253.39	738745.15	181.14
SH	1041197.15	738778.7	180.584
SH	1041193.23	738775.42	180.405
SH	1041189.61	738771.93	180.41
SH	1041185.89	738768.75	180.371
SH	1041182.47	738764.98	180.286
SH	1041178.65	738761.79	180.227
SH	1041175.22	738758.41	180.194
SH	1041171.3	738755.34	180.125
SH	1041200.48	738782.28	180.431
SH	1041204.2	738785.86	180.53
SH	1041207.32	738789.65	180.39
SH	1041210.64	738793.33	180.446
SH	1041214.16	738797.21	180.694
SH	1041217.29	738800.8	180.512
SH	1041220.81	738804.57	180.792
SH	1041224.03	738808.06	180.839

SH	1041227.36	738811.74	180.902
SH	1041231.08	738815.83	181.009
SH	1041234.2	738819.21	181.253
SH	1041238.03	738823.39	181.014
SH	1041241.35	738827.27	181.085
SH	1041244.58	738831.26	181.109
SH	1041248.1	738834.64	181.046
SH	1041251.22	738838.13	181.13
SH	1041254.75	738842.11	181.101
SH	1041258.06	738845.59	180.893
SH	1041261.38	738849.37	180.66
SH	1041264.81	738852.75	180.616
SH	1041268.63	738856.13	180.423
SH	1041271.76	738860.72	180.507
SH	1041274.88	738864	180.236
SH	1041201.95	738777.16	180.341
SH	1041198.63	738773.59	180.471
SH	1041195	738769.61	180.355
SH	1041191.78	738766.11	180.373
SH	1041188.46	738762.33	180.423
SH	1041184.93	738758.65	180.327
SH	1041205.37	738780.85	180.405
SH	1041208.69	738784.63	180.369
SH	1041212.11	738788.11	180.444
SH	1041212.31	738788.41	180.463
SH	1041215.53	738791.79	180.539
SH	1041218.86	738795.58	180.578
SH	1041222.28	738799.16	180.77
SH	1041225.9	738802.94	180.773
SH	1041229.23	738806.53	180.752
SH	1041232.45	738810.21	180.834
SH	1041235.77	738813.79	180.87
SH	1041239	738817.38	180.908
SH	1041242.62	738821.25	180.956
SH	1041245.84	738824.94	180.952
SH	1041249.27	738828.63	181.004
SH	1041252.49	738832.11	181.06
SH	1041256.22	738836.19	180.979
SH	1041259.73	738840.07	180.814
SH	1041262.95	738843.55	180.57
SH	1041266.28	738847.24	180.54

SH	1041269.6	738850.82	180.45
SH	1041272.82	738854.5	180.373
SH	1041276.25	738858.48	180.287
SH	1041206.85	738775.94	180.311
SH	1041203.42	738772.26	180.3
SH	1041200.1	738768.67	180.364
SH	1041196.68	738765.09	180.247
SH	1041193.35	738761.41	180.208
SH	1041189.93	738757.83	180.449
SH	1041210.16	738779.82	180.372
SH	1041213.58	738783.51	180.447
SH	1041217.01	738786.99	180.666
SH	1041220.43	738790.67	180.611
SH	1041223.85	738794.36	180.812
SH	1041227.18	738797.94	180.734
SH	1041230.6	738801.72	180.831
SH	1041234.02	738805.41	180.844
SH	1041237.45	738809.08	180.892
SH	1041240.77	738812.67	180.895
SH	1041244.19	738816.35	180.968
SH	1041247.72	738820.23	181.019
SH	1041251.14	738823.82	181.035
SH	1041254.47	738827.6	181.016
SH	1041257.88	738831.18	180.923
SH	1041261.2	738834.66	180.795
SH	1041264.73	738838.64	180.696
SH	1041268.45	738842.52	180.64
SH	1041271.47	738845.6	180.612
SH	1041274.79	738849.19	180.444
SH	1041278.62	738853.37	180.285
SH	1041211.63	738774.51	180.401
SH	1041208.12	738770.83	180.374
SH	1041204.69	738767.15	180.304
SH	1041201.37	738763.67	180.256
SH	1041197.95	738759.99	180.42
SH	1041194.42	738756.2	180.377
SH	1041215.05	738778.19	180.359
SH	1041218.48	738781.77	180.508
SH	1041221.9	738785.56	180.608
SH	1041225.32	738789.14	180.654
SH	1041228.75	738792.82	180.713

SH		1041232.37	738796.4	180.79
SH		1041235.69	738799.89	180.742
SH		1041239.02	738803.47	180.825
SH		1041242.54	738807.25	180.826
SH		1041245.86	738811.04	180.948
SH		1041249.29	738814.72	180.923
SH		1041252.81	738818.2	180.818
SH		1041256.54	738822.19	180.913
SH		1041259.65	738825.77	180.887
SH		1041263.07	738829.35	180.721
SH		1041266.39	738832.83	180.671
SH		1041270.02	738836.72	180.646
SH		1041273.44	738840.29	180.469
SH		1041276.86	738843.98	180.388
SH		1041280.09	738847.36	180.333
SH		1041283.61	738851.15	180.22
SH		1041216.63	738773.18	180.455
SH		1041213.61	738769.9	180.329
SH		1041208.87	738764.92	180.422
SH		1041205.16	738760.94	180.342
SH		1041201.54	738757.26	180.502
SH		1041216.22	738772.69	180.456
SH		1041220.25	738776.97	180.475
SH		1041223.88	738780.65	180.547
SH		1041227	738784.13	180.674
SH		1041230.62	738787.7	180.727
SH		1041233.74	738791.3	180.775
SH		1041237.67	738795.27	180.957
SH		1041241.19	738798.85	181.006
SH		1041244.21	738802.34	180.898
SH		1041247.74	738805.72	180.869
SH		1041251.16	738809.31	180.821
SH		1041254.68	738812.89	180.728
SH		1041258.09	738816.57	180.736
SH		1041261.72	738820.35	180.824
SH		1041265.04	738823.84	180.697
SH		1041268.47	738827.62	180.572
SH		1041271.99	738830.9	180.587
SH		1041275.51	738834.89	180.559
SH		1041278.53	738838.27	180.471
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SH		1041284.68	738845.03	180.283
SH		1041288.6	738849.22	180.224
SH		1041221.52	738771.95	180.478
SH		1041218.1	738768.37	180.343
SH		1041214.58	738764.58	180.428
SH		1041211.36	738761.2	180.473
SH		1041207.84	738757.53	180.562
SH		1041225.15	738775.53	180.578
SH		1041227.76	738778.33	180.649
SH		1041232.09	738782.8	180.819
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SH		1041239.14	738789.96	181.02
SH		1041242.66	738793.65	181.003
SH		1041245.78	738796.83	180.971
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SH		1041270.74	738822.81	180.608
SH		1041273.76	738825.68	180.63
SH		1041277.18	738829.17	180.555
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SH		1041226.42	738770.53	180.591
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SH		1041219.47	738763.26	180.482
SH		1041216.45	738760.28	180.479
SH		1041230.04	738774.21	180.701
SH		1041233.47	738777.69	180.739
SH		1041236.99	738781.37	180.945
SH		1041240.41	738784.85	180.933
SH		1041243.93	738788.43	180.945
SH		1041247.36	738791.92	180.885
SH		1041251.08	738795.59	180.855
SH		1041254.5	738799.28	180.731
SH		1041257.92	738802.76	180.733

SH		1041261.44	738806.25	180.609
SH		1041264.86	738809.83	180.554
SH		1041268.38	738813.51	180.581
SH		1041271.81	738816.89	180.736
SH		1041275.23	738820.58	180.554
SH		1041278.05	738823.36	180.545
SH		1041282.28	738827.64	180.361
SH		1041286	738831.62	180.256
SH		1041289.02	738834.5	180.194
SH		1041289.32	738835.1	180.248
SH		1041293.25	738838.88	180.152
SH		1041296.57	738842.27	180.136
SH		1041231.32	738769.19	180.611
SH		1041227.89	738765.61	180.688
SH		1041224.77	738762.53	180.596
SH		1041220.95	738758.55	180.69
SH		1041235.04	738772.88	180.795
SH		1041238.46	738776.26	180.807
SH		1041242.08	738779.84	180.947
SH		1041245.41	738783.23	180.867
SH		1041249.03	738786.91	180.903
SH		1041252.55	738790.49	180.756
SH		1041256.17	738793.96	180.565
SH		1041260.09	738797.94	180.616
SH		1041263.81	738801.73	180.584
SH		1041267.14	738805.01	180.521
SH		1041270.56	738808.5	180.441
SH		1041273.68	738811.58	180.535
SH		1041277.2	738815.06	180.547
SH		1041280.92	738818.84	180.41
SH		1041284.45	738822.42	180.357
SH		1041287.97	738825.91	180.231
SH		1041291.39	738829.39	180.21
SH		1041294.92	738833.07	180.216
SH		1041298.34	738836.65	180.155
SH		1041301.36	738839.63	179.932
SH		1041236.31	738767.77	180.782
SH		1041232.89	738764.38	180.761
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SH		1041225.74	738757.22	180.909
SH		1041239.83	738771.25	180.901

SH		1041243.46	738774.82	180.982
SH		1041247.28	738778.81	181.006
SH		1041250.5	738781.89	180.77
SH		1041254.02	738785.48	180.764
SH		1041257.45	738788.86	180.791
SH		1041261.26	738792.64	180.714
SH		1041264.68	738796.12	180.613
SH		1041268.31	738799.8	180.539
SH		1041272.13	738803.38	180.441
SH		1041275.25	738806.56	180.333
SH		1041278.87	738810.25	180.512
SH		1041282.6	738813.83	180.299
SH		1041285.92	738817.12	180.345
SH		1041241.21	738766.44	180.823
SH		1041237.68	738762.96	180.786
SH		1041233.86	738759.38	181.043
SH		1041230.44	738756.2	181.018
SH		1041244.93	738769.82	180.858
SH		1041248.95	738773.6	180.942
SH		1041252.37	738776.88	181.039
SH		1041256.1	738780.26	180.79
SH		1041259.81	738783.84	180.729
SH		1041263.53	738787.32	180.623
SH		1041266.55	738790.41	180.575
SH		1041270.37	738793.89	180.413
SH		1041273.89	738797.06	180.573
SH		1041246.1	738765.21	180.881
SH		1041242.48	738762.03	180.937
SH		1041238.46	738758.25	181.144
SH		1041235.14	738755.26	181.091
SH		1041249.83	738768.69	180.99
SH		1041253.45	738771.67	180.978
SH		1041257.27	738775.25	180.75
SH		1041260.98	738778.53	180.706
SH		1041264.9	738782.11	180.677
SH		1041269.53	738786.28	180.526
SH		1041271.64	738788.27	180.518
SH		1041275.26	738791.56	180.58
SH		1041250.9	738763.78	180.918
SH		1041247.28	738760.71	181.04
SH		1041243.16	738757.32	180.996

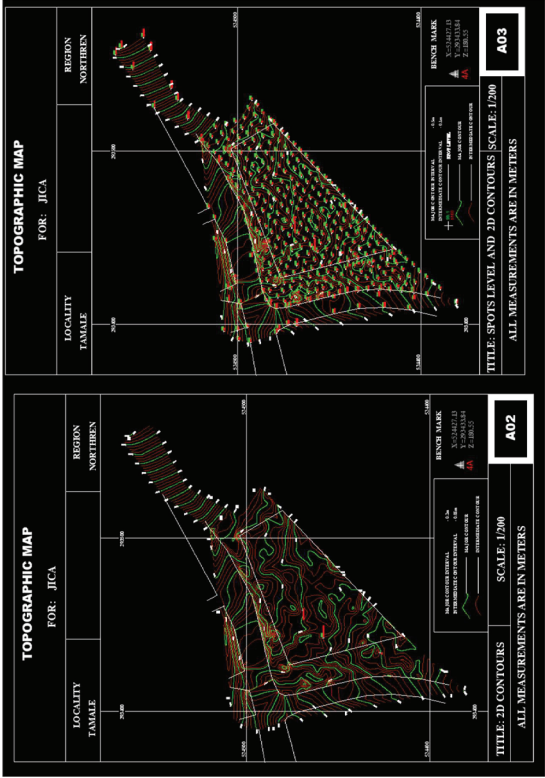
SH	1041238.73	738753.65	181.199
SH	1041255.02	738767.06	180.951
SH	1041258.43	738769.94	180.966
SH	1041262.45	738773.32	180.756
SH	1041266.47	738776.6	180.529
SH	1041269.89	738779.59	180.527
SH	1041255.79	738762.35	180.873
SH	1041251.57	738759.17	181.111
SH	1041247.35	738756	181.234
SH	1041243.13	738752.82	181.232
SH	1041259.6	738765.23	180.959
SH	1041264.33	738768.8	180.758
SH	1041267.74	738771.38	180.699
SH	1041271.96	738774.57	180.805
SH	1041260.58	738760.72	180.955
SH	1041256.47	738757.84	181.117
SH	1041252.65	738755.16	181.154
SH	1041248.83	738752.59	181.147
SH	1041244.11	738749.32	181.111
SH	1041264.19	738763.3	180.974
SH	1041268.31	738765.98	180.818
SH	1041265.57	738759.3	180.967
SH	1041261.35	738756.11	181.065
SH	1041256.94	738753.24	181.122
SH	1041252.72	738749.57	181.268
SH	1041256.11	738747.24	181.292
SH	1041259.92	738750.13	181.213
SH	1041264.34	738753.4	181.107
SH	1041263.71	738747.8	181.272
SH	1041269.07	738758.47	181
SH	1041267.74	738752.58	181.271
SH	1041266.31	738748.28	181.296
SH	1041264.59	738745.69	181.145
SH	1041260.68	738744.02	181.393
11 KV POLE	1041260.87	738760.12	180.691
mtn i chamber	1041250.93	738751.27	181.397
mtn i chamber 1	1041250.13	738751.48	181.398
mtn i chamber 2	1041249.72	738750.38	181.415

mtn i chamber 3	1041250.32	738749.97	181.414
wall	1041197.05	738778.5	180.558
SGN C 273 2022 4	1041197.15	738778.7	180.532
ROAD	1041186.11	738753.94	180.473
ROAD	1041188.05	738743.63	180.43
ROAD	1041201.86	738744.86	180.597
ROAD	1041203.83	738755.35	180.624
ROAD	1041216.62	738754.47	180.744
ROAD	1041215.76	738744.27	180.746
ROAD	1041229.25	738741.09	180.877
ROAD	1041232.11	738750.98	180.901
ROAD	1041255.09	738744.45	181.278
ROAD	1041254.43	738734.15	181.34
ROAD	1041259.41	738731.31	181.458
ROAD	1041260.88	738743.92	181.418
ROAD	1041264.19	738745.2	181.192
ROAD	1041260.6	738729.21	181.52
SGN C 273 22 1	1041258.38	738761.54	181.103
SGN C 273 22 2	1041286.13	738835.92	180.444
11 KV POLE	1041286.62	738835.52	180.59
SGN C 273 22 3	1041262.89	738850.87	180.642
Wall	1041262.89	738850.87	180.648
Nim Tree	1041285.23	738820.02	180.435
Nim Tree	1041251.48	738812.8	180.906
baobab tree	1041223.8	738802.15	180.759
tick tree	1041216.54	738792.9	180.631
tick tree0	1041218.34	738774.58	180.627
nim tree	1041221.22	738771.15	180.489
nim tree	1041234.87	738760.47	180.967
nim tree	1041210.3	738769.82	180.537
nim tree	1041195.71	738770.7	180.417
borehole 1	1041240.27	738777.35	180.84
borehole 2	1041251.57	738793.29	180.786
road 3	1041271.64	738769.76	181.141
road 33	1041268.04	738753.57	181.167
road 63	1041280.11	738746.4	181.269

road entrance	1041276.53	738732.72	181.027
road entrance	1041274.78	738724.12	181.027
road	1041281.09	738725.19	180.909
road	1041281.92	738731.19	180.827
wall	1041289.43	738730.54	180.624
road	1041280.31	738746.7	180.889
road entrance			
road	1041282.88	738757.9	180.91
road entrance			
road	1041287.37	738755.36	180.649
concrete	1041287.37	738755.26	180.644
concrete	1041286.92	738747.77	180.713
road	1041283.5	738761.19	181.152
road	1041288.42	738781.88	180.996
wall	1041294.43	738782.85	180.441
road	1041276.77	738791.85	180.954
road	1041281.85	738806.63	180.732
streetlight	1041249.73	738733.77	181.326
WATER CHAMBER	1041266.29	738779.1	180.44
WATER CHAMBER	1041266.39	738779	180.978
WATER CHAMBER	1041266.59	738780	180.428
WATER CHAMBER	1041266.59	738780.1	180.96
WATER CHAMBER	1041267.99	738779.7	180.405
WATER CHAMBER	1041267.99	738779.7	180.95
WATER CHAMBER	1041267.79	738778.69	180.435
WATER CHAMBER	1041267.79	738778.69	180.961
WATER CHAMBER	1041271.18	738776.67	180.882
WATER CHAMBER	1041271.38	738777.17	180.896
WATER CHAMBER	1041270.38	738777.07	180.863
WATER CHAMBER	1041270.48	738777.58	180.804

ROAD443	1041273.08	738776.56	181.081
ROAD473	1041278.82	738800.34	180.795
ROAD503	1041285.5	738813.22	180.71
ROAD533	1041292.88	738827.68	180.365
ROAD563	1041302.56	738839.92	180.047
ROAD593	1041309.73	738853.1	179.51
ROAD623	1041318.94	738870.75	178.871
ROAD6653	1041330.27	738892.3	178.08
ROAD6683	1041334.42	738899.98	177.854
road5432	1041346.49	738893.81	177.792
wall42211	1041349.47	738889.79	177.94
road5253	1041339.81	738881.64	178.228
road6464	1041328.18	738859.39	179.078
road6494	1041315.3	738863.97	179.147
road entrance	1041298.04	738801.63	180.531
road entrance	1041294.6	738795.35	180.543
wall	1041294.43	738782.75	180.323

IMAGE OF TOPOGRAPHICAL MAP



PICTURES OF REAL-TIME KINEMATICS

PREPARATORY SURVEY FOR THE PROJECT OF
ENHANCEMENT OF POWER SUPPLY RELIABILITY IN
TAMALE



TAMALE, GHANA

DECEMBER 2022
MARCH 2023

Geotechnical Investigation Report

Prepared by

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1.0 INTRODUCTION

1.1 Background

This report addresses deeper depths of the geotechnical investigations carried out for YACHIYO ENGINEERING COMPANY LIMITED at the location for the transmission lines. YACHIYO ENGINEERING COMPANY LIMITED of Japan contracted KALYN SURVEYS AND SERVICES for both percussion (SPT) and rock core drill (ROTARY) to determine and interprets the physical, mechanical, and chemical characteristics of the subsurface soil in order to establish a reasonable geotechnical parameters and recommendation for an economic design pylons for a transmission line.

The field reconnaissance was carried out prior to the general geotechnical investigation. The work was carried out from the 4th to 9th January, 2023 for the transmission lines.

1.2 Objectives of the Geotechnical Report

The study involves the exploration and sub-surface investigations of soil material properties which include strength, compressibility, texture (nature) and consistency as a reliability measure of the sub soil to facilitate adequate geotechnical characterization of the site for the proposed development. The chemical analysis of ground water and its effect also where encountered during investigation would be evaluated. In particular, the findings of the investigations are to facilitate the economic design and construction of the proposed works.

2.0 THE SITE

2.1. Location

The project site is as shown in Appendix A-Fig 1.

2.2. Geology of the Project Area

2.2.1 Physical features

The Tamale area is underlain by the Voltaian Basin comprising a relatively low-lying, fairly flat internal area surrounded by a narrow rim of highly dissected highlands with outward facing scarps, except on the eastern side where scarps in the Buem rocks face westwards.

The basin is drained by the Volta River and its tributaries, and the rim is breached at several places on the north and west sides where the White Volta, Sisili, Kulpawn, Lora, Labani and Black Volta rivers enter the basin.

The eastern rim is unbroken except near Ajena where the Volta escapes from the basin in a magnificent gorge cut through the Akwapim range. The southern rim, which forms the divide between the Volta drainage and the southerly flowing streams of the Colony and Southern and Western Ashanti, is breached by the headwaters of the Puru and Afram rivers and also by the Ongwan, but is otherwise unbroken.

2.2.2 Rock Types

In the absence of identifiable fossils the classification and subdivision of the Voltaian beds are based on lithological features and stratigraphical sequences. Owing, however, to very marked lateral changes in facies in some of the beds, notably those in the lower half of the system, and to overlaps resulting from movements during deposition, the detailed correlation of the beds in different areas is by no means simple.

The first attempt at classifying the Voltaian rocks was made by Cooper in 1926. His classification of the rocks in the area between Nkoranza, Ejura and Tamale is as follows

- (a) Siliceous Sandstones group
- (b) Thin-bedded Sandstones and Sandy Shale group
- (c) Mudstone group
- (d) Calcareous Sandstone group
- (e) Clay-Shales group.

2.3. Geohazards of the Tamale Area

The past and recent information indicate the project area is less prone to seismic hazards as indicated in Appendix C, and flooding.

3.0 SITE INVESTIGATION

3.1 Standard Penetration Test

This test was done in accordance with BS 1377: 1990 Part 9 covers the determination of the resistance of the penetration of a split-barrel sampler and obtaining disturbed samples of the soil for identification purpose and also BS 5930 standard code of practice for site investigation.

Once the borehole has reached the required test depth, the borehole was cleaned by flushing with water before starting test. It was performed using a split-barrel sampler with a 50.8mm external and 34.9mm internal diameter which was connected to the lower end of boring rods. The sampler was driven into soil by means of a 63.5kg hammer falling freely through a height of 76cm onto an anvil attached to the top of the rods. A trip-release mechanism and guiding assembly were used to control the falling hammer and the driving energy was thus transmitted through the rods to the SPT sampler. The sampler was driven 45cm into soil with the number of blows required for each 15cm of penetration recorded. The resistance, N-value, was taken as the number of blows for the last 30cm of penetration.

At the end of the test, the sampler was withdrawn and some extracted soil was placed into a plastic container and then labeled. These samples were used to describe the type of soil existing in the boring points.

A total of 60 SPT- N - values were taken in order to get the information and technical data on the in-situ strength and type of soil.

3.2 Rock Coring

The rocks were cored using diamond coring equipment, SIMCO TR 4000 HQ core size with triple tube core barrel production of 6.1 mm diameter cores. After taking out coring tool from borehole, the core samples were removed carefully from core barrel, the core sample was properly placed in a standard core box. The TCR, SCR, RQD, colour and estimated strength etc. were recorded before taking photographs of the core, the core photographs are shown in Appendix E.

The following three conventional standard methods were performed on each core run.

- a. Total core recovery (TCR)
- b. Solid core recovery (SCR)
- c. Rock quality designation (RQD)

BS 5930 provided definitions for each of the aforementioned indices. In summary, the TCR is the total length of the core recovered expressed as a percentage of the core run length. Similarly SCR is the cumulative length of pieces of solid core recovered and is also express as percentage of the core run length. RQD is defined as the cumulative length of solid core pieces greater than 100mm in length and again is expressed as a percentage of the core run length. Based on RQD value performed the rating of descriptive terms which have been incorporated into BS 5930.

4.0 LABORATORY TESTS ON SOIL AND ROCK SAMPLES

The samples recovered from both Standard Penetration Test and Rock Core Drill were tested for the following parameters:

- i. Natural Moisture Content
 - ii. Liquid, Plastic and Plasticity index
 - iii. Particle Size Distribution
 - iv. Specific gravity of soil
 - v. Triaxial test
 - vi. Uniaxial Compression Test
- All the laboratory test results have been summarized in Appendix F.

5.0 DISCUSSIONS ON THE FIELD RESULTS.

5.1 Ground conditions

This section briefly describes the soil conditions encountered at site. Detailed soil conditions are presented in each log of boring in the Appendix F of Borehole Logs. Based on the data collected from 3 boreholes, the subsoil can be classified as follows:

- (1) Silty Sand (Top Soil)
- (2) SHALE – Moderately Weathered
- (3) SANDSTONE– Moderately Weathered (SIII), Slightly Weathered (SII) (Voltaian Formation)

(1) Top Soil (Fill)

From the surface to the depth of 0.00 to 2.0 meter was made up of top soil (Silty Sand), medium dense, dry brownish, fine grained silty sand.

(2) SHALE and SANDSTONE - Moderately Weathered (SIII), Slightly Weathered (SII) (Voltaian Formation)

This rock was encountered in all the boreholes at depth of 3.0 to 15.0 meters. The rock is moderately to slightly weathered, fine to very fine, dark reddish brown SANDSTONE between 3.0m and 7.0m, dark reddish brown to greyish slightly weathered SHALE / SANDSTONE from 7.0-10.0m (Voltaian Formation) and medium-grained, dark reddish brown slightly weathered SHALE/SANDSTONE rocks.

The RQD is poor, fair, and good to excellent. The SPT-N-values generally range between 4 and above (refusal) for between 6 and refusal for the boreholes of the transmission lines

5.2 BEDROCK

The project area lies within geological formation known as Voltaian Formation. The Voltaian Formation is mostly consisted of the sediment of Siliceous Sandstones group, Thin-bedded Sandstones and Sandy Shale, Mudstone, Calcareous SANDSTONE and Clay-Shales.

5.3 Strength characteristics (Shallow Foundation).

In general two methods of determinants are used in estimating the strength characteristics of the sub soil materials namely:

- 1. The Laboratory shear strength
- 2. The SPT N-value test (field)

5.3.1 BEARING CAPACITY BASED ON IN-SITU SPT -N -VALUES

FIELD: $Q = \frac{N}{6} [(B + 1)/B]^2 / K$, for footing width B greater than 4 feet and $K = 1 + 0.33 (D/B) \leq 1.33$.

Transmission Line

JICA - 8 at 3m
 $Q = \frac{40}{6} * [(3+1)/(3)^2] / 1.33$
 $Q = 8.911 \text{ kips/sq}^2$
 $Q = 426.67 \text{ kN/m}^2$
Applying a factor of safety of 2.5
 $Q = 170.67 \text{ kN/m}^2$

JICA-12 at 2.5m
 $Q = \frac{13}{6} * [(3+1)/(3)^2] / 1.275$
 $Q = 3.02106 \text{ kips/sq}^2$
 $Q = 144.649 \text{ kN/m}^2$
Applying a factor of safety of 2.5
 $Q = 57.86 \text{ kN/m}^2$

JICA-24 at 2m
 $Q = \frac{54}{6} * [(3+1)/(3)^2] / 1.22$
 $Q = 13.11475 \text{ kips/sq}^2$
 $Q = 627.938 \text{ kN/m}^2$
Applying a factor of safety of 2.5
 $Q = 251.1751 \text{ kN/m}^2$

JICA-8	N	B(Width of footing)	Q (kN/m2)	safe B.C	Depth	K	Fs
	19	2	456.0	182.401	1	1.33	2.5
	19	2	292.83	117.132	1	1.165	2.5
	19	3	242.83	97.13446	1	1.11	2.5
	114	2	1539.0	615.6033	2	1.33	2.5
	114	3	1325.6	530.2586	2	1.22	2.5
	40	3	426.66	170.6676	3	1.33	2.5
JICA-12	N	B(Width of footing)	Q (kN/m2)	safe B.C	Depth	K	Fs
	6	2	92.473	36.98904	1	1.165	2.5
	6	3	76.685	30.67404	1	1.11	2.5
	13	2	175.501	70.20038	2	1.33	2.5
	13	3	151.17	60.46809	2	1.22	2.5
	13	3	144.649	57.859645	2.5	1.275	2.5

	17	3	181.334	75.53373	3	1.33	2.5
	17	4	169.916	67.9663	3	1.2475	2.5
	65	4	609.378	243.7513	4	1.33	2.5
JICA-24	N	B(Width of footing)	Q (kN/m2)	safe B.C	Depth	K	Fs
	14	2	215.769	86.30776	1	1.165	2.5
	14	3	178.932	71.57276	1	1.11	2.5
	14	4	161.26	64.50381	1	1.0825	2.5
	54	2	729.004	291.6016	2	1.33	2.5
	54	3	627.938	251.1751	2	1.22	2.5
	54	4	577.954	231.1815	2	1.165	2.5

Table 5.3.1 Transmission Line Bearing Capacities

5.4 DEEP FOUNDATION ANALYSIS IN SHALE/SANDSTONE

Pile foundations founded in the underlying shale rock provide alternative to shallow raft foundation. Currently the most favoured type of pile in the country are bored cast in –situ and caisson or drilled shafts or cast in –situ because of the readily availability of equipment. The pile design procedure will depend on the type of pile and the method of installation.

Concept based on EuroCode 7 part 2, Skempton (1966) and Australian Geomechanics design rules as follows:

- 1. The equivalent Young modulus of the rock
- 2. The average Unconfined Compressive Strength
- 3. The average roughness of the sidewalls for a deep foundation
- 4. The bearing capacity is usually predicted on the basis of undrained shear strength
- 5. By calculation from profiles of ground tests
- 6. By calculation from ground parameters

Practically the selected bored pile was chosen due to the following:

- 1. Availability of equipment in the country
- 2. Soil or rock can be inspected and compared with site investigation data.
- 3. Can be installed in very long lengths, with very large diameters
- 4. Can be installed without appreciable noise or vibration to adjacent structures and working in a limited headroom

EUROCODE 7 part 2/SKEMPTON METHOD LABORATORY UNCOMPRESSIVE STRENGTH METHOD

LOAD OF SHAFT (P_S) = A_S * 0.45 * S_U

Where A_S = Area on shaft

S_U = Average undrained shear strength

LOAD AT BASE (P_b)

=9 * A_b * S_u

Where A_b = Area of base of shaft

S_u = Average undrained shear strength at base of shaft

THEN END BEARING RESISTANCE / TOTAL LOAD ON PILE = P_s + P_b

In principle, the Stability of piles can be evacuated based on available Factor of Safety FS provided by Burland, Butter and Duncan (1966) and suggested two simple stability criteria as follows:

P_a ≤ L_g + L_s / F , Ensures overall SATBILITY

P_{a11} ≤ L_s + L_{at}+F_B, Guard against local OVER STRESSING OF BASE

Using Laboratory Uniaxial Compressive Strength to determine Undrained Shear Strength							
Name	Depth	P _b (Load at base)	P _s (Load along the shaft)	P _{a11} (Overall Stability)	End bearing /total stressing resistance	Working Load	
J8	10m	249.86	119.62	184.74	202.9	369.48	65.12
J12	10m	249.86	119.62	184.74	202.9	369.48	65.12
J24	10m	249.86	119.62	184.74	202.9	369.48	65.12

Table 5.4.1 Laboratory Uniaxial Compressive Strength to determine Undrained Shear Strength

Alternatively,

SIRVIKIYA'S EQUATION

Using Sirvikiya's Equation for evaluating Undrained Shear Strength

S_U = 3.33N_{VALUE} – 0.75NM_C + 0.2LL + 1.67Pl

Where NM_C is Natural Moisture Content

LL is Liquid Limit

Pl is Plastic Limit

Example JICA-8 at 10m

S_U = 3.33(40) – 0.75(0) + 0.1(0) + 1.67(0)

= 3.33(40)

= 133.2

Average N_{VALUE} around shaft

S_U = 3.33(32.2) – 0.75(0) + 0.1(0) + 1.67(0)

= 107.23

P_S = 0.45 * 107.226 * π * 0.94 * 10

= 1,425.1KN/m²

= 1.425MPa

P_b = 9 * 133.2 * π * (0.94)²

= 9 * 133.2 * π * 0.8836

= 3,328.19

= 3.32MPa

End Bearing Resistance / Total load on pile = 3.32 MPa + 1.425 MPa

= 4.745 MPa

CHECKING OVERALL STABILITY

P_a = L_g + L_s / F

= 3.32+1.425

= 4.745

= 2.37MPa

OVERSTRESSING OF BASE

P_{a11} = L_s + L_g/F_B

= 1.425 + 3.32

= 1.425 + 1.1067

= 2.53 MPa

It is also assumed that the settlement will be large enough to mobilize the full SHAFT ADHESION, hence P_S = 89.71MPa.

Therefore, the LOAD at the BASE / WORKING LOAD is

= Overall Stability – Load on shaft

= (2.37 – 1.425) MPa

= 0.945MPa

Using Sirivikya Equation to determine Undrained Shear Strength- FIELD N VALUE (Result in kN/m ²)							
Name	Depth	P _b (Load at base)	P _s (Load along the shaft))	P _a (Overall Stability)	P _{a11} (Over stressing at base)	End bearing /total resistance	Working Load
J8	9m-	3,328.2	1,425.1	2,376.6	2,534.5	4,753.30	951.54
	10m						
J12	9m-	2,080.1	920.6	1,500.3	1,613.9	3,000.37	579.78
	10m						
J24	9m-	2,912.2	1,434.0	2,173.1	2,404.7	4,346.13	739.11
	10m						

Table 5.4.2 Sirivikya Equation to determine Undrained Shear Strength

5.4.1 BORED CAST IN-SITU PILE:

Drilled piles also called drilled shaft, drilled piers, cast in drilled hole piles or cast –in-situ Piles, a borehole is drilled into the ground, then concrete (and often some sort of reinforcing is placed into the borehole to form the pile. Rotary boring techniques allow larger diameter piles than any other piling method and permit pile construction through particularly dense or hard strata. Construction methods depend on the geology of the site: in particular whether boring is to be undertaken in dry ground conditions or through water-saturated strata, wet boring. Caisson is often used when the sides of the borehole are likely to slide off before concrete is poured.

End bearing piles, drilling continues until the borehole has extended a sufficient depth (socketing) into a sufficiently strong layer. Depending on the site geology this can be a rock layer or hardpan, or other dense, strong layers. Both the diameter of the pile and the depth of the pile are highly specified to the ground conditions and nature of the project. Pile depths may vary substantially across a project if the Sheet piling is a form of driven piling using thin interlocking sheets of steel to obtain a continuous barrier in the ground. The main application of sheet piles is in retaining walls and cofferdams erected to enable permanent works to proceed. Normally, a vibrating hammer, t-crane and crawler drilling are used to establish sheet piles.

6.0SHALLOW FOUNDATION RECOMMENDATIONS

Foundation construction needs to satisfy two basic and independent design criteria, firstly the bearing pressure transmitted to the foundation soils should not exceed the net allowable soil bearing capacity with an appropriate safety factor. Secondly, settlements during the operating life of the structure should not be of a magnitude that will cause structural damage to the structures or their utility connections. Settlements are a function of among other things, the underlying soil condition, the foundation size and shape, and the applied foundation pressure of the foundation elements.

6.1. Foundation Depth & Type

The entire project area is underlain by about approximately 2.0m top soil (Silty Sand), medium dense, dry brownish, fine-grained silty sand.

It is anticipated that foundations be founded economically below ground level between 2.0m and 3.0m).

SOIL REPLACEMENT

Similarly reconstituted or improved soil replacement with good material such as crushed granitic rock of minimum thickness for high bearing capacity can be used as an alternative to shallow foundations instead of strip or raft foundations.

7.0 DEEP FOUNDATIONS RECOMMENDATIONS

7.1 Foundation Depth and Type

PILES

1. Pile design approach was based on calculations profiles of ground test and parameter
2. Determination of the number of piles to support a building is to be carried out on the basis of static load tests on site prior to construction
- 3.

Concept based on Australian Geomechanics Society, Ref: Holden J9, C1894 – the construction of bored piles in weathered sedimentary rock

1. The equivalent Young's Moduli of the rock
2. The average unconfined compressive strength
3. The average roughness of the sidewalls for a deep foundation
4. By calculation from profiles of ground tests
5. By calculation from ground parameters

$$Q_U = Q_{(BASE \text{ RESISTANCE})} + Q_{(SHAFT \text{ RESISTANCE})}$$

When firm soil is not near the ground surface, a common means of transferring the weight of an imposed structure to the ground is through vertical members such as PILES, CAISSONS, or PIERS.

Generally, caissons and piers are larger in diameter than piles, shorter in length, and installed by an excavation technique whereas piles are installed by driving.

In view of the above, caissons may not be recommended for Shallow Foundations for transmission lines due to economic reasons at 2m-3m depths.

Refer to tables 5.4.1 and 5.4.2

8.0 SUMMARY AND RECOMMENDATIONS

8.1 Summary

The subsurface conditions prevailing on the site and given the type of structure and equipment to be installed permit the use of either a conventional shallow foundation in the form of pad and strip or continuous footing types or matt to be considered for supporting the structure between 2.0m and 3.0m. However, to improve the bearing capacity, a two (2) meter soil replacement with granitic boulders ranging between (100 – 400) mm must be placed in lifts of 200mm thick and satisfactorily compacted to appreciable standards.

It became apparent that the in-situ N values or bearing pressures were more reliable and consistent at deeper depths with the laboratory shear strength results hence a deep foundation was recommended for heavy duty equipment.

The foundations are however expected to be designed to negligible settlement; as such it is therefore proposed that;

- A raft foundations at shallow depths are expected to be placed on a reconstituted soil replacement of two (2) meter thickness to achieve a very high modulus of subgrade reaction to accommodate a bearing pressure of the order of (300 to 400) kN/ m².
- A deep foundation at minimum 10m depth of bored cast in-situ pile or caisson/ rock socket pile is recommended with minimum settlement for heavy duty equipment.
- The Class 42.5N type cement from GHACEM (Local suppliers using the silicate/ gypsum type cement) is suitable to be used, this is likely to generate an expected strength in the domain of C40 (35 – 40N/mm²). This is however to be confirmed with sufficient concrete mix design using the available material components on site.

- A sheet pile steel or composite material is recommended at various stages of foundation construction to protect slopes of excavations within and outside the working area.
- In case of an encounter with groundwater, de- watering during and after construction to provide working area and maintain stability of existing structures is recommended.

9.0 EARTHQUAKE CONSIDERATIONS IN DESIGN

The Northern Region area of Ghana including Tamale is seismically stable.

The site falls outside previously recorded seismic activities. Even though this can be considered stable enough to withstand load. In the absence of any site-specific instrumental data, a minimum horizontal ground acceleration of 0.12g may be considered.

10.0 LIMITATIONS & UNIFORMITY OF CONDITIONS

This report has been prepared for the exclusive use of the client YACHIYO ENGINEERING COMPANY LIMITED-/APAN for specific applications to develop pylons for a transmission line. The engineer has to conform with generally accepted geotechnical practices common to this local area. The engineer makes no other warranty, express or implied.

- As of this present date findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property could result whether due to natural processes or the actions of man on Legislation or broadened of knowledge may also arise in the application of adjacent properties standards. Such changes outside the engineer's control may result in this report invalid wholly or partially.
- It is encouraged not to apply any part of this report's conclusions and recommendations under the condition of **changes in nature, and location of the proposal**. Again the engineer is not responsible for any claims changes in nature, design and location of the proposal. **The engineer must be contacted to provide a review of this report's applicability to changes perceived on damages or liability** associated with any other party's interpretation of this subsurface report. The reuse of this report's information or engineering analyses without the express written permission or authorization of the engineer constitutes a breach.
- The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, the engineer will provide supplemental recommendations as dictated by the field conditions.



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APPENDIX A

(SITE DETAILS WITH BOREHOLE LOCATIONS)

APPENDIX B

(GEOLOGICAL MAP OF GHANA AREA SHOWING THE SITE)

Preparatory Survey for the Project of Enhancement of
Power Supply Reliability in Tamale

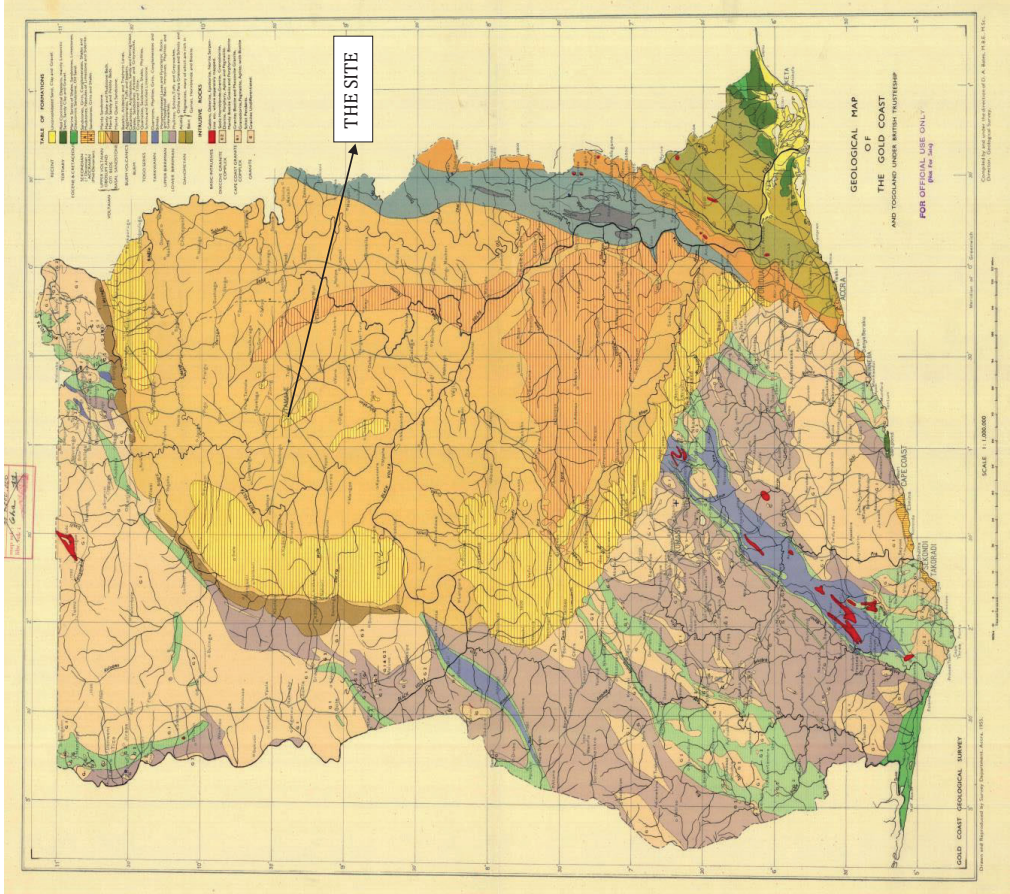


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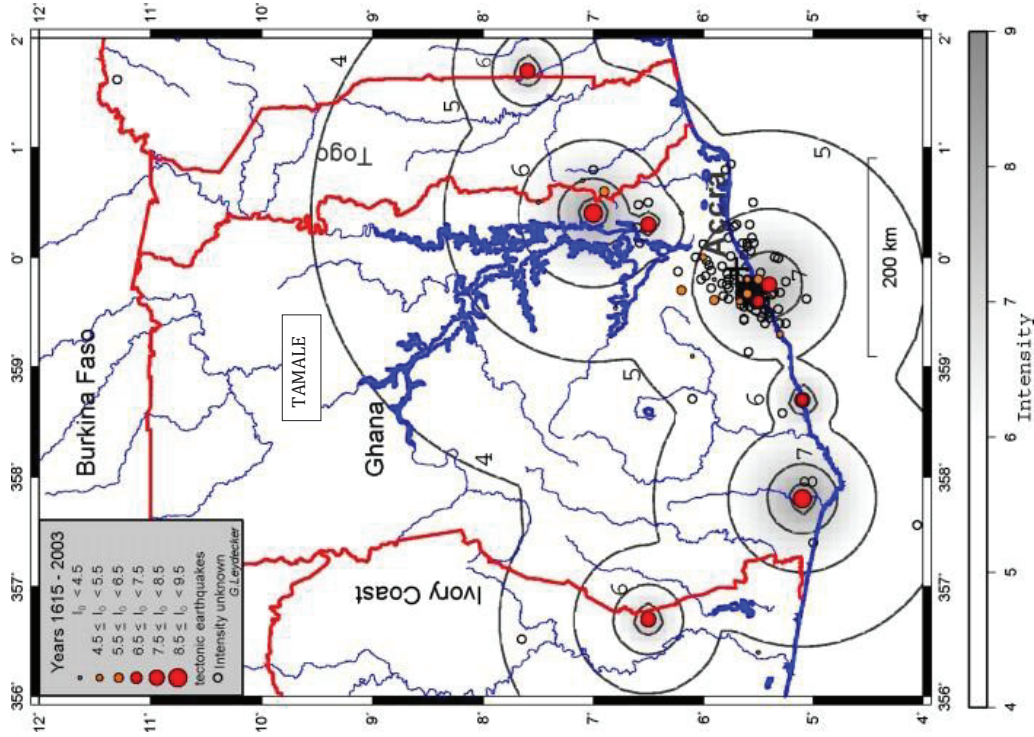
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APPENDIX C

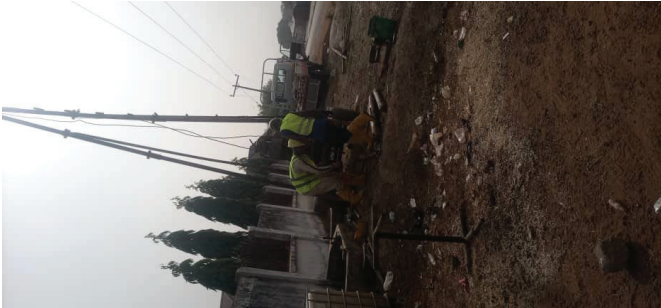
(GEO HAZARDS MAP)



APPENDIX D

STANDARD PENETRATION (SPT) AND ROTARY ACTIVITIES PICTURES

TRANSMISSION LINES - JICA 8, 12 & 24
BOREHOLES



ROTARY



SPT
JICA-8



ROTARY



SPT



ROTARY



SPT
JICA-12



SPT
JICA-24
A14-54

APPENDIX E

(ROCK CORE DRILL PICTURES)

TRANSMISSION LINES - JICA 8, 12 & 24 BOREHOLES



JICA-8



JICA-12



JICA-24

APPENDIX F

(FACTURAL SUBSURFACE
RESULTS)

Preparatory Survey for the Project of Enhancement of Power Supply Reliability in Tamale

[illegible]

Preparatory Survey for the Project of Enhancement of Power Supply Reliability in Tamale

[illegible]

CLIENT: ACITY O ENGINEERING COMPANY LIMITED										PROJECT: Enhancement of Power Supply Reliability in Tanabe										WATER LEVEL									
LOCATION: Tanabe										WATER LEVEL										WATER LEVEL									
PROJECT NO: 2023-001										PROJECT NO: 2023-001										PROJECT NO: 2023-001									
DESIGNED BY: J. Doe										DESIGNED BY: J. Doe										DESIGNED BY: J. Doe									
CHECKED BY: M. Smith										CHECKED BY: M. Smith										CHECKED BY: M. Smith									
DATE: 2023-01-01										DATE: 2023-01-01										DATE: 2023-01-01									
PREPARED BY: J. Doe										PREPARED BY: J. Doe										PREPARED BY: J. Doe									
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