### APPENDIX 5 FIELD REPORT

### IMPROVEMENT OF THE POWER DISTRIBUTION SYSTEM THE REPUBLIC OF GHANA PREPARATORY SURVEY THE PROJECT

THE SECOND FIELD SURVEY

## FIELD REPORT

February 21st, 2011

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Deputy Chief Exective Volta River Authority (VRA)

Witness

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### 1. Introduction

engineering aspects, this Field Report has been prepared based on the results of the second field In order to build mutual understanding between the Ghanaian side and the Second Preparatory Survey Team (hereinafter referred to as "the Team") for the Project for Improvement of the Distribution System in the Republic of Ghana (hereinafter referred to as "the Project") on the technical and survey and discussions with the Ghanaian side, i.e., Volta River Authority - Northern Electricity Department (VRA-NED) and Ministry of Energy (MOE).

It has been confirmed by the Ghanaian side and the Team that the candidate components of the Project are as shown as follows in the Minutes of Discuss ons (M/D) signed by both parties on 28th January, 2011. However, the final components of the Project will be decided by the Government of Japan.

## Table 1 Summary of the Project

	$\neg$		Improvement of Tamale distribution system		Improvement of Sunyani distribution system
		8	(1) Construction of UDS Primary Substation	€	Construction of Kotokrom Primary Substation.
			> 1 set of 34.5/11.5kV Transformer, 7.5MVA		> 1 set of 34.5/11.5kV Transformer, 7,5MVA
			2 sets of 34.5kV Switchgear Cubicle		2 sets of 34.5kV Switchgear Cubicle
			5 sets of 11 5kV Switchgear Cubicle		5 sets of 11.5kV Switchgear Cubicle
			11.5/0.433kV Station Transformer, 100kVA		➤ 11.5/0.433kV Station Transformer, 100kVA
	uoi		<ul> <li>Substation Building (Approx. 260m²)</li> </ul>		<ul> <li>Substation Building (Approx, 260m²)</li> </ul>
200		(2)	Installation of a 34.5 kV Sub-transmission Line from	(3)	Installation of a 34.5 kV Sub-transmission Line from
	Su		Tamale BSP to UDS Primary Substation		Sunyami BSP to Kotokrom Primary Substation
Tool .	pue		(Approx. 19km including 5km underground cable)		(Approx. 8.5km including 0.5km underground cable)
	ment	3	Installation of 11.5kV Distribution Lines from UDS	(3)	Installation of 11.5 kV Distribution Lines from Kotokrom
	nre		Primary Substation for connection with the existing lines:		Primary Substation for connection with the existing lines:
	301		1. UDS Feeder Approx. 0.2km		1. Hospital Feeder Approx. 4.3km
			2, Tolon Feeder Approx. 0.7km		2. New Dormma Feeder Approx. 0.6km
			3. Sheshegu Feeder Approx. 0.3km		3. Chiraa Feeder Approx. 0.7km
		(4)	Extension of 34-5kV Switchgear in Tamale BSP	(4)	Extension of 34.5kV Switchgear in Sunyani BSP
			5 3 sets of 34.5kV Swrtchgear Cubicle		3 sets of 34.5kV Switchgear Cubicle
				(5)	11.5 kV Ring Main Unit at Sunyani Regional Hospital
		0	Maintenance equipment and tools	ê	Maintenance equipment and tools
	эша		> 1 set of Cable fault detector		7 1 set of Cable fault detector
	cnr		- I unit of Truck with an aerial bucket		> 1 unit of Truck with an aerial bucket
- 7	Pro		Spare parts and maintenance tools		Spare parts and maintenance tools
	-				

### 2. Project Site Information

### 2.1 Project Site Locations

The new primary substation, i.e., UDS primary substation, will be located near the UDS (University of Development Study) in western area of Tamale District, where severe voltage drop in 11.5kV lines is expected by increase of demand in Distribution System Master Plan Study prepared by JICA.

The new primary substation, i.e., Kotokrom primary substation, will be located in eastern area of Sunyani District and will contribute to improvement of power supply to north-eastern half of the Sunyani District.

The Project Site Locations are shown as Fig. 1.

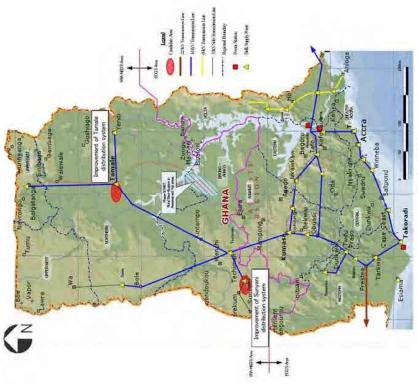


Fig.1 Project Site Locations

## 2.2 Beneficiary of the Project

#### 2.2.1 Tamale

### (1) Primary beneficiaries

### 1) Consumers

- The existing consumers: 5,084 households
- ➤ The waiting consumers: 3,916 households.
- Total beneficiaries: 9,000 households (approximately 66,600 populations 1)

### 2) Public Facilities

### (a) Hospitals

- First beneficiaries: 4,498 patients/rionth (accumulated) of three medical centers
- Second beneficiaries: 36 medical staffs of three medical centers. They will be relieved from risks of medical accidents because the blackout, fluctuation, low voltage and the damages on the medical equipmen will decrease with the stable electric supply by the process.

Table 2 Major Beneficiaries of Hospitals in the Tamale Project (Monthly)

_		_	_	_
Medical staff	1 doctor 3 parttime doctors 5 nurses 2 midwives 8 nurse assisstants	1,270 1 medical assistant 2 nurses 8 community nurses	1,182 2 midwives 4 community nurses	40 4,498 36 medical staffs
Total*	2.046 I doctor 3 partim 5 nurses 2 midwiv 8 nurse a	1,270	1,182	4,498
Emergency	,40	20	15	40
Surgery	9		4	9
Inpatient	200		y-	200
Outpatient	1,500	1,250	1,167	3,917
No. Name of Hospital   Outpatient   Inpatient   Surgery   Emergency   Total*   Medical staff	God Cares Community Hospital	2 Tolon Health Center	3 Nyankpala Health Center	4 Total
No.	-	C	m	4

Note: \* Accumulated figure

### (b) Schools

- First beneficiaries: 2,095 students (Boarders using more electricity in the night)
- Second beneficiaries: 2,872 studerts (higher educational students before getting jobs, excluding the boarders)
- Third beneficiaries: 17,959 students (lower educational: primary and secondary school students)
- ➤ Total beneficiaries: 22,926 students

\*\*

Mean household size at 7.4 persons of Northern Region by the Census 2000

Table 3 Major Beneficiaries of Schools in the Tamale Project

No.	Name	No. of Students	No. of Boarders   No. of Teachers	No. of Teachers
-	University Development of Study (UDS)/Faculty of Agriculture	2,300	1,000	18
CI	Grich Business College	100	06	01
m	Tamale Vocational Training Institute	180	45	II
4	Bisco High School	009,1	800	89
6	Tolon High School	787	091	32
6	Subtotal	4,967	2,095	661
7	The other Primary/Secondary Schools	17,959	1	
00	Total	22,926	2,095	661

### (2) Secondary beneficiaries

- Communities supported by Nyankpala and Tolon Health Centers outreach service including immunization: 79 communities (approximately 75,200 populations)
- Students including boarders and teachers close to the Project feeder: 10,863 students.
   The schools in Table 4 are out of the Project feeder but they can also obtain benefit because their feeder line's electric load will be reduced with the Project.

Table 4 Secondary Beneficiaries of Schools in the Tamale Project

NA	Name	No of Students	No of Boardore	No of Torchor
	TARING	TAO, OF STUDENTS	TVO. OI DOGINGS	LYO. OF LEACHER
1	TACE Training School (for Teachers)	820	295	4
7	Batco Training School (for teachers)	830	200	4
3	Tamale Polytechnic	005'9	877	250
4	Tamasco High School	2,583	2,583	104
5	Ghana Institute of Language	100	•	
9	Total	10,863	2,583	452

### 2.2.2 Sunyani

### (1) Primary beneficiaries

#### 1) Consumers

- The existing consumers: 4,577 households
- The waiting consumers: 4,380 households
- Total heneficiaries: 8 957 households (approximately 47,500 populations\*)

### 2) Public Facilities

### (a) Hospitals

- First beneficiaries: 20,807 patients/month (accumulated) of two medical centers
- Second beneficiaries: 366 medical staffs of two medical centers. They will be relieved from risks of medical accidents because the blackout, fluctuation, low voltage and the damages on the medical equipment will decrease with the stable electric supply by the

Project

Table 4 Major Beneficiaries of Hospitals in the Sunyani Project (Monthly)

	Table 4	rame - major beneficialies of reospitais in the Sunyain reoject (monthly	A 10 50 10	OS DITORIS II	THE SHIPPHIE	110 011	A COLUMN )
100	Name of Hospital	Outpatient	Inpatient	Surgery	Emergency	Total*	Medical staff
	Sunyani Regional Hospital	17,800	1,368	300	410	19,878	58 doctors 294 nurses
2	Chiraa Health Center	929		Y		929	1 medical assistant 10 community nurses
	Total	18 750	1 368	300	410	20.807	366 medical etaffe

Note: \* Accumulated figure

#### (b) Schools

- First beneficiaries: 969 students (Boarders using more electricity in the night)
- Second beneficiaries: 2,313 studerts (higher educational students before getting jobs, excluding the boarders)
- Third beneficiaries: 23,310 students (lower educational: primary/secondary school students)
- ➤ Total beneficiaries: 26,592 students

Table 5 Major Beneficiaries of Students and Boarders of the Sunyani Project

Jo.	Name	No. of Students	No. of Students   No. of Boarders   No. of Teachers	No. of Teachers
-	Nurse Training School Sunyani	437	300	12
cı.	Catholic Technical Institute (Electrical Installation)	65	49	Ś
m	Sunyani Business School	450	300	20
4	Chiraa High School	1,010	320	34
S	Twene Amanfo High School	1,320	*	
9	Subtotal	3,282	696	1.2
7	The other Primary/Secondary Schools	23,310	8	
00	Total	26.592	696	1/2

### (2) Secondary beneficiaries

- Communities supported by Suryani Regional Hospital outreach service: 169 communities (approximately 600,000 populations) are subjected.
  - Sunyani Regional Hospital outreaches other areas for medical cares. They daily dispatches a team consist of doctors and nurses for several hospitals to assist them. They also hold training workshops for midwives and nurses working in rural areas. Some graduates of Nurse Training School Sunyani will also be allocated for community healthcare facilities.

<sup>&</sup>lt;sup>1</sup> Mean household size at 5.3 persons of Brong-Ahalo Region by the Census 2000

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# 2.3 Power Demand Forecast in the Project Sites

The Power Demand Forecast for Improvement of Tamale distribution system is shown Table 6. In the target year of the Project, 2018, 5 years after commissioning of the Project, the demand will reached to approx. 6.8 MVA.

And the Power Demand Forecast for Improvement of Sunyani distribution system is shown Table 7. In the target year of the Project, 2018, 5 years after commissioning of the Project, the demand will reached to approx. 6.7 MVA.

Table 6 Power Demand Forecast for Improvement of Tamale distribution system

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# 2.4 Environmental and Social Considerations

### 2.4.1 Land Acquisition

#### (I) Tamale

### 1) UDS primary substation

VRA will obtain an approval to use the land owned by Animal Research Institute under the Ministry of Science and Technology. VRA has already sent the institute a letter for the approval. After VRA obtain the approval, they will make an agreement to permanently use the land for the primary substation with the institute. VRA will also inform Town and Country Planning Department (TCPD) the land area of substation and obtain its authorizat on of the land use for the primary substation.

# 2) 34.5kV sub-transmission line and 11.5kV distribution lines

VRA will use the road reserve allocated for installing utilities by TCPD. Those widths are specified according to the types of roads. 15m from a center of local road or district road is typical width for the road reserve. VRA will draw the feeder lines on the plan drawings of TCPD and submit it to TCPD for authorization of the route. A part of the 34.5kV sub-transmission line (underground cable) passes on the boarder of military owned land which is not used. VRA will obtain an approval to use the land with a letter attaching the plan drawing of the Project.

#### (2) Sunyani

### 1) Kotokurom Substation

VRA has obtained an approval letter to use the land for the Kotokurom substation, which is owned by the barrack. VRA will make an agreement to permanently use the land for substation with the barrack.

## 2) 34,5kV sub-transmission lines

VRA will use the Way Leave of 161kV transmission line within 30m width for installation of the 34.5kV sub-transmission line. VRA sent GRIDCO which manages 161kV transmission line a letter to use the Way Leave, and will obtain the approval from GRIDCO. For a part of the sub-transmission line planed on the border of barrack area, VRA will obtain an approval to use the land from the barrack with a letter attaching the plan drawings.

### 3) 11.5kV distribution line

VRA will use the road reserve of Sunyani-Techiman Road to install 11.5kV distribution line, which is allocated for installing utilities by TCPD, VRA will take the same procedure as the case of Tamale for the Project.

## 2.4.2 Environmental Permit (EP)

VRA will register respective regional offices of Environmental Protection Agency (EPA) the Project attaching necessary documents to obtain an Environmental Permit (EP). EPA will assess the documents and decide to issue the EP, to require EIA or Preliminary Environmental Report (PER). According to the Environmental Impact Assessment Guideline for the Energy Sector, the PER will be expected to obtain the EP for the Project. The Environmental Department of VRA will be in charged for the EP matter.

# 3. Design Conditions and Technical Specifications

### 3.1 Design Conditions

Design conditions to be applied to the Project are described as follows.

### 3.1.1 Climatic Conditions

Natural conditions for the equipment and facilities design are described as follows.

Table 8 Climatic Conditions

	Table 8 Climatic Conditions	Conditions
Region		Northern and Brong-Ahafo
Altitude		Less than 1,000m
	Maximum	40°C
Ambient Temperature	Minimum	2.01
	Mean	30°C
Maximum Humidity		%58
Max. Wind Velocity		34m/sec.
Rainfall		800mm/year
Seismic Force		Horizontal 0.1G
Soil Bearing Capacity		5 ton/m²

# 3.1.2 Basic Electrical Design Conditions

Basic conditions for designing electrical equipment and materials are described as follows.

Table 9 Basic Electrical Design Conditions

Item	Distributio	Distribution System	Station Service Power	ice Power
Nominal Voltage	34.5kV	11.5kV	AC 415/240V	DC 125V
Maximum Voltage	36 kV	12KV	AC 435/252V	DC 131V
Frequency		SOHz		N/N
Rated Short-time Withstand Current	25kA (1sec.)	12.5kA (1sec.)	12.5kA (1sec.)	N/A
Lightong Impulse Withstand Voltage (LIWV)	170 kV	75kV	N/A	N/A
Earthing System	FRE	Filective Farthing System	System	NIN

Station Service Power N/A V/N N/A V/V N/A Outdoor: IP43 Indoor: IP20 above the Grand Level N/A N/A N/A N/A N/A Distribution System 315 220 9 7 25mm/kV 370 320 9 7 Minimum Creepage Distance of Phase to Ground (mm) Phase to Phase (mm) Minimum Clearance of Road crossing (m) Protection Class (IP) Irem Minimum Height of Road side (m) Bare Conductor

# 3.1.3 Applicable Codes / Standards and Units

With regard to the Project design, relevant international standards such as IEC, ISO and Japanese standards are applied to the major functions of equipment and facilities in conformity with the existing electrical equipment and facilities in Ghana. For the system of units, the International System of Units (SI) is applied.

- International Electrotechnical Commission (IEC): Applied to major functions of electrical products in general
- International Standardization Organization (ISO): Applied to performance evaluation of industrial products in general
- Japanese Industrial Standard (JIS): Applied to industrial products in general
- > Japanese Electrotechnical Commission (JEC): Applied to electrical products in general
  - > Standards for Japan Electrical Manufacturer's Association (JEM); Same as above
- Japanese Electrical Wire and Catle Maker's Association (JCS): Applied to electric wire and cables
- Relevant Technical Standards on Electrical Installation: Applied to electrical work in general

## 3.2 Basic Plans of Components

# 3.2.1 Improvement of Tamale distribution system in Northern Region

# (1) Construction of UDS Primary Substation

One (1) set of new step down transformer (34.5/II 5kV, 7.5MVA with On Load Tap Changer) shall be installed in outdoor. The 34.5kV switchgear cubicles, 11.5kV switchgear cubicles, Low voltage AC panel and DC power system shall be installed in the substation building.

36kV and 12kV aluminum conductors armored type cables shall be directly buried under the ground about 1.2 meter depth. Low voltage and control cables copper conductor shall be installed inside cable

conduits.

The earthing resistance of the substation is supposed to be less than 1 ohm.

(2) Installation of a 34.5kV Sub-transmission Line from Tamale BSP to UDS Primary Substation

## 1) 34.5kV Sub-transmission Line

A 34.5kV sub-transmission line of approx. 19km (approx. 5km is underground cable, approx. 14km is overhead line,) shall be constructed between Tamale BSP and UDS Primary Substation.

A 34.5kV sub-transmission line shall be passed beside Stadium Road, Old Runway Road and Nyankpala Road to the direction of UDS Primary Substation.

The conductor size of a 34.5kV feeder line is AAAC 120mm2. The conductor size of cable is 185mm2.

## 2) 34.5kV Switchgear in Tamale BSP

In order to supply 34.5kV power from Tamale BSP to UDS primary substation, new 34.5kV switchgears shall be installed and connected to the existing 34.5kV switchgear (Buipe / Yapei) inside the existing 34.5kV switchgear room in Tamale BSP.

(3) Installation of 11.5kV Distribution Lines from UDS Primary Substation to 11.5kV distribution lines

### 1) 11.5kV Distribution Line

The following three (3) 11.5kV distribution lines shall be installed. The conductor size of 11.5kV feeder line is AAAC 120mm2.

- From UDS primary substation to the UDS feeder
- (Overhead line: approx. 200m)
- From UDS primary substation to the Tolon feeder
- (Overhead line; approx, 300m and underground cable; approx, 400m)
  - From UDS primary substation to Sheshegu feeder
    (Overhead line: approx. 300m and underground cable: approx 30m)

# 3.2.2 Improvement of Sunyani distribution system in Brong-Ahafo Region

# (1) Construction of Kotokrom Primary Substation

One (1) set of new step down transformer (34.5/11.5kV, 7.5MVA with On Load Tap Changer) shall be installed in outdoor. The 34.5kV switchgear cubicles, 11.5kV switchgear cubicles, Low voltage AC panel and DC power system shall be installed in the substation building.

36kV and 12kV aluminum conductor armored type cables shall be directly buried under the ground about 1.2 meter depth. Low voltage and control cables copper conductor shall be installed inside cable conduits.

The earthing resistance of the substation is supposed to be less than I ohm.

(2) Installation of a 34.5kV Sub-transmission Line from Sunyani BSP to Kotokrom Primary Substation.

## 1) 34.5kV Sub-transmission Line

A 34.5kV sub-transmission line of approx. 8.5km (approx. 0.5km is under ground cable, approx 8.0km is overhead line.) shall be constructed between Sunyani BSP and Kotokrom Primary Substation.

A 34.5kV sub-transmission line shall be passed inside way leave of 161kV transmission line (Techiman line) from tower No. 157 to tower No. 144 and turn to the direction of Kotokrom Primary Substation.

The conductor size of a 34.5kV feeder line is AAAC 120mm2. The conductor size of cable is 185mm2.

## 2) 34.5kV Switchgear in Sunyani BSP

In order to supply 34.5kV power from Sunyani BSP to Kotokrom primary substation, new 34.5kV switchgears shall be installed and connected to the existing 34.5kV switchgear (Berekum feeder) inside the existing 34.5kV switchgear room in Sunyani BSP.

(3) Installation of 11.5kV Distribution Lines from Kotokrom Primary Substation to 11.5kV distribution lines

### 1) 11.5kV Distribution Line

The following three (3) 11.5kV distribution lines shall be installed.

- From Kotokrom primary substation to the Hospital feeder
- (Overhead line: approx. 4.3km and underground cable: approx 30m)
- From Kotokrom primary substation to the New Dorman feeder (Overhead line: approx. 600m and underground cable: approx. 30m)
- From Kotokrom primary substation to the Chiran feeder

(Overhead line: approx. 700m and underground cable: approx 30m)

# 2) 11.5kV Ring Main Unit in Sunyani Regional Hospital

In order to supply reliable and stable electricity to Sunyani Regional Hospital, new Ring Main Unit (RMU) shall be installed outside near the existing electrical pole inside premise of the Hospital.

New RMU shall have three (3) feeders (one for outgoing to the existing RMU inside electrical room in the Hospital, one for incoming from Sunyani BSP (Feeder No. 27F8B) and one for incoming from Kotokrom Primary Substation).

A mechanical interlock both incoming feeders is provided.

# 3.3 Procurement Plan of Equipment and Materials

# 3.3.1 Improvement of Tamale distribution system in Northern Region

Technical specifications for Improvement of Tamale distribution system in Northern Region are shown in Table 10, Table 11 and Table 12.

The network diagram, single line diagrams, arrangement at the bulk supply points, general layouts of substations and route maps for distribution lines for Improvement of Tamale distribution system are shown in Part 1 of the attached "Drawings" in the end of this field report as follows.

- > 34.5 / 11.5 kV network diagram in the area improved under the Project
- Single line diagram of the primary substation installed under the Project
- > Single line diagram in the BSP
- General layout in the primary substation installed under the Project
- > Layout in the BSP control building
- Route Maps for the distribution lines installed under the Project

Table 10 Construction of UDS Primary Substation

Character, on innice sea, with on one of a 54.5 kV 11.5 kV 7.5 MVA ONANN 3.4.5 kV + 10% to -10% Primary winding: Delta Secondary winding: Star (neutral lead out)
noq i
Dyn i i About 6% Elephant type cable duet with bottom cover
About 6%

Litem/Equipment Specification  - Rated current of CB - Rated burst of CB - Transformer feeder switchgear cubicle a) Number of cubicle b) Current transformer for metering - Current transformer for protection - Current transformer - Current ground relay and transformer - Current ground relay and transformer - Component of Switchgear Cubicles - Component of Switchgear - Current ground relay and transformer - Component of Switchgear - Current ground relay and transformer - Current breaker (CB) - Type of CB -
thstand thstand or metering or protection or protection or cubicles
-

leable	
85mm2,	
core, I	

No.	Item/Equipment	Specification	Quantity
4	2.2) Outgoing feeder switchgear cubicle a) Number of cubicle b) Circuit breaker (CB) - Type of CB - Rated voltage of CB - Rated current of CB - Rated short-time withstand current c) Earthing switch (ES)	VCB, withdrawal type 12kV 630A 12.5kA (1 sec.)	3 sets
	- Type of ES d) Current uransformer for metering - Current ratio - Accuracy class - Burden	Mechanical interlock with CB Primary: 200-100A Secondary: 5A CL: 0.5 50VA	
	e. Current ratio - Current ratio - Accuracy class - Burden f) Metering	Primary: 200-100A Secondary: 5A CL; 5P20 50VA Multi-meter (V, A, W, VA, VAR, PF, Hz and WH)	
	g) Protection relay	Over current relay, Over current ground relay and Auto reclosing relay	. (
	2.2) sation transformer recter switchgear cubicle b) Cricuit breaker (CB) - Type of CB - Rated voltage of CB - Rated short-time withstand current	VCB, withdrawal type 12kV 630A 12.5kA (1 sec.)	1 soc
	c) Earthing switch (ES) - Type of ES d) Current transformer for metering - Current ratio - Accuracy class - Burden	Mechanical interlock with CB Primary: 200-100A Secondary: 5A CL: 0.5 50VA	
	e) Current transformer for protection - Current ratio - Accuracy class - Burden f) Metering	Primary: 200-100A Secondary: 5A CL: 5P20 50VA Multi-meter (V, A, W, VA, VAR, PF, Hz and WH) Over current relay. Over current ground relay and Auto reclosing relay	
4	Station Transformer (STR)  1) Type of STR  2) Rated primary voltage and tap  3) Rated secondary voltage  4) Rated capacity  5) Number of phases  6) Frequency  7) Winding connection and vector  symbol	Outdoor, oil immersed type clauses of 115kV±2.5% and ±5% taps (off-load tap clauses) 433.250V 100kVA 3 50Hz 5 50Hz Scondary winding: Delta Secondary winding: Star (neutral lead out) Dyn I I	चंड -
	No imposition of protection     Current tratio     Accuracy class     Burden     Burden	About 3% Primary: 100-50A Secondary: 5A CL: 10P10 25VA Elechant type cable duet with bottom cover	

Quantity	<u>8</u>	l se	J lot	l set	3 sets	1 lot	1 101
Specification	Indoor, self-standing type AC-415/240V (3 phase 4 wires) Earth leakage circuit breaker (ELCB), 4 poles, 400AF/400AT Primary: 200A Secondary: 5A CL: 1.0 25VA Ammeter with change-over switch	Indoor, self-standing type DC 125V Earth leakage circuit breaker (ELCB) Battery charget has floating and equalizing	Lead acid type 1.25V (2V per cell) 5% cells 1.2 hours Minimum 150Ah/10hrs (battery capacity is to be decided subject to during 12hours black out.)	Double steel poles with lightning arresters and disconnecting switch 36kV, 10kA, zinc-oxide gapless type 36kV, 630A, 25kA (1 sec.)	Double steel poles with lightning arresters and disconnecting switch 12kV, 10kA, zinc-oxide gapless type 12kY, 400A, 12.5kA (1 sec.)	Armored type eables for directly buried under the ground. Aluminum conductor, XLPE insulation, aluminum wire armored and PVC sheath I core, 185mm2, I cable per phase (from 34.5kV disconnecting switch pole to 34.5kV switchgear and from 34.5kV switchgear to transformer 34.5kV side)	Armored type cables for directly buried under the ground Aluminum conductor, XLPE insulation, aluminum wire armored and PVC sheath I core, 185min2, 3cables per phase (from transformer 11.5kV side to 11.3kV switchear) Leable ner phase
Item/Equipment	LV Service panel  1) Number of panel  2) Type of panel  3) Rated voltage (Number of phase and wire)  4) Type of breakers  5) Current transformer for metering  - Current ratio  - Accuracy class  - Burden  6) Metering	DC Service panel and battery charger 1) Number of panel 3) Kape of panel 4) Rated voltage 4) Type of breaker 5) Battery charger	Battery  1) Number of battery  2) Type of battery  3) Rated voltage (voltage per cell)  4) Number of battery cell  5) Discharge time (AC black-out time)  6) Capacity of battery	34.5kV disconnecting switch pole 1) Number of pole 2) Type 3) Equipment mounted on pole Lightning arresters Disconnecting switch	11.5kV disconnecting switch pole 1) Number of pole 2) Type 3) Equipment mounted on pole - Lightning arresters - Disconnecting switch	36kV Cables  1) Type  2) Conductor, insulation and sheath 3) No. of core and size	12kV Cables  1) Type  2) Conductor, insulation and sheath  3) No. of core and size
No.	ŵ	é		<b>∞</b>	6	0	1

No.	Item/Equipment	Specification	Quantit
		(from 11.5kV switchgear to 11.5kV disconnecting switch pole)   Leore, 185mm2, Teale per phase	
1		trom (11.2k v switchged) to station	

Table 11 Installation of 34.5kV Sub-transmission Line from Tamale BSP to UDS Primary

		Substation	9
Sil	Hem/Equipment	Specification	Quantity
Cro (Cro (Sect)	1) Type of electrical pole a) 3A (Intermediate pole) b) 3B (Light angle pole) c) 3C (Medium angle pole) d) 3D (Heavy angle pole c) 3E (Gross pole) f) 3F (Section pole) g) 3K (Disconnecting switch pole)	Line angle 0-5 deg. Line angle 5-20 deg. Line angle 20-60 deg. Line angle 66-90 deg. Line angle 90 deg.	
oJo	2)Type of conductor	AAAC 120mm2	
Swite ber o	34.5kV Switchgear Cubicles in Tamale BSP 1) Type 2) Number of cubicle	Indoor type, SF6 gas insulated cubicle Three (3) cubicles - One (1): connection to existing switchgear (former Buipe/Yapei feeder) - One (1): outgoing feeder flaupe/Yapei)	<u>a</u>
4) Circuit Bre 5) Metering 6) Protection 7) AC control 8) DC control 9) Number of	4) Circuit Breaker 5) Metering 6) Protection 7) AC control source 8) DC control source 9) Number of cable termination kit	36kV, 800A, 25kA (1sec.) Multi-meter (V. A. W. VA, VAR. PF. Hz and WH) Over current relay, Over current ground relay and Auto reclosing relay and Auto reclosing relay To be supplied from the existing LV Panel (AC 3 phase 4 wires, 415/240V) To be supplied from the existing DC Panel (DC 125V) 3 feeders - Existing switchgear connection feeder new cables; 36kV, XLPE, copper conductor, 1 core, 240 mm2, 2 cables per phase) - Burper/yapel feeder (existing cables; 36kV, XLPE, aluminum conductor, 1 core, 185 mm2, 1 cable per phase, with aluminum wire armoured vipe) - UDS feeder	
		phase, with aluminum wire armoured	
36kV Cables			1 lot
1) Specifications	suor	Copper conductor, XLPE insulation, 1 core, 240mm2 PVC sheath, 2 cables per phase	

0.	Item/Equipment	Specification	Quantity
		Ifrom existing 34.5kV switchgear (former Bujec/Tapel feeder) to new 34/5kV switchgear). Aluminum conductor, XLPE insulation, 185mm2, aluminum wire armourd and PVC steath 1 cable per phase (from new 34/5kV switchgear cubicle to 34/5kV disconnecting switch pole for UDS	

Table 12 Installation of 11,5kV Distribution Line from UDS Substation

Quantity	1 lot	1 101
Specification	L ne angle 0-5 deg. L ne angle 5-20 deg. L ne angle 50-50 deg. L ne angle 60-90 deg. L ne angle 90 deg.	Armored type cables for directly buried under the ground Aluminum conductor, XLPE insulation, aluminum wire armoured and PVC sheath I core, 185mm. (from new 11.5kV disconnecting switch pole (Tolon feeder) to existing section pole) I core, 185mm. (from 18.5mm. (from 18.5mm.)
Item/Equipment	11.5kV Distribution Line  1) Type of electrical pole a) IA (Intermediate pole) b) IB (Light angle pole) c) IC (Medium angle pole) d) ID (Heavy angle pole e) IE (Cross pole) f) IF (Section pole) g) IK (Disconnecting switch pole) 2) Type of conductor	12kV Cables  1) Type  2) Conductor, insulation and sheath  3) No. of core and size
No.	÷	m

# 3.3.2 Improvement of Sunyani distribution system in Brong-Ahafo Region

Technical specifications for Improvement of Sunyani distribution system in Northern Region are shown in Table 13, Table 14 and Table 15, The network drawings, single line diagrams, arrangements at the bulk supply points, general layouts of substations and route maps for distribution lines for Improvement of Tamale distribution system are shown in Part 2 of the attached "Drawings" in the end of this field report as follows.

> 34,5 / 11,5 kV network drawings in the area improved under the Project

Single line diagram of the primary substation installed under the Project

- > Single line diagram for arrangement in the BSP
  - > General layout in the primary substation

- General Layout in the BSP
   Route Maps for the distribution lines installed under the Project

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No.	Item/Equipment	Specification	Quantity
3.	34.5/11.5kV Transformer 1) Type	r, oil inn	1.50
	2) Rated primary voltage 3) Rated secondary voltage 4) Rated Capacity 5) Cooling type 6) Number of phases 7) Frequency 8) Tap voltage 9) Number of Taps 10) Step voltage 11) Winding connection and vector symbol	34.5kV 11.5kV 75MVA ONAN 30H2 34.5kV+10% to -10% 17.taps 1.25% Primary winding: Delta Secondary winding: Star (neutral lead out) Dyn11 About 6%	
0	13) Cable cover 34.5kV Switchgear Cubicles	Elephant type cable duct with bottom cover	
	1) Type 2) Component of Switchgear Cubicles	Indoor type cubicle	
	I. I Incoming feeder switchgear cubicle     a) Number of cubicle     b) Circuit breaker (CB)     Time of CB	VCB withdrawel town	1 set
	- Rather of CB	36kV	
	- Rated short-time withstand	25kA (1 sec.)	
	current c) Earthing switch (ES) - Type of ES	Mechanical interlock with CB	
	2.2) Transformer feeder switchgear		1 set
	a) Number of cubicle     b) Current transformer for metering		
	- Current ratio - Accuracy class - Burden	Primary: 200-100A Secondary: 5A CL: 0.5 50VA	
	c) Current transformer for protection		
	- Current ratio - Accuracy class	Primary: 200-100A Secondary: 5A CL: 5P20	
	d) Potential transformer	SUVA	
	<ul> <li>Voltage ratio</li> <li>Accuracy class</li> </ul>	Primary: 34.5/\3kV Secondary: 115/\3V CL: 0.5	
	- Burden c) Metering	100VA Multi-meter (V, A, W, VA, VAK, PF, Hz and	
	f) Protection relay	W H) Under voltage relay, Over current relay, Over string ground relay and transformer differential relay and transformer	

Quantity	) set								3 sets						1 set
Specification	Indoor type cubicle	800A	VCB, withdrawal type 12kV 12kV 12kV 12kV 12kV	Mechanical interlock with CB	Primary; 400-200A Secondary: 5A CL; 0.5 50VA	Primary: 400-200A Secondary: 5A CL: SP20 50VA	Primary: 11.5/\/3kV Secondary: 11.5/\/3V CL: 0.5 100VA	Multi-meter (V, A, W, VA, VAR, PF, Hz and WH)  Under voltage relay, Over voltage relay, over current ground relay and Auto voltage		VCB, withdrawal type 12kV, 650A 610A 12.5kA (1 sec.)	Nechanical interlock with CB	Primary: 200-100A Secondary: 5A CL: 0.5 50VA	Primary: 200-100A Secondary: 3A CL; 5P20 50VA VA VA VA PF H2 and	WH) Over current relay, Over current ground relay and Auto reclosine relay	VCB, withdrawal type 12kV 630A
Item/Equipment	11.5kV Switchgear Cubicles 1) Type 2) Component of Switchgear Cubicles 2.1) Transformer feeder switchgear cubicle	a) Number of cubicle b) Bus bar current	c) Urgui Organica - Type of CB - Rated voltage of CB - Rated current of CB	current d) Earthing switch (ES) - Type of ES	e) Current transformer for meterning - Current ratio - Accuracy class - Burden	f) Current transformer for protection - Current ratio - Accuracy class - Burden	g Potential transformer - Voltage ratio - Accuracy class - Burden	h) Metering i) Protection relay	2.2) Outgoing feeder switchgear cubicle a) Number of cubicle b) Georgia bending (D)	- Type of CB - Rated voltage of CB - Rated voltage of CB - Rated solver of CB - Rated solver-time withstand	current c) Earthing switch (ES) - Type of ES	d) Current transformer for metering - Current ratio - Accuracy class - Burden	e) Current transformer for protection - Current ratio - Accuracy class Burden	g) Protection relay	2.3) Station transformer feeder switchgare cubicle a) Number of cubicle b) Circuit breaker (CB) - Type of CB - Rated outlease of CB - Rated curren of CB
No.	e6														

No.	Item/Equipment	Specification	Quantity
	- Rated short-time withstand current current (ES) - Type of ES d) Current transformer for metering - Current ratio - Accuracy class - Burden - Current transformer for protection - Current train - Current ratio - Current ratio - Accuracy class - Burden - Accuracy class - Burden - Burden	12.5kA (1 sec.) Mechanical interlock with CB. Primary: 200-100A Secondary: 5A CL: 0.5 50VA Primary: 200-100A Secondary: 5A CL: 5P20 50VA	
	f) Metering g) Protection relay	Multi-meter (V., A., W., VA, VAR, PF, Hz and WH)  We over current relay, Over current ground relay and Auto reclosing relay	
	Station Transformer (STR) 1) Type of STR 2) Rated primary voltage and tap	Outdoor, oil immersed type 11. SkV±2.5% and±5% taps (off-load tap changer)	J set
	3) Rated secondary voltage 4) Rated eapseiry 5) Wunber of phases 6) Frequency 7) Winding connection and vector symbol 6) I	433-250V 190kVA 3 50Hz Primary winding: Delta Secondary winding: Star (neutral lead out) Den 11 Aby 11	
		About 37a Primary: 100-50A Secondary; 5A 25U: 10P10 25VA Elephant type cable duct with bottom cover	
	LV Service panel  1) Number of panel  2) Type of panel  3) Rated voltage (Number of phase and write)	Indoor, self-standing type AC 415/240V (3 phase 4 wires)	. इंद
	4) Type of breakers 5) Current transformer for metering	Earth leakage circuit breaker (ELCB), 4 poles, 400AF/400AT Primary: 200A Secondary: 5A CL: 1.0 25VA Ammeter with change-over switch Over current ground relaw	
	DC Service panel and battery charger 1) Number of panel 2) Type of panel 3) Rated voltage 4) Type of breaker 5) Battery charger	Indoor, self-standing type DC 125V Earth leakage circuit breaker (ELCB) Battery charger has floating and equalizing function	l set
	Battery  1) Number of battery  2) Type of battery  3) Rated voltage (voltage per cell)  4) Number of battery cell  5) Discharge time (AC black-out time)  6) Capacity of battery	Lead acid type 125V (2V per cell) 58 cells 12 hours Minimum 150Ah/10hrs (battery capacity is to be decided subject to during 12hours black	- lot

No.	Item/Equipment	Specification	Quantity
		Out.)	
×	34.5kV disconnecting switch pole 1) Number of pole 2) Type 3) Equipment mounted on pole - Lightning arresters	Double steel poles with lightning arresters and disconnecting switch 36KV, 10KA, zinc-oxide gapless type	l set
5	11.3kV disconnecting switch pole 1) Number of pole 2) Type - Lighting arresters - Lighting arresters - Disconnecting switch	Double steel poles with lightning arresters and disconnecting switch 12kV, 10kA, zinc-oxide gapless type 12kV, 400A, 12,5kA (1 sec)	3 sets
0	36kV Cables  1) Type  2) Conductor, insulation and sheath  3) No. of core and size	Armored type cables for directly buried under the ground. Aluminum conductor, XLPE insulation, aluminum wire armoured and PVC sheath 1 core, 185mm2, 1 cable per phase (from 34.5kV discomeeting switch pole to 34.5kV switchgear and from 34.5kV switchegear to transformer 34.5kV	1 la
=	12kV Cables 1) Type 2) Conductor, insulation and sheath 3) No, of core and size	Armored type cables for directly buried under the ground. Aluminum conductor, XLPE insulation, aluminum wire armoured and PVC sheath I core, 185mu2, 3 cables per phase (from transformer 11.5kV side to 11.5kV switchgear). I core, 185mu2, 1 cable per phase (from 11.5kV switchgear to 11.5kV disconnecting switch pole). I core, 185mu2, 1 cable per phase (from 11.5kV switchgear to 11.5kV disconnecting switch pole).	l lot

Table 14 Installation of 34.5kV Sub-transmission Line from Sunyani BSP to Kotokrom Primary Substation

No.	Item/Equipment	Specification	Quantity
	34.5kV Sub-transmission Line		1 lot
	a) A (Intermediate pole b) 3A (Intermediate pole) b) 3B (Light angle pole) c) 3C (Medium angle pole) d) 3D (Heavy angle pole c) 3E (Cross pole) f) 3F (Section pole) g) 3K (Disconnecting switch pole)	L ne angle 0-5 deg. L ne angle 5-20 deg. L ne angle 20-60 deg. L ne angle 60-90 deg. L ne angle 90 deg.	
	2)Type of conductor	AAAC 120mm2	
3.5	34,5kV Switchgear Cubicles in Sunyani BSP		l lot
	1) Type 2) Number of cubicle	Indoor type, SF6 gas insulated cubicle Trree (3) cubicles	

		- Checutanion	Carrent
	<ul><li>3) Bus bar current</li><li>4) Circuit Breaker</li><li>5) Metering</li></ul>	One (1): connection to existing switchgear (former Berekum feeder) One (1): outgoing feeder (Berekum) One (1): outgoing feeder (Kotokrom) 800A 36kV, 800A, 25kA (1sec.) Multi-meter (V, A, W, VA, VAR, PF, Hz and W.H)	
	6) Protection	Over current relay, Over current ground relay	
	7) AC control source	To be supplied from the existing LV Panel	
	8) DC control source	To be supplied from the existing DC Panel	
	9) Number of eable termination kit	3 feeders  Existing switchgear connection feeder (new cables: 34.5kV, XLPE, aluminum conductor, 1 core, 185mm2, 2 cables per phase, with aluminum wire armoured type)  Berekum feeder  Berekum feeder  (existing cables: 34.5kV, XLPE, aluminum conductor, 1 core, 185mm2, 1 cable per phase, with aluminum wire armoured type)  Kotokrom feeder  (new cables: 34.5kV, XLPE, aluminum conductor, 1 core, 185mm2, 1 cable per phase, with aluminum wire armoured type)	
m	36kV Cables  1) Specifications	Copper conductor, XLPE insulation, 1 core, 240mm2 PVC sheath, 2 cables per phase (from existing 34.5kV switchgear (former Burpe/Yapei feeder) to new 34.5kV switchgear) Aluminum conductor, XLPE insulation, 185mm2, aluminum wire armourd and PVC sleah per phase (from new 34.5kV switchgear cubicle to 34.5kV disconnecting switch pole for UDS	101 101

No.	Item/Equipment	Specification	Quantity
His I	11.3kV Distribution Line  (1) Type of electrical pole a) 1A (Intermediate pole) b) 1B (Light angle pole) c) 1C (Medium angle pole) d) 1D (Heavy angle pole e) 1E (Cross pole) g) 1K (Section pole) g) 1K (Disconnecting switch pole)	Line angle 0-5 deg. Line angle 5-20 deg. Line angle 20-60 deg. Line angle 60-90 deg. Line angle 90 deg. AAAC 120mm2	1 loc
2	11.5kV Ring Main Unit (RMU) 1) Type 2) Number of feeder	Outdoor type, SF6 gas Incoming: 2 feeders with earthing switch Outcoing: 1 feeder with earthing switch	l set

Table 15 Installation of 11.5kV Distribution Line from Kotokrom Substation

nein/Equipment
3) Rated voltage A lated current 5) Rated short-time withstand current 6) Mechanical interlock 7) Number of cable termination
J. Type  2) Conductor, insulation and sheath 3) No. of core and size

# 3.3.3 Drawings and Other Relevant Documents

The pole dressings for the distribution lines for the Project are shown in Part 2 of the attached "Drawings" in the end of this field report as follows.

# 3.4 Procurement Plan of Spare Parts and Maintenance Tools

The testing tools, maintenance tools, replacement parts, emergency spare parts and consumables for the Project are shown as Table 16.

Table 16 Spare Parts and Maintenance Tools

No	Description	Q*ty
0	Testing Instruments	1 lot
(1)	Oil Insulation Tester	2 sets
(2)	Cable Earth Fault Locator	2 sets
(3)	Single Phase Protection Relay Tester	2 sets
(4)	3 Phase Protection Relay Tester	2 sets
(5)	Analog Tester	2 sets
(9)	Phase Rotation Meter	2 sets
(7)	Voltage Detector (AC3-35 kV)	2 sets
(8)	Voltage Detector (AC 600 V)	2 sets
(6)	Insulation Resistance Tester (Megger) 500 V	2 sets
(10)	(10) Insulation Resistance Tester (Megger) 1,000 V	2 sets

(9)	(6) Space Heater	2 sets
9	Various Meters	2 sets
(8)	Various CTs	2 sets
(6)	Various VTs	2 sets
(10)	Various Switches	2 sets
m	For 11.5kV Switchgear	l lot
(1)	Various Lamps or LEDs (100%)	2 scts
(2)	Various Fuses	2 sets
(3)	(3) Various MCCBs	2 sets

3.3

No.	Description	Q'ty
(4)	Various Protection Relays	2 sets
(5)	Various Auxiliary Relays	2 sets
(9)	Space Heater	2 sets
(2)	Various Meters	2 sets
(8)	Various CTs	2 sets
(6)	Various VTs	2 sets
(10)	Various Switches	2 sets
3,4	For Low Voltage Distribution Pane	l lot
(3)	Various Lamps or LEDs (100%)	2 sets
(2)	Various Fuses	2 sets
3	Various MCCBs	2 sets
(4)	Various Meters	2 sets
3,5	DC Supply System	l lot
(1)	Various Lamps or LEDs (100%)	2 sets
(2)	Various Fuses	2 sets
(3)	Various MCCBs	2 sets
(4)	Various Meters	2 sets
3.6	Cable Termination Kit	l lot
(3)	36kV Outdoor Type	2 sets
(2)	36kV Indoor Type	2 sets
(3)	36kV Indoor Socket Type for GIS	2 sets
(4)	12kV Outdoor Type	2 sets
(5)	12kV Indoor Type	2 sets
(9)	12kV Indoor Socket Type for RMU	l set
	Emergency Spare Parts	1 lot
(1)	36kV Circuit Breaker	2 sets
(2)	12kV Circuit Breaker	2 sets

2 sets 2 sets 2 sets

2 sets 2 units 1 lot 1 lot

2 sets

(5) Lifter for Drawing 36kV Circuit Breaker (6) Lifter for Drawing 12kV Circuit Breaker

(4) Industrial Tool for Electrical Work

(2) Crimping Tool (10 to 250 mm2) (1) Compression Tool with Dices

(3) Cable Cutter

(7) Torch for Cable Terminal Treatment

(8) Truck with Aerial Bucket

Replacement Parts

For 34.5/11.5kV Transformer

3.1

(3) Oil Temperature Meter

(2) Buchholz Relay

(1) Gasket

2 sets 2 sets

2 sets

2 sets

(1) Various Lamps or LEDs (100%)

For 34,5kV Switchgear

3.2

(6) 11.5kV Bushing

(5) 34.5kV Bushing

(4) Oil Level Meter

l lot

2 sets

2 sets

2 sets 2 sets

(4) Various Protection Relays

(3) Various MCCBs

(2) Various Fuses

(5) Various Auxiliary Relays

2 sets 2 sets

(12) Portable Earth Resistance Tester

(13) Digital-type Multi-meter

(14) Clip-on Meter

Maintenance Tools

(11) DC Dielectric (0~100 kV)

2 sets

Q'ty

2. sets 2 sots 2 sets 2 sets

2 sets

1 lot

2 sets

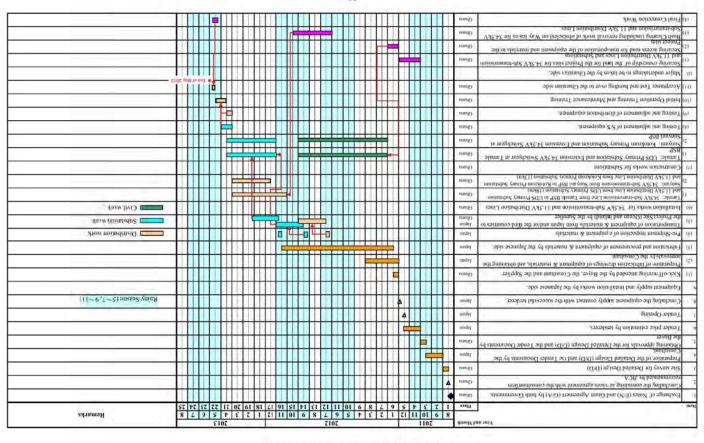
Note: A word "set" means a group for three phase.

# 3.5 Tentative Implementation Schedule of the Project

The tentative implementation schedule is shown as Table 17. In case that the Project is decided by the Japanese Government, the Project will proceed as fellows in case of the earliest scenario, as shown as Table 17. Both installation work of Tamale and Sunyani will start at the same time in February, 2012.

- The Exchange of Notes between the Chanaian and Japanese Government will be signed in August, 2011.
- The Tender Opening will be held in December 2011.
- Installation work of the Project will start in January, 2012.
- Commissioning of the Project will be in May, 2013.

#### Table 17 Tentative Implementation Schedule



# 4. Work Demarcations for Both Parties

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as shown as Table 18.

Table 18 Work Demarcations for Both Parties

(1) Securing of lands of the Project sites (New substancing of lands of the Project sites (New substancing and a routes of 34 5kV sub-transmission fines and 115kV clearly and leveling and preparation, bush clearly and removal of obstacles in the Project sites Installation of femees and gates in and around the new substancins construction period  (2) Fernancent fences, gates and gates during construction period  (2) Permanent fences, gates and gated house Road works (1) Temporary fences and gates during construction period  (2) Access road to the Project sites (1) Road within the Project sites (2) Access road to the Project sites (3) Electrical works (4) Electrical works (5) Dialermal writing (5) Water supply works (6) Mater supply works (7) Electrical works (8) Dialermal writing (9) Water supply works (1) Electrical works (2) Water supply works (3) Dialermal writing (4) Drainage works (4) Electrical works (5) Drainage works (6) Material transportation in Ghann (7) Procedures for lax exemption and customs (8) Internal transportation from the port of disembarkation in Ghann (2) Procedures for lax exemption and customs (3) Internal transportation from the Project sites (4) Exemption or payment of volue-added tax (5) Procedures for lax exemption works (6) Entance at the part of disembarkation in Ghann (7) Procedures for lax exemption and customs (8) Internal transportation from the Project sites (9) Entance to the payment of volue-added tax (1) Evernation of the Project sites (1) Exemption of maintenance of facilities (2) Procedures recessary to obtain the following permits for the Japanese Consultant and the Equipment after the Project (9) Entance of the project sites (1) Entance of the project sites (2) Entance of the project sites (3) Internal transportation of the Project sites (4) Ex	3	The fact of the same of the sa	Tobeo	To be covered by	No.	Item No.
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(2) Land leveling and preparation, bash redering and preparation, bash redering and removed of obstacles in the redering construction period construction in the regulations of the new substations and partners or substations of the reduction work to the new substations of the reduction work to the new substations of the regulation of water times of the reduction of water times of the reduction to a port of disconstruction of water times and surrange works and removal construction to a port of disconstruction to the regulation to a port of disconstruction to the regulation of obstacles for the abstance of the reduction of water times for the proposition of the port of disconstruction to the proper operation or popular of value-sided tax (VAI) on the port of manifest of the Japanese Consultant and disconstruction and manifestation to the proper operation and manifestation to the Project sites of the Japanese Consultant and Contracter — Permits for the Japanese Consultant and Contracter — Permits for the Japanese Consultant and Contracter — Permits of the following fees based on the Banking Arrangement after the Project — Permits of the following fees based on the Banking Arrangement of the proper operation and manifestation to the proper operation and manifestation to the proper operation of the proper operation and manifestation to the proper operation of the prope		Securing of lands of the Project sit substations and routes of sub-transmission fines and distribution lines)		D	Including a land in the Sunyani Regional Hospital for the new Ring Main Unit to be provided by the Japanese side.	e
Installation of fences and gates in and around the new substations  (1) Temporary fences and gates during Construction period  (2) Permanent fences, gates and gates during Construction period  (3) Access road to the Project sties  (4) Access road to the Project sties  (5) Access road to the Project sties  (6) Access road to the Project sties  (7) Building service facilities for the new substations  (8) Electrical works  (9) Electrical works  (1) Electrical works  (1) Electrical works  (2) Access road to the new substations  (3) Primary connection work to the new substations  (4) Physing work after primary connection and installation of water tank  (3) Drainage works  (4) Drainage works  (5) Drainage works  (6) Marinedair transportation to a port of contact the substation in Ghann  (5) Procedures and lax procedures  (6) Marinedair transportation from the port of disembarkation in Ghann  (7) Procedures for tax exemption and customs clearance at the port of disembarkation in Ghann  (6) Instrumental transportation from the port of disembarkation in Ghann  (6) Instrumental transportation from the port of disembarkation in Ghann  (7) Procedures for the Japanese Consultant and contractor  (8) Instrument of the Project sites  (9) Exemption or payment of value-added tax  (1) Exemption or payment of value-added tax  (2) Procedures and an instituent of the following permits for the Japanese Consultant and Contractor  (1) Proper operation and maintenance of facilities  (2) Procedure and maintenance of facilities  (3) Procedure and a maintenance of facilities  (4) Proper operation and maintenance of facilities  (5) Proper operation and maintenance of facilities  (6) Proper operation of the following fees based on the Baymen coll the following fees based on the Baymen collaboration of the following fees based on the Baymen collaboration of the following fees based on the Baymen collaboration con the following fees based on the following fees		1		0	uding relocation of a temporary ma the route of sub-transmission ribution lines	
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Building service facilities for the new substations  (1) Electrical works  (2) Water supply work to the new substations  (2) Water supply work to the new substations  (3) Primary connection work to the new installation of water tank  (b) Phying work after primary connection and installation of water tank  (c) Drainage works  (d) Drainage works  (e) Drainage works  (e) Drainage works  (f) Marinediar transportation  (g) Inside the substation  (g) Internal transportation from the port of disembarkation in Ghana  (g) Internal transportation from the port of disembarkation to the Project sites  (h) Exemption or payment of value-added tax  (AAT) on locally proputed items  Procedures necessary to obtain the following permits for the Japanese Consultant and Contractor  - Permits for the Japanese Consultant and Contractor  - Permits for the Japanese Consultant and Contractor  - Permits for the Project sites  Procedures and maintenance of facilities  and the Equipment affer the Project  - Permits for the Japanese Consultant and Contractor  - Permits for the Japanese Consultant and Bahama Artanagement:  - Other expenses that are not covered by grant aid  Bahama Artanagement:  (1) APP advising commission		(1) Road within the Project sites (2) Acress road to the Project siles	Q	C		
(1) Electrical works  a) Extension work to the new substations  (b) Internal wiring  a) Primary connection work to the new substations  a) Primary connection work to the new substations  b) Physical work after primary connection and installation of water trans.  (3) Drainage works  a) Oracide the substation  Transportation of the Equipment, customs procedures and the procedures  (1) Marinedair transportation to a port of disembarkation in Gham  (2) Procedures for tax exemption and customs clearance at the port of disembarkation  (3) Internal transportation from the port of disembarkation to the Project sites  (4) Exemption or payment of value-added tax (5) Internal transportation from the following permits for the Japanese Consultant and course.  Procedure accesser sestricted areas  Procedure and maintenance of facilities  and the Equipment after the Project  Other expenses that are not covered by grant aid Bayment of the following fees based on the Bayment of the following fees based on the Bayment of the following fees based on the		iding service facilities for the				ю
a) Extension work to the new substations  b) Internal wring  (2) Water supply works  a) Primary connection work to the new substations  b) Paping work after primary connection and installation of water ank  (3) Drainage works  a) Ouside the substation  b) Inside the substation  (3) Inside the substation  (4) Marie and tax procedures  (5) Procedures and tax procedures  (6) Marine are the port of disembarkation  (7) Procedures for tax exemption and ensions  (8) Internal transportation from the port of disembarkation in Gham  (9) Internal transportation from the port of disembarkation in the Project sites  (4) Exemption or payment of value-added tax  (A) Exemption or payment of value-added tax  (A) Exemption or payment of value-added tax  (A) Exemption or payment of value-added tax  (b) Exemption or payment of value-added tax  (c) Outractor  - Permits required for installation works  - Permits required for installation works  - Permits to access restricted areas  Proper operation and maintenance of facilities  and the Equipment after the Project  Other expenses that are not covered by grant aid  Bayment of the following fees based on the  Bayment of the following fees based on the  Bayment of the following seconnission		(1) Electrical works				
Delibermal swiring   Col. Water supply works		a) Extension work to the new substations		N/A	Station transformer will be installed.	
(2) Water supply works  a) Frimary connection work to the new  a) Primary connection work to the new  (b) Piping work after primary connection and  installation of water rank  (c) Drainage works  a) Obtaside the substation  (c) Drainage works  (d) Drainage works  (e) Drainage works  (e) Drainage works  (e) Drainage works  (f) Marinedar transportation to a port of  disembarkation in Ghana  (c) Procedures and tax procedures  (d) Marinedar transportation from the port of  disembarkation in Ghana  (d) Internal transportation from the port of  disembarkation to the Project sites  (e) Exemption or payment of value-added tax  (AAT) on locally procured items  Procedures necessary to obtain the following  permits for the Japanese Consultant and  Contractor  - Permits required for installation works  - Permits for the Japanese Consultant and  Contractor  - Permits for the Project  - Permits for the Project  - Permits for the Japanese Consultant  and the Equipment affer the Project  and the Equipment affer the Project  Other expenses that are not covered by grant aid  Bahafing Artanagement:  (1) APP advising commission		b) Internal wiring	Ö			
		(2) Water supply works				
b) Plying work after primary connection and installation of water finh.  Installation of water finh.  D) Drainage works  a) Outside the substation  D) Inside the substation  Transportation of the Equipment, customs  Transportation of the Equipment, customs  Transportation in Ghana  (1) Marine/air transportation to a port of disembarkation in Ghana  (2) Procedures for tax exemption and customs  clearance after port of disembarkation of the Project sites  (A) Internal transportation from the port of disembarkation to the Project sites  (A) Exemption or payment of value-added tax  (AAT) on locally presured items  Procedures necessary to obtain the following permits for the Japanese Consultant and Contractor  - Permits required for installation works  - Permits required for installation works  - Permits to access restricted areas  Proper operation and maniferance of facilities  and the Equipment affer the Project  Other expenses that are not covered by grant aid  Bahafus Aranagement:  (1) APP advising commission		ry connection work		0		
(3) Drainage works  a) Outside the substation  b) Instance the substation  Transportation of the Equipment, customs procedures and tax procedures  (1) Marinedar transportation to a port of confisembarkation in Ghan  (2) Procedures for tax exemption and customs elemance at the port of disembarkation  (3) Internal transportation from the port of disembarkation of the Project sites  (4) Exemption or payment of value-added tax  (A) Exemption or payment of value-added tax  (B) Exemption or payment of value-added tax  (Contractor  Permits required for installation works  Permits to access restricted incus  Proper operation and maintenance of facilities  and the Equipment after the Project  Disher expenses that are not covered by grant aid  Bayment of the following fees based on the Bayment of the following fees based on the Payment of the following fees based on the following fees based or the feet following fees based on the feet		<ul> <li>b) Piping work after primary connection and installation of water tank</li> </ul>	o			
		(3) Dramage works				
0 0 0 0 0		a) Outside the substation		0		
0 0 0 0 0		b) Inside the substation	0			
0 0 0 0 0		ipment,				4,5
(2) Procedures for tax exemption and customs clearance at the port of disembarkation.  (3) Internal transportation from the port of disembarkation in the Project sites.  (4) Exemption or payment of value-added tax  (b) Exemption or payment of value-added tax  Procedures necessary to obtain the following permits for the Japanese Consultant and Couractor.  - Permits for the Japanese Consultant and Couractor.  - Permits to access restricted areas.  Permits to access restricted areas.  Permits to access restricted areas.  Perper operation and maintenance of facilities and the Equipment after the Project.  Other expenses that are not covered by grant aid.  Bayment of the following fees based on the Bayment of the following fees based on the Albadysing commission.		Marine/air transportation to a port disembarkation in Ghana	Q			
(3) Internal transportation from the port of disembarkation to the Project sites  (4) Exemption or payment of value-added tax  (5) Exemption or payment of value-added tax  (AAT) on locally precured items  Procedures necessary to obtain the following permits for the Japanese Consultant and Contractor.  - Permits for the Japanese Consultant and Contractor.  - Permits required for installation works  - Permits to access restricted areas  Proper operation and maniferance of facilities  and the Equipment affer the Project  Other expenses that are not covered by grant aid  Bahming Artanement:  (1) APP advising commission		100	4	0		
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Procedures necessary to obtain the following permits for the Japanese Consulant and Contractor - Permits required for installation works - Permits required for installation works - Permits to access restricted areas Proper operation and maniferance of facilities and the Equipment after the Project Other expenses that are not covered by grant and Bahang Artangement:   On the Padvising commission On the Bahang Artangement:  (1) APP advising commission O				0		
Proper operation and maintenance of facilities and the Equipment after the Project.  Other expenses that are not covered by grant aid Payment of the following fees based on the Banking Arrangement:  (1) APP advising commission		Procedures necessary to obtain the following permits for the Japanese Consultant and Contractor:  - Permits required for installation works - Permits to access restricted areas		o	The permits shall be obtained before project implementation.	9
Other expenses that are not covered by grant aid Payment of the following fees based on the Banking Arrangement: (1) AP advising commission		Proper operation and mannenance of facilities and the Equipment after the Project.		Ö	Including bush clearing and removal of obstacles along 34.5kV sub-transmission lines and 11.5kV distribution lines.	7
Payment of the following fees based on the Banking Arrangement:  (1) APP advising commission		Other expenses that are not covered by grant aid		0		×
ion O		Payment of the following fees based on the Banking Arrangement.				ō
		(1) AP advising commission		0 0	Approx. 10,000 Japanese Yen	

No	Undertakings	Tobes	To be covered by	Notes Notes Item?	Item No.
10	Giving due environmental and social	Japan	Consula	10	10
	Project.		)		
Ξ	Securing of land of temporary material storage yard with fence and gate		0	To be utilized VRA's Commercial Yard at BSPs of Tatuale and Sunyam	-
12	Securing parking space during construction period		o		
13	Site offices	0		For the Japanese Consultant and Contractor	
14	Proper storage and safety management of the Equipment at temporary material storage yard	0			
15	Securing of working space along routes of 34.5kV sub-transmission lines and 11.5kV distribution lines and traffic control		0		
91	Relocation of existing overhead/underground cables or papes of power, telephone, water supply/deninge, etc. and obtaining necessary permissions		Q.	When necessary.	1000
17	Obtaining permissions on Road crossing during underground cabling work		α	When necessary.	
18	Providing of disposal site of soil and discharged water caused by the construction work		0		
61	Manufacturing and procurement of the Equipment.	o.		"The Equipment" is defined as the equipment and materials to be provided the Japanese side under the Project	
20	Installation of the Equipment, adjust and testing	O		The Ghanaian side is required to lend test equipment and tools to be provided on the Project to the Japanese Contractor during construction.	
21	Temporary power cut during construction		0		
22	Re-connection work of the existing cables from the existing cubicle to the new one on extension of 34.5kV feeder in Tamale and Sunyani BSPs		Ö	Cable termination kit shall be provided by the Japanese side.	1
23	Modification of a cross arm and shifting jumper wares on the existing pole at the connection point of 11.5kV Tolon Feeder in Tamale		0	Including necessary materials	
24	Installation of caloles onto the existing pole at the connection point of 11.5kV Sheshegu Feeder in Tantale		0	Cables and cable termination kit shall be provided by the Japanese side.	
63	Final connection to the existing 11.5kV distribution lines		0		
26	Provision of materials for the above mentioned final connection	0			
27	Provision of trainings for Initial operation and maintenance of the Equipment	0			
38	Installation of Low voltage distribution network fed from the 11.5kV distribution lines		0		
29	Assuring security for personnel in the Project sites		D	When necessary	
30	Managing any dispute from enstoners regarding temporary power cut for construction work including compensation for customers		0	If necessary	
<u> </u>	Public notice of scheduled power cut and safety measures for the consumers during the implementation stage		0		

Remarks: \* is described in the "Minutes of Discussion" signed between the Ghanaian and Japanese side

# PART 1 Improvement of Tamale Distribution System in Northern Region

## 1. 34.5/11.5 kV Network Diagram

Tamale 34.5/11.5 kV Network Diagram DWG No. GE-T01

### 2. Single Line Diagram

Single Line Diagram of UDS Primary Substation DWG No. E-T01 DWG No. E-T02

Layout of Tamale Bulk Supply Point Control Building Single Line Diagram of Tamale Bulk Supply Point General Layout of UDS Primary Substation Cable Route of Tamale Bulk Supply Point DWG No. GA-T02 **DWG No. GA-T03** DWG No. GA-T01 3. General Layout

## 4. Route Map of Distribution System

Route Map of Tamale Distribution System DWG No. R-T01~T15

# PART 2 Improvement of Sunyani Distribution System in Brong-Ahafo Region

## 1. 34.5/11.5 kV Network Diagram

Sunyani 34.5/11.5 kV Network Diagram DWG No. GE-S01

### 2. Single Line Diagram

Single Line Diagram of Kotokrom Primary Substation Single Line Diagram of Sunyani Bulk Supply Point DWG No. E-S01 DWG No. E-S02

### 3. General Layout

General Layout of Kotokrom Primary Substation Cable Route of Sunyani Bulk Supply Point Layout of Sunyani Bulk Supply Point DWG No. GA-502 DWG No. GA-S03 DWG No. GA-S01

Location of RMU2 [VRA] Sunyani Regional Hospital

## 4. Route Map of Distribution System

DWG No. GA-S04

Route Map of Sunyani Distribution System DWG No. R-S01~S12

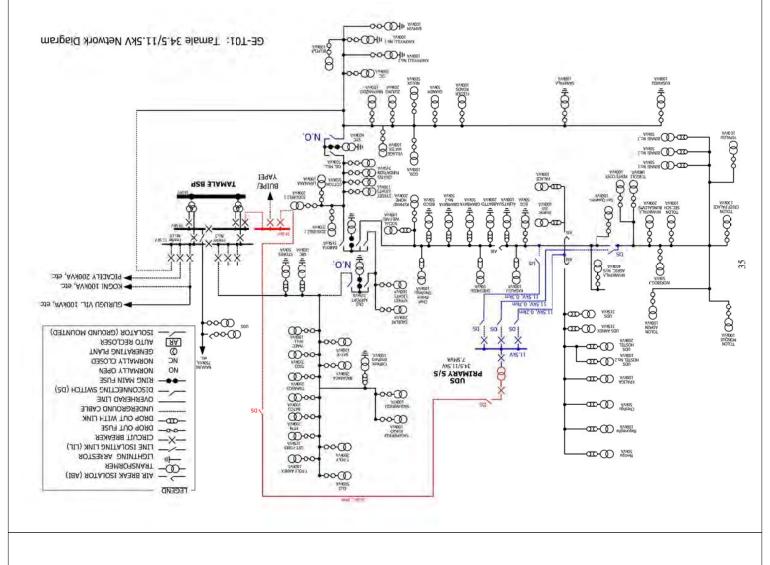
# PART 3 Pole Assembly Drawing for Distribution Line

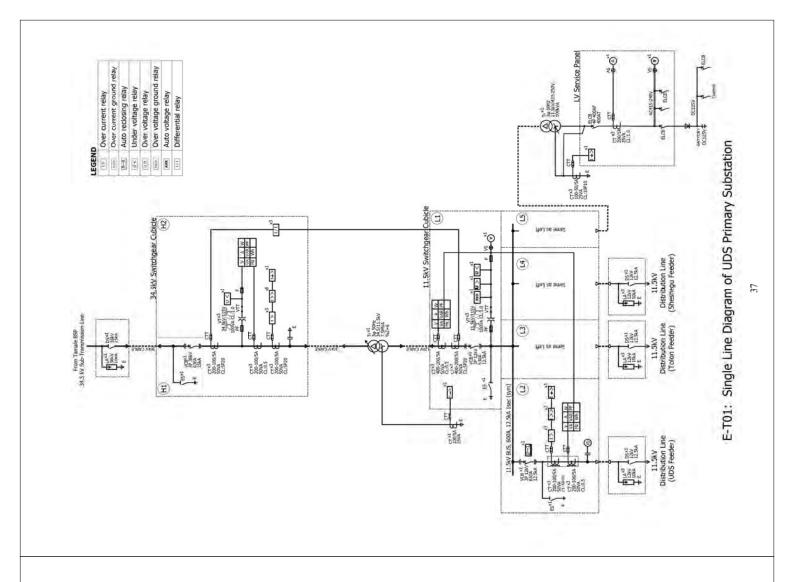
DWG No. T	PA-A	DWG No. TPA-A 11.5 / 34.5kV Intermediate Pele (Line Angle 0 to 5 degrees)	HA/3A
DWG No. TPA-B	PA-B	11.5 / 34.5kV Light angle Pola (Line Angle 5 to 20 degrees)	[1B/3B]
DWG No. TPA-C		11.5 / 34.5kV Medium angle Pole (Line Angle 20 to 60 degrees)	[1C/3C]
DWG No. T	PA-D	DWG No. TPA-D 11.5 / 34.5kV Heavy angle Pcle (Line Angle 60 to 90 degrees)	(1D/3D)
DWG No. TPA-E	PA-E	11.5 / 34,5kV Cross Pole (Line Angle 90 degrees)	[1E/3E]
DWG No. TPA-F	PA-F	11.5 / 34.5kV Section Pole	[IF/3F]
DWG No. T	PA-G	DWG No. TPA-G 11.5 / 34.5kV T-off Pole	[16/36]
DWG No. TPA-H	PA-H	11.5 / 34.5kV Terminal Pole	[HE/HI]
DWG No. TPA-J	PA-J	11.5 / 34.5kV Disconnecting Switch Pole (Horizontal Type)	[111/31]
DWG No. TPA-K	PA-K	11.5 / 34.5kV Disconnecting Switch Pole (Vertical Dead End Type)	[1K/3K]
DWG No. T	PA-M	DWG No. TPA-M 11.5 / 34.5kV Disconnecting Switch Pole (Vertical Section Type)	[1M/3M]
DWG No. T	PA-Z	DWG No. TPA-Z Material Composition of Assembly Parts	

PART 1 Improvement of Tamale Distribution System

in Northern Region

. 34.5/11.5 kV Network Diagram

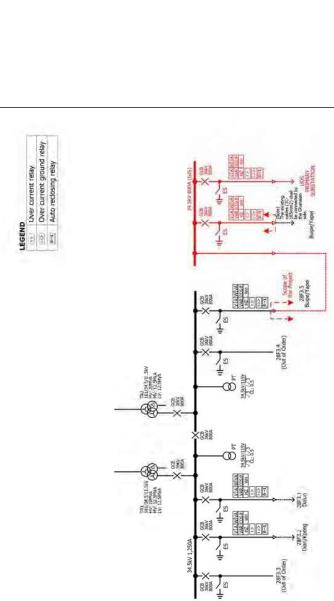




PART 1 Improvement of Tamale Distribution System in Northern Region

Single Line Diagram

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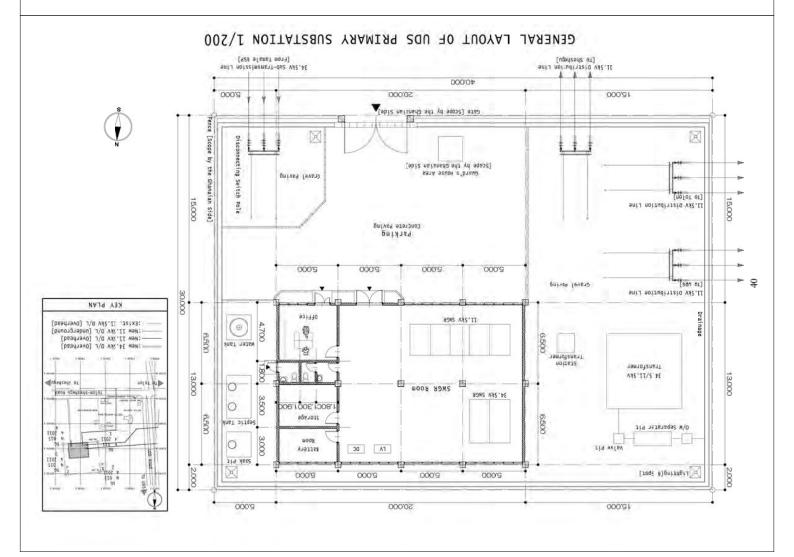


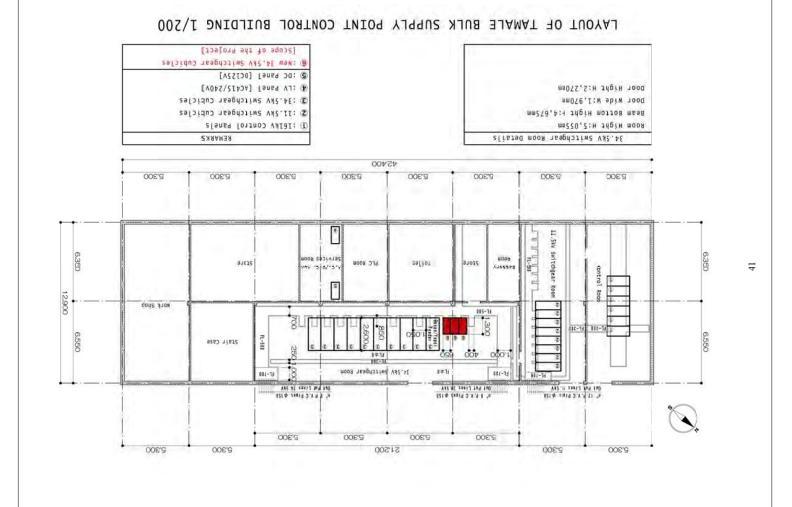
PART 1 Improvement of Tamale Distribution System in Northern Region

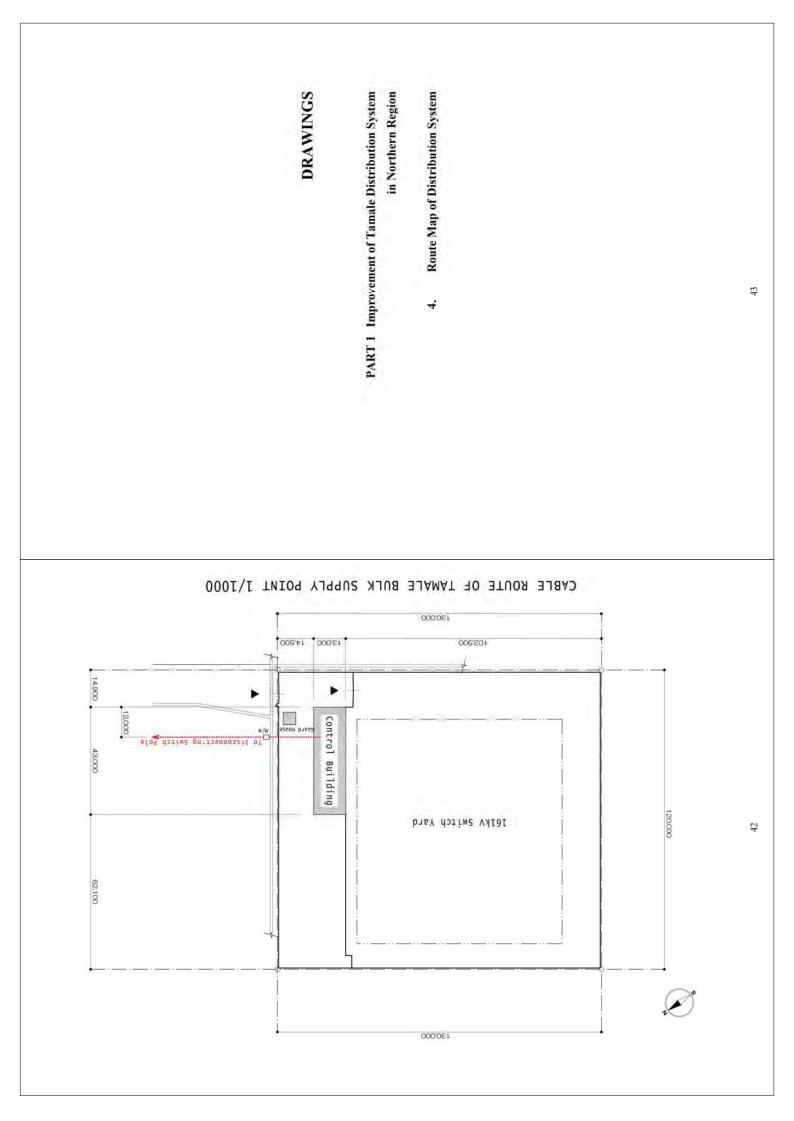
### 3. General Layout

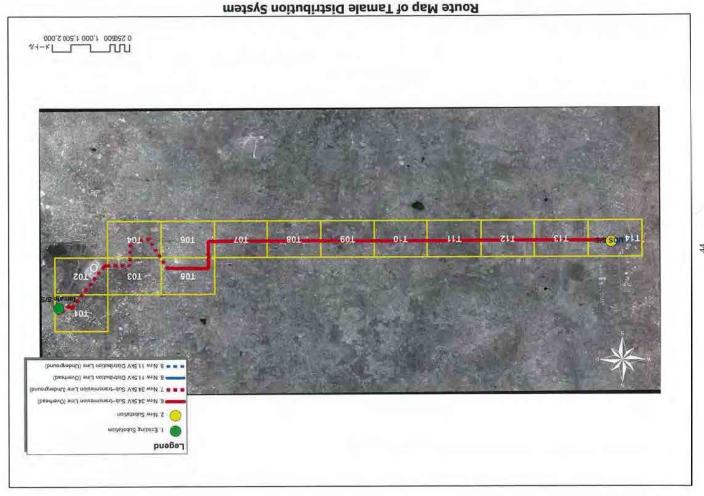
33

E-T02: Single Line Diagram of Tamale BSP (Extension of 34.5 kV Feeder)









Route Map of Tamale Distribution System

8. New 11.5kV Distribution Line (Overhea

Route Map of Tamale Distribution System

