1. Member List of the Study Team

First Field Survey

Name	Assignment	Organization
Fuyuki SAGARA	Team Leader	Japan International Corporation Agency
Kazunari NOGAMI	Chief Consultant/ Power Supply Planning 1	Yachiyo Engineering Co., Ltd.
Masatsugu KOMIYA	Deputy Chief Consultant/ Power Supply Planning 2	Yachiyo Engineering Co., Ltd.
Kenji SAKEMURA	Substation Planning	West Japan Engineering Consultants, Inc.
Masayuki TAMAI	Transmission Planning	Yachiyo Engineering Co., Ltd.
Tatsunari HAYASHI	Power Flow Analysis	West Japan Engineering Consultants, Inc.
Yasuo HORIGOME	Facility Planning	Yachiyo Engineering Co., Ltd
Kyohei KUROHANE	Procurement Planning/ Cost Estimation	Yachiyo Engineering Co., Ltd.
Takeshi OMURA	Social and Environmental Considerations	Yachiyo Engineering Co., Ltd.

Spare Parts List for GRIDCo

No.	Name of Spare Parts	Q'ty
1.	132 kV Gas Insulated Switchgear	
(1)	Closing coil for CB	1
(2)	Trip coil for CB	1
(3)	Closing contactor for DS & ES	1
(4)	Opening contactor for DS & ES	1
(5)	Interlock coil for DS & ES	1
(6)	Space heater element	6
(7)	SF6 gas and storage cylinder	3
2.	161/34.5 kV, 125 MVA Transformer	
(1)	161 kV Bushing	1
(2)	34.5 kV Bushing	1
(3)	Buchholz relay	1
(4)	Oil thermometer	1
(5)	Oil level gauge	1
(6)	MCCB (each type)	1
(7)	Auxiliary relay (each type)	1
(8)	Fuse (each type)	100%
(9)	Lamp (each type)	100%
(10)	LED lamp (each type, with socket)	1
3.	Control and Protection	
(1)	Meter (each type)	1
(2)	Switch (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	MCCB (each type)	1
(5)	Auxiliary relay (each type)	3
(6)	Magnetic contactor (each type)	1
4.	Transformer voltage regulation control	
(1)	Transformer voltage regulator	1
(2)	MCCB (each type)	1
(3)	Meter (each type)	1
(4)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(5)	Fuse (each type)	1
5.	161/34.5 kV Transformer protection	
(1)	Protection relay (each type)	1
(2)	MCCB (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	Fuse (each type)	1
6.	161 kV Transmission line protection	
(1)	Protection relay (each type)	1
(2)	MCCB (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	Fuse (each type)	1
7.	161 kV Bus protection	
(1)	Protection relay (each type)	1
(2)	MCCB (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	Fuse (each type)	1
8.	DC Power supply	
(1)	MCCB (each type)	1
(2)	Meter (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	Fuse (each type)	1
9.	AC Distribution panel	
(1)	MCCB (each type)	1
(2)	Meter (each type)	1
(3)	Lamp (each type)	100%
	LED lamp (each type, with socket)	10%
(4)	Fuse (each type)	1
10.	161 kV XLPE Cable	
(1)	Cable termination kit for 161 kV XLPE cable (each type, 3 phases)	1

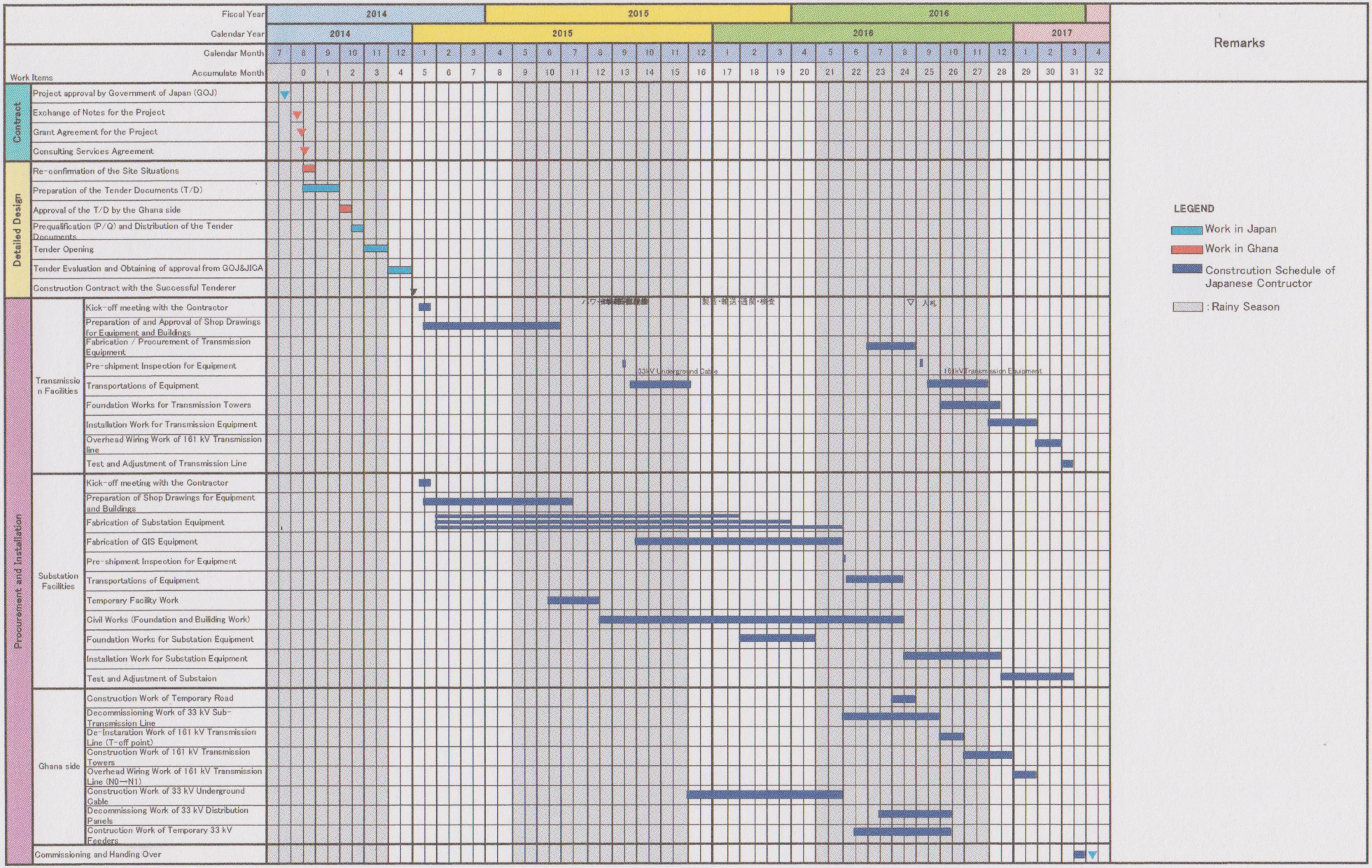
Spare Parts List for ECG

No.	Name of Spare Parts
1.	33 kV Switchgear
(1)	Lamp (each type)
	LED lamp (each type, with socket)
(2)	MCCB (each type)
(3)	Protection relay (each type)
(4)	Auxiliary relay (each type)
(5)	Magnetic contactor (each type)
(6)	Trip coil (each type)
(7)	Closing coil (each type)
(8)	Space heater element
(9)	Meter (each type)
(10)	Switch (each type)
2.	DC Power supply
(1)	MCCB (each type)
(2)	Meter (each type)
(3)	Lamp (each type)
	LED lamp (each type、with socket)
(4)	Fuse (each type)
3.	33 kV XLPE Cable
(1)	Cable termination kit for 161 kV XLPE cable (each type, 3 phases)

Testing Equipment and Maintenance Tools

No.	Equipment	Unit	Q'ty
MT-1	Oil purifier with tank	set	1
MT-2	Transformer oil withstand voltage tester	set	1
MT-3	Phase rotation meter	set	2
MT-4	Voltage detector (200 kV AC)	set	2
MT-5	Voltage detector (3 to 34.5 kV AC)	set	2
MT-6	Voltage detector (600 V AC)	set	2
MT-7	Megger (500 V DC)	set	2
MT-8	Megger (1,000 V DC)	set	2
MT-9	Digital multifunctional tester	set	2
MT-10	Analog multifunctional tester	set	2
MT-11	Portable type earthing resistor tester	set	2
MT-12	Clamp meter	set	2
MT-13	Maintenance tools (for electrical works)	set	2
MT-14	Gas handling unit for GIS	set	2

Tentative Implementation Schedule of the Project



1. Present Situation and Power Demand Forecast in the Project Site

1.1 Demand Forecast in Accra Area

(1) Upper level plan for the Project

GRIDCo had prepared the following master plan studies and is developing the power system in Ghana. In addition, these studies have been reviewed under the assistance of United States Trade and Development Agency (USTDA) in December 2012. The Japan's Grant Aid Project shall keep in consistency with the existing upper level plan of the Recipient as follows.

Table 2.1-1 Existing Master Plan Studies

Studies	Study Period
Transmission System Master Plan for Ghana (November 2011)	2010 – 2021
Generation Master Plan Study for Ghana (February 2012)	2011 - 2026
Technical Assessment Report by USTDA (Feasibility Study for the Eastern Transmission Line)	2012 - 2026

The demand forecasts (base case) estimated in the above mentioned studies are applied in the Outline Design of the Project. They have, however, been estimated with targeting the whole system in Ghana. Therefore, The Team reviewed the demand forecast with targeting Accra Area in considering of historical data of demand on each BSP provided from GRIDCo to the Team and in consistency with the philosophy on the demand forecasts estimated in the above mentioned studies.

The following descriptions are conditions and results of demand forecast for the Outline Design of the Project.

(2) Target year of the Project

The commissioning year of the Project is assumed to be in 2017 in case of adaption of the Project by the Japanese Government and the earliest progress (However, it is paid attention that no commitment is made for realization of the Project by the Japanese side at the stage of the Preparatory Survey of the Project).

In consideration of urgency of the Japan's Grant Aid for the Project, effectiveness of the Project shall be evaluated at least within a few years. On the other hand, the target year for design of the Project shall be set not to go over the capacity of the Project within a few years.

In consideration of the above conditions and experience of similar projects under the Japan's Grant Aid, the target year for evaluation of effectiveness and design of the Project set as follows.

Table 2.1-2 Target year of the Project

Items	Target year
Target year for evaluation of effectiveness of the Project	3 years after commissioning (2017)
Target year for design of the Project	10 years after commissioning (2027)

(3) Conditions for demand forecast in Accra Area

In economic analysis in Technical Assessment Report by USTDA, it has been revealed that real GDP has strong correlation with power consumption in Ghana but then population has not. As the result of the economic analysis, the following function is obtained for approximation of the demand forecast in Ghana (***a1***, ***a2*** and ***a3*** are invariables). The same function is applied for the demand forecast in Accra Area of the Project. Invariables such as ***a1***, ***a2*** and ***a3*** in the function shall, however, be estimated in accordance with approximation with using the historical data of macro-economic parameters and demand on each BSP provided from GRIDCo to the Team.

$$\boldsymbol{Ln}\,(\text{Power Consumption}_{\,i}) = \boldsymbol{a1} + \boldsymbol{a2} \times \boldsymbol{Ln}\,(\text{Real GDP}_{\,i}) + \boldsymbol{a3} \times \boldsymbol{Ln}\,(\text{Power Consumption}_{\,i-1})$$

1) Macro-economic Parameters and their annual growth (Base case)

The following table shows the historical data for Ghana's population and real GDP (Constant 2005 US$) from 1992 to 2011 shown in Technical Assessment Report by USTDA. It is described that in the report the data has been obtained from two different, reliable sources: the U.S. Bureau of Census, in the case of the population, and the World Bank, in the case of the GDP. Real GDP shown in the table is applied for approximation to show correlation between power consumption and real GDP.

Table 2.1-3 Ghana's Population and Real GDP from 1992 to 2011

Year	Population	GDP (constant 2005 US$)
1992	15,655,847	6,018,522,257
1993	16,141,178	6,310,420,587
1994	16,610,887	6,518,664,466
1995	16,992,937	6,786,739,258
1996	17,354,886	7,099,096,283
1997	17,722,810	7,396,999,769
1998	18,116,256	7,744,687,665
1999	18,520,249	8,085,453,654
2000	18,935,103	8,384,615,439
2001	19,357,355	8,720,000,057
2002	19,798,703	9,112,400,059
2003	20,250,113	9,586,244,863
2004	20,689,541	10,123,074,575
2005	21,126,090	10,720,336,364
2006	21,563,400	11,406,437,892
2007	21,996,825	12,143,084,616
2008	22,427,962	13,166,950,385
2009	22,858,579	13,780,416,117
2010	23,286,035	14,692,687,226
2011	23,714,498	16,690,892,880

[Source] Technical Assessment Report by USTDA, 2012

2) Load factor

The following table shows the historical data and average of load factor shown in Technical Assessment Report by USTDA. The average of load factor shown in the table is applied for transformation from power consumption to peak demand in the demand forecast of the Project.

Table 2.1-3 Ghana's Population and Real GDP from 1992 to 2011

Year	Average demand (MW)	Peak demand (MW)	Load Factor
2000	564	822	69%
2001	589	860	69%
2002	611	869	70%
2003	640	1,007	64%
2004	685	1,064	64%
2005	732	1,169	63%
2006	769	1,277	60%
2007	732	1,299	56%
2008	845	1,345	63%
2009	914	1,432	64%
2010	1,005	1,615	62%
2011	1,076	1,668	65%
Average	**764**	**1,202**	**64%**

[Source] Technical Assessment Report by USTDA, 2012

3) Historical data of demand on each BSP provided from GRIDCo to the Team

The following table shows the historical data of demand on each BSP provided from GRIDCo to the Team shown in Technical Assessment Report by USTDA. The historical data shown in the table is applied for approximation to show correlation between power consumption and real GDP.

In addition to demand shown below power supply from Winneba BSP to Accra Area in 33 kV also consider as demand of Accra Area.

Table 2.1-4 Historical data of demand on each BSP in Accra Area

Unit: GWh

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Achimota BSP	1524	1398	1265	1423	1508	1607	1564	1572	1748	1787	1975	2117	2025	1850
Mallam BSP		208	415	339	371	410	502	449	612	667	774	844	1044	1184
A3 BSP													0.21	396

[Source] Technical Assessment Report by USTDA, 2012

(4) Result of demand forecast in Accra Area

As the result of econometric analysis under the above mentioned conditions, the following function is obtained for approximation of the demand forecast in Accra Area. R-square is calculated to 0.974 and the goodness of fit is observed.

$$\boldsymbol{Ln}\,(\text{Power Consumption}_{i}) =$$
$$\boldsymbol{-13.082} + \boldsymbol{0.86707} \times \boldsymbol{Ln}\,(\text{Real GDP}_{i}) + \boldsymbol{0.84191} \times \boldsymbol{Ln}\,(\text{Power Consumption}_{i-1})$$

In accordance with the above obtained function, the following figure is obtained as the demand forecast in Accra Area. In the demand forecast by the Team, demand in each year is assumed relatively higher than one in the master plan studies but their averages of annual growth rate are the almost same and in range of 6% to 6.5%. The demand in 2017, the target year for evaluation of effectiveness of the Project is 757 MW and the target year for design of the Project is 1,374 MW in the demand forecast by the Team.

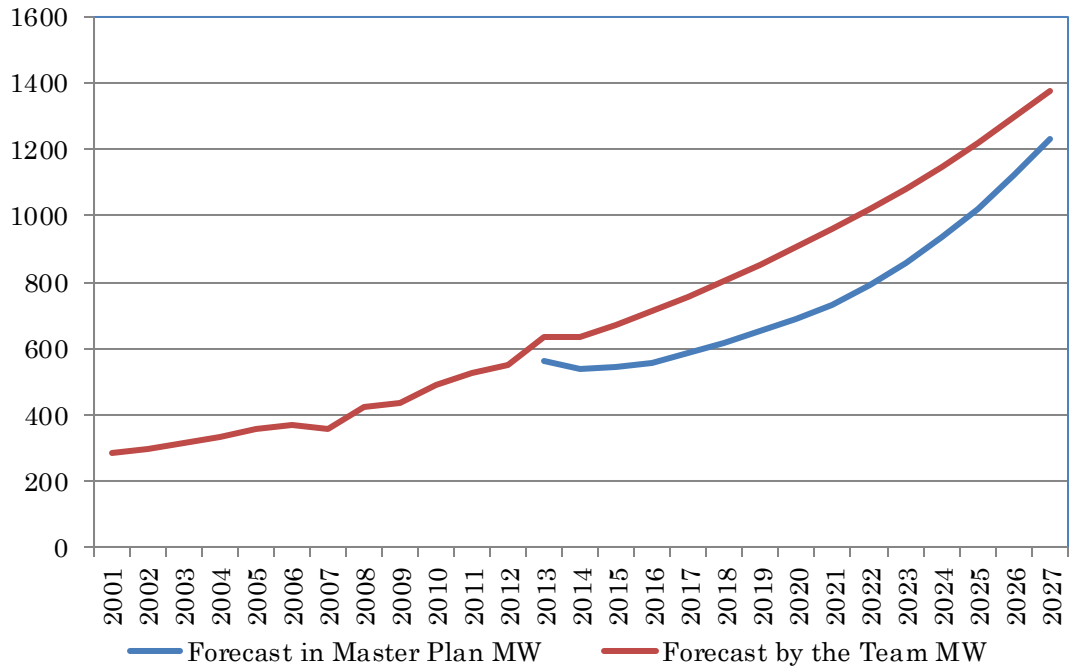


Figure 2.1-1 Demand Forecast for design of the Project

(5) Power Demand on each BSP in Accra Area

In accordance with the above mentioned demand forecast, power demand on each BSP in Accra Area will be estimated as the example of load distribution to confirm the appropriateness and effectiveness of the project as a Japan's Grant Aid project.

1.2 Power flow analysis

(1) Objectives of Load Flow Analysis for the Project

The load flow analysis of the Project aims to confirm appropriateness and effectiveness of the Project as a Japan's Grant Aid project. The load flow analysis will be carried out at the time of target year for evaluation of effectiveness of the Project (2017) and the target year for design of the Project (2027).

From the view of the study objective, the Team will conduct load flow analysis for the area focused on the Project instead of the whole transmission system in Ghana. Basic Concept of Power Flow Analysis is shown in Table 3-1.

Table 3-1 Basic Plan for Load Flow Analysis

Area	- Transmission system between Akosombo and Aboadze (see Fig. 3-1)
Voltage level	- 161kV or more of the transmission system in the area - Primary substation and 33kV distribution liens in Accra area
Demand	- Demand forecast is aforementioned section 2.1. - Power factor is 87% (see Table 3-3).

Section for analysis	- Commission year (2017) - Target year for evaluation of effectiveness of the Project (2020) - Target year for design of the Project (2027)
Evaluation	- Power flow is within each capacities of the equipment like transformers, transmission line conductors, etc. - Voltage limit is "within ±5% of the nominal voltage at all times under Normal State" regulated at Art 12.10 in "NATINAL ELECTRICITY GRID CODE (October 2009)". - Rated short-time current is within the interrupting capability of Circuit Breakers.

(2) Model

For the purpose of the analysis, transmission system between Akosombo power station and Aboadze power station, which supply power to Accra area, was modeled based on the data (see Annex-2) of generators, transmission lines and transformers provided by GRIDCo.

Fig. 3.1 shows a load flow chart simulated by the model based on the actual peak demand and generating power. From the verification between the load flow result and actual load flow/bus voltage, the Team confirmed the model is available for the analysis.

(3) Basic Data for the Load Flow Analysis

The load flow analysis of the Project will be carried out in accordance with the data provided by GRIDCo and ECG during the first field survey, shown in Annex-2.

The following table shows the average of power factor at each BSP shown in Transmission System Master Plan for Ghana by GRIDCo. The averages of power factor for Achimota BSP and Mallam BSP shown in the table are applied to the load flow analysis of the Project.

Table 3-3 Power Factor at Substations

BSP	Power Factor
Achimota	0.87
Mallam	0.87
New Tema	0.87
Kenyase	0.92
Kumasi	0.87
Techiman	0.92
Tamale	0.92
Sawla	0.92
Others	0.90

[Source] Transmission System Master Plan for Ghana, 2011

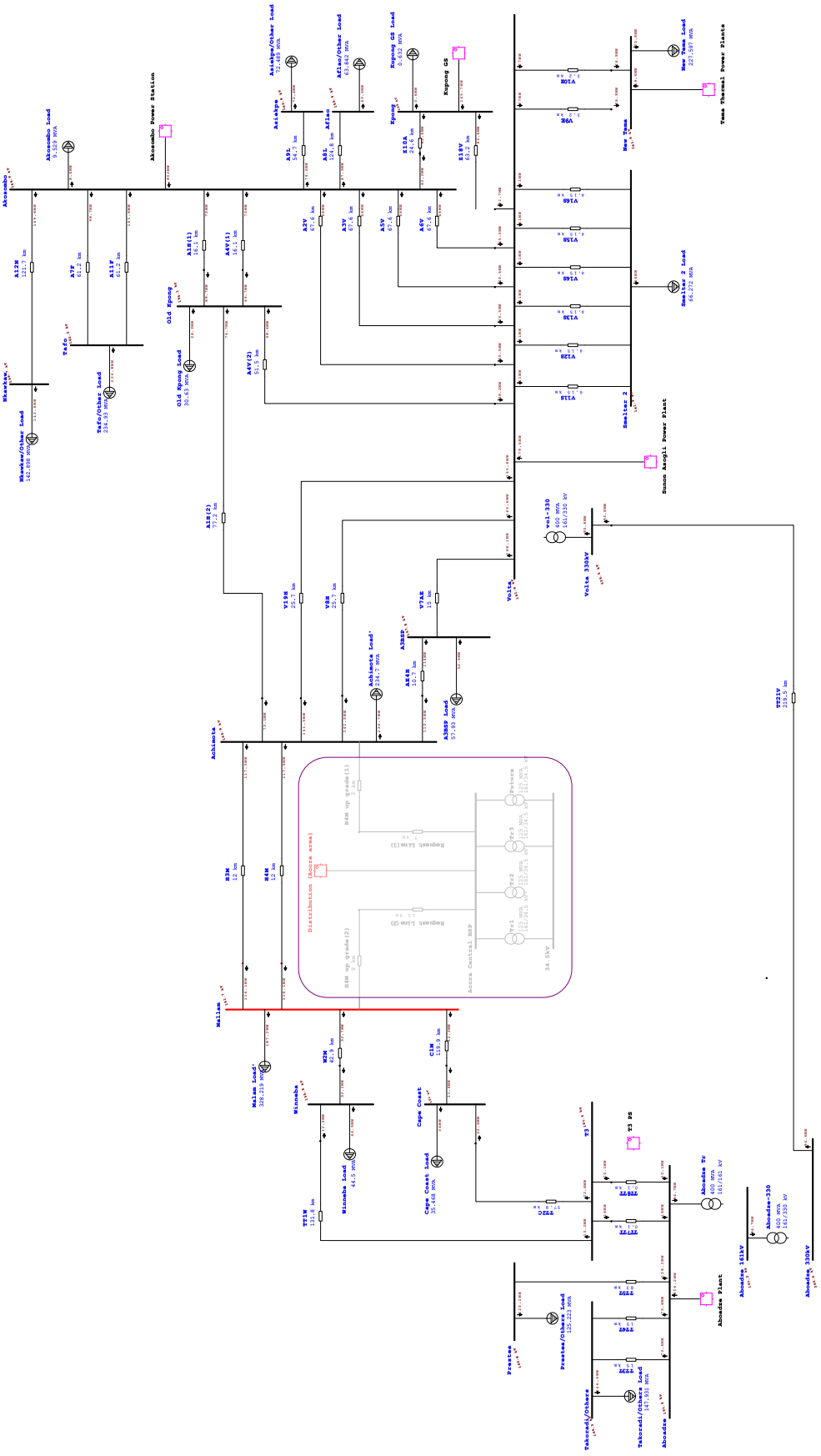


Fig.3-1 Model and the Result of Load Flow (May 7, 2013)

(1) Main Characteristics Generator

Location	Unit	Type	Rated				Impedance Rated capacity MVA Base
			(MW)	(KV)	(MVA)	PF (%)	Xd" (p.u.)
Akosombo	Akosombo G1	Hydro	170.5	14.4	179.50	95	0.210
	Akosombo G2	Hydro	170.5	14.4	179.50	95	0.210
	Akosombo G3	Hydro	170.5	14.4	179.50	95	0.210
	Akosombo G4	Hydro	170.5	14.4	179.50	95	0.210
	Akosombo G5	Hydro	170.5	14.4	179.50	95	0.210
	Akosombo G6	Hydro	170.5	14.4	179.50	95	0.210
Aboadze T1	TAPCo GT1	Gas Turbine	120.4	13.8	141.70	85	0.214
	TAPCo GT2	Gas Turbine	120.4	13.8	141.70	85	0.214
	TAPCo HRSG	Steam Turbine	123.5	13.8	145.30	85	0.220
Aboadze T2	TICo GT1	Gas Turbine	120.4	13.8	141.70	85	0.214
	TICo GT2	Gas Turbine	120.4	13.8	141.70	85	0.214
Aboaze T3	T1-G1	Gas Turbine	31.0	13.8	38.75	80	0.217
	T1-G2	Gas Turbine	31.0	13.8	38.75	80	0.217
	T1-G3	Gas Turbine	31.0	13.8	38.75	80	0.217
	T1-G4	Gas Turbine	31.0	13.8	38.75	80	0.217
	T1-G5 (HRSG)	Steam Turbine	31.0	13.8	38.75	80	0.217
Kpong	Kpong G1	Hydro	45.9	13.8	51.00	90	0.270
	Kpong G2	Hydro	45.9	13.8	51.00	90	0.270
	Kpong G3	Hydro	45.9	13.8	51.00	90	0.270
	Kpong G4	Hydro	45.9	13.8	51.00	90	0.270
Sunon Asogli	Asogri(1) GT1	Gas Turbine	29.0	11.0	36.29	80	0.148
	Asogri(1) GT2	Gas Turbine	29.0	11.0	36.29	80	0.148
	Asogri(1) HRSG	Gas Turbine	29.0	11.0	36.29	80	0.148
	Asogri(2) GT1	Gas Turbine	29.0	11.0	36.29	80	0.148
	Asogri(2) GT2	Gas Turbine	29.0	11.0	36.29	80	0.148
	Asogri(2) HRSG	Steam Turbine	29.0	11.0	36.29	80	0.148
Tema TT1PP	TT1PP GT1	Gas Turbine	113.4	14.4	141.70	80	0.179
	CENIT GT	Gas Turbine	113.4	14.4	141.70	80	0.179
Tema MRP	MRP GT1	Gas Turbine	47.3	11.5	52.50	90	0.171
	MRP GT2	Gas Turbine	20.0	11.5	22.25	90	0.171
	MRP HRSG	Steam Turbine	15.0	11.5	16.70	90	0.171
TT2PP	TT2PP GT1	Gas Turbine	7.8	11.0	9.75	80	0.171
	TT2PP GT2	Gas Turbine	7.8	11.0	9.75	80	0.171
	TT2PP GT3	Gas Turbine	7.8	11.0	9.75	80	0.171
	TT2PP GT5	Gas Turbine	12.9	11.0	13.10	80	0.244
	TT2PP HRSG	Steam Turbine	12.9	11.0	13.10	80	0.244
Bui	Bui1	Hydro	133.0	13.8	147.80	90	0.270
	Bui2	Hydro	133.0	13.8	147.80	90	0.270
	Bui3	Hydro	133.0	13.8	147.80	90	0.270

(2) Main Characteristics Transmission Lines

Location		Line No.	Voltage	Length	Conductor			Impedance(pu)			Thermal rating	
From	To		(kV)	(km)	Type	Code	Size (mm^2)	R	X	Y	(A)	(MVA)
Akosombo	Old Kpong	A1H(1)	161	16.1	AAC	LILAC	403	0.00510	0.02450	0.01220	764	213
		A4V(1)	161	16.1	AAC	LILAC	403	0.00510	0.02450	0.01220	764	213
	Volta	A2V	161	67.6	AAC	LILAC	403	0.02120	0.10290	0.05128	764	213
		A3V	161	67.6	AAC	LILAC	403	0.02120	0.10290	0.05128	764	213
		A5V	161	67.6	AAC	LILAC	403	0.02120	0.10290	0.05128	764	213
		A6V	161	67.6	AAC	LILAC	403	0.02120	0.10290	0.05128	764	213
	Kpong	Z10A	161	24.6	AAC	LILAC	403	0.00770	0.03810	0.01830	764	213
	Tafo	A7F	161	61.2	AAC	MISTLETOE	282	2.70000	9.70000	2.20000	610	170
		A11F	161	61.2	ACSR	TOUCAN	182 x 2	1.60000	6.80000	3.10000	653 x 2bundle	182 x 2bundle
	Asiekpe	A9L	161	54.7	AAC	DAFFODIL	177	0.03940	0.08890	0.03870	459	128
	Aflao	A8L	161	124.8	AAC	DAFFODIL	177	0.08837	0.20254	0.08827	459	128
Old Kpong	Volta	A4V(2)	161	51.5	AAC	LILAC	403	0.01620	0.07840	0.03905	764	213
	Achimota	A1H(2)	161	77.2	AAC	LILAC	403	0.02434	0.11751	0.05856	764	213
Achimota	Mallam	H3M	161	12.0	AAC	MISTLETOE	282	0.70000	2.40000	0.60000	610	170
		H4M	161	12.0	AAC	MISTLETOE	282	0.70000	2.40000	0.60000	610	170
Mallam	Cape Coast	C1M	161	119.9	AAC	MISTLETOE	282	0.05336	0.18728	0.08801	610	170
	Winneba	W2M	161	42.9	AAC	MISTLETOE	282	0.02045	0.07182	0.03377	610	170
T3	Winneba	TT1W	161	131.8	AAC	MISTLETOE	282	0.04217	0.16248	0.07654	610	170
	Cape Coast	TT2C	161	57.8	AAC	MISTLETOE	282	0.02356	0.09065	0.04263	610	170

Location		Line No.	Voltage	Length	Conductor			Impedance(pu)			Thermal rating	
From	To		(kV)	(km)	Type	Code	Size (mm^2)	R	X	Y	(A)	(MVA)
Volta	Kpong	Z18V	161	63.2	AAC	HAWTHORN	604	0.01140	0.08430	0.03890	979	273
	New Tema	V9E	161	3.2	AAC	TOUCAN	265 x2	0.00085	0.00358	0.00324	653 x 2bundle	182 x 2bundle
		V10E	161	3.2	AAC	TOUCAN	265 x2	0.00085	0.00358	0.00324	653 x 2bundle	182 x 2bundle
	Smelter Two	V11S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
		V12S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
		V13S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
		V14S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
		V15S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
		V16S	161	5.2	AAC	LILAC	403	0.00128	0.00646	0.00311	764	213
	A3BSP (Accra East)	V7AE	161	15.0	AAC	LILAC	403	0.00470	0.02290	0.01137	764	213
	Achimota	V8H	161	25.7	AAC	LILAC	403	0.00810	0.03980	0.01950	764	213
		V19H	161	25.7	AAC	LILAC	403	0.00810	0.03980	0.01950	764	213
	Aboadze	TT21V	330	219.5	ACSR	TERN	430 x2	0.90000	5.67000	46.35000	500 x 2bundle	875 x 2bundle
A3BSP (Accra East)	Achimota	AE4H	161	10.7	AAC	LILAC	403	0.00340	0.01630	0.00811	764	213
Aboadze Plant	T3	TT6TT	161	0.1	ACSR	uncoded	400 x2	0.00003	0.00015	0.00007	875 x 2bundle	244 x 2bundle
		TT7TT	161	0.1	ACSR	uncoded	400 x2	0.00003	0.00015	0.00007	875 x 2bundle	244 x 2bundle
	Takoradi	TT3T	161	15.0	AAC	MISTLETOE	282	0.00610	0.02350	0.01100	610	170
		TT4T	161	15.0	AAC	MISTLETOE	282	0.00610	0.02350	0.01100	610	170
	Prestea	TT5T	161	83.0	ACSR	TOUCAN	265 x2	0.01953	0.08532	0.07726	653 x 2bundle	182 x 2bundle

(3) Main Characteristics Transformers

Location			Rating			Impedance (%) Rating Power MVA Base	Vector Grope	Load Tap Changer
			Voltage (%)		Power (MVA)			
	From	To	Prim.	Sec.				
Achimota	Achimota 161kV	Achimota 34.5kV	161	34.5	66	11.71	YNd11	On-Load
	Achimota 161kV	Achimota 34.5kV	161	34.5	66	11.30	YNd11	On-Load
	Achimota 161kV	Achimota 34.5kV	161	34.5	66	11.30	YNd11	On-Load
	Achimota 161kV	Achimota 34.5kV	161	34.5	66	11.38	YNd11	On-Load
	Achimota 161kV	Achimota 34.5kV	161	34.5	66	11.30	YNd11	On-Load
Mallam	Mallam 161kV	Mallam 34.5kV	161	34.5	66	11.38	YNd11	On-Load
	Mallam 161kV	Mallam 34.5kV	161	34.5	66	11.34	YNd11	On-Load
	Mallam 161kV	Mallam 34.5kV	161	34.5	66	11.06	YNd11	On-Load
	Mallam 161kV	Mallam 34.5kV	161	34.5	66	11.06	YNd11	On-Load
A3BSP	A3BSP 161kV	A3BSP 34.5kV	161	34.5	66	11.51	YNd11	On-Load
	A3BSP 161kV	A3BSP 34.5kV	161	34.5	66	10.19	YNd11	On-Load
Akosombo	Akosombo G1	Akosombo 161kV	14.4	161	200	13.39	YNd1	Off-Load
	Akosombo G2	Akosombo 161kV	14.4	161	200	13.29	YNd1	Off-Load
	Akosombo G3	Akosombo 161kV	14.4	161	180	13.00	YNd1	Off-Load
	Akosombo G4	Akosombo 161kV	14.4	161	200	13.35	YNd1	Off-Load
	Akosombo G5	Akosombo 161kV	14.4	161	200	13.35	YNd1	Off-Load
	Akosombo G6	Akosombo 161kV	14.4	161	180	13.30	YNd1	Off-Load
Aboadze T1	TAPCo GT1	Aboadze 161kV	13.8	169	155	12.60	YNd1	Off-Load
	TAPCo GT2	Aboadze 161kV	13.8	169	155	12.60	YNd1	Off-Load
	TAPCo HRSG	Aboadze 161kV	13.8	169	155	12.60	YNd1	Off-Load
Aboadze T2	TICo GT1	Aboadze 161kV	13.8	161	141	11.45	YNd1	Off-Load
	TICo GT2	Aboadze 161kV	13.8	161	141	11.45	YNd1	Off-Load
Aboadze T3	T1-G12	T3 161kV	13.8	161	62.5	0.10	YNd1	Off-Load
	T1-G34	T3 161kV	13.8	161	62.5	0.10	YNd1	Off-Load
	T1-G5 (HRSG)	T3 161kV	13.8	161	62.5	0.10	YNd1	Off-Load
Kpong G.S.	Kpong G1	Kpong G.S. 161kV	13.8	169	51	10.60	YNd1	Off-Load
	Kpong G2	Kpong G.S. 161kV	13.8	169	51	10.50	YNd1	Off-Load
	Kpong G3	Kpong G.S. 161kV	13.8	169	51	10.40	YNd1	Off-Load
	Kpong G4	Kpong G.S. 161kV	13.8	169	51	10.60	YNd1	Off-Load
Sunon Asogli	G1 (Gas Turbine)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load
	G2 (Gas Turbine)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load
	G3 (HRSG)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load
	G4 (Gas Turbine)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load
	G5 (Gas Turbine)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load
	G6 (HRSG)	Sunon Asogli 161kV	11.0	161	50	7.10	YNd1	Off-Load

Location			Rating			Impedance (%) Rating Power MVA Base	Vector Grope	Load Tap Changer
			Voltage (%)		Power (MVA)			
	From	To	Prim.	Sec.				
Tema TT1PP	TT1PP GT1	TT1PP 161kV	14.4	161	145	14.85	YNd1	Off-Load
	CENIT GT	TT1PP 161kV	14.4	161	145	14.85	YNd1	Off-Load
Tema MRP	MRP Generator	Tema MRP 161kV	11.5	161	165	13.10	YNd1	Off-Load
Tema TT2PP	TT2PP Generator	Tema TT2PP 161kV	11.0	161	75	9.08	YNd1	Off-Load
Bui	Bui G1	Bui 161kV	14.4	161	160	13.13	YNd1	Off-Load
	Bui G2	Bui 161kV	14.4	161	160	13.00	YNd1	Off-Load
	Bui G3	Bui 161kV	14.4	161	160	13.08	YNd1	Off-Load
Aboadze	Aboaze 330kV	Aboadze 161kV	330	161	200 x2	10.00	YNd11	-
Volta	Volta 330kV	Volta 161kV	330	161	200 x2	10.00	YNd11	-

(4) Main Characteristic Capacitor

Location	Voltage (kV)	Bank No.	Rating/bank (Mvar)	Total rating (Mvar)
Achimota	34.5	5	21.8	109.0
New Tema	34.5	2	10.8	21.6
Winneba	34.5	2	21.6	43.2
Cape Coast	34.5	2	10.8	21.2
Accra East	34.5	2	21.6	43.2
Mallam	34.5	2	21.6	43.2

(5) Existing and Planned Generation

Power Station	Generator	Type	Commission Year	Capacity
Akosombo	Akosombo G1	Hydro	existing (1965)	170.525 MW
	Akosombo G2	Hydro	existing (1965)	170.525 MW
	Akosombo G3	Hydro	existing (1965)	170.525 MW
	Akosombo G4	Hydro	existing (1965)	170.525 MW
	Akosombo G5	Hydro	existing (1972)	170.525 MW
	Akosombo G6	Hydro	existing (1972)	170.525 MW
Aboadze T1	TAPCo GT1	Gas Turbine	existing (1998)	120.4 MW
	TAPCo GT2	Gas Turbine	existing (1998)	120.4 MW
	TAPCo HRSG	Steam Turbine	existing (1998)	123.5 MW
Aboadze T2	TICo GT1	Gas Turbine	existing (2001)	120.4 MW
	TICo GT2	Gas Turbine	existing (2001)	120.4 MW
	TICo HRSG	Steam Turbine	2015	123.5 MW
Aboadze T3	T1-G1	Gas Turbine	existing (2013)	31 MW
	T1-G2	Gas Turbine	existing (2013)	31 MW
	T1-G3	Gas Turbine	existing (2013)	31 MW
	T1-G4	Gas Turbine	existing (2013)	31 MW
	T1-G5 (HRSG)	Steam Turbine	existing (2013)	31 MW
Aboadze T3 expansion	T2-G	Gas Turbine	2015	120 MW
	T2-HRSG	Steam Turbine	2015	60 MW
Aboadze T4	T4-G1	Gas Turbine	2018	133.3 MW
	T4-G2	Gas Turbine	2018	133.3 MW
	T4-HRSG	Steam Turbine	2018	133.3 MW
Kpong GS	Kpong G1	Hydro	existing (1982)	45.9 MW
	Kpong G2	Hydro	existing (1982)	45.9 MW
	Kpong G3	Hydro	existing (1982)	45.9 MW
	Kpong G4	Hydro	existing (1982)	45.9 MW
Kpone	Kpone GT1	Gas Turbine	2014	120.5 MW
	Kpone GT2	Gas Turbine	2014	120.5 MW
	Kpone HRSG	Steam Turbine	2016	123.5 MW
Asogli	Asogri(1) GT1	Gas Turbine	existing (2010)	29.0 MW
	Asogri(1) GT2	Gas Turbine	existing (2010)	29.0 MW
	Asogri(1) HRSG	Gas Turbine	existing (2010)	29.0 MW
	Asogri(2) GT1	Gas Turbine	existing (2010)	29.0 MW
	Asogri(2) GT2	Gas Turbine	existing (2010)	29.0 MW
	Asogri(2) HRSG	Steam Turbine	existing (2010)	29.0 MW
	Asogri(3) GT1	Gas Turbine	2016	60 MW
	Asogri(3) GT2	Gas Turbine	2016	60 MW
	Asogri(3) HRSG	Steam Turbine	2016	60 MW
	Asogri(4) GT1	Gas Turbine	2016	60 MW
	Asogri(4) GT2	Gas Turbine	2016	60 MW
	Asogri(4) HRSG	Steam Turbine	2016	60 MW

Power Station	Generator	Type	Commission Year	Capacity
Tema TT1PP	TT1PP GT1	Gas Turbine	existing (2009)	113.4 MW
	CENIT GT	Gas Turbine	existing (2012)	113.4 MW
	TT1PP HRSG	Steam Turbine	2017	113.4 MW
Tema MRP	MRP GT1	Gas Turbine	existing (2007)	47.3 MW
	MRP GT2	Gas Turbine	existing (2007)	20 MW
	MRP HRSG	Steam Turbine	existing (2007)	15 MW
Tema TT2PP	TT2PP GT1	Gas Turbine	existing (2010)	7.8 MW
	TT2PP GT2	Gas Turbine	existing (2010)	7.8 MW
	TT2PP GT3	Gas Turbine	existing (2010)	7.8 MW
	TT2PP GT5	Gas Turbine	existing (2010)	13.1 MW
	TT2PP HRSG	Steam Turbine	existing (2010)	13.1 MW
Bonyere 1	GT1	Gas Turbine	2016	150 MW
	GT2	Gas Turbine	2016	150 MW
	HRSG	Steam Turbine	2016	150 MW
Bonyere 2	GT1	Gas Turbine	2017	150 MW
	GT2	Gas Turbine	2017	150 MW
	HRSG	Steam Turbine	2017	150 MW
Bui	Bui1	Hydro	existing (2013)	133 MW
	Bui2	Hydro	existing (2013)	133 MW
	Bui3	Hydro	existing (2013)	133 MW
Pwalugu	Pwalugu 1	Hydro	2026	24 MW
	Pwalugu 2	Hydro	2026	24 MW
Hemang	Heman 1	Hydro	2020	46.5 MW
	Heman 2	hydro	2020	46.5 MW
Juale	Juale 1	Hydro	2020	41.5 MW
	Juale 2	Hydro	2020	41.5 MW

3. Environmental and Social Considerations

3.1 Environmental Permit (EP)

3.1.1 Schedule of Environmental and Social Impact Assessment (ESIA)

GRIDCo started the process to obtain an Environmental Permit (EP) for the Project as they submitted an Environmental Assessment (EA) application of the Project on Environmental Protection Agency (EPA) in October 2013. EPA requested GRIDCo to conduct ESIA for the Project in the end of December 2013 after the screening process.

GRIDCo will procure a local consultant to conduct the ESIA and prepare an Environmental Impact Statement (EIS). The draft EIS will be submitted to EPA for review and comments will be given if necessary. GRIDCo will revise the draft EIS and submit it to EPA and EPA will issue the EP if they approve it. Table 3-1 explains an expected time schedule of ESIA that GRIDCo has planned to obtain the EP for the Project by July 2014 with six-month implementation period of ESIA.

The EP is issued with specific conditions including the mitigation measures over the entire construction activities of the Project.

Table 3-1 Expected Time Schedule of ESIA Conducted by GRIDCo

No.	ESIA Procedures	Scheduled Month	Year
1	Submission of EA Application (Registration Form)	October	2013
2	Project Screening	December	
3	Scoping (Terms of Reference) including Public Hearing	February	2014
4	EIA Study	February – April	
5	Draft EIS Submission	April	
6	Draft EIS Review (50 Working Days) including Public Hearing	April - June	
7	Draft EIS Submission after Review	July	
8	EP Issued (15 Working Days)	July	

Source: GRIDCo, JICA Study Team

3.1.2 Land Issues for the ROW of Project

The necessary lands for the Project should be secured prior to the EP so that the Project is evaluated how feasible on the scheduled Japan Grand Aid procedure. In this context, public lands can be used for the Project because no land acquisition procedures are required although resettlement can occur.

For the Project, GRIDCo is going to use the existing 15 meters ROW of 33 kV sub-transmission line after the 33 kV sub-transmission line is decommissioned and removed. Therefore, GRIDCo should secure the following land matters by 15th February, 2014 in advance to accommodate the Japan Grand Aid procedure although GRIDCo will fulfill these obligations in the ESIA.

For 161 kV Transmission Line:

- Evidence showing the ROW of 161 kV transmission line for the Project between Avenor branch point and Graphic Road Primary Substation, which belongs to ECG with legal basis. (ECG says that they have 15 meters ROW on the existing 33 kV line.)
- Consent with Accra City Municipal Government to use land in the playground for constructing a 161 kV tower and for the 161 kV overhead line over passing two roads and the playground (GRIDCo may prepare an agreement by exchange of documents signed by both parties.)
- Consent with the owners of bus parking space and a vacant building for the 161 kV overhead line over passing the parking space (GRIDCo may prepare an agreement by exchange of documents signed by both parties.)
- Consent with Accra City Municipal Government or any other authorities to use utility space for the underground cable installation along Graphic Road (GRIDCo may prepare an agreement by exchange of documents signed by both parties.)

For 33 kV Sub-transmission Line:

- Appropriate route where GRIDCo (ECG) installs the underground cable of 33 kV sub-transmission line with using the cables procured by the Japanese side between Avenor Primary Substation and Graphic Road Primary Substation in order to avoid any adverse impacts on residents and structures on the route.
- Relating the above, an evidence showing the ROW of route. (GRIDCo (ECG) should use the public space between the rail track and the buildings to avoid impacts on the informal settlers through coordination with the railway company. GRIDCo (ECG) may prepare an agreement by exchange of documents signed by both parties.)
- Measures to avoid resettlement if GRIDCo (ECG) needs to demolish or remove the structures on the route. (GRIDCo (ECG) should demolish or remove the structures and recover those after they installed the underground cable.)

3.2 Anticipated Impacts on Environmental and Social Considerations

3.2.1 Focal Points of Adverse Impacts on Environment and Social Conditions

The results of 1st field survey shows that most lands on the Project route composes of two sections, the north and south sections straddled Ring Road West. The Project Site has totally flat in topography and the requested route passes over residence of informal settlers, grass field and factory sites. Most part of the north section is dominated by the residence of informal settlers. The grass fields and factories are located in the south section.

Through the 1st field survey, the Team found the following focal points which should be considered most in the Project Site.

- Structures around the towers can be affected on the Project route
- Socio-economic activities can be affected on the Project route

- Ambient Noise from the 161/34.5 kV Transformers at Accra Central BSP in the existing Graphic Road Sub-station

3.2.2 Land Acquisition and Involuntary Resettlement

The existing 15 meters ROW of 33 kV sub-transmission line can be used for the 161 kV transmission line in the Project. The land requirements and construction works are limited at the ground level around the existing 33 kV sub-transmission towers. Moreover, the Team is designing the structures of 161 kV transmission towers to reduce their sizes on the ground and of the foundation as much as possible. The sizes will be less than double of the existing towers except special towers. Consequently, the Project can minimize the adverse impact on the structures and socio-economic activities of informal settlers around the towers.

However, more space should be secured for construction works, accesses and security reasons during the construction period. The Team estimates this construction space including the tower foundations at 15 meter square for each. People and structures in this area should be removed for the Project.

The Existing Conditions:

Table 3-2 summarizes the existing conditions on the Project Route. Three critical sites for resettlement were identified at tower number N6, N9 and N14 on the Project Route. Those towers are surrounded by small scale buildings with simple structure of the informal settlers. These structures and the resident socio-economic activities will be affected by the constructions of 161 kV transmission towers. Total 151 population in 22 households were identified by the social survey.

Table 3-2 Affected Population in 15m Square Area

Tower No.	Household	Population	Tower No.	Household	Population
N1	0	0	N10	0	0
N2	1	4	N11	0	0
N3	0	0	N12	0	0
N4	1	4	N13	0	0
N5	0	0	N14	6	28
N6	5	38	N15	1	6
N7	0	0	N16	0	0
N8	0	0	N17	0	0
N9	8	71	N18	0	0
Total				22	151

Source: JICA Study Team

Besides, the end point of overhead line at number N18 is located in a private sector, a car service workshop. The tower should be designed with special feature and structure for the end point of overhead line. The tower may require more land of the existing 33 kV tower.

Meanwhile, an existing 33 kV sub-transmission tower is located in very little space in a plastic

factory, LETAP Packaging Factory. (See Number E0 in Table 3-3.) The site has no enough space which can be secured for the construction works without affecting the factory buildings. Nor the access can be secured easily in the factory. Therefore, the Team has concluded to exclude this site to construct 161 kV transmission tower from the Project Route. Physical conditions are also summarized in section 3.4.

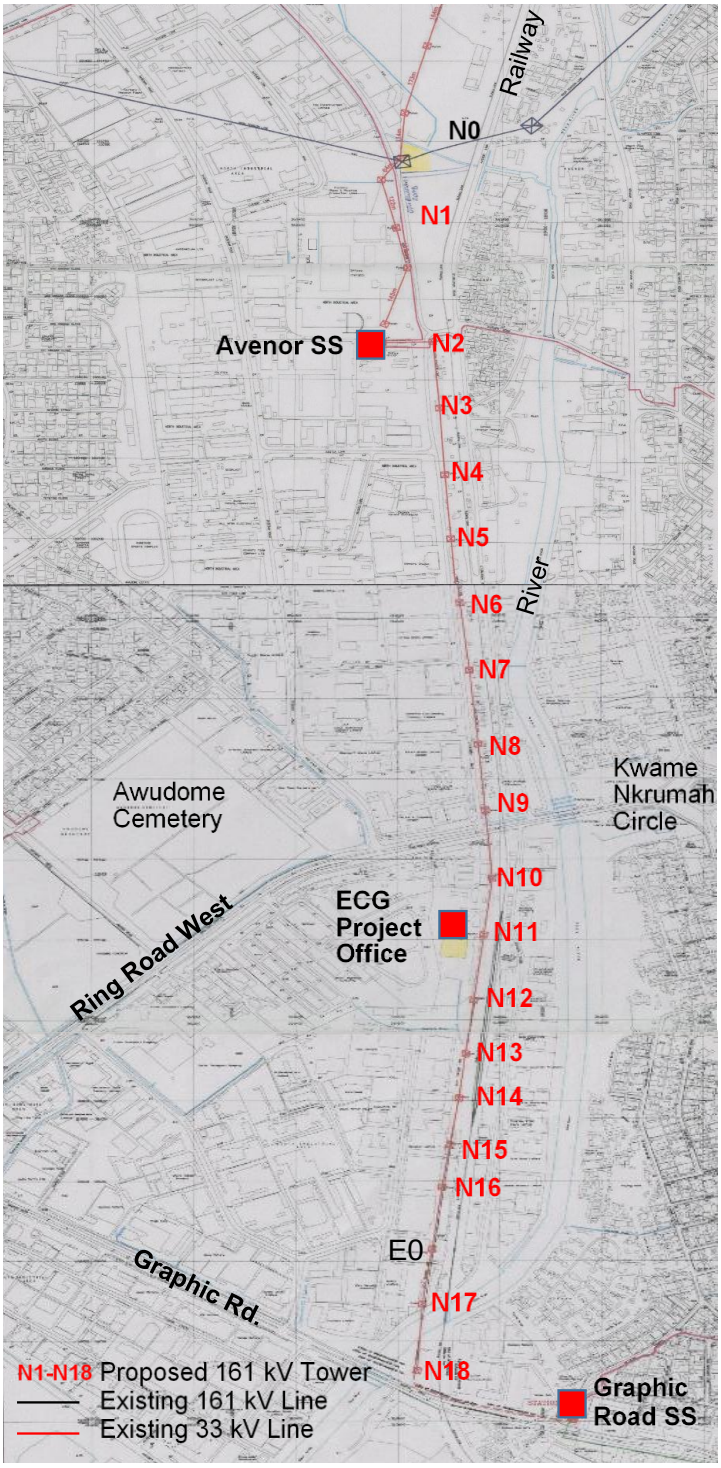


Figure 3-1 Proposed 161 kV Tower Locations

Table 3-3 Existing Conditions on Proposed 161 kV Transmission Line Route

No.	Type	Location Code	Distance (m)	Local Conditions	Note	Photo
N0	by GRIDCo	N: 5.584262 E:-0.219947		- Along a road - Parking space for trucks and cars	No resettlement	
N1	（YY）	N: 5.582600 E:-0.220268	190.0	- Open space owned by Accra City	No resettlement	
N2	（YY）	N: 5.579820 E:-0.220282	310.0	- Along Otublohum Rd. - At the T intersection corner - Small scale shops with simple structure are adjoining	Some resettlement Commercial: 4 population, 1 household	
N3	YY）	N: 5.578316 E:-0.220180	160.5	Along Otublohum Rd. Parking space for large buses, small scale buildings with simple structure are adjoining	No resettlement	
N4	（XX）	N: 5.576812 E:-0.220021	160.5	- Along Otublohum Rd. - Small scale buildings with simple structure and goat market are adjoining	Some resettlement Commercial: 4 population, 1 household	

No.	Type	Location Code	Distance (m)	Local Conditions	Note	Photo
N5	（XX）	N: 5.575289 E:-0.219864	155.4	− Along Otublohum Rd. − Parking space for large buses, small scale buildings with simple structure are adjoining	No resettlement	
N6	（XX）	N: 5.573832 E:-0.219733	181.3	− Along Otublohum Rd. − Surrounded by small scale buildings with simple structure	**Critical site of resettlement** Dwelling: 34 population, 4 households Commercial: 4 population, 1 household	
N7	（XX）	N: 5.572297 E:-0.219612	150.2	− Along Otublohum Rd. − Parking space for large buses and machinery, small scale buildings with simple structure are adjoining	No resettlement	
N8	（YY）	N: 5.570694 E:-0.219432	165.7	− Along Otublohum Rd. − Parking space for large buses, a simple structure building are adjoining	No resettlement	
N9	（YY）	N: 5.569124 E:-0.219311	150.2	− Along Otublohum Rd. − Surrounded by small scale buildings with simple structure	**Critical site of resettlement** Dwelling: 42 population, 4 households Commercial: 29 population, 4 household	
N10	（YY）	N: 5.567666 E:-0.219160	150.2	− Along railway − Wall of bus terminal is close − Grass field	No resettlement	

No.	Type	Location Code	Distance (m)	Local Conditions	Note	Photo
N11	（XX）	N: 5.566368 E:-0.219313	129.5	− Along railway − Wall of ECG Project Office is close − Grass field	No resettlement	
N12	（XX）	N: 5.564893 E:-0.219509	150.2	− Along railway − Wall of ECG Project Office is close − Grass field	No resettlement	
N13	（XX）	N: 5.563630 E:-0.219680	119.1	− Along railway − Cultivation	No resettlement	
N14	（YY）	N: 5.562670 E:-0.219829	98.4	− Along railway − Surrounded by small scale buildings with simple structure	**Critical site of resettlement** Dwelling: 13 population, 3 households Commercial: 15 population, 3 household	
N15	（YY）	N: 5.561550 E:-0.219956	103.6	− Along railway − Wall of ESKAY Therapeutics LTD is close − Small scale buildings with simple structure (recycle shop) are adjoining − Public toilet is close	Some resettlement Dwelling: 6 population, 1 households	
N16	（YY）	N: 5.560646 E:-0.220109	145.0	− In the parking space of TOYOTA Ghana Workshop Limited	In factory	

No.	Type	Location Code	Distance (m)	Local Conditions	Note	Photo
E0	-	-	-	− In LETAP Packaging Factory − Factory buildings are very close to the existing 33 kV tower	**Narrow Space,** Excluded from 161 kV transmission route	
N17	（YY）	N: 5.557966 E:-0.220427	258.9	− In the parking space of NAMCO Netherland African Manufacturing Co. − A wall and small scale structure are close	In factory	
N18	NEW Type	N: 5.556549 E:-0.220630	145.0	− Along Grahic Road − Car Service Workshop is adjoining	In business establishment	

Source: JICA Study Team

Mitigation Measures:

GRIDCo will prepare a Resettlement Action Plan (RAP) through the ESIA study. GRIDCo has own environmental management system stated in the "Framework for Environmental and Social Management of Bulk Transmission Line Projects in Ghana, January 2009" which also includes the land acquisition and resettlement policy framework applying the World Bank Operational Policies OP 4.12 Involuntary Resettlement (December 2001).

In addition, GRIDCo is preparing the "Land Acquisition and Resettlement Policy Framework" separated by the environmental and social management framework, which is waiting for review of GRIDCo Committee. GRIDCo complies these policy frameworks with the legislations of Ghana on environmental and social considerations in the ESIA and the RAP preparations. All environmental and social impacts including resettlement matters are studied to be mitigated in the ESIA and the RAP.

3.2.3 Noise

The Existing Conditions:

Ambient noise is generated from the 161/34.5 kV transformer operations and the noise level is anticipated at 85 dB(A). According to Town and Country Planning Department of Accra City, the Accra Central BSP (in the Graphic Road Primary Substation) is located in "Light Industry Areas" where permissible noise levels are 65 dB(A) in daytime and 60 dB(A) in nighttime, which are

stipulated in Environmental Quality Guidelines for Ambient Noise (EPA) shown in Table 3-4.

Table 3-4 Environmental Quality Guidelines for Ambient Noise (EPA)

Zone	Description of Area of Noise Reception	Permissible Noise Level in dB(A)	
		DAY (6:00-22:00)	NIGHT (22:00-6:00)
A	Residential areas with low or infrequent transportation	55	48
B1	Educational (school) and health (hospital, clinic) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship located in this zone	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

Source: EPA

Mitigation Measures:

The Team will propose the design of 161/34.5 kV transformers and the control building to meet the guidelines for ambient noise as the details are described in Chapter 4. Each transformer is covered by iron box with insulation so that the noise levels will decrease under 60 dB(A) from the transformers.

3.2.4 Other Prospected Impacts and Mitigation Measures

Other prospected adverse impacts are listed as follows and most of them are caused during the construction period. GRIDCo's "Framework for Environmental and Social Management of Bulk Transmission Line Projects in Ghana, January 2009" stipulates how GRIDCo mitigates these adverse impacts. The Environmental Management Plan (EMP) is prepared in the ESIA and contractor(s) are also required to prepare own EMP, so-called HSES (Health, Safety, Environmental and Social) Management Plan, according to the ESIA/EMP. The contractor shall spell out how the contractors will achieve environmental targets and objectives specified in the ESIA/EMP. Most of adverse impacts during the construction period will be mitigated by executing the HSES Management Plan.

- Obstruction of the existing social infrastructures and services: Traffic can be disturbed by construction vehicle nearby the construction sites during the construction period. Telecommunication lines and water supply pipe settled underground can be affected by the installation works of 161 kV transmission underground cable along Graphic Road.
- Obstruction of cultural property: There are no cultural heritages nearby the Project Route. However, some small houses of worships can be seen nearby the existing towers. They may be affected by the construction works.
- HIV/AIDS: As the Project does not have large-scale construction works and the local employment can be expected, no considerable influx of workers is expected. Therefore, there is low risk of infectious diseases due to the mass inflow of laborers from other areas. However, the

external workers could induce/illicit for sexual relationships with the local peoples and it would enlarge risks on both of them without sensitizations.

- Groundwater contamination: The boring survey identified water table levels are high at about 1.6 meters from the ground level. Leakage and/or spillage of insulation oil of transformers can temporally contaminate groundwater during the construction period at Accra Central BSP.
- Accident: Although a contractor will use few heavy machinery, the manual nature of the work means that there is a possibility of accidents involving workers. The works to construct towers and install wires also can induce the accidents both on the workers and local people.

3.3 Resettlement Action Plan

3.3.1 Resettlement Policy for the Project

The following key policies are extracted from the policy frameworks mentioned above for the Project. These policies mostly covers JICA's Guidelines for Environmental and Social Considerations and WB Operational Policies OP 4.12.

- Except where unavoidable, all necessary steps should be taken to avoid built up areas or sites of environmental and social cultural significance;
- Alternative sites where the impact will be minimized or avoided should be preferred;
- Acquisition of ROW are carried out in such a way as to minimize as much as possible the impact on people;
- GRIDCo is committed to ensuring the restoration of the livelihood of all people adversely affected by its operations;
- Compensation Payment should be fair and adequate and the affected persons should not be made worse off as a result of the implementation of any of GRIDCo Projects;
- GRIDCo must ensure that the livelihood and living standards of the affected people prior to the displacement should not be made worse off but rather improved;
- Resettlement or compensation payments are made on the basis of open market value or Replacement Cost of the property;
- Prior to the commencement of constructional activities, the PAPs should have been paid their compensation to enable them relocate;
- The affected people should be engaged and fully involved in the planning, implementation and monitoring of the resettlement process;
- Grievance redress system is established with grievance redress committee;
- Census and Inventory are conducted in
- Lack of formal title to land should not be a bar to compensation or resettlement/rehabilitation. All affected person are eligible regardless of legal or ownership titles;
- Cash compensation for the loss of income during the transition period;

- Vulnerable groups such as households headed by women or children, the aged, and the physically disabled etc. are cared to be provided to improve their socio-economic conditions rather than simply restoring then to their pre-project levels of vulnerability.

3.3.2 Procedure of Land Acquisition and Resettlement Works

According to the land acquisition and resettlement policies, GRIDCo may take the following steps for resettlement as described in Table 3-5. The RAP will be studied and prepared in the ESIA. Public consultations will also be conducted in the ESIA. The PAPs are initially consulted in this stage. The ESIA will be scheduled until July. GRIDCo may start Census and Inventory works immediately after E/N.

Lands Management Section of Engineering Department of GRIDCo is responsible to the land acquisition and resettlement works. Another important institution is Land Valuation Division (LVD) of Lands Commission. The LVD determines all matters of compensations for land compulsorily acquisition, especially undertakes valuation of immovable properties.

Table 3-5 Expected Resettlement Procedures

No.	Resettlement Steps	Responsible Organization
A.	Pre-Resettlement Implementation Stage	
(1)	RAP Preparation	− GRIDCo Lands Management: Environmental Unit, Lands Acquisition Unit − Local Consultant
(2)	Institutional Arrangements	− GRIDCo Engineering Department
B.	Resettlement Implementation Stage	
(3)	Census and Inventory	− GRIDCo Lands Management: Surveying Unit, Lands Acquisition Unit − Lands Commission: Land Valuation Division − PAPs or PAP's representatives
(4)	Valuation of Lost Assets and Incomes	− GRIDCo Lands Management: Lands Acquisition Unit − Lands Commission: Land Valuation Division − Independent Valuers (Private Valuation Consultants)
(5)	Compensation Entitlement	− GRIDCo Lands Management: Lands Acquisition Unit − Lands Commission: Land Valuation Division − Independent Valuers
(6)	Negotiation and Consent	− GRIDCo Lands Management: Lands Acquisition Unit − Lands Commission: Land Valuation Division
(7)	Budget Disbursement	− GRIDCo
(8)	Payment and Relocation	− GRIDCo Lands Management: Lands Acquisition Unit − Lands Commission: Land Valuation Division − Opinion leaders, an elder or chief
C.	Cross-Culling Issues	
(9)	Public Consultation Meeting	− GRIDCo Lands Management: Environmental Unit, Lands Acquisition Unit
(10)	Grievance Redress Mechanism (GRM)	− GRIDCo Lands Management: Environmental Unit, Lands Acquisition Unit − Grievance Redress Committee − Commission on Human Rights and Administrative Justice (CHRAJ) − Courts
(11)	Monitoring and Evaluation	− GRIDCo Lands Management Environmental Unit, Lands Acquisition Unit

Source: Framework for Environmental and Social Management of Bulk Transmission Line Projects in Ghana January 2009, Land Acquisition and Resettlement Policy Framework, JICA Study Team

3.4 Physical Conditions around the Existing Towers

N2

A white wall building

Small shop

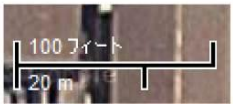
Parking space

N3

A small building

Bus parking space

Parking space



15m Square

N4

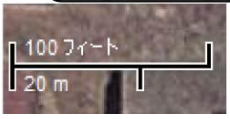
Small buildings around

Goat market

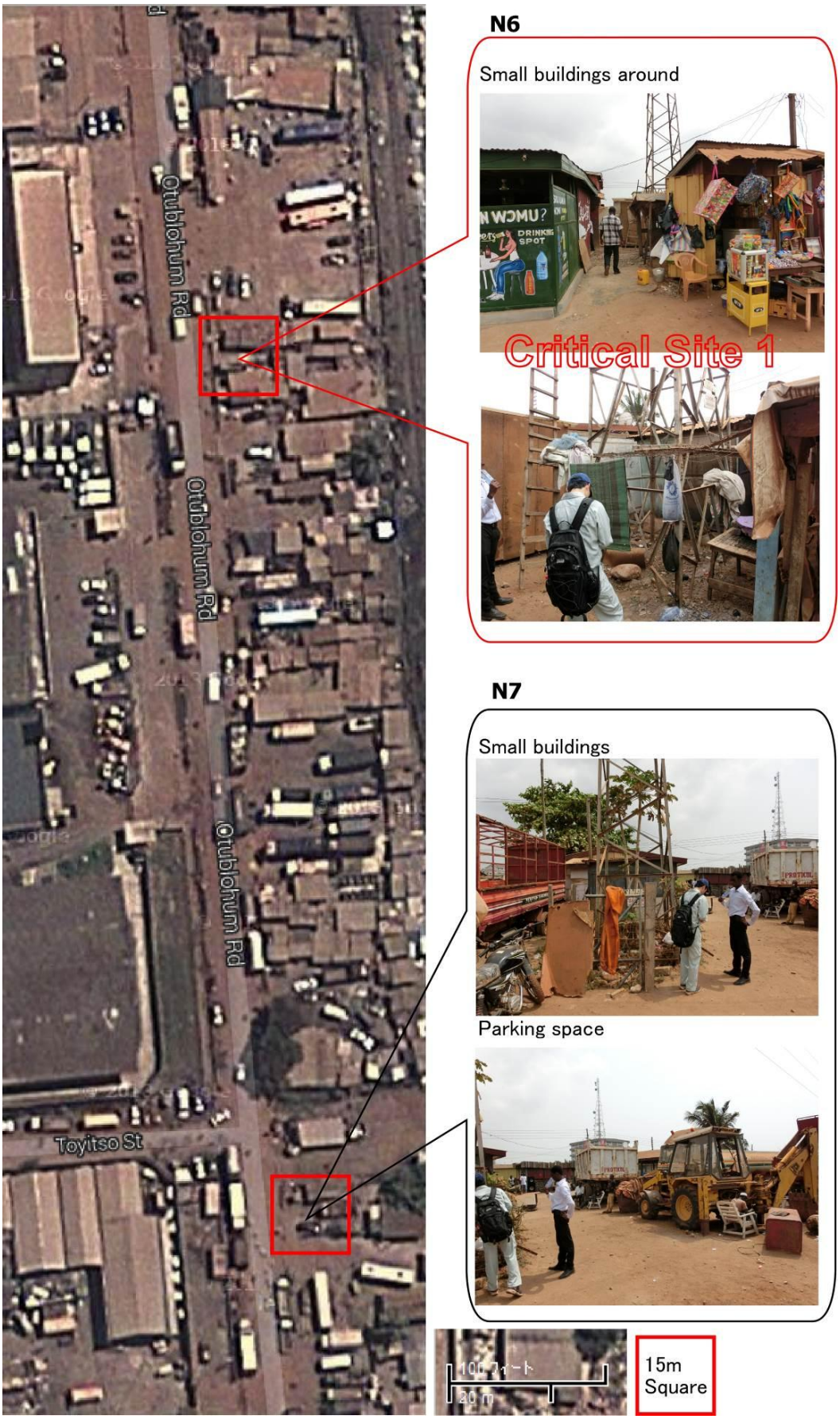
N5

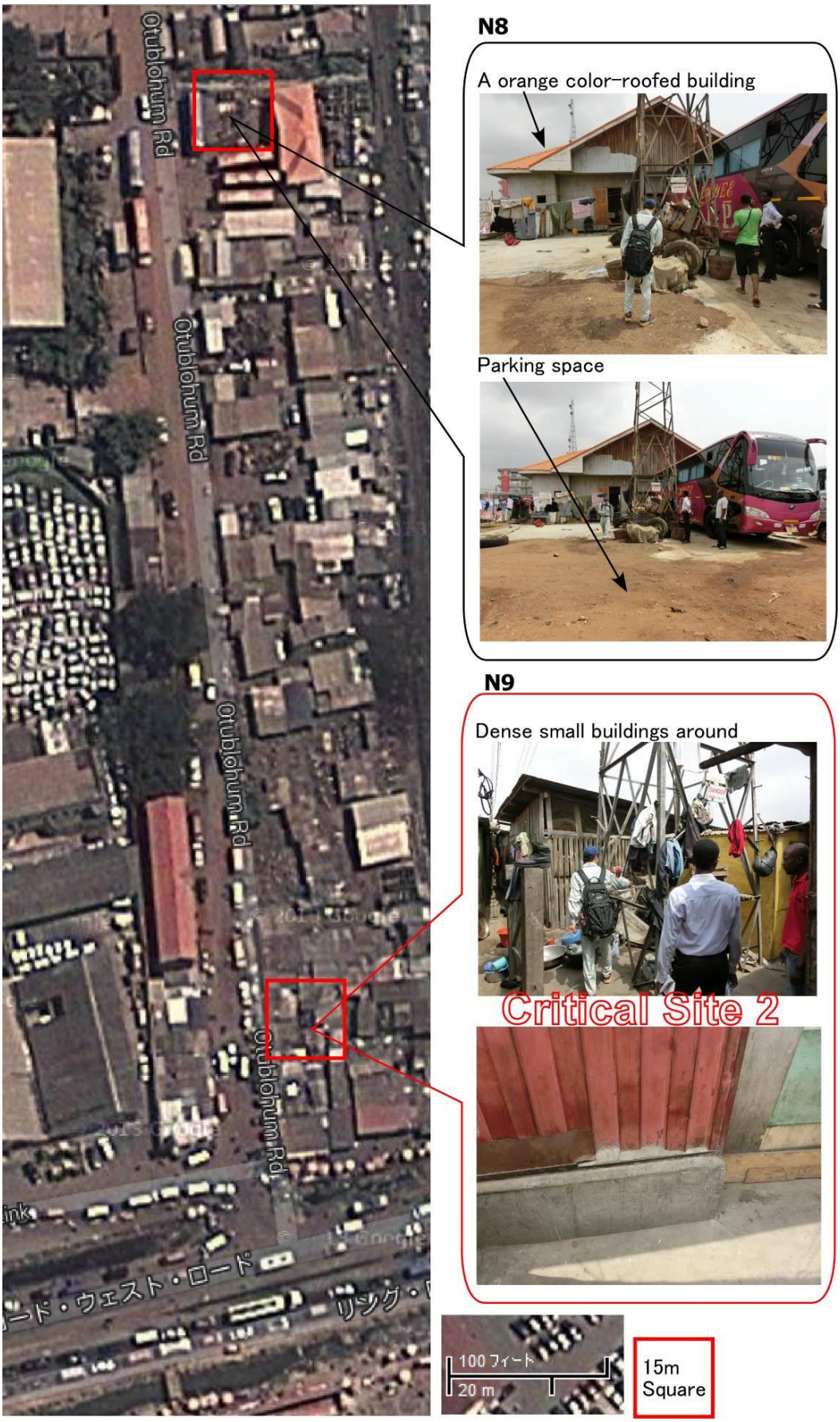
Small buildings

Parking space



15m
Square


Otublohum Rd
Otublohum Rd
Otublohum Rd
Toyitso St
N6
Small buildings around
Critical Site 1
N7
Small buildings
Parking space
15m
Square


Otublohum Rd
Otublohum Rd
Otublohum Rd
Otublohum Rd
N8
A orange color-roofed building
Parking space
N9
Dense small buildings around
Critical Site 2
100 フィート
20 m
15m
Square

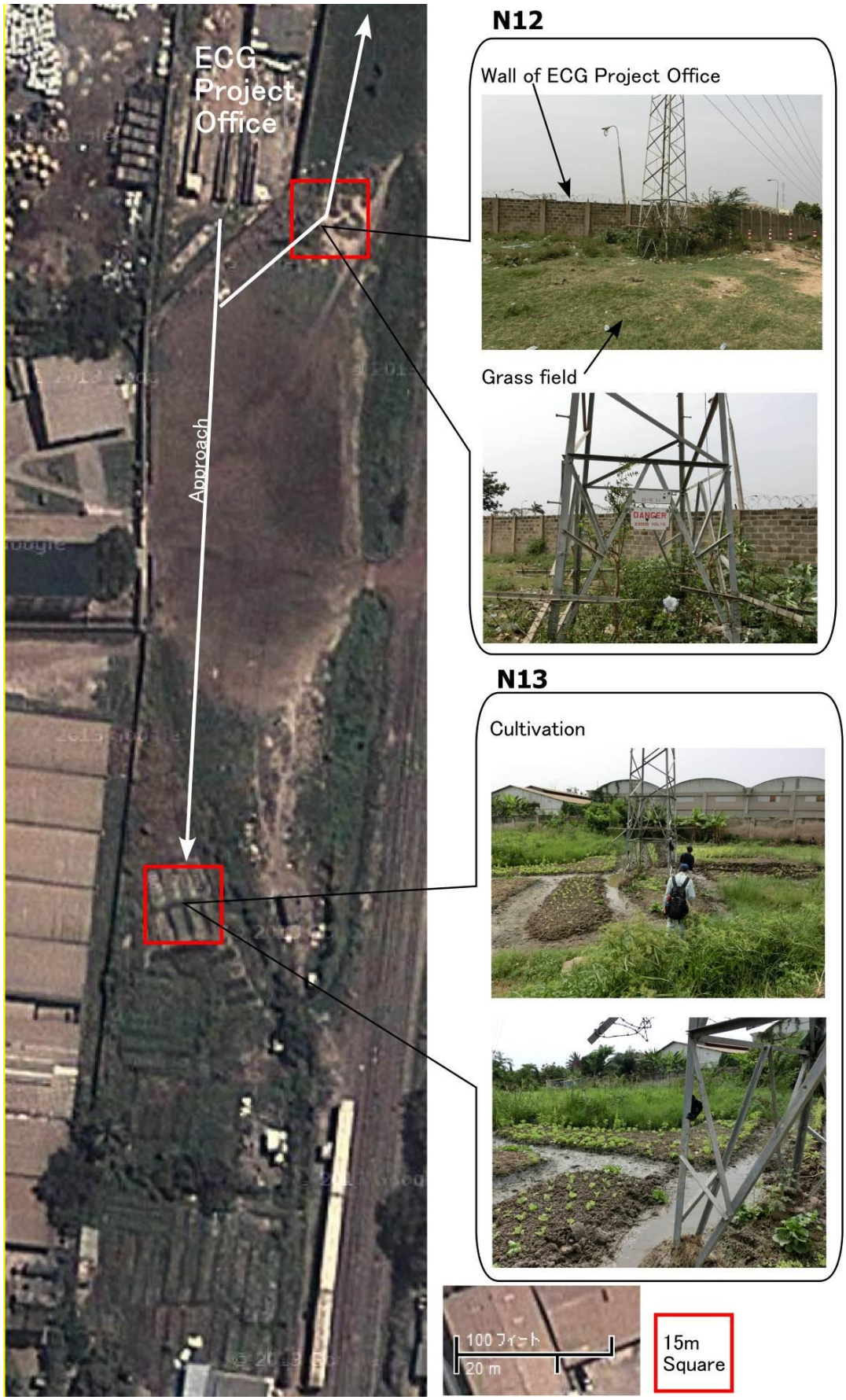
N10

Grass field

N11

Wall of ECG Project Office

Grass field


ECG
Project
Office
Approach
N12
Wall of ECG Project Office
Grass field
DANGER
N13
Cultivation
100 フィート
20 m
15m
Square

N14

Dense small buildings around

Critical Site 3

From the railway side

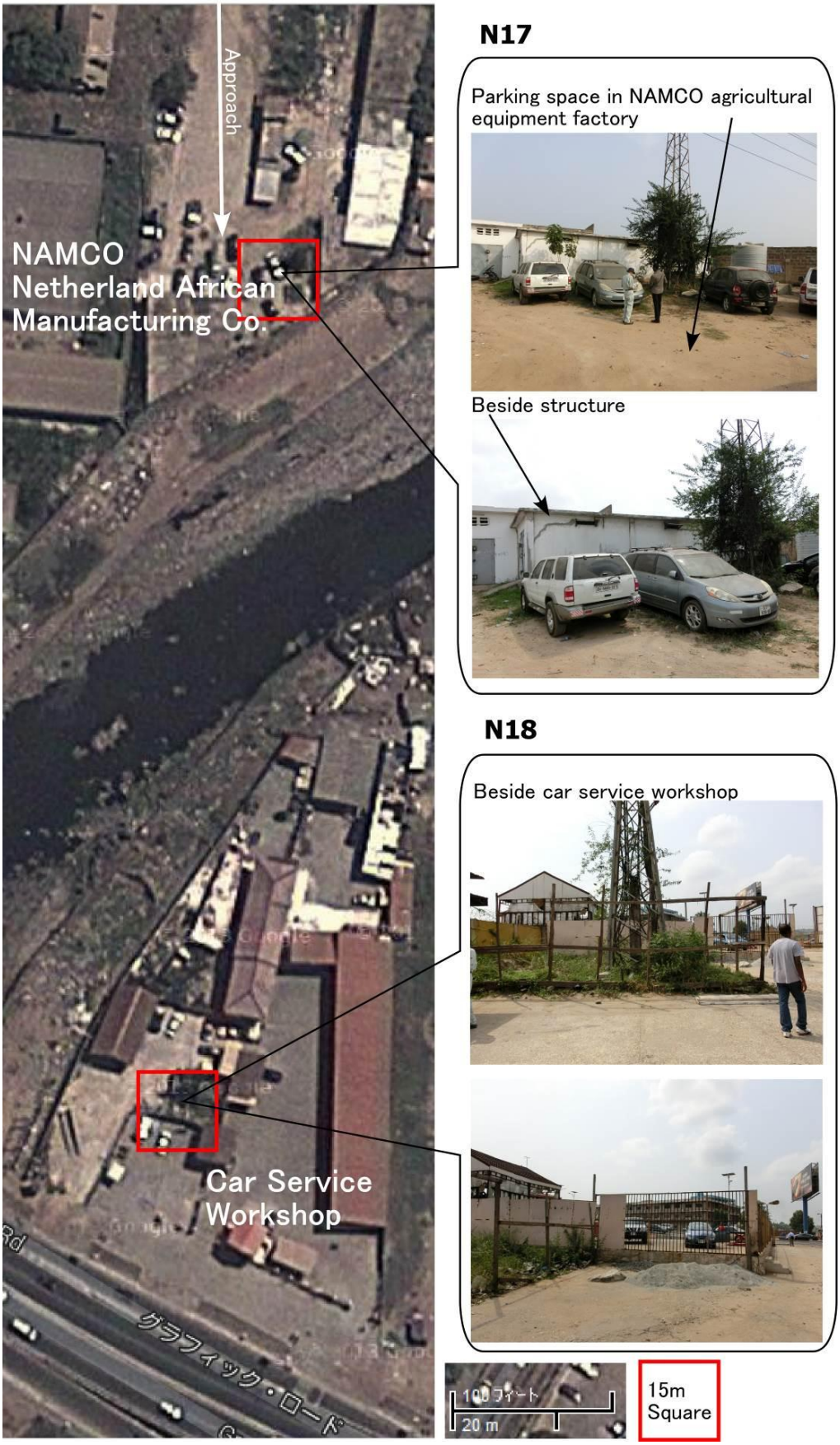
N15

In a recycle service

Critical Site 4

15m
Square


TOYOTA
Ghana Workshop
Limited
Approach
Approach
LETAP
Packaging
N16
Parking space
Parking gate
Narrow space in plastics factory
Critical Site 5
100フィート
20 m
15m
Square


Approach
NAMCO
Netherland African
Manufacturing Co.
Car Service
Workshop
グラフィック・ロード
N17
Parking space in NAMCO agricultural equipment factory
Beside structure
N18
Beside car service workshop
100フィート
20 m
15m
Square

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

Table 2.1.2-1 Climatic Conditions

	Mean Temperature (degrees centigrade)		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan.	23.4	32.1	10.9	1
Feb.	24.1	32.7	21.8	2
Mar.	24.1	32.5	57.1	5
Apr.	24.2	32.2	96.8	6
May.	23.9	31.2	131.2	10
Jun.	23.1	29.3	221.0	15
Jul.	22.5	28.5	66.0	9
Aug.	22.2	28.0	28.0	7
Sep.	22.4	29.0	67.8	8
Oct.	23.9	30.5	62.4	7
Nov.	23.5	31.6	27.7	3
Dec.	23.4	31.7	16.1	2

[Source] Accra Meteorological Observatory 2014.01 (Average of 30 years from 1961-1990)

2. Comparison of required area for the Bulk supply Points

Accra Central BSP is extremely narrow compared to the other BSP, like Achimoto BSP and Mallam BSP as you can see in Table 4-1 Site Area Comparison Table.

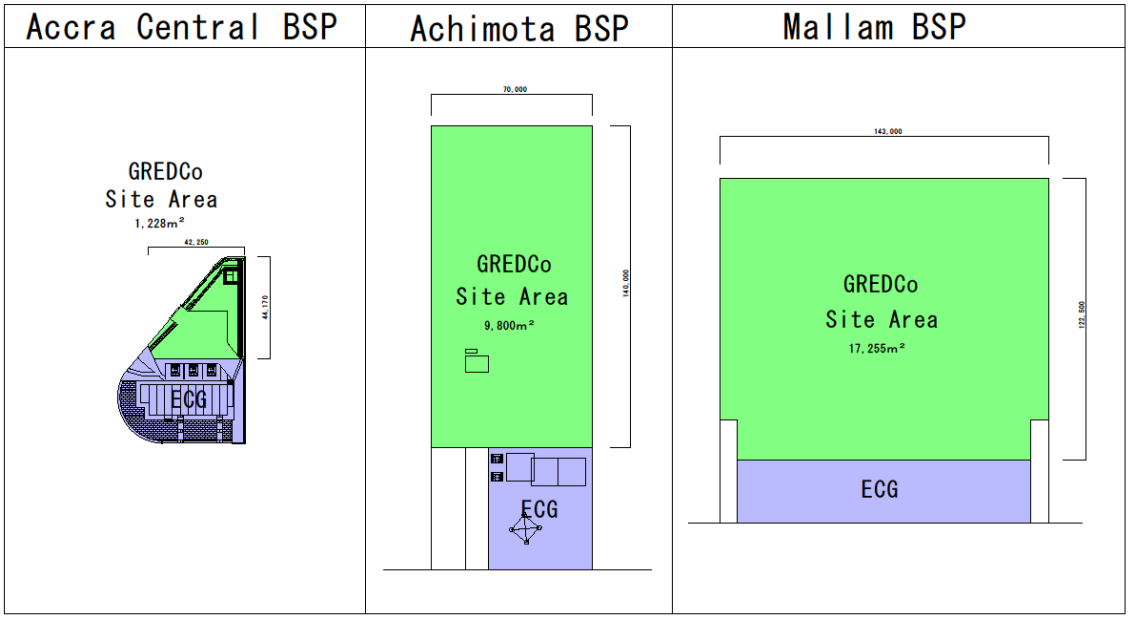
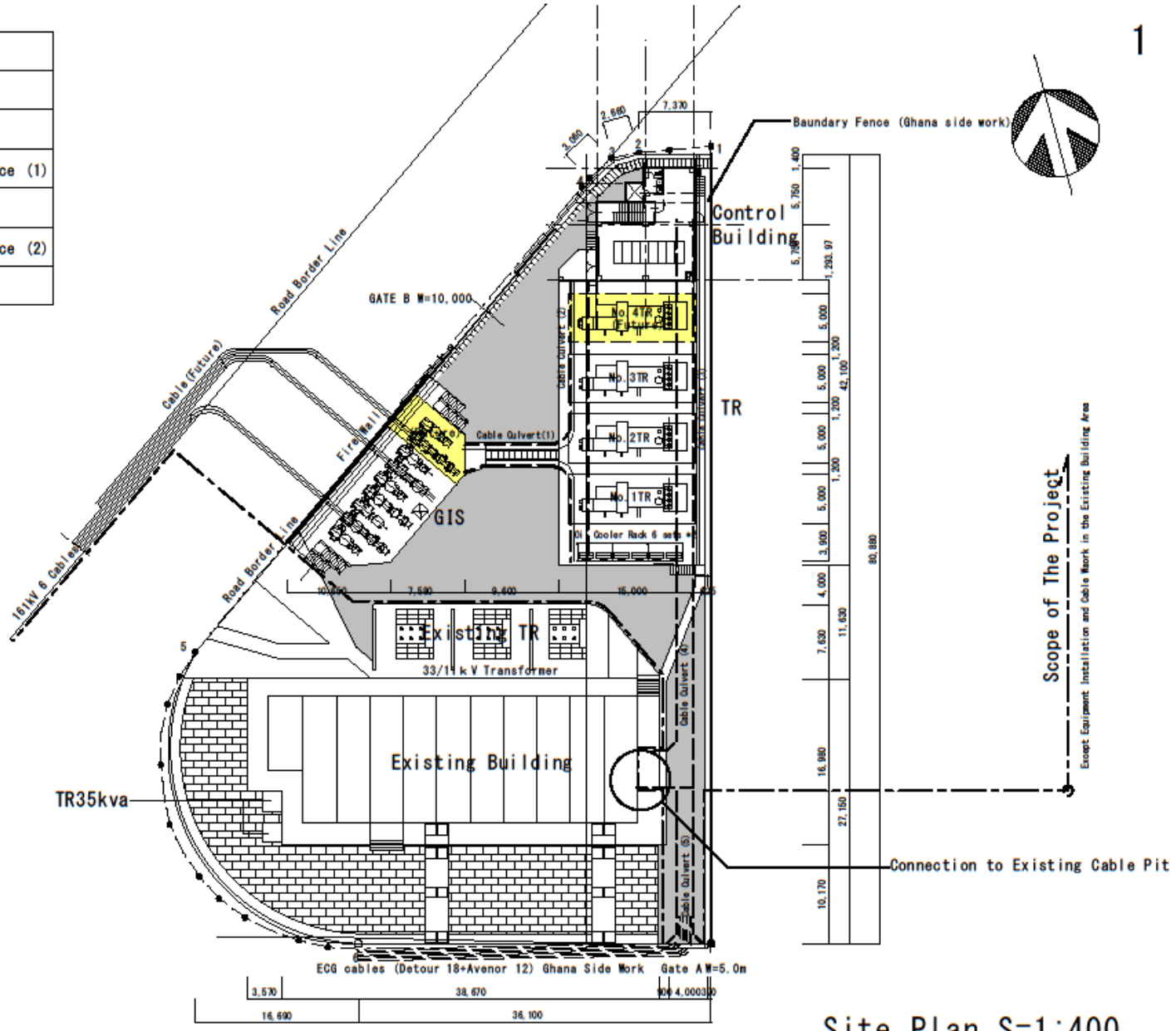
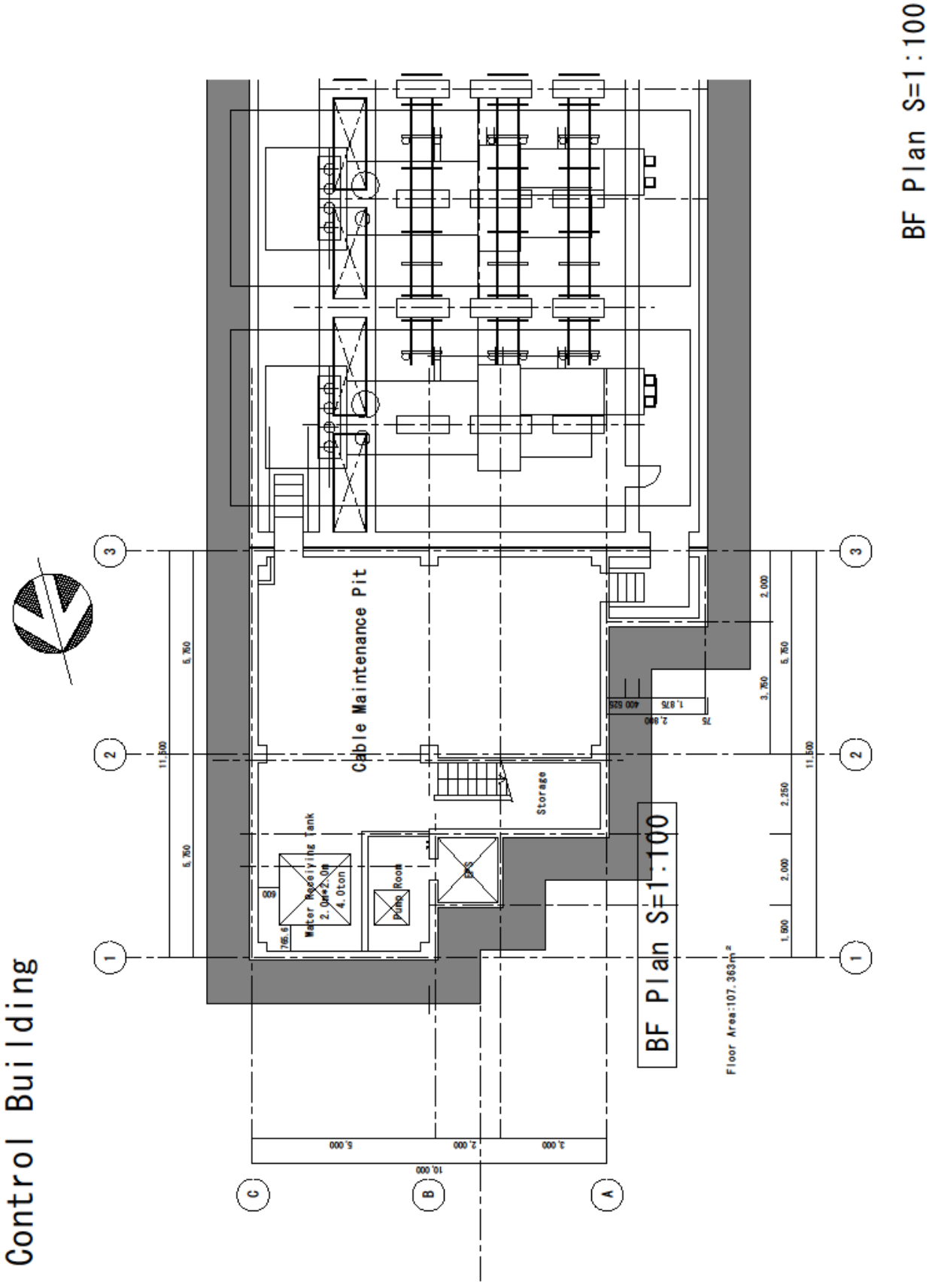


Table4-1: Site Area Comparison

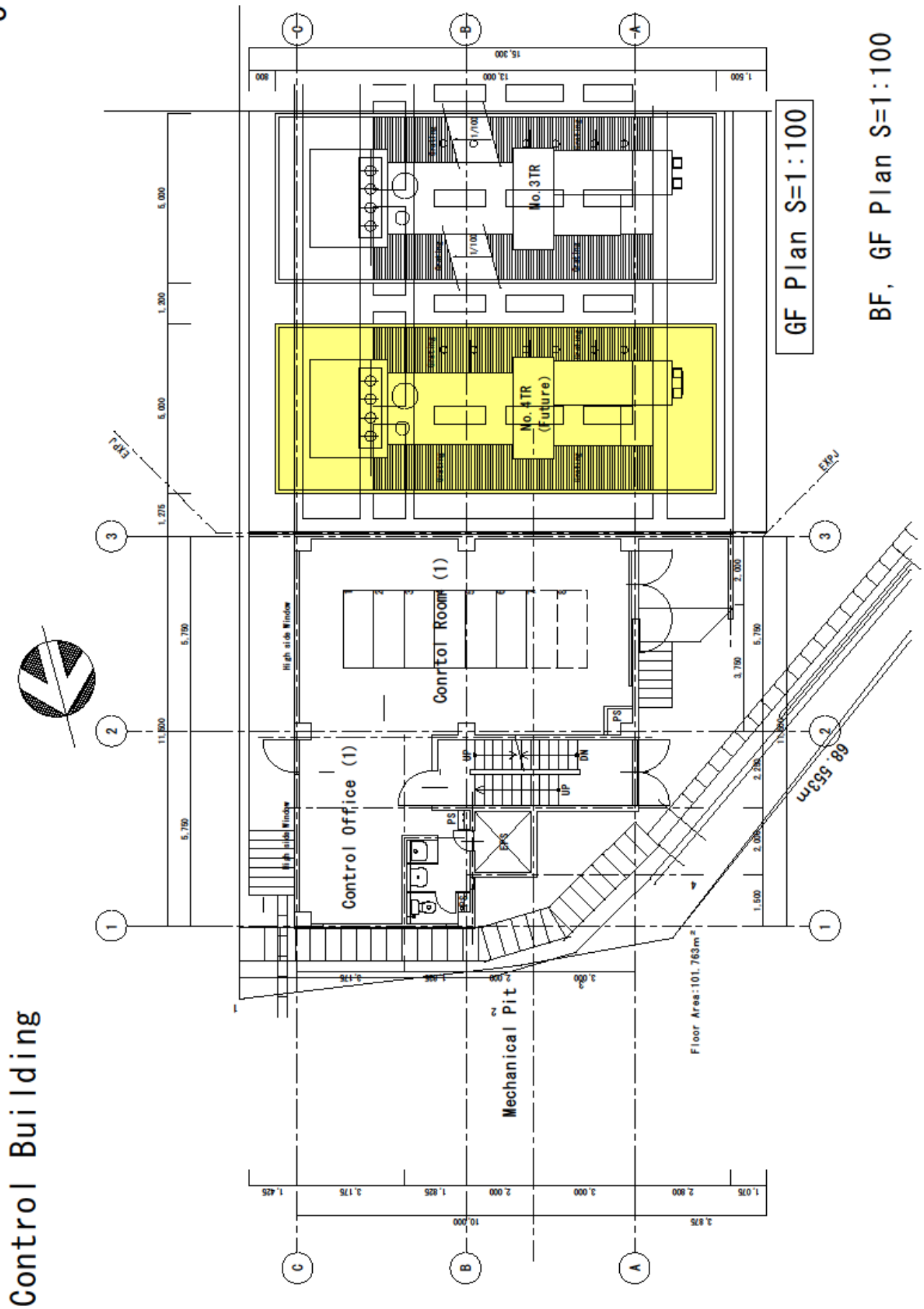
A-01 SITE LAYOUT of ACCRA CENTRAL BSP

Facility List	
1.	Control Building
	BF Cable Pit, Water Tank, Pump
	GF Control Room (1), Control Office (1)
	1F Control Room (2), Battery Room
	2F Control Room (3), Control Office (2)
	RF Trans, Air-con unit
2.	GIS
	BF Cable Pit
	GF GIS 3sets, space for future
3.	Trans
	BF Mechanical Pit,
	BF Cable Culvert (2), (3)
	GF Trans No.1, 2.3& Space No.4
	Oil cooler Rack (12sets)
4.	Cable Culvert
	Cable Culvert (1) GIS-TR
	Cable Culvert (4) TR-Existing
	Cable Culvert (5) Existing 33kV
5.	Fire Wall
	Fire wall for GIS
6.	Gate B
	W=10m full open gate

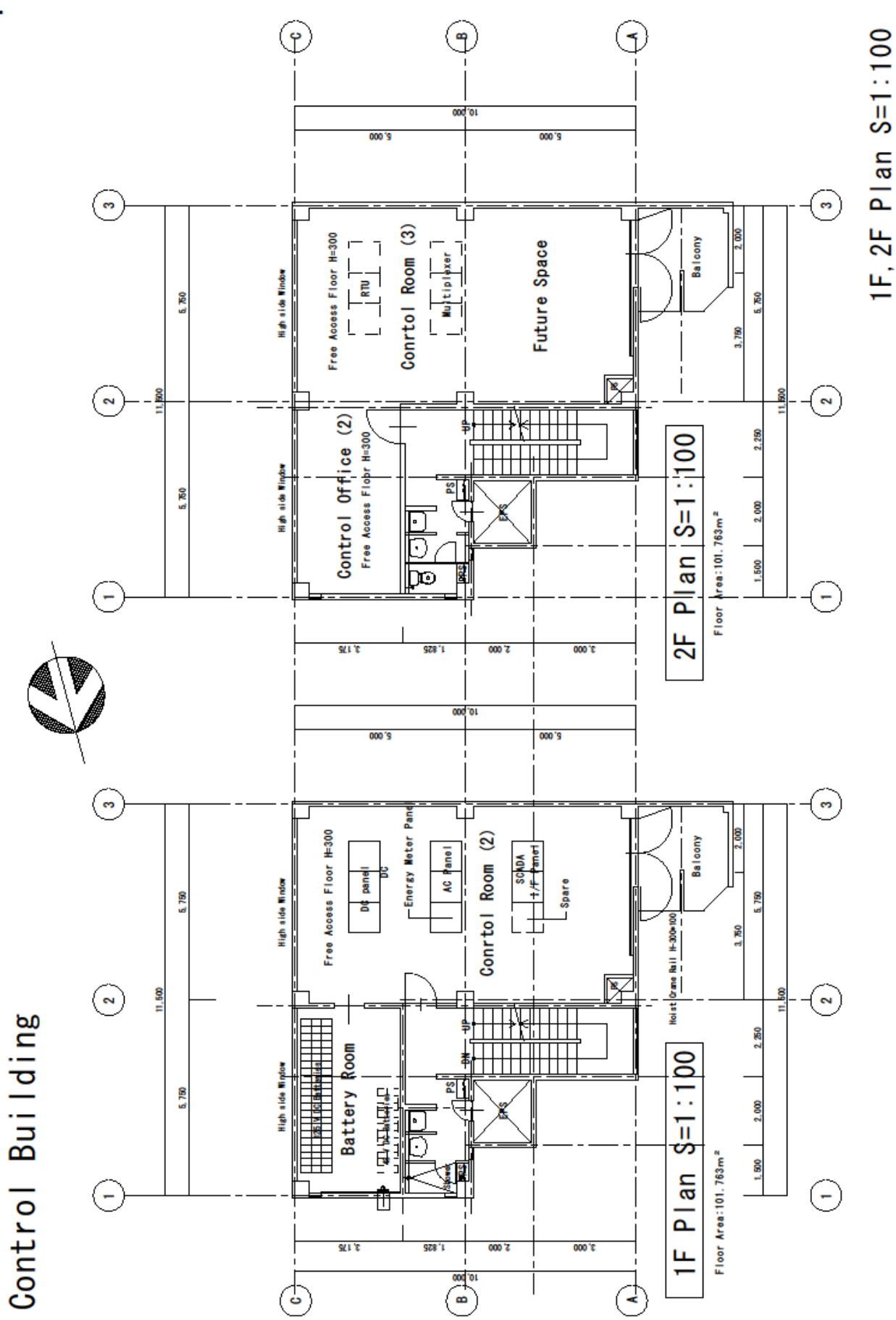




A-02 CONTOL BUILDING BF PLAN of ACCRA CENTRAL BSP

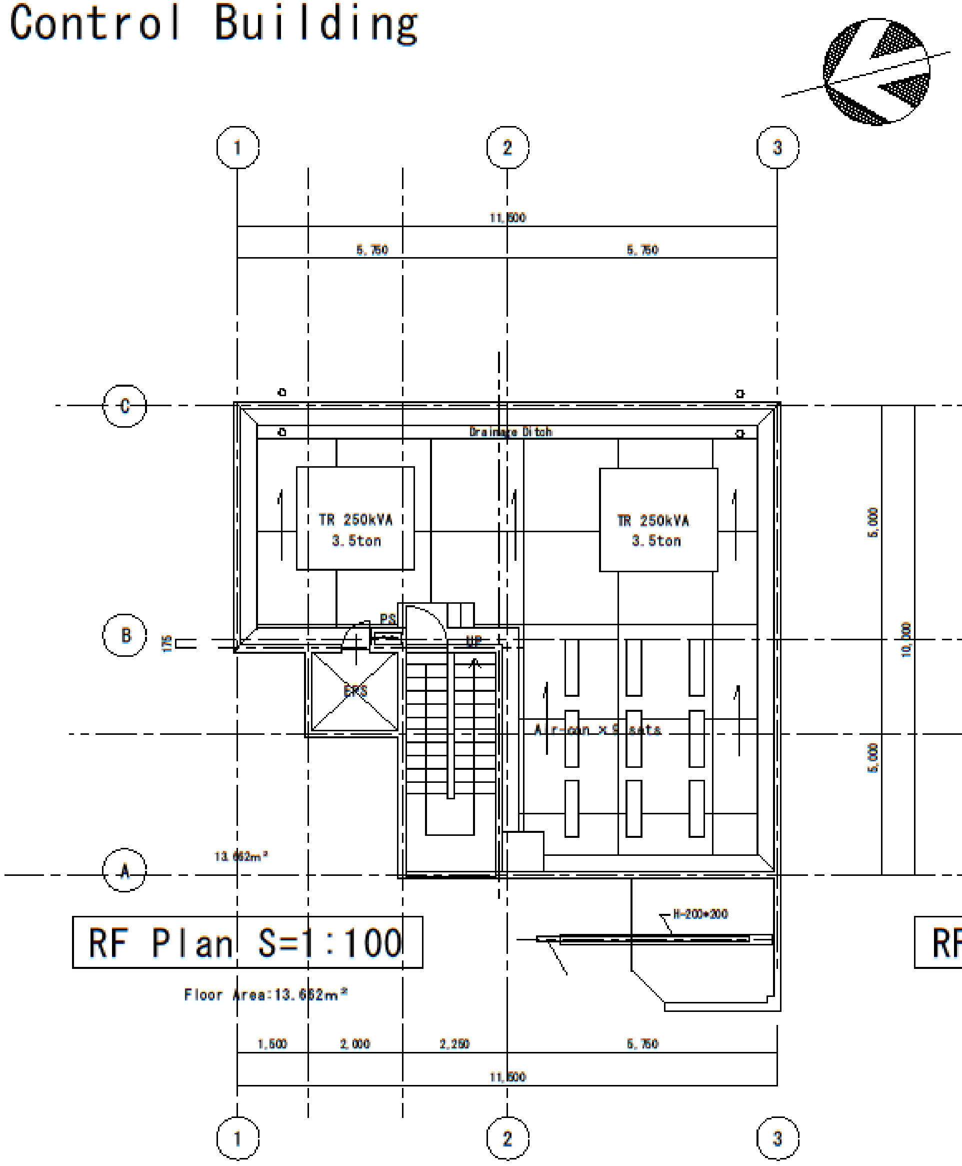


A-03 CONTOL BUILDING GF PLAN of ACCRA CENTRAL BSP



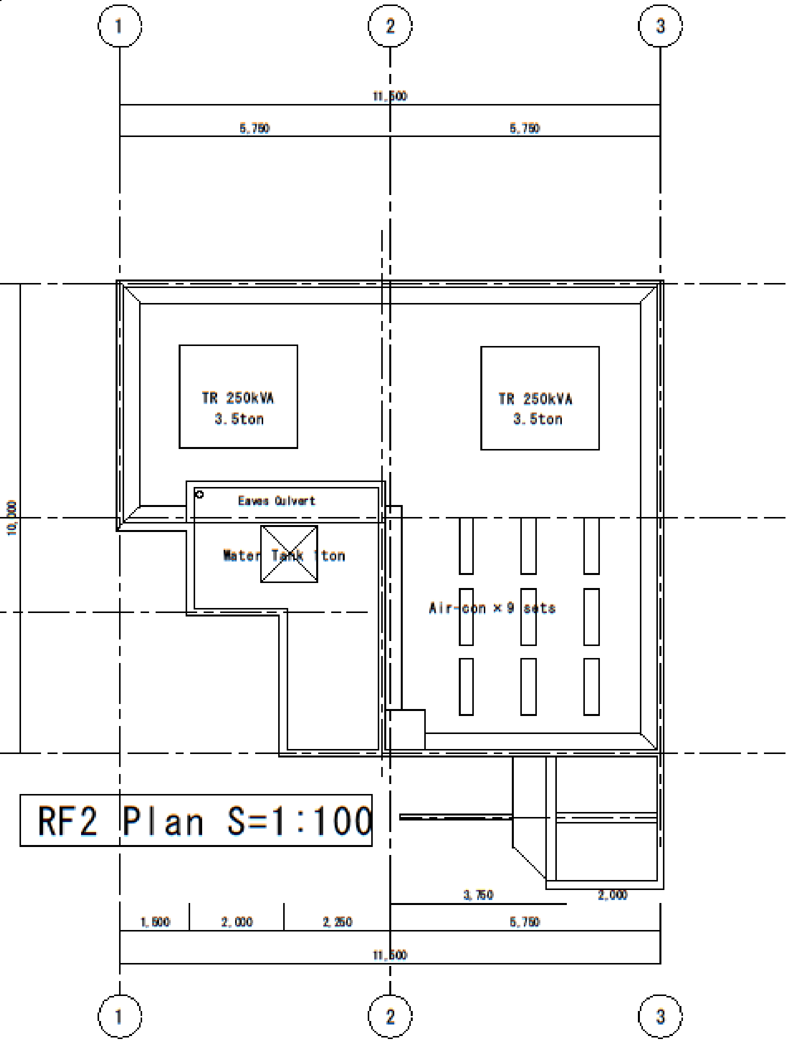
A-04 CONTOL BUILDING 1F, 2F PLAN of ACCRA CENTRAL BSP

Control Building



RF Plan S=1:100

Floor Area:13.662m²

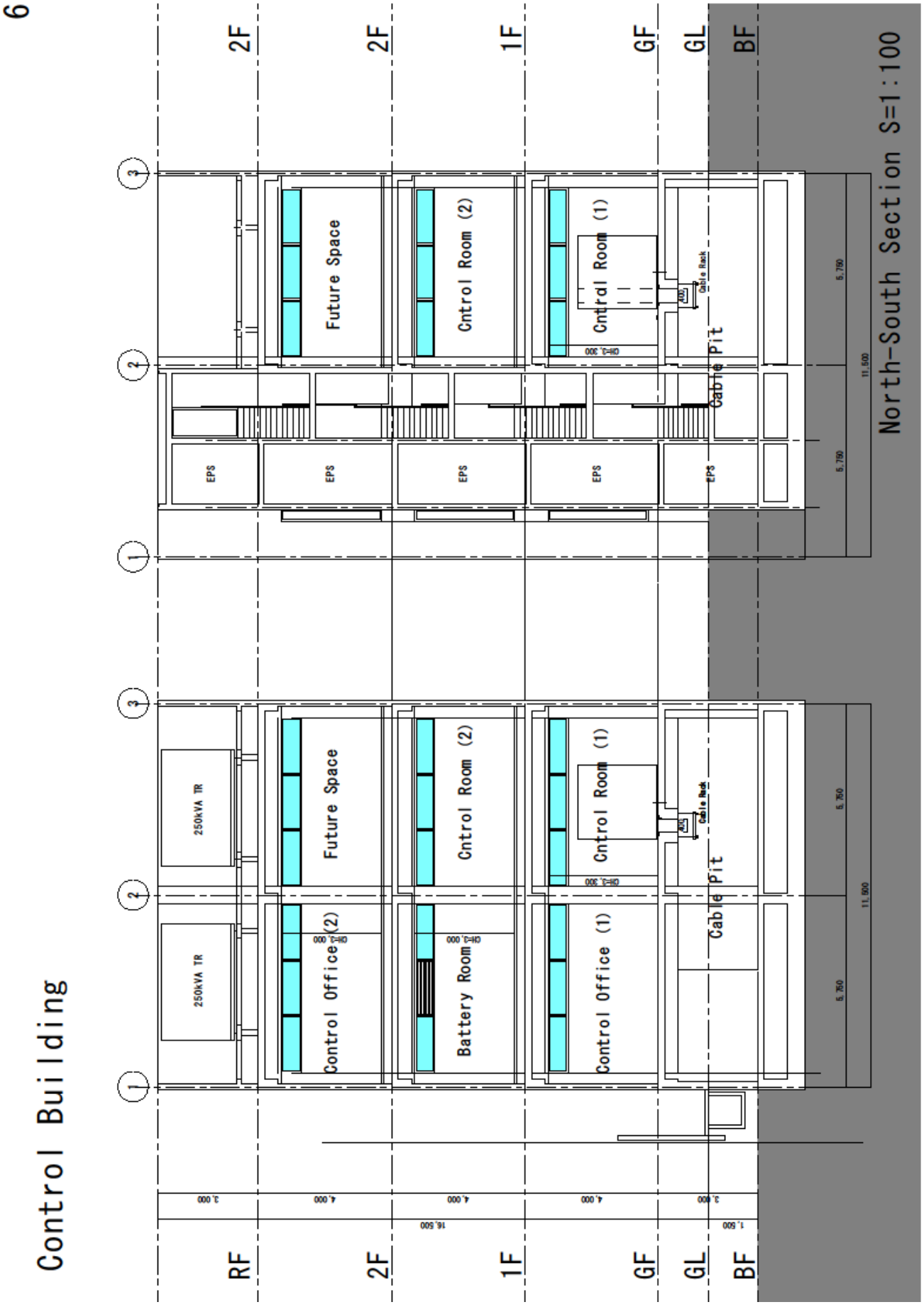


RF2 Plan S=1:100

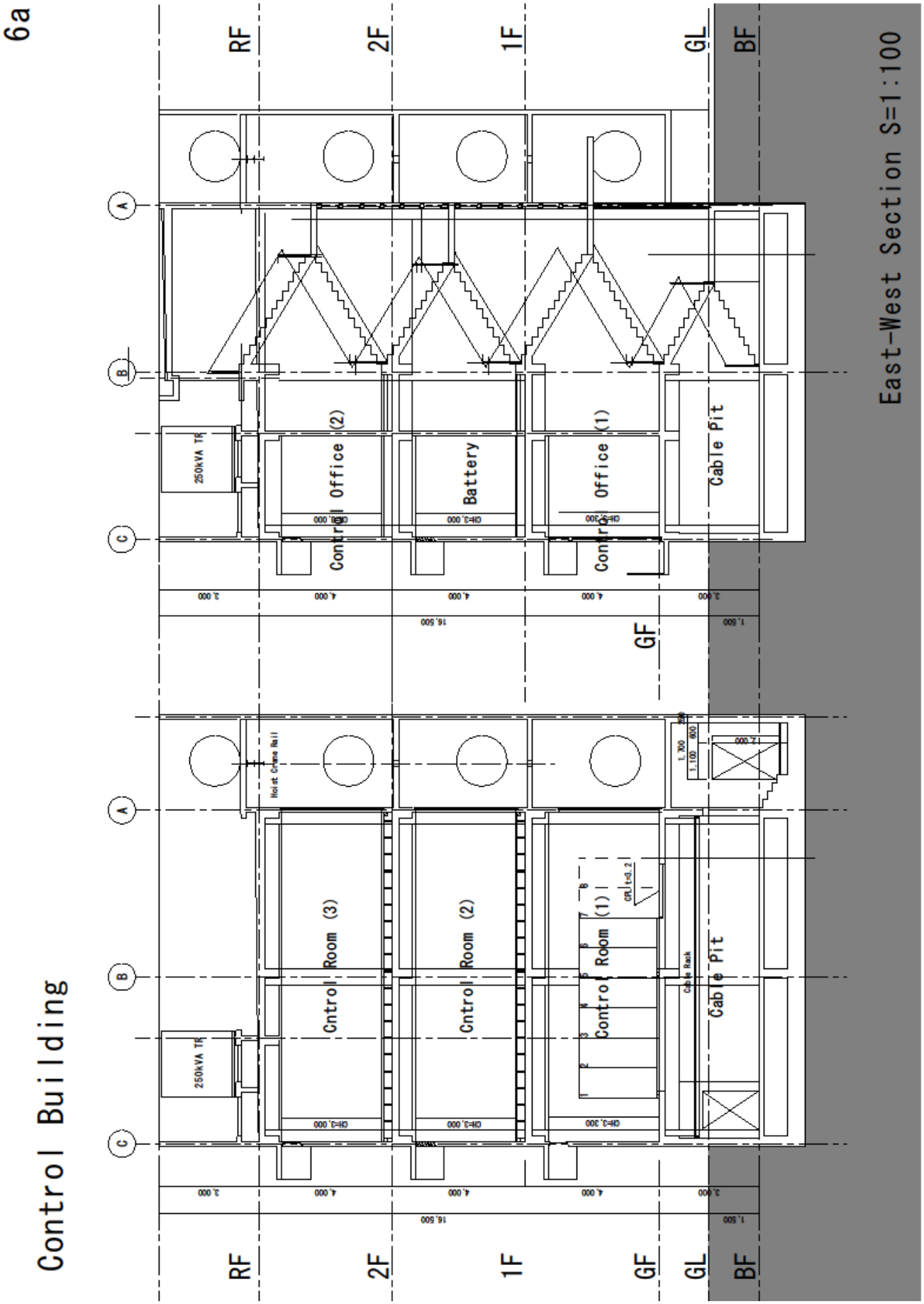
RF, Roof Plan S=1:100

A-7

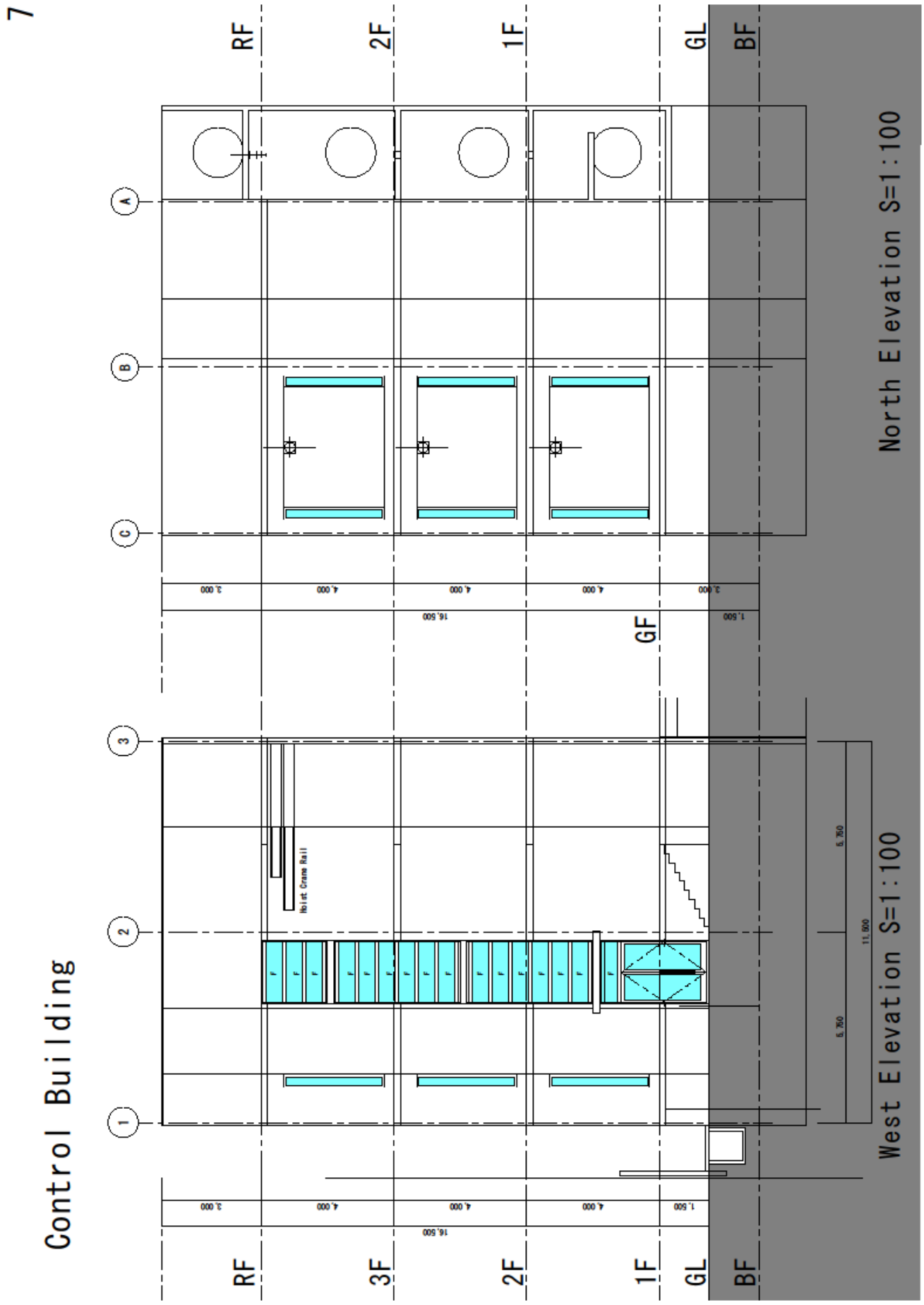
A-05 CONTOL BUILDING RF, Roof PLAN of ACCRA CENTRAL BSP



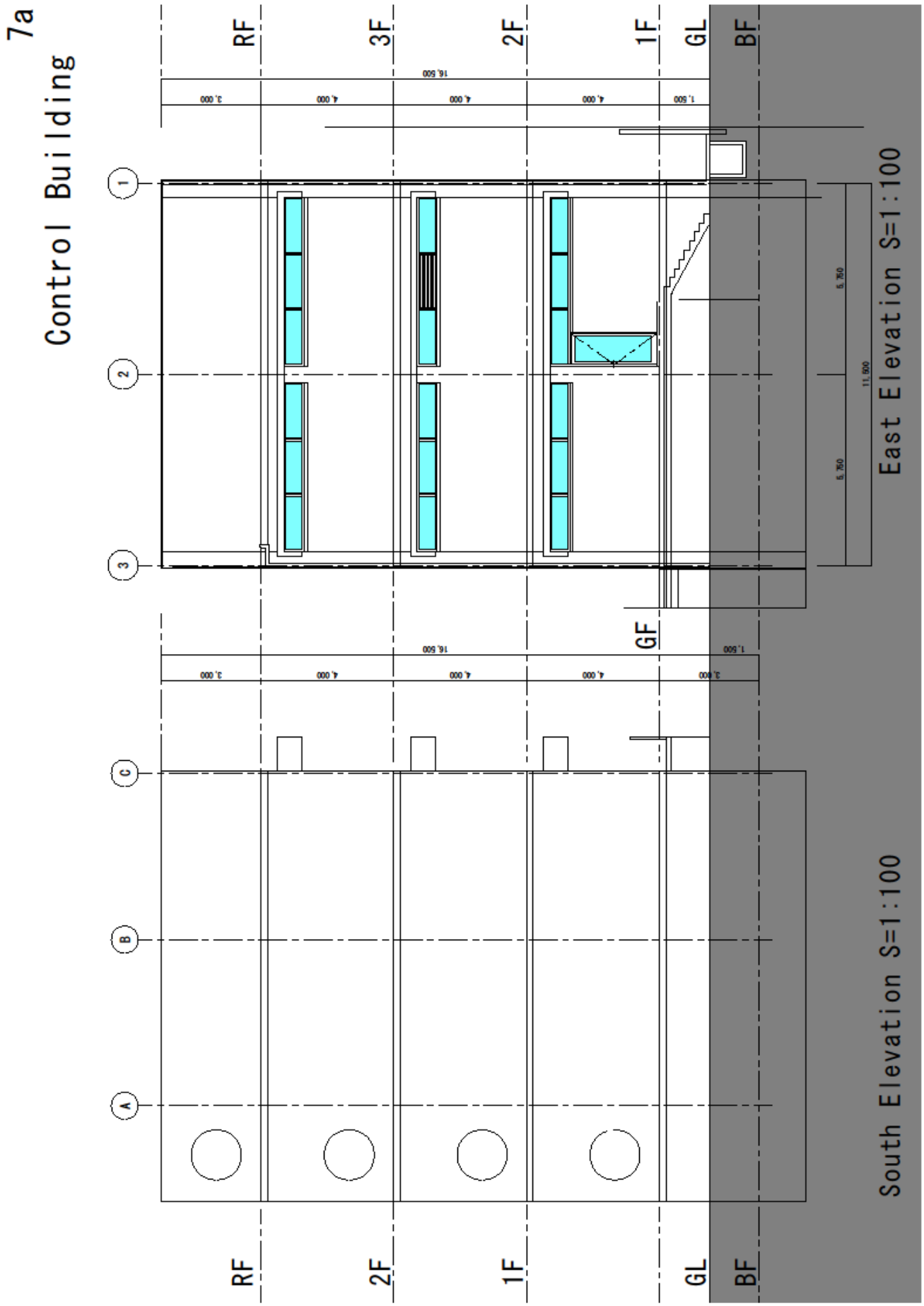
A-06 CONTOL BUILDING SECTION (1) of ACCRA CENTRAL BSP



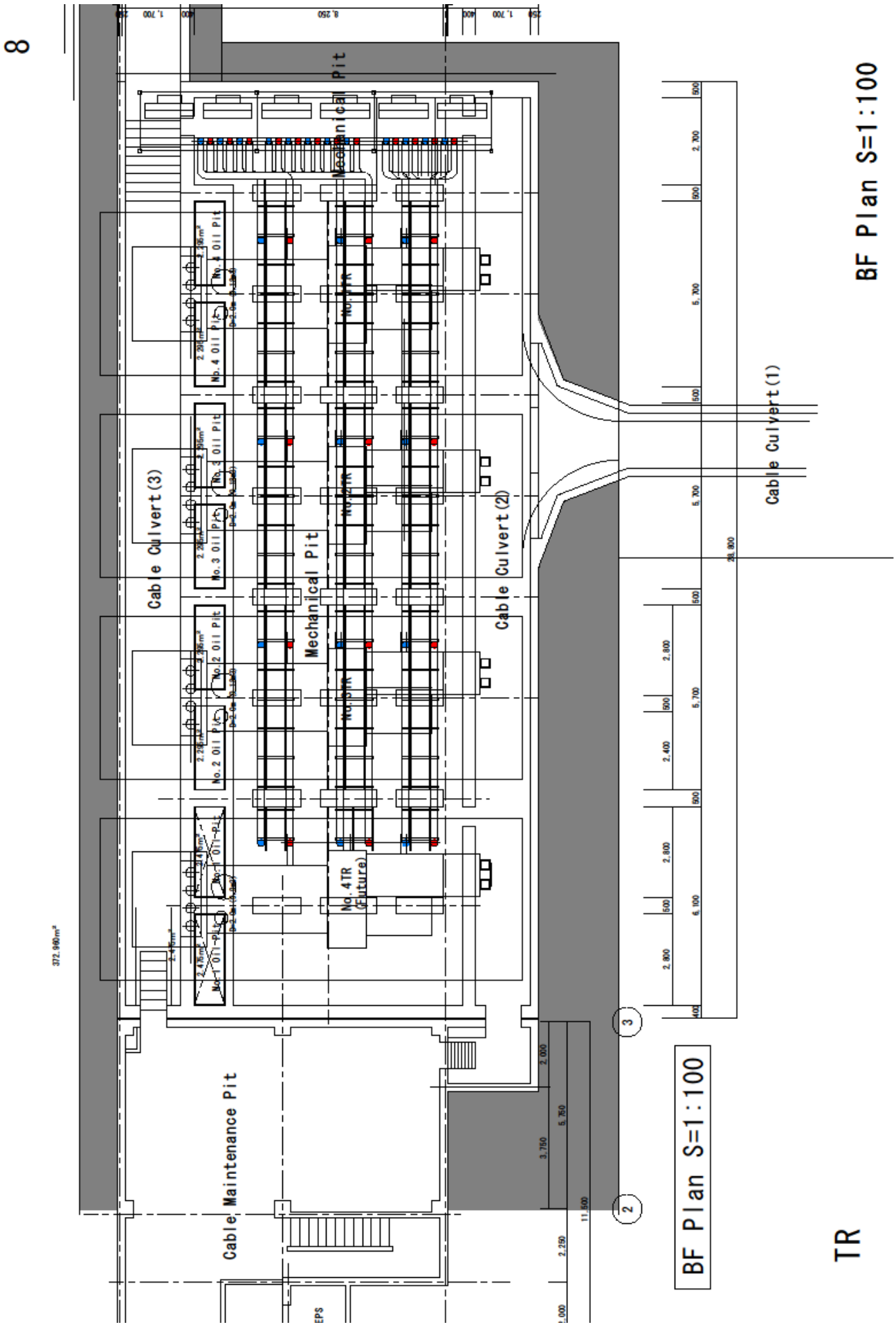
A-07 CONTOL BUILDING SECTION (2) of ACCRA CENTRAL BSP



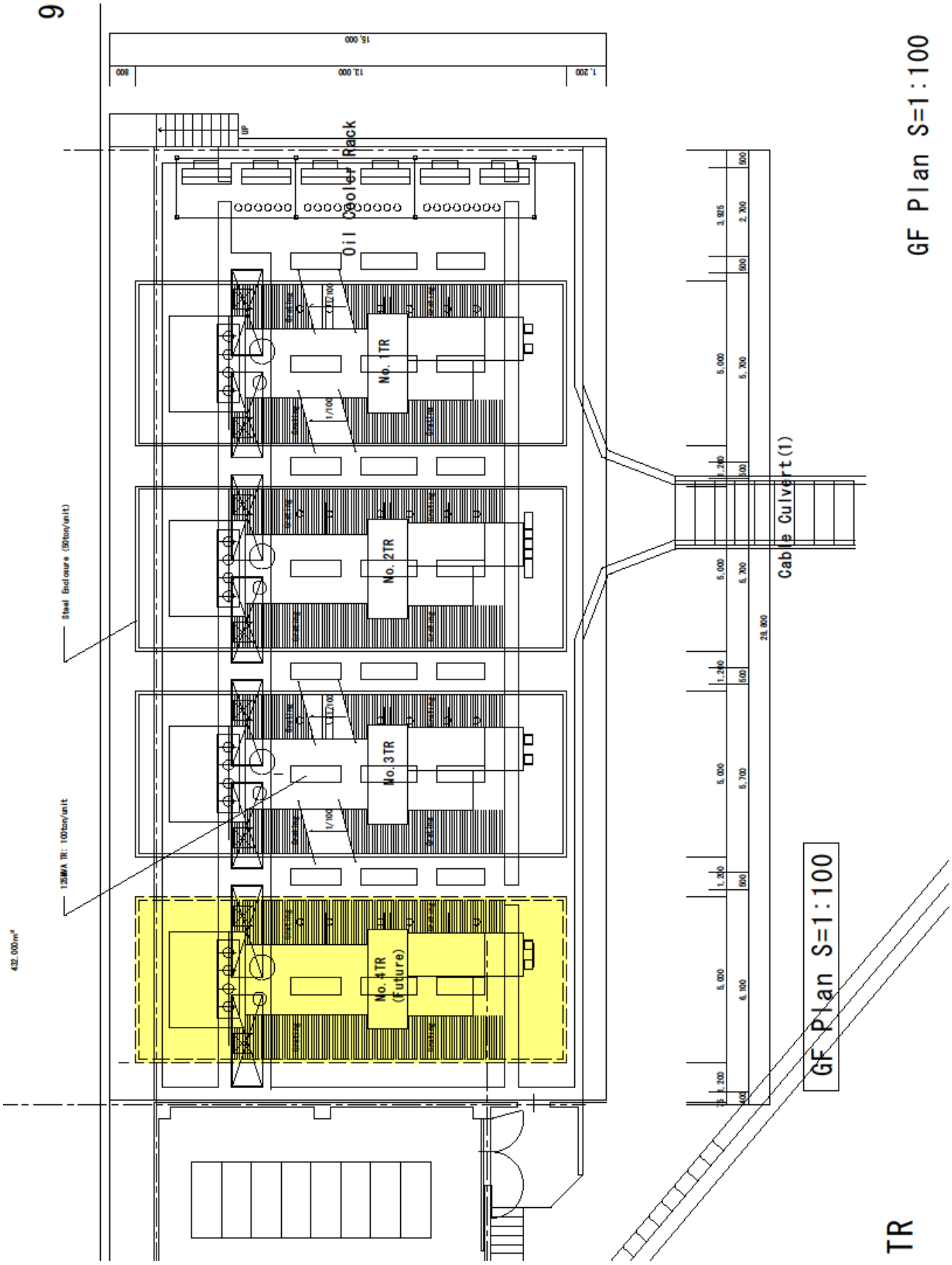
A-08 CONTOL BUILDING ELEVATION (1) of ACCRA CENTRAL BSP



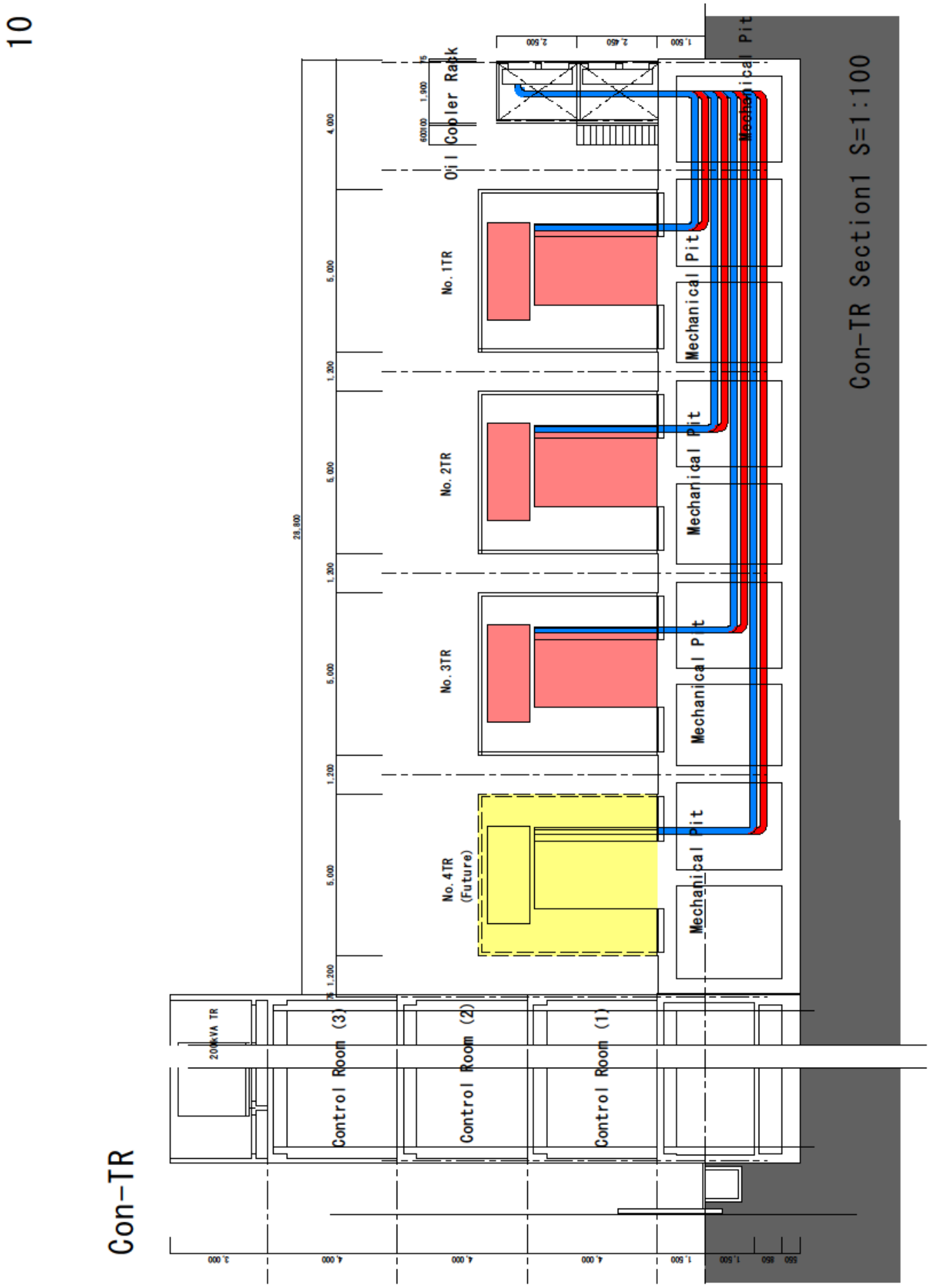
A-09 CONTOL BUILDING ELEVATION (2) of ACCRA CENTRAL BSP



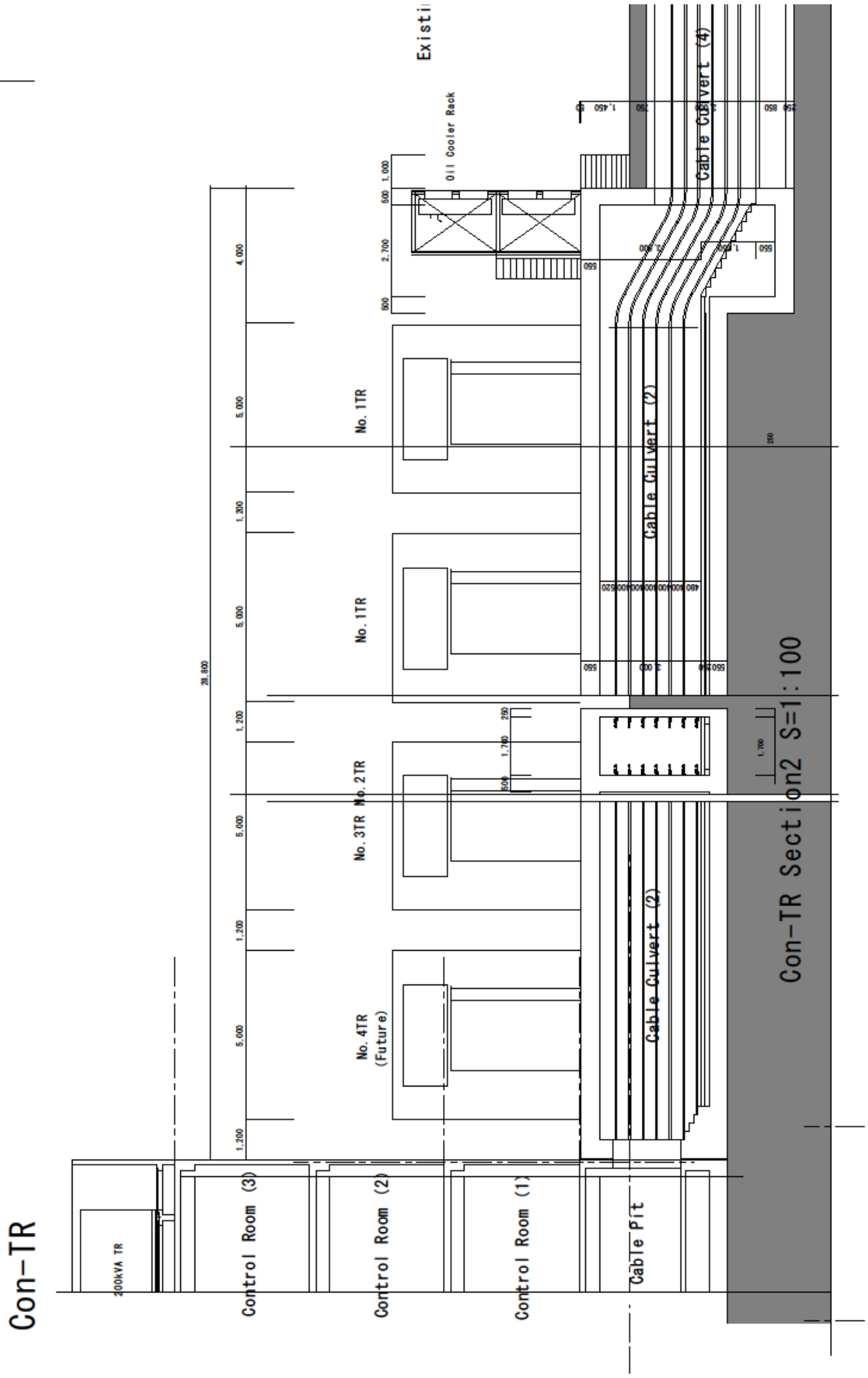
A-10 125MVA TRANSFORMER BF PLAN of ACCRA CENTRAL BSP



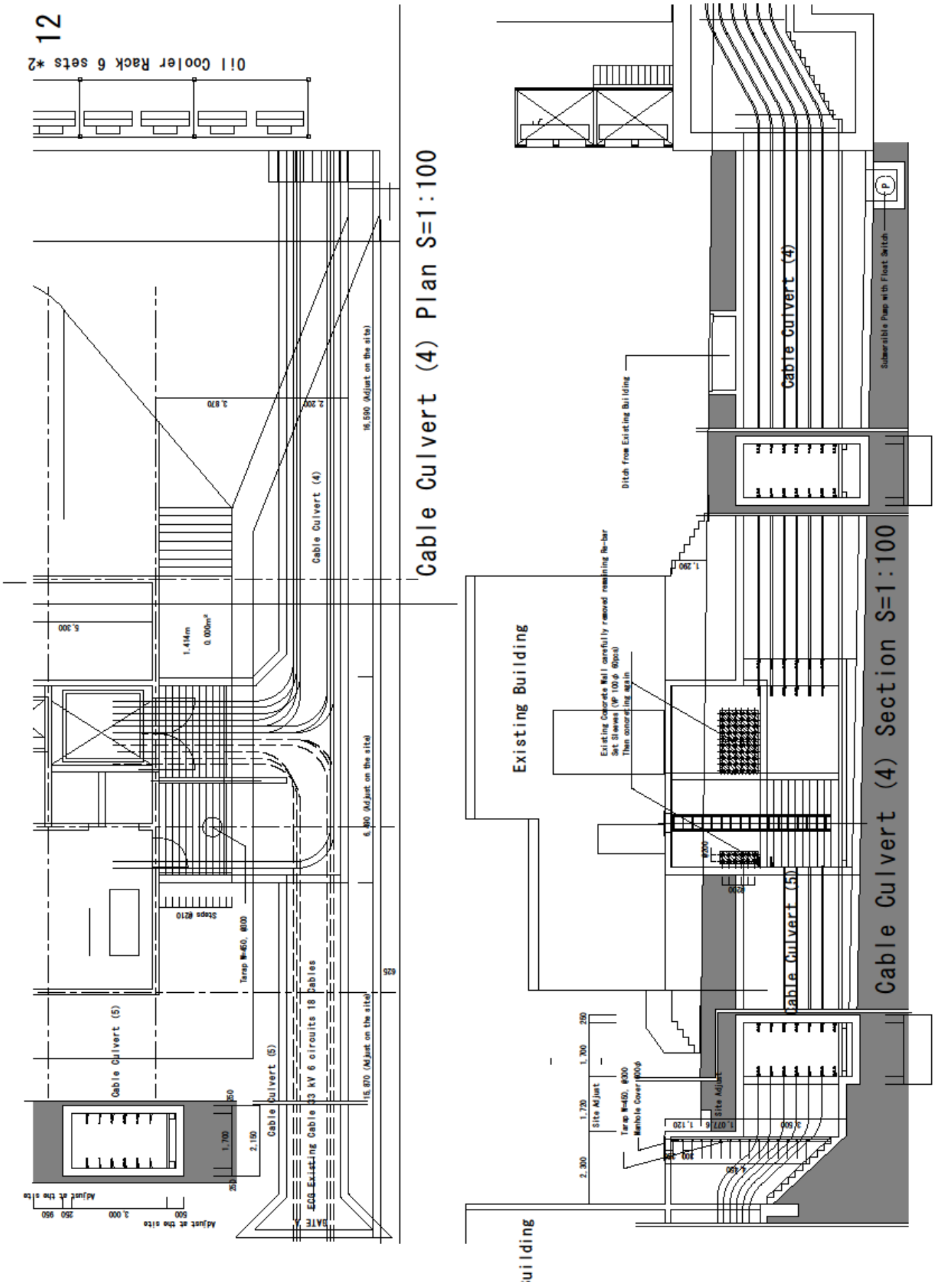
A-11 125MVA TRANSFORMER GF PLAN of ACCRA CENTRAL BSP



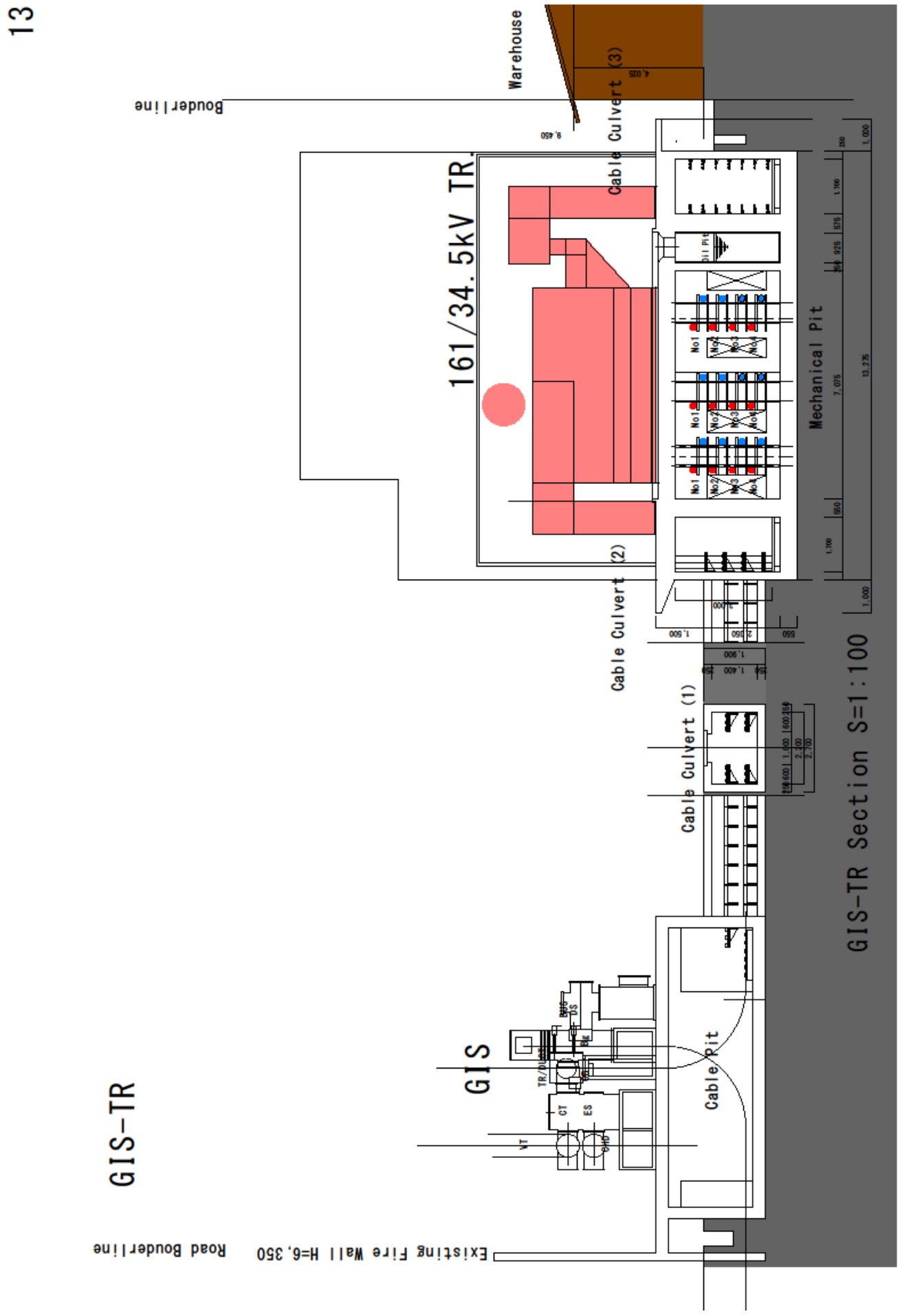
A-12 Con-TR SECTION (1) of ACCRA CENTRAL BSP



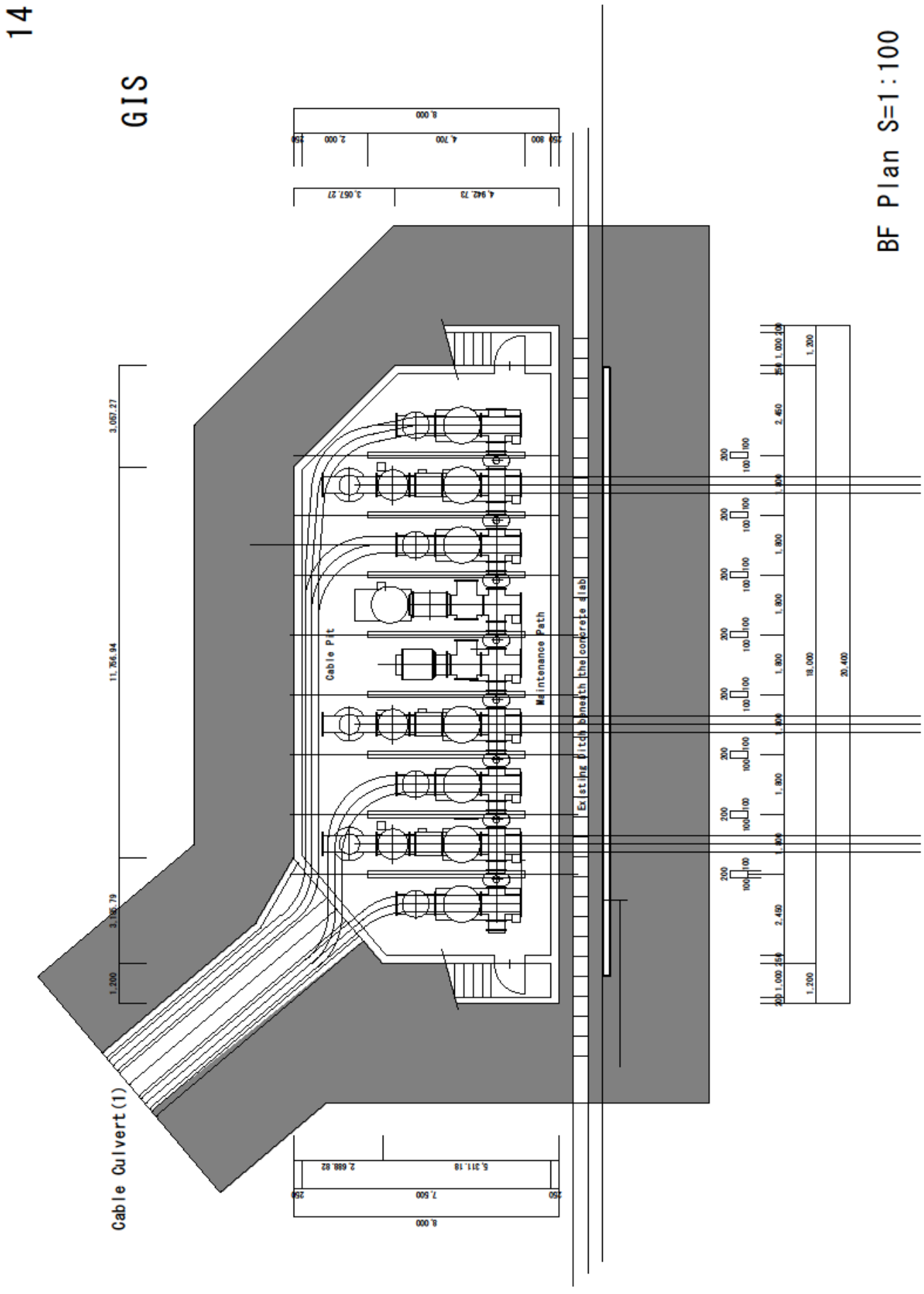
A-13 Con-TR SECTION (2) of ACCRA CENTRAL BSP



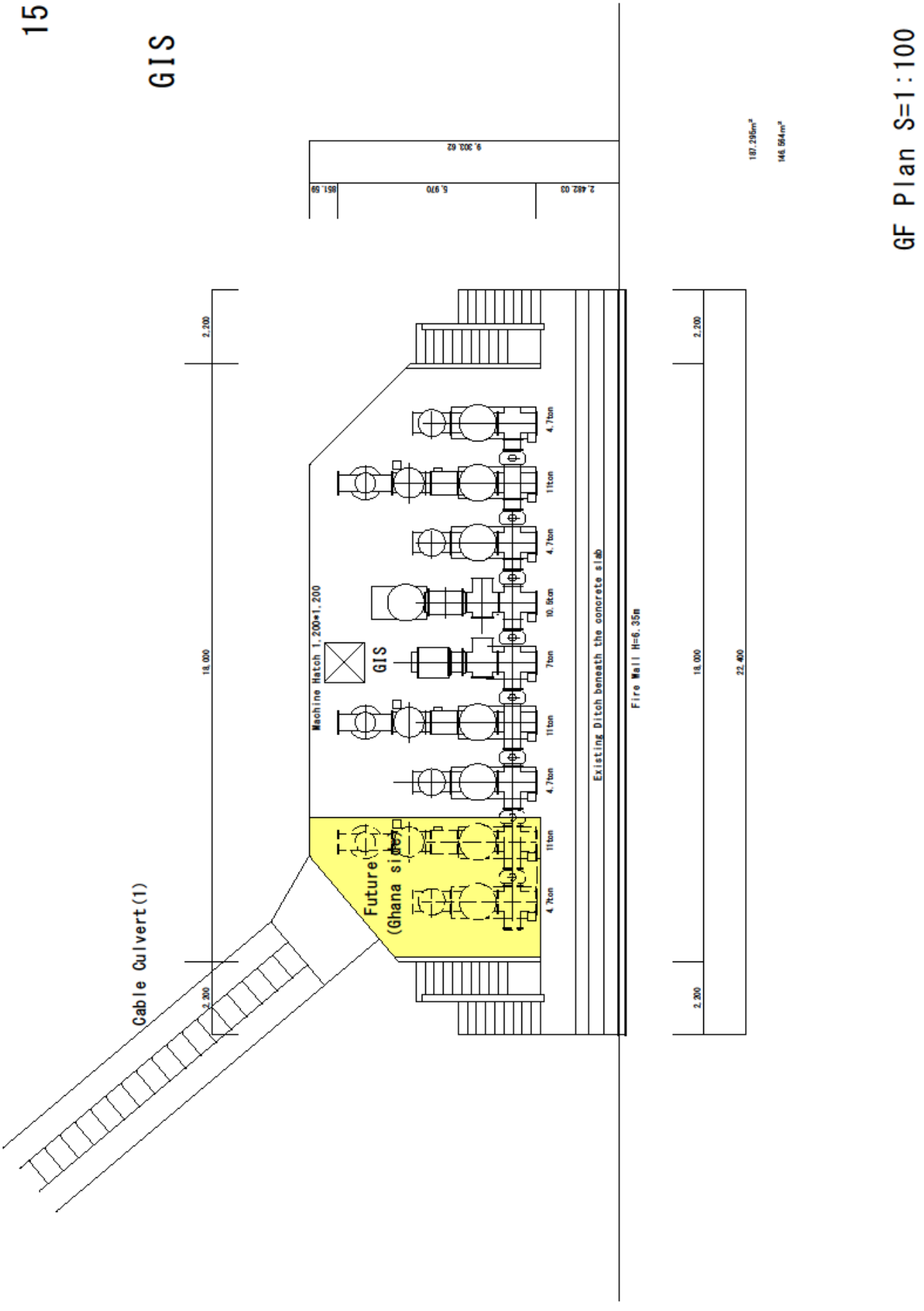
A-14 Culvert (4) SECTION, PLAN of ACCRA CENTRAL BSP



A-15 GIS-TR SECTION of ACCRA CENTRAL BSP



A-16 GIS BF PLAN of ACCRA CENTRAL BSP



A-17 GIS GF PLAN of ACCRA CENTRAL BSP

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[Source] Accra Meteorological Observatory 2014.01 (Average of 30 years from 1961-1990)

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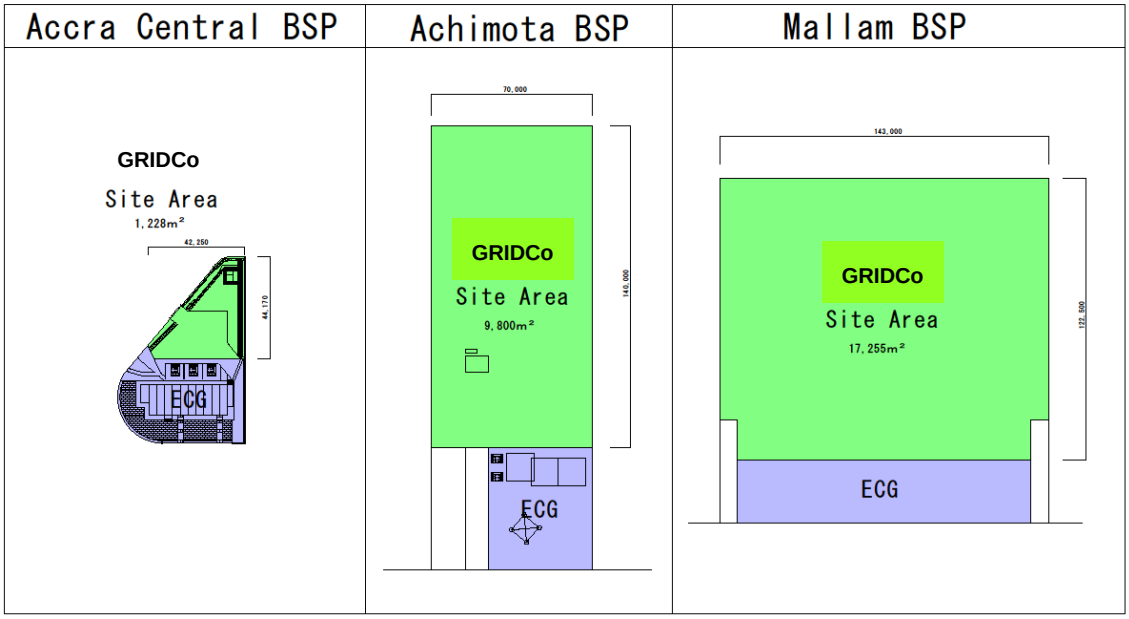

Table4-1: Site Area Comparison