Ministry of Energy and Natural Resources
Electricity of Djibouti
The Republic of Djibouti

PREPARATORY SURVEY REPORT
ON
THE PROJECT
FOR
IMPROVEMENT OF POWER SUPPLY
IN
THE REPUBLIC OF DJIBOUTI

FEBRUARY 2015

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING CO., LTD.
WEST JAPAN ENGINEERING CONSULTANTS, INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on “the Project for Improvement of Power Supply in the Republic of Djibouti” and entrusted the survey to Yachiyo Engineering Co., Ltd. and West Japan Engineering Consultants, Inc.

The survey team held a series of discussions with the officials concerned of the Government of Djibouti, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Djibouti for their close cooperation extended to the survey team.

February 2015

Takumi UESHIMA

Director General,

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SUMMARY

① Overview of the Country

The Republic of Djibouti (hereinafter referred to as “Djibouti”) of 90 million people (2012, UNFPA), while 23,200 km^2 (about 1.3 times the Shikoku island of Japan) small, is a strategic point of maritime transport connecting the European and the Middle East and Asia through the Red Sea. And while it is located in the geopolitical important place, gateway to East Africa inland connecting African countries and the Middle East coastal countries, it has maintained political stability, and has become a stabilizing factor in the "Horn of Africa" region. French and US forces are stationed for stability in the region. Recently global society is focused on the region as the base of anti-piracy measures off the coast of Somalia and Japan's Self-Defense Forces are also conducting activities for the anti-piracy based in Djibouti from 2009.

Large part of Djibouti consists of dessert, where agriculture is undeveloped, pasture of pastoral people is traditional and non-commercial, and the area is not rich in water resources and ground water resources. Development has been delayed in the primary industry and the secondary industry, and 74.1% of GDP (AfDB, etc. 2011) is the tertiary industry accounted. Djibouti relies mainly on proceeds from transport and port services rendered Ethiopia for exports, as well as on the revenues for services and rental revenues related to French Army and the US military force, and foreign aid. In recent years, the refugees accepted from neighboring countries, including Somalia has been pressure on the economy, while trade and port transport industry with Ethiopia is in the good condition. Thus economy is growing at the rate of more than 5% per annum. In addition, investment from the Gulf countries is increasing, infrastructure development is being carried out, such as Dorare container terminal, aiming to be the "Logistics bases of Africa".

While such strong economic growth, the benefits of economic growth are not distributed to the rural areas, making the gap between Djibouti City, the capital and regional areas in terms of wealth has become remarkable. In addition to it, the living environment is becoming more serious in rural areas and population influx of the capital has been accelerated because production capacity of agriculture and pasture is decreasing in such areas caused by the repeating drought damage due to the effects of climate change. As a result, population of urban suburbs is rapidly increasing, causing saturation and competition of the labor force, which has led to further rise in the unemployment rate.

② Background of the Project

Backed up by the stable economic growth described above, demand for power in the country has been growing at an average rate of 6% a year. The peak demand was expected to increase from 69.8 MW in 2011 to 138 MW in 2015 and to 165 MW in 2020 (both according to the World Bank’s Master Plan). To respond to such increase in demand for power, there is an urgent need to expand and improve power supply facilities and the country plans to increase power supply by increasing power import from Ethiopia, which started in May 2011, and by constructing new diesel power plants. However, there is a delay in the improvement works of power transmission and transformation facilities proposed by the World Bank in its Electricity Master Plan and existing transmission and transformation facilities may not be able to catch up with increasing power supply. Under such circumstances, the government of Djibouti requested the government of Japan to provide a grand aid. In the response to this request, the government of Japan implemented the preliminary survey and the government of Japan decided to implement the Preparatory Survey pertaining to implementation as a grant aid undertaking.

③ Outline of the Study Findings and Project Contents

In response to the request, JICA dispatched the Study Team to Djibouti from September 1st to September 21st, 2013 (the first field survey), from October 18th to November 8th, 2013 (the second field survey), from December 20th to December 31st, 2013 (the third field survey), and from March 28th to April 12th 2014 (the forth field survey) in order to reconfirm the contents of the request and discuss the contents for implementation with related agencies on the Djibouti side (responsible government agency: Ministry of Energy and Natural Resources (MERN), and implementing agency: Electricity of Djibouti (EdD)), survey the Project sites and gather related materials and data.

On returning to Japan, the Study Team examined the necessity, social and economic impacts and validity of the Project based on the field survey materials and compiled the findings into the draft preparatory study report. Furthermore, JICA dispatched the Study Team to Djibouti for the fifth field survey from November 20 to November 28, 2014 in order to explain and discuss the draft preparatory study report and reach a basic agreement with the Djiboutian counterparts.

The Project plan compiled based on the survey findings targets procurement and installation of substation equipment such as transformer of 230/63 kV, 63 MVA, transmission equipment such as steel towers, overhead transmission line and underground transmission line, foundation and/or construction work for the above mentioned equipment, and procurement of spare parts.

Outline of the basic design is the list below.

Outline of the Basic Design

Category	Equipment	
Procurement of materials and equipment and Installation work planning	1. Jaban As Substation (Expansion)	
	- 230/63 kV Transformer（63 MVA）	1 set
	- 230 kV Switchgear	1 lot
	- 63 kV Switchgear	3 lots
	- 230 kV Control & Protection Panels	1 lot
	- 63 kV Control & Protection Panels	1 lot
	- Other Control & Protection Panels	1 lot
	- Low voltage Facilities	1 lot
	- Communication Facilities	1 lot
	- Grounding materials	1 lot
	- Dead End Gantry (2 Circuits)	1 lot
	2. Boulaos Substation (Expansion)	
	- 63 kV Switchgear	1 lot

Category	Equipment	
	- 63 kV Control & Protection Panels	1 lot
	- Other Control & Protection Panels	1 lot
	- Low voltage Facilities	1 lot
	- Communication Facilities	1 lot
	3. Transmission line	
	- Steel Tower	1 lot
	- 63 kV Overhead Conductor	1 lot
	- 63 kV Underground cable	1 lot
	- Optical fiber composite overhead ground wire	1 lot
	- Underground optical fiber	1 lot
	- Insulator, hardware, grounding materials	1 lot
	4. Construction	
	(1) Foundations for equipment	1 lot
	(2) Cable pit	1 lot
	(3) Expansion of Building for 63 kV switchgears	1 lot
Procurement of materials and equipment	Procurement of following materials and equipment	
	(1) Spare Parts	1 lot

④ Project Implementation schedule and Cost Estimation

In the case of the actual implementation of the Project under the grant aid scheme of the Government of Japan, the Djibouti Side is expected to pay the costs of its undertakings listed below. Cost to be borne by the recipient country: USD 83,000.- (approx. 8.6 million yen) The contents and costs to be borne by the Djiboutian side will primarily be Payment for bank commission based on banking commission of an Authorization to Pay (A/P) and Payment commission : USD 30,000.- (approximately 3.1 million yen), Land leveling on the Project site along the transmission line : USD 21,000.- (approximately 2.2 million yen), Construction of access road to the transmission line : USD 26,000.- (approximately 2.7 million yen), and Data survey of the underground of the Djibouti city for the installation of underground cable : USD 6,000.- (approximately 0.6 million yen). The implementation schedule for the Project will be approximately 2.5 months for Execution design and 21months for Main components.

⑤ Project Evaluation

(1) Relevance

As described below, the Project will benefit the general public as well as contribute to realizing the development plan and energy policy of Djibouti. Therefore, the relevance of the cooperation project is considered high.

1) Number of Beneficiaries

The implementation of the Project will lead to the supply of high-quality electricity to about 475,000 people living in the capital area of Djibouti (2009 Population Census). The number of electricity customers in the target area of the Project is about 38,400 households in total; about 37,700 general customers and about 700 special customers including medium-voltage customers (20 kV).

2) Urgency

In Djibouti, it is expected that steady economic growth and large-scale logistics infrastructure development plans will lead to significant increase in electricity demand. It is expected that, without improvement of transmission and transformation facilities to catch up with increasing electricity demand, power supply will be disturbed and such issues as deterioration of living environment for the residents, deterioration of public services and damage to trading and port projects will be caused. Therefore, there is an urgent need for improvement through the implementation of the Project.

3) Contribution to the Stable Operation of Public Welfare Facilities

The city of Djibouti, the target area of the Project, is the capital of the country of Djibouti that has more than half of the total population and is also the center in politics, economy, education, medical care, etc. of the country.

The increase in capacity of transmission and transformation facilities through the implementation of the Project will help stabilize the power supply to public welfare facilities and contribute to the stable operation of such facilities.

4) Capabilities for Operation and Maintenance

Conducting daily operation and maintenance work for 230 kV and 63 kV transmission lines and 230/63 kV and 63/20 kV transformation facilities, the EdD has enough experience in operation and maintenance of similar facilities. Therefore, the EdD, as the executing agency, can properly handle operation and maintenance of the transmission and transformation facilities to be procured and installed in the Project with its technical capabilities. In addition, since the maintenance costs for newly procured and installed equipment through the project (consumables, spare parts, etc.) per year is about 5.8 million yen, and this is 0.24% of the parts purchase cost of EdD, EdD is able to afford the cost. There will be no issues with the implementation of the Project.

5) Project to Contribute to the Development Plan of Djibouti

Energy plays an important role in achieving “Pillar 1: Accelerate growth and preserve the major macroeconomic balances”, one of the four strategic pillars of the National Initiative for Social Development (Initiative Nationale pour le Développement Social [National Initiative for Social

Development], INDS, 2008-20120), a development plan of Djibouti. Although energy is a determinant of economic growth and pursuit of competitiveness, energy supply in Djibouti is insufficient and expensive. Only 50% of the national population has access to modern energy, mostly in urban area. Such current situations of energy supply noticeably hinder the development of the country. Therefore, they have a policy to promote development of a transmission system with such key facilities as transmission lines between local power sources of geothermal heat, wind, etc. and the city of Djibouti as well as the interconnection transmission line from Ethiopia.

As the Project is to stabilize electricity supply and improve quality of electricity by increasing transmission and transformation capacity in the capital area of Djibouti, it will contribute to the county's development plan and energy policy described above.

6) Environmental and Social Impacts

The implementation of the Project will require seisin of land under overhead transmission lines (24m wide). As the result of a local survey shows that most of the overhead lines will go through unused land, involuntary resident relocation or compensation for agricultural crops concerning land acquisition are not expected and all easement has been granted from the Direction of National Property. The noise from the transmission and transformation facilities of the Project will be minor. The underground line from the Nagad Connection Point to the Boulaos Substation will go under urban street and there is no involuntary resident relocation expected. The impact is expected to be avoidable with proper diversions and restrictions of traffic during construction as there is not much traffic in the city.

The EdD inquired the Direction of Regional Development and Environment about whether the Project will need environmental impact assessment under the Ordinance of the Direction 2011-029 concerning environmental permit, and was told it would not be necessary.

Based on the above, the Project will not cause any particular impact on the environment or the society.

7) Scheme of Japan's Grant Aid

Considering that the major equipment will be procured from Japan and the Project will be completed within the time limit of a grant aid fixed in the E/N, the Project has realistic contents and process schedule within the scheme of a grant aid. Therefore, the Project can be implemented without particular difficulty.

(2) Effectiveness

The following effects are expected to be produced from the implementation of the Project.

1) Quantitative Effects

Indicator	Standard value (Actual value of 2014)	Target value (2020) (3 years after the completion of the Project)	Reference (2020) Without implementation of the Project
Load factor (%) of the 230/63 kV transformers at Jaban As Substation	53.6	62.2	105.3
Load factor (%) of the transmission line between Jaban As Substation and Palmeraie Connection Point	48.3	63.1	102.6

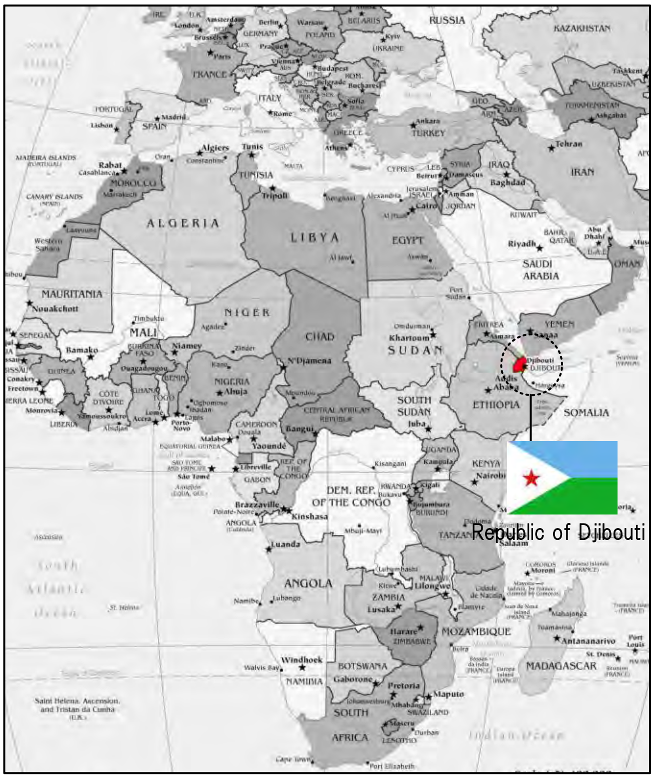
2) Qualitative Effects (Entire Project)

Current state and issues	Measures in the Project (Works related to the Cooperation project)	Effects and improvements produced by the Project
In Djibouti, electricity supply facilities have not been improved to catch up with the expected increase of electricity demand associated with large-scale development plans for port facilities, railways and a new airport.	Construction of transmission lines and improvement of transformation facilities	Negative effect that supply restriction might cause on economic activities, public services and life of local residents can be avoided through the creation of facilities to match increasing electricity demand.

CONTENTS

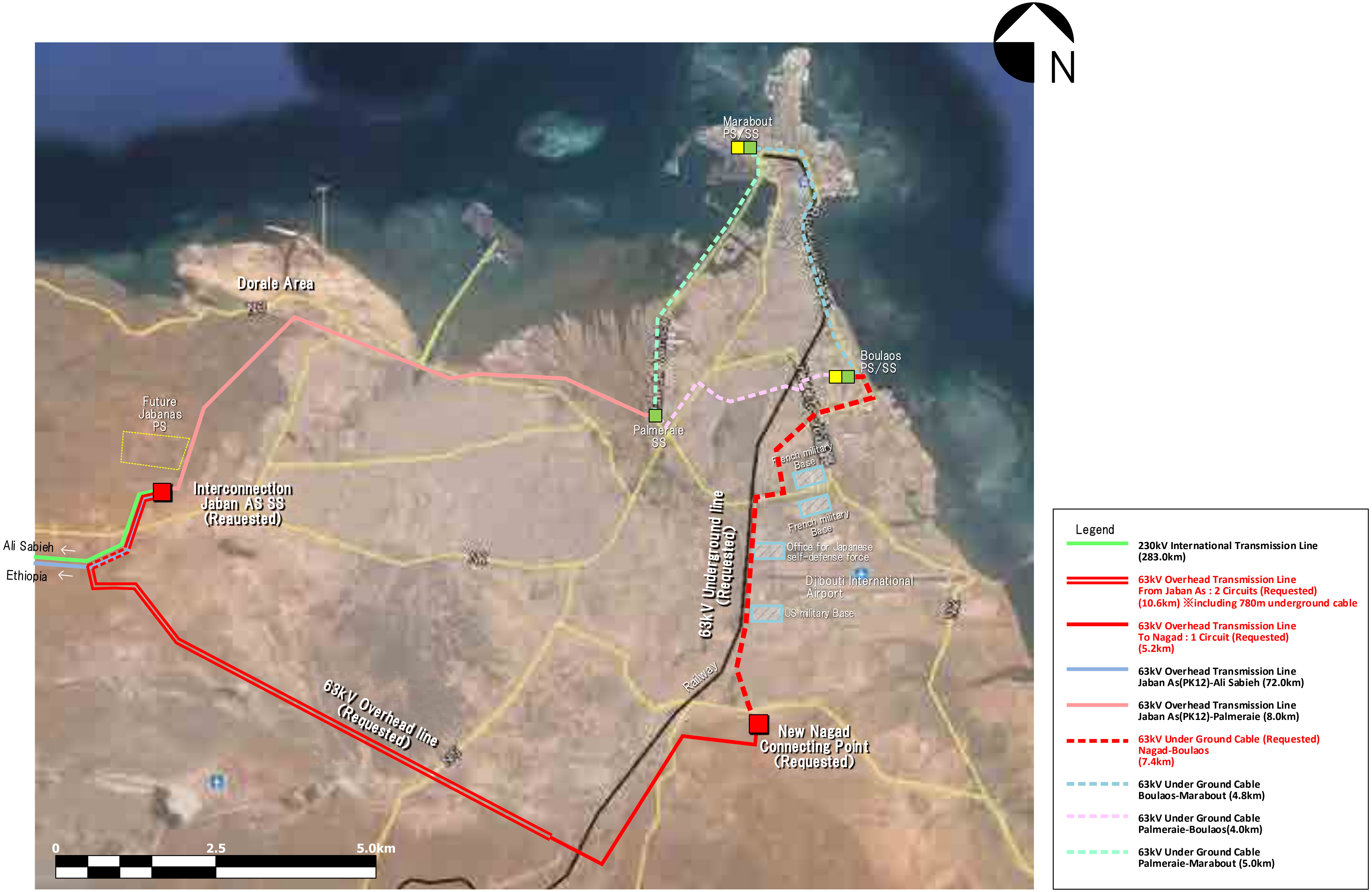
Annex

Map of the Republic of Djibouti

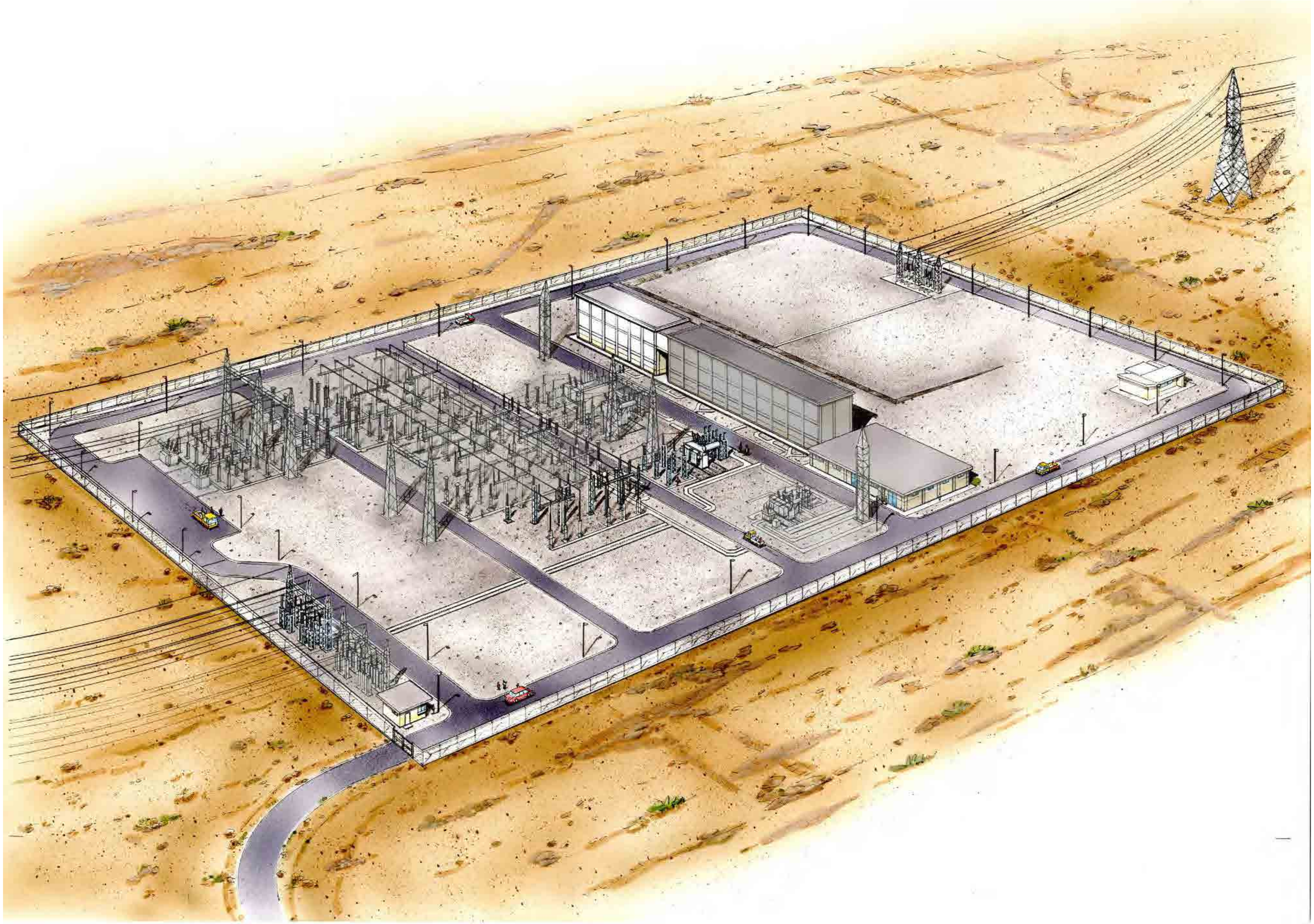


Map of Africa

Location Map of the Requested Components



Project Site Map



Perspective

LIST OF FIGURES AND TABLES

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ABBREVIATIONS

AfDB	African Development Bank
ASEAN	Association of Southeast Asian Nations
CERD	Centre d'Etude et de Recherche de Djibouti
DAC	Development Assistance Committee
DATE	Direction de l'Aménagement du Territoire et de l'Environnement [Division of National Land Planning and Environment]
DPFZA	Djibouti Port and Free Zone Authority
EdD	Electricite de Djibouti [Electricity of Djibouti]
EEPCO	Ethiopian Electric Power Corporation
EIA	Environmental Impact Assessment
EDAM-IS2	Djibouti Household Survey-Social Indicators II (2002)
EDIM	Djibouti Multiple Indicators Survey
EU	European Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
IMF	International Monetary Fund
INDS	Initiative Nationale pour le Développement Social
ISPS	International Ship and Port Facility Security
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteer
MENR	Ministère de l'Energie et des Ressouces Naturelles [Ministry of Energy and Natural Resources]
MHUEAT	Ministère de l’Habitat, de l'Urbanisme, de l'Environnement et de l’Aménagement du Territoire [Ministry of Habitation, Urban Planning and Environment]
OECD	Organization for Economic Cooperation and Development
OPGW	OPtical-fiber composite overhead Ground Wire
PPA	Power Purchase Agreement
PRSP	Poverty Reduction Strategy Paper
SCADA	Supervisory Control And Data Acquisition
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFPA	United Nations Population Fund
WHO	World Health Organization

Chapter 1 Background of the Project

1-1 Background and Outline of the Request for Grant Aid

Located in the "Horn of Africa" in East Africa, The Republic of Djibouti (hereinafter referred to as "Djibouti") has an important position for sea transportation that connects Europe, Middle East and Asia through the Red Sea. As the country maintains political stability while being a geopolitically important gateway to inland East Africa, it has received attention of the international community in the recent years as a base for anti-piracy operations in Somalia. Djibouti has French and American military bases as well as German and Spanish. The Japanese Maritime Self-Defense Force also built a base in June 2011.

Although recent acceptance of refugees from neighboring countries including Somalia has weighed on the economy, the economy of the country has been relatively strong as trade with Ethiopia and port projects have been successful. Moreover, with increasing investment from Gulf countries, infrastructure improvements such as opening of the Doraleh Container Terminal have been made to make the country a "distribution base in Africa". Against this background, the country's economy has been steadily growing at a rate of more than 5% a year.

Backed up by the stable economic growth described above, demand for power in the country has been growing at an average rate of 6% a year. The peak demand was expected to increase from 69.8 MW in 2011 to 138 MW in 2015 and to 165 MW in 2020 (both according to the World Bank's Master Plan). To respond to such increase in demand for power, there is an urgent need to expand and improve power supply facilities and the country plans to increase power supply by increasing power import from Ethiopia, which started in May 2011, and by constructing new diesel power plants. However, there is a delay in the improvement works of power transmission and transformation facilities proposed by the World Bank in its Electricity Master Plan and existing transmission and transformation facilities may not be able to catch up with increasing power supply. Under such circumstances, the government of Djibouti requested the government of Japan to provide a grand aid. As other development plans were also under way in Djibouti at the same time, we repeated discussions with EdD during a field survey and, through the following processes from (1) to (3), conducted close investigation so that the request would suit the present conditions of Djibouti.

(1) Contents of the request of the recipient country

With planned redevelopment projects including construction of hotels and commercial and industrial facilities, there was a possibility of increase in power demand in the near future in the area around the fishing port in Djibouti city. Considering the above-mentioned background, the government of Djibouti requested the government of Japan to provide a grant aid for (1) the construction of a 63/20 kV substation in the fishing port area and (2) the construction of a transmission line between Jaban As area and Djibouti city (August 2011).

(2) Request for changes (as of November 2013)

Djibouti has been depending on power imported from Ethiopia for most of the power supply since they started importing power from the country in 2011. The government of Djibouti plans to respond to increasing domestic power demand with power imported from Ethiopia, power from new diesel power plants in Djibouti and power generated with renewable energy such as geothermal power. Such power will all be supplied in Djibouti city via Jaban As Interconnection Transmission Line Substation. Therefore, it is expected that the capacity of the 230/63 kV transformers of Jaban As Interconnection Transmission Line Substation (currently 126MVA) will not be able to catch up with increasing domestic power demand in the near future.

Around the Jaban As Substation, which also serves as a 63/23 kV distributing substation, it is expected that there will be an increasing number of large customers including a cement factory, a dry port (container terminal) and a seawater desalination plant (to be constructed in Doraleh with aid from EU). Around the fishing port, there are other plans to increase and improve transformation capacity, such as upgrade of the Palmeraie Connection Point to a substation (63/20 kV transformer, 40MVA x 1 unit, to be completed in 2015) with aid from EU and increase of 63/20 kV transformers at Marabout Substation (36 MVA x 1 unit, source of funding to be determined). Therefore, it was decided that the request for a substation near the fishing port was withdrawn and that a request to expand 230/63 kV and 63/20kV transformation equipment at Jaban As Substation would be made. Moreover, for the Nagad Station development project in the "Urban Planning Master Plan", which was under way at the same time as the Project, there was also a request to construct a switching station adjacent to a railway substation in Nagad under the Project to supply power to the railway.

(3) Final Request (April 2014)

There was a strong request for the construction of Nagad Switching Station as of November 2013. However, as a result of additional study, it was decided to transmit power for the railway through a different route from the one planned in the Project and the request for the construction of a switching station in Nagad was withdrawn.

On the other hand, as the future development plan indicated that power demand in Nagad would almost certainly increase, it was decided that in the Project two overhead transmission lines would be used till the planned construction site for a substation in Nagad and one of the lines would be connected to Boulaos Substation via underground cable.

The contents of the final request are shown in Table 1-1.1.

Table 1-1.1 Changes in Request

	Request (August 2011)	Request for Change (November 2013)	Final Request (April 2014)
Transformation equipment	Construction of a new substation near the fishing port ●63/20 kV transformers, 40 MVA x 2 units ●63 kV breaker ●20 kV breaker ●Control and protection system ●Communication equipment ●Substation building	Expansion of Jaban As Interconnection Transmission Line Substation (1) Expansion of 230/63 kV transformation equipment ●230/63 kV transformer, 63 MVA x 1 unit ●230 kV breaker ●63 kV breaker ●Control and protection system ●Expansion of substation building (including (2)) (2) Expansion of 63/20 kV transformation equipment ●63/20 kV transformer, 40 MVA x 1 unit ●63 kV breaker ●20 kV breaker ●Control and protection system ●Capacitor bank 12.6 MVar (3) Construction of Nagad Switching Station ●63 kV breaker ●Control and protection system ●Communication equipment ●Switching station building	Expansion of Jaban As Interconnection Transmission Line Substation (1) Expansion of 230/63 kV transformation facilities ●230/63 kV transformer, 63 MVA x 1 unit ●230 kV breaker ●63 kV breaker ●Control and protection system ●Expansion of substation building
Transmission equipment	Construction of 63 kV transmission lines ●Overhead line (Jaban As Interconnection Transmission Line Substation – Nagad Connection Point, 11 km) ●Underground line (Nagad Connection Point - Boulaos Substation, 7.6 km) ●Breaker on the side of Boulaos Substation ●Control and protection system ●Communication equipment	Construction of 63 kV transmission lines ●Overhead line (Jaban As Interconnection Transmission Line Substation – Nagad Switching Station, 11.3 km) ●Underground line (Nagad Switching Station - Boulaos Substation, 7.5 km) ●Breaker on the side of Boulaos Substation ●Control and protection system ●Communication equipment	Construction of 63kV transmission lines ●Overhead line (Jaban As Interconnection Transmission Line Substation – Nagad Connection Point, 14.8 km, including a 780 m underground line) ●Underground line (Nagad Connection Point - Boulaos Substation, 7.8 km) ●Breaker on the side of Boulaos Substation ●Control and protection system ●Communication equipment

1-2 Natural Condition

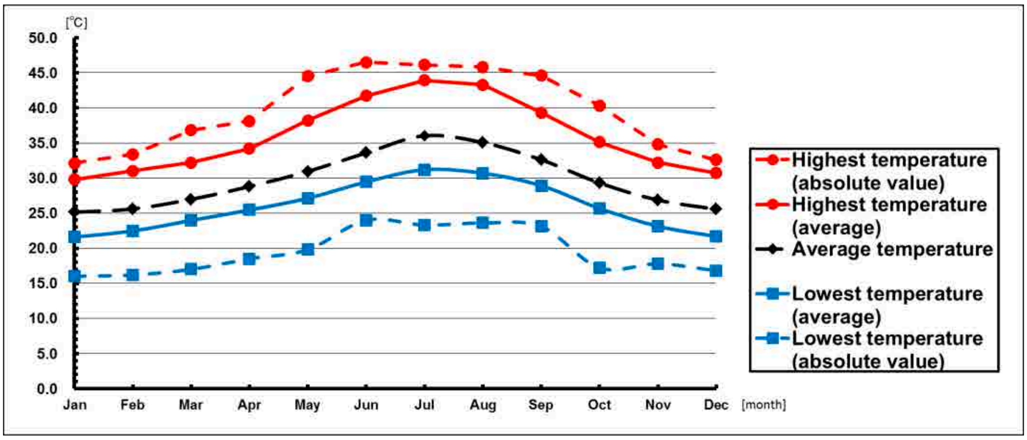
(1) Temperature

Djibouti is in an arid zone and has high temperatures throughout the year. The lowest temperature of the day is over 20 degrees all year round. From May to October, the highest temperature of the day exceeds 35 degrees. Table 1-2.1 and Figure 1-2.1 show temperatures of each month at the Djibouti Airport in Djibouti city.

Table 1-2.1 Highest and Lowest Temperatures of Each Month in Djibouti City

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Highest temperature (absolute value)	32.1	33.4	36.8	38.1	44.5	46.5	46.1	45.8	44.6	40.3	34.8	32.6
Highest temperature (average)	29.8	31.0	32.2	34.2	38.2	41.7	43.9	43.3	39.3	35.1	32.2	30.7
Average temperature	25.1	25.6	27.0	28.8	31.0	33.6	36.0	35.1	32.6	29.3	26.9	25.6
Lowest temperature (average)	21.6	22.5	24.0	25.5	27.1	29.4	31.2	30.7	28.9	25.7	23.1	21.7
Lowest temperature (absolute value)	16.0	16.2	17.0	18.5	19.8	24.0	23.3	23.6	23.1	17.2	17.8	16.8

Source: Prepared by the Study Team based on data from the National Meteorological Observatory at the Djibouti Airport (2002-2012)



Source: Prepared by the Study Team based on data from the National Meteorological Observatory at Djibouti Airport (2002-2012)

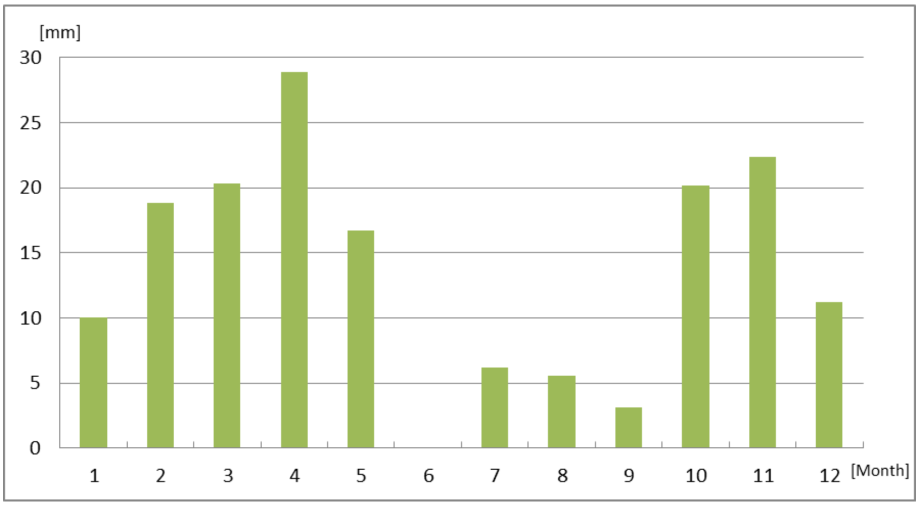
Figure 1-2.1 Highest and Lowest Temperatures of Each Month in Djibouti City

(2) Amount of Rainfall

In Djibouti, as rainfall is low throughout the year and reaches only around 30 mm a month at most, there are no rivers or freshwater lakes that always have surface water. However, rainwater may flow into wadi from neighboring countries. Monthly rainfall is shown in Table 1-2.2 and Figure 1-2.2.

Table 1-2.2 Monthly Rainfall in Djibouti

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Precipitation	10.0	18.8	20.3	28.9	16.7	0.1	6.2	5.6	3.1	20.2	22.4	11.2	164



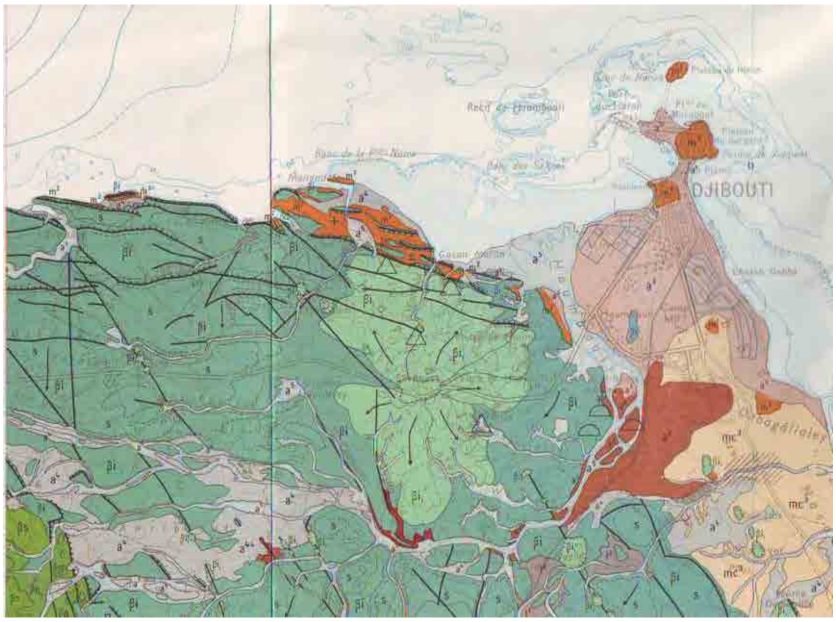
Source: Prepared by the Study Team based on data from WMO

Figure 1-2.2 Monthly Rainfall in Djibouti

Djibouti city is on the coast and sea winds bring rain on about 10 days each in December and January. It also has khamsin, a dry hot wind, sometimes from June to September. Although rainfall is low in September, there may be thunderstorms in some areas.

(3) Geographical Features

With great rift valleys crossing the country, Djibouti has frequent earthquakes. According to the staff of the Djibouti Center for Research Studies (Centre d'Etude et de Recherche de Djibouti, CERD), every day there are about 20 earthquakes with a seismic intensity of 1 or below. Earthquakes of magnitude 5.5 were observed in 1972 and 1992. There is a crater lake called Lake Assal in central Djibouti. The lake surface is about 150 m below sea level and its salt concentration is higher than the Dead Sea. Djibouti has many areas with rocks or groundwater that have high concentration of salt. The layers of earth along the power transmission route and at the site for Nagad Connecting Point planned in the Project mainly consist of basalt rock and red clay made of weathered basalt rock. The underground cable route has river alluvium made of mud containing conglomerates. Figure 1-2.3 shows the layers of earth in the surrounding area.



Source: CERD

Note: βi: pyrite basalt of iron basalt character, β i$_1$: spilite basalt of iron basalt character and porphyry, s: red clay of weathered basalt, a^2: conglomerate and mud containing gravel

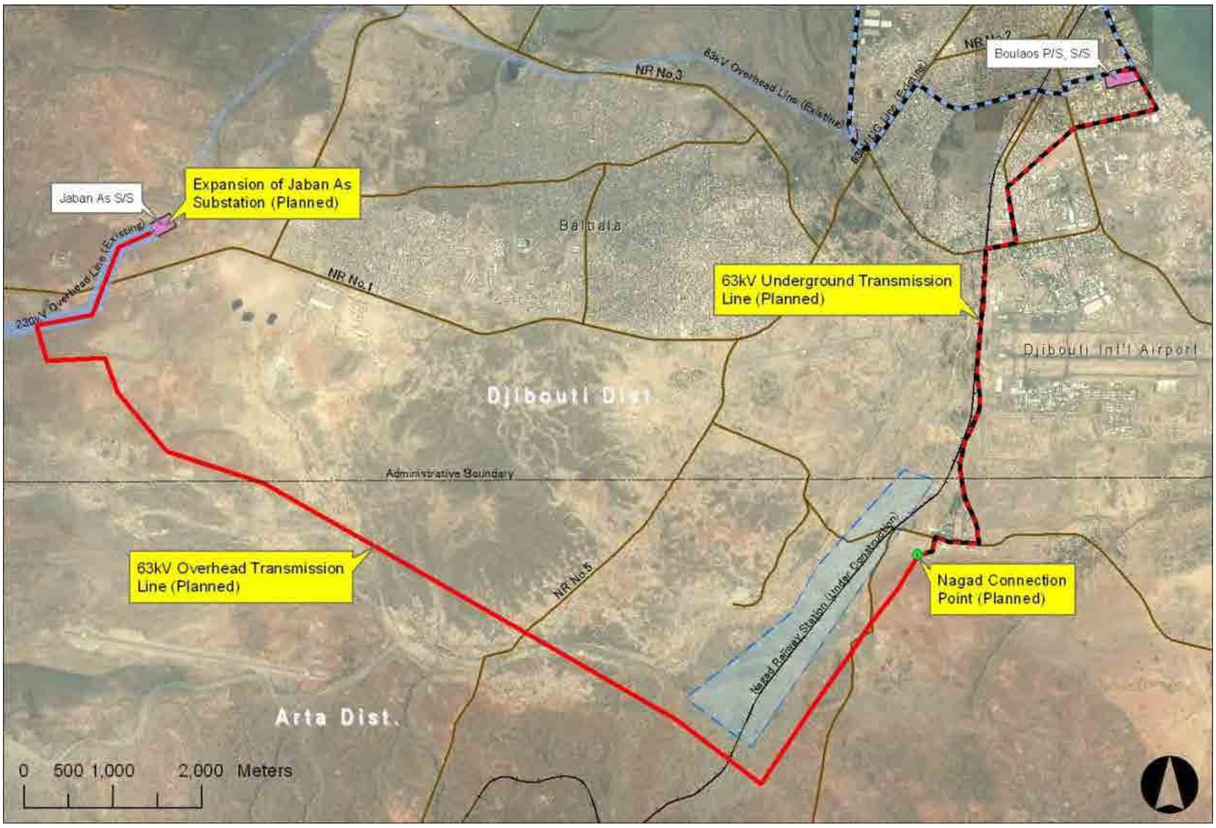
Figure 1-2.3 Layers of Earth in the Project Site

1-3 Environmental and Social Considerations

1-3-1 Environmental Impact Assessment

1-3-1-1 Summary of Project Components Having Environmental and Social Impacts

The Project consists of two components as shown in the following figure: one is an expansion of the Jaban As Interconnection Transmission Line Substation (hereinafter referred to as “Jaban As Substation”) located in the western part of the Prefecture of Djibouti, and the other is construction of a 63 kV transmission line connecting from Jaban As Substation via Nagad Connection Point to Boulaos Substation. All works related to the expansion will be on the premises of the existing substation except transport of materials and equipment, and are assumed, due to the site conditions, to have no negative environmental and social impacts on the surroundings. The presence of 230/63 kV transformers and other substation equipment to be newly built under the Project will have no particular new negative environmental and social impacts, either, even after they are put into operation. On the other hand, the construction of the 63 kV transmission line will involve the possibility of land acquisition, construction of access roads, and possible temporary traffic restrictions at crossings with existing roads, so it will require environmental and social considerations.

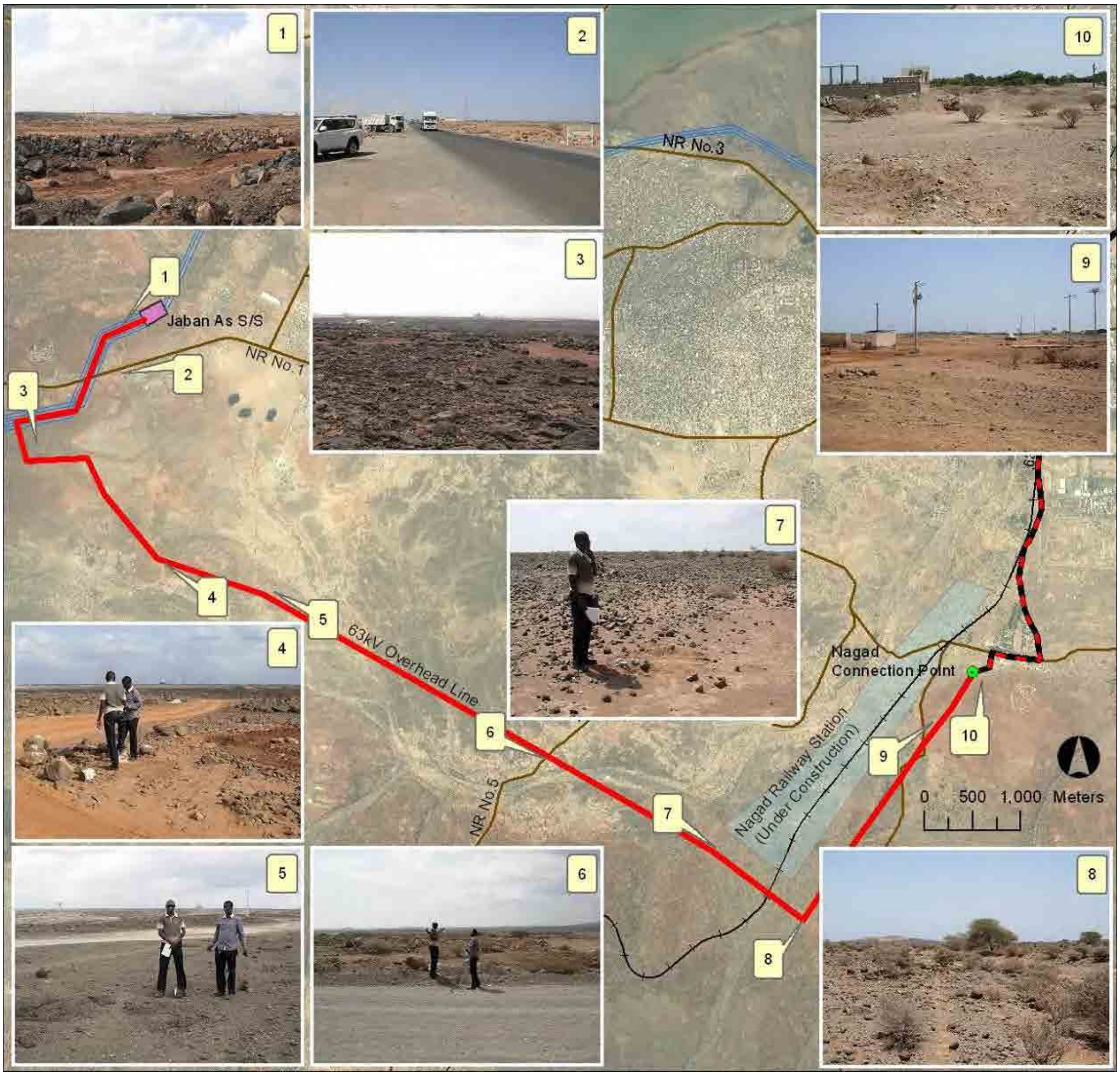


Source: the Study team

Figure 1-3-1-1.1 Locations of Project Sites

1-3-1-2 State of Affairs in Base Environment and Society

As illustrated in the figure in the preceding section, the 63 kV transmission line consists of an overhead transmission line from Jaban As Substation in the western part of the Prefecture of Djibouti, via vacant land ranging between the southern part of the prefecture and the Prefecture of Arta, to Nagad Connection Point; and an underground transmission line which will be laid on existing road site between the Nagad Connection Point and Boulaos Substation.



Source: the Study team

Figure 1-3-1-2.1 Present State of Affairs of the 63 kV Overhead Transmission Line

The overhead transmission line will be laid down from Jaban As Substation, passing over National Route No.1 along the existing 230 kV interconnection line and the 63 kV overhead line (Jaban As to Ali Sabieh), diverting from the existing overhead line and running through vacant land from the southern part of the Prefecture of Djibouti to the Prefecture of Arta before reaching the Nagad Connection Point. As shown in the figure above, neither residential houses nor community exists in the vicinity of the overhead line. There is neither residential house nor community all along the line that could be negatively affected by the presence of the overhead line, either.

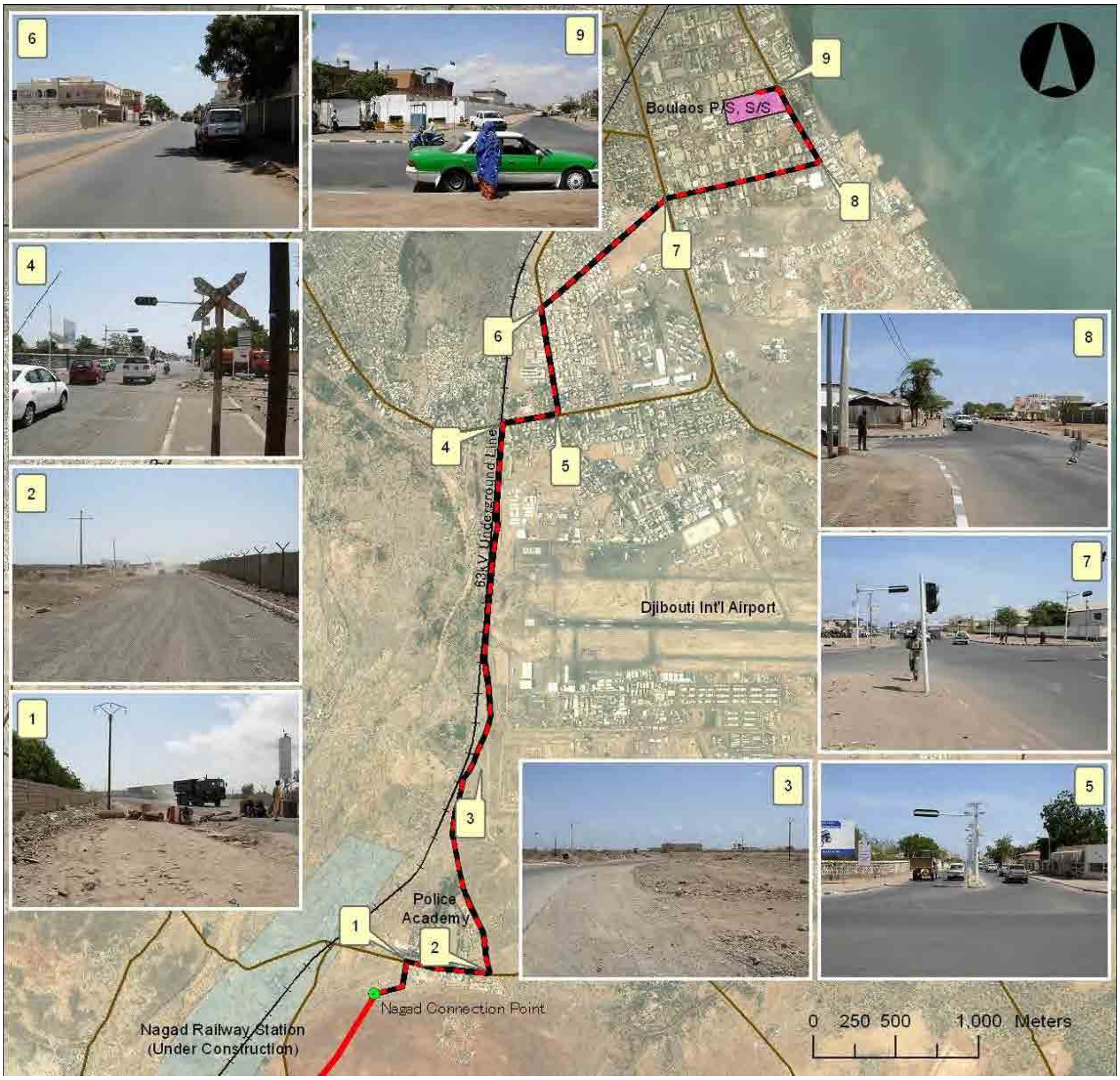
There is no need of land acquisition because the overhead line along the existing one will use a transmission corridor owned by EdD. As stated in the following section "Comparative Reviews of Alternative Options", the land for the transmission corridor has been designated for the distribution industry by the Direction of Habitat and Urban Planning of the Ministry of Habitat, Urbanism, Environment and Land Planning (MHUEAT). Currently, most of the land is vacant, but some lots have been sold to private companies. Thus, the overhead line in the figure above diverts from the transmission corridor to avoid land lots already sold, stretching to a vacant part in the south.

Desolate land in the south, where there are only briars and acacia trees native to dry land, is vacant and most part of the land is not owned by anyone and in fact belongs to the national government. The 63kv overhead line will take a route avoiding rock quarries and cement plants across the land. Field surveys and hearings to the Direction of Regional Development and Environment (DATE) have confirmed that neither rare animals and plants nor routes of migrant birds exist in the vicinity of the 63kv overhead line. It has also been confirmed that no sanctuary of any plants or animals is included in the land, which is proved by an EIA report on interconnection lines and descriptions in an EIA report on a project for a road linking the southern part of the Prefecture of Djibouti and Loyada near the border with Somalia.

Photo 1-3-1-2.1 Landscape of Vacant Land in the South (the south of the Nagad Railway Station site)

As in the following figure, the underground line begins at the connection point in Nagad, runs north along an existing road in the west of the Djibouti International Airport before entering the built-up area of the City of Djibouti. Certain measures must be taken to reduce impacts on road traffic in the built-up area, because the construction work involves at least three major crossings with existing roads. Dust, noise and vibration controls must be taken especially in the built-up area.

The underground transmission line work in road areas will need coordination with existing buried objects and consistency with future plans for water supply and sewerage, and other systems. In a 63 kV underground transmission line project in the past (Boulaos – Marabout, etc.), EdD held prior discussions with the Direction of Road Transport of the Ministry of Infrastructure and Transport, the National Office for Water Supply and Sanitation and other organizations concerned in order to determine the location of the underground transmission line. By following this previous case to decide on the location of the underground line in road areas in consultation with organizations concerned, prior discussion for the Project was held on November 24, 2014 with the National Office for Water Supply and Sanitation, Djibouti Telecom, ADR and DHU. After the discussion, the information of berried objects in the Djibouti city, such as water and sewerage pipe and communication line was collected. By referring to the information, installation of 63 kV underground cable shall be carefully implemented especially on the location where the berried objects are existing.



Source: the Study team

Figure 1-3-1-2.2 Present State of Affairs of the 63 kV Underground Transmission Line

1-3-1-3 Systems and Organizations for Environmental and Social Considerations in Recipient Country

(1) Legal System related to Environmental and Social Considerations

Having the Environment Law (Loi n°51/AN/09 6ème) enacted in 2009 as the fundamental law for environment, Djibouti enacted in 2011 a ministerial decree on revisions to the procedures for environmental impact assessment (Décret n°2011-029/PR/MHUEAT portant révision de la procédure d'étude d'impact environnemental) of the MHUEAT (hereinafter referred to as the "Ministerial Decree No. 2011-029") and completed the current framework for environmental management together with other environment-related laws and regulations. This legal framework, however, seems to be insufficient because neither the national nor regional governments have stipulated any emission standards or regulations in relation to the air quality, water quality, noise, vibration and other forms of pollution, and also because no law on waste management has been stipulated.

An annex of the Ministerial Decree No. 2011-029 regulates projects that need to make environmental impact assessment (EIA), classifying them into those requiring simple assessment and those requiring detail one.

The following table presents the legal system of Djibouti related to environmental and social considerations. (For the legal system for land acquisition, see the following section "Legal Framework of Land Acquisition".)

Table 1-3-1-3.1 Legal System of Djibouti related to Environmental and Social Considerations

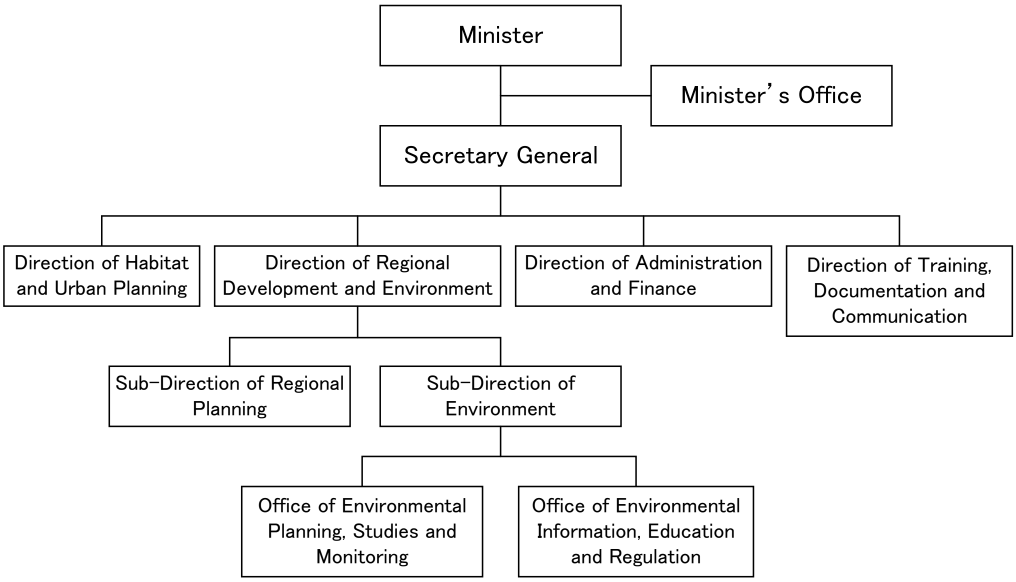
Category	Name of Law/Ministerial Decree
Laws	Environment Law (Law No. 51, 2009, AN/09 6eme)
	Law on Establishment of Terrestrial and Marine Protected Areas (Law No. 45, 2004, AN/04/5ème)
	Mining Law (Law No. 66/ AN/94/3L)
Ministerial decree	Decree on Revisions to the Environmental Impact Assessment Procedures (Decree No. 2011-029/PR/MHUEAT)
	Decree on the Regulation of the Transportation of Dangerous Products (Decree No. 2003-0212/PRE/MHUEAT)
	Decree on the Protection of Biodiversity (Decree No. 2004-0065/PR/MHUEAT)
	Decree on the Establishment of National Committee for Sustainable Development (CNDD) (Decree No. 2004-0092/PR/MHUE)
	Decree on Environmental Impact Assessment (Decree No. 2001-0011/PR/MHUE)

Source: the DATE

The Law on Establishment of Terrestrial and Marine Protected Areas is the only law that designates protected areas in the country, and specifically designates Day Forest, Mabla Forest, Lake Abbe and Lake Assal as terrestrial protected areas. Any of these areas are distant from the project site, so the law will not be applicable to the Project.

(2) Organizations related to Environmental and Social Considerations

In Djibouti, the Ministry of Habitat, Urbanism, Environment and Land Planning (MHUEAT) has centralized authority over environmental administration at the national and regional levels, and the Direction of Regional Development and Environment (DATE), a subsidiary of the MHUEAT, is in charge of practical administration. The following figure outlines the organizational chart involving the DATE.



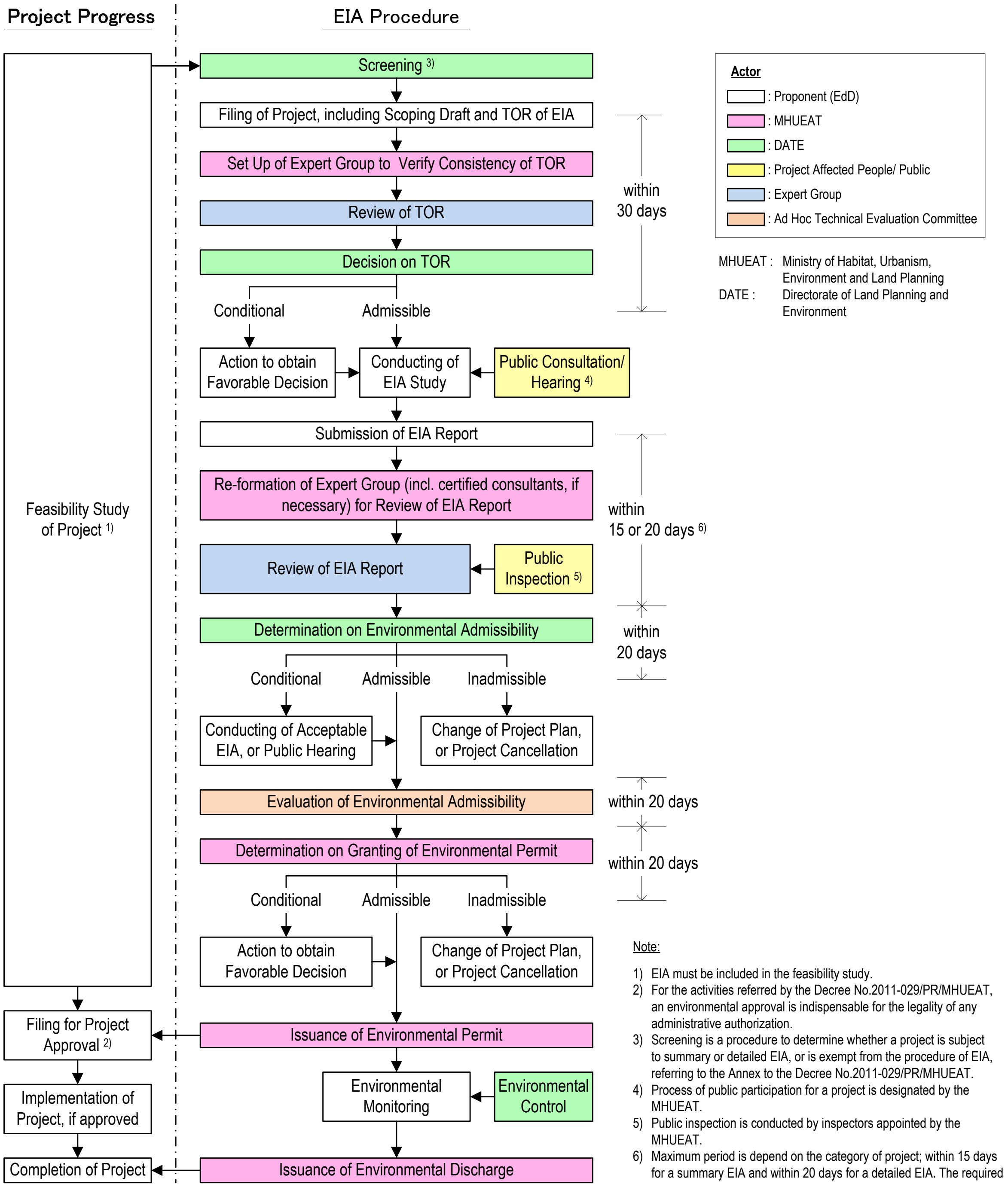
Source: the DATE

Figure 1-3-1-3.1 Organizational Chart Including the Direction of Regional Development and Environment

(3) Environmental Impact Assessment (EIA) Procedures

As stated above, the annex of the Ministerial Decree No. 2011-029 regulates projects subject to mandatory environment impact assessment (EIA), classifying them into those requiring simple assessment of environmental impact and those requiring detail assessment. As for transmission lines, the construction of medium-voltage transmission lines alone is subject to simple assessment. But, the regulations set forth in the annex have some unclear parts: they have no reference at all to high-voltage transmission lines and provide no definition of "medium-voltage". Moreover, the main text of the decree gives no clear picture of public discussion and inspection about EIA. The DATE also recognizes these unclear parts of the decree: when the Study Team asked them about the necessity of implementing EIA for the 63 kV transmission line to be built under the Project, the DATE recognized these unclear parts of the decree, presenting their view that the necessity or otherwise of EIA would be determined not just according to the nature and size of projects but from the comprehensive perspectives taking into account the social impact, location and other factors of the projects. At a later date, the DATE issued the letter to declare that EIA was not required for the Project. (Appendix 10.1)

Just for information, the following figure outlines the EIA procedures in Djibouti which begins with screening.



MHUEAT : Ministry of Habitat, Urbanism, Environment and Land Planning
DATE : Directorate of Land Planning and Environment

Note:

1) EIA must be included in the feasibility study.
2) For the activities referred by the Decree No.2011-029/PR/MHUEAT, an environmental approval is indispensable for the legality of any administrative authorization.
3) Screening is a procedure to determine whether a project is subject to summary or detailed EIA, or is exempt from the procedure of EIA, referring to the Annex to the Decree No.2011-029/PR/MHUEAT.
4) Process of public participation for a project is designated by the MHUEAT.
5) Public inspection is conducted by inspectors appointed by the MHUEAT.
6) Maximum period is depend on the category of project; within 15 days for a summary EIA and within 20 days for a detailed EIA. The required time for public inspection is not included in the maximum period.

Source: Prepared by the Study Team based on Decree No. 2011-029

Figure 1-3-1-3.2 Procedural Flow of Environmental Impact Assessment (EIA)

After the DATA completes the screening and a project operator submits necessary documents including the TOR for EIA, it normally takes a maximum of 30 days for the project operator to obtain the approval for the TOR. After a project operator makes EIA and submits an assessment report, it normally has to wait for a maximum of 80 days until it obtains the environmental approval. It is likely, however, to take longer for a project operator to obtain the relevant approval, because these maximum days do not include any additional period that is required when the authority asks the project operator to revise the TOR submitted or that is required to inspect the environmental impact assessment report.

(4) Environmental and Social Considerations System of the Project Implementing Agency (EdD)

EdD, the implementing agency, has neither department nor staff members in charge of environmental and social considerations, and thus its environmental and social considerations system is extremely vulnerable. Even if required to make EIA for any projects, EdD cannot assess environmental impact on its own and thus normally formulate a working team comprising personnel in charge at the relevant ministries, agencies and local governments for each project. In the project for construction of the Ethiopia-Djibouti 230 kV interconnection transmission line in Djibouti, as well as Jaban As Substation, the project operator was requested to make EIA. Thus, EIA was made by a working team that comprised staff members of EdD and personnel in charge at the DATA, the Direction of National Property and other organizations of the central government, and the government of Arta Region and other regional governmental agencies.

Incidentally, there is no certification system of private consultants that engage in EIA surveys. The hearings to the DATA also confirmed no such private consultants in Djibouti which have the capacity to make EIA surveys.

1-3-1-4 Comparison and Examination of Alternative Routes

The following alternative options including the option to choose nothing have been compared and reviewed to optimize the environmental and social impacts of the Project.

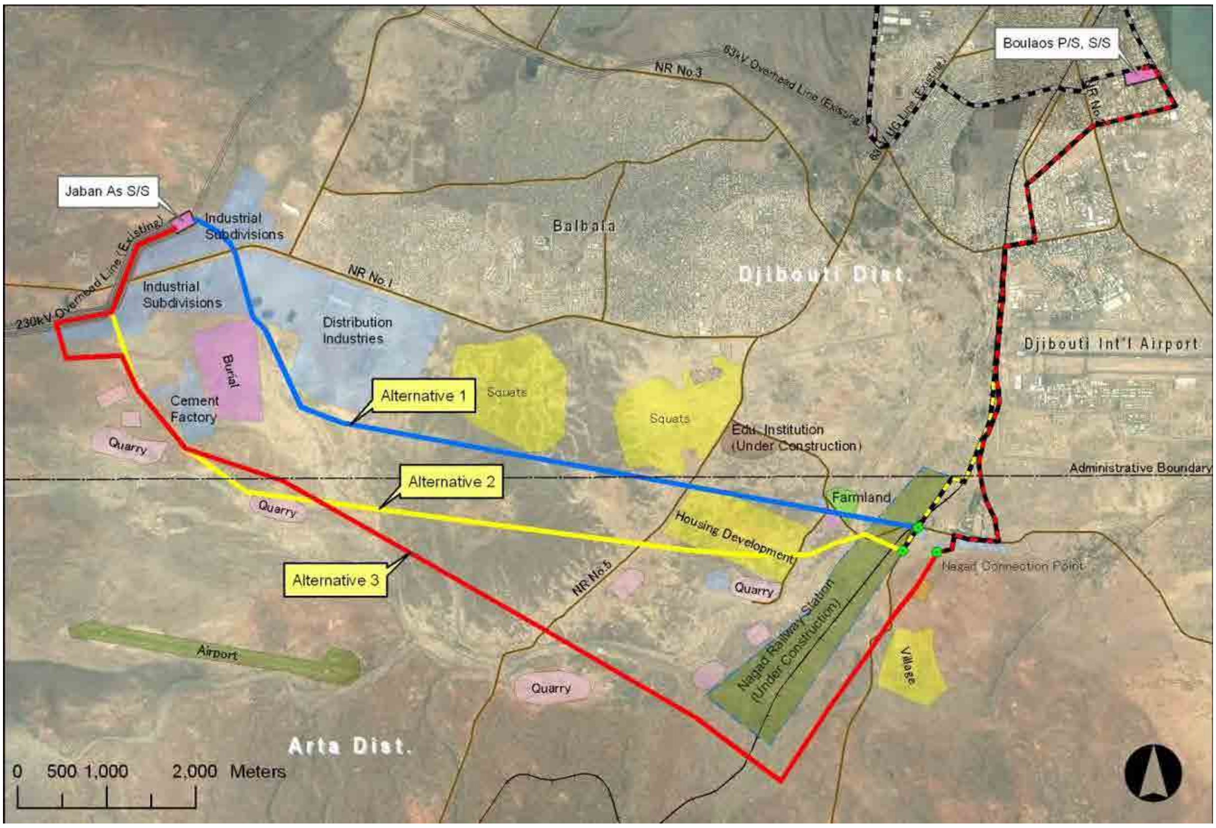
Alternative 1: The initially requested route, where the overhead line runs from the eastern side of Jaban As Substation, crosses National Route No. 1 and the planned site for Nagad Railway Station and reaches the newly built Nagad Connection Point, where the underground line starts to go up north along the existing railway and roads before reaching Boulaos Substation.

Alternative 2: The route, where the overhead line runs from the western side of Jaban As Substation along the existing transmission line, crosses National Route No. 1 and the planned site for Nagad Railway Station and reaches the newly built Nagad Connection Point, where the underground line starts to go up north along the existing railway and roads before reaching Boulaos Substation.

Alternative 3: The route, where the overhead line runs from the western side of Jaban As Substation along the existing transmission line, crosses National Route No. 1, bypasses the planned site for Nagad Railway Station in the south and reaches the newly built Nagad Connection Point, where the underground line starts to go up north along the existing roads before reaching Boulaos Substation.

Alternative 4: The Project will not be implemented.

The following figure illustrates the routes in Alternatives 1, 2 and 3 and the state of development in the surrounding areas.



Source: the Study Team

Figure 1-3-1-4.1 Alternative Routes of the 63 kV Transmission Line and the Use of Land Surrounding the Overhead Transmission Line

Alternative 1 presents the transmission line route requested by EdD at the time of the first field survey: the total extension is approximately 16.8 km (the total extension of the overhead line: approx. 9.6 km and the total extension of the underground line: approx. 7.2 km). As the figure shows, the areas along the National Route No. 1, where the 63 kV overhead line crosses, have been considerably well developed. There are makeshift restaurants chiefly for truckers in lots for sale (industrial use) in underdeveloped are in the north of the national route, and, in the south, warehouses and other structures for the distribution industry in relatively large lots for sale. This suggests that quite a few land lots in these wide areas have been already sold to the private sector. The transmission line route will get close to an illegally occupied area in the west of the National Route No. 5, and go across a cemetery, land occupied by waste material dealers, farmland and so on in the vicinity of the Nagad Railway Station. The underground line from the Nagad Connection Point will go up north along the existing railway and roads, but how to use the land for the railway currently unused is undetermined.

Alternative 2 presents the route, where the overhead line will go along the existing 230 kV overhead interconnection line and the 63kV overhead line leading to Ali Sabieh, cross the National Route No. 1, via vacant land further down south compared to the route in Alternative 1, reach the Nagad Connection Point, and, as in Alternative 1, go up north along the existing railway and roads and reach Boulaos Substation. The total extension will be approximately 18.9 km (the total extension of the overhead line: approx. 11.4 km and the total extension of the underground line: approx. 7.5 km). Because this route uses the premises of the existing transmission line when crossing the National Route No. 1, so there is no need to acquire any land. Moreover, Alternative 2 will affect the smaller area of land privately owned in vacant land in the south, compared to Alternative 1.

Alternative 3 is an option that might be adopted in case the Project fails to obtain the consent from the Chinese company responsible for the development of the Nagad Railway Station concerning the crossing of the transmission lines over the land for the station. The route in this option will bypass the railway station site in the south which was confirmed in the field survey conducted between late March and early April, 2014. During the field survey, the Direction of National Property at last published information about land lots already sold for industrial use and other private-owned land lots, which made it possible to design a transmission line route that could avoid using private-owned land lots and require no land acquisition. The total extension of the route will be approximately 23.2 km (the total extension of the overhead line: approx. 15.8 km and the total extension of the underground line: approx. 7.4 km).

The following table summarizes the result of comparing and examining the alternatives presented above.

Table 1-3-1-4.1 Results of Comparison and Examination of Alternative Transmission Line Routes

Item		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Summary of the route	Zone	Jaban As Substation – (crossing the Nagad Railway Station site) – New Nagad Connection Point - Boulaos Substation	Jaban As Substation – (crossing the Nagad Railway Station site) - New Nagad Connection Point - Boulaos Substation (the line will be partially laid on the premises of the existing overhead line)	Jaban As Substation – Nagad Connection Point – Boulaos Substation (the line will be partially laid on the premises of the existing overhead line) (bypassing the Nagad Railway Station site in the south)	The Project will not be implemented.
	Extension	Total: 16.8 km (Overhead: 9.6 km) (Underground: 7.2 km)	Total: 18.9 km (Overhead: 11.4 km) (Underground: 7.5 km)	Total: 23.2 km (Overhead: 15.8 km) (Underground: 7.4 km)	-
	Use of surrounding area	Industrial site (mainly truck terminals, warehouses and distribution industries), illegally occupied land, vacant land, large-scale housing development, cemetery, farmland, and new railway station	Land for existing transmission line, industrial site, vacant land, quarry, cement factory, large-scale housing development, waste disposal site and new railway station	Land for existing transmission line, industrial site, vacant land, quarry and cement factory	-
Technical aspects	Avoiding or minimizing land acquisition	Acquisition of private-owned land will be needed near the place where the line crosses the National Route No. 1 and in Nagad. The land management administration in Djibouti	The alternative will use the land for the existing overhead line and thus be able to avoid already highly developed industrial sites. It is also less likely to need land acquisition and take time	This is the route which the Direction of National Property consents to and recommends. It will not require any acquisition of private land. But it is necessary to confirm temporary rights of	The Djibouti Urban Development Master Plan currently under preparation regards the vacant land in the south as a promising are for future urbanization. The area is in fact under rapid

Item		Alternative 1	Alternative 2	Alternative 3	Alternative 4
		requires certain time to confirm the status of land ownership including temporary right to land possession. Thus, it will take enormous amount of time to consider in detail routes that can avoid and minimize the impacts.	to confirm the status of land ownership, compared to Alternative 1. Thus, it will be relatively easy to consider in detail routes that can avoid and minimize the impacts.	possession granted by the local government. If such rights are confirmed, appropriate compensations will be needed.	development. Thus, it will be greater burden in many aspects in terms of land acquisition if the route of transmission line is determined after the land has been developed.
	Project cost (for transmission line) (construction cost only)	Approx. 1.42 billion yen	Approx. 1.51 billion yen	Approx. 1.37 billion yen	-
Environmental and social considerations	Social environment	There is no ordinary residential area near the overhead line zone. But some part of the zone is close to illegally occupied land and may be likely to induce new illegal occupancy of land underneath the overhead line. Moreover, both the overhead and underground lines cross the existing arterial roads, so the construction work will require traffic restriction.	There is neither ordinary residential area nor illegally occupied land near the overhead line zone. But it has been found that the route will cross a site for large-scale housing development by a state-run company. Moreover, as in Alternative 1, both the overhead and underground lines cross the existing arterial roads, so the construction work will require traffic restriction.	There is neither ordinary residential area nor illegally occupied land near the overhead line zone. As in Alternative 1, both the overhead and underground lines cross the existing arterial roads, so the construction work will require traffic restriction.	As pointed out in the section of technical aspects, if this Project is implemented at the stage where urbanization of the southern part of Djibouti has advanced, negative impacts on society and environment, including involuntary relocation of residents, will increase.
	Natural environment	The land around the overhead line route is covered chiefly by basalt rock and deserted with sparsely grown briars and acacia trees. Thus, the line will have no negative impact on the natural environment. The underground line will be buried on land for railway and roads, so have no negative impact on the natural environment.	The land around the overhead line route is covered chiefly by basalt rock and deserted with sparsely grown briars and acacia trees. Thus, the line will have no negative impact on the natural environment. The underground line will be buried on land for railway and roads, so have no negative impact on the natural environment.	The land around the overhead line route is covered chiefly by basalt rock and deserted with sparsely grown briars and acacia trees. Thus, the line will have no negative impact on the natural environment. The underground line will be buried on land for railway and roads, so have no negative impact on the natural environment.	-
Recommendable optimal alternative and reasons		The alternative is not recommendable on the grounds that it requires a great deal of private-owned land acquisition, that the overhead line is close to built-up areas including illegally occupied ones, and that it is difficult to lay down the line to cross the land for railway station.	The alternative has less impact on private-owned land and the route is distant from the built-up areas in comparison with Alternative 1, but it is not recommendable because it is difficult to lay down the line to cross the land for railway station.	The construction will cost relatively high, but this alternative is recommendable as the most optimal one because it requires no land acquisition, which enables smooth implementation of the Project.	The alternative is not recommendable because the southern part of Djibouti has been rapidly urbanized and the postponing of the Project will increase the economic and social burdens in future.

Source: the Study Team

1-3-1-5 Scoping

EdD and the Study Team worked together to set a total of 30 check items that could influence environment and society in compliance with the JICA Guidelines for Environmental and Social Considerations (April, 2010) and other standards, and formulated proposed scoping in the following table. The proposed scoping will be used when EdD requests the DATA to conduct screening in relation to the necessity or otherwise of EIA for the Project.

Table 1-3-1-5.1 Proposed Scoping

Category			Assessment		Reasons for assessment
			Before and after construction work	While in service	
Social environment	1	Land acquisition and involuntary resettlement	D	D	All the land easement for the overhead transmission line will be granted by the Direction for National Property, and the underground transmission line will be laid on road sites, and thus no private-owned land acquisition will be required. No involuntary resettlement of residents will be required, either.
	2	Poverty group	D	D	No poverty group exists on the project site and its surrounding.
	3	Ethnic minorities and indigenous peoples	D	D	Neither ethnic minority nor indigenous people exist on the project site and its surrounding.
	4	Local economy such as employment and livelihood	D	D	The overhead transmission line will be laid on vacant land in the southern part of the City of Djibouti, and the underground transmission line on existing road sites. Thus, the Project will have little impact on the local economy.
	5	Utilization of land and local resources	D	D	The overhead transmission line will be laid on vacant land in the southern part of the City of Djibouti, and the underground transmission line on existing road sites. Thus, the Project will have little impact on utilization of land and local resources.
	6	Water use	D	D	The Project will include no undertaking that influence the water use on the project site and its surrounding during the construction work and after commencement of services.
	7	Existing social infrastructures and services	B-	D	**During construction:** construction work will require temporary traffic regulations (closure or alternate passage) while the overhead and underground transmission lines are laid in the areas, where the lines cross existing roads. **After commencement of services**: No work will influence existing social infrastructures and services.
	8	Social capital and local decision-making institutions	D	D	Neither social capital nor local decision-making institution exists on the project site and its surrounding.
	9	Equality of benefits and losses	D	D	The construction and presence of the transmission lines will bring no unfair benefits or losses to the surrounding areas.
	10	Local conflict of interest	D	D	The construction and presence of the transmission lines will cause no particular local conflict of interest in the surrounding areas.
	11	Cultural heritage	D	D	No cultural heritage exists on the project site and its surrounding.
	12	Landscape	D	D	Neither landscape, tourist place nor scenery requiring preservation exists on the project site and its surrounding.
	13	Gender	D	D	It is hardly possible that the construction and presence of the transmission lines will have negative impact on gender issues.
	14	Children's rights	D	D	It is hardly possible that the construction and presence of the transmission lines will have negative impact on children's rights.
	15	Infectious diseases such as HIV/AIDS	D	D	It is hardly possible that the construction and presence of the transmission lines will fuel the spread of infectious diseases. The construction work is relatively small scale and construction workers will be locally hired, so it is unlikely that any infectious disease comes from other regions.
	16	Working conditions including occupational safety	B-	B-	**During construction:** It is necessary to work environment for construction workers. **After commencement of services**: It is necessary to consider safety control at the time of regular inspections.

Category			Assessment		Reasons for assessment
			Before and after construction work	While in service	
Natural environment	17	Protected areas	D	D	No protected area exists on the project site and its surrounding.
	18	Ecosystem	D	D	Most of the project site and its surrounding is bare land, where no rare species exists. No routes of migrant birds exist nearby. Thus, the Project will have little impact on the ecosystem.
	19	Hydrology	D	D	It is hardly possible that the construction and presence of the transmission lines will cause any change to the water flow or river bed.
	20	Topography and geology	D	D	The construction work involves no large-scale earth-filling or earth-cutting, so will have little impact on topography and geology.
Anti-pollution measures	21	Air quality	B-	D	**During construction:** The operation of construction machinery is likely to temporarily deteriorate the air quality. **After commencement of services**: The presence of the transmission lines will never influence the air quality.
	22	Water quality	B-	D	**During construction:** Oil leakage from construction machinery is likely to contaminate water, but because the work is not large scale, the impact will be limited in terms of degree and extent. **After commencement of services**: The presence of the transmission lines will never influence the water quality.
	23	Waste	B-	D	**During construction:** Construction waste will be generated. **After commencement of services**: The presence of the transmission lines will not generate any waste.
	24	Soil contamination	B-	D	**During construction:** Oil leakage from construction machinery is likely to contaminate soil, but because the work is not large scale, the impact will be limited in terms of degree and extent. **After commencement of services**: The presence of the transmission lines will never contaminate soil.
	25	Noise and vibration	B-	D	**During construction:** The operation of construction machinery is likely to make noise and vibration, but because the work is not large scale, the impact will be limited in terms of degree and extent. **After commencement of services**: The presence of the transmission lines will never make noise or vibration.
	26	Subsidence	D	D	The construction and presence of the transmission lines will never cause ground subsidence.
	27	Odor	D	D	It is hardly possible that the construction and presence of the transmission lines causes odor.
	28	Sediment	D	D	It is hardly possible that the construction and presence of the transmission lines will influence sediment.
Others	29	Accidents	B-	B-	**During construction:** It is necessary to consider avoidance of any accident while construction vehicles come in and out of existing roads. **After commencement of services**: It is necessary to regulate entries to the facilities concerned to prevent accidents.
	30	Trans-boundary impacts and climate change	D	D	It is hardly possible that the construction and presence of the transmission lines will influence trans-boundary issue or climate change.

Assessment

A+/-: The Project is likely to have significant positive/negative impacts.
B+/-: The Project is likely to have positive/negative impacts to some extent, if not significant.
C+/-: The Degree of impacts of the Project is unknown. (Further survey is needed. The degree of impacts will be clarified in the course of further survey.)
D: The Project is likely to have no impacts.
Resource: the Study Team

The impacts of the project implementation are classified into four categories: A (possibly significant positive/negative impacts); B (possibly positive/negative impacts to some extent, if not significant); C (the degree of impacts unknown); and D (no impacts expected). The survey has found that the Project will have negative impacts to some extent in eight check items: ((i) existing social infrastructures and services; (ii) working conditions including occupational safety; (iii) air quality; (iv) water quality; (v) waste; (vi) soil contamination; (vii) noise and vibration; and (viii) accidents).

1-3-1-6 TOR of Environmental and Social Considerations Survey

The contents and methods of an environmental and social considerations survey have been examined concerning eight check items that have been assessed as “having impacts to some extent, if not significant” in the proposed scoping. The following table summarizes the contents and methods.

Table 1-3-1-6.1 Proposed TOR of Environmental and Social Considerations Survey

Check item	Survey item	Survey method
Existing social infrastructures and services	(1) Confirmation of impacts of construction work of the transmission line	(1) (a) Confirmation of the place where the transmission line crosses roads; (b) confirmation of the contents, methods, period, location and scope of construction work; (c) confirmation of types, and operation sites and period of construction machinery; and (d) field investigation and hearing
Working conditions including occupational safety	(1) Occupational safety measures at construction sites (2) Occupational safety measures after commencement of services (regular inspections and maintenance and management work)	(1) (a) study of occupational safety measures on construction sites of similar facilities; and (b) examination of internal regulations on occupational safety, relevant guidelines and other rules of EdD (2) Examination of internal regulations on occupational safety, relevant guidelines and other rules of EdD
Air quality	(1) Confirmation of impacts of construction work of the transmission line	(1) (a) confirmation of the contents, methods, period, location and scope of construction work; (b) confirmation of types, and operation sites and period of construction machinery; and (c) Case study of similar projects
Water quality	(1) River water quality (2) State of use of river water for domestic use	(1) (a) hearings to relevant organizations; and (b) research of available information and materials (2) (a) hearings to relevant organizations; and (b) research of available information and materials
Waste	(1) Treatment method of construction waste	(1) (a) hearings to relevant organizations; and (b) case study of similar projects
Soil contamination	(1) Oil leak prevention during construction work	(1) (a) confirmation of the contents, methods, period, location and scope of construction work; and (b) confirmation of types, and operation sites and period of construction machinery
Noise and vibration	(1) Distances from sources to residential areas, hospitals and schools (2) Confirmation of impacts of construction work of the transmission line	(1) field investigation and hearing (2) (a) confirmation of the contents, methods, period, location and scope of construction work; and (b) confirmation of types, and operation sites and period of construction machinery
Accidents	(1) Distribution of residential areas, and various facilities including hospitals and schools, and traffic of surrounding roads (2) Accident prevention measures including access limit after commencement of services	(1) field investigation and hearing (2) Confirmation of the contents and location of installation work of guard fences, warning signs, etc.

Source: the Study Team

The proposed TOR of environmental and social considerations survey will be used together with the proposed scoping in the previous section when the DATA requests the implementation of EIA for the

Project.

1-3-1-7 Results of Environmental and Social Considerations Survey

The results of environmental and social considerations survey conducted in accordance with the scoping are presented below.

Table 1-3-1-7.1 Results of Environmental and Social Considerations Survey

Environmental check item	Survey results
Existing social infrastructures and services	The construction works for the overhead transmission line at the places where the line crosses the National Route No. 1 and for the underground transmission line at the places where the line crosses roads in built-in areas are expected to influence the traffic flow.
Working conditions including occupational safety	Safety measures at the time of regular inspections, maintenance and management work after commencement of services, as well as safety measures during the construction work, will be needed.
Air quality	The construction work of the overhead transmission line will neither require any large-scale work nor have any residential areas, or schools, hospitals or any other facilities requiring special considerations in the vicinity. Thus it will have little impact on air quality (by causing dusts). The construction work of the underground transmission line will be conducted in existing built-in areas, and thus will have impact on the surrounding environment through the operation of construction machinery and vehicles carrying materials and machinery.
Water quality	There is neither river nor fresh water lake with surface water at all times near the project site. Water sometimes flows from basins on the Ethiopian side and upper streams, as well as rainwater during the rainy season, into surrounding dry riverbeds (wadi). But, according to the field survey and hearings to the DATA, the surface water is not used for daily lives, agriculture or other purposes. In light of the size and nature of the construction work for the transmission line, it is hardly possible for the Project to deteriorate the quality of the surface water that comes from these basins and remains temporarily in the dried riverbeds.
Waste	The Project will not involve any large-scale work, but the foundation work to install towers and the construction work for the underground transmission line will generate waste soil, and the construction work will generate waste.
Soil contamination	The Project will not involve any large-scale work and thus it is hardly possible that it will severely contaminate soil. But care must be taken for oil leakage from construction machinery and disposal of waste oil.
Noise and vibration	The construction work of the underground transmission line will be conducted in existing built-in areas, so care must be taken for noise and vibration from excavators and other construction machines.
Accidents	The construction work of the underground transmission line will be conducted in existing built-in areas, so measures must be prepared to prevent accidents. As for installation of towers for the overhead line, measures to prevent entries to the installation work site and measures to prevent accidents after commencement of services must be taken.

Source: the Study Team

1-3-1-8 Impact Assessment

The following table summarizes the results of EIA of the Project in accordance with the results of the environmental and social considerations survey described above.

Table 1-3-1-8.1 Proposed Scoping and the Survey Results

Category			Impact assessment at the time of scoping		Impact assessment based on survey results		Reasons for assessment
			Before and during construction	**After commencement of services**	**Before and during construction**	**After commencement of services**	
Social environment	1	Land acquisition and involuntary resettlement	D	D	N/A	N/A	
	2	Poverty group	D	D	N/A	N/A	
	3	Ethnic minorities and indigenous peoples	D	D	N/A	N/A	
	4	Local economy such as employment and livelihood	D	D	N/A	N/A	
	5	Utilization of land and local resources	D	D	N/A	N/A	
	6	Water use	D	D	N/A	N/A	
	7	Existing social infrastructures and services	B-	D	B-	N/A	**During construction:** construction work will require temporary traffic regulations (closure or alternate passage) while the overhead and underground transmission lines are laid in the areas, where the lines cross existing roads. **After commencement of services**: No work will influence existing social infrastructures and services.
	8	Social capital and local decision-making institutions	D	D	N/A	N/A	
	9	Equality of benefits and losses	D	D	N/A	N/A	
	10	Local conflict of interest	D	D	N/A	N/A	
	11	Cultural heritage	D	D	N/A	N/A	
	12	Landscape	D	D	N/A	N/A	
	13	Gender	D	D	N/A	N/A	
	14	Children's rights	D	D	N/A	N/A	
	15	Infectious diseases such as HIV/AIDS	D	D	N/A	N/A	
	16	Working conditions including occupational safety	B-	B-	B-	B-	**During construction:** It is necessary to work environment for construction workers. **After commencement of services**: It is necessary to consider safety control at the time of regular inspections.
Natural environment	17	Protected areas	D	D	N/A	N/A	
	18	Ecosystem	D	D	N/A	N/A	
	19	Hydrology	D	D	N/A	N/A	
	20	Topography and geology	D	D	N/A	N/A	
Anti-pollution measures	21	Air quality	B-	D	B-	N/A	**During construction:** For the construction work for the underground transmission line in built-in areas, care must be taken to control dust and gas emissions due to operation of construction machinery. **After commencement of services**: No particular impact is expected on air quality.
	22	Water quality	B-	D	D	N/A	Water flowing from the upper course and rainfall temporarily remains in surrounding riverbeds as surface water, which is not used for any purpose at all. Moreover, since the Project involves no large-scale work, the construction work will not deteriorate the quality of the surface water.
	23	Waste	B-	D	B-	N/A	**During construction:** Construction waste will be generated. **After commencement of services**: No particular impact is expected in respect of wastes.

Category			Impact assessment at the time of scoping		Impact assessment based on survey results		Reasons for assessment
			Before and during construction	**After commencement of services**	**Before and during construction**	**After commencement of services**	
	24	Soil contamination	B-	D	B-	N/A	**During construction:** Oil leakage from construction machinery is likely to contaminate soil, but because the work is not large scale, the impact will be limited in terms of degree and extent. **After commencement of services**: No particular impact is expected in respect of soil contamination.
	25	Noise and vibration	B-	D	B-	N/A	**During construction:** The operation of construction machinery is likely to make noise and vibration, but because the work is not large scale, the impact will be limited in terms of degree and extent. **After commencement of services**: No particular impact is expected in respect of noise and vibration.
	26	Subsidence	D	D	N/A	N/A	
	27	Odor	D	D	N/A	N/A	
	28	Sediment	D	D	N/A	N/A	
Others	29	Accidents	B-	B-	B-	B-	**During construction:** It is necessary to consider avoidance of any accident while construction vehicles come in and out of existing roads. **After commencement of services**: To prevent accidents, entry of any third party to the construction site must be regulated.
	30	Trans-boundary impacts and climate change	D	D	N/A	N/A	

Assessment

A+/-:	The Project is likely to have significant positive/negative impacts.
B+/-:	The Project is likely to have positive/negative impacts to some extent, if not significant.
C+/-:	The Degree of impacts of the Project is unknown. (Further survey is needed. The degree of impacts will be clarified in the course of further survey.)
D:	The Project is likely to have no impacts.

Resource: the Study Team

1-3-1-9 Measures to Reduce Impacts and Their Costs

The following table summarizes measures to reduce impacts and their costs

Table 1-3-1-9.1 Measures to Reduce Impacts and Their Costs

No.	Item subject to impact	(Proposed) measures to reduce impacts	Implementing organization	Organization responsible	Costs
1	Existing social infrastructures and services	**During construction:** Installing temporary roads, protective scaffolding, etc. to secure the traffic flow during the construction work of the transmission line at the places where the line crosses roads.	Contractors	EdD	Included in the overall project cost
2	Working conditions including occupational safety	**During construction:** Installing safety facilities, conducting safety education for workers, etc. to prevent industrial accident. **After commencement of services**: Installing safety facilities; conducting regular inspections, and maintenance and management work; and conducting education with safety manuals and other resources.	Contractors and EdD	EdD	Included in the overall project cost and the annual facility management cost of EdD
3	Air quality	**During construction:** Regularly sprinkling water and using protective sheets to minimize dusts; and effectively operating construction machinery to minimize nitrogen oxide and other toxic gases.	Contractors	EdD	Included in the overall project cost
4	Waste	**During construction:** Leveling waste soil generated in the construction work within the premises of the project site; and disposing of waste materials in compliance with instructions of the DATE.	Contractors	EdD	ditto

No.	Item subject to impact	(Proposed) measures to reduce impacts	Implementing organization	Organization responsible	Costs
5	Soil contamination	**During construction:** Conducting regular inspections of construction machinery to minimize oil leakage; and appropriately handling waste oil at the time of oil replacement.	Contractors	EdD	ditto
6	Noise and vibration	**During construction:** Using low-noise construction machines; conducting works in residential areas during daytime only; and regularly inspecting and conducting maintenance work of heavy equipment and construction vehicles.	Contractors	EdD	ditto
7	Accidents	**During construction:** Stationing guards at the gates for trucks and other construction vehicles to public roads	Contractors and EdD	EdD	ditto

Source: the Study Team

1-3-1-10 Monitoring Plan

Djibouti has not developed any environmental standards for air quality, noise and other aspects, and has in general no system to supervise the environmental conditions in terms of laws and regulations, organizations, equipment and other aspects. On the other hand, the Project will include no large-scale works, and thus have only limited and minor impacts on environment. In order to minimize impacts of the construction work on existing social infrastructures and services, ensure the safety at the worksites, and minimize air pollution and the amount of waste, it is necessary to incorporate appropriate work methods and other specifications of the construction work, as well as appropriate items that must be monitored by contractors, in contracts on the construction work with contractors. At the same time, the contractors are required to build a supervising system to ensure monitoring activities.

The following table summarizes the monitoring plan for the Project.

Table 1-3-1-10.1 Monitoring Plan

Environmental item	Item	Location	Frequency	Method	Organization responsible
[During construction]					
Existing social infrastructures and services	Traffic flow	Places where the overhead/underground transmission lines cross roads	Once each at the construction sites	Visual inspection and hearing	Contractors
Working conditions	Safety control	Construction site	Once/month	Hearing	Contractors
Air quality	Dust control	Construction site for the underground transmission line	Twice/month	Visual inspection and hearing	Contractors
Waste		Construction site	Twice/month	Hearing	Contractors
Soil contamination	Waste oil disposal	Construction site	Twice/month	Hearing	Contractors
Noise and vibration	Noise	Residential areas near construction site for the underground transmission line	Twice/month	Simplified noise measurement	Contractors
Accidents	Traffic safety	Gates of construction vehicles to public roads	Twice/month	Visual inspection and hearing	Contractors
[After commencement of services]					
Working conditions	Safety control	Transmission facilities	Twice/year	Hearing	EdD
Accidents	Safety facilities	Transmission facilities	Twice/year	Visual inspection and hearing	EdD

Source: the Study Team

1-3-1-11 Stakeholders Meeting

On December 10, 2013, the first Stakeholders meeting was held with MENR, EdD, governor of Djibouti prefecture, governor of Alta, Direction of Habitat and Urban Planning, and Project team for Construction of Nagad Station. The issue on decision of the transmission line route, such as development plan near Nagad Station was studied.

The decision of the transmission line route was made taking into consideration of above mentioned issues and the latest situation of the Project site. The final design and specifications of the construction work under the Project was presented to EdD at the time of the third field survey during the preliminary survey of the project, that is, at the time of giving account of and discussing the draft final report (DFR). EdD reviewed the outline, validity, and alternatives of the Project according to the DFR, explained about expected negative impacts and other aspects of the Project to the parties concerned in Djibouti, formulate the consensus about the environmental and social aspects, and hold stakeholders meetings to build an implementation system of the Project. The following table lists major stakeholders.

Table 1-3-1-11.1 Major Stakeholders of the Project

Major stakeholders	
Ministries and offices of the central government	Direction of Habitat and Urban Planning (Ministry of Housing, Urban Planning, the Environment and Land Management (MHUEAT)) Direction of Road Transport (Ministry of Infrastructure and Transport)
Related organization	The National Office for Water Supply and Sanitation Djibouti Telecom

Source: the Study Group

The stakeholders meeting coordinated the underground transmission line and already buried objects on the road sites to determine the location to lay the line.

1-3-2 Land Acquisition and Resettlement of Residents

1-3-2-1 Necessity for Land Acquisition and Resettlement of Residents

As stated in the previous Sections 1-3-1-4 “Comparison and Examination of Alternative Routes” and 1-3-1-5 “Scoping”, the Project will require no private-owned land acquisition. In addition, because there is no residential building on land underneath the overhead transmission line and the underground transmission line will be laid within existing road sites or on government-owned land, the Project will require no resettlement of residents, either. The width of the land underneath the overhead transmission line is not stipulated by law, but EdD plans to make the land width under the 63 kV overhead transmission line under the Project at 24m in principle and requested the Direction of National Property to grant the right to use the land for the transmission line and the Jaban As-Nagad 230 kV overhead transmission line. In response, the Direction of National Property replied in a letter dated March 10, 2014 (Appendix 10.2), proposing a new Jaban As-Nagad transmission corridor that requires no land acquisition at all. Accordingly, EdD and the Study Team jointly conducted a field survey at the time of the additional field survey of the preliminary survey on the Project during the late

March and early April, 2014, confirmed that there was no structure that could interfere with the Project within the premises, and decided to adopt the route of 63 kV overhead transmission line proposed by the Direction of National Property.

Of the 63 underground transmission line route, some 300m between the Nagad Connection Point to be newly developed and the closest existing road is vacant land with no owner, that is, government-owned land, and the width of this road is set at 6m.

1-3-2-2 Legal Framework concerning Land Acquisition

In Djibouti, land is classified into registered land and unregistered land. The former is owned by individuals, corporate persons or the national government, and the latter is vacant land without owners and thus belongs to the national government. Registered land is transferred by the national government to owners who are granted the permanent ownership. The Direction of National Property has the authority to manage registered land and is in charge of management of national land including vacant land, sales and registration of land and other land-related affairs.

There are some unregistered land lots for which prefectural governments grant temporary possessory rights to individuals and corporate persons. The ownership of these land lots remains in the hands of the national government, so that no parties with temporary possessory rights are allowed to build permanent structures. But prefectural governments independently issue temporary possessory rights without referring to any organization of the national government, and the Direction of National Property does not have a proper understanding of the state of affairs about the issuance of such rights. In 1997, the Prime Minister Office notified the regional governments to give up the issuance of temporary possessory rights, but the regional governments conventional continue to issue these rights. To have temporary possessory rights granted, parties are normally required to build a certain structure permitted within three months. Most of simplified residential buildings in Balbara District

When EdD is acquiring the right to use unregistered land (government-owned land) for the transmission line, it will have to confirm if there are any land lots for which the relevant regional governments have already granted temporary possessory rights, and, if so, give compensation to the parties holding temporary possessory rights and apply for the land use to the Direction of National Property. The direction will drafts a presidential order for granting the right to use the land concerned in accordance with the application of EdD, asking the Prime Minister Office to review the draft order. The draft order will eventually come into effective when it is signed by the president. On the other hand, when EdD is acquiring any registered land lots, it will have to create an inventory of the land lots concerned and make an application for land acquisition to the Direction of National Property. The direction will draft a presidential order for the land acquisition in accordance with application of EdD, similarly asking the Prime Minister Office to review the draft order. The draft order will eventually come into effective when it is signed by the president. According to the Direction of National Property, in the procedures for acquisition of the right to use unregistered land, it normally takes one month or so, after the application is made, to have a presidential order made effective. In the procedures for acquisition of private-owned land, it also takes one month or so.

The following table lists laws and regulations related to land acquisition in Djibouti.

Table 1-3-2-2.1 Legal System of Djibouti related to Land Acquisition

Category	Name of Law
Law	Law to Stipulate Regulations on Application of Law related to Land Possession (Law No. 178, 1991, AN/91/2ème)
	Law on Organization concerning Land Possession (Law No. 177, 1991, AN/91/2ème)
	Law on Organization concerning Private Land (Law No. 173, 1991, AN/91/2ème)
	Law to Regulate Land Acquisition for Public Interest (Law No. 172, 1991, AN/91/2ème)
	Law on Attachment and Organization of Public Land (Law No. 171, 1991, AN/91/2ème)
Decree	Decree on Regulations of Composition and Authority of National Committee for Land Possession (No. 2012-0469)
	Decree on Permanent Possession of Land Lots of the Nation (No. 2010-0500)

Source: the Study Team

1-3-2-3 Right to Use Land for the Transmission Line

On April 19, 2014, EdD requested the Direction of National Property to grant the right to use land for the 63 kV overhead transmission line (road width: 24 m), the connection point (15m x 15 m) and the 63kV underground transmission line from the connection point to existing road (road width: 6 m), together with the right to use land for the Jaban As-Nagad 230kV overhead transmission line and the Nagad Substation (Appendix 10.3). Prior to making the application, EdD confirmed that no temporary possessory rights had been attached to the necessary land lots in both Prefectures of Djibouti and Arta and made the application to the Direction of National Property. Thus, the presidential order enacted to grant the right to use national land was issued on September 17, 2014 (Appendix 10.4).

1-3-3 Others

1-3-3-1 Proposed Monitoring Forms

EdD will monitor items necessary for the Project based on reports from contractors during the construction term, and based on environmental measuring, hearings and so on carried out on its own account after the commencement of services. It will then report the monitoring results to JICA on a regular basis. It will continue reporting to JICA for one year after the commencement of services.

Proposed monitoring forms for the Project are presented as follows.

[During construction]

(1) Permits and approval/briefing to local residents

Items to be monitored	State of affairs during the report period
Response to matters pointed out by residents and local communities	
Response to matters pointed out by governmental organizations	

(2) Existing social infrastructures and services (traffic flow)

Items to be monitored	State of affairs during the report period
Traffic control and staff allocation during the construction period at the places where the transmission line crosses roads	
Response to complaints, etc. from residents and local communities	

(3) Working conditions (safety control)

Items to be monitored	State of affairs during the report period
Safety control, industrial accidents, etc. on the construction sites	
Response to matters pointed out by construction workers	

(4) Air quality (dust control)

Items to be monitored	State of affairs during the report period
Dust control on the construction sites for the underground transmission line	
Response to complaints, etc. from residents and local communities	

(5) Waste

Items to be monitored	State of affairs during the report period
Method of disposing of construction waste (including waste soil)	

(6) Soil contamination (disposal of waste oil)

Items to be monitored	State of affairs during the report period
Regular inspections of construction machinery	
Disposal of waste oil	

(7) Noise and vibration (noise)

Item (unit)	Measured value (average value)	Measured value (maximum value)	Local standard level	Reference international standards (WHO)	Remarks (place, frequency, method, etc. of measuring)
Noise (dB)				70 dB	

Items to be monitored	State of affairs during the report period
Response to complaints, etc. from residents and local communities	

(8) Accidents (road safety)

Items to be monitored	State of affairs during the report period
Safety measures at the gates of construction vehicles to public roads	
Traffic accidents occurred due to the construction work	

[After commencement of services]

(1) Working conditions (safety control)

Items to be monitored	State of affairs during the report period
Regular inspections and safety education to maintenance and management workers	
Traffic accidents reported at the time of regular inspections, and maintenance and management work	

(2) Accidents (safety facilities)

Items to be monitored	State of affairs during the report period
Safety measures at the transmission facilities (protective fences, warning signs, etc.)	
Unauthorized entry of third parties	

1-3-3-2 Environmental Checklist

EdD and the Study Team have formulated the following environmental checklist.

Environmental Checklist for Transmission Line (1)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	1) Have EIA reports been already prepared in official process?	N	EIA is not required for the construction of 64kV transmission line by the Djiboutian laws. However, EdD will ask the competent authority about the necessity of EIA when the specification of the transmission line is finalized by Japanese side. When EIA is required, EdD will complete the EIA reports and obtain environmental permit from the competent authority by the time when the E/N between the GOJ and the GOD will be signed.
		2) Have EIA reports been approved by authorities of the host country's government?	N	EIA report is not required for the project.
		3) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	EIA report is not required for the project.
		4) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	No other environmental permits are required.
	(2) Explanation to the Local Stakeholders	1) Have contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the local stakeholders?	N	EdD will identify stakeholders and have stakeholders meetings as soon as the Project's specification is decided and the potential impacts are clarified.
		2) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	N	The stakeholders meeting have not been held yet.
	(3) Examination of Alternatives	1) Have alternative plans of the project been examined with social and environmental considerations?	Y	The alternative plans including zero-option have been examined in the preparatory survey implemented by JICA.
2 Pollution Control	(1) Water Quality	1) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	N	Although earthmoving activities will be expected at the site, there is hardly any possibility of water quality degradation in downstream. Because magnitude of the earthmoving is very small and the amount of precipitation is very small throughout the year.
3 Natural Environment	(1) Protected Areas	1) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N/A	Not applicable
	(2) Ecosystem	1) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N/A	Not applicable
		2) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N/A	Not applicable

Environmental Checklist for Transmission Line (2)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(2) Ecosystem	3) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N/A	Not applicable
		4) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	N/A	Not applicable
		5) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	N/A	Not applicable
		6) In case where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	N/A	Not applicable
	(3) Topography and Geology	1) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	N/A	Not applicable
		2) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	N/A	Not applicable
		3) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	N/A	Not applicable
4 Social Environment	(1) Resettlement	1) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	N	Neither involuntary resettlement nor land acquisition is caused by the project.
		2) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	N/A	Not applicable
		3) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	N/A	Not applicable
		4) Are the compensations going to be paid prior to the resettlement?	N/A	Not applicable
		5) Are the compensation policies prepared in document?	N/A	Not applicable

Environmental Checklist for Transmission Line (3)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	6) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	N/A	Not applicable
		7) Are agreements with the affected persons obtained prior to resettlement?	N/A	Not applicable
		8) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	N/A	Not applicable
		9) Are any plans developed to monitor the impacts of resettlement?	N/A	Not applicable
		10) Is the grievance redress mechanism established?	N/A	Not applicable
	(2) Living and Livelihood	1) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	N/A	Not applicable
		2) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	N/A	Not applicable
		3) Is there any possiblity that installation of structures, such as power line towers will cause a radio interference? If any significant radio interference is anticipated, are adequate measures considered?	N/A	Not applicable
		4) Are the compensations for transmission wires given in accordance with the domestic law?	N/A	Not applicable
	(3) Heritage	1) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N/A	Not applicable
	(4) Landscape	1) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N/A	Not applicable
	(5) Ethnic Minorities and Indigenous Peoples	1) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N/A	Not applicable
		2) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N/A	Not applicable

Environmental Checklist for Transmission Line (4)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(6) Working Conditions	1) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	N/A	The project will not violate any laws and ordinances associated with working conditions.
		2) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	Tangible safety considerations are in place based on EdD's safety policy and regulations.
		3) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	Intangible measures are planned and implemented for individuals involved in the project, based on EdD's safety policy and regulations.
		4) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	Y	There are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individuals involved, or local residents.
5 Others	(1) Impacts during Construction	1) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	Adequate measures are considered to reduce impacts during construction.
		2) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	Y	Adequate measures are considered to reduce impacts.
		3) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	Adequate measures are considered to reduce impacts.
	(2) Monitoring	1) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	EdD will develop and implement monitoring program for the environmental items.
		2) Are the items, methods and frequencies of the monitoring program adequate?	Y	EdD will develop and implement adequate monitoring program in terms of items, methods and frequencies.
		3) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	EdD will establish adequate monitoring framework.
		4) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	N	There are not any regulatory requirements pertaining to the monitoring report system.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) Relations with Upper Level Plans

Energy plays a crucial role in “strengthening Djibouti’s competitiveness and to create conditions for strong and sustainable economic growth”. This is one of four strategic pillars set out in the second generation Poverty Reduction Strategy Paper (PRSP) entitled “the National Initiative for Social Development” for 2008-2012. Although energy is a determinant in pursuit of economic growth and competitiveness, it is short and expensive in Djibouti: a mere 50 percent of the people have access to modern forms of energy, most of whom are residents in urban areas. This state of affairs about the energy supply extremely interfered with the development of the country. In such circumstances, the country is currently planning to develop an energy supply system based on electricity transmission networks linking domestic, renewable power sources such as thermal and wind power energy to the City of Djibouti, and the interconnection transmission lines to bring in supplementary energy from Ethiopia.

In line with the policy described above, this Project set out as the overall goal “vitalizing social and economic activities in the City of Djibouti by stabling supplying electricity and ensuring the credibility of electricity supply”, and as the project purpose “stabilizing the electricity supply to the entire City of Djibouti by constructing transmission lines and improving substation facilities for the city”.

(2) Project Outline

The objective of this Project is to stabilize the electricity supply and improve the quality of electricity by strengthening the capacity of power transmission and substations in the metropolitan area, thereby contributing to realization of the foregoing development plan and energy policies of Djibouti.

This cooperation project will construct a 63 kV transmission line from Jaban As Substation, via Nagad, to Boulaous Substation and improve the 230/63 kV substation equipment at Jaban As Substation for the City of Djibouti, where the electricity demand is expected to sharply increase in near future.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

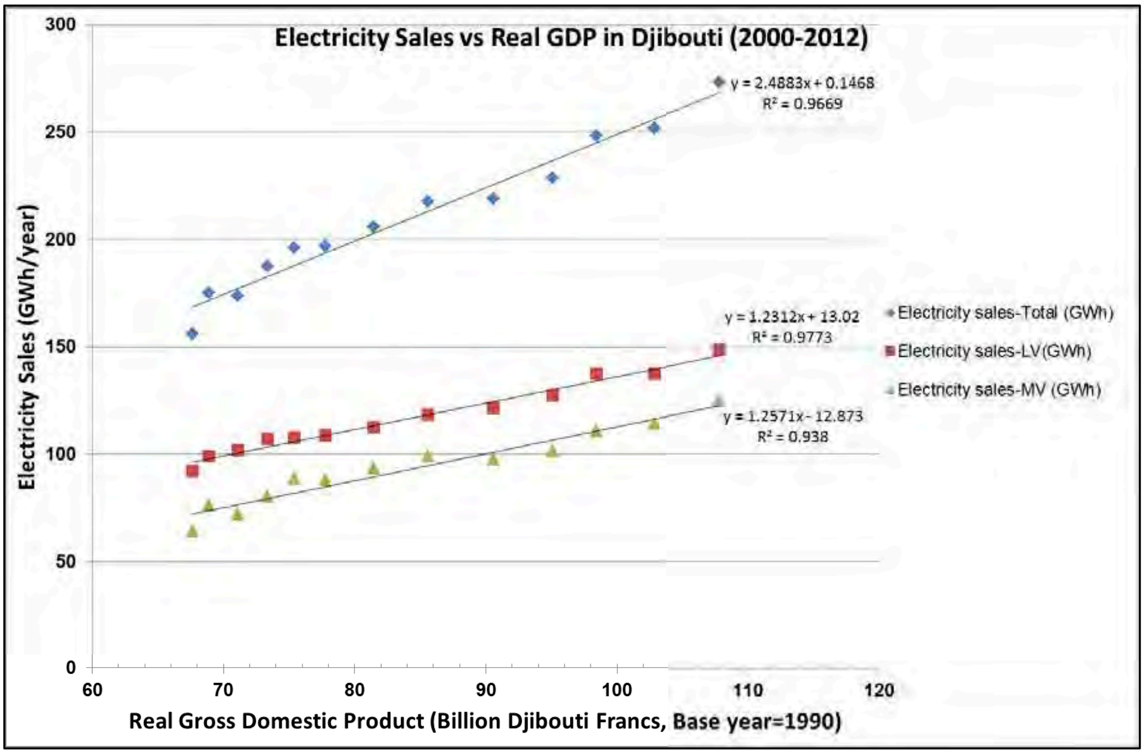
2-2-1-1-1 Electricity Demand Forecasting

(1) Building of Forecasting Model

Low-voltage (380/220V) electricity demand has been forecast by conducting regression analysis (linear regression) on the relationship between low-voltage electricity demand and real GDP during 2000-2012, where electricity sales (kWh) is an explained variable and real GDP is an explanatory variable. Figure 2-2-1-1-1.1 shows the correlation between the two variables, suggesting that they are highly correlated in the linear regression model.

For medium-voltage (20 kV) electricity demand, a linear regression was made but the load of large consumers expected to be connected to the electric power system in future (Table 2-2-1-1-1.2) was added to the actual electricity sales (kWh) in 2012. But the load was not simply added but set in consideration of the simultaneous usage rate, 0.6.

The actual load factor in 2012 (0.58) was used to convert annual electricity demand (kWh) to maximum electricity (kW).



Source: Prepared by the Study Team based on data of EdD and IMF

Figure 2-2-1-1-1.1 Correlation between EdD Electricity Sales and Real GDP

(2) Sources of data for the analyses

- ✧ Low-voltage electricity demand: EdD data on electricity sales. Stated in reply to the questionnaire.
- ✧ Load capacity of large consumers: EdD data state in reply to the questionnaire. But the electricity demand that will not be connected to the Djibouti electricity system (Goubet Mineral Port, Tadjourah-Galafi Railway, Tadjourah Port, Obok Ship-Repair Yard, etc.) is excluded.
- ✧ Real GDP: World Economic Outlook Database 2013, International Monetary Fund
- ✧ GDP growth rate (forecast): the figures from IMF Staff Reports as shown in the following table. It was assumed that the growth rate would continue to be at 5.8% during 2033-2035.

Table 2-2-1-1-1.1 Real GDP Growth Rate used for Electricity Demand Forecasting

Year	2013	2014	2015	2016～2032
GDP growth rate	5.0%	5.0%	5.5%	5.8%

Source: IMF Staff Reports

Table 2-2-1-1-1.2 Large Consumers Taken into Account for Demand Forecasting

Name of large consumer	Substation supplying electricity	Load (MW)	Year(s) to be connected
(1) Haramous (residential complex)	Boulaos	4.0	2013～2016
(2) Commercial Buildings (shopping center)	Boulaos	4.0	2014～2017
(3) Cement factory in PK 12	Janban As	3.0	2013
(4) Cement factory of Ali Sabieh	Ali Sabieh	4.0	2013
(5) The Army of the United States	Nagad	8.0	2014～2016
(6) Doraleh container terminal	Janban As	12.0	2014～2016
(7) Doraleh/PK 12 free trade zone	Janban As	15.0	2014～2022
(8) INMAA Housings in Haramous (residential complex)	Boulaos	5.0	2014～2016
(9) Barwaqo2 Housings (residential complex)	Janban As	2.0	2015
(10) Seawater desalination plant	Janban As	10.0	2015
(11) Chebeleh Airport (new airport)	Nagad	25.0	2017～2022
(12) New multi-purpose port	Janban As	17.0	2021～2023
(13) Damerjog livestock port	Boulaos	1.0	2015
(14) Khor Ambado free trade zone	Janban As	15.0	2023～2030
(15) LNG terminal	Janban As	5.0	2023～2025
(16) Commercial area	Marabout	5.0	2023～2027
(17) Poste Education	Janban As	0.26	2014
(18) Lots LOCRETE	Janban As	1.92	2014
(19) Lot HODANE	Janban As	2.18	2014
(20) Ministry of Health	Janban As	0.26	2014
(21) LOCRET factory	Janban As	0.26	2014
(22) Poste IMMOBILIER	Janban As	0.96	2014

Source: EdD

(3) Transmission and distribution loss

As for low-voltage electricity consumers, it was assumed that the transmission and distribution loss would be improved by 0.7% each year from the actual loss of 28.7% in 2012 to 13% in 2035. As for medium-voltage electricity consumers, on the other hand, the transmission and distribution loss was assumed to be 12% throughout the years subject to the demand forecasting because the loss is relatively lower than that of low-voltage electricity consumers.

(4) Results of demand forecasting

Figure 2-2-1-1-1.2 and Table 2-2-1-1-1.3 show the results of power demand forecast for the City of Djibouti.

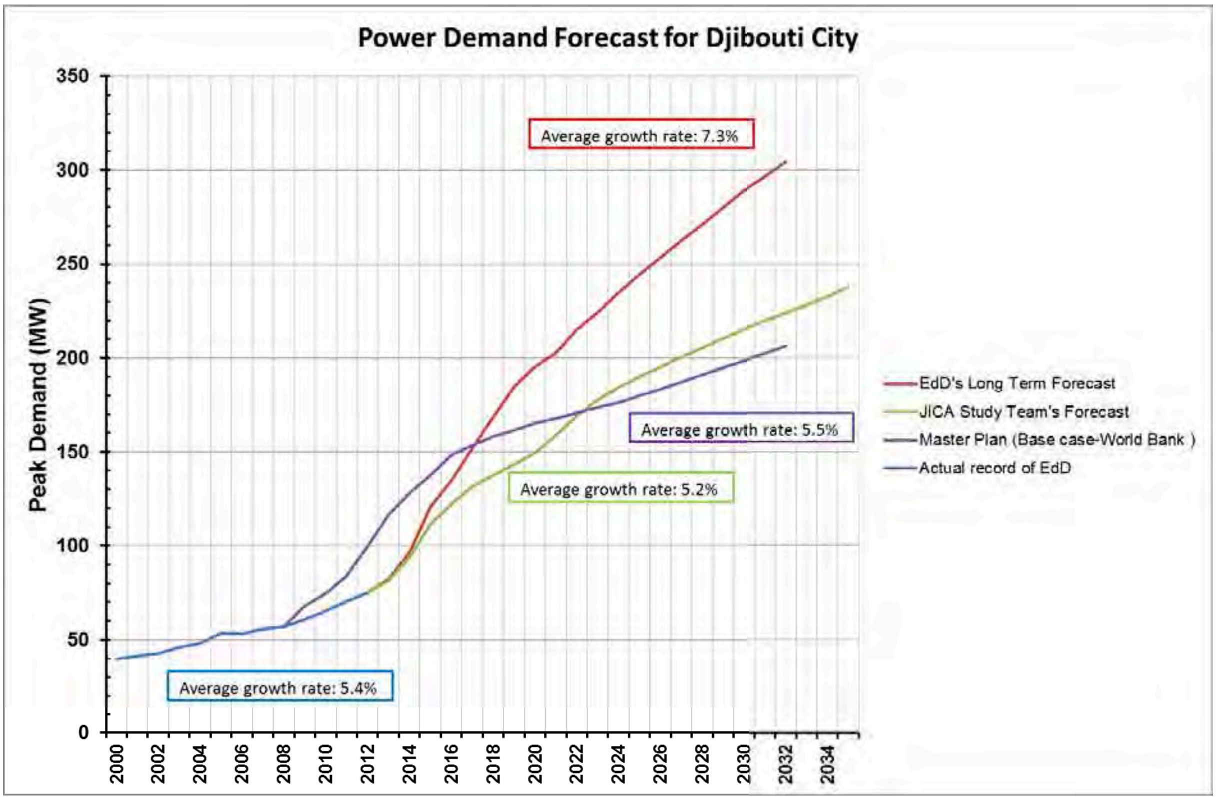


Figure 2-2-1-1-1.2 Power Demand Forecast for the City of Djibouti

Table 2-2-1-1-1.3 Power Demand Forecast for the City of Djibouti

Unit:MW

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035
Actual record of EdD	75.0	—	—	—	—	—	—	—	—	—	—	—
EdD's long-term forecast	—	82.4	96.4	120.6	134.9	152.0	168.2	184.6	195.2	244.4	289.1	—
JICA Study team's forecast	—	81.3	94.1	111.5	122.2	131.7	137.5	143.4	149.4	190.0	215.5	237.8
World Bank Maser Plan (base case)	99.7	116.3	128.2	137.6	148.6	153.3	158.1	161.6	165.2	179.9	198.5	—

(5) Electricity demand forecasting, by substation

Based on the electricity demand forecasting for the entire city of Djibouti, electricity demand of new large consumers that will be connected to substations and the current loads of the substations, the electricity demand at each substation to which Jaban As Substation supplies electricity has been forecast. Table 2-2-1-1-1.4 shows the electricity demand in future at each substation.

Table 2-2-1-1-1.4 Electricity Demand Forecast, by Substation

Unit: MW

Substation	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Marabout	24.7	25.3	23.2	23.9	24.4	24.9	25.5	26.2	26.9	27.7	29.1	30.7	32.1	33.7	35.4	36.4	37.5	38.6	39.8	41.0	42.3	43.7	45.2
Boulaos	39.6	42.2	42.4	45.8	47.6	48.8	50.1	51.1	52.3	53.5	54.7	56.1	57.2	58.7	60.3	61.9	63.6	65.4	67.3	69.2	71.3	73.5	75.8
Jaban As (63/20kV)	12.4	19.3	22.4	27.3	28.6	30.0	31.4	32.8	37.7	43.2	48.8	51.6	54.3	55.7	57.2	58.7	60.2	61.7	61.8	62.0	62.1	62.3	62.5
New Nagad	0.0	2.7	4.1	5.5	11.0	13.3	15.6	17.9	20.2	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Palmeraie	0.0	0.0	14.7	15.1	15.4	15.8	16.1	16.6	17.0	17.5	18.0	18.5	19.0	19.6	20.2	20.8	21.5	22.2	23.0	23.8	24.6	25.5	26.4
Ali Sabieh	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	4.9	5.0	5.0	5.1	5.1	5.2	5.2	5.3	5.4	5.4	5.5
Total	**81.3**	**94.1**	**111.5**	**122.2**	**131.7**	**137.5**	**143.4**	**149.4**	**158.9**	**169.2**	**178.1**	**184.3**	**190.0**	**195.2**	**200.5**	**205.3**	**210.3**	**215.5**	**219.6**	**223.8**	**228.2**	**232.9**	**237.8**

2-2-1-1-2 Load Flow Analysis

Load flow analysis has been conducted for a period between 2016, when the Project starts the operation, and 2035 and confirmed that the Request by Djibouti is appropriate to receive cheaper power supply from Ethiopia than electricity generated by diesel power stations.

(1) Data on Electric Power System

The electric power system of Djibouti comprises diesel power stations, with 230 kV, 63 kV and 20 kV power transmission and distribution facilities. To build a power system configuration model for the load flow analysis, data on the electric power system in Djibouti has been collected (Tables 2-2-1-1-2.1 to 2-2-1-1-2.4).

[Power Stations]

Table 2-2-1-1-2.1 Boulaos Power Station

No.	Commission Date	Type	Fuel Oil	Nominal Output (MW)	Service Output (MW)	Load Type
G1	1976	Alstom Pielstick 18PC2-2	heavy	6.0	4.0	peak
G12	2004	Caterpillar	heavy	7.25	6.5	base
G13	2001	Wartsila GMT 16VA32	heavy	6.0	4.5	base
G14	2001	Wartsila GMT 16VA32	heavy	6.0	4.5	base
G15	2001	Wartsila GMT 16VA32	heavy	6.0	4.5	base
G16	2001	Wartsila GMT 16VA32	heavy	6.0	4.5	base
G17	2003	Caterpillar	heavy	7.25	–	decommission
G18	2004	Caterpillar	heavy	7.25	6.5	base
G21	1984	FINCANTIERI B550/18	heavy	15.2	–	decommission
G22	2007	Wartsila Vassa 18V46	heavy	17.0	14.0	base
G23	2011	MAN 9L52/55A	heavy	8.5	6.5	base
G24	1988	MAN 9L52/55A	heavy	5.5	4.5	base
G25	2000	Wartsila GMT 18V46	heavy	14.4	13.4	base
G31	2010	SEMT PIELSTICK PA6	light	4.5	4.0	peak
G32	2010	SEMT PIELSTICK PA6	light	4.5	4.0	peak
Total				121.35	–	–

Source: EdD and Field Survey

Table 2-2-1-1-2.2 Marabout Power Station

No.	Commission Date	Type	Fuel Oil	Nominal Output (MW)	Service Output (MW)	Load Type
M1	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
M2	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
M3	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
M4	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
M5	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
M6	1999	Wartsila GMT 16V25	light	3.0	2.4	peak
Total				18.0	—	—

Source: EdD and Field Survey

[Transmission System]

Table 2-2-1-1-2.3 Substation

Substation	Voltage	Transformer Capacity
Jaban As	230/63 kV	63 MVA × 2
	63/20 kV	40 MVA × 1
Marabout	63/20 kV	36 MVA × 1
Boulaos	63/20 kV	36 MVA × 2
Ari Sabieh	63/20 kV	12 MVA × 1

Source: EdD and Field Survey

Table 2-2-1-1-2.4 Transmission Line

Line	Voltage	Length	Conductor	Rating Capacity
(a) Dire Dawa – Jaban As	230 kV	283 km	Overhead line Ash (180 mm^2) × 2	290 MVA × 2
(b) Jaban As – Palmeraie	63 kV	8.2 km	Overhead line Aster (366 mm^2) × 2	65 MVA × 2
(c) Palmeraie – Boulaos	63 kV	3.8 km	Underground cable 800 mm^2 × 1	72 MVA × 1
(d) Palmeraie – Marabout	63 kV	5 km	Underground cable 800 mm^2 × 1	72 MVA × 1
(e) Boulaos – Marabout	63 kV	4.8 km	Underground cable 400 mm^2 × 1	36 MVA × 1
(f) Jaban As – Ali Sabieh	63 kV	72 km	Overhead line Ash (180 mm^2) × 2	40 MVA × 2

Source: EdD and Field Survey

(2) Building of Power System Model

Based on the data on the power systems, and supply and demand presented in the previous section, the power system model for Djibouti has been built with ETAP load flow calculation program. For reference, Table 2-2-1-1-2.1 shows the load flow incorporating power supply and demand on July 31, 2012, when the country saw its maximum record of power demand in 2012. Flow lines in vermillion in the figure indicate that the system voltage was outside the range of ±5 %.

Annex 6-I shows the details of major input data.

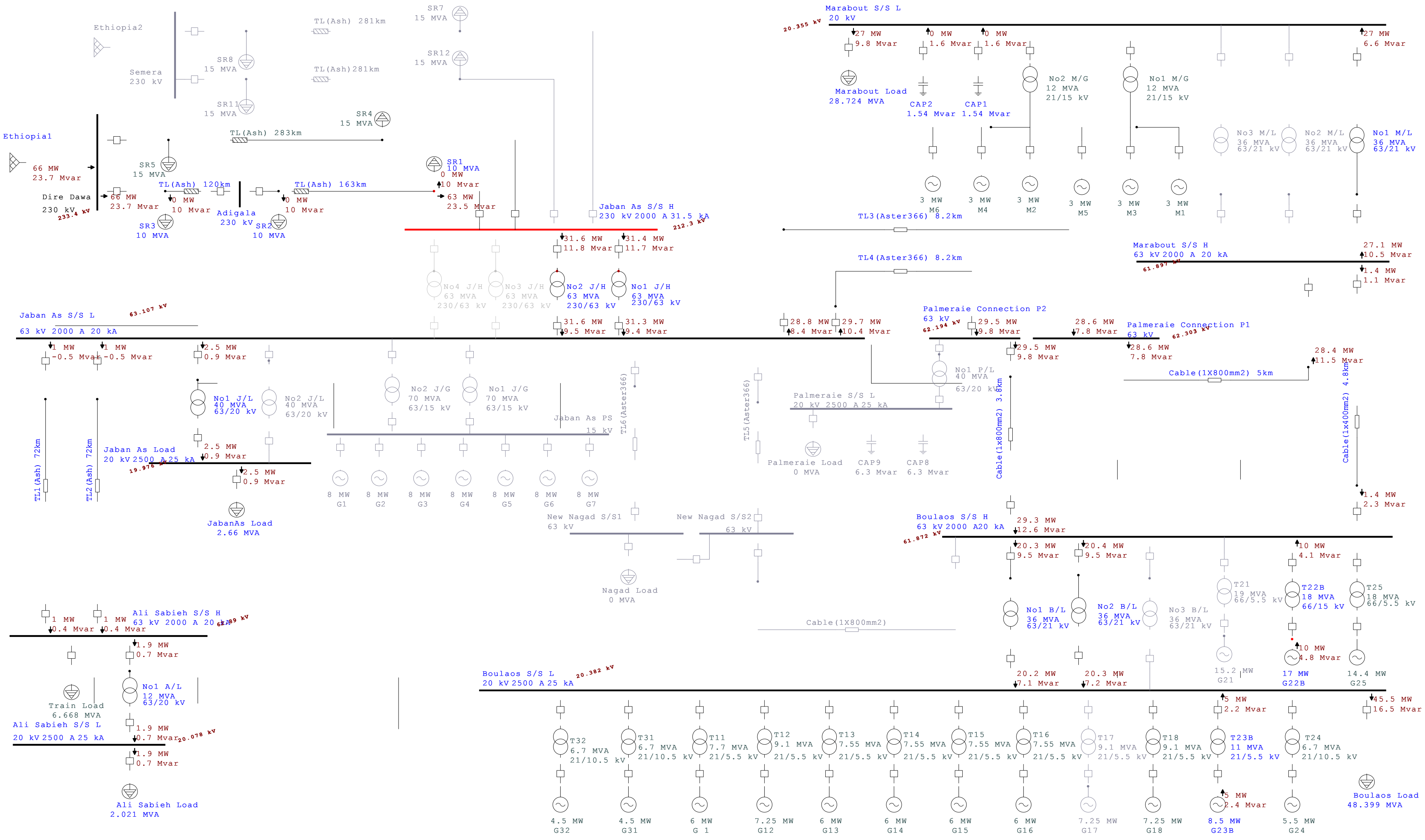


Figure 2-2-1-1-2.1 Power System Model and Load Flow Results (July 31, 2012)

(3) Case Studies

After ETAP system configuration has been confirmed, based on the demand forecasts in the previous section, Section 2-2-1-1-1, the following power development plans, and case studies have been conducted for a period between 2016, when the Project starts the operation, and 2035.

1) Power development plan other than the Project

[1] Conversion of Palmeraie site to substation (the operation starts in 2015)

A grid control center will be constructed on Palmeraie site (the point where overhead line is draw into underground) with the support of EU. Together with this, the transmission line from Jaban As Substation to Boulaos Substation will be converted to substation. This will enable Palmeraie Substation to supply a part of demand that has been supplied by Boulaos Substation.

- 40 MVA transformer (63/20 kV) x 1 set
- 6.3 MVar Capacitors x 2 sets

[2] Jaban As Power Station (the operation starts in 2015)

A diesel power station with the total output of 56 MW will be constructed next to Jaban As Substation by 2015. It will be equipped with the double circuit transmission line to supply electricity to 63 kV bus of Jaban As Substation.

- 8 MW diesel power generators x 7 sets
- 70 MVA transformers x 2 sets

[3] Expansion of interconnection transmission line (the operation starts in 2017)

230 kV double circuit international transmission line will be additionally constructed to interconnect from Semera Substation in Ethiopia to Jaban As Substation in Djibouti.

Figure 2-2-1-1-2.2 outlines the power development plan of Djibouti.

60 MW wind power station to be developed by Qatar Petroleum and the geothermal power station in Djibouti will be connected at Point PK51 on the international transmission line from Dire Dawa Substation in Ethiopia to Jaban As Substation. Since the Project is for 63 kV transmission lines from Jaban As Substation, power supply from these two stations will be considered to be part of power supply from Ethiopia and will not be included in the system model for load flow analysis.

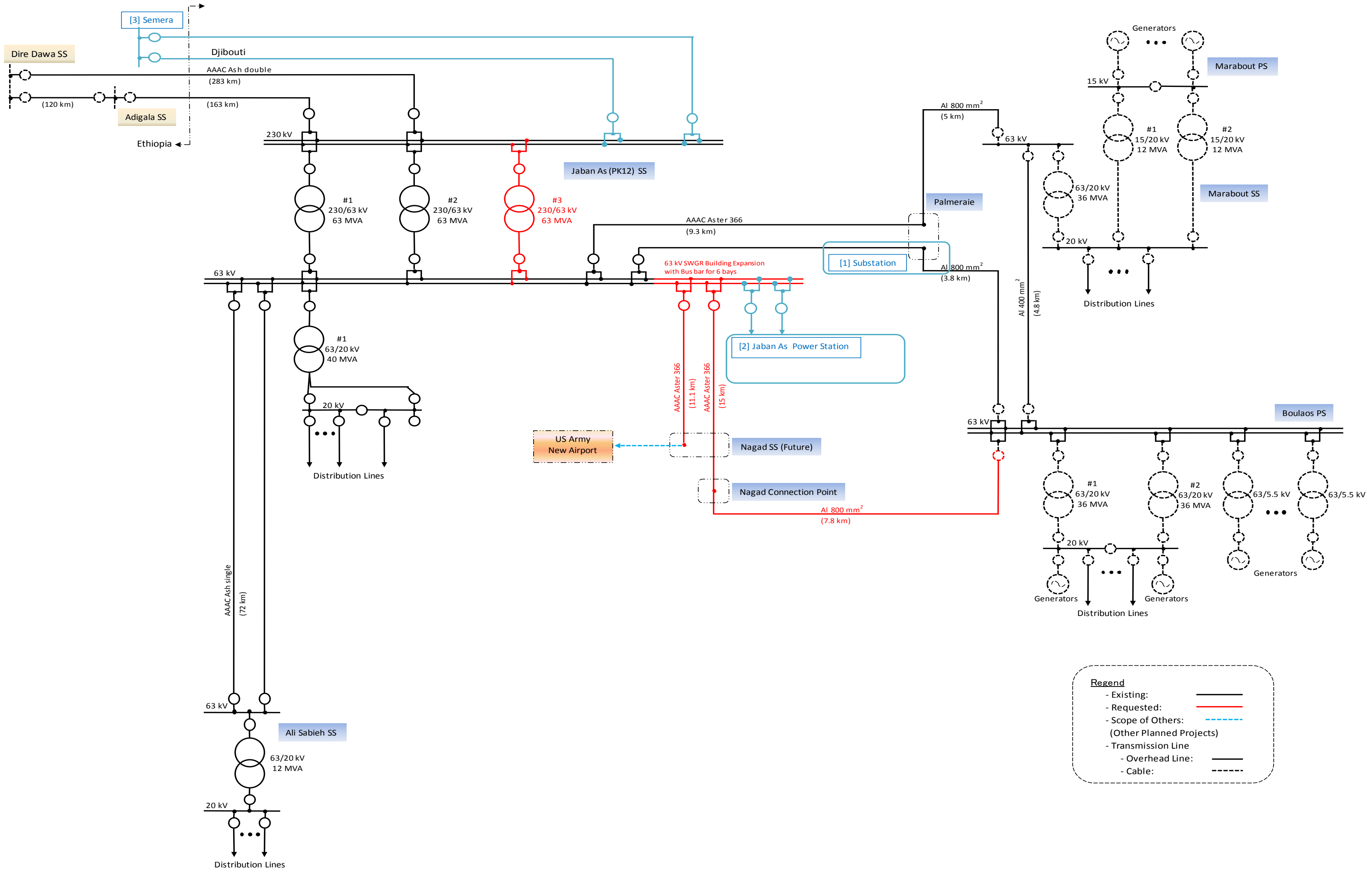


Figure 2-2-1-1-2.2 Outline of Power Development Plan

2) Conditions for the analysis

- According to hearings to EdD about the grid operation scheme, the power supply basically consists of 75 % of import and 25 % of domestic supply, so this supply ration is applied to the case studies.
- Jaban As Power Station will start the operation in 2015, which is expected to be more efficient than the existing diesel power generators, so that the operation of this station is considered to be the base load power operation. However, the diesel generators at Marabout Station are old and require high fuel costs, so the operation of the station is considered to be peak load operation as in the case of the current operation by EdD. The operation of Boulaos Power Station is considered to be middle-load operation, though it has been for base load operation.
- The system voltage should be within the range of ±5 % as the operation criteria of international transmission lines [1].
- The power factor of consumers is set at 90 % according to the record surveyed. It is also assumed that heavy consumers will take measures to set their load at around 90 % in future.

3) Results of the analysis and confirmation of the effects of the Project

The following sections summarize the results of the analysis and the effects of requested components of the Project. Table 2-2-1-1-2.8 lists the case study results, and Annex 6-II illustrates diagrams of the analytical results of the case studies.

(a) 2019: Necessity and effects of expansion of 63 kV transmission line (under the Project)

Case 6 [Analytical results for the existing system (Figure 2-2-1-1-2.3)]

In the event the Project will not be implemented, the following problems will occur.

(i) Overhead line from Jaban As Substation via Palmeraie Substation to Boulaos Substation will have overload of 0.7 %.

(ii) An increase in power demand at Boulaos Substation will make two 63/20 kV transformers have overload of 12.2 % (which will occur in 2018 if the Project is not implemented).

Case 7 [the effects of expansion of transmission lines (Figure 2-2-1-1-2.4)]

- The implementation of the Project will solve Problems (i) and (ii) above.
- Problem (ii), overload of two 63/20 kV transformers at Boulaos Substation, will be solved because the expansion of transmission lines under the Project will enable Nagad Substation to supply the power demand that has been supplied by Boulaous Substation.
- Expansion of transmission lines under the Project will save power system loss of 1.60 MW, compared to Case 6.

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[1] Source: “Least Cost Electricity Master Plan, Djibouti”, The World Bank, November 2009 and ”ETHIOPIA-DJIBOUTI POWER INTERCONNECTION PROJECT”, EEPCO/EDD, January 2008

(b) 2021: Necessity and effects of installation of No. 3 230/63 kV transformers for Jaban As Substation (under the Project) and No. 2 63/20 kV transformers for Jaban As Substation (Master Plan)

Case 10 [Analytical results under the condition that the transmission line in (a) is added to the existing system (Figure 2-2-1-1-2.5)]

(iii) Two 230/63 kV transformers at Jaban As Substation will have overload of 4.0 %.

(iv) No. 1 63/20 kV transformer at Jaban As Substation will have overload of 11.4 %.

Case 11 [Effects of installation of No. 3 230/63 kV transformer at Jaban As Substation (under the Project) (Figure 2-2-1-1-2.6)]

- The overload, Problem (iii), will be solved, and installation of the transformer will save power system loss of 0.17 MW.

Case 12 [Effects of installation of No. 2 63/20 kV transformers at Jaban As Substation (Figure 2-2-1-1-2.7)]

- The overload, Problem (iv), will be solved.

(c) 2025: Necessity and effects of Nos. 2 & 3 63/20 kV transformers at Marabout Substation (Master Plan)

Case 17 [Analytical results under the condition that the transmission line in (a) and the transformers in (b) are added to the existing system (Figure 2-2-1-1-2.8)]

(v) No.1 63/20 kV transformer at Marabout Substation will have overload of 3.1 %.

Case 18 [Effects of installation of Nos. 2 & 3 63/20 kV transformers at Marabout Substation (Figure 2-2-1-1-2.9)]

- The overload, Problem (vi), will be solved.

(d) 2031: Necessity and effects of No. 3 63/20 kV transformer at Boulaos Substation (Master Plan)

Case 25 [Analytical results under the condition that the transmission line in (a) and the transformers in (b) and (c) are added to the existing system (Figure 2-2-1-1-2.10)]

(vi) Nos. 1 & 2 63/20 kV transformers at Boulaos Substation will have overload of 2.2 %.

Case 26 [Effects of installation of No. 3 63/20 kV transformers at Boulaos Substation (Figure 2-2-1-1-2.11)]

- The overload, Problem (vii), and Problem (viii) will be solved.

(e) 2032: Necessity and effects of No. 4 230/63 kV transformer at Jaban As Substation

Case 27 [Analytical results under the condition that the transmission line in (a) and the transformers in (b), (c) and (d) are added to the existing system (Figure 2-2-1-1-2.12)]

(vii) Nos. 1 & 2 and 3 230/63 kV transformers at Jaban As Substation will have overload of approximately 2.3 %.

(viii) Some points of the bus line will be unable to maintain the voltage range of ±5 %.

Case 28 [Effects of installation of No.4 63/20 kV transformers at Jaban As Substation (Figure 2-2-1-1-2.13)]

- The overload, Problem (viii), will be solved.

(f) Necessity of systematic introduction of capacitors

- As shown in Case 29 (Figure 2-2-1-1-2.14), some points of the bus line will be unable to maintain the voltage range of ±5 %. To avoid this risk, certain measures must be taken, including (i) setting the supply voltage from Ethiopia somewhat higher; and/or (ii) adequately installing capacitors by Djibouti (Case 30, Figure 2-2-1-1-2.15).

(g) Confirmation of the status of the system at minimum demand

- The maximum demand in 2012 was 75 MW on July 31 and the minimum demand (except outage) was 21.9 MW on January 6. Accordingly, the minimum demand is set at approximately 29 % of the maximum demand, and the load flow analysis has confirmed the state of the system in 2017 when the Project starts the operation, and proved that there is no particular problem with the status of system including voltage (Case 4, Figure 2-2-1-1-2.16).

(4) Short-Circuit Current Study

The 3-phase short-circuit current study has been calculated under the condition, where all the generators except those decommissioned, G17 and G21, are operated (the condition in 2035). Table 2-2-1-1-2.5 shows the results.

Table 2-2-1-1-2.5 Short-Circuit Current Levels

Substations	Bus voltage	Short-circuit current
Jaban As	230 kV	6.5 kA
	63 kV	14.6 kA
	20 kV	13.6 kA
Boulaos	63 kV	11.5 kA
Marabout	63 kV	10.9 kA

(5) Validity of the Project and recommendations

1) Validity of the Project

- It is expected that the existing 63 kV transmission line between Jaban As Substation and Boulaos Substation will have overload in 2019, and that the existing 230/63 kV transformers at Jaban As Substation supplying power from the international transmission line to Djibouti will have overload in 2021, causing problems with power supply to the country. Thus, the Project that will start the operation in 2017 is appropriate.
- Table 2-2-1-1-2.6 indicates, the project effects will be sustainable, so the Project is appropriate.

Table 2-2-1-1-2.6 Sustainability of the Effects

the Project	Sustainability of the effects
Expansion of 63 kV transmission line	Even in 2035 (19 years after commencement of the operation), the transmission line between Jaban As Substation and Boulaos / Marabout Substations will have no overload. (In 2035, load factor of 63 kV transmission line between Jaban As Substation and Boulaos Substation will be 92.8 %.)
No.3 230/63 kV transformer at Jaban As Substation	230/63 kV transformers at Jaban As Substation supplying power from the international transmission line will have no overload until 2031 (15 years after commencement of the operation).

- The implementation of the Project is expected to reduce power system loss of 1.22 MW at the time the operation starts in 2017 (Case 2).

2) Recommendations

- To avoid any problem with power supply, Djibouti should install additional transformers planned under Master Plan by the years specified in Table 2-2-1-1-2.7.

Table 2-2-1-1-2.7 Facilities Necessary to be installed

Facility	Necessary year
No.2 63/20 kV transformer at Jaban As Substation	2021
Nos.2&3 63/20 kV transformers at Marabout Substation	2025
No.3 63/20 kV transformer at Boulaos Substation	2031

- Djibouti should consider installing No.4 63/20 kV transformer at Jaban As Substation because a possible problem is expected to arise to power supply from the international transmission line to the country in 2032.

- To maintain the bus voltage within ±5 %, Djibouti should install the capacitors planned under Master Plan.

Table 2-2-1-1-2.8 List of Case Studies and Results (1/2)

(1/2)

Case		Base	Case1	Case2	Case3	Case4	Case5	Case6	Case7	Case8	Case9	Case10	Case11	Case12	Case13	Case14	Case15	Case16
Year		2012	2016	2017			2018	2019		2020		2021				2022	2023	2024
Operation Year		-4	-1	1			2	3		4		5				6	7	8
Ivent (●: Operation)																		
Demand																		
Maximum		●	●	●	●		●	●	●	●		●	●	●		●	●	●
Minimum						●					●				●			
The Project																		
230/63kV Tr x 1 at Jaban As					●	●							●	●	●	●	●	●
63kV Transmission Lines					●	●			●	●	●	●	●	●	●	●	●	●
Other Projects																		
Semera International Transmission Line				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Palmeraie Substation			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Jaban As Power Station			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Master Plan																		
63/20kV Tr x 1at Jaban As S/S														●	●	●	●	●
No2 and No3 63/20kV Tr at Marabout																		
No3 63/20kV Tr at Boulaos																		
Capacitor at Jaban As, Marabout and Boulaos																		
Recommendation																		
No.4 230/63kV Tr at Jaban As																		
Load Allocation																		
Power Factor		0.94	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Marabout	MW	27.0	23.9	24.4	24.4	7.1	24.9	25.5	25.5	26.2	7.7	26.9	26.9	26.9	7.9	27.7	29.1	30.7
	MVar	9.8	11.6	11.8	11.8	3.5	12.0	12.4	12.4	12.7	3.7	13.0	13.0	13.0	3.8	13.4	14.1	14.9
	MVA	28.7	26.6	27.1	27.1	7.9	27.6	28.3	28.3	29.1	8.5	29.9	29.9	29.9	8.7	30.8	32.3	34.1
Boulaos	MW	45.5	51.3	58.6	47.6	13.9	62.1	65.7	50.1	51.1	14.9	52.3	52.3	52.3	15.3	53.5	54.7	56.1
	MVar	16.5	24.8	28.4	23.1	6.7	30.1	31.8	24.3	24.7	7.2	25.3	25.3	25.3	7.4	25.9	26.5	27.2
	MVA	48.4	57.0	65.1	52.9	15.4	69.0	73.0	55.7	56.8	16.6	58.1	58.1	58.1	17.0	59.4	60.8	62.3
Jaban As	MW	2.5	27.3	28.6	28.6	8.4	30.0	31.4	31.4	32.8	9.6	37.7	37.7	37.7	11.0	43.2	48.8	51.6
	MVar	0.9	13.2	13.9	13.9	4.0	14.5	15.2	15.2	15.9	4.6	18.3	18.3	18.3	5.3	20.9	23.6	25.0
	MVA	2.7	30.3	31.8	31.8	9.3	33.3	34.9	34.9	36.4	10.6	41.9	41.9	41.9	12.2	48.0	54.2	57.3
New Nagad	MW	0.0	0.0	0.0	11.0	3.2	0.0	0.0	15.6	17.9	5.2	20.2	20.2	20.2	5.9	22.5	22.5	22.5
	MVar	0.0	0.0	0.0	5.3	1.6	0.0	0.0	7.6	8.7	2.5	9.8	9.8	9.8	2.9	10.9	10.9	10.9
	MVA	0.0	0.0	0.0	12.2	3.6	0.0	0.0	17.3	19.9	5.8	22.4	22.4	22.4	6.6	25.0	25.0	25.0
Palmeraie	MW	0.0	15.1	15.4	15.4	4.5	15.8	16.1	16.1	16.6	4.8	17.0	17.0	17.0	5.0	17.5	18.0	18.5
	MVar	0.0	7.3	7.5	7.5	2.2	7.7	7.8	7.8	8.0	2.3	8.2	8.2	8.2	2.4	8.5	8.7	9.0
	MVA	0.0	16.8	17.1	17.1	5.0	17.6	17.9	17.9	18.4	5.4	18.9	18.9	18.9	5.5	19.4	20.0	20.6
Ali Sabieh	MW	1.9	4.7	4.7	4.7	1.4	4.7	4.7	4.7	4.8	1.4	4.8	4.8	4.8	1.4	4.8	4.9	4.9
	MVar	0.7	2.3	2.3	2.3	0.7	2.3	2.3	2.3	2.3	0.7	2.3	2.3	2.3	0.7	2.3	2.4	2.4
	MVA	2.0	5.2	5.2	5.2	1.5	5.2	5.3	5.3	5.3	1.5	5.3	5.3	5.3	1.5	5.4	5.4	5.4
Total	MW	76.9	122.3	131.7	131.7	38.5	137.5	143.4	143.4	149.4	43.6	158.9	158.9	158.9	46.4	169.2	178.0	184.3
	MVar	27.2	57.0	61.5	61.5	18.0	64.3	67.2	67.2	70.0	20.4	74.6	74.6	74.6	21.8	79.6	83.8	86.9
	MVA	81.8	135.9	146.3	146.3	42.7	152.7	159.4	159.4	166.0	48.5	176.5	176.5	176.5	51.5	188.0	197.8	204.8
Power Production																		
Import	MW	57.7	91.7	98.8	98.8	28.8	103.1	107.6	107.6	112.0	32.7	119.2	119.2	119.2	34.8	126.9	133.5	138.2
	%	79	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Deasel Generator	MW	15.0	30.6	32.9	32.9	9.6	34.4	35.9	35.9	37.3	10.9	39.7	39.7	39.7	11.6	42.3	44.5	46.1
	%	21	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Total	MW	72.7	122.3	131.7	131.7	38.4	137.5	143.5	143.5	149.3	43.6	158.9	158.9	158.9	46.4	169.2	178.0	184.3
Transmission Loss																		
Loss (Jaban As to 20kV Bus)	MW	1.12	2.62	3.05	1.83	0.18	3.38	3.73	2.13	2.33	0.21	2.56	2.48	2.39	0.22	2.61	2.83	3.01
	%	1.54	2.14	2.32	1.39	0.47	2.46	2.60	1.48	1.56	0.48	1.61	1.56	1.50	0.47	1.54	1.59	1.63

Case		Case17	Case18	Case19	Case20	Case21	Case22	Case23	Case24	Case25	Case26	Case27	Case28	Case29	Case30	Case31	Case32
Year		2025			2026	2027	2028	2029	2030	2031		2032		2033		2034	2035
Operation Year		9			10	11	12	13	14	15	15	16		17		18	19
Ivent (●: Operation)																	
Demand																	
Maximum		●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Minimum				●													
The Project																	
230/63kV Tr x 1 at Jaban As		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
63kV Transmission Lines		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Other Projects																	
Semera International Transmission Line		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Palmeraie Substation		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Jaban As Power Station		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Master Plan																	
63/20kV Tr x 1at Jaban As S/S		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No2 and No3 63/20kV Tr at Marabout			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No3 63/20kV Tr at Boulaos											●	●	●	●	●	●	●
Capacitor at Jaban As, Marabout and Boulaos															●	●	●
Recommendation																	
No.4 230/63kV Tr at Jaban As													●	●	●	●	●
Load Allocation																	
Power Factor		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Marabout	MW	32.1	32.1	9.4	33.7	35.4	36.4	37.5	38.6	39.8	39.8	41.0	41.0	42.3	42.3	43.7	45.2
	MVar	15.5	15.5	4.5	16.3	17.1	17.6	18.2	18.7	19.3	19.3	19.9	19.9	20.5	20.5	21.2	21.9
	MVA	35.7	35.7	10.4	37.4	39.3	40.4	41.7	42.9	44.2	44.2	45.6	45.6	47.0	47.0	48.6	50.2
Boulaos	MW	57.2	57.2	16.7	58.7	60.3	61.9	63.6	65.4	67.3	67.3	69.2	69.2	71.3	71.3	73.5	75.8
	MVar	27.7	27.7	8.1	28.4	29.2	30.0	30.8	31.7	32.6	32.6	33.5	33.5	34.5	34.5	35.6	36.7
	MVA	63.6	63.6	18.6	65.2	67.0	68.8	70.7	72.7	74.8	74.8	76.9	76.9	79.2	79.2	81.7	84.2
Jaban As	MW	54.3	54.3	15.9	55.7	57.2	58.7	60.2	61.7	61.8	61.8	62.0	62.0	62.1	62.1	62.3	62.5
	MVar	26.3	26.3	7.7	27.0	27.7	28.4	29.2	29.9	29.9	29.9	30.0	30.0	30.1	30.1	30.2	30.3
	MVA	60.3	60.3	17.6	61.9	63.6	65.2	66.9	68.6	68.7	68.7	68.9	68.9	69.0	69.0	69.2	69.5
New Nagad	MW	22.5	22.5	6.6	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
	MVar	10.9	10.9	3.2	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
	MVA	25.0	25.0	7.3	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Palmeraie	MW	19.0	19.0	5.6	19.6	20.2	20.8	21.5	22.2	23.0	23.0	23.8	23.8	24.6	24.6	25.5	26.4
	MVar	9.2	9.2	2.7	9.5	9.8	10.1	10.4	10.8	11.1	11.1	11.5	11.5	11.9	11.9	12.4	12.8
	MVA	21.2	21.2	6.2	21.8	22.4	23.1	23.9	24.7	25.6	25.6	26.4	26.4	27.3	27.3	28.3	29.3
Ali Sabieh	MW	4.9	4.9	1.4	5.0	5.0	5.1	5.1	5.2	5.2	5.2	5.3	5.3	5.4	5.4	5.4	5.5
	MVar	2.4	2.4	0.7	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.7
	MVA	5.4	5.4	1.6	5.6	5.6	5.7	5.7	5.8	5.8	5.8	5.9	5.9	6.0	6.0	6.0	6.1
Total	MW	190.0	190.0	55.5	195.2	200.6	205.4	210.4	215.6	219.6	219.6	223.8	223.8	228.2	228.2	232.9	237.9
	MVar	89.7	89.7	26.2	92.1	94.7	97.0	99.4	101.9	103.8	103.8	105.8	105.8	107.9	107.9	110.2	112.6
	MVA	211.2	211.2	61.7	216.9	222.9	228.2	233.8	239.6	244.0	244.0	248.7	248.7	253.6	253.6	258.8	264.3
Power Production																	
Import	MW	142.5	142.5	41.6	146.4	150.5	154.1	157.8	161.7	164.7	164.7	167.9	167.9	171.2	171.2	174.7	178.4
	%	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Deasel Generator	MW	47.5	47.5	13.9	48.8	50.2	51.4	52.6	53.9	54.9	54.9	56.0	56.0	57.1	57.1	58.2	59.5
	%	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Total	MW	190.0	190.0	55.5	195.2	200.7	205.5	210.4	215.6	219.6	219.6	223.9	223.9	228.3	228.3	232.9	237.9
Transmission Loss																	
Loss (Jaban As to 20kV Bus)	MW	3.26	3.06	0.24	3.32	3.23	3.37	3.66	3.83	4.07	3.86	4.11	3.95	4.11	3.86	4.04	4.30
	%	1.72	1.61	0.43	1.70	1.61	1.64	1.74	1.78	1.85	1.76	1.84	1.76	1.80	1.69	1.73	1.81

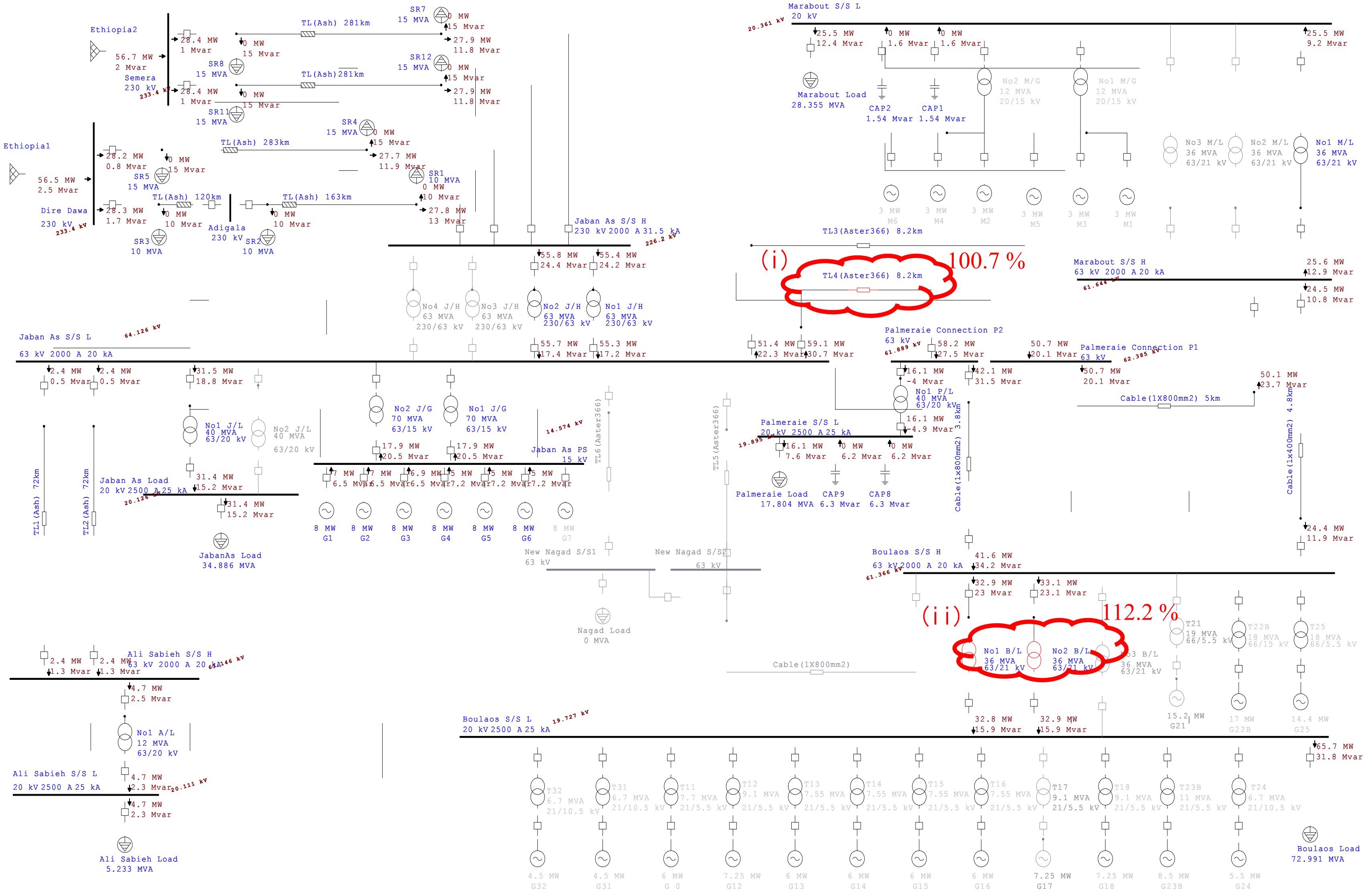


Figure 2-2-1-1-2.3 Case 6: Analytical Results (as of 2019) of the Existing System

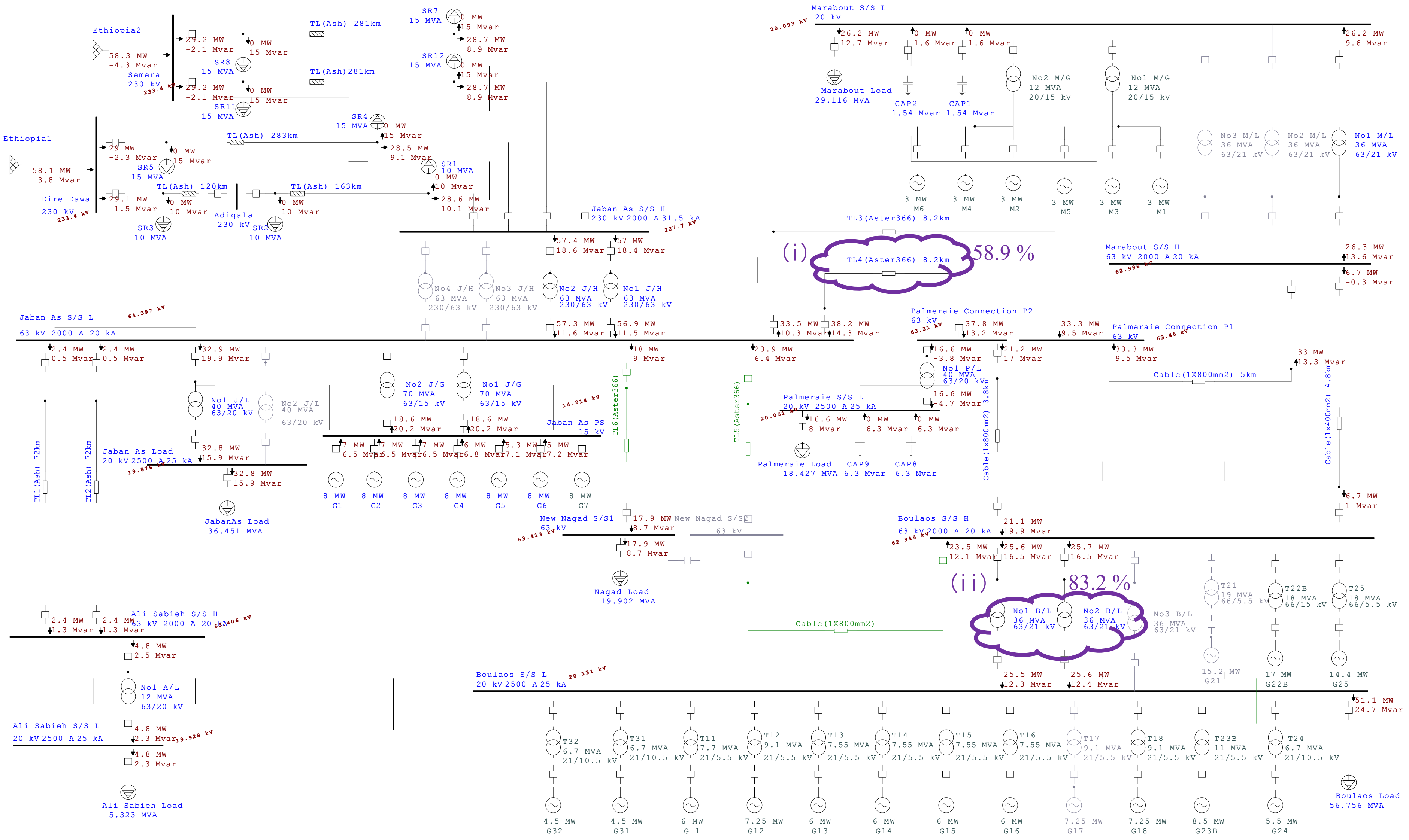


Figure 2-2-1-1-2.4 Case 7: Effects of Expansion of Transmission Line (as of 2019)

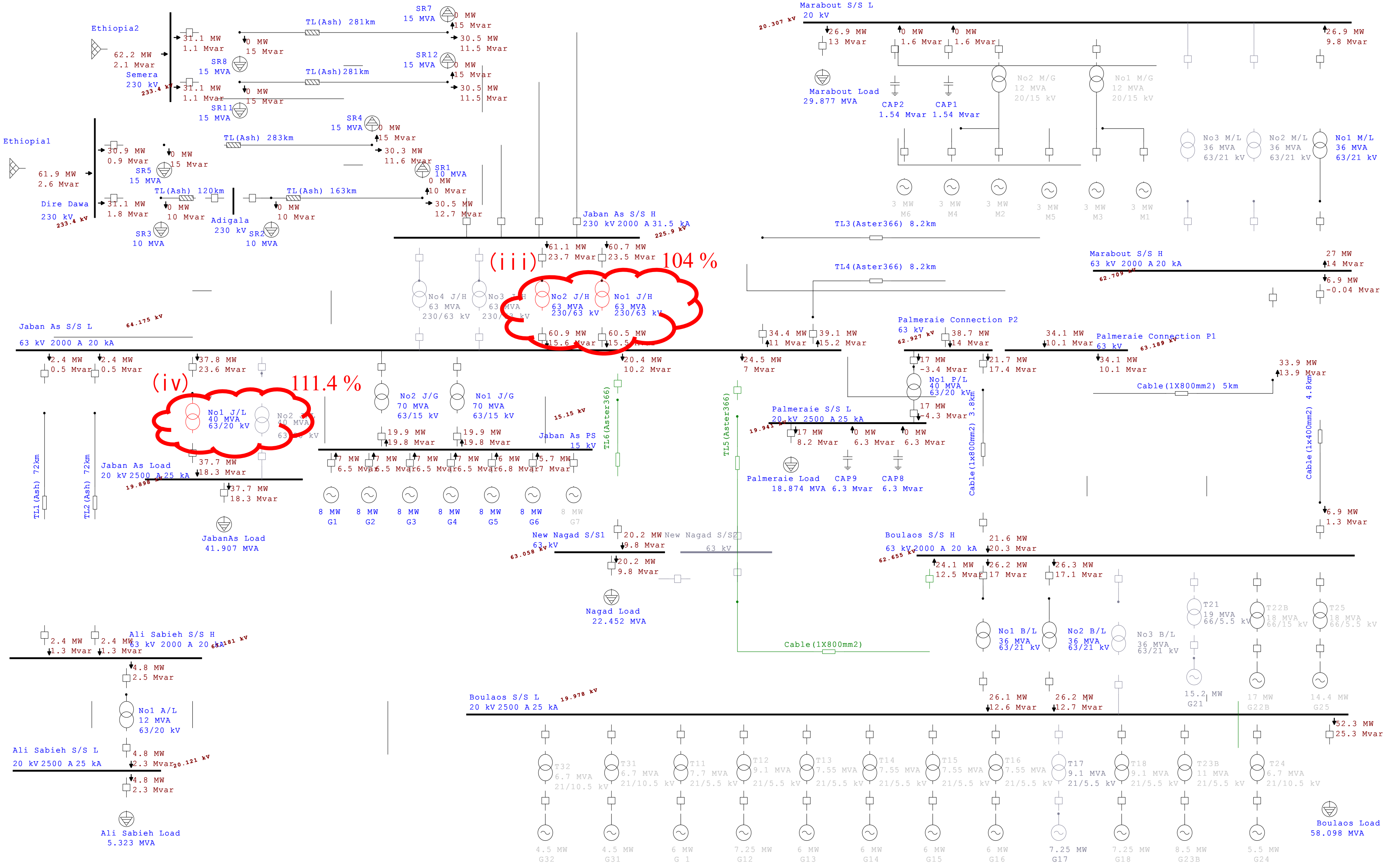


Figure 2-2-1-1-2.5 Case 10: Analytical Results (as of 2021) of the Existing System and Transmission Line which will be expanded in 2020

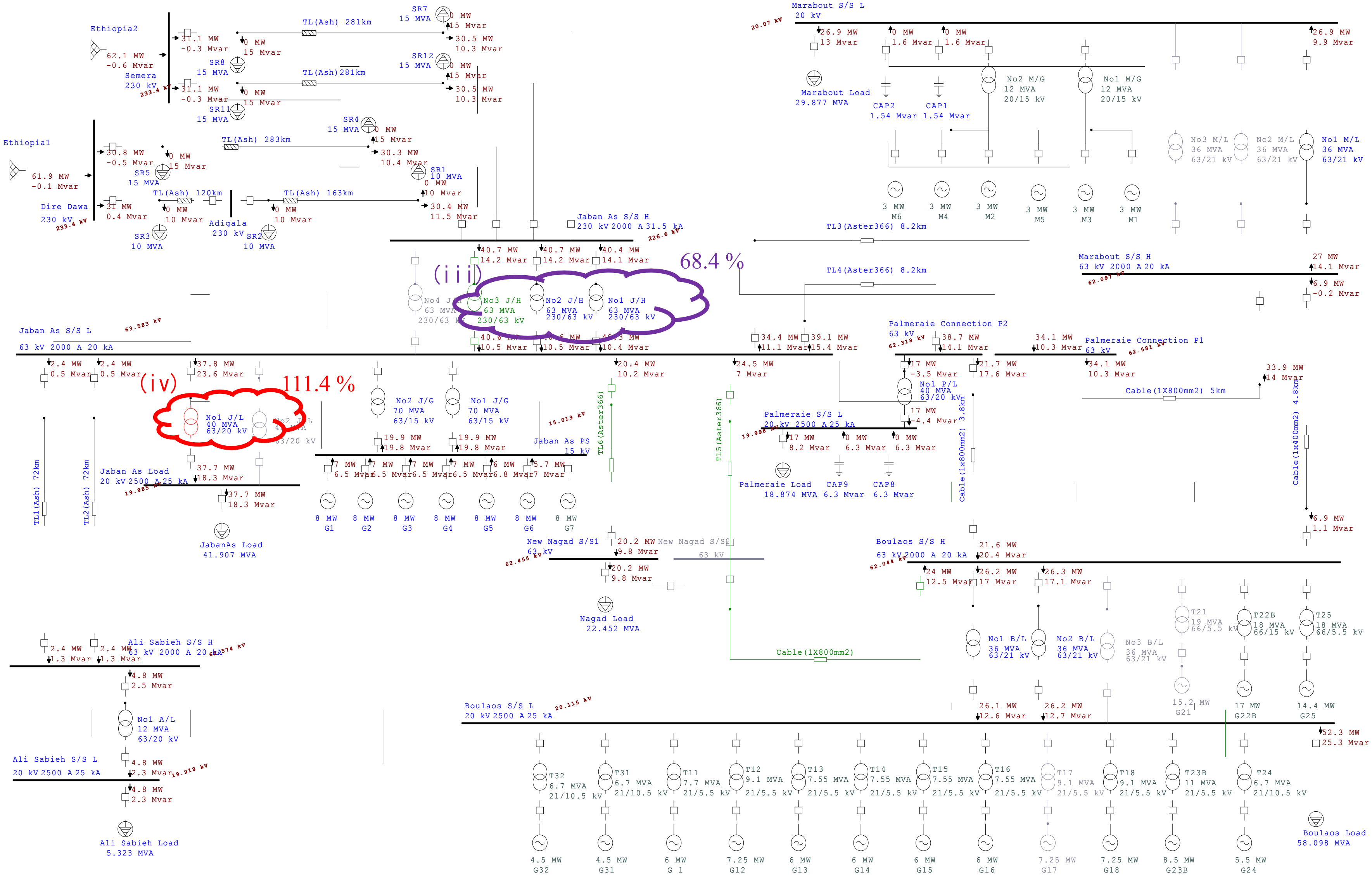


Figure 2-2-1-1-2.6 Case 11: Effects of Installation of No.3 230/63 kV Transformer at Jaban As Substation (as of 2021)

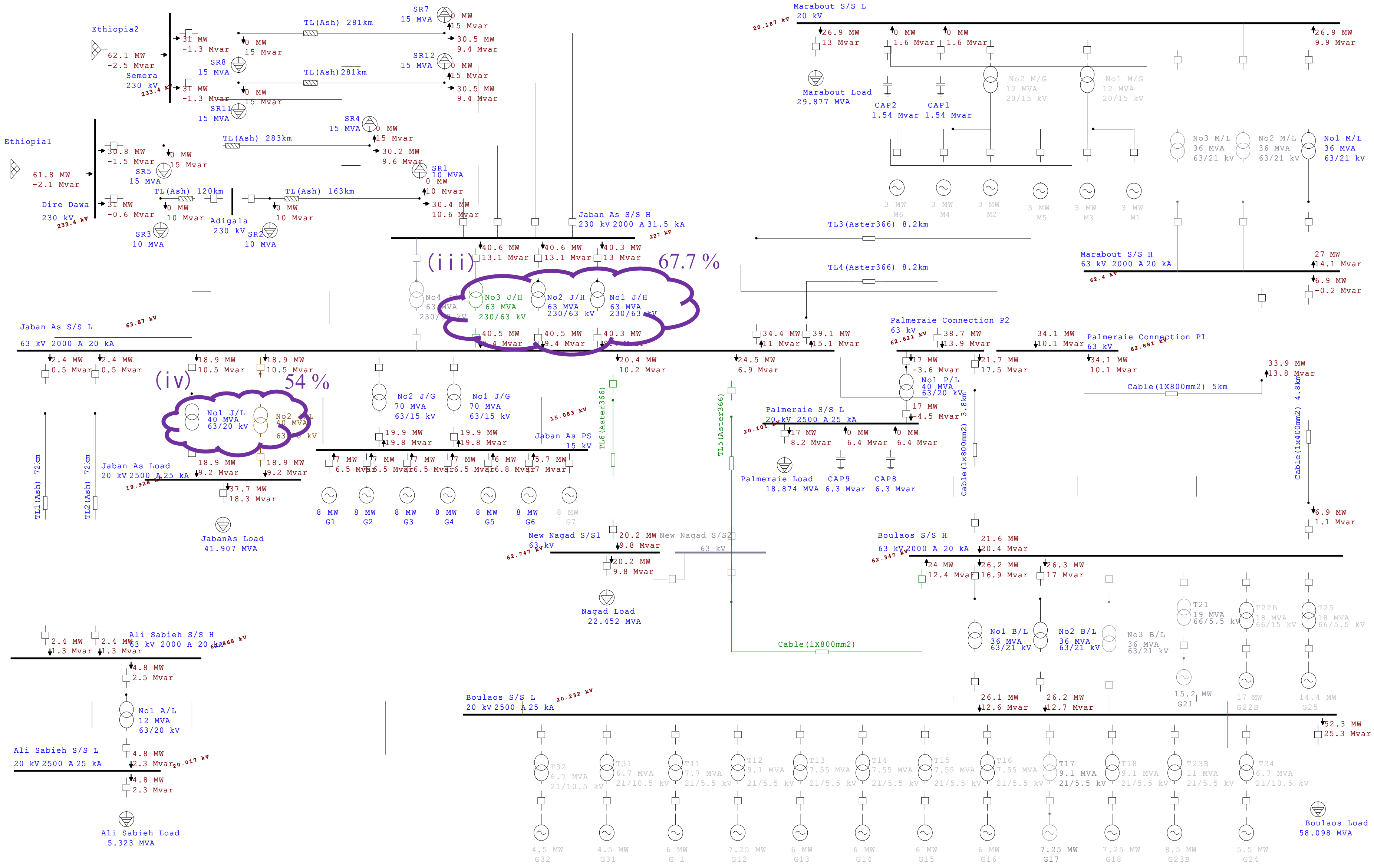


Figure 2-2-1-1-2.7 Case 12: Effects of Installation of No.2 63/20 kV Transformer at Jaban As Substation (as of 2021)

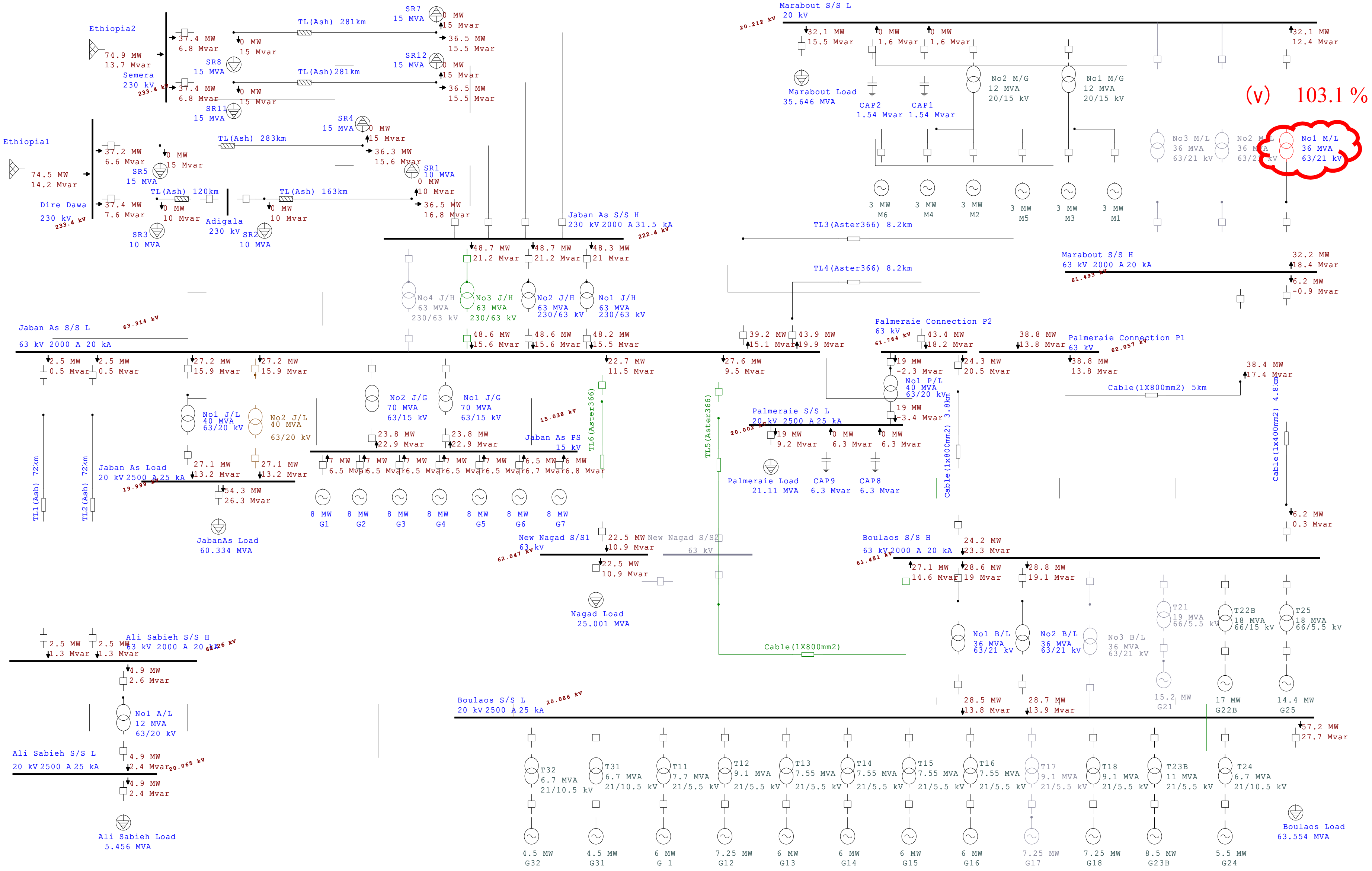


Figure 2-2-1-1-2.8 Case 17: Analytical Results (as of 2025) of the Existing System, Transmission Line which will be expanded in 2020 and Transformer which will be installed in 2021

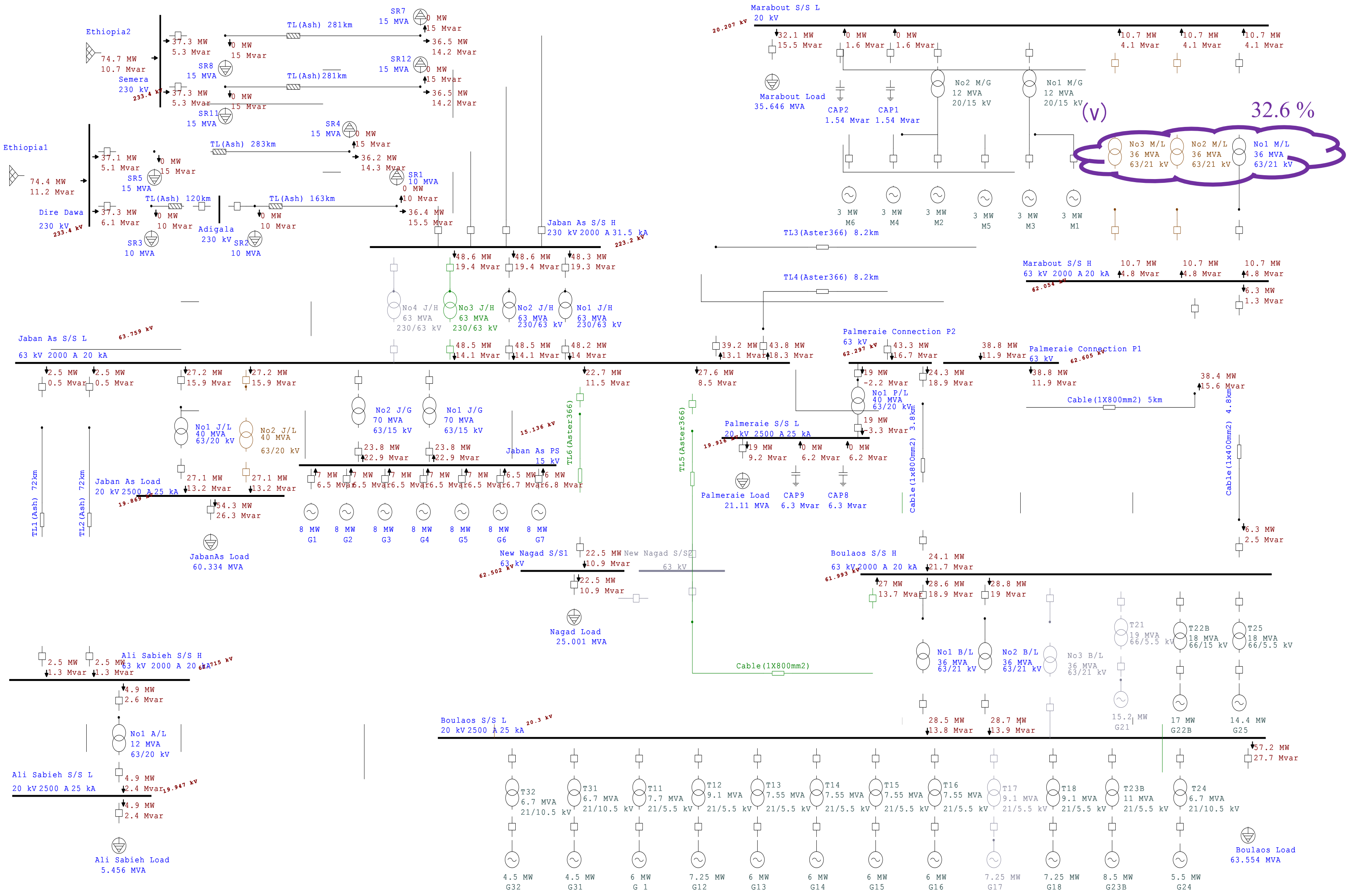


Figure 2-2-1-1-2.9 Case 18: Effects of Installation of Nos. 2&3 63/20 kV Transformers at Marabout Substation (as of 2025)

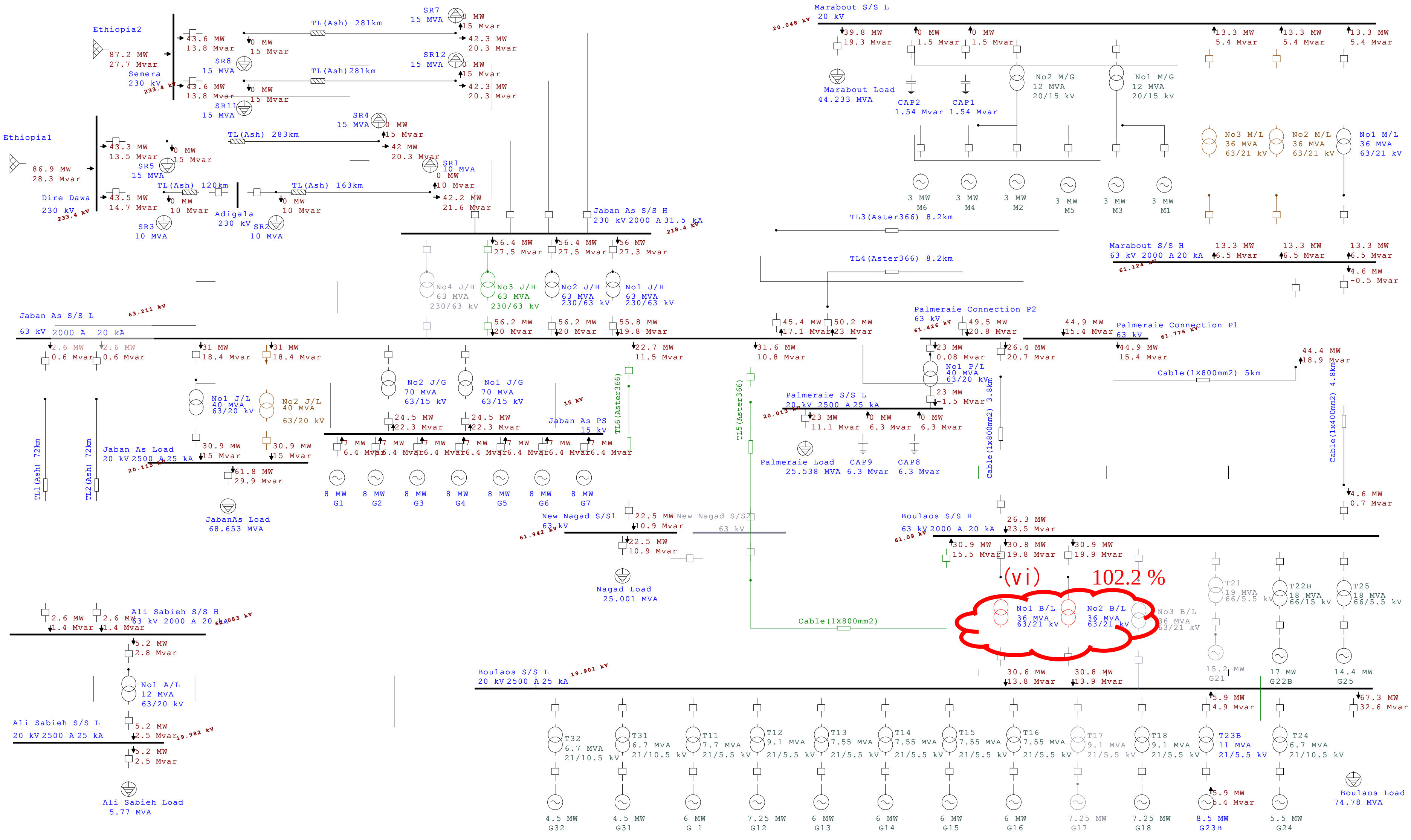


Figure 2-2-1-1-2.10 Case 25: Analytical Results (as of 2031) of the Existing System, Transmission Line which will be expanded in 2020 and Transformers which will be installed in 2021/2025

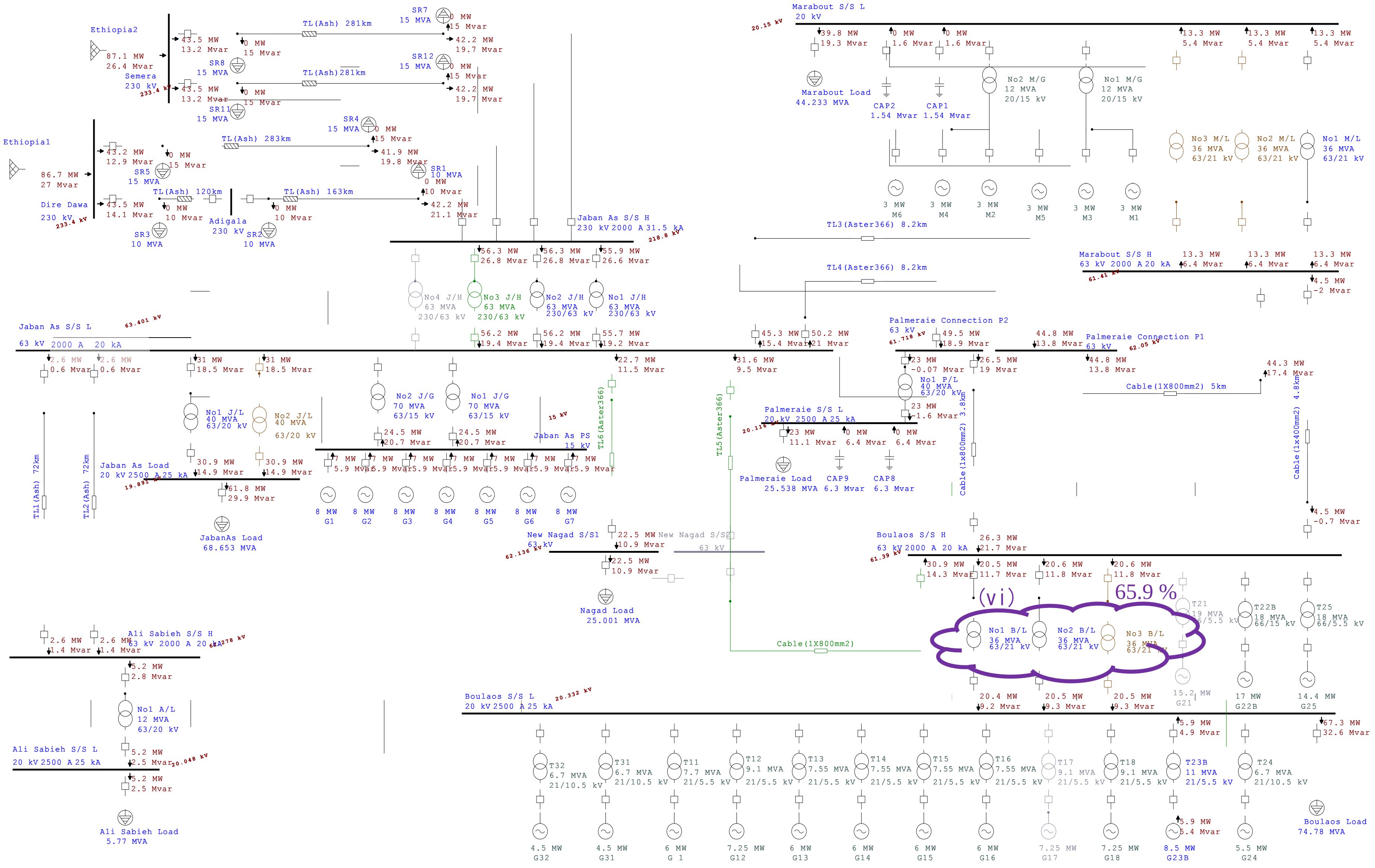


Figure 2-2-1-1-2.11 Case 26: Effects of Installation of No.3 63/20 kV Transformer at Boulaos Substation (as of 2031)

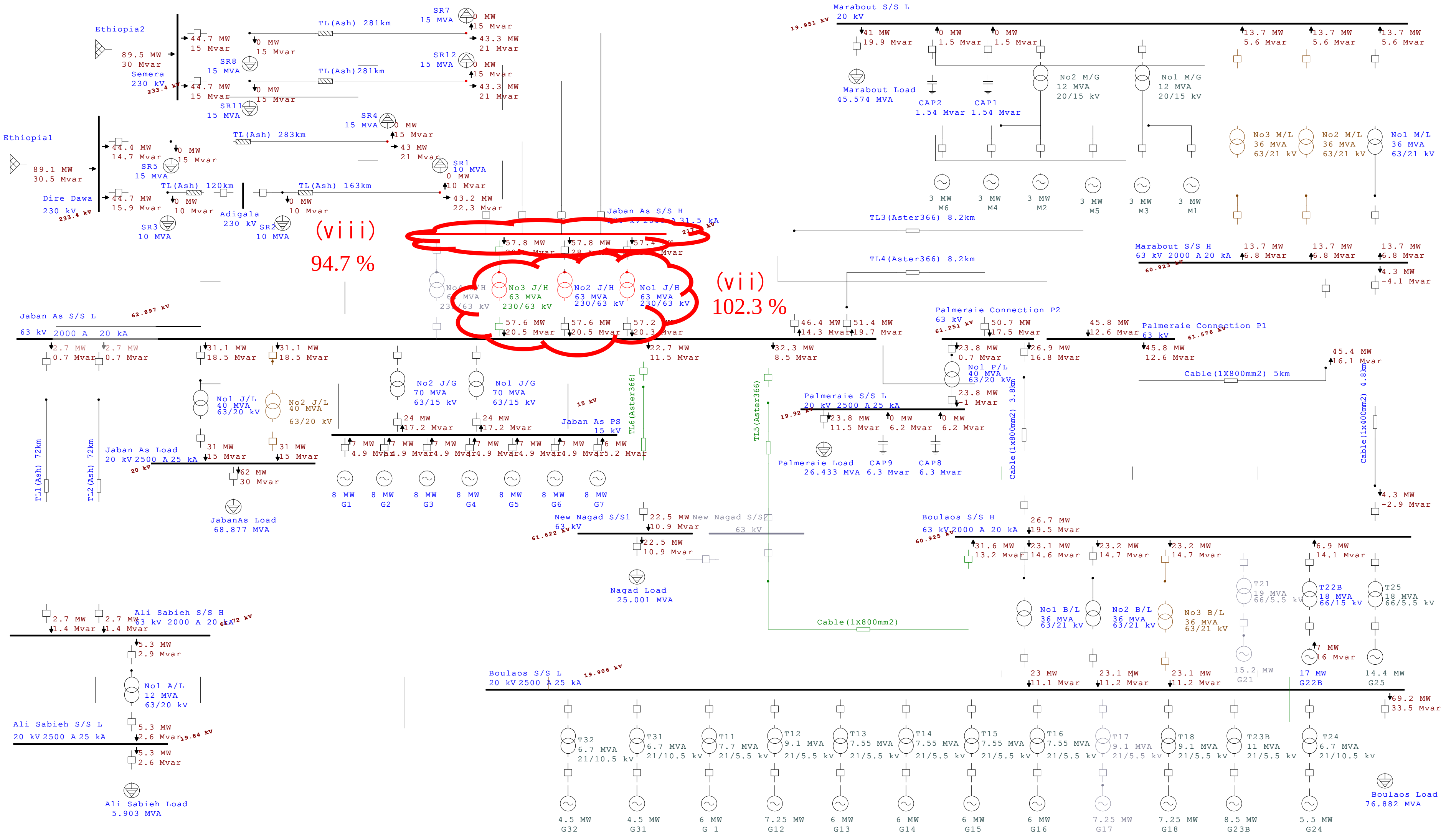


Figure 2-2-1-1-2.12 Case 27: Analytical Results (as of 2032) of the Existing System, Transmission Line which will be expanded in 2020 and Transformers which will be installed in 2021/2025/2027

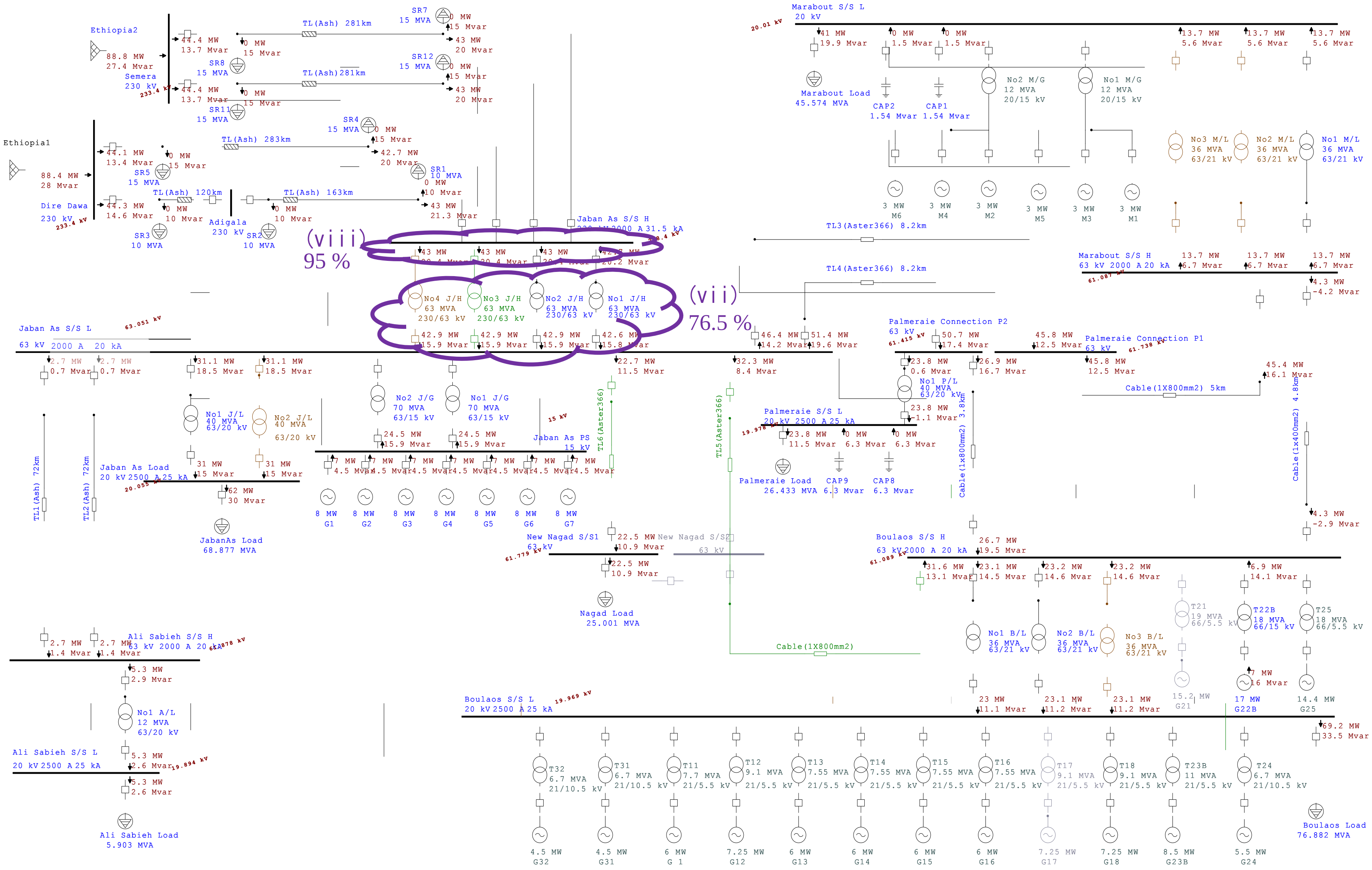


Figure 2-2-1-1-2.13 Case 28: Effects of Installation of No.4 230/63 kV Transformer at Jaban As Substation (as of 2032)

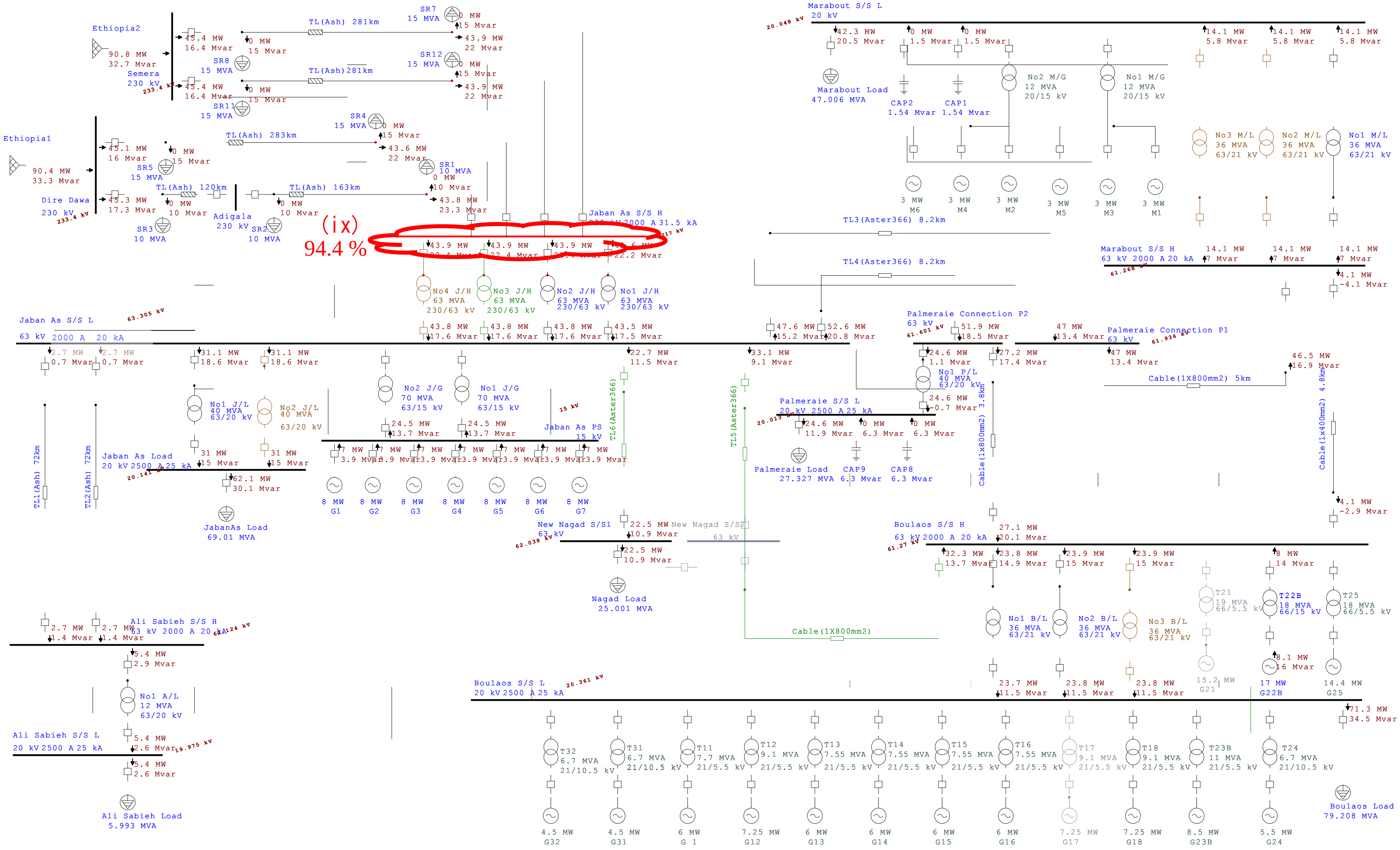


Figure 2-2-1-1-2.14 Case 29: Analytical Results (as of 2033) of the Existing System, Transmission Line which will be expanded in 2020 and Transformers which will be installed in 2021/2025/2027/2032

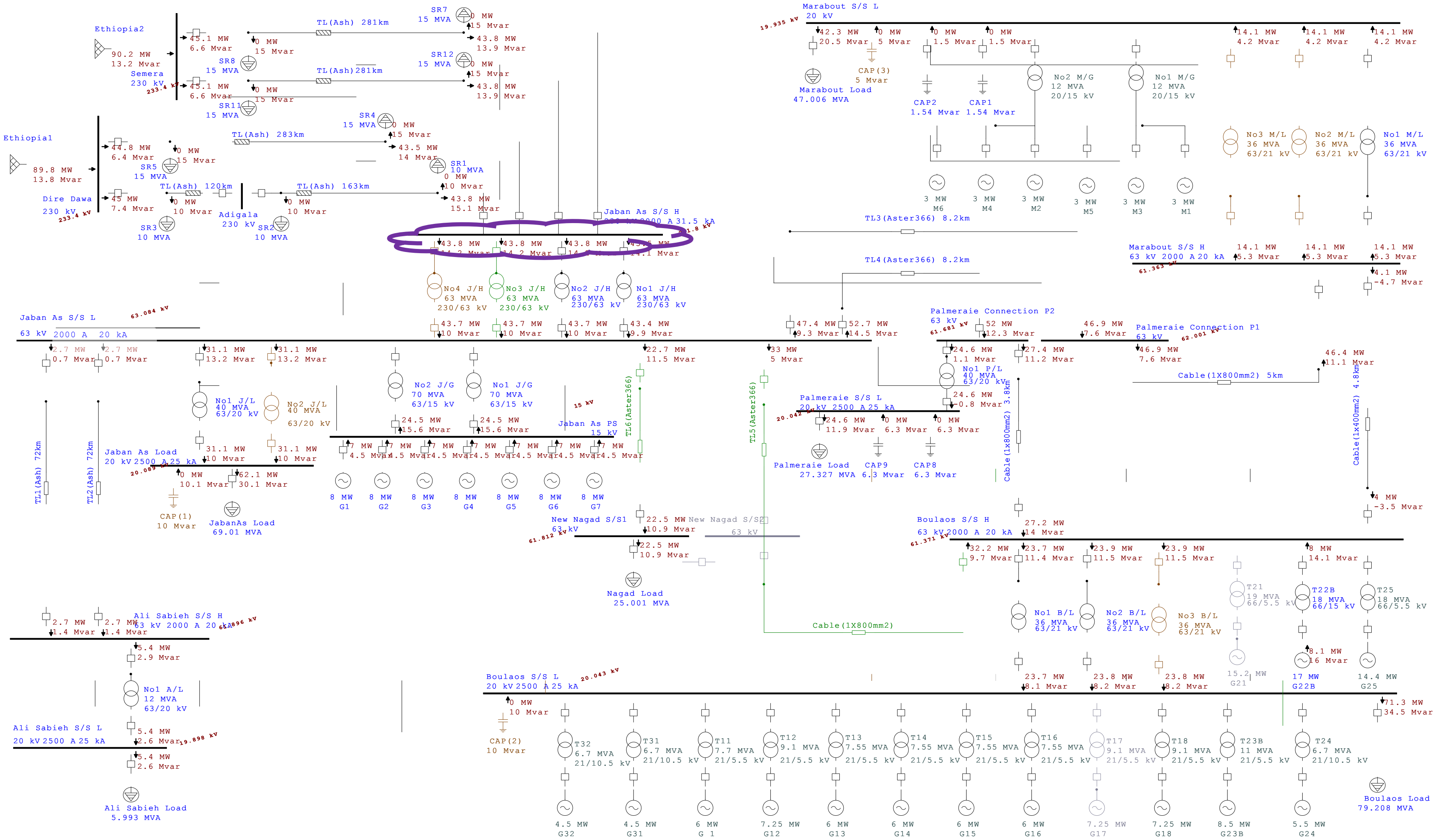


Figure 2-2-1-1-2.15 Case 30: Effects of Installation of Capacitors (as of 2033)

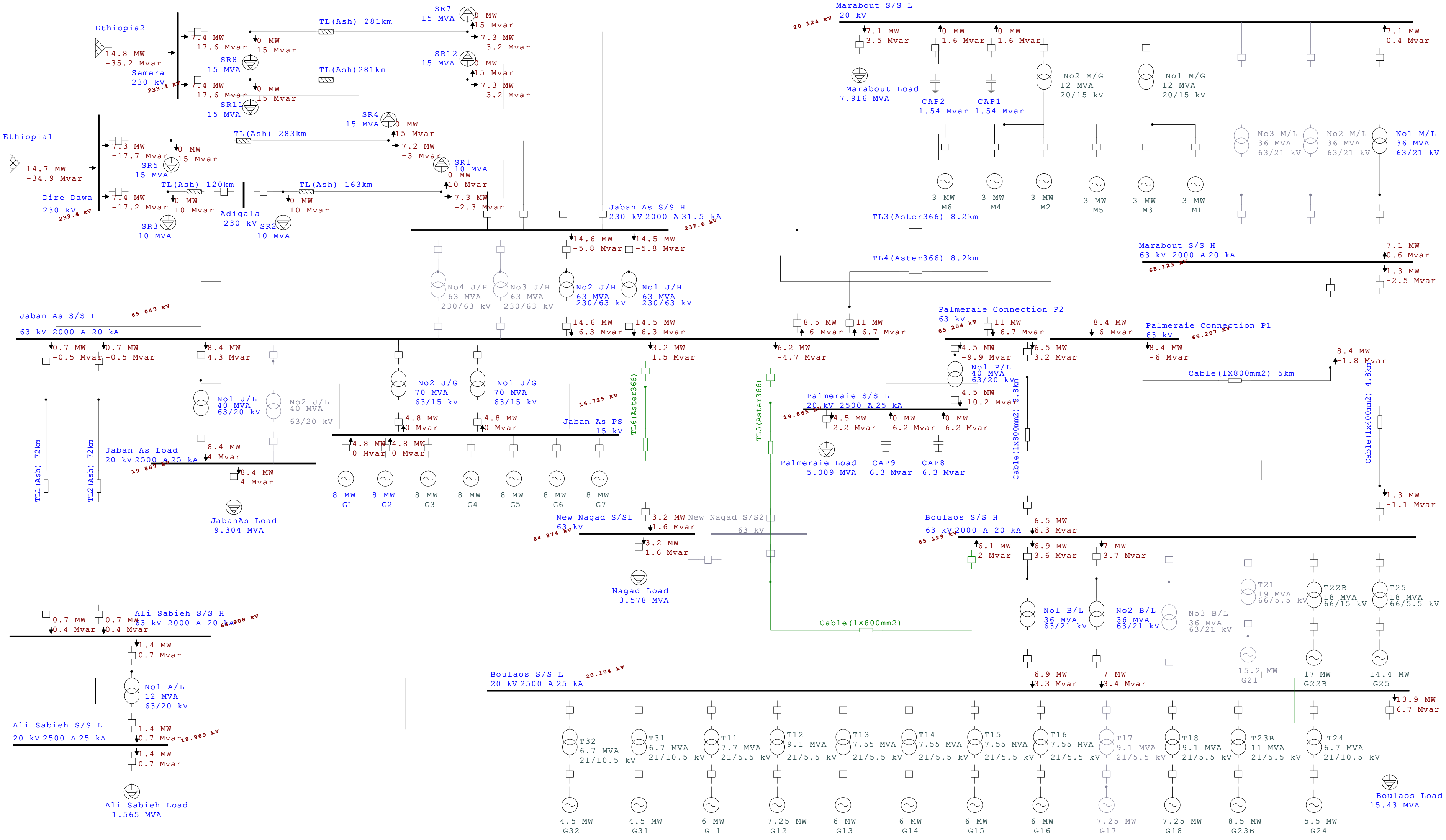


Figure 2-2-1-1-2.16 Case 4: Status of System with Minimum Demand at the Time of Commencement of the Operation of the Project (as of 2017)

2-2-1-1-3 Relevance of the Request

(1) Relevance of the Request

1) Expansion of Jaban As Substation (on the 230/63 kV side)

Currently the total capacity of the 230/63 kV transformers of Jaban As Substation is 126MVA (63MVA x 2, 113MV with a power factor of 0.9). On the assumption that 75% of the total power demand in the whole city of Djibouti will be covered with power imported from Ethiopia, the 230/63 kV transformers at Jaban As Substation will be overloaded in 2020 and later. Considering the record that 90% of the total power was imported from Ethiopia in 2012 and the current status that as much as 100% of the total power demand in the city may have to be covered with power from Ethiopia depending on the load status as well as the power development plan of the Ethiopia, the transformers may become overloaded even earlier. As Jaban As Substation is the only substation to receive 230 kV power from Ethiopia and transmit 63 kV power across the country, capacity shortage of its 230/63 kV transformers will limit power import from Ethiopia. Therefore, the request is urgent and relevant.

2) 63 kV transmission line (Jaban As Substation – Nagad – Boulaos)

There is only one transmission line from Jaban As Substation to the city of Djibouti, which is via Palmeraie, and the result of flow analysis indicates that the transmission line will become overloaded in 2018. Although it has been decided that the power for the railway between Addis Abab, the capital of Ethiopia, and Djibouti Port will be supplied from another transmission line, power demand around the Nagad area is expected to increase substantially with planned construction of a new airport and a new US military base around the area and ongoing improvement works at a port for livestock export on the eastern coast. Considering the development plan in Djibouti, the request is relevant and urgent.

2-2-1-2 Policy on Natural Environmental Conditions

(1) Policy on temperature

The climate of the City of Djibouti is semi-arid tropical, and the temperature is high year-around. During the period between May and October, in particular, the maximum temperature at daytime exceeds 35 degrees so that it is necessary to, for example, use ice cubes when mixing concrete and placing it in the late afternoon when the temperature starts to fall. In addition, materials and equipment will be selected in consideration of the temperature in the city.

(2) Policy on salt damage

Any of the project sites is located within 10km of the sea coast, so salt-tolerant equipment will be procured. Since there is not much rainfall in Djibouti, salt accumulates and the concentration of salt is quite high in groundwater and surface ground. The salt concentration is also high in tap water supplied to general households and local contractors say that ordinary water pipes would erode within three months or so if they were not made salt tolerant. Some contractors procure aggregates with freshwater or water with law salt concentration by themselves, but if the Project uses contractors with no supply route of such aggregates, it is necessary to add freshwater to reduce the salt concentration when mixing concrete, or use salt-tolerant cement from the beginning.

(3) Policy on earthquake conditions

Djibouti is located on the African Great Rift Valley and has 20 or more earthquakes including those with a seismic intensity of 1 or smaller, but large earthquakes rarely occur. Large earthquakes occurring in the past include magnitude 5.5 earthquakes in 1972 and 1992, neither of which apparently caused any significant damage to the City of Djibouti. Many buildings are block masonry construction, and no especially anti-seismic building is seen in the city. Accordingly, the Project will adopt the horizontal seismic coefficient of 0.15G as a design condition.

2-2-1-3 Policy on social and economic conditions

More than 90% of the population is Islam. Daily working hours differ that in Japan because of the practice of ritualistic prayer (Salat) and the climate conditions. Salat is usually performed five times a day; around 5:00, noon, 15:00, 18:00 and 19:00. But the time for Salat varies depending on the season. Quite a few retail stores are closed between 14:00 and 16:00. During this break, people practice the habit of getting together and sitting in a circle to chat with a wad of khat in their mouths. Khat contains a slight amount of a stimulant that causes excitement and the work efficiency tends to fall after the socializing practice, so that it is necessary to manage time by, for example, starting working at 7:00 in the morning and ending at 15:00 in the afternoon without break. Moreover, a work schedule must be created on the premise that there will be delay in the work progress during Ramadan and id-ul-adha (or Festival of Sacrifice).

2-2-1-4 Policies on Construction/Procurement Conditions or Special Conditions in the Industry/Commercial Practice

(1) Materials and equipment

Djibouti depends on import for most construction materials and equipment, so the Project will make procurement in consideration of the cost incurred and schedule in relation to import. According to local contractors, construction materials and equipment are chiefly imported from Dubai and Turkey, and procurement usually takes 45 days or so. Galvanizing is also conducted in Dubai, except for the work on pipes. Timber is precious in Dubai and costs some 10 times as much as steel, so pipes are used for scaffolding.

(2) Workers

Local workers will be hired as many as possible while their capacity is taken into account. But because special facility and electric technicians and engineers are unavailable in Djibouti, workers from the Philippines, India, Pakistan, Sri Lanka and Bangladesh are usually hired at construction sites. Small offices, residential housings and other structures can be built with Djibouti workers without any problem. The country has an employment policy to give priority to Djibouti workers, so foreigners need to have an invitation letter of the Ministry of Labor when they work as site workers. This policy is not applicable to consultants or specialists.

2-2-1-5 Policy on Use of Local Companies (construction companies and consultants)

The Project will, in principle, use construction equipment and workers of local construction companies for installation and facility construction works, but need to have engineers from Japan for quality control, schedule management, safety management, test coordination and other works. In Djibouti, there are three local foreign-financed contractors among others. Judging from the performance of construction works ordered by EdD, these three foreign-financed contractors seem to produce quality work, compared to other local contractors. These three contractors have their own intake sources and quarries for water and aggregates with low salt concentration.

2-2-1-6 Policy on Operation, Maintenance and Management

Equipment and facilities to be procured and installed under the Project are equivalent to those which EdD currently operates, maintains and manages, and because EdD has already had manuals for such equipment and facilities, there is no need to give special consideration in this respect. Even so, it is desirable to conduct on-the-job training (OJT) during the construction period of the Project in order to ensure consistency between facilities to be introduced in the Project and the existing ones, and efficient operation, maintenance and management.

Regarding the structure for operation and maintenance, EdD was restructured for the operation of interconnection with Ethiopia that started in 2011, and, as of 2013, the Interconnection Service is responsible for operation and maintenance of Jaban As Substation and the 63 kV overhead line and the Transmission and Distribution Service is responsible for such work of the 63 kV underground line and Boulaos Substation. According to EdD, the equipment and facilities to be procured and installed under the Project will be operated and maintained with a structure suited for the conditions when actual operation starts while the existing structure will also be considered. OJT should also be conducted after checking with EdD about the operation and maintenance structure.

2-2-1-7 Policy on Grade Setting for Facilities, Equipment, etc.

In light of the conditions described above, the basic policy on procurement of materials and equipment, scope of installation and the technical levels under the Project will be set out as follows.

(1) Policy on grade setting

Of the transforming, switching and transmitting facilities to be procured under the Project, the grades of facilities for the existing substations, and telecommunications and protection facilities for the new switching station will be the same as those of the existing facilities to ensure compatibility and operability. The facilities for the new switching station will be the same as the existing ones or Japanese made products. Protection coordination with the existing facilities will be taken into account, and the grades will be determined so that equipment and facilities will be within the technical level of EdD, which will be in charge of the operation, maintenance and management.

(2) Policy on standards

For technical and economic purposes, materials meeting the international standards of the International Electrotechnical Commission (IEC) or Japanese standards of JIS, JEC or JEM will be used as much as possible for the Project. The DTU, French standards used in Djibouti, will also be referred to for the installation of cables and other materials.

2-2-1-8 Policy on Construction/Procurement Methods, and Construction Schedule

Most of the materials and equipment to be procured under the Project are difficult to obtain in Djibouti and thus will be procured in Japan or third countries. Estimated time required for procurement from Dubai or Turkey is about 45 days, and about two months from Japan. In either case, marine transport will be chiefly used, and import materials will be unloaded at the Port of Djibouti. A national route leads from the port to Jaban As Substation (approx. 15km), which is paved and used as a major route for land transport to Ethiopia. Thus, there will be no particular problem with land transport. As for the route from the port to Nagad Connection Point (approx. 12km), the road near the construction site of the connection point is unpaved, but there is a material yard nearby, so large vehicles pass through the road on a daily basis. Either way, no heavy item such as transformers will be carried to Nagad Connection Point under the Project, and thus there will be no problem, either.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

2-2-2-1-1 Design Conditions (climate conditions, conditions of electrical mode, applicable standards and units)

The design conditions of the Project are as follows.

On designing, ambient air temperature was taken into account for the calculation of sag, to determine the height of the overhead line from the ground and strength of the support such as steel tower.

(1) Climate conditions

Table 2-2-2-1-1.1 shows the climate conditions suitable for the designs of the transforming, transmitting and distributing facilities, buildings and foundations.

Table 2-2-2-1-1.1 Climate Conditions

Area		Djibouti
Altitude		1,000 m or lower
Outside air temperature	Ave. max.	46.5℃
	Max.	55℃
	Min.	16.0℃
Average maximum humidity		87.1%
Maximum wind speed		66 knots (34m/s)
Rainfall (monthly maximum)		903 mm
Maximum insolation		1100 W/m^2
Seismic force		0.15G
Soil bearing capacity		5 ton/m^2

Note: The data above are from the project for the Ethiopia-Djibouti transmission line and records in Djibouti in the previous 10 years (2002-2012).

(2) Conditions of electrical system

Table 2-2-2-1-1.2 shows the conditions of the electrical system suitable for the designs of the transforming, transmitting and distributing facilities.

Table 2-2-2-1-1.2 Conditions of the Electrical System

Item	Transmission system		Distribution system	Station service power	
Nominal voltage	230 kV	63 kV	20 kV	380-220V AC	125&48V DC
Maximum voltage	245 kV	72.5 kV	24 kV	+10 %	+10 %
Frequency	50Hz				N/A
Maximum short-circuit capacity	31.5 A (1sec.)	20 kA (1sec.)	12.5 kA (1sec.)	N/A	
Lightening impulse withstand voltage	1,050 kV	325 kV	125 kV	N/A	
Earthing system	Effective earthing		Resistance grounding	N/A	
Minimum creepage distance of insulator	31 mm/kV (note 1)			N/A	
Minimum clearance of conductor	(note 2)			N/A	
Phase to ground (mm)	3,000	1,000	500	N/A	
Phase to phase (mm)	4,000	1.800	900	N/A	
Clearance and wayleave	(note 3)				
Protection class (IP)	(note 4)				
SCADA and telecommunications facilities	(note 5)				

Notes:

1. Since the project sites are located about 6 km away from the coast, contamination by sea water should be taken into consideration. Therefore, minimum creepage distance of insulator is 31mm/kV (heavily salted area).
2. The minimum clearance of the conductors for the transmission and distribution lines will be determined in accordance with relevant standards and EdD standards. The minimum clearance of the conductors for the 20 kV switchgear cubicles will be determined by manufacturer's standards.
3. The height and clearance of the transmission and distribution lines will be determined in accordance with the requirements of EdD, Djibouti National Roads Agency, etc. as in Table 2-2-2-1-1.3. In case that special arrangement is required, EdD will consult with relevant parties to obtain necessary permission.
4. Protection class (IP) for the 20 kV switchgear cubicles, low-voltage panels, control panels and protection relay panels will be set as follows:
   Outdoor: IP44 Indoor: IP20
5. Extension and modification of the Supervisory Control and Data Acquisition (SCADA) System at the existing Jaban As Substation, and designing and procurement of the telecommunication system (optical-fiber systems) with the existing Boulaos Power Station will be conducted.

Table 2-2-2-1-1.3 Clearance of the Conductors for Transmission and Distribution Lines, and Clearance of Supporting Structures

Item	63 kV transmission line
Height of conductor for transmission and distribution lines	
General area (m)	6.5
Roads (m)	8.0
Railway (m)	10.0
Water courses and sea route (m)	6.5
Area occupied with transmission and distribution liens (m)	24
Clearance of electric conductors to residences (m)	5.0
Clearance for voltages of 230 kV or lower (m)	4.0
Clearance for voltage of 230 kV (m)	6.0
Clearance between supporting structures of transmission and distribution lines, and the center of roads (m)	30.0
Clearance between supporting structures of transmission and distribution lines, and railway (m)	30.0

(3) Applicable standards and units

For designing the Project, consistency with the existing facilities in Djibouti will be taken into account, and IEC, ISO and other international standards, as well as Japanese ones, will be applied to major functions of equipment.

- International Electrotechnical Commission (IEC): Applied to major functions of electrical products in general

- International Organization for Standardization (ISO): Applied to performance evaluation of industrial products in general
- Japanese Industrial Standards (JIS): Applied to industrial products in general
- Japanese Electrotechnical Commission (JEC): Applied to electrical products in general
- Standards of the Japan Electrical Manufacturers' Association (JEM): ditto
- Japanese Electrical Wire and Cable Makers' Association (JCS): Applied to electric wire and dabbles
- Institute of Electrical and Electronics Engineers, Inc. (IEEE): Applied to electrical products in general
- Deutsches Institut fuer Normung (DIN): ditto
- British Standards Institution (BS): ditto
- Verband Deutscher Elektrotechniker (VDE): ditto
- Comite Consultatif International Telegraphique et Telephonique (CCITT): Applied to optical-fiber composite overhead ground wire
- Document Technique Unifié (DTU): Applied to construction work
- Technical Standards concerning Electrical Equipment (Japan): applicable to a wide range of electrical works

2-2-2-1-2 Transmission routes and methods (including selection of the scope of overhead and underground lines)

The Project will procure transmitting facilities on two sites: the 63 kV overhead transmission line (partially underground) between Jaban As Substation and Nagad Connection Point, and the 63 kV underground transmission line between Nagad Connection Point and Boulaos Substation.

(1) Construction of the 63 kV overhead transmission line between Jaban As Substation and Nagad Connection Point

1) Outline of the components

The 63 kV overhead transmission line between Jaban As Substation and Nagad Connection Point will be underground up to the point where it crosses an existing transmission line (780 m) but suspended on dual circuit tower in the remaining part (10.6 km). The line will be suspended on a single circuit tower between the construction site of Nagad Substation and Nagad Connecting Point, whose distance is 5.2 km. As illustrated in the route map of the transmission line between Jaban As Substation and Boulaos Substation, most part of the overhead transmission line will pass through almost flat, waste land.

Section 2-2-2-1-1 "Design Conditions" will be applied to the design of the 63kv tower. Wind and gravity loads of OPGW (Optical-fiber composite overhead ground wire) will be taken into consideration when designing the supporting structure of the line.

The standard intervals between supporting towers will be in compliance with 350m, the standard of EdD, and set at 300-400m. The slack of cables will be set at around 3%.

For materials and diameter of conductor and optical cable overhead earth wire will be AAAC ASTER 366 and OPGW 100 mm^2, respectively, as adopted for existing transmission lines of EdD.

The schematic drawing will be presented in DWG. No. T-01～T08 “Suspension Tower and Strain Tower”.

2) Technical specifications of major equipment and materials

Table 2-2-2-2-2.1 in Appendix shows the technical specifications of major equipment and materials.

(2) Construction of the 63 kV underground transmission line between Nagad Connection Point and Boulaos Power Station

1) Outline of the components

The 63 kV underground power cable will be laid between Nagad Connection Point and Boulaos Substation, whose distance is approximately 7.4km. As illustrated in the route map of the transmission line between Jaban As Substation and Boulaos Substation, the underground cable will be buried taking advantage of sidewalks of the roads in the built-in areas. The standard depth of the underground power cable will be set at 1,400 mm.

Regarding flood, there will not be a problem in the location of the 63 kV underground cable according to the local hearing investigation.

The Djibouti electricity standards (800 mm^2 XLPE single core, armored cables) will be applied to the 63kv underground power cables.

2) Technical specifications of major equipment and materials

Table 2-2-2-2-2.2 in Appendix shows the technical specifications of major equipment and materials.

(3) Construction of the underground communication line between Nagad Connecting point and existing Boulaos Substation

1) Outline of the components

The 63 kV underground power cable will be laid between Nagad Connection Point and Boulaos Substation, whose distance is approximately 7.4 km.

It will be laid along the 63 kV underground power cable as illustrated in the route map of the transmission line between Jaban As Substation and Boulaos Substation.

The Djibouti electricity standards (double sheath, 24 fibers, dry core, armored tube) will be applied to the types and number of optical fiber cables, where the compliance with the standards is basically required.

2) Technical specifications of major equipment and materials

Table 2-2-2-2-2.3 shows the technical specifications of major equipment and materials.

2-2-2-1-3 Location and arrangement of facilities of substations

There are two locations of substations planned in the Project and which are existing Jaban As substation and also existing Boulaos substation.

(1) Jaban As substation (Expansion)

Since Jaban As substation is the only 230 kV substation which import electricity from Ethiopia, the following facilities with their associated switchgear, control, supervisory and protection equipment shall be installed to meet the increasing electricity demand in Djibouti by importing low-cost power with large proportion and high electricity quality.

- One 230/63 kV 63 MVA Transformer
- Two bays for outgoing 63 kV transmission lines (For Nagad area and one of the two lines interconnecting to Boulaos substation)

One additional 230/63 kV transformer has been designed for future and the space has also been secured since the substation was constructed so that the original design shall be applied for the Project.

Switchgear for 63 kV system has been installed in the switchgear building in which only one vacant bay will be available when above mentioned bay for 230/63 kV transformer is installed so that expansion of the switchgear building shall be made and additional two bays for outgoing transmission lines shall be constructed with switchgear and its associated equipment.

The layout drawings for Jaban As substation are referred as DWG. No. SS - L - 01, General Layout , DWG. No. SS - L - 02, 63 kV Switchgear Building Layout and DWG. No. SS - L - 03 Control Building Layout.

(2) Boulaos substation in Boulaos power station (Expansion)

In order to meet the increasing distribution demand in near future which is supplied from Boulaos power station, an additional transmission line from Jaban As substation through Nagad area shall be constructed. New switchgear and its associated facilities shall be installed at the existing unutilized bay in 63 kV in-house substation in Boulaos power station to interconnect the transmission line.

The layout drawings for Boulaos substation are referred as DWG. No. SS - L - 04, 63 kV Substation Building Layout and DWG. No. SS - L - 05, 63 kV Substation Relay Room Layout.

2-2-2-2 Equipment Plan

2-2-2-2-1 Outline of the Basic Plan (components in table form)

Overview of the basic plan of the Project that takes into account the aforementioned (refer to 2-2-1) basic policy are as shown in Table 2-2-2-2-1.1.

Table 2-2-2-2-1.1 Overview of the basic plan

Category	Equipment	
Procurement of materials and equipment and Installation work planning	1. Jaban As Substation (Expansion)	
	(1) 230/63 kV Transformer（63 MVA）	1 set
	(2) 230 kV Circuit Breaker	1 set
	(3) 230 kV Disconnecting Switch	2 sets
	(4) 230 kV Current Transformer	3 sets
	(5) 230 kV Lightning Arrestor	3 sets
	(6) 230 kV Bus connecting Conductor	1 lot
	(7) 63 kV Circuit Breaker	3 sets
	(8) 63 kV Disconnecting Switch	6 sets
	(9) 63 kV Disconnecting Switch with Earth Switch	3 sets
	(10) 63 kV Current Transformer	9 sets
	(11) 63 kV Voltage Transformer	6 sets
	(12) 63 kV Lightning Arrestor	18 sets
	(13) 63 kV Power Cable and terminal	1 lot
	(14) 63 kV Conductor for main Bus and Subbranch	1 lot
	(15) Dead End Gantry (2 Circuits)	1 lot
	(16) Bay Control Panel (2 panels)	1 lot
	(17) Mimic Control Panel Modification	1 lot
	(18) Micro SCADA system Modification	1 lot
	(19) Transformer Protection Relay Panel	2 panels
	(20) Transmission Line Protection Relay Panel	1 panel
	(21) 230 kV Bus Protection Panels Modification	1 lot
	(22) 63 kV Bus Protection Panel Modification	1 lot
	(23) D.C. Distribution Panel Modification	1 lot
	(24) A.C. Distribution Panel Modification	1 lot
	(25) Communication Facilities	1 lot
	(26) Cable Connection Materials (incl. grounding materials）	1 lot
	(27) Associated Civil Facilities (Polycon FRP or FEP)	1 lot
	(28) Associated Civil Facilities (Foundations and Cable Pit)	1 lot
	2. Boulaos Substation (Expansion)	
	(1) 63 kV Circuit Breaker	1 set
	(2) 63 kV Combined Instrument Transformer	3 sets
	(3) 63 kV Lightning Arrestor	3 sets
	(4) 63 kV Switchgear connecting materials	1 lot
	(5) D.C. Distribution Panel Modification	1 lot
	(6) Bay Control Panel	1 panel
	(7) Transmission Line Protection Relay Panel	1 panel
	(8) Mimic Control Panel Modification (installed in Central control Room)	1 lot
	(9) Communication Facilities	1 lot
	(10) Cable Connection Materials (incl. grounding materials)	1 lot
	3. Nagad Connecting Point (New construction)	

Category	Equipment	
	(1) 63 kV Lightning Arrestor (2) Supporting Insulator 4. 63 kV transmission line (1) Steel Tower (2 Circuits) (2) Steel Tower (1 Circuit) (3) Number Plate (4) Insulator, hardware, grounding materials (5) Supplys for Overhead transmission line (6) Overhead Conductor (7) Underground cable (8) Terminal, Protector tube (9) Steel Tower	1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot
Procurement of materials and equipment	Procurement of following materials and equipment (1) Spare Parts	 1 lot

2-2-2-2-2 Transmission Equipment (equipment names, major specifications, quantities, etc.)

(1) Construction of the 63 kV overhead transmission line between Jaban As Substation and Nagad Connecting Point

1) Basic matters

The following components will be procured and constructed.

- 63 kV dual circuit transmission tower
- Optical-fiber composite overhead ground wire
- Porcelain insulator
- 63 kV dual circuit underground transmission line (780m)
- Optical fiber cable

(2) Construction of the 63 kV overhead transmission line between the Nagad Substation site and Nagad Connecting Point

1) Basic matters

The following components will be procured and constructed.

- 63 kV single circuit transmission tower
- Optical-fiber composite overhead ground wire
- Porcelain insulator

Table 2-2-2-2-2.1 Jaban As Substation-Nagad Connecting Point 63kv Overhead Transmission Line: Technical Specifications for Major Equipment and Materials

No.	Item	Specifications	Quantity
1	Tower type	Self-supporting lattice tower (the body and legs will be expanded)	1 set
1-1	Jaban As Substation – Nagad Substation 63kV overhead dual circuit transmission tower	Type A	16
		Type B	5
		Type C	2
		Type R	4
		Type R+3	1
		Type ZZ	2
1-2	Nagad Substation – Nagad Connecting Point 63kV overhead single circuit transmission tower	Type A	8
		Type A+5	1
		Type B	3
		Type B+5	1
		Type R	3
		Type ZZ	1
2	Type and diameter of conductor	AAAC ASTER 366	1 set
3	Type of optical-fiber composite overhead ground wire (OPGW)	Optical fiber mounted on stainless steel pipes in aluminum extruded material	1 set
	Sectional area of OPGW	100 mm^2	
	a) Mode	Dual window, single mode (ITU-T G.652)	
	b) Wavelength (nm)	1550	
	c) Number of optical fibers	48	
4	Type and number of suspension insulators	Porcelain disc type (250 mm) 6 insulators/phase	1 set
5	Metal fittings		1 set
6	Incidental civil engineering work (foundation of the tower)		1 set
7	The specifications of the line underground will be equivalent to those specified in the following sections (2) and (3).		

(3) Construction of the underground communication line between Nagad Connecting Point and existing Boulaos Substation

1) Basic matters

The following component will be constructed.

- 63 kV single circuit transmission tower

Table 2-2-2-2-2.2 Nagad Connecting Poinnt - Boulaos Substation 63kv Underground Transmission Line: Technical Specifications for Major Equipment and Materials

No.	Item	Specifications	Quantity
1	Type	Direct burial single core cable, armored	1 set
2	Insulator and insulation	Aluminum insulator, XLPE insulation	
3	Cable size	800 mm^2	
4	Incidental civil engineering work (Pit)		1 set

(4) Construction of the underground communication line between Nagad Connecting Poinnt and Boulaos Substation

1) Basic matters

The following component will be constructed.

- Optical fiber cable

Table 2-2-2-2-2.3 Nagad Connecting Poinnt - Boulaos Substation 63kv Underground communication Line: Technical Specifications for Major Equipment and Materials

No.	Item	Specifications	Quantity
1	Type of optical cable	Loose tube, dry core, armored, double sheath	1 set
	a) Mode	Dual window, single mode (ITU-T G.652)	
	b) Wavelength (nm)	1550	
	c) Number of optical fibers	24	

2-2-2-2-3 Transformation Equipment (equipment names, major specifications, quantities, etc.)

(1) Jaban As Substation (Expansion)

1) Basic Item

The following components are planned for expansion of Jaban As substation.

- Additional one 230/63 kV 63 MVA Transformer and its associated switchgear with supervisory, control and protection equipment
- 63 kV bay expansions for additional two (2) transmission lines and their associated switchgear with supervisory, control and protection equipment

2) Technical Specifications for major equipment and materials

Table 2-2-2-2-3.1 Janan As Substaion Technical Specifications for major equipment and materials

No.	Item / Equipment	Specifications	Quantity
1	230/63 kV Transformer		1 Set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	230 kV	
	3) Rated secondary voltage	63 kV	
	4) Rated Capacity	50.4/63 MVA	
	5) Cooling type	ONAN/ONAF	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	230 kV +10 % to -10 %	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary：Star (neutral lead out) Secondary：Star (neutral lead out) Third：Delta YNyn0(d11)	
	12) Impedance	13.5 % at 63 MVA	
	13) Others	Parallel operation with existing two transformers (%Z=13.56 % & 13.46 %) shall be considered.	
2	230 kV Circuit Breaker		1 Set
	1) Type	Outdoor, SF6 gas insulated	
	2) Rated voltage	230 kV	
	3) Rated lightning impulse withstand	1,050 kV	

No.	Item / Equipment	Specifications	Quantity
	voltage		
	4) Frequency	50Hz	
	5) Rated current	3,150 A	
	6) Rated short-circuit breaking current	31.5 kA	
	7) Rated duration of short circuit	3 s	
3	230 kV Disconnecting Switch		2 Sets
	1) Type	Outdoor, pantographic, motor operation type	
	2) Rated voltage	230 kV	
	3) Rated lightning impulse withstand voltage	1,050 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	2,000 A (with bus transfer current switching capability)	
	7) Rated short-time withstand current	31.5 kA	
	8) Rated duration of short circuit	3 s	
	9) Accessory	Operating box	
4	230 kV Current Transformer		3 Sets
	1) Type	Outdoor	
	2) Highest Voltage	245 kV	
	3) Rated lightning impulse withstand voltage	1,050 kV	
	4) Rated primary current	200-400-800 A	
	5) Rated secondary current	1 A	
	6) Thermal short time current	31.5 kA (1 s)	
	7) Number of cores	5 (one for measuring and four for protection)	
	8) Rated output	30 VA or above	
	9) Accuracy	0.2 and 10P30	
5	230 kV Lightning Arrestor		3 Sets
	1) Type	Outdoor, metal oxide type	
	2) Rated voltage	198 kV	
	3) Discharge current	20 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	
6	230 kV Switchgear connecting aterials		1 Lot
	1) Conductors	Al 36 mm diameter conductor wire, etc.	
	2) Connecting materials	Clamps, connectors and fittings	
	3) Post insulators	Creepage distance: 31 mm/kV or above	
	4) Steel supports	For DSs, CTs, LAs, and post insulators	
	5) Marshaling kiosk	Outdoor, stainless steel enclosed	
7	63 kV Circuit Breaker		3 Sets
	1) Type	Indoor, SF6 gas insulated	
	2) Rated voltage	63 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	1,250 A	
	7) Rated short-circuit breaking current	20 kA or above	
	8) Rated duration of short circuit	3 s	
	9) Rated operating sequence	O - 0.3 s - CO - 3 min. – CO Single phase rapid auto reclosing function shall be required for two transmission lines only.	
8	63 kV Disconnecting Switch		6 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A(with bus transfer current switching capability)	

No.	Item / Equipment	Specifications	Quantity
	7) Rated short-time withstand current	20 kA	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For bus connection	
9	63 kV Disconnecting Switch with Earth Switch		3 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A	
	7) Rated short-time withstand current	20 kA	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For line feeder connection Earth switch for transmission lines shall have induced current switching capability.	
10	63 kV Current Transformer		9 Sets
	1) Type	Indoor	
	2) Highest Voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Rated primary current	400-800 A	
	5) Rated secondary current	1 A	
	6) Thermal short time current	20 kA (1 s)	
	7) Number of cores	4 (one for measuring and three for protection)	
	8) Rated output	30 VA	
	9) Accuracy	0.5 and 10P30	
11	63 kV Voltage Transformer		6 Sets
	1) Type	Indoor, Capacitor type	
	2) Highest Voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Rated primary voltage	63/√3 kV	
	5) Rated secondary voltage	100/√3 V	
	6) Number of cores	2	
	7) Rated output	100 VA	
	8) Accuracy	0.5/3P and 3P	
	9) Remarks	For line feeder	
12	63 kV Lightning Arrestor		18 Sets
	1) Type	Metal oxide type	
	2) Rated voltage	60 kV	
	3) Discharge current	10 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	
13	63 kV Power cable		1 Lot
	1) Type	Single core aluminum conductor, XLPE insulated, armored and PVC or PE outer sheath	
	2) Highest voltage	72.5 kV	
	3) Nominal conductor cross section	800 sq. mm	
	4) Place to be used	- From 63 kV SWGR to gantry for transmission lines (approx. 1,500 m) - From 230/63 kV Tr. to 63 kV SWGR (approx. 100 m)	
	5) Cable sealing end	With necessary accessories: 18 sets	
14	63 kV Switchgear connecting materials		1 Lot
	1) Conductors	Al 100 mm*10 mm plates for main and branch buses Al 36 mm diameter conductor wires, etc.	
	2) Connecting materials	Terminals, connectors, etc.	

No.	Item / Equipment	Specifications	Quantity
	3) Post insulators	Creepage distance: 31 mm/kV or above	
	4) Steel supports	For LA, DS, cable, post insulators, etc.	
	5) Marshaling kiosk	Metal enclosed panel for each bay	
15	Dead end gantry		1 Set
	1) Type	Galvanized steel structure, for two transmission lines	
	2) Size	Width: 14 m (2*7 m span) Overall Height: 10.5 m from foundation Horizontal beam height: 8 m from foundation	
	3) Remarks	For 2 circuits 63 kV transmission lines to Nagad area	
16	Bay Control Panels		2 Panels
	1) Type	Indoor, self-stand and front side operation panel	
	2) Bays to be controlled	- 230/63 kV transformer bay: one - 63 kV transmission line: two	
	3) Main equipment to be mounted	Bay Control Unit (BCU), control switches with indicator, selector switch, transformer tap voltage control unit (transformer bay panel only)	
	4) Remarks	The configuration and man-machine interface shall be same as the existing control panels.	
17	Mimic Control Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification of existing panel	The following bays of control and monitoring function shall be additionally equipped. - No. 3 230/63 kV transformer bay	
	3) Additional Panel	The additional panel shall be installed beside the existing panel. The width shall be determined to equip additional six 63 kV bays with the same man-machine interface as the existing one. Supervisory equipment of 63 kV double bus for six bays and two bays for transmission lines shall be mounted and the space for future four bays shall be secured.	
	4) Main equipment to be mounted	Control switches with indicator, mimic symbols, meters (P, Q, I & V)	
	5) Remarks	The supervisory function shall be well coordinated with the bay control panels.	
18	Micro SCADA system modification		1 Lot
	1) Modification	Supervisory function for the expanded four bays (230 kV: one bay and 63 kV: 3 bays) shall be additionally included. a) Communication hardware The existing network shall be expanded to connect new BCUs, protection relays and necessary communication equipment such as I/O modules HUB, network cables, connecters, etc. b) Software The supervisory software shall be modified to accommodate the new four bays and 20 kV capacitor bank.	
	2) Remarks	Easy accommodation of future 63 kV four bays shall be considered.	
19	Transformer Protection Relay Panel		2 Panels
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relay with current ratio differential and over current base function	
	3) Configuration	Duplex, two sets of one independent protection panel per one transformer	
	4) Digital relay communication	IEC 61850 for micro SCADA communication	
	5) Transformers to be protected	- No. 3 230/63 kV transformer	
20	Transmission Line Protection Relay Panel		1 Panel
	1) Type	Indoor, self-stand and front side operation panel	

No.	Item / Equipment	Specifications	Quantity
	2) Protection	Digital relays with distance (impedance detection) , current ratio differential and over current base function	
	3) Auto reclosing	Single phase rapid auto reclosing and three phase auto reclosing shall be equipped. Communication through optic fiber (OPGW) with Boulaos S/S for one line and with future Nagad S/S for the other line shall be prepared.	
	4) Configuration	Single, one protection panel per one transmission line	
	5) Digital relay communication	IEC 61850 for micro SCADA communication	
	6) Transmission lines to be protected	- Transmission line to Boulaos S/S through Nagad area (combination of overhead and cable line) - Transmission line to Nagad area (future S/S)	
21	230 kV Bus Protection Panels modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Bus bar differential protection with breaker failure protection (Siprotec 7SS52, Siemens is under use)	
	3) Configuration	Duplex, two sets of one independent protection panel	
	4) Modification	Modification for additional 230/63 kV transformer feeder - Additional bay units and necessary equipment - Panel inside wiring - Central unit modification - Necessary connection with the bay control and protection relay panels	
22	63 kV Bus Protection Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Bus bar differential protection with breaker failure protection (Siprotec 7SS52, Siemens is under use)	
	3) Configuration	Single	
	4) Modification with additional panel installation	In order to accommodate additional three 63 kV feeders for the bus protection panel, additional one panel shall be installed beside the existing panel. - Additional bay units and necessary equipment - Panel inside wiring - Central unit modification - Necessary connection with the bay control and protection relay panels	
	5) Remarks	Four feeders in future shall be considered in the design of new additional panel.	
23	D.C. Distribution Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification	Additional D.C. control power supply for new facilities of additional bays - MCCBs, terminal blocks, wiring, name plates, etc.	
24	A.C. Distribution Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification	Additional A.C. power supply for new facilities of additional bays and buildings - MCCBs, terminal blocks, wiring, name plates, etc.	
25	Communication Facilities		1 Lot
	1) General	Additional communication network shall be installed through fiber optical cable (OPGW) between Jaban As S/S and Boulaous P/S. Additional future Nagad S/S shall be considered in the design.	
	2) Modification	Voice and data communication including protection relay signal shall be secured among said stations. Necessary equipment for Communication panels	

No.	Item / Equipment	Specifications	Quantity
	 3) Fiber optical cable 4) Fiber optical cable connection box	(Rack-1 & 2) to accommodate additional network shall be equipped. Lose tube fiber optic cable, dry core, armored and double sheath (IEC 60794-3-10) - Number of fibers: 24 - Place to be used: From the gantry of transmission line to Nagad area to communication room in the control building (approx. 200 m) - Necessary accessories for connection of cables Boxes for connection between optical fibers (OPGW, fiber optical cable)	
26	Others 1) Low voltage cables 2) Grounding materials 3) Cabling materials	 - Power cables XLPE insulated - Control cables PVC insulated shield type - Copper conductors and PVC insulated cables 70sq. mm and 120sq. mm - Earthing rod 1.5 m length - Connectors - Conduits, junction boxes and fittings - Cable trays - Cable hangers	1 Lot

(2) Boulaos power station

1) Basic Item

The following components are planned for Boulaos 63 kV substation in the power station.

- 63 kV bay expansion for additional one (1) transmission line and its associated switchgear with supervisory, control and protection equipment

2) Technical Specifications for major equipment and materials

Table 2-2-2-2-3.2 Boulaos power station Technical Specifications for major equipment and materials

No.	Item / Equipment	Specifications	Quantity
1	63 kV Circuit Breaker 1) Type 2) Rated voltage 3) Rated lightning impulse withstand voltage 4) Number of phase 5) Frequency 6) Rated current 7) Rated short-circuit breaking current 8) Rated duration of short circuit 9) Remarks	 Indoor, SF6 gas insulated 63 kV 325 kV 3 50Hz 1,250 A 20 kA or above 3 s The existing old circuit breaker will be replaced with the breaker specified above.	1 Set
2	Combined Instrument transformer 1) Type 2) Highest voltage 3) Rated lightning impulse withstand voltage 4) Frequency 5) Thermal short time current	 Indoor 72.5 kV 325 kV 50 Hz 20 kA (1 s)	3 Sets

No.	Item / Equipment	Specifications	Quantity
	6) Voltage transformer	- Rated primary voltage: 63/$\sqrt{3}$ kV - Rated secondary voltage: 100/$\sqrt{3}$kV - Number of cores: 2 - Rated output: 50 VA - Accuracy: 0.5 and 3P	
	7) Current transformer	- Rated primary current: 400 - 800 A - Rated secondary current: 1 A - Number of cores: 3 (one for measuring and two for protection) - Rated output: 30 VA - Accuracy: 0.5 and 10P30	
	8) Remarks	The existing old instrument transformers will be replaced with the ones specified above.	
3	63 kV Lightning Arrestor		3 Sets
	1) Type	Metal oxide type	
	2) Rated voltage	60 kV	
	3) Discharge current	10 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	
4	63 kV Switchgear connecting materials		1 Lot
	1) Conductors	Al 80 mm*5 mm or greater plates for branch buses	
	2) Connecting materials	Terminals, connectors, etc.	
	3) Post insulators	Creepage distance: 31 mm/kV or above: 3 sets	
	4) Steel supports	For instrument transformers, LA, post insulators and disconnecting switch operating mechanism	
	5) Marshaling kiosk	Metal enclosed panel	
5	D.C distribution panel modification		1 Lot
	1) Type	Indoor, self-stand front door panel	
	2) Modification	Additional control power supply for the new transmission line bay facilities	
	3) Equipment to be mounted	Molded case circuit breaker, terminal block and wiring	
6	Bay Control Panel		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Bays to be controlled	63 kV transmission line to Nagad S/S	
	3) Main equipment to be mounted	Control switches with indicator, selector switch, annunciation windows, meters (P, Q, V & I), energy meter, etc.	
	4) Remarks	The configuration and man-machine interface shall be same as the existing Palmeraie transmission line control panels.	
7	Transmission Line Protection Relay Panel		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection) , current ratio differential and over current base function Communication through optic fiber (OPGW) with Jaban As S/S shall be prepared.	
	3) Configuration	Single, one protection panel per one transmission line	
	4) Transmission line to be protected	Transmission line to Jaban As S/S through Nagad area (Combination of cable and overhead line)	
8	Mimic Control Panel modification		1 Lot
	1) Type	Indoor, mosaic block self-stand type	
	2) Modification	Supervisory function in the plant control room for new transmission line shall be achieved.	
	3) Main equipment to be mounted	Control switches, meters(I, V), annunciation windows, etc.	
9	Communication Facilities		1 Lot
	1) General	Additional communication network shall be installed through fiber optical cable (OPGW)	

No.	Item / Equipment	Specifications	Quantity
		between Jaban As S/S and Boulaous P/S. Additional future Nagad S/S shall be considered in the design. Voice and data communication including protection relay signal shall be secured among said stations.	
	2) Modification	Necessary equipment for Communication panel (SDH (Synchronous Digital Hierarchy) cabinet) to accommodate additional network shall be equipped.	
	3) Fiber optical cable	Lose tube fiber optic cable, dry core, armored and double sheath (IEC 60794-3-10) - Number of fibers: 24 - Place to be used: From the relay room of 63 kV SWGR building to the relay room adjacent to control room in the building (approx. 130 m) - Necessary accessories for connection of cables	
	4) Fiber optical cable connection box	Boxes for connection between optical fibers	
10	Others		1 Lot
	1) Low voltage cables	- Power cables XLPE insulated - Control cables PVC insulated shield type	
	2) Grounding materials	- PVC insulated cables - Connectors	
	3) Cabling materials	- Conduits, junction boxes and fittings - Cable trays - Cable hangers	

2-2-2-2-4 Buildings for Substations and Switching Station (Name of the building, major specifications, building area, etc.)

Jaban As Substation (to be built at the existing substation)	
Building name	Major specifications
Switchgear building x 1	Reinforced concrete construction, two-storied Building area: 339.50m^2 Floor area: 1st floor - 291.00 m^2 2nd floor - 339.50 m^2 Total floor area: 630.50 m^2 Lighting and sockets system

2-2-3 Outline Design Drawing

The basic design drawings are integrated in the attachment.

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

This Project is within Japan’s grant aid cooperation framework and thus will be implemented after the Government of Japan approves it; the Governments of Japan and Djibouti agree on exchange of notes (E/N); and JICA and the Government of Djibouti conclude a grant agreement (G/A). The following sections state the basic matters and matters requiring special considerations when the Project is put into practice.

(1) Project implementing agency

The implementing agency of the Project on the Djibouti side is the Electricite de Djibouti (EdD). The relevant department of EdD will implement the Project and, after completion of the procurement of installation of equipment and facilities under the Project, operate, maintain and manage these equipment and facilities. EdD will also be required to appoint relevant personnel to be responsible for the Project, and maintain close contact and discuss with the Japanese consultant and contractor. The personnel responsible at EdD will give sufficient account of the Project to other EdD officers, relevant organizations and local citizens concerned so as to obtain their understanding of and cooperation to the implementation of the Project.

(2) Consultant

For procurement of equipment and installation work for the Project, a Japanese corporate consultant, recommended by JICA to the Djibouti side, will conclude a design and supervisory service agreement with EdD and engage in supervision of execution design, procurement and installation work. The consultant will also create bidding documents based on the detail design of the Project and implement the bidding for the sake of EdD, the project implementing agency.

(3) Contractor

According to Japan's grant aid cooperation framework, Japanese corporations will be selected as the contractor by the Djibouti side in general open bidding and engage in procurement of materials and equipment, and installation work for the Project. Because the contractor are required to continue supplying spare parts and backup services in case of malfunctions or other event even after the completion of the Project, they must carefully establish a liaison system after the delivery of the materials, equipment and facilities.

(4) Necessity of Dispatch of Engineers

The Project covers procurement and installation works for transformers and related facilities at Jaban As Substation; the transmission line and related facilities between Jaban As Substation and Nagad Connection Point; and the underground cable and related facilities between Nagad Connection Point and Boulaos Substation. A series of works will be carried out by a number of work groups. The work in Nagad Connection Point is expected to coincide with the construction work of a railway station by a Chinese contractor, so that it is necessary to carefully manage the work schedule, perform quality and safety management and make mutual adjustments with the Chinese contractor. To this end, it is essential to dispatch a Japanese worker as the foreman who understand Japan's grant aid cooperation scheme and can manage and supervise the construction work from the beginning to the end.

2-2-4-2 Implementation Conditions

(1) Important notice for procurement of materials and equipment

Djibouti replies on import for most of materials and equipment, and local procurement is difficult so that procurement must be made from Japan or third countries. As for cement and other construction materials, too, it is difficult to locally procure, for example, special materials such as salt tolerant ones, which will be thus imported from Dubai or Turkey. Accordingly, the time required, about 45 days, and cost incurred must be taken into consideration.

(2) Safety management

Because of a spate of pirate attacks near Djibouti, armed forces of some countries as well as troops of Japan's Self-Defense Forces are stationed. Thanks to these measures, there is little pirate attacks at the moment. On the other hand, however, a suicide bomb attack occurred at a restaurant in the City of Djibouti in May 2014. Care must be taken for safety management at all times since the country borders Somalia, which have a serious security problem. Care must also be taken for the personnel concerned with the Project should take a positive attitude about the management of materials and equipment.

(3) Tax exemption

Three types of tax exemption procedures are available for materials and equipment to be procured under the Project: complete tax exemption, tax refund and provisional permission for tax exemption. All the procedures require the following steps to be taken.

I. EdD brings a list of materials and equipment possibly subject to tax exemption to the Ministry of Budget to apply for tax exemption procedures.

II. The Ministry of Budget applies for the tax exemption to gain the approval of the president.

III. After approval, the president notifies the Ministry of Budget and EdD of a decree of tax exemption.

1) Complete tax exemption

To gain tax exemption, all materials and equipment must be stated in the contract in advance. As for materials and equipment procured outside the country, the contractor will send original bills of lading (B/L), packing lists and other documents to EdD and their copies to a customs clearing agent. The agent will bring these documents, together with a letter of approval issued by EdD, to make tax exemption procedures. It normally takes about two weeks to complete the procedures, but it should be noted that it took one month or more in a case, where the contractor began the document procedures after materials and equipment arrived at the port. As for materials and equipment locally procured, the contractor will present, at the time of procurement, an approved list of materials and equipment eligible for tax exemption, the presidential decree, and a letter of approval issued by EdD.

2) Tax refund

Tax refund is available to materials and equipment which are locally procured but are not covered by tax exemption at the time of procurement. In this case, necessary documents are submitted later for the procedures at the customs office.

3) Provisional permission for tax exemption

Provisional permission for tax exemption will be applicable to equipment that will be brought out of Djibouti after the completion of the Project. A deposit must be placed at the customs clearance office. The deposit will be fully refunded when the equipment concerned has been brought out of the country without any problem, or when it breaks down and the disposal of the equipment is confirmed. The deposit will also be refunded when the equipment is sold in Djibouti and the purchaser has paid the relevant customs duties.

(4) Transport

The customs clearance procedures will be conducted at the Port of Djibouti for materials and equipment that are transported to Djibouti by sea. Customs duties will be exempted as stated in the previous section, handling charges must be recorded as a part of marine transport cost for the Project.

There is no particular problem with domestic transport of transformers, towers, transmission lines and other heavy items because there is a national route which is paved and used for transport to Ethiopia. Still, it is necessary to take into consideration traffic congestion that may arise when large and heavy items are transported, and safety management.

No national route is available on the way to Nagad Connection Point, but there is a material yard of local contractors nearby and large vehicles pass through the road, so there will be no problem.

2-2-4-3 Scope of Works

The scope of works of the Project to be conducted by Japan and Djibouti is as shown in Table 2-2-4-3.1.

Table 2-2-4-3.1 Scope of Works to Be Conducted by Japan and Djibouti

Item	Procurement of equipment and materials		Installation		Note
	Japan	Djibouti	Japan	Djibouti	
1. Genaral					
(1) Shipping	○		○		
(2) Prompt unloading, customs clearance and tax exemption		○		○	
(3) Inland transportation	○		○		
(4) Exemption or payment of tax such as VAT on the equipment or materials procured in Djibouti		○		○	(As needed)
(5) Obtainment of the necessary permission for the Project		○		○	To be completed before the commencement of the Project as needed
(6) Commissions paid to the Japanese bank for banking services based upon the B/A		○		○	
(a) Advising commission of A/P		○		○	
(b) Payment commission		○		○	
(7) Implementation of Environmental and social considerations and preparation of the budget		○		○	
2. General construction					
(1) Provision of storage space for equipment and materials		○		○	To be completed by the time works by Japan start
(2) Ensuring of safety of field workers during construction		○	○	○	Measures for safety during the construction period to be taken as needed
(3) Dealing with customers and compensation for necessary power outage and other inconveniences during construction		○		○	
(4) Communication to customers about planned power outage during construction		○		○	
(5) Road traffic control		○		○	(As needed)
(6) Provision of a disposal site for waste soil and a treatment plant for waste water from construction		○		○	(As needed)
(7) Securement of the services to be connected to building equipment (water, waste water, rainwater, phones, etc.)		○		○	(As needed)
(8) Procurement of office furniture and fixtures		○		○	(As needed)
3. Jaban As Substation					
(1) Removal of wastes, existing structures etc. from the site		○		○	To be completed by the time works by Japan start
(2) Improvement of access roads		○		○	(As needed)
(3) Drainage system of access roads		○		○	(As needed)
(4) Installation of temporary fences and gates	○		○		
(5) Construction of a temporary office	○		○		

Item	Procurement of equipment and materials		Installation		Note
	Japan	Djibouti	Japan	Djibouti	
(6) Civil engineering works for the substation (including works for equipment foundation, roads in the site and exterior lighting)	○		○		
(7) Construction of a new building for a switching station	○		○		
(8) Transformation equipment works (procurement, installation, commissioning, adjustment, etc.)	○		○		
(9) Switching station equipment works (procurement, installation, commissioning, adjustment, etc.)	○		○		
(10) Earth works	○		○		
(11) Connection to the 230 kV transmission line	○		○		
(12) Connection of the existing 63 kV equipment and the improved equipment	○		○		
4. Nagad Connection Point					
(1) Securement of land and obtainment of use permit for access roads and work site		○		○	
(2) Improvement works of access roads and work site		○		○	(As needed)
5. Overhead line (Jaban As Substation – Nagad Connection Point)					
(1) Securement of land and obtainment of use permit for access roads and work site		○		○	
(2) Improvement works of access roads and work site		○		○	(As needed)
(3) Tree cutting, removal/relocation of obstacles etc. from the above-described land, and land grading		○		○	(As needed)
(4) Installation of temporary fences and gates	○		○		(As needed)
(5) Installation of permanent fences and gates		○		○	(As needed)
(6) Transmission tower works	○		○		
(7) Overhead transmission line works	○		○		
(8) Connection works of the related transformation equipment described above	○		○		
6. Underground cable (Nagad Connection Point – Boulaos Substation)					
(1) Securement of land and obtainment of use permit for access roads and work site		○		○	
(2) Improvement works of access roads and work site		○		○	(As needed)
(3) Tree cutting, removal/relocation of obstacles etc. from the above-described land, and land grading		○		○	(As needed)
(4) Underground cable works	○		○		
(5) Connection works of the related transformation equipment described above	○		○		

Item	Procurement of equipment and materials		Installation		Note
	Japan	Djibouti	Japan	Djibouti	
(6) Removal of existing 63 kV breakers from Boulaos Substation		○		○	For installation of new breakers to connect underground transmission lines
7. Other					
(1) Acceptance test			○	○ (Witness)	
(2) Initial operation instruction and management instruction			○ (Instruction)	○ (Selection of trainees)	

Note: Items with ○ are in the scope.

2-2-4-4 Consultant Supervision

According to Japan's grant aid cooperation scheme, the consultant will bear in mind the purposes of the basic design produced in the preliminary survey, formulate a consistent project team for execution design and construction supervision works, and smoothly implement the works. The consultant will station at least one engineer on the project site during the stage when it supervises the construction work for the purposes of managing the work schedule and performing quality and safety management. Prior to shipment from Japan, experts will witness factory inspections and pre-shipment inspections of materials and equipment manufactured in Japan, if necessary, in order to avoid any troubles after they have arrived on the project site.

(1) Basic policy for construction supervision

The consultant shall basically manage construction progress so that the works will be completed as scheduled and ensure quality, amount of finished work and delivery date of equipment and materials specified in the contract. The consultant shall also supervise and instruct contractors to ensure safe execution of construction works at the sites. The followings are the major points to remember for construction supervision.

1) Process management

The consultant shall compare the construction schedule developed at the time of contracting and the actual progress every month or week to ensure that the contractor will meet the delivery date specified in the contract. If delay is expected, the consultant shall remind and request the contractor to present and implement measures so that construction and delivery of equipment and materials will be completed within the schedule specified in the contract. The consultant shall compare the schedule and the progress mainly concerning the following points.

(a) Check the completed amount of works (amount of equipment and materials produced at plant and amount of completed civil engineering and construction works at sites).

(b) Check the delivery status of equipment and materials (equipment and materials for transformation and transmission and those for civil engineering and construction works).
(c) Check the status of temporary works and preparation of construction equipment.
(d) Check the unit cost and the actual cost for engineers, technicians, workers, etc.

2) Management of quality and amount of completed work

Concerning the following points, the consultant shall provide supervision to see whether equipment and materials produced, delivered or installed and facilities constructed satisfy the quality and amount specified in the contract documents. In case the requirements for quality or amount of finished work are not likely to be satisfied, the consultant shall immediately request the contractor to make correction, change and/or adjustment.

(a) Check production drawings and specifications of equipment and materials.
(b) Witness plant inspection of equipment and materials or check the result of plant inspection.
(c) Check methods for packaging, transportation and temporary storage at the site.
(d) Check working drawings and installation instructions for equipment and materials.
(e) Check instructions for commissioning, adjustment, test and inspection of equipment and materials.
(f) Supervise installation works of equipment and materials on site and witness commissioning, adjustment, test and inspection.
(g) Check finished works on site against working drawings for installation and production drawings of equipment and materials.

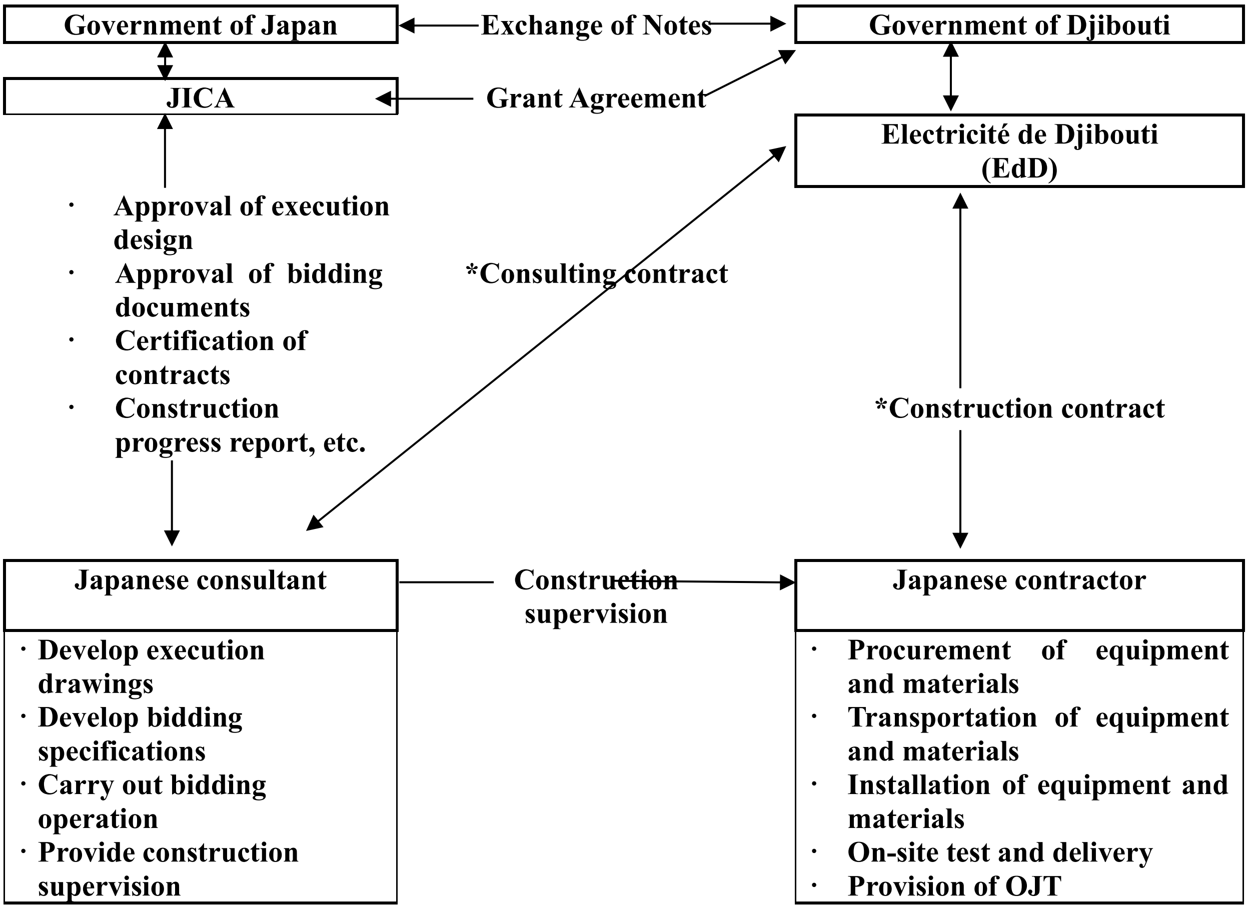
3) Safety control

Through consultation and cooperation with the responsible person of the contractor, the consultant shall provide supervision concerning safety to prevent industrial accidents and accidents involving third parties on site during the construction period. The points to remember for on-site safety control are the followings.

(a) Establish safety control regulations and appoint a person in charge.
(b) Prevent accidents by conducting periodic inspection of construction equipment.
(c) Determine routes for construction vehicles, transporting machines etc. and ensure safe traveling.
(d) Take welfare measures for workers and ensure that they take vacation days.

(2) Overall relations concerning implementation of the Project

Figure 2-2-4-4.1 shows relations among implementing bodies of the Project including those for construction supervision.



Note: Consulting contract and vendor contract need to be certified by JICA.

Figure 2-2-4-4.1 Relations for Project Implementation

(3) Construction supervisor

According to the construction contract, the contractor will procure and deliver materials and equipment for expansion of Jaban As Substation; construction of the new overhead transmission line; and construction of the new underground cable. The contractor will then undertake civil engineering and construction works necessary for the expansion and construction. For this purpose, the contractor will conclude subcontracts with local contractors in Djibouti. On this occasion, the contractor will dispatch engineers with similar overseas work experience to the project site to instruct and give advice to the local contractors. Because the management of local contractors requires the knowledge of Japan’s grant aid cooperation scheme, it is preferable to dispatch Japanese engineers.

2-2-4-5 Quality Control Plan

The supervisors of the consultant will supervise and check if the quality of materials and equipment procured and the construction and installation works completed under the Project satisfy the quality and requirements specified in the contract documents (technical specifications, execution drawings, etc.) in reference to the following perspectives. In case they find it difficult to ensure the quality and requirements, they will require the contractor to make corrections, revisions or adjustments.

- (i) Checking of drawings and specifications of materials and equipment
- (ii) Witnessing of factory inspections of materials and equipment, or checking of the result of factory inspections
- (iii) Checking of packing, transport and method of provisional storing on site
- (iv) Checking of construction drawings of materials and equipment and instruction manuals for installation work
- (v) Checking of instruction manuals for test operation, adjustment, tests and inspections of materials and equipment at factories and on site
- (vi) Supervision of on-site installation work of materials and equipment, and witnessing of test operation, adjustment, tests and inspections
- (vii) Checking of installation drawings of equipment, drawings and the installation work completed on site
- (viii) Checking of completion drawings

In Djibouti, where there are the severe environmental conditions and special procurement conditions, care must be taken particularly for concrete mixing and other works. Local workers reportedly added tap water with high salt concentration to concrete mixing at their own discretion in projects in the past. To avoid such incidents, the supervisors must call on local workers to observe precautions for routine construction work, and supervise their work procedures.

2-2-4-6 Procurement Plan

Among the components of the Project, the transformers for Jaban As Substation will be Japanese-made. The switching and protection facilities will be procured in Japan or third countries, but the consistency with the existing facilities will be secured. The towers, overhead transmission line, underground cable, communication facilities, and materials and equipment for the transmission lines will be all Japanese or third-country made so as not to make the specifications considerably differ from the existing facilities.

As for materials and equipment for the construction work, Djibouti, Japanese or third countries' products will be adopted. But in light of the local environmental conditions, they must satisfy in principle the applicable standards and specifications set forth in the Project.

Although there is no particular problem with marine transport, surface transport and storage places, materials and equipment must be packed in a manner suitable for the protection under these transport, landing and storage conditions.

Table 2-2-4-6.1 Sources of Equipment and Materials for the Project

Equipment/material	Procurement source		
	Djibouti	Japan	Third country (See note)
(Major equipment)			
(a) Switching equipment at Jaban As Substation	–	○	○
(b) Protection equipment at Jaban As Substation	–	○	○
(c) Transformers at Jaban As Substation (230/63 kV)	–	○	–
(d) Connecting equipment at Nagad Connecting Point	–	○	○
(e) Tower	–	○	○
(f) Overhead transmission line	–	○	○
(g) Underground cable	–	○	○
(h) Communication equipment	–	○	○
(i) Equipment and materials for transmission lines	–	○	○
(j) Spare items and maintenance tools	–	○	○
(Construction equipment and materials)			
(a) Sand and gravel	○	–	–
(b) Cement	○	–	–
(c) Fresh concrete	○	–	–
(d) Steel products	○	–	–
(e) Iron frames	○	–	–
(f) Building equipment, exterior materials and fittings	○	–	–
(Construction machinery/transportation vehicles)			
(a) General construction machinery	○	–	–

Note: The third countries shall basically be DAC member countries, ASEAN member countries or the countries of origin of the existing equipment at EdD.

2-2-4-7 Operational Guidance Plan

Initial operational training and operational training will be conducted by Japanese engineers during the installation work and the test adjustment period, respectively, during the project term. Training will be basically on-the-job training (OJT) conducted by instructors of the manufacturers in accordance with operation, maintenance and management manuals. It is desirable for the contractor to refer to various manuals and other documents for the existing facilities and propose operation, maintenance and management methods that are efficient and consistent with the existing maintenance and management system and methods.

Training will aim at personnel of the Interconnection Service and the Transmission and Distribution Service, both of which are chiefly in charge of the operation of the facilities procured under the Project. But to improve the technical capacity of EdD, it will cover any EdD personnel who are able to participate in training.

For smooth implementation of this training plan, EdD will maintain close contact and discuss with the Japanese consultant and contractor, and select full-time engineers who will participate in OJT. The selected EdD engineers are required to commit themselves to an improvement of the maintenance and management capacity of EdD by communicating knowledge they have learned through training to personnel who did not participate in training.

2-2-4-8 Implementation Schedule

After the Government of Japan approves the implementation of the Project, the Governments of Japan and Djibouti agree on exchange of notes (E/N), and the project commences based on Japan’s grant aid cooperation scheme. The Project chiefly consists of three stages: (i) execution designing; (ii) selection of the contractor (creation of bidding documents, bid announcement, bidding, evaluation of bidders, and contract agreement); and (iii) procurement of materials and equipment, and installation work.

Because the Project is classified as a “Type I-G” grant aid project, it will be divided into the portion of execution designing and the main part and the Governments of Japan and Djibouti agree on exchange of notes (E/N) twice. The first E/N covers the designing and supervisory cost incurred from the process from the field survey to works related to approval of bidding documents, and the second E/N covers the designing and supervisory cost incurred from the process from the publication of bidding documents to the completion of the construction work, as well as the costs of procurement of materials and equipment, and the installation work. Figure 2-2-4-8.1 illustrates the project implementation schedule.

As shown in Figure 2-2-4-8.1, the project term will be 19.0 months.

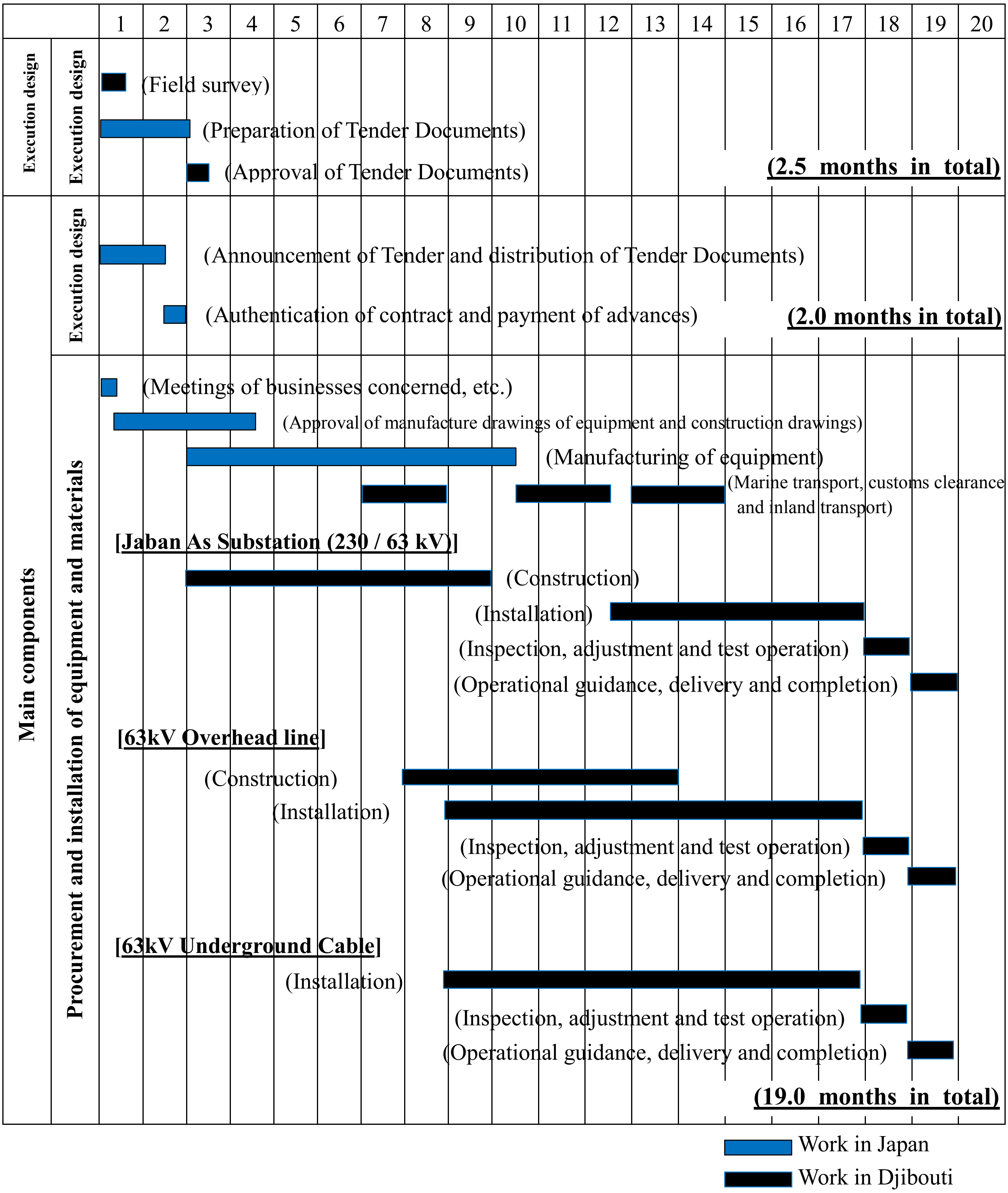


Figure 2-2-4-8.1 Project Implementation Schedule

2-3 Obligations of Recipient Country

The country of Djibouti shall implement and/or cover the cost of the following items. (See also 2-2-4-3 “Scope of Construction/Scope of Procurement and Installation”.)

Common Items

(1) Provision of information and data necessary for the Project

(2) Communication and application to relevant organizations including the Direction of Habitat and Urban Planning and the Direction for National Property

(3) Prompt unloading, customs clearance and tax exemption in Djibouti port of the equipment and materials necessary for the Project

(4) Tax exemption and provision of facilities for the equipment and materials necessary for the Project and the Japanese persons dispatched

(5) Procurement of the equipment and materials necessary for the Project and exemption of business tax for Japanese corporations and persons

(6) Bearing of overweight charge for the transportation in Djibouti of the equipment and materials necessary for the Project

(7) Bearing of registration fees for the registration of consultants and building contractors for the Project

(8) Bearing of the cost to open an account at an authorized foreign exchange bank in Japan and payment fees

(9) Bearing of all the costs necessary for the implementation of the Project that are not included in Japan’s grant aid

(10) Appointment of expert engineers for technical transfer for operation and maintenance of the Project; check of the construction works during the construction period; and witness of quality inspection of equipment and materials

(11) Appropriate use and maintenance of the facilities and equipment constructed or procured with Japan’s grant aid

(12) Execution of environment monitoring

Preparation works

(13) Securement of land for the access roads for the works of transmission lines, and construction of the roads

(14) Improvement of the access road to Jaban As Substation

(15) Application for land use and securement of land for the construction of new transmission lines

(16) Removal of obstacles from the transmission route

(17) Land grading for the construction of new transmission lines

(18) Provision of free temporary use of land for the construction office, storage space for equipment and materials, etc.

2-4 Project Operation Plan

2-4-1 Basic Policy

To improve the credibility of electricity supply and stably supply electricity, it is essential to appropriately operate and maintain the transmission and transforming facilities, and to conserve the surrounding environment. It is preferable to reduce the rate of accidents involving the facilities, prevent accidents, and implement appropriate operation and management (O&M) for higher credibility, safety and efficiency under the severe environment in Djibouti.

Figure 2-4-1.1 outlines the basic approach to maintenance and management.

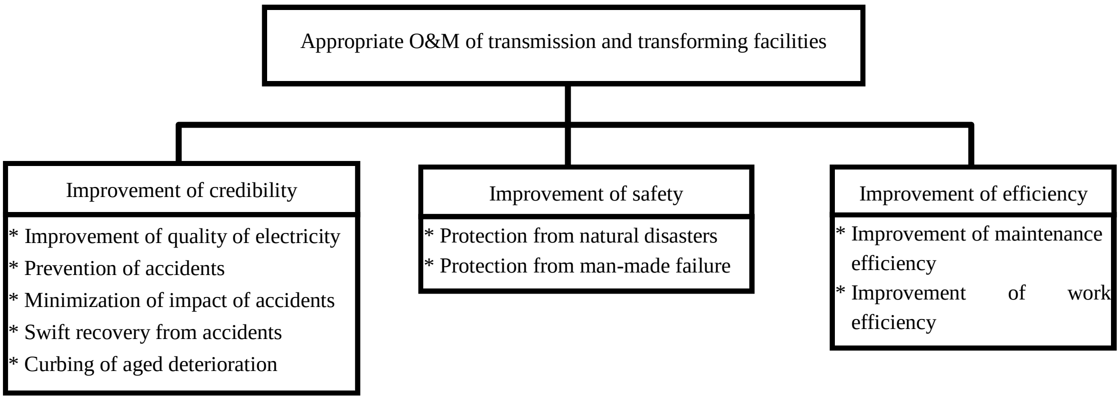


Figure 2-4-1.1 Basic Approach to Maintenance and Management

On-the-job training (OJT) on the operation, maintenance and management of the facilities will be conducted by engineers dispatched from the Japanese contractor during the installation work and the test adjustment period. The Project will also provide the recipient agency with backup supplies, testing tools, maintenance tools, and operation and maintenance manuals. Moreover, the existing operation, maintenance and management system and methods will be confirmed to propose a system and method that are consistent with the existing system and methods. All this will make it possible to fully demonstrate the effects of the Project.

2-4-2 Policy on Regular Inspection

(1) Regular inspection of the transmission line

Because Djibouti is always exposed to salt breeze and severe natural environment, the facilities must be regularly patrolled. Accidents could happen to the overhead transmission line because of various reasons including strong winds and other natural forces, and aged deterioration. Once an accident occurs, power outage is likely to affect a wide area.

Regular inspection tours will check if there is any extraneous matter from the air, bird nest, overgrown tree that has got too close to any electrically-conductive part or any other abnormality in the structures. Inspection tours will also help collect information about any plan to build a new building nearby, road construction plans or other relevant matters, enabling to confirm if such incidents may affect the transmission facilities.

Inspection tours will be made basically once or twice a month. But in case of a strong wind, heavy rain or other abnormal climate, or any disaster, an emergency inspection should be made. Moreover, the soundness of the towers (slack) will be confirmed once each year.

(2) Periodical maintenance of facilities for substation

The recommended standard periodical maintenance items for the facilities of substations, which are planned to be procured and installed under the Project, are shown in Table 2-4-2.1. These maintenance works shown in Table 2-4-2.1 are categorized in two; one is so called 'Patrol inspection' that relies on the five senses of human to detect abnormal heat generation, sound, etc. of equipment by daily patrol, the other one is so called 'General inspection' that are like a functional test of interlock mechanism among devices, calibration of instruments for maintaining accuracy and works which are unable to conduct while the equipment is under operation such as checking of tightening of bolts and of surface pollution condition of insulators around electric charging portion.

General inspection should be made every one to two year. The parts like fuses, instruments and relays mounted in panels those of which are predicted some performance degradation, insulation deterioration, characteristics change, wear of contacts, etc. should be appropriately replaced by checking of characteristics and frequency of use at the timing of General inspection.

Table 2-4-2.1 Typical maintenance item for substation equipment

Item	Inspection	Patrol inspection	General inspection
Appearance	Condition of indicators and lumps	X	X
	Abnormal sound and smell check	X	X
	Color change of terminals by abnormal heat	X	X
	Crack, breakage and/or contamination check of busing or porcelain tube	X	X
	Rust of panels, frames, etc. check	X	X
	Abnormal temperature check by temperature gauge indication	X	X
	Tightening check of busing terminals	X	X
Operating device and control panel	Condition of instruments	X	X
	Operation counter check		X
	Panel condition check such as rust, intrusion of moisture and contamination, etc.		X
	Replenishment of lubrication oil and cleaning		X
	Tightening check of terminals for wirings and cables	X	X
	Condition of on/off indicators		X
	Leakage check of air, oil and gas		X
	Operation medium pressure check before and after operation (air, oil, etc.)		X
	Check of operation mechanism of indicators		X
	Rust, deformation, damage check of operation mechanism and cleaning	X	X
	Check abnormality of clamps and pins		X
	Auxiliary relays and switches check and cleaning		X
	D.C. power supply system check	X	
Measurement and test	Insulation resistance measurement		X
	Contacts resistance measurement		X
	Check heater circuits disconnection		X
	Functional check of relays		X

Furthermore, it is recommendable that facilities and equipment which use more than 10 to 15 years should be maintained by means of conducting detailed inspection under the supervision of original manufacture's expert. This detailed inspection should include necessary replacement of parts, which are predicted to have consumed or almost consumed their lives, and adjustment for longer healthy operation.

2-4-3 Schedule for Procurement of Spare parts

(1) Classification and selection of spare parts

The spare parts procured under the Project are categorized as followings.

1) Consumables

The consumables are defined as the parts which are required to be replaced periodically in less than one year period due to consuming their life or degradation under the normal operation of the equipment and are procured 100 % under the Project for one year operation of the equipment supplied by the Project.

2) Spare parts

The spare parts are defined as the parts which are little consuming their life in short term under the normal operation of the equipment, however, the parts, which have the high possibility of reaching their life or of damage through the frequent operation and/or accumulated operational time, are selected to procure under the Project. As the Project for substations is expansion of the existing ones, some existing spare parts EdD possesses can be utilized so that the careful selection of spare parts to be supplied is considered to avoid redundant procurement of same duplicate parts.

(2) Special tools for maintenance

Since the design of substations to be expanded under the Project is in compliance with the existing ones and EdD has necessary special tools and instruments for maintenance to maintain substation properly, no special tools for maintenance for substation are procured this time.

(3) Budget preparation for spare parts

The spare parts, which are to be replaced depending on the condition of deterioration and to be replaced required in the event of an emergency such as an accident, have to be purchased in advance upon the examination of required parts for aforesaid periodical General inspection. It is planning to procure minimum spare parts required for one year operation. Therefore, it is necessary for Djibouti to budget of the cost of purchasing additional spare parts required for after one year of the Project completion.

Table 2-4-3.1 Spare Parts and Their Quantities

Type of instrument	Quantity of replacement parts to be procured in the project
Fuse for 230kV equipment (100 % each)	1 set
Lamp for 230kV equipment (100 % each)	1 set
Space heater for 230kV equipment	1
Packing for 230kV equipment (100 %)	1 set
Trip coil for 230kV equipment	1
Closing coil for 230kV equipment	1
MCCB for 230kV equipment (each type)	2
Auxiliary relay for 230kV equipment (each type)	2
Electromagnetic Contactor for 230kV equipment (each type)	1
Trip coil for 63kV equipment	1
Closing coil for 63kV equipment	1
MCCB for 63kV equipment (each type)	3
Auxiliary relay for 63kV equipment (each type)	3
Electromagnetic Contactor for 63kV equipment (each type)	2
MCCB for Control panel (each type)	3
Auxiliary relay for Control panel (each type)	3
Timer for Control panel (each type)	2
Lamp for Control panel (100 % for each)	3 sets
Fuse for Control panel (100 % for each)	2 sets
Auxiliary relay for Protection panel (each type)	2
Fuse for Protection panel (100 % for each type)	2 sets
MCCB for DC distribution panel (each type)	1
MCCB for AC distribution panel (each type)	1
Optical fiber cable for Communication system	2 sets

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

In the case of the actual implementation of the Project under the grant aid scheme of the Government of Japan, the Djibouti Side is expected to pay the costs of its undertakings listed below. Cost to be borne by the recipient country: USD 83,000.- (approx. 8.6 million yen)

(1) The contents and costs to be borne by the Djioutian side are as follows.

1) Payment for bank commission based on banking commission of an Authorization to Pay (A/P) and Payment commission:
   USD 30,000.- (approximately 3.1 million yen)

2) Land leveling on the Project site along the transmission line:
   USD 21,000.- (approximately 2.2 million yen)

3) Construction of access road to the transmission line:
   USD 26,000.- (approximately 2.7 million yen)

4) Data survey of the underground of the Djibouti city for the installation of underground cable:
   USD 6,000.- (approximately 0.6 million yen)

(1) Estimation conditions

(a) Estimation point: April 2014

(b) Exchange rate:
1 USD = 103.76 JPY (TTS mean value from Janurary 2014 to March 2014)
1 EURO = 142.29 JPY (TTS mean value from Janurary 2014 to March 2014)
1 DJF = 0.58 JPY (TTS mean value from Janurary 2014 to March 2014)

(c) Work and procurement period: The periods of detail design, and procurement and installation are as shown in the work schedule.

(d) Others: This cooperation project will be implemented according to the Grant Aid Scheme of the Government of Japan.

2-5-2 Operation and Maintenance Cost

The Transmissionand Distribution Department and Interconnection Department of EdD will operate and maintain the equipment and facilities to be supplied under the Project in addition to the existing equipment and facilitities. There will not be additional employment caused by the Project and EdD will reorganize the organization in the Departments. Regarding the maintenance tools, existing ones are able to be utilized for the maintenance of the equipment procured and installed in the Project.

EdD must keep in stock spare parts (consumable goods and replacement parts) necessary for the sound operation of the Transmission and Substation facilities and thus EdD must earmark a certain amount of budget (equivalent to approx. 5.8 million yen/year) for such spare parts. EdD's business income and expenditure varies year by year, becoming positive figure and negative figure. EdD needs to confirm the leftover of the spare parts and develop a plan for the procurement. In the Project, the equipmemt and facilities are designed as similar to the existing ones as possible for share of the spare partes of the existing equipmemt and facilities. It should be noted that because inexpensive power purchase 6~7 US cents / kWh from Ethiopia has been started since May 2011, the management situation of the EdD deemed to be greatly improved.

Chapter 3 Project Evaluation

3-1 Preconditions

Preconditions for the project implementation are seisin of land under overhead transmission lines, land grading for transmission line construction, improvement of access roads for works and acquisition of environmental permit concerning the implementation of the Project.

3-2 Necessary Inputs by Recipient Country

The following matters will have to be implemented by Djibouti to achieve the overall plan of the Project.

(a) Carry out daily maintenance works properly so that the transmission and transformation facilities to be procured and installed by the Japanese side will be made best use of.

(b) Conduct in a planned manner distribution and training of the personnel who will operate and maintain the transmission and transformation facilities to be constructed in the Project and ensure that the operation of such facilities will start smoothly.

(c) Procure and restock necessary spare parts without delay for the maintenance of the transmission and transformation facilities to be constructed in the Project and carry out periodic maintenance without fail.

(d) Improve the lower distribution system (20 kV) to match the improved upper system (63 kV transmission system) so that the Project outputs will reach end-users.

3-3 Important Assumptions

For the EdD to provide the inputs listed above, it is important to secure enough revenue from the electricity business that matches the expenditure. To achieve this, the government is expected to allocate budget so that the government organizations of Djibouti, many of whom fail to pay electricity bills, can make payments without delay.

3-4 Project Evaluation

3-4-1 Relevance

As described below, the Project will benefit the general public as well as contribute to realizing the development plan and energy policy of Djibouti. Therefore, the relevance of the cooperation project is considered high.

(1) Number of Beneficiaries

The implementation of the Project will lead to the supply of high-quality electricity to about

475,000 people living in the capital area of Djibouti (2009 Population Census). The number of electricity customers in the target area of the Project is about 38,400 households in total; about 37,700 general customers and about 700 special customers including medium-voltage customers (20 kV).

(2) Urgency

In Djibouti, it is expected that steady economic growth and large-scale logistics infrastructure development plans will lead to significant increase in electricity demand. It is expected that, without improvement of transmission and transformation facilities to catch up with increasing electricity demand, power supply will be disturbed and such issues as deterioration of living environment for the residents, deterioration of public services and damage to trading and port projects will be caused. Therefore, there is an urgent need for improvement through the implementation of the Project.

(3) Contribution to the Stable Operation of Public Welfare Facilities

The city of Djibouti, the target area of the Project, is the capital of the country of Djibouti that has more than half of the total population and is also the center in politics, economy, education, medical care, etc. of the country.

The increase in capacity of transmission and transformation facilities through the implementation of the Project will help stabilize the power supply to public welfare facilities and contribute to the stable operation of such facilities.

(4) Capabilities for Operation and Maintenance

Conducting daily operation and maintenance work for 230 kV and 63 kV transmission lines and 230/63 kV and 63/20 kV transformation facilities, the EdD has enough experience in operation and maintenance of similar facilities. Therefore, the EdD, as the executing agency, can properly handle operation and maintenance of the transmission and transformation facilities to be procured and installed in the Project with its technical capabilities. In addition, since the maintenance costs for newly procured and installed equipment through the project (consumables, spare parts, etc.) per year is about 5.8 million yen, and this is 0.24% of the parts purchase cost of EdD, EdD is able to afford the cost. There will be no issues with the implementation of the Project. It should be noted that because inexpensive power purchase 6~7 US cents / kWh from Ethiopia has been started since May 2011, the management situation of the EdD deemed to be greatly improved.

(5) Project to Contribute to the Development Plan of Djibouti

Energy plays an important role in achieving “Pillar 1: Accelerate growth and preserve the major macroeconomic balances”, one of the four strategic pillars of the National Initiative for Social Development (Initiative Nationale pour le Développement Social [National Initiative for Social Development], INDS, 2008-20120), a development plan of Djibouti. Although energy is a determinant of economic growth and pursuit of competitiveness, energy supply in Djibouti is insufficient and expensive. Only 50% of the national population has access to modern energy, mostly in urban area. Such current situations of energy supply noticeably hinder the development of the country. Therefore, they have a policy to promote development of a transmission system with such key facilities as transmission lines between local power sources of geothermal heat, wind, etc. and the city of Djibouti as well as the interconnection transmission line from Ethiopia.

As the Project is to stabilize electricity supply and improve quality of electricity by increasing transmission and transformation capacity in the capital area of Djibouti, it will contribute to the county’s development plan and energy policy described above.

(6) Environmental and Social Impacts

The implementation of the Project will require seisin of land under overhead transmission lines (24m wide). As the result of a local survey shows that most of the overhead lines will go through unused land, involuntary resident relocation or compensation for agricultural crops concerning land acquisition are not expected and all easement has been granted from the Direction of National Property. The noise from the transmission and transformation facilities of the Project will be minor. The underground line from the Nagad Connection Point to the Boulaos Substation will go under urban street and there is no involuntary resident relocation expected. The impact is expected to be avoidable with proper diversions and restrictions of traffic during construction as there is not much traffic in the city.

The EdD inquired the Direction of Regional Development and Environment about whether the Project will need environmental impact assessment under the Ordinance of the Direction 2011-029 concerning environmental permit, and was told it would not be necessary.

Based on the above, the Project will not cause any particular impact on the environment or the society.

(7) Scheme of Japan’s Grant Aid

Considering that the major equipment will be procured from Japan and the Project will be completed within the time limit of a grant aid fixed in the E/N, the Project has realistic contents and process schedule within the scheme of a grant aid. Therefore, the Project can be implemented without particular difficulty.

3-4-2 Effectiveness

The following effects are expected to be produced from the implementation of the Project.

(1) Quantitative Effects

Indicator	Standard value (Actual value of 2014)	Target value (2020) (3 years after the completion of the Project)	Reference (2020) Without implementation of the Project
Load factor (%) of the 230/63 kV transformers at Jaban As Substation	53.6	62.2	105.3
Load factor (%) of the transmission line between Jaban As Substation and Palmeraie Connection Point	48.3	63.1	102.6

(2) Qualitative Effects (Entire Project)

Current state and issues	Measures in the Project (Works related to the Cooperation project)	Effects and improvements produced by the Project
In Djibouti, electricity supply facilities have not been improved to catch up with the expected increase of electricity demand associated with large-scale development plans for port facilities, railways and a new airport.	Construction of transmission lines and improvement of transformation facilities	Negative effect that supply restriction might cause on economic activities, public services and life of local residents can be avoided through the creation of facilities to match increasing electricity demand.

[Annex]

A-1 Member List of the Study Team

(1) First Field Survey

No.	Name	Assignment	Period	Organization
1	Hiroo TANAKA	Team Leader	13Sep.2013~20Sep.2013	Japan International Corporation Agency
2	Katsuya KUGE	Planning Management	13Sep.2013~20Sep.2013	Japan International Corporation Agency
3	Nobuhiko AOKI	Financial Cooperation Planning	13Sep.2013~20Sep.2013	Japan International Corporation Agency
4	Kyoji FUJII	Chief Consultant / Substation Facilities & Transmission System Planning	1Sep.2013~19Sep.2013	Yachiyo Engineering Co., Ltd.
5	Keiichiro OHASHI	Substation Facilities Planning	1Sep.2013~21Sep.2013	West Japan Engineering Consultants, Inc.
6	Katsuhiro MORIYAMA	Transmission & Distribution System Planning	1Sep.2013~21Sep.2013	Yachiyo Engineering Co., Ltd.
7	Tatsunari HAYASHI	Power Flow Analysis	1Sep.2013~21Sep.2013	Kyushu Electric Power Co.,inc
8	Masao YAMAKAWA	Procurement Planning / Cost Estimation	6Sep.2013~20Sep.2013	Yachiyo Engineering Co., Ltd.
9	Shigeki TAKASHIMA	Environmental and Social Consideration	1Sep.2013~21Sep.2013	Yachiyo Engineering Co., Ltd.
10	Kiyohito HOSAKA	Interpreter	1Sep.2013~21Sep.2013	Franchir Co., Ltd.

(2) Second Field Survey

No.	Name	Assignment	Period	Organization
1	Kyoji FUJII	Chief Consultant / Substation Facilities & Transmission System Planning	18Oct.2013～8Nov.2013	Yachiyo Engineering Co., Ltd.
2	Keiichiro OHASHI	Substation Facilities Planning	18Oct.2013～7Nov.2013	West Japan Engineering Consultants, Inc.
3	Katsuhiro MORIYAMA	Transmission & Distribution System Planning	18Oct.2013～7Nov.2013	Yachiyo Engineering Co., Ltd.
4	Tatsunari HAYASHI	Power Flow Analysis	18Oct.2013～7Nov.2013	Kyushu Electric Power Co.,inc
5	Takayasu KASE	Construction Planning / Cost Estimation	18Oct.2013～7Nov.2013	Yachiyo Engineering Co., Ltd.
6	Masao YAMAKAWA	Procurement Planning / Cost Estimation	18Oct.2013～7Nov.2013	Yachiyo Engineering Co., Ltd.
7	Shigeki TAKASHIMA	Environmental and Social Consideration	18Oct.2013～7Nov.2013	Yachiyo Engineering Co., Ltd.
8	Kiyohito HOSAKA	Interpreter	18Oct.2013～7Nov.2013	Franchir Co., Ltd.

(3) Third Field Survey (additional)

No.	Name	Assignment	Period	Organization
1	Shigeki TAKASHIMA	Environmental and Social Consideration	20Dec.2013~31Dec.2013	Yachiyo Engineering Co., Ltd.

(4) Fourth Field Survey (additional)

No.	Name	Assignment	Period	Organization
1	Kyoji FUJII	Chief Consultant / Substation Facilities & Transmission System Planning	28Mar.2014~5Apr.2014	Yachiyo Engineering Co., Ltd.
2	Katsuhiro MORIYAMA	Transmission & Distribution System Planning	28Mar.2014~5Apr.2014	Yachiyo Engineering Co., Ltd.
3	Shigeki TAKASHIMA	Environmental and Social Consideration	28Mar.2014~12Apr.2014	Yachiyo Engineering Co., Ltd.
4	Norihiko IGUCHI	Interpreter	28Mar.2014~12Apr.2014	Franchir Co., Ltd.

(5) Fifth Field Survey

No.	Name	Assignment	Period	Organization
1	Hiroshi SATO	Team Leader	22Nov.2014~28Nov.2014	Japan International Corporation Agency
2	Katsuya KUGE	Planning Management	22Nov.2014~28Nov.2014	Japan International Corporation Agency
3	Kyoji FUJII	Chief Consultant / Substation Facilities & Transmission System Planning	22Nov.2014~28Nov.2014	Yachiyo Engineering Co., Ltd.
4	Keiichiro OHASHI	Substation Facilities Planning	20Nov.2014~28Nov.2014	West Japan Engineering Consultants, Inc.
5	Katsuhiro MORIYAMA	Transmission & Distribution System Planning	20Nov.2014~28Nov.2014	Yachiyo Engineering Co., Ltd.
6	Masao YAMAKAWA	Procurement Planning / Cost Estimation	20Nov.2014~28Nov.2014	Yachiyo Engineering Co., Ltd.
7	Norihiko IGUCHI	Interpreter	20Nov.2014~28Nov.2014	Franchir Co., Ltd.

A-2 Study Schedule

(1) The First Field Survey

No.	Date(Day)	Contents of Survey		Stay at
		JICA Member	Consultant Member	
		Mr. Tanaka, Mr. Kuge, Mr. Aoki	Mr. Fujii, Mr. Ohashi, Mr. Moriyama, Mr. hayashi, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka	
1	1 Sep. (Sun)		① Trip by air {Tokyo - Dubai - Djibouti }	Djibouti
2	2 Sep. (Mon)		① Courtesy call (JICA Djibouti Office, Ministry of Energy and Natural Resources (MENR)、Electricete de Djibouti (EdD)) ② Submission and explanation of Inception Report(IC/R) and Questionnaire and Discussion about request from survey team for the survey ③ Confirmation of required component and the project for supply to Dorale region	Djibouti
3	3 Sep. (Tue)		① Site survey at existing substation (Collection of specification and operating record) ② Confirmation of existing transmission line route ③ Survey of market, fishing port and site for IMO Training Center ④ Internal meeting（Confirmation of component）	Djibouti
4	4 Sep. (Wed)		① Explanation of IC/R , confirmation of requirement and explanation of ODA system ② Site survey at existing substation (Collection of existing specification and operating record) and maintenance system, confirmation of budget, and etc. ③ Confirmation of other donors	Djibouti
5	5 Sep. (Thu)		① Environmental Impact Assessment ② Survey on maintenance organization ③ Site survey at existing substation and transmission line ④ Preparation of basic design (confirmation of demand forecast, analysis of tidal current and consideration of route of transmission line)	Djibouti
6	6 Sep. (Fri)		① Organizing collected data ② Site survey ③ Preparation of basic design (confirmation of demand forecast, analysis of tidal current and consideration of route of transmission line)	Djibouti
7	7 Sep. (Sat)		① Site survey ② Preparation of basic design (confirmation of demand forecast, analysis of tidal current and consideration of route of transmission line) ③ Arrival of Mr. Yamakawa	Djibouti
8	8 Sep. (Sun)		① Environmental Impact Assessment ② Confirmation of existing transmission line route（Access road etc.） ③ Preparation of basic design (confirmation of demand forecast and analysis of tidal current) ④ Survey of market for procurement work	Djibouti
9	9 Sep. (Mon)		① Survey on substation (PK12) ② Preparation of basic design (confirmation of demand forecast and analysis of tidal current) ③ Preparation of the outline of the first field survey	Djibouti

No.	Date(Day)	Contents of Survey		Stay at
		JICA Member	Consultant Member	
		Mr. Tanaka, Mr. Kuge, Mr. Aoki	Mr. Fujii, Mr. Ohashi, Mr. Moriyama, Mr. hayashi, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka	
10	10 Sep. (Tue)		① Survey of site for IMO Training Center, Port of Djibouti, Transmission line route around new Nagad Station ② Preparation of basic design (confirmation of demand forecast, analysis of tidal current, consideration of specification of facilities and equipment, arrangement plan, and operation/maintenance plan) ③ Preparation of the outline of the first field survey	Djibouti
11	11 Sep. (Wed)		① Telephone meeting with JICA main branch ② Site survey (Division of Domains) ③ Preparation of basic design(analysis of tidal current, confirmation of specification of facilities and equipment, and arrangement plan) ④ Preparation of the outline of the first field survey	Djibouti
12	12 Sep. (Thu)		① Confirmation and discussion with the local subcontractor about expecting site (environmental survey) ② Site survey (Division of Habitation and Urban Planning) ③ Preparation of basic design(analysis of tidal current, confirmation of specification of facilities and equipment, and arrangement plan) ④ Preparation of the outline of the first field survey	Djibouti
13	13 Sep. (Fri)	Trip to {Tokyo - Dubai}	① Site survey (230kV Transmission line route, Market survey) ② Preparation of basic design (consideration of analysis of tidal current, specification of facilities and equipment, and arrangement plan) ③ Preparation of the outline of the first field survey	Djibouti
14	14 Sep. (Sat)	Trip to {Dubai - Djibouti}	① Site survey (Transmission Line) ② Preparation of basic design (analysis of tidal current, specification of facilities and equipment, and arrangement plan) ③ Preparation of the outline of the first field survey	Djibouti
15	15Sep. (Sun)	① Discussion with Governmental Organization including MENR ② Preparation of the draft of MD ③ Site survey (Jaban As Substation, Marabout Substation, Boulaos Substation, Nagad area, and site for IMO training center) ④ Preparation of basic design (determination of specification of facilities and equipment, arrangement plan, and operation/maintenance plan) ⑤ Preparation of the outline of the first field survey		Djibouti
16	16 Sep. (Mon)	① Preparation and discussion of MD with president of EdD ② Site survey (Environmental and Social Considerations survey, Confirmation of procedure of duty exemption and etc.) ③ Preparation of basic design ④ Preparation of the outline of the first field survey		Djibouti
17	17 Sep. (Tue)	① Preparation and discussion of MD ② Site survey ③ Preparation of basic design ④ Preparation of the outline of the first field survey		Djibouti

No.	Date(Day)	Contents of Survey		Stay at
		JICA Member	Consultant Member	
		Mr. Tanaka, Mr. Kuge, Mr. Aoki	Mr. Fujii, Mr. Ohashi, Mr. Moriyama, Mr. hayashi, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka	
18	18 Sep. (Wed)	① Signing of MD ② Trip by air {Djibouti - Ethiopia}	① Signing of MD Mr. Fujii (Project Manager) ① Trip by air {Djibouti - Addis Ababa} The other members ① Site survey ② Preparation of basic design ③ Preparation of the outline of the first field survey ④ Signing of Technical Memorandum ⑤ Report to JICA Djibouti office	Djibouti
19	19 Sep. (Thu)	① Report (Embassy of Japan in Ethiopia, JICA Ethiopia office) ② Trip by air{Ethiopia - Dubai}	Mr. Fujii (Project Manager) ① Courtesy call(Embassy of Japan in Ethiopia and JICA Ethiopia Office) ② Meeting with Ethiopian Electric Power Corporation ③ Survey on transmission facilities The other members ① Report to EdD ② Trip by air {Djibouti - Dubai}	Dubai
20	20 Sep. (Fri)	① Trip by air {Dubai - Tokyo}	① Trip by air Mr. Fujii (Project Manager) {Addis Ababa - Accra - Freetown } ② Trip by air {Dubai - Tokyo}	On board
21	21 Sep. (Sat)		① Trip by air {Dubai - Tokyo}	-

(2) The Second Field Survey

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Date(Day)</th><th colspan="2">Contents of Survey</th><th rowspan="3">Stay at</th></tr>
<tr><th colspan="2">Consultant Member</th></tr>
<tr><th>Mr. Fujii, Mr. Moriyama, Mr. Kase, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka</th><th>Mr. Ohashi, Mr. Hayashi</th></tr>
<tr><td>1</td><td>18 Oct. (Fri)</td><td>① Trip by air {Tokyo - Dubai - Addis Ababa - Djibouti}</td><td>① Trip by air {Fukuoka - Seoul}</td><td>Djibouti</td></tr>
<tr><td>2</td><td>19 Oct. (Sat)</td><td>① Discussion with EdD (Confirmation of component and etc.)
② Internal meeting</td><td>① Trip by air {Seoul - Addis Ababa - Djibouti}</td><td>Djibouti</td></tr>
<tr><td>3</td><td>20 Oct. (Sun)</td><td colspan="2">① Confirmation of Project Components (Urban-development project, EdD's project and etc.)
② Discussion with EdD (Confirmation of Questionnaire)
③ Courtesy call (JICA Djibouti Office)
④ Discussion with candidate for local consultant (Environmental and Social Considerations, topographical and geological survey)
⑤ Survey on local construction cost</td><td>Djibouti</td></tr>
<tr><td>4</td><td>21 Oct. (Mon)</td><td colspan="2">① Confirmation of Project Components
② Discussion with candidate for local consultant (Environmental and Social Considerations, topographical and geological survey)
③ Preparation of Specification
④ Survey on local construction cost
⑤ Preparation of Draft Field Report
⑥ Preparation of the outline of the second field survey</td><td>Djibouti</td></tr>
<tr><td>5</td><td>22 Oct. (Tue)</td><td colspan="2">① Discussion on Project Components
② Survey on the progress of the Urban-development project
③ Discussion with candidate for local consultant (Environmental and Social Considerations, topographical and geological survey)
④ Preparation of Specification
⑤ Survey on natural environment
⑥ Survey on local construction cost
⑦ Preparation of Draft Field Report
⑧ Preparation of the outline of the second field survey</td><td>Djibouti</td></tr>
<tr><td>6</td><td>23 Oct. (Wed)</td><td colspan="2">① Discussion on Project Components
② Site survey (PK12, Nagad area)
③ Acquisition of the Project plan from Division of Habitation and Urban Planning
④ Discussion with candidate for local consultant (Environmental and Social Considerations)
⑤ Preparation of Specification
⑥ Survey on local construction cost
⑦ Preparation of Draft Field Report
⑧ Preparation of the outline of the second field survey</td><td>Djibouti</td></tr>
<tr><td>7</td><td>24 Oct. (Thu)</td><td colspan="2">① Discussion on Project Components with President of EdD
② Discussion with candidate for local consultant (Environmental and Social Considerations, topographical and geological survey)
③ Preparation of Specification
④ Survey on natural environment
⑤ Survey on local construction cost
⑥ Preparation of Draft Field Report
⑦ Preparation of the outline of the second field survey</td><td>Djibouti</td></tr>
<tr><td>8</td><td>25 Oct. (Fri)</td><td colspan="2">① Organization of collected documents
② Preparation of Specification
③ Preparation of Draft Field Report
④ Preparation of the outline of the second field survey</td><td>Djibouti</td></tr>
</table>

No.	Date(Day)	Contents of Survey		Stay at
		Consultant Member		
		Mr. Fujii, Mr. Moriyama, Mr. Kase, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka	Mr. Ohashi, Mr. Hayashi	
9	26 Oct. (Sat)	① Site survey with EdD around PK12 ② Site survey at Boulaos substation ③ Preparation of Specification ④ Survey on natural environment ⑤ Preparation of Draft Field Report ⑥ Preparation of the outline of the second field survey		Djibouti
10	27 Oct. (Sun)	① Preparation of Specification ② Survey on local construction cost ③ Preparation of Draft Field Report ④ Preparation of the outline of the second field survey		Djibouti
11	28 Oct. (Mon)	① Preparation of Specification ② Survey on local construction cost ③ Survey on natural environment ④ Site survey on communication circumstances in Djibouti ⑤ Preparation of Draft Field Report ⑥ Preparation of the outline of the second field survey		Djibouti
12	29 Oct. (Tue)	① Preparation of Specification ② Survey at Laboratoire Central du Bâtiment et de l'Equipement (LCBE) ③ Survey on natural environment ④ Preparation of Draft Field Report ⑤ Preparation of the outline of the second field survey		Djibouti
13	30 Oct. (Wed)	① Site survey at around Nagad Connecting point ② Preparation of Specification ③ Survey on natural environment ④ Survey on topography and wadi at Centre d'Etude et de Recherche de Djibouti (CERD) ⑤ Preparation of Draft Field Report ⑥ Preparation of the outline of the second field survey		Djibouti
14	31 Oct. (Thu)	① Discussion with former chief of division of Public works ② Preparation of Specification ③ Preparation of Draft Field Report ④ Preparation of the outline of the second field survey		Djibouti
15	1 Nov. (Fri)	① Preparation of Specification ② Preparation of Draft Field Report ③ Preparation of the outline of the second field survey		Djibouti
16	2 Nov. (Sat)	① Submission of Draft Field Report to EdD ② Contract with local consultant for Environmental and Social Considerations ③ Preparation of the outline of the second field survey		Djibouti
17	3 Nov. (Sun)	① Survey on transmission line route and placement of pegs ② Preparation of the outline of the second field survey		Djibouti
18	4 Nov. (Mon)	① Modification of Draft Field Report ② Survey on earthquakes and rainfall at CERD Arta office ③ Contract with local consultant for topographical and geological survey ④ Preparation of the outline of the second field survey		Djibouti
19	5 Nov. (Tue)	① Modification of Draft Field Report ② Preparation of the outline of the second field survey ③ Report to JICA Djibouti office	① Modification of Draft Field Report ② Preparation of the outline of the second field survey ③ Report to EdD ④ Trip by air {Djibouti - Addis Ababa}	Djibouti

No.	Date(Day)	Contents of Survey		Stay at
		Consultant Member		
		Mr. Fujii, Mr. Moriyama, Mr. Kase, Mr. Takashima, Mr. Yamakawa, Mr. Hosaka	Mr. Ohashi, Mr. Hayashi	
20	6 Nov. (Wed)	① Report to EdD Mr. Fujii (Project Manager) ② Signing of Field Report by director general of EdD ③ Trip by air {Djibouti - Addis Ababa} The other members ① Trip by air {Djibouti - Addis Ababa - Dubai}	① Trip by air { Addis Ababa - Seoul}	Dubai
21	7 Nov. (Thu)	Mr. Fujii (Project Manager) ① Report to JICA Ethiopia office ② Trip by air{ Addis Ababa - Dubai} The other members ① Trip by air {Dubai - Tokyo}	① Trip by air { Seoul - Fukuoka}	On board
22	8 Nov. (Fri)	Mr. Fujii (Project Manager) ① Trip by air {Dubai - Tokyo}}		-

(3) The Third Field Survey

No.	Date(Day)	Contents of Survey	Stay at
		Consultant Member	
		Mr. Takashima, Mr.Iguchi	
1	20 Dec. (Fri)	① Trip by air {Tokyo - Dubai - Addis Ababa - Djibouti}	Djibouti
2	21 Dec. (Sat)	① Discussion with EdD and local Consultant (Confirmation of progress of simplified draft plan for relocation of residents)	Djibouti
3	22 Dec. (Sun)	① Discussion with EdD about alternatives for Transmission line route ② Preparation of report on Environmental and Social Considerations survey	Djibouti
4	23 Dec. (Mon)	① Site Survey (Transmission line route) ② Discussion with EdD about alternatives for Transmission line route	Djibouti
5	24 Dec. (Tue)	① Discussion with EdD and local Consultant about alternatives for Transmission line route ② Preparation of report on Environmental and Social Considerations survey	Djibouti
6	25 Dec. (Wed)	① Report to JICA Djibouti office ② Discussion with EdD about alternatives for Transmission line route	Djibouti
7	26 Dec. (Thu)	① Discussion with EdD about procedure of confirmation of Transmission line route ② Preparation of report on Environmental and Social Considerations survey	Djibouti
8	27 Dec. (Fri)	① Site Survey (Transmission line route) ② Preparation of the outline of the second field survey	Djibouti
9	28 Dec. (Sat)	① Guidance of local Consultant for preparation of simplified draft plan for relocation of residents ② Preparation of report on Environmental and Social Considerations survey	Djibouti
10	29 Dec. (Sun)	① Guidance of local Consultant for preparation of simplified draft plan for relocation of residents ② Preparation of report on Environmental and Social Considerations survey	Djibouti
11	30 Dec. (Mon)	① Trip by air {Djibouti - Addis Ababa - Dubai}	On board
12	31 Dec. (Tue)	① Trip by air {Dubai - Tokyo}	-

(4) The Fourth Field Survey

No.	Date(Day)	Contents of Survey	Stay at
		Consultant Member	
		Mr. Fujii, Mr. Moriyama, Mr. Takashima, Mr. Iguchi	
1	28 Mar. (Fri)	① Trip by air {Tokyo - Dubai - Addis Ababa - Djibouti}	Djibouti
2	29 Mar. (Sat)	① Discussion with EdD (Confirmation of crossing point of Transmission lines and etc.) ② Internal meeting	Djibouti
3	30 Mar(Sun)	① Discussion on Transmission line route including confirmation of Urban-development project, EdD's project and etc. ② Courtesy call (JICA Djibouti Office)	Djibouti
4	31 Mar. (Mon)	① Discussion on Transmission line route including confirmation of Urban-development project, EdD's project and etc. ② Preparation of Draft Field Report	Djibouti
5	1 Apr. (Tue)	① Discussion on Transmission line route including confirmation of Urban-development project, EdD's project and etc. ② Site survey along Transmission line route with EdD, and Division of Habitation and Urban Planning ③ Survey on the progress of IMO training center in Dorale region ④ Preparation of Draft Field Report	Djibouti
6	2 Apr. (Wed)	① Discussion on Transmission line route including confirmation of Urban-development project, EdD's project and etc. ② Site survey along Transmission line route with EdD and local consultant of geological survey ③ Discussion on Draft Field Report with EdD.	Djibouti
7	3 Apr. (Thu)	① Discussion on and signing of Draft Field Report with Director general of EdD ② Report to JICA Djibouti office ③ Discussion with local consultant (Environmental and Social Considerations, topographical and geological survey) ④ Discussion with the Principal of IMO training center in Dorale Mr. Fujii (Project Manager) ① Trip by air {Djibouti - Addis Ababa}	Djibouti
8	4 Apr. (Fri)	Mr. Fujii (Project Manager) ① Report to JICA Ethiopia office ② Trip by air {Addis Ababa - Dubai} Mr. Moriyama ① Trip by air {Djibouti - Addis Ababa - Dubai} Mr. Takashima ① Discussion with local consultant (Environmental and Social Considerations,)	Djibouti
9	5 Apr. (Sat)	Mr. Fujii (Project Manager) ① Trip by air {Dubai - Tokyo} Mr. Moriyama ① Trip by air {Dubai - Tokyo} Mr. Takashima, Mr. Iguchi ① Discussion with local consultant (Environmental and Social Considerations,)	Djibouti
10	6 Apr. (Sun)	① Discussion with local consultant concerning partial cancellation of the contract of resettlement plan	Djibouti
11	7 Apr. (Mon)	① Site survey along Transmission line route	Djibouti
12	8 Apr. (Tue)	① Site survey along Transmission line route	Djibouti
13	9 Apr. (Wed)	① Report to JICA Djibouti office	Djibouti
14	10 Apr. (Thu)	① Discussion with local consultant concerning partial cancellation of the contract of resettlement plan	Djibouti
15	11 Apr. (Fri)	① Trip by air {Djibouti - Addis Ababa - Dubai}	On board
16	12 Apr. (Sat)	① Trip by air {Dubai - Tokyo}	-

(5) The Fifth Field Survey

No.	Date(Day)	Content of the survey		Stay in
		Official Team	Consultant Team	
		Mr. Sato, Mr. Kuge	Mr. Fujii, Mr. Ohashi, Mr. Moriyama, Mr. Yamakawa, Mr. Iguchi	
1	20 Nov. (Thu)		Mr. Ohashi ① Travel {Fukuoka-Incheon- Dubai} Mr. Moriyama ② Travel {Dubai-Accra} Mr. Yamakawa, Mr. Iguchie ③ Travel {Tokyo-Dubai}	On board
2	21 Nov. (Fri)		Mr. Ohashi, Mr. Moriyama, Mr. Yamakawa, Mr. Iguchi ① Travel {Dubai-Addis Ababa-Djibouti}	Djibouti
3	22 Nov. (Sat)	① Travel {Tokyo-Dubai-Addis Ababa-Djibouti} ② Internal meeting	Mr. Fujii ① Travel {Dar es Salaam-Addis Ababa-Djibouti} All members ② Explanation of Draft Final Report (DFR) to EDD and MERN ③ Internal meeting	Djibouti
4	23 Nov. (Sun)	① Confirmation of transmission route and substations	① Explanation of DFR and equipment specifications to EDD ② Confirmation of transmission route and substations	Djibouti
5	24 Nov. (Mon)	① Meeting on M/M (draft) (EDD and MERN)	① Meeting to confirm the transmission route (Participants : DG/EDD, D/Urbanisme, D/Transports, ONEAD, Djibouti Telecom) ② Meeting on M/M (draft) (EDD and MERN)	Djibouti
6	25 Nov. (Tue)	① Protocol visit to the Japanese Embassy	① Explanation/confirmation of DFR/equipment specifications at EDD ② Confirmation of transmission route	Djibouti
7	26 Nov. (Wed)	① Signature M/M ② Report to JICA ③ Report to Embassy ④ Travel {Djibouti-Addis Ababa}	① Signature M/M ② Revision of DFR/equipment specifications Mr. Fujii ① Report to JICA of Djibouti ② Report to Embassy ③ Travel {Djibouti-Addis Ababa}	Djibouti
8	27 Nov. (Thu)	① Report on the survey (JICA Ethiopia) ② Travel {Addis Ababa-Dubai}	Mr. Fujii ① Report on the survey (JICA Ethiopia) ② Travel {Addis Ababa-Dubai} Other members ① Travel {Djibouti-Addis Abeba-Dubaï}	On board
9	28 Nov. (Fri)	① Travel {Dubai-Tokyo}	Mr. Fujii, Mr. Yamakawa, Mr. Iguchi ① Travel {Dubai-Tokyo} Mr. Ohashi ① Travel {Dubai-Incheon-Fukuoka} Mr. Moriyama ① Travel {Dubai-Accra}	-

A-3 List of Parties Concerned

Ministry of Budget   Ministère du Budget

1. Division of Domains   Direction des Domaines

Mr. Houssein Mahamoud Barreh	Directeur

Minister of Foreign and International Cooperation   Ministère des Affaires Etrangères et de la Coopération Internationale

1. Division of Bilateral Cooperation   Direction des Relations Bilatérales

Mr. Yacin Houssein Douale	Directeur
Mr. Omar Hahamoud Farah	Conseiller

Ministry of Energy and Natural Resources   Ministère de l'Energie et des Ressouces Naturelles

Mr. Ali Yacoub Mahamoud	Ministre

1. Division of Natural Resources   Direction des Ressources Naturelles

Mr. Ali Barreh	Ingénieur de l'environnement

Ministry of Habitation, Urban Planning and Environment   Ministère de l'Habitat, de l'Urbanisme et de l'Environnement

1. Division of National Land Planning and Environment   Direction de l'Aménagement du Territoire et de l'Environnement (DATE)

Mr. Houssein Rirache Robleh	Directeur de l'Aménagement du Territoire et de l'Environnment
Mr. Idris Ismael Nour	Sous-Directeur de l'Aménagement du Territoire et de l'Environnement
Mr. Abdoulkader Ahmed Aouled	Sous-directeur de l'Environnement
Mr. Mohamed Ahmed Djibril	

2. Division of Habitation and Urban Planning   Direction de l'Habitat et de l'Urbanisme

Mr. Mohamed Ali Houssein	Directeur de l'Habitat et de l'Urbanisme
Mr. Mohamed Ali Houssein	Sous-directeur de l'Habiat

Electricity of Djibouti   Electricite de Djibouti

Mr. Djama A. Guelleh	Directeur Général
Mr. Aboubaker Hassan Guessod	Directeur Général Adjoint
Mr. Jean-Paul Siry	Directeur Général Adjoint
Ms. Roda Aden Okieh	Attachée au Directeur General chargée de projets de developpement et des moyens de production
Mr. Fatah Omar Farah	Financial Manager
Mr. Ismaël DIALLO	Directeur du projet de l'Interconnexion
Mr. Djama Ali Djama	Chef de département maintenance service interconnexion
Mr. Ahmed Mohamed Ahmed	Chef de département télécommunication service interconnexion
Mr. Awaleh Moussa	Chef de département exploitation service inteconnexion

Ms. Hamoud Souleiman	Chef de service énergies conventionnelles (MERN)
Mr. Ali Mohamed Ahmed	Ingénieur service interconnexion (exploitation)
Mr. Mahamoud Ali Farah	Ingénieur service interconnexion (maintenance)
Mr. Abdoulkader Hassan Mohamed	Ingénieur service interconnexion (Communication et Scada)

International Port of Djibouti Port Autonome International de Djibouti

Mr. Wahib Daher Aden	Directeur du Terminal à Conteneurs
Mr. Anissa Ali	Chef de département Relations Publiques et Communication

Djiouti International Airport Aeroport de Djibouti

Mr. Mohamed Yacoub Mahamoud	Directeur général
Mr. Abdourahman Hassan Ali	Directeur de sécurité de l'aéroport

Djitouti National Meteorological Observatory Service météorologique national

Mr. Osman Saad Said	Chef de division métérologie
Mr. Abdellahi Idan Ismail	Senior forcaster
Mr. Abdoul Karim Moussa	Ingénieur en météorologie
Mr. Omar Gouled Allaleh	Ingénieur en météorologie

Centre Régional de Formation Maritime

Ms. Mina Houssein Douahel	Directrice

Laboratoire Central du Bâtiment et de l'Equipement (LCBE)

Mr. Alexendre Adam	Directeur

Centre d'Etude et de Recherche de Djibouti (CERD)

Mr. Mohamed Ahmed Daoud	Géologue
Mr. Antoine-Marie Caminiti	Géologue
Mr. Osman Mohamed Ali	Géologue

Observatoire Géophysique d'Arta

Mr. Souleiman Hassan	Responsable

Independent Construction Company (ICC)

Mr. Yasser Attia	Chef de projet

COLAS

Mr. Vincent Micollier	Chef de secteur route
Mr. Régis Thieulin	Responsible technique/Larobaroire
Mr. Gregory Dehecq	Responsable du service topographie et études

COSMEZZ

Mr. Sergio Mezzedimi	Directeur général
Mr. Valter Pecci	Conseiller technique
Mr. Theobard Nshimiyumuremyi	Superviseur du laboratoire géotechnique
Mr. Celestino Federici	Directeur adjoint régional
Mr. Lanto	Comptable
Ms. Roberta Tabalocci	

ALLIANCE CONSTRUCTIONS SARL

Mr. Pradip R. Maliye	Directeur administratif
Mr. Moustapha Abdi Omer	Assistant administratif
Mr. Karim El Abed	Chef de projet
Mr. Giovanni Carissimi	Chef de projet

VERZI EGER SARL

Mr. Michele Verzi	Directeur général

Inma Group of Companies

Mr. Rajagapalan Narayana Pillai	Ingénieur

Bureau d'Etudes et de Maîtrise d'Oeuvre (BEMO)

Mr. Mohamed Ali Hassan	Directeur

Ingénieur-Conseil de la Corne d'Afrique (I.C.C.A)

Mr. Mahamoud Ahmed Awaleh	Directeur général
Mr. Abdourazak Ali Osman	Directeur administratif, financier et marketing

Cabinet d'Avocats

Mr. Mohamed Abayagid	Directeur Général
Mr. Kadya Houmed Yacin	Chef de projet
Mr. Abdallah Souleiman	Socio-économiste
Mr. Omar Mohamed	Socio-économiste

A-4 Minutes of Discussions

Minutes of Discussions
on the Preparatory Survey on
the Project for Improvement of Power Supply
in the Republic of Djibouti
(First Field Survey)

In response to the request from the Government of Republic of Djibouti (hereinafter referred to as "Djibouti"), the Government of Japan decided to conduct the Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Power Supply (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Djibouti the Preparatory Survey Team for the first field survey (hereinafter referred to as "the Team"), headed by Mr. Hiroo Tanaka, Deputy Director General, Industrial Development and Public Policy Department, JICA, and is scheduled to stay in the country from September 1 to September 20, 2013.

The Team held discussions with the concerned officials of the Government of Djibouti.

In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the second field survey.

Djibouti, September 18, 2013

田中啓生

Mr. Hiroo Tanaka

Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Djama Ali Guelleh

General Director
Electricite de Djibouti (EdD)
Republic of Djibouti

Witness

Mr.Yacin Houssein Douale

Director of Bilateral Relations
Ministry of Foreign Affairs and International Cooperation
Republic of Djibouti

Witness

Mr. Bouh Moussa Sougueh

Acting Director of Energy
Ministry of Energy and Natural Resources (MENR)
Republic of Djibouti

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ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve and reinforce power supply by constructing new substation and overhead/underground transmission line in Djibouti.

2. Project Site

The Project sites based on the request from the Djibouti side are located in Djibouti as shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible organization is Ministry of Energy and Natural Resources (MENR).
(2) The implementing organization is Electricite de Djibouti (EdD).
(3) The organization structures of MENR and EdD are shown in Annex-2 and Annex-3.

4. Items Requested by the Djibouti side

As a result of discussions, requested components and priority have been identified as follows:

(1) Construction of 63kV Transmission Line (Interconnection PK12 Substation ~ Boulaos Substation via Nagad) including the Nagad switching station
(2) Expansion of the Interconnection PK 12 Substation by procurement of 230/63kV transformer
(3) Expansion of the Interconnection PK 12 Substation by procurement of 63/20kV transformer

Djibouti side explained the future power forecast from the PK 12 Substation by the large scale customers of the cement factory, container terminal, free zone, Barwaqo residential area and sea water desalinization plant in the Doraleh area, and JICA understood importance of requested component (3).

Djibouti side requested JICA to complete construction of the 63kV Transmission Line up to the Nagad Connecting Point from the Interconnection PK 12 Substation before January, 2016.

JICA requested the Djibouti side that the Undertakings of Djibouti side including land acquisition and construction of access road for the 63kV Transmission Line should be taken as scheduled.

JICA will assess the appropriateness and the priority of the requested components from the viewpoint of necessity and relevance as Japan's Grant Aid scheme, and will report the findings to the Government of Japan. The scope of the Project for the further analysis will be confirmed after consultation with the Government of Japan.

5. Japan's Grant Aid Scheme

(1) The Djibouti side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4.
(2) The Djibouti side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project.

6. Schedule of Next Preparatory Survey

Based on the result of the Survey, JICA will send the next Preparatory Survey Team for Outline Design to Djibouti in October 2013, and submit the Draft Final Report on Preparatory Survey to Djibouti side in March, 2014.

7. Other Relevant Issues

(1) Status of the Survey

The Team explained that the purpose of the Survey is to collect necessary information and data

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for evaluating the relevance, appropriateness and urgency of the Project, and also to identify the priority of the requested components as well as other issues to be cleared for implementation of the Project.

(2) Coordination among relevant donors and agencies

The Team requested the Djibouti side to ensure coordination among relevant donors and agencies for smooth implementation of the Project.

(3) Environmental and Social Considerations

a) The Team requested the Djibouti side to ensure access to the project sites and undertake expropriation if necessary in order to secure the sites.

b) The Team requested the Djibouti side to conduct the required environmental works, and obtain approval on environmental clearance for implementation of the Project.

c) The Djibouti side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as Djibouti laws and regulations.

d) The Djibouti side agreed to make necessary arrangements with governmental organizations concerned in order to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.

(4) Counterpart Personnel

The Team requested the Djibouti side that necessary number of counterpart personnel shall be assigned to the Team and necessary arrangements with related organizations be made during the Survey in Djibouti.

(End)

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Annex-1	Location of the Requested Project Sites
Annex-2	Organization Structure of Ministry of Energy and Natural Resources
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Annex-4	Japan's Grant Aid
Annex-5	Flow Chart of Japan's Grant Aid Procedures
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LOCATION OF THE REQUESTED PROJECT SITES

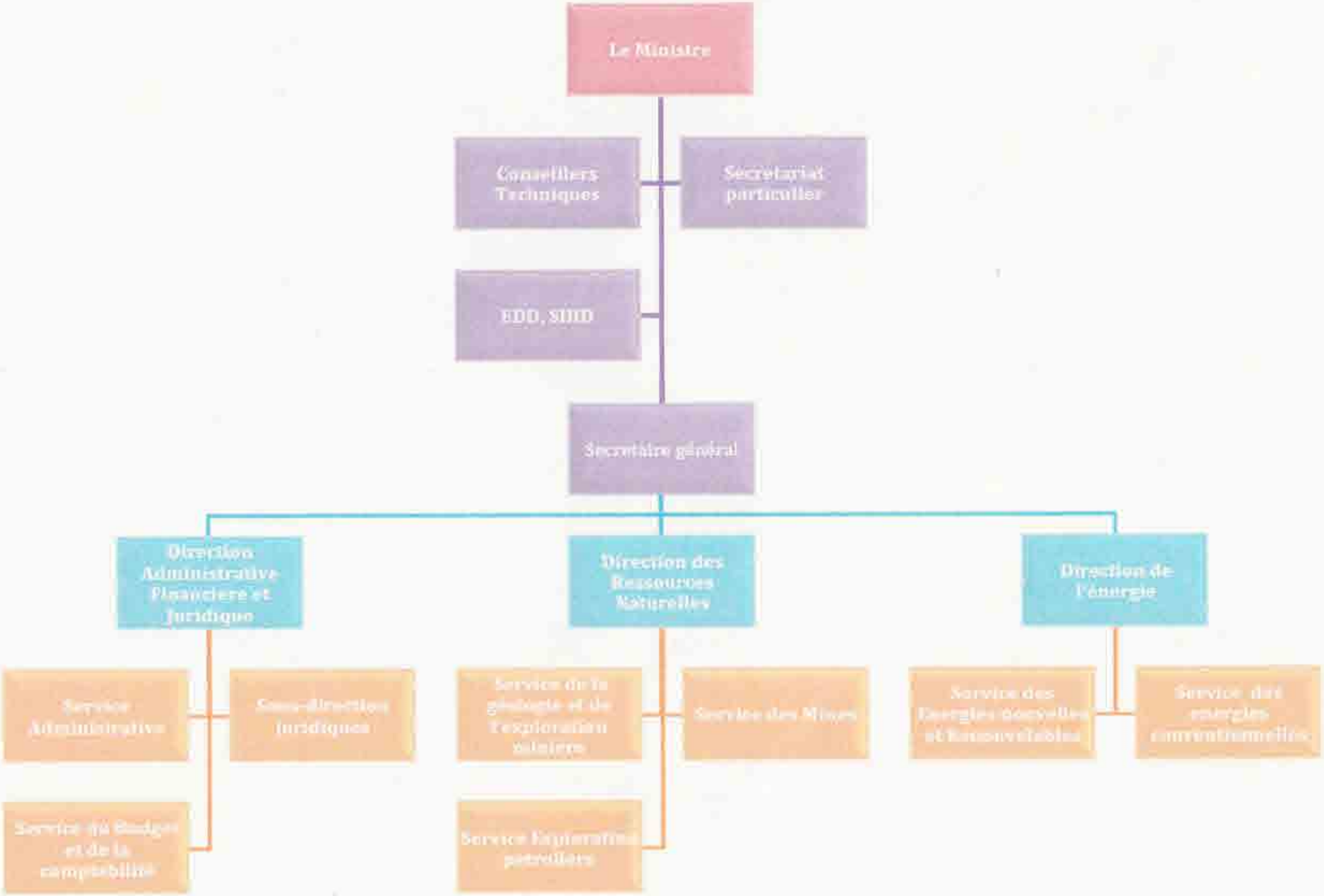
Map of the Republic of Djibouti

Map of Africa

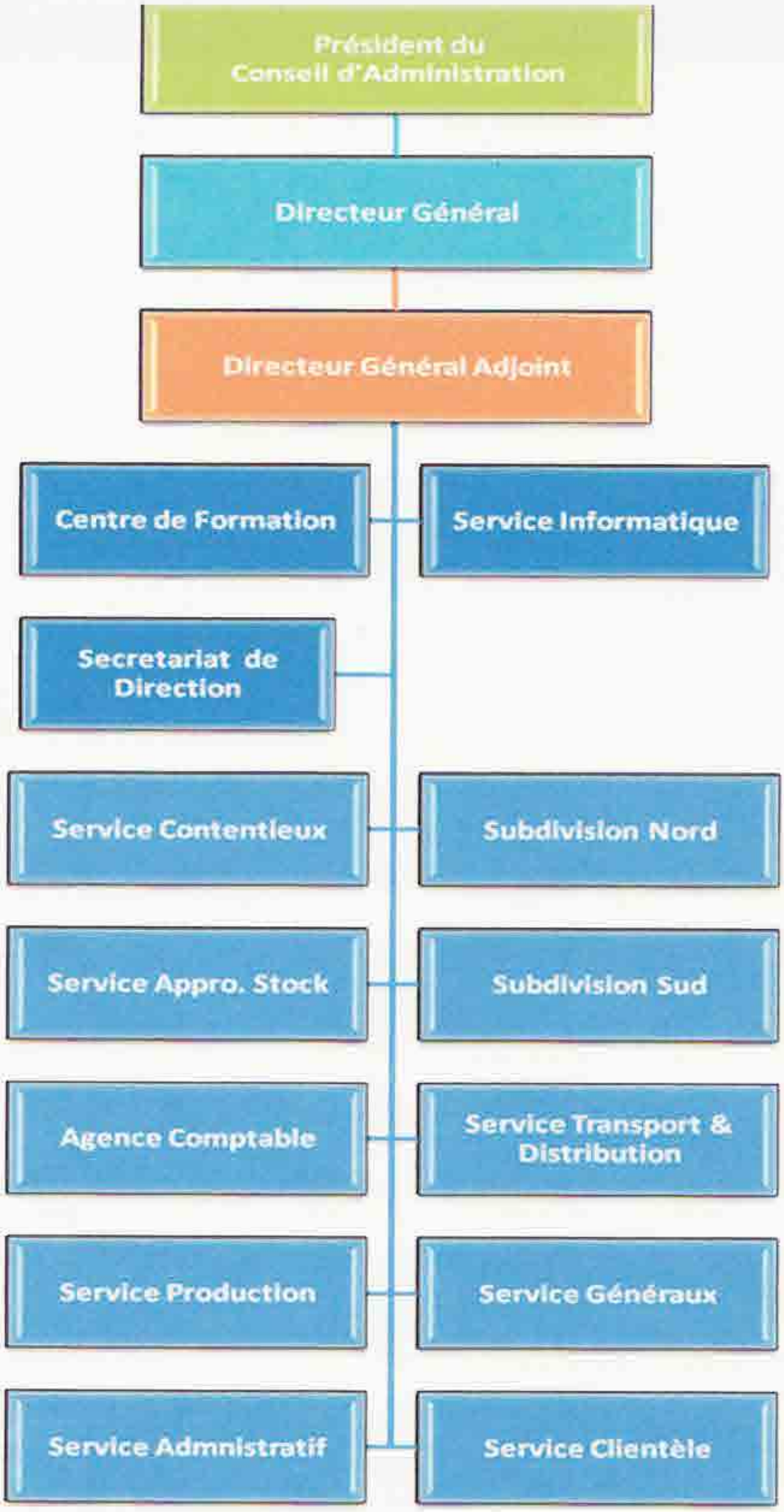
Location Map of the Requested Components

Annex-2

ORGANIZATION STRUCTURE OF MINISTRY OF ENERGY AND NATURAL RESOURCES



ORGANIZATION STRUCTURE OF ELECTRICITE DE DJIBOUTI



JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1.Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as “the E/N”) will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

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

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under

BMS

an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

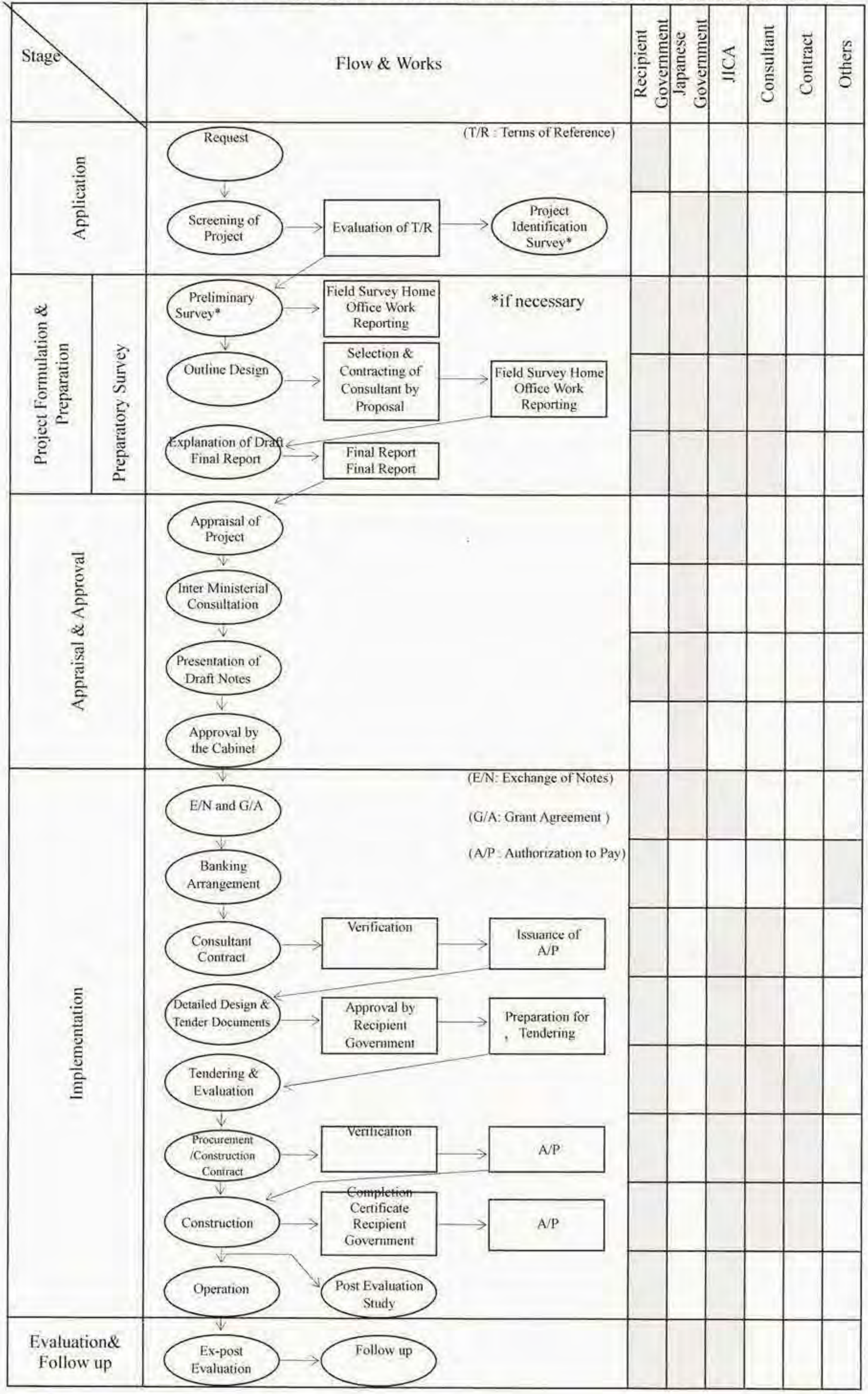
(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

Annex-5

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



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Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites:		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

Minutes of Discussions
on the Preparatory Survey
on the Project for Improvement of Power Supply
in the Republic of Djibouti

In response to the request from the Government of the Republic of Djibouti (hereinafter referred to as "Djibouti"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Power Supply (hereinafter referred to as "the Project")

JICA sent to Djibouti the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Dr. Hiroshi Sato, Director, Team 2, Energy and Mining Group, Industrial Development and Public Policy Department, JICA. The Team is scheduled to stay in the country from 21st to 27th November, 2014.

The Team held discussions with the concerned officials of Djibouti (hereinafter referred to as "the Djibouti side"). In the course of the discussions, the Djibouti side agreed and accepted the contents of the Draft Final Report and the Draft Technical Specifications, both sides have confirmed the main items described in the sheets attached hereto.

Dibouti, 26th November, 2014

Le Directeur Général

Dr. Hiroshi Sato
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Djama Ali Guelleh
General Director
Electricite de Djibouti (EdD)
Republic of Djibouti

Witness

Mr. Yacin Houssein Douale
Director of Bilateral Cooperation
Ministry of Foreign Affairs and International Cooperation
Republic of Djibouti

Witness

Mr. Aboubaker Houssein Doualeh
Permanent Secretary
Ministry of Energy and Natural Resources (MENR)
Republic of Djibouti

ATTACHMENT

1. Contents of the Draft Final Report

The Djibouti side agreed and accepted in principle the contents of the Draft Final Report explained by the Team. The Team emphasized that the scope, the schedule and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Djibouti. The Djibouti side understood it.

2. Objective of the Project

The objective of the Project is to improve and reinforce power supply by expanding existing substation and overhead/underground transmission line in Djibouti.

3. Project Site

The Project sites are located as shown in Annex-1.

4. Responsible and Implementing Organizations

(1) The responsible organization is Ministère de l'Energie et des Ressources Naturelles (MENR).
(2) The implementing organization is Electricite de Djibouti (EdD).
(3) The organization structures of MENR and EdD are shown in Annex-2 and Annex-3.

5. Components of the Project

The components of the project are shown in Table below.

Category	Equipment	
Procurement of materials and equipment and Installation work planning	1. Jaban As Substation (Expansion)	
	- 230/63 kV Transformer （63 MVA)	1 set
	- 230 kV Switchgear	1 lot
	- 63 kV Switchgear	3 lots
	- 230 kV Control & Protection Panels	1 lot
	- 63 kV Control & Protection Panels	1 lot
	- Other Control & Protection Panels	1 lot
	- Low voltage Facilities	1 lot
	- Communication Facilities	1 lot
	- Grounding materials	1 lot
	- Dead End Gantry (2 Circuits)	1 lot
	2. Boulaos Substation (Expansion)	
	- 63 kV Switchgear	1 lot
	- 63 kV Control & Protection Panels	1 lot
	- Other Control & Protection Panels	1 lot
	- Low voltage Facilities	1 lot
	- Communication Facilities	1 lot
	3. Transmission line	
	- Steel Tower	43 sets
	- 63 kV Overhead Conductor	1 panel
	- 63 kV Underground cable	1 lot
	- Optical fiber composite overhead ground wire	1 lot
	- Underground optical fiber	1 lot
	- Insulator, hardware, grounding materials	1 lot
	4. Construction	
	(1) Foundations for equipment	1 lot
	(2) Cable pit	1 lot
	(3) Building for switchgears	1 lot
Procurement of materials and equipment	Procurement of following materials and equipment	
	(1) Spare Parts	1 lot

6. Japan's Grant Aid Scheme

(1) The Djibouti side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and Annex-5.

(2) The Djibouti side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project.

7. Project Cost

The Djibouti side agreed that the cost for the Project should not exceed the amount agreed on Exchange of Notes (E/N). The Djibouti side also agreed that the cost for the Project contains procurement cost of equipment, transportation cost up to the Project site, construction cost and the Consultant fees.

8. Confidentiality of the project

(1) Detailed specifications of the Facilities and Equipment

Both sides agreed that all the information related to the Project including detailed drawings and specifications of the facilities and equipment and other technical information shall not be disclosed to any outside parties (i.e. outside of JICA and the Djibouti side) before the conclusion of all contract(s) for the Project.

(2) Confidentiality of the Cost Estimation

The Team explained the estimated cost of the Project as described in Annex 7. Both sides agreed that the estimated cost for the Project should never be duplicated or disclosed to any outside parties (i.e. outside of JICA and the Djibouti side) before tender for the Project. Djibouti side also understood that the estimated cost for the Project attached as Annex 7 is not the final and is subject to change as a result of examination through revision of the Outline Design Study.

9. Possibility of Change in Scope, Schedule and Cost of the Project

Djibouti side and the Team confirmed that the scope, the schedule, and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Djibouti.

10. Other Relevant Issues

(1) Transmission Line Route

1) Both side finalized the transmission line route of the Project as shown in Annex-8 and Annex-9.

2) The Djibouti side assured the Team that no private land existed along the transmission line route and no land acquisition was required for the Project.

- Overhead Line from Jaban As to Nagado

3) The Djibouti side secured the land use for the overhead line route from Jaban As to Nagado by DECRET N°2014-252/PRIMB, le Président de la République, Chef du Gouvernement, as shown in Annex-10. And the Djibouti side assured the Team that the land leveling along the transmission line and the construction of access road to the transmission line will be finished no later than start of construction work of Jaban As.

- Underground Line from Nagado to Boulaos

4) The Djibouti promised to finish mapping the underground facilities, such as water pipes, sewage pipes and telephone lines, for the installation of underground cable with Office National de l'Eau et de l'Assainissement, Djibouti Telecom, l'Agence Djiboutienne des Routes et le Direction de l'Habitat et de l'Urbanisme and report it to JICA Djibouti Office by the end of December, 2014.

(2) Environment and Social Consideration

The Djibouti side assured the Team that the environmental impact assessment was not required for the Project based on the letter, N°270/DATE/14, Direction de L'amenagement du Terrltoire et de L'environnement, Minlstere de L'habitat, de L'urbanisme et de L'envlronnement, as shown in Annex-11.

(3) Project Cost to be borne by the Djibouti side

The Djibouti side assured the Team that the Project cost to be borne by Djibouti side, mentioned in Annex-7, shall be allocated from own fund timely.

(End)

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Annex-1	Location of the Project Sites
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Annex-7	Estimated Project Cost
Annex-8	Final Transmission Line Route
Annex-9	Details of Transmission Line Route
Annex-10	Decret N°2014-252/Primb, le Président de la République, Chef du Gouvernement
Annex-11	N°270/Date/14, Direction Irection de L'amenagement du Terrltoire et de L'environnement, Minlstere de L'habitat, de L'urbanisme et de L'envlronnement

Annex - 1

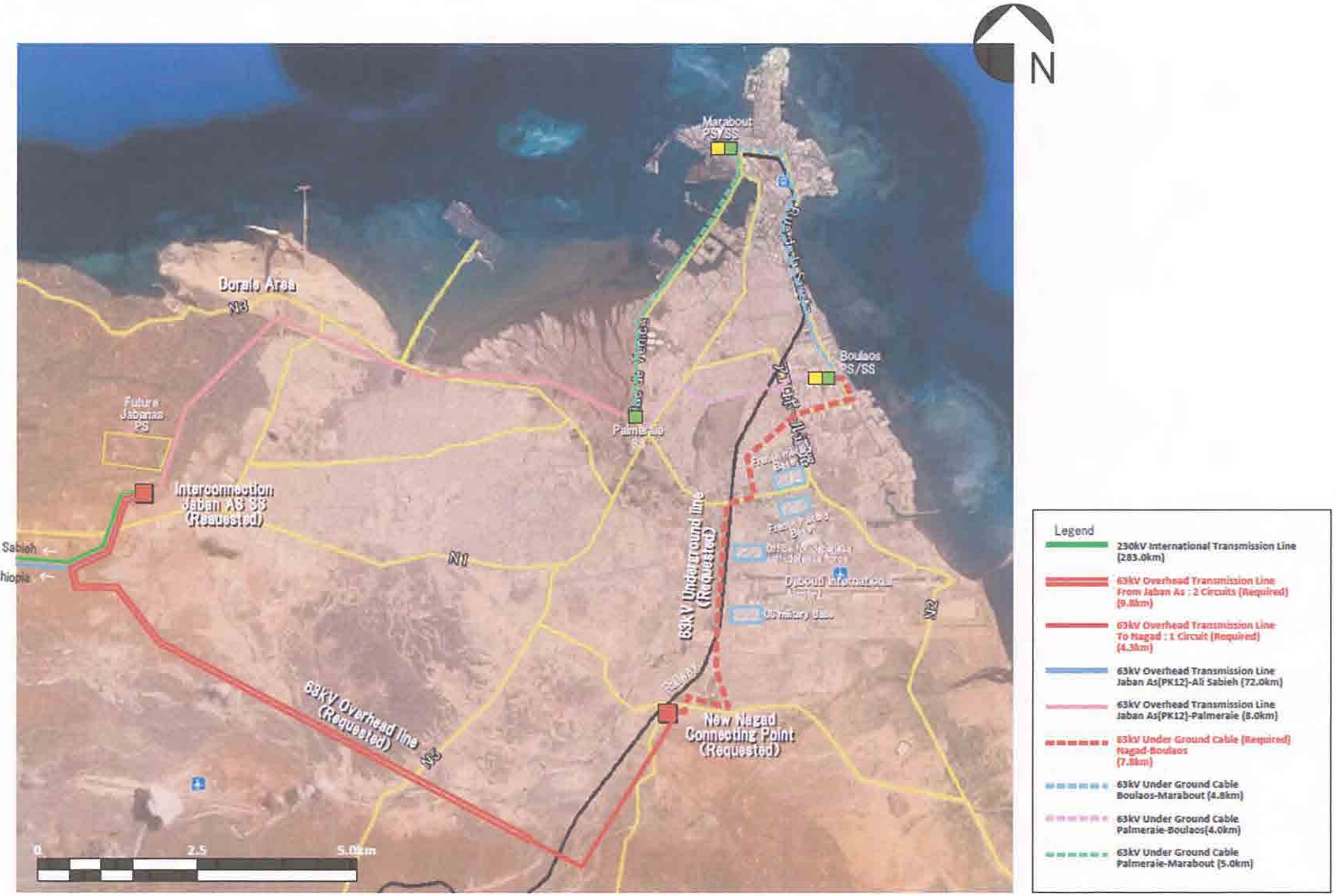
LOCATION OF THE PROJECT SITES

Map of the Republic of Djibouti

Map of Africa

Location Map of the Requested Components

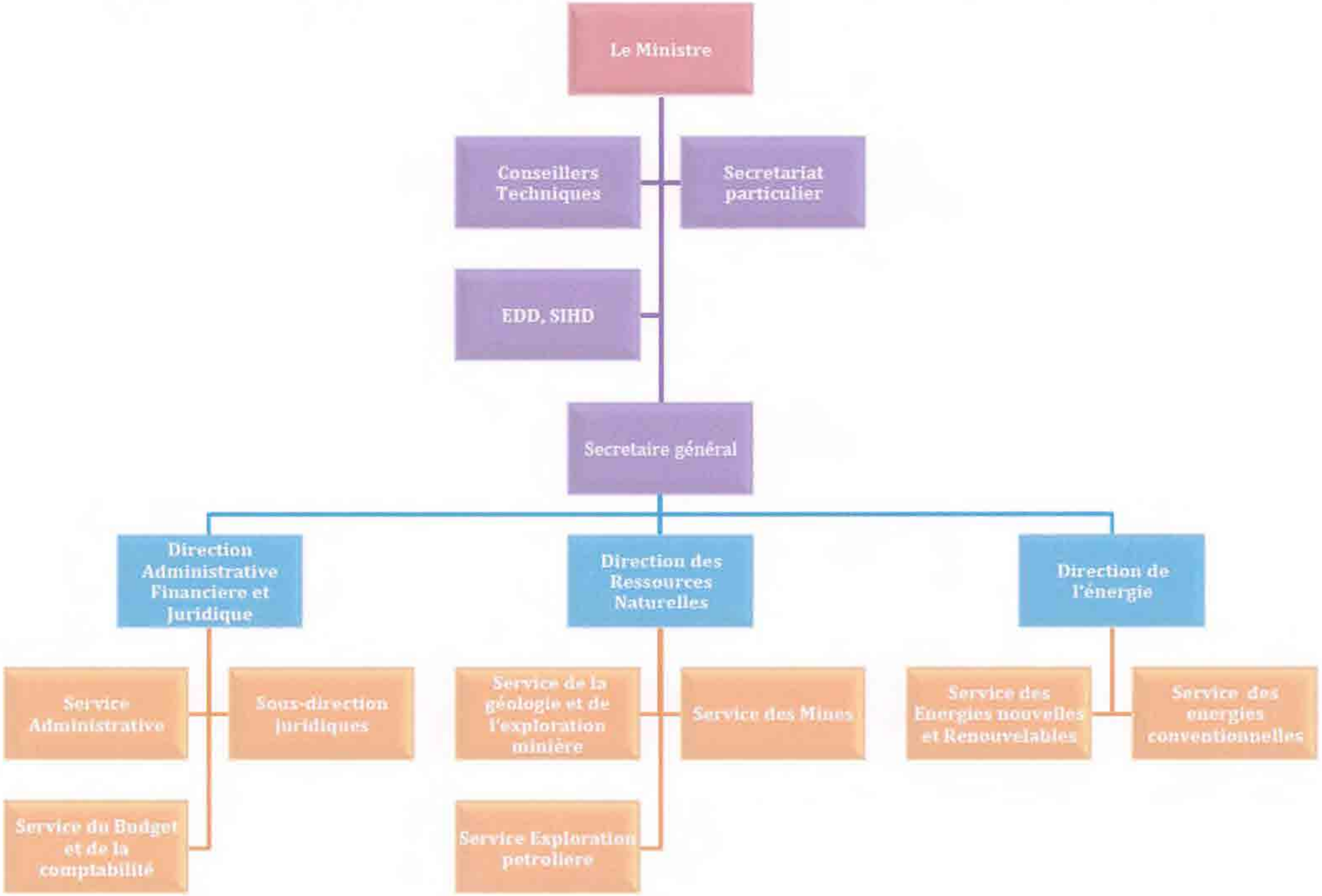
LOCATION OF THE PROJECT SITES



Site Location Map

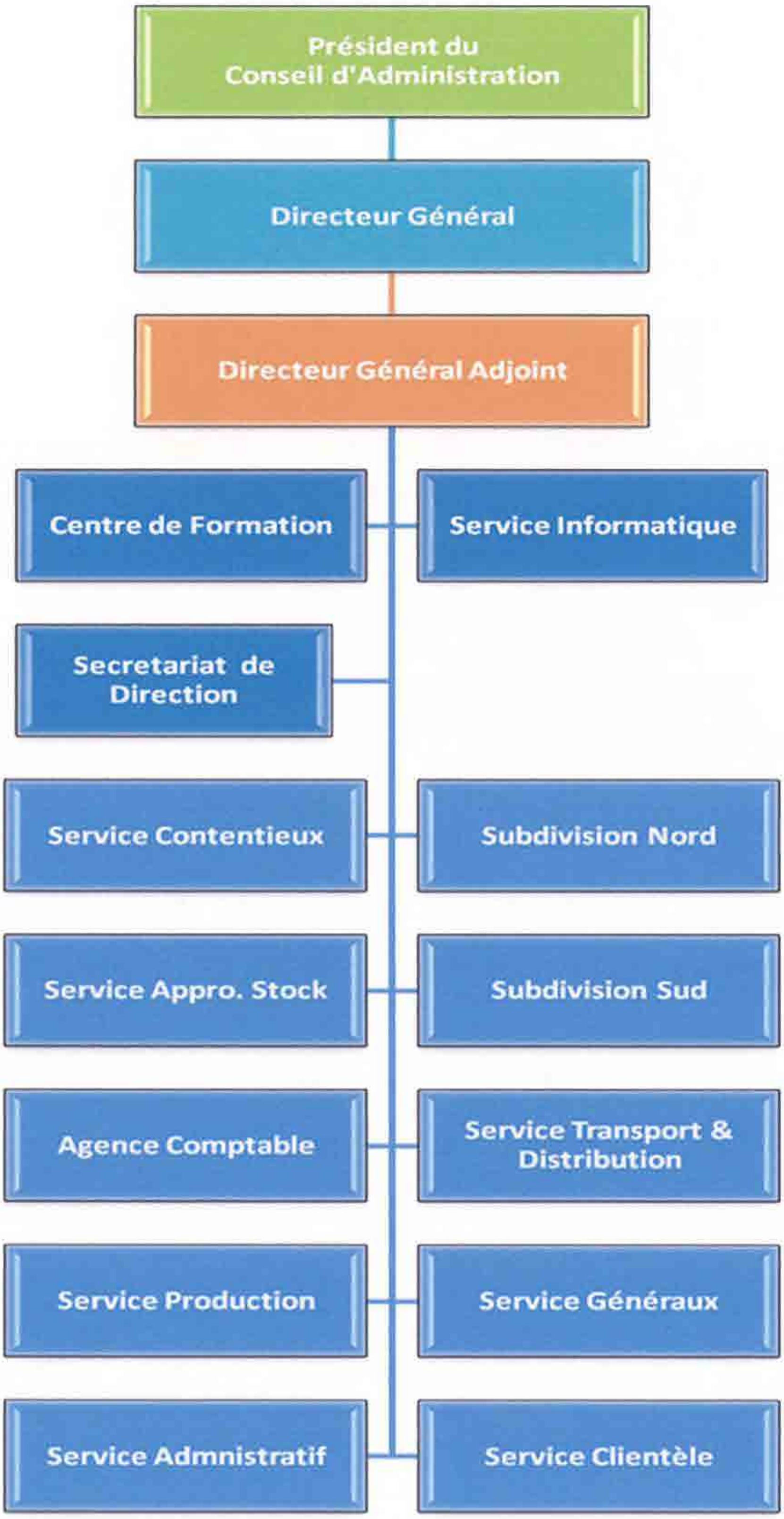
Annex-2

ORGANIZATION STRUCTURE OF MINISTRY OF ENERGY AND NATURAL RESOURCES



Annex-3

ORGANIZATION STRUCTURE OF ELECTRICITE DE DJIBOUTI



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JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

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In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

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Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-7.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

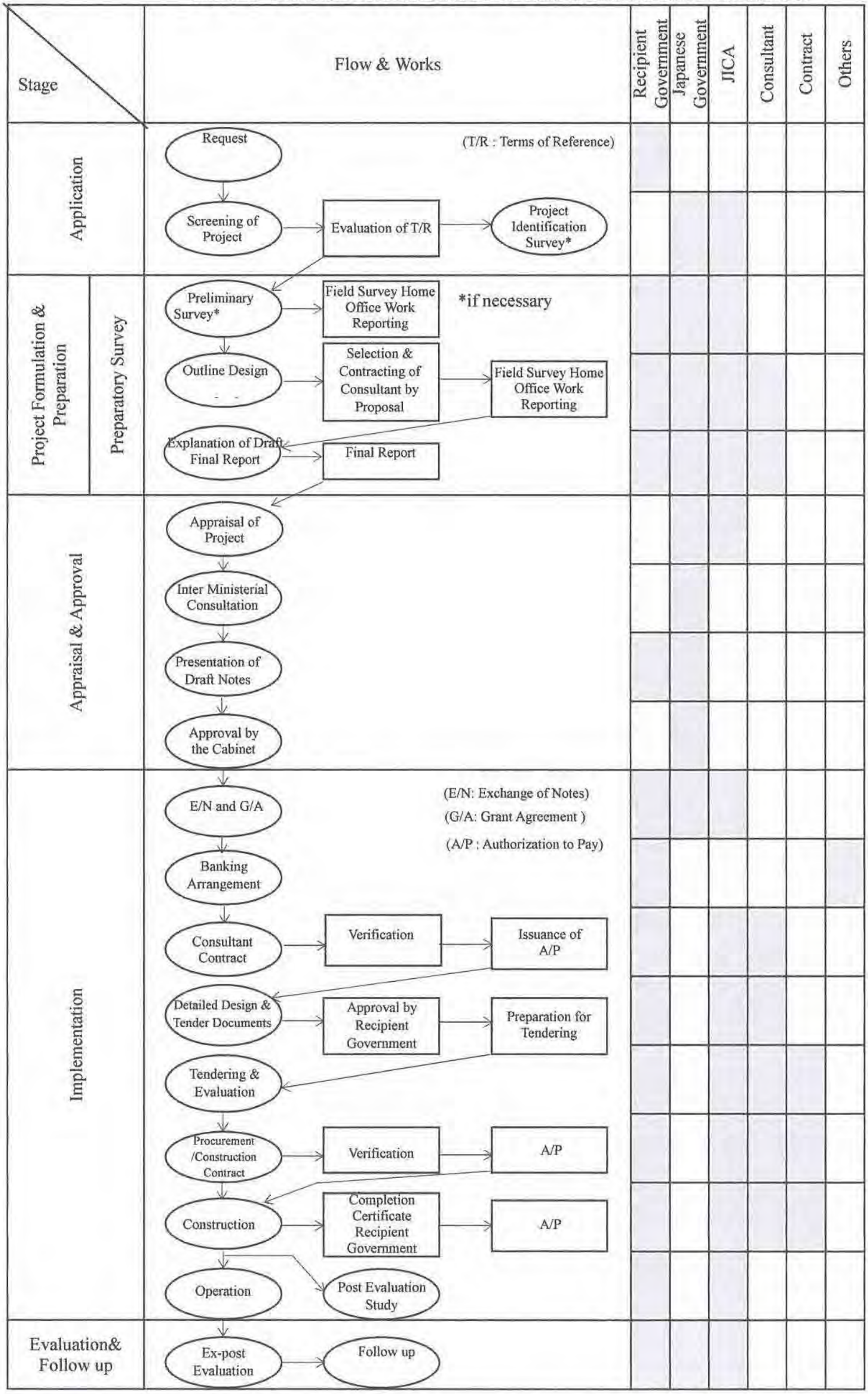
(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

Annex-5

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site (including Access road)		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

Annex-7

(Confidential)
Estimated Project Cost

The cost of the Project will be （CONFIDENTIAL）. The content of the project cost are shown separately for the Japanese borne portion and the Djibouti side borne portion in accordance with the conditions in item 3. (3) below.

This cost estimate is provisional and subject to change as a result of examination by the Government of Japan for the approval of the Grant.

1. Cost to be borne by the Japanese side:

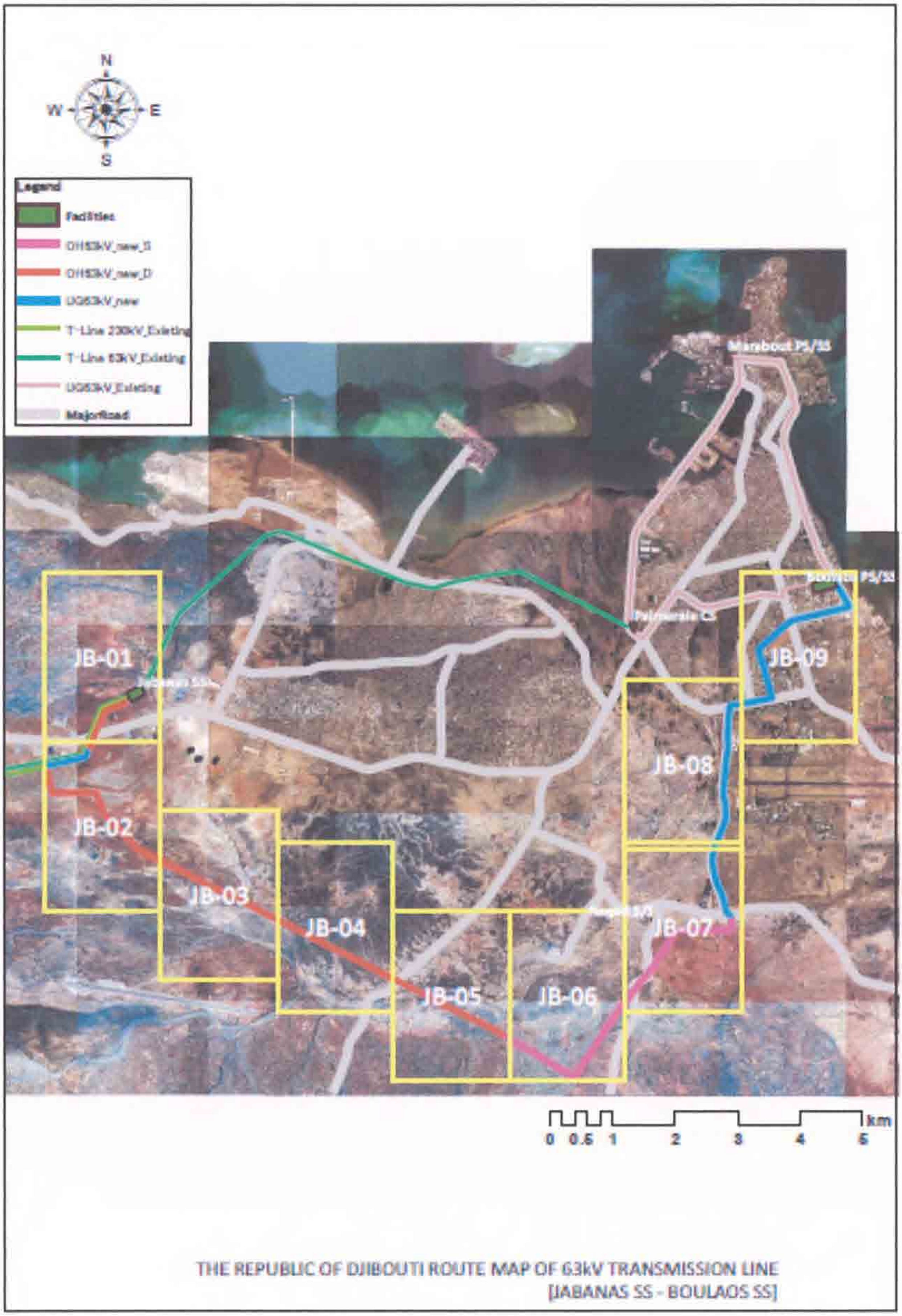
Approximate Total cost for Japanese Portion

（CONFIDENTIAL）

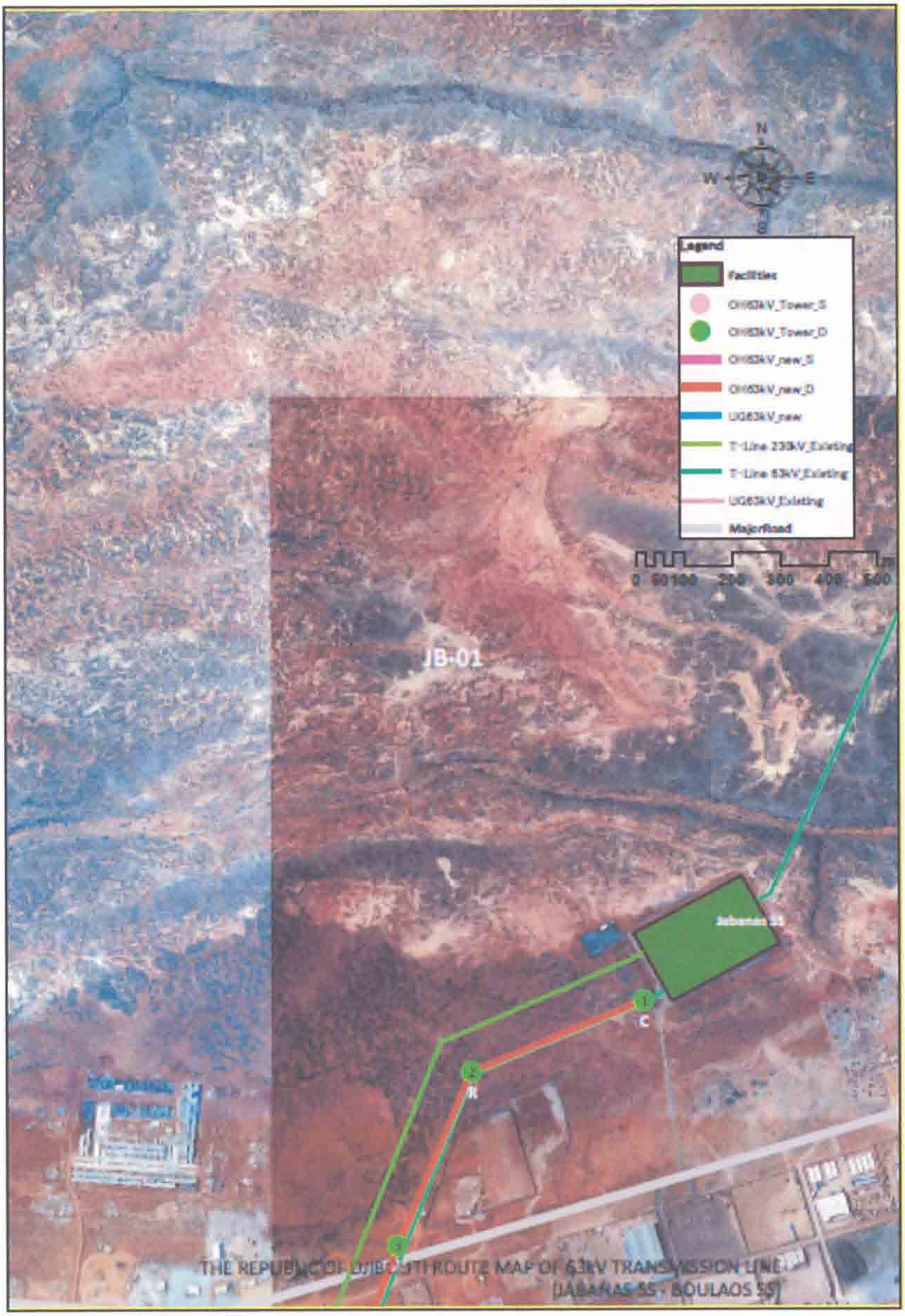
2. Cost to be borne by the Djibouti side: US$ 83,000 (=approximately JP¥ 8.6 million)

Cost Items	US$	(≒JP¥)
1. Payment for bank commission based on banking commission of an Authorization to Pay (A/P) and Payment commission	US$ 30,000 -	JP¥ 3,100,000 -
2. Land leveling on the Project site along the transmission line	US$ 21,000 -	JP¥ 2,200,000 -
3. Construction of access road to the transmission line	US$ 26,000 -	JP¥ 2,700,000 -
4. Data survey of the underground of the Djibouti city for the installation of underground cable	US$ 6,000 -	JP¥ 600,000 -
Approximate Total cost	US$ 83,000 -	JP¥ 8,600,000 -

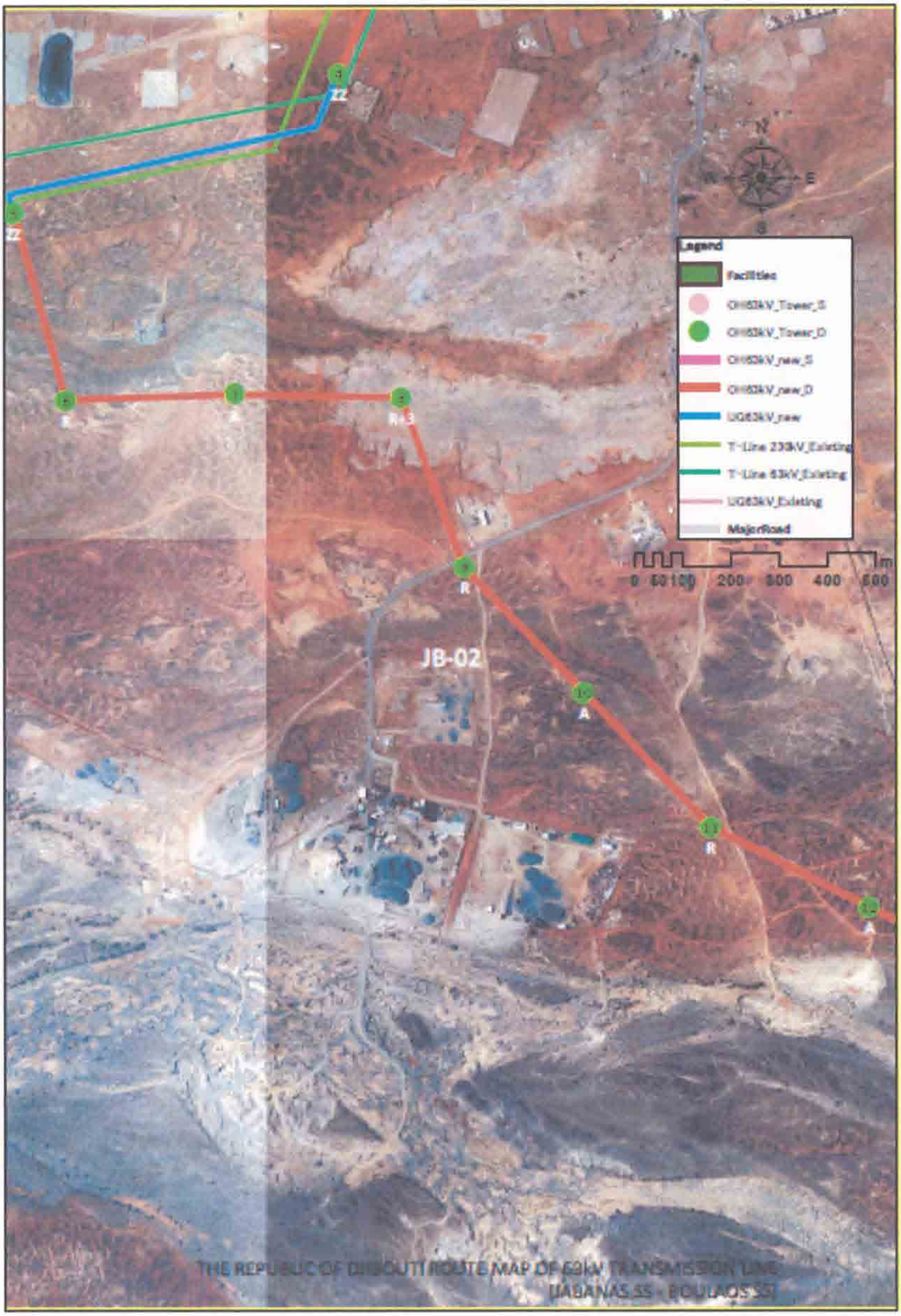
3. Conditions for estimation
   (1) Time of estimation: April 2014
   (2) Foreign exchange rates:
   1 USD = 103.76 JPY (TTS mean value from Janurary 2014 to March 2014)
   1 EURO = 142.29 JPY (TTS mean value from Janurary 2014 to March 2014)
   1 DJF = 0.58 JPY (TTS mean value from Janurary 2014 to March 2014)
   (3) Others:
   The above estimation was carried out in accordance with relevant rules and the guideline of the Japanese Grant Aid.



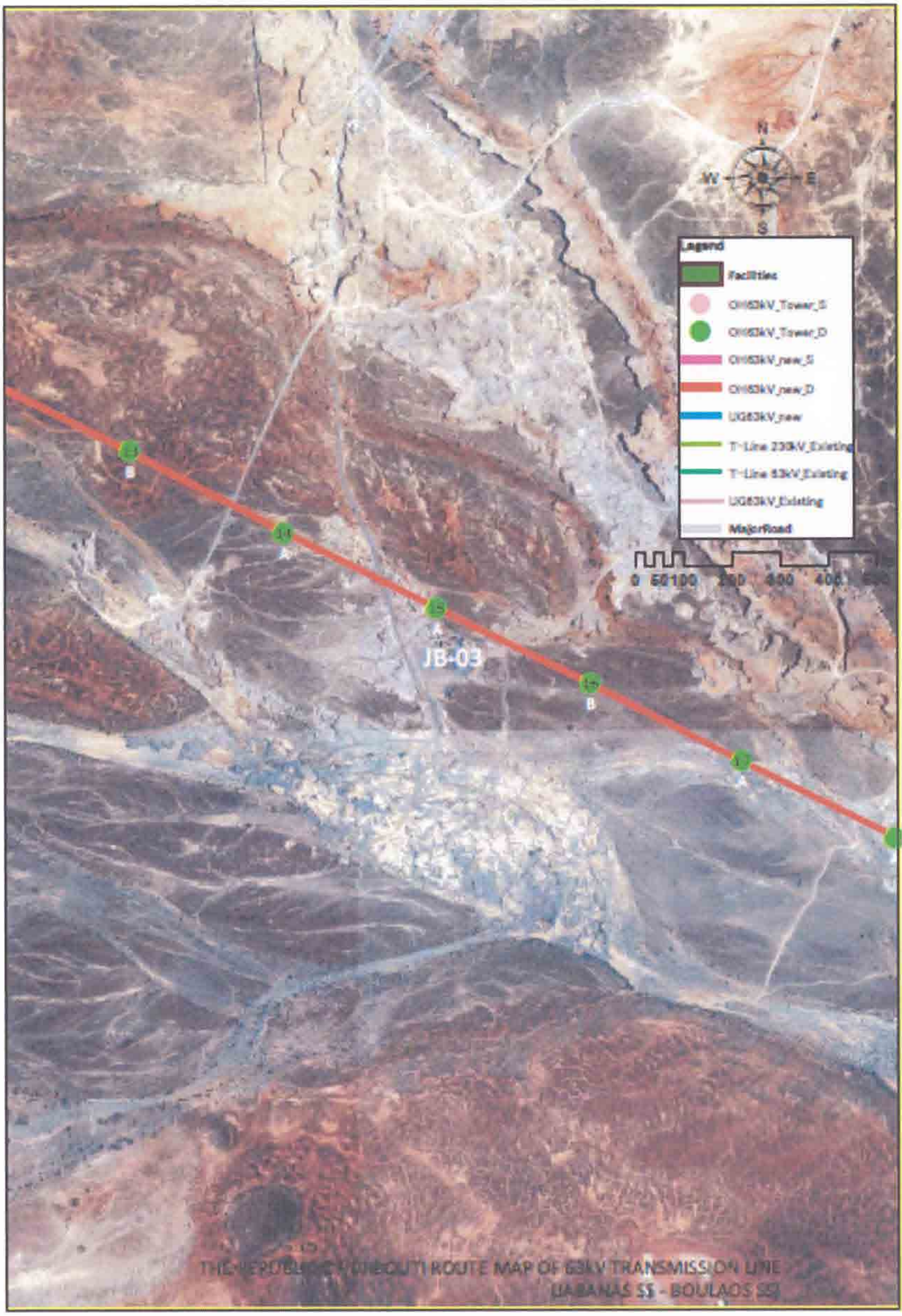
Final Transmission Line Route



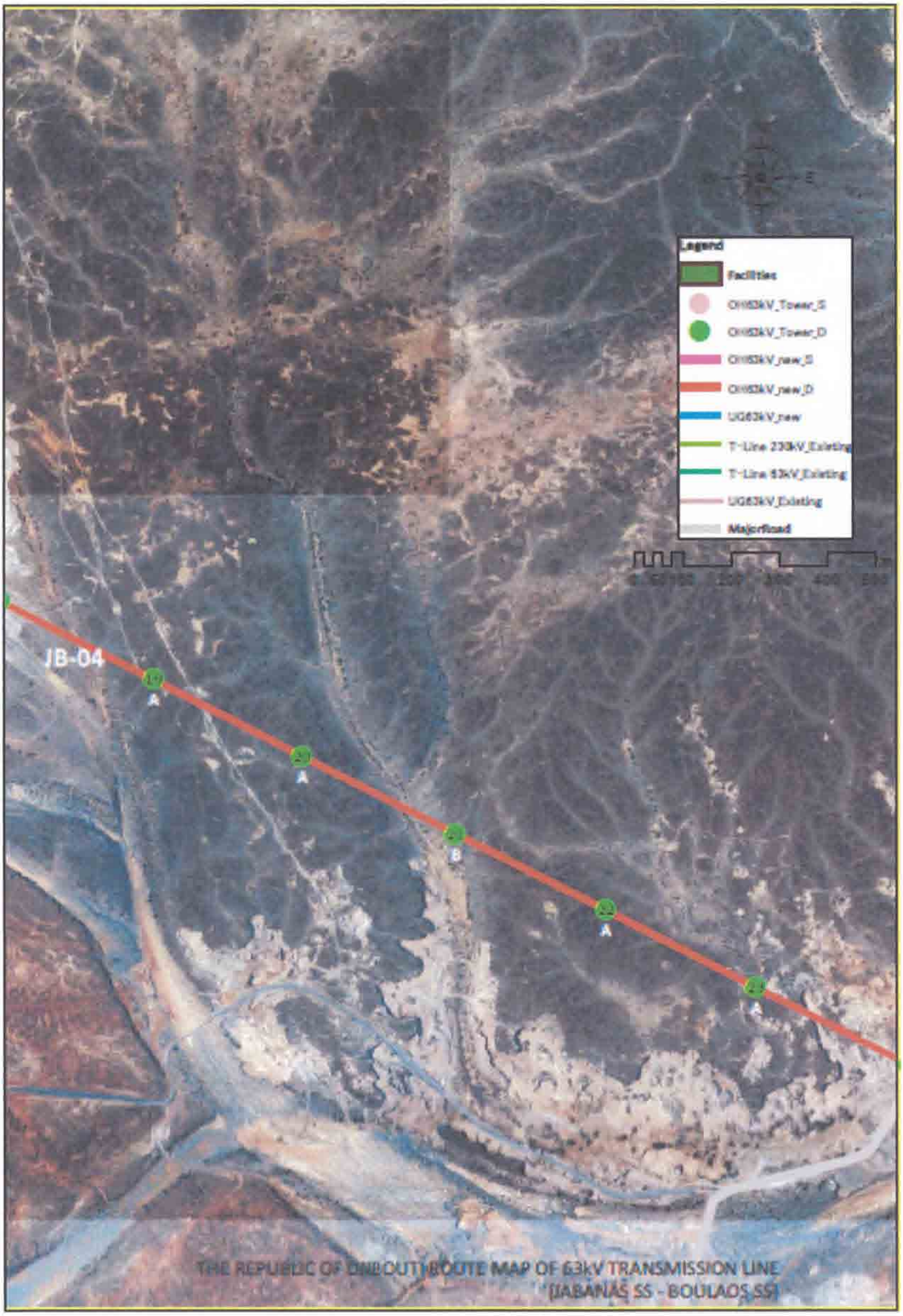
Details of Transmission Line Route (JB-01)



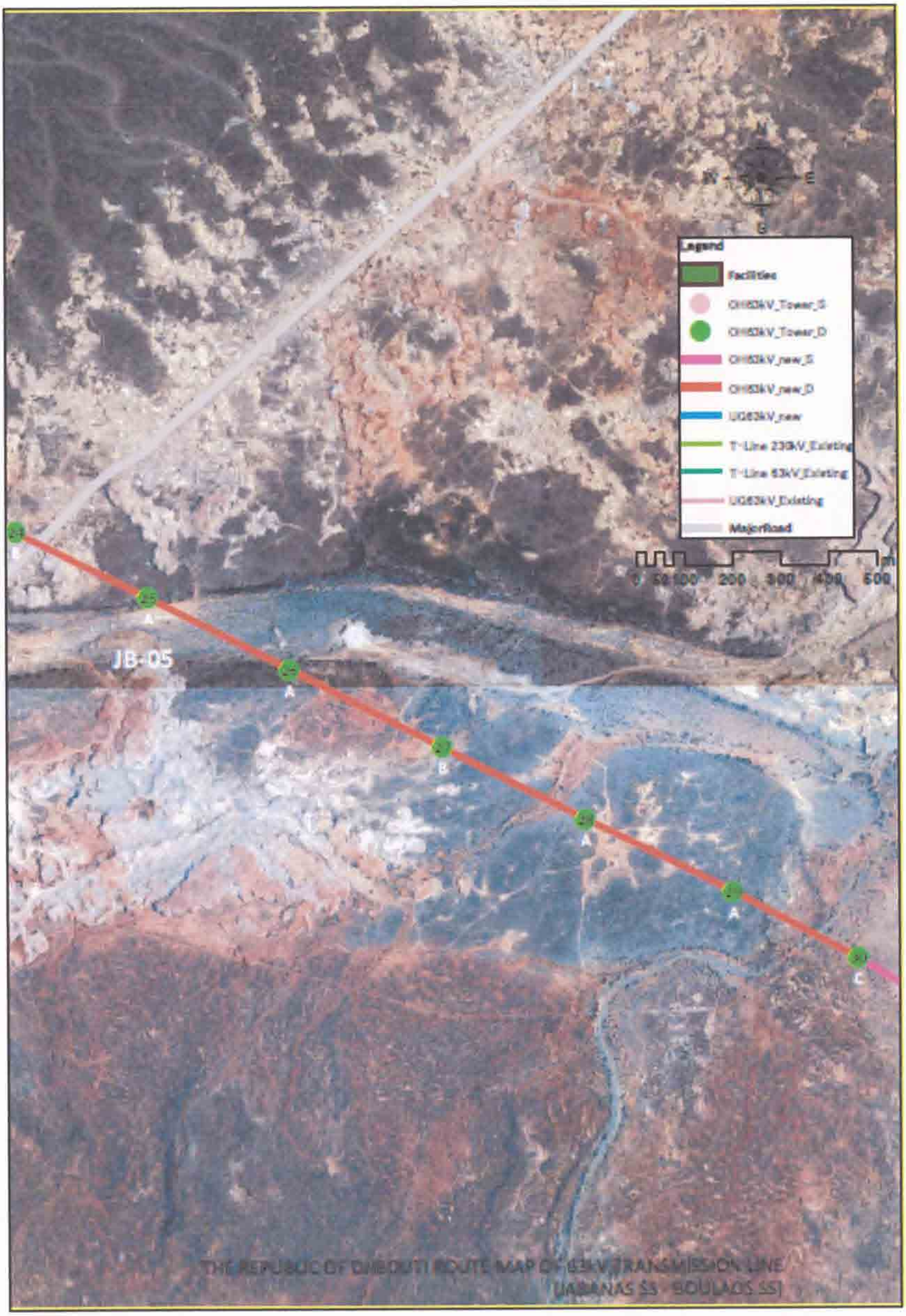
Details of Transmission Line Route (JB-02)



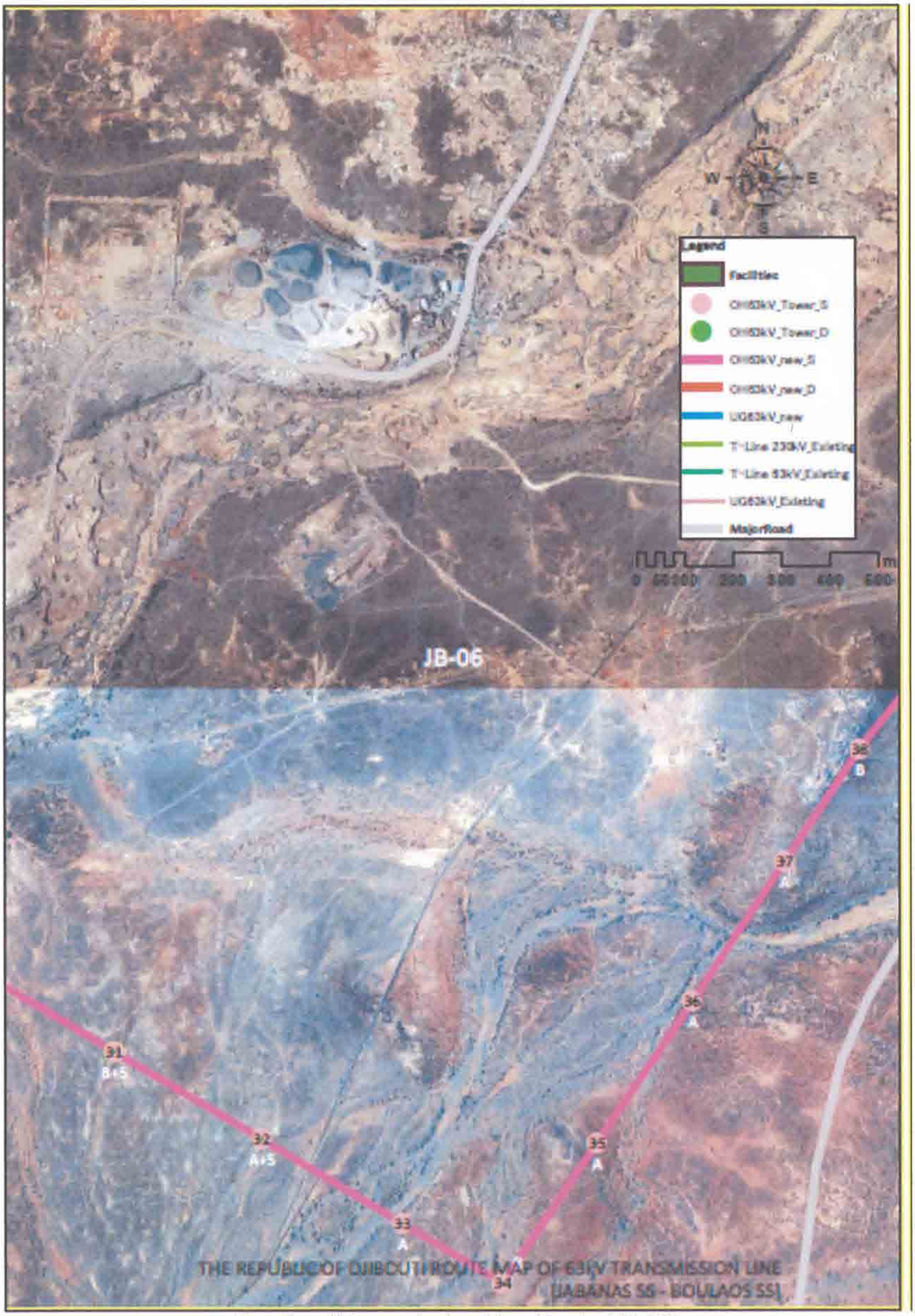
Details of Transmission Line Route (JB-03)



Details of Transmission Line Route (JB-04)

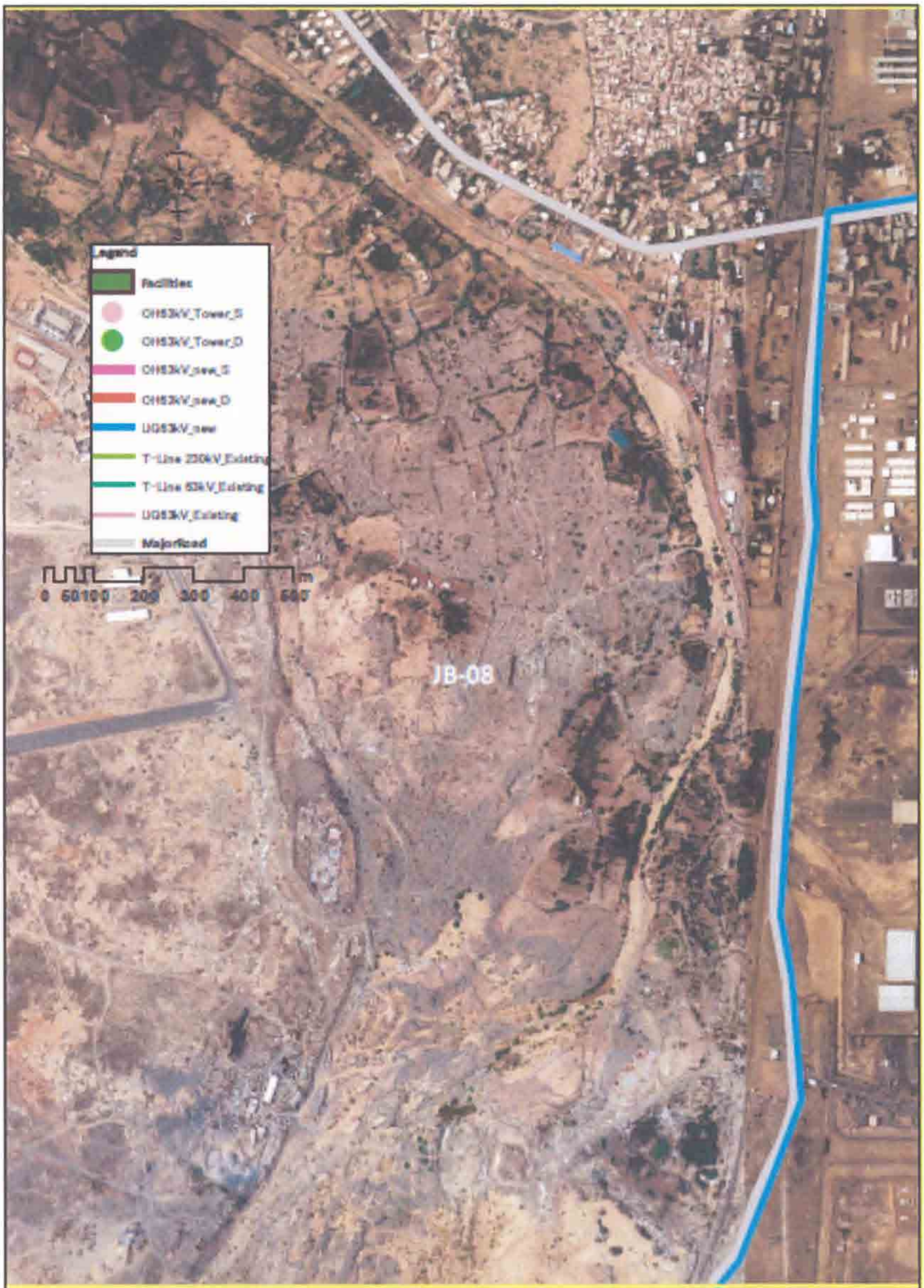


Details of Transmission Line Route (JB-05)



Details of Transmission Line Route (JB-06)

Details of Transmission Line Route (JB-07)



Details of Transmission Line Route (JB-08)

Details of Transmission Line Route (JB-09)

Annex-10

MINISTERE DU BUDGET

République de Djibouti
Unité - Egalité - Paix

Visa : Premier Ministre

Ministre du Budget

Le Premier Ministre

Le Ministre

1760514
1889

Décret n° 2014-252/PR/MB

Portant affectation au profit du Ministère de l'Energie et des Ressources Naturelles, une parcelle de terrain constituée d'un ensemble de corridors pour l'alimentation en électricité du secteur de Nagad.

LE PRÉSIDENT DE LA RÉPUBLIQUE, CHEF DU GOUVERNEMENT

VU La constitution n° 92-01102/PRE du 15 septembre 1992 ;

VU La Loi n°173/AN/91/2ème L du 10 Octobre 1991 portant organisation du Domaine Privé de l'Etat ;

VU La Loi n° 160/AN/12/6em L MEFIP du 09/06/12 portant réorganisation du Ministère de l'Economie et des Finances chargée de l'Industrie et de la Planification.

VU Le décret n°2013-044/PRE du 31 mars 2013 portant nomination du Premier Ministre ;

VU Le décret n°2013-045/PRE du 31 mars 2013 portant nomination des membres du Gouvernement ;

VU Le Décret n°2013-058/PRE du 14 avril 2013 fixant les attributions des membres du Gouvernement ;

VU La lettre n°980/MA/2014/DP/ED/EDD du 23 juin 2014 du Directeur Général de l'électricité du Djibouti ;

SUR Proposition du Ministre du Budget ;

Le conseil des Ministres entendu en sa séance du 09 Septembre 2014.

DECRETE

Article 1 : Il est affecté au Ministère de l'Energie et des Ressources Naturelles, une parcelle de terrain constituée d'un ensemble de corridors reliant la centrale de JABANASS de PK 12 au secteur de la Gare-Station Nagad.

Article 2 : La dite parcelle sera mise à la disposition de l'Electricité de Djibouti et est destinée à une zone de sécurité dont l'emprise servira de passage de toutes les lignes électriques de 63 et 230 KV.

Article 3 : Son itinéraire est constituée d'une longueur totale d'environ 13,52 km avec des largueurs d'emprise variant entre 6, 15, 24, 100 et 283 selon les différents secteurs dont les descriptions sont indiquées suivants les plans ci-annexés.
Des servitudes de voiries pourront traverser lesdits corridors aux besoins de l'Etat.

Article 4 : Dans les vingt jours de la date du présent décret, le Ministre du budget, par l'entremise du Directeur des Domaines et de la Conservation Foncière, fera remise de la dite parcelle au Directeur de l'Electricité de Djibouti.

Article 5 : Les formalités d'enregistrements du présent décret sont gratuites.

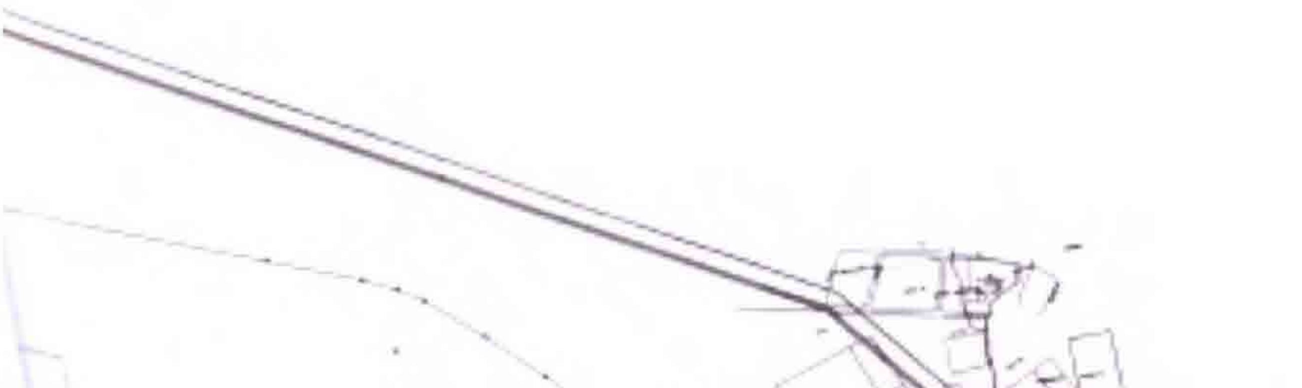
Article 6 : Le présent décret sera enregistré, publié, et communiqué partout ou besoin sera.

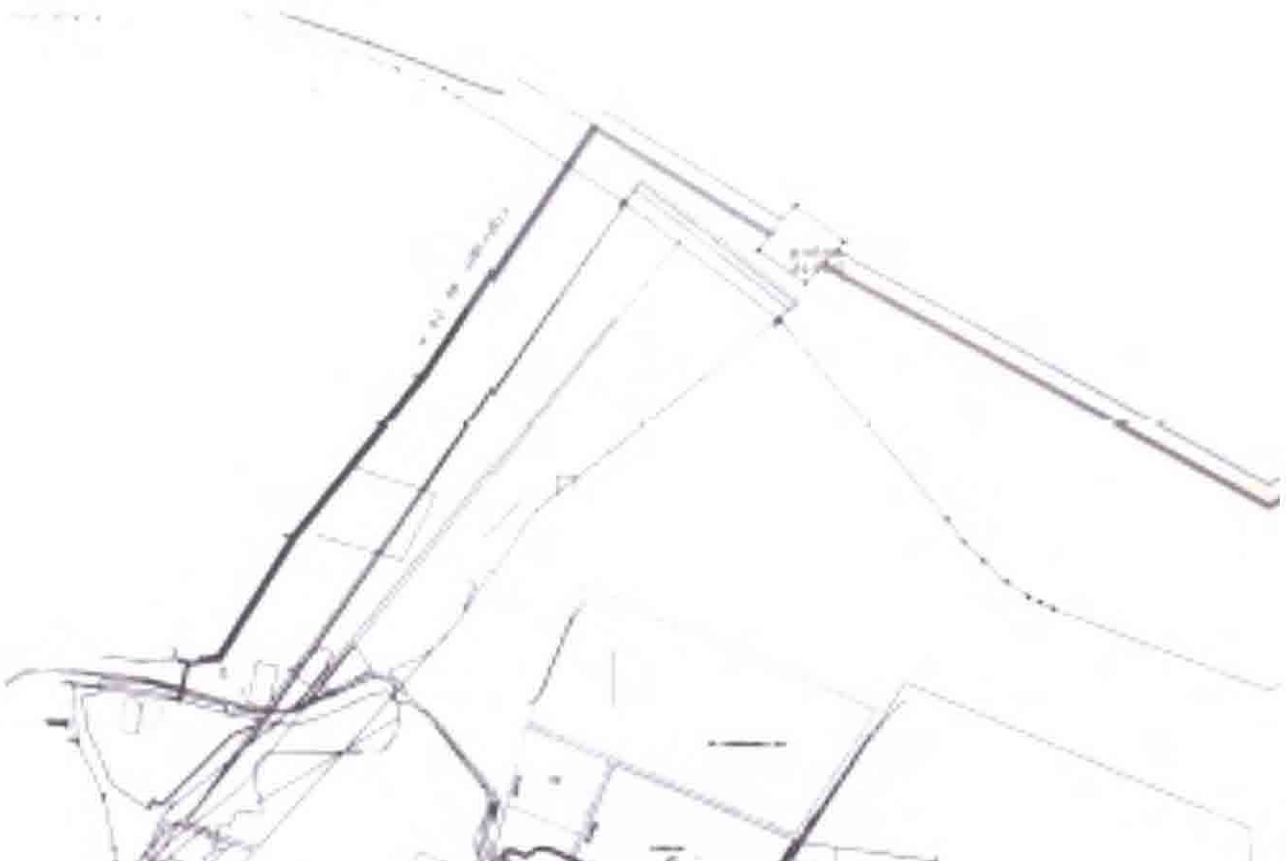
Fait à Djibouti, le 16 SEP 2014

Le Président de la République,
Chef du Gouvernement

LE PRESIDENT
الرئيس

ISMAÏL OMAR GUELLEH





Annex-11

- DRC
- DRCA
- Dicello

بسم الله الرحمن الرحيم

REPUBLIQUE DE DJIBOUTI
UNITE - EGALITE - PAIX

MINISTERE DE L'HABITAT, DE L'URBANISME
ET DE L'ENVIRONNEMENT

DIRECTION DE L'AMENAGEMENT
DU TERRITOIRE ET DE L'ENVIRONNEMENT

جمهورية جيبوتي
الوحدة - المساواة - السلام
وزارة الإسكان والتعمير والبيئة
إدارة التهيئة الترابية والبيئة

3 0 AOUT 2014
REÇU LE
DIRECTION E.D.D.

DIRECTION GENERALE EDD
ENTREE
Le 3 0 AUG 2014
Sous le N° 2604

Djibouti, le 30/08/14
N°270/DATE/14

Le DIRECTEUR

A Monsieur le Directeur Général de l'E D D

Objet : Projet de renforcement du système des distributions d'énergie à Djibouti-ville
Réf : V/L n°1680/MA/2014/DPED en date du 27/08/2014.

Monsieur le Directeur Général,

Faisant suite à votre courrier ci-haut référencé relatif au projet de renforcement du système de distribution d'énergie à Djibouti-ville par la mise en place d'une lige de 63 Kv et suite à notre réunion de concertation avec notre département sur ledit projet dans laquelle toutes les informations nécessaires ont été fournies, j'ai l'honneur de vous informer que ledit projet ne nécessite pas la réalisation d'une étude d'impact environnemental. Toutefois durant la construction de cette ligne, les mesures environnementales les plus appropriées doivent être observées.

HOUSSEIN RIRACHE ROBLEH

Ampliation
- MHUE
- SG

A-5 Technical Memorandum

TECHNICAL MEMORANDUM
FOR
THE 1st PREPARATORY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY
IN
THE REPUBLIC OF DJIBOUTI

AGREED UPON BETWEEN
ELECTRICITE DE DJIBOUTI (EdD)
AND
JICA PREPARATORY SURVEY TEAM

Djibouti, 19th September 2013

For

Mr. Kyoji FUJII
Chief Consultant
JICA Preparatory Survey Team
Yachiyo Engineering Co., Ltd.

Mr. Ismael DIALLO
Director of Interconnection Project
Electricite de Djibouti

Electricite du Djibouti (hereinafter referred to as "EdD") and JICA Preparatory Survey Team for the Project for Improvement of Power Supply in the Republic of Djibouti (hereinafter referred to as "the Team") had series of technical discussion to form a mutual understanding on the scope of the Project and pending items to be fulfilled by the both parties before the commencement of second field survey. Both parties agreed to record the following points as a conclusion of the discussions.

1. Clarification of requested components

The details of requested components at the time of the first field survey are clarified as follows:

(1) 63kV transmission lines

1) Overhead line

From PK12 substation to Nagad, double circuits

2) Underground cable

From Nagad to Boulaos substation, single circuit

3) Connection point at Nagad

EdD requested JICA to include Nagad switching station instead of Nagad connection point which simply connects overhead lines and underground cables without switching function. The relevance of the request will be evaluated by the Team and reported to JICA for its consideration. The results will be informed to EdD at the beginning of the second field survey.

(2) Expansion of PK12 Substation

1) Additional 230/63 kV transformer

- A) One 230/63 kV, 63 MVA transformer
- B) One set of 230kV switchgear for the transformer including circuit breaker, disconnecting switches, instrument transformers, arrestor, etc.
- C) One set of 63kV switchgear for the transformer including circuit breaker, disconnecting switches, instrument transformers, arrestor, etc.
- D) Protection and supervisory equipment including existing panel modification
- E) Power & Control cables

2) Additional 63/20 kV transformer

- A) One 63/20 kV, 40 MVA transformer
- B) One set of 63kV switchgear for the transformer including circuit breaker, disconnecting switches, instrument transformers, arrestor, etc.
- C) Protection and supervisory equipment including existing panel modification
- D) Power & Control cables
- E) (Existing 20 kV SWGR will be utilized for receiving the secondary power of the transformer)

3) Additional 63 kV Transmission Line Bays

   A) Expansion of 63 kV substation building for 6 bays
   B) 63 kV double bus expansion to the new building for 6 bays
   C) Four sets of 63kV switchgear for 4 transmission lines (outgoing for Nagad and Dorale) in the new building including circuit breakers, disconnecting switches, instrument transformers, arrestors, etc.
   D) Protection and supervisory equipment including existing panel modification
   E) Power & Control cables
   F) Gantry for 2 new transmission lines for Nagad

4) Additional 20 kV Capacitor Bank

   A) 12.6 Mvar Capacitor Bank for 20 kV bus
   B) Supervisory equipment modification
   C) Power & Control cables
   D) (Existing 20 kV SWGR will be utilized for connecting the capacitor.)

(3) Modification of Boulaos Substation

1) Modification for new underground cable transmission line

   A) One 63 kV circuit breaker and instrument transformers
   B) Protection and supervisory equipment including existing panel modification
   C) Cables
   D) (Existing bay in the 63 kV substation building with primary equipment will be utilized except circuit breaker and instrument transformer.)

2. Data and information requested

The following data and information shall be collected by EdD and provided to the Consultant at the beginning of the second field survey which is scheduled from 19th October 2013.

(1) Transmission

Urban development Master plan of the Djibouti city
(Railway, New Airport and Transmission line)

(2) Substation

Boulaos substation

The specifications of the existing equipment for 63 kV Boulaos substation which will be utilized for new underground cable transmission line to PK12 should be provided such as ones of line switch, instrument transformer those of which can be obtained from their name plates and ones of insulator and bus bar material & size.

And the bus bar and equipment arrangement drawing for the above mentioned transmission line bay should be provided for the detailed design of circuit breaker and instrument transformer replacement.

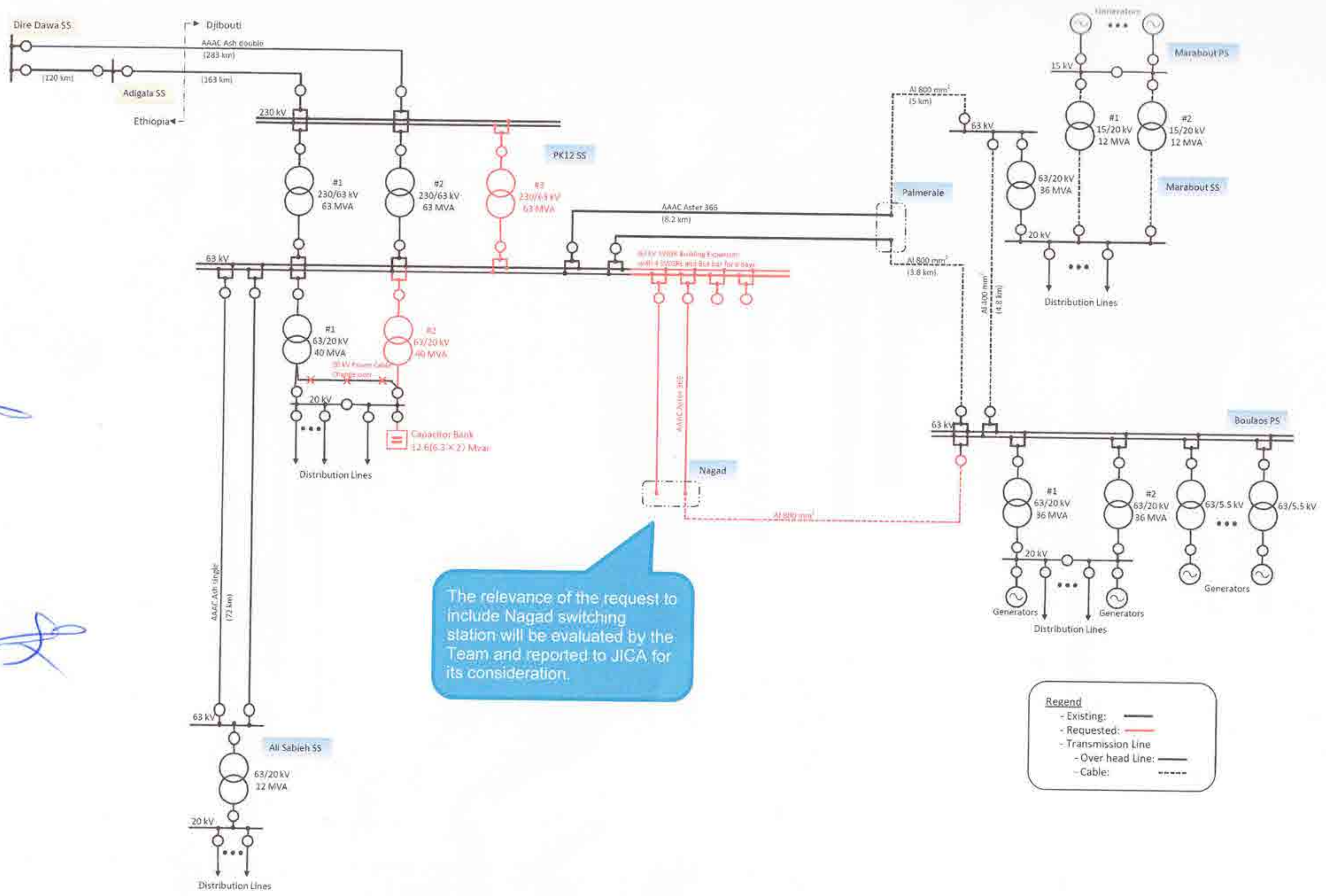
(3) General

Meteorological Data (average of past 10 years)

3. Preparation of presentation materials

The Team shall prepare presentation materials which describe the outline and contents of the requested Japan's grant aid project and submit them to EdD at the beginning of the second field survey.

(End)



The relevance of the request to include Nagad switching station will be evaluated by the Team and reported to JICA for its consideration.

Single line diagram of Djibouti power system and requested components

TECHNICAL MEMORANDUM
FOR
THE 2nd PREPARATORY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY
IN
THE REPUBLIC OF DJIBOUTI

AGREED UPON BETWEEN
ELECTRICITE DE DJIBOUTI (EdD)
AND
JICA PREPARATORY SURVEY TEAM

Djibouti, 5th November 2013

Mr. Kyoji FUJII
Chief Consultant
JICA Preparatory Survey Team
Yachiyo Engineering Co., Ltd.

Mr. Ismael DIALLO
Director of Interconnection Project
Electricite de Djibouti

Electricite du Djibouti (hereinafter referred to as "EdD") and JICA Preparatory Survey Team for the Project for Improvement of Power Supply in the Republic of Djibouti (hereinafter referred to as "the Team") had series of technical discussion to form a mutual understanding on the scope of the Project, priority order and technical specifications of project components and items to be undertaken by each party. Both parties agreed to record the following points as a conclusion of the discussions.

1. Components of the Project and their priority order

Table-1 shows the results of priority evaluation conducted by the Team. Upon strong request of EdD and considering the importance of electricity supply to railway which connects Djibouti and Ethiopia, both sides reevaluated and agreed on the priority order of Project components as shown in Table-2.

If the result of detailed cost estimation exceeds the ceiling of the Project budget, component(s) will be dropped from the scope of the Project until estimated project cost falls below the ceiling in accordance with the priority order shown in Table-2.

Table-1 Priority evaluation by the Team

Evaluation criteria	Evaluation results				
	PK12 S/S 230/63kV transformer	63kV transmission line	PK12S/S 63/20kV transformer	PK12 S/S 20kV Capacitor bank	Nagad switching station
① Urgency in terms of power supply capacity and/or quality ( ): year when addition of equipment is required and reasons	4 (2020, overload)	5 (2018, overload/ end of 2015, power supply for railway)	3 (2022, overload)	5 (2018, low voltage)	3 (end of 2015, power supply for railway)
② Benefit (direct/ indirect)	5	5	4	4	4
③ Correlation with other donors' assistance or investment projects	5	5	3	3	5
④ Consistency with strategy on power import from Ethiopia	5	4	3	4	3
⑤ Project cost	3	3	5	5	5
⑥ Necessary permits and period required for granting them	5	3	5	5	5
⑦ Contribution to improving power supply reliability	5	5	3	3	4
⑧ Environmental and social impact	5	4	5	5	5
Sum of evaluation points	37	34	31	34	34
Priority order	1	2	3	2	2

Table-2 Priority order of Project components agreed by Both Sides

Priority order	Project components
1 (Highest)	Construction of 63kV transmission line from PK12 substation to Boulaos substation via Nagad
2+	Expansion of PK12 substation by procurement and installation of a 230/63kV transformer and related equipment
2	Construction of Nagad switching station
2-	Expansion of PK12 substation by procurement and installation of a 63/20kV transformer and related equipment
3 (Lowest)	Procurement and installation of capacitor banks for PK12 substation on 20kV side

2. Items to be undertaken by each party

Even after coming back to Japan from the second field survey, the Team needs some more information to complete the study. Some works such as "Resettlement Action Plan survey" and "Topographic and Soil Investigation" are subcontracted to local consultants. In order for the smooth and timely information collection and following design and cost estimation, EdD and the Team shall undertake items described in Table-3.

Table-3 Items to be undertaken by each party

	EdD	**The Team**
(1) Monitoring of works sub-contracted to local consultants		
1) Abbreviated RAP (Resettlement Action Plan) survey	● Monitor the progress of survey ● Provide necessary assistance to a local consultant for the smooth implementation the survey ● Inform the Team of any delay, problem and disputes if observed	● Provide necessary instruction to a local consultant
2) Topographic survey and soil investigation	● Monitor the progress of survey ● Provide necessary assistance to a local consultant for the smooth implementation the survey	● Provide necessary instruction to a local consultant
(2) Railway project	● Inform the Team of the progress and details of railway project, particularly, ➢ Layout of Nagad railway station ➢ Electrical system design and equipment arrangement for Nagad station	● Incorporate the information into project design if necessary
(3) Urban planning	● Obtain necessary permits and approvals for 63kV transmission line route from PK12 to Boulaos via Nagad	
(4) EIA	● Confirm whether EIA is required for the Project or not ● If required, take necessary measures to obtain EIA permit and/or license	● Provide information on project components and locations

3. Basic plan and technical specifications

Design conditions to be applied to and basic plan of the Project components are shown in Annex-I. Detailed technical specifications of major equipment and materials to be procured and installed under the Project are shown in Annex-II. Outline design drawings such as single line diagram and plot plan of each substation, an elevation and floor plan of switchgear houses at PK12 substation and Nagad switching station, etc. are shown in Annex-III.

Transmission line route, the location on Nagad switching station and railway traction substation which are used as the basis of outline design and cost estimation are shown in Table-4 and Attachment.

Table-4 GPS Coordinates of transmission line, railway traction substation and Nagad switching station

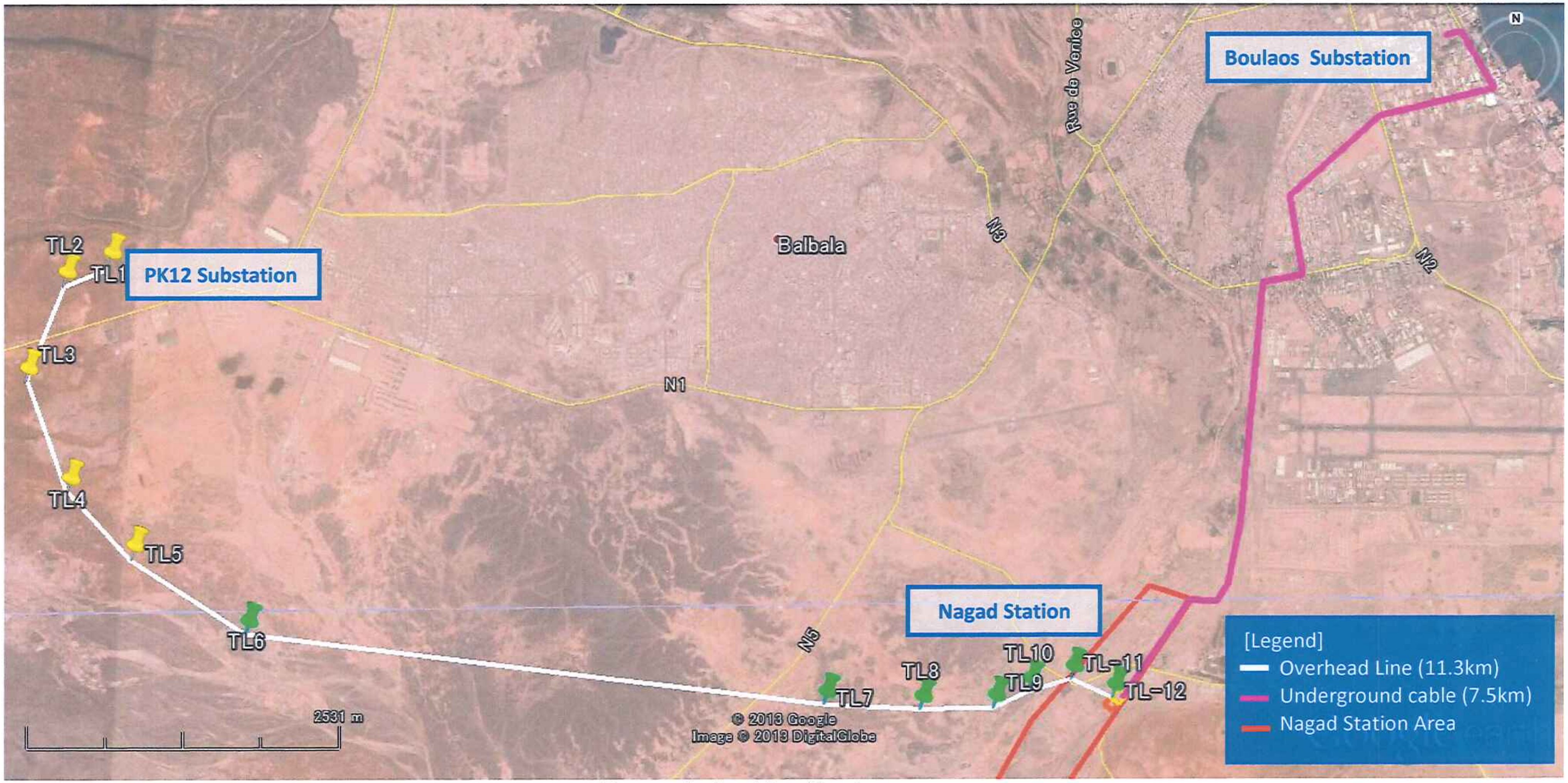
Facility	GPS Coordinates		
	Point	Latitude	Longitude
Overhead transmission Line	TL1	11°33'33.90"N	43° 3'25.20"E
	TL2	11°33'28.60"N	43° 3'13.00"E
	TL3	11°33'03.90"N	43° 3'03.40"E
	TL4	11°32'35.60"N	43° 3'13.20"E
	TL5	11°32'14.20"N	43° 3'31.40"E
	TL6	11°31'58.50"N	43° 3'54.10"E
	TL7	11°31'38.20"N	43° 6'38.00"E
	TL8	11°31'36.62"N	43° 7'3.06"E
	TL9	11°31'36.90"N	43° 7'23.30"E
	TL10	11°31'41.18"N	43° 7'32.40"E
	TL11	11°31'44.45"N	43° 7'43.90"E
	TL12	11°31'39.53"N	43° 7'55.04"E
Railway traction substation	TSS1	11°31'39.47"N	43° 7'54.60"E
	TSS2	11°31'37.57"N	43° 7'53.01"E
	TSS3	11°31'35.86"N	43° 7'55.25"E
	TSS4	11°31'37.75"N	43° 7'56.76"E
Nagad switching station	TSS1	11°31'39.47"N	43° 7'54.60"E
	SWS2	11°31'42.21"N	43° 7'56.82"E
	SWS3	11°31'40.39"N	43° 7'59.22"E
	SWS4	11°31'37.60"N	43° 7'56.99"E

4. Tentative Implementation Schedule

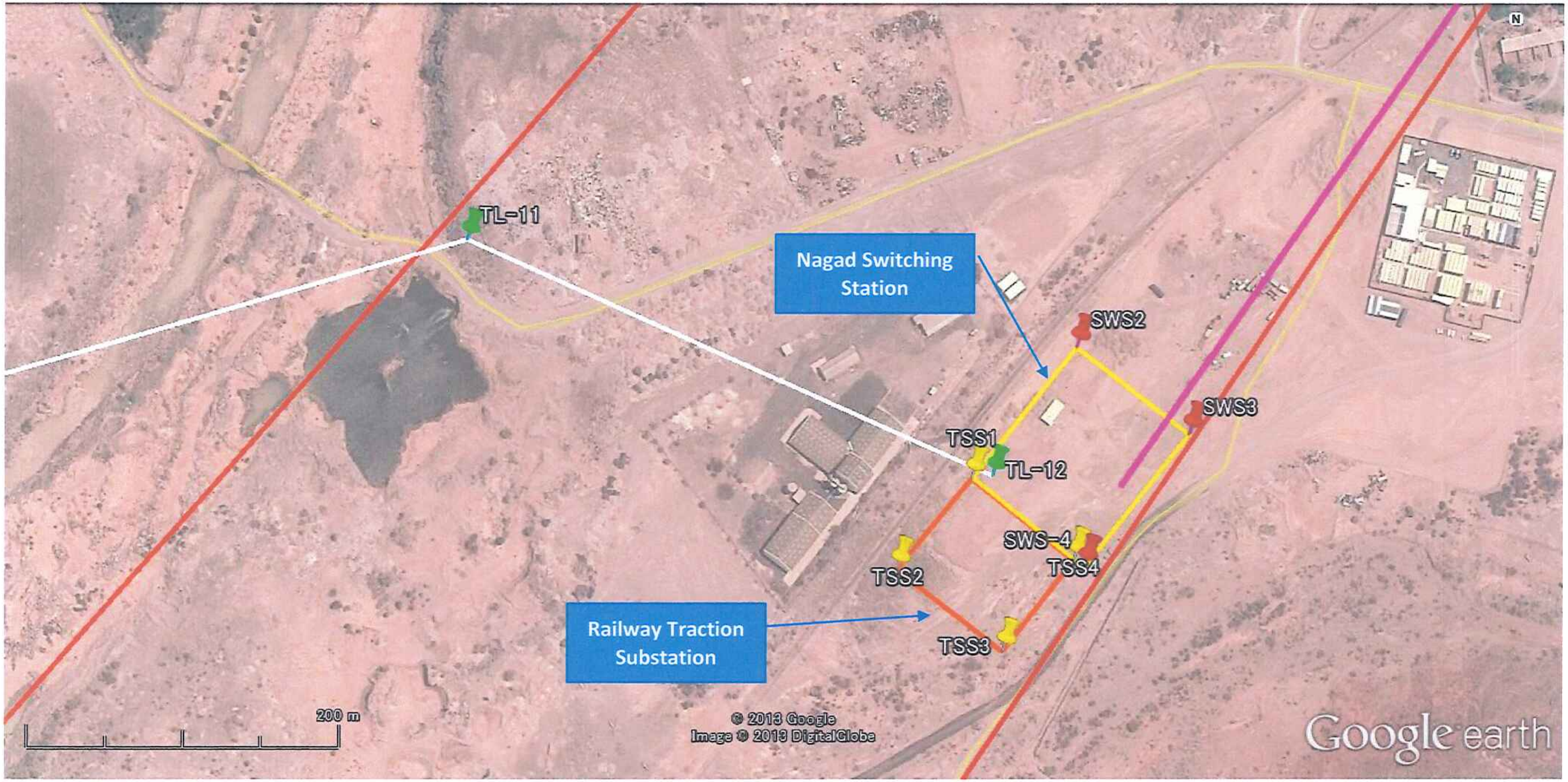
Tentative implementation schedule of the Project supposing that the Exchange of Notes (E/N) will be concluded in May 2014, is shown in Annex-IV. The schedule is provisional and might be changed later. However, the construction period shall be within 24 months after the E/N according to the Japan's Grant Aid scheme.

Attachment

Annex-I:	Transmission Line Route
Annex-II:	Design Conditions and Basic Plan (1) Design conditions (2) Applicable codes/Standards and Unit (3) Basic Plan
Annex-III:	Technical Specifications
Annex-IV:	Outline Design Drawings
Annex-V:	Tentative Implementation Schedule



Transmission Line Route



Location of Nagad Switching Station

Design Conditions and Basis Plan

(1) Design Conditions

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

(i) Climatic Conditions

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

Table 1 Expansion of PK12 S/S Weather condition

Region		Djibouti
Altitude		Less than 1,000m
Ambient Temperature	Average maximum	46.5℃
	Maximum	55℃
	Minimum	16.0℃
Average Maximum Humidity		87.1%
Max. Wind Velocity		66knots (34m/s) (See Note 1)
Rainfall (Maximum Monthly)		903mm
Maximum Solar Radiation		1100 W/m^2
Earth quake loading		0.15G
Soil Bearing Capacity		5 ton/m^2

(Note)

1. The maximum wind velocity to be applied to the design is estimated based on the past records of mean wind velocity measured at meteorological stations in Djibouti. The highest mean wind velocity in Djibouti which was recorded for the past 10 years (from 2002 to 2012) by Djibouti Meteorological Agency and Ethiopia-Djibouti interconnection project data.

(ii) Basic Electrical Design Conditions

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

Table 2 Condition of the electrical system

Item	**Transmission System**		**Distribution System**	**Station Service Power**	
Nominal Voltage	230kV	63kV	20kV	380-220V AC	125 & 48V DC
Maximum Voltage	245kV	72.5kV	24kV	+10 %	+10 %
Frequency	50Hz				N/A
Maximum Short Circuit Capacity	31.5kA (1sec.)	20kA (1sec.)	12.5kA (1sec.)	N/A	
Lightning Impulse Withstand Voltage (LIWV)	1,050kV	325kV	125kV	N/A	
Earthing System	Effective Earthing System			N/A	
Minimum Creepage Distance of Insulator	31mm/kV (See Note 1)			N/A	
Minimum Clearance of Conductor	(See Note 2)			N/A	
Phase to Ground (mm)	3,000	1,000	500	N/A	
Phase to Phase (mm)	4,000	1.800	900	N/A	

Item	Transmission System	Distribution System	Station Service Power
Clearance and Wayleave	(See Note 3)		
Protection Class (IP)	(See Note 4)		
SCADA and Communication Systems	(See Note 5)		

(Notes)

1. Since the project sites are located about 6 km away from the coast, contamination by sea water should be taken into consideration. Therefore, minimum creepage distance of insulator is 31mm/kV (Heavily salted area).
2. The minimum clearance of conductor for transmission and distribution lines shall be determined in accordance with relevant standards (IEC 60071.2) and regulations. The minimum clearance of conductor for 20kV switchgear cubicles shall be determined by manufacturer's standards.
3. The height and clearance of transmission and distribution lines shall be determined in accordance with the requirements of EdD, Djibouti National Roads Agency, etc. described as follows. However, in case that special arrangement is required, EdD shall consult with relevant parties to obtain necessary permission.

Table 3 Distance from conductor of the distribution lines and transmission lines

Item	63kV
Height of Conductor	
General Area (m)	6.5
Road (m)	8.0
Railway (m)	10.0
Waterway, Fairway (m)	6.5
Width of Wayleave (m)	24.0
Clearance between conductor and Buildings(m)	5.0
Power supply circuits up to 230KV (m)	4.0
Power supply circuits 230kV (m)	6.0
Clearance between supporting structure and road center	30.0
Clearance between supporting structure and railway (m)	30.0

4. Protection class (IP) for 20kV switchgear cubicles, low voltage panels, control panels and protection relay panels are as follows.
   Indoor: IP20
5. Extension and modification of SCADA (Supervisory Control and Data Acquisition) and communication systems (optical fiber systems) for substations shall be designed and provided by this project.

(2) Applicable Codes/Standards and Units

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

When IEC or ISO Recommendations or DIN, BS, VDE Standards are referred to, the edition shall be that current at the Date of Tender, together with any Amendments issued to that date.

- 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 Cable Maker's Association (JCS): Applied to electric wire and cables
- Institute of Electrical and ENGINEERs Inc. (IEEE): Applied to electrical products in general
- Deutsches Institut fuer Normung (DIN): Same as above
- British Standards Institution (BS): Same as above
- Verband Deutscher Elektrotechniker (VDE): Same as above
- Comite Consultatif International Telegraphique et Telephonique (CCITT): Applied to Optical fiber
- Relevant Technical Standards on Electrical Installation: Applied to electrical work in general
- Document Technique Unifié (DTU): Applied to construction work

(3) Basic Plan of Components

(i) Expansion of PK12 Substation (S/S)

(a) Outline of the Components

One (1) 230/63 kV, 63 MVA step down transformer and its associated 230 kV outdoor switchgear, 63 kV indoor switchgear and control, supervisory and protection facilities shall be installed to convey imported electric power from Ethiopia to Djibouti to meet the increasing electricity demand. Furthermore, one (1) 63/20 kV, 40 MVA distribution step down transformer and its associated 63 kV indoor switchgear, 20 kV cables and control, supervisory and protection facilities shall be installed as well for the demand of neighbor customers.

Since the new double circuits transmission lines from PK12 S/S to new Nagad switching station (S/S) is requested to be constructed as a component, new two (2) bays for the lines shall be installed including the expansion of 63 kV switchgear building which is designed to accommodate future four (4) more bays in future. Those of new transmission line bays also require switchgear and control, supervisory and protection facilities.

As the electricity import has being increased and the domestic diesel generators are little contributing electric power to the Djibouti grid, reactive power is predicted insufficient to keep the voltage within allowable tolerance. Therefore, one (1) set of 12.6 Mvar indoor capacitor bank shall be installed in also newly constructed capacitor bank building to connect 20 kV distribution bus through circuit breaker.

The dead end gantry for new 63 kV overhead double circuits transmission lines mentioned above shall be installed at adjacent to the substation boundary and cable pit shall be constructed from new expanded 63 kV switchgear building to the gantry for power cable installation.

The new cable pit for low voltage and control cables from expanded 63 kV switchgear building to the existing control building shall be constructed to secure the cable route for additional six (6) bays because of insufficient cross sectional vacant area in the existing buried sleeves between the switchgear building and control building.

(b) Technical Specifications of Major Equipment and Materials

Regarding electrical system and layout of the substation refer to attached drawings (DWG. No. E-01, E-02, E-03 and C-03 (Plan 2) in Annex-II).

Technical specifications of major equipment and materials are shown in Table-1 of the Attachment.

(ii) Expansion of Boulaos Power station (63 kV S/S)

(a) Oultline of the Components

The existing unused bay in the 63 kV substation building in which the switchgear has been installed since early 1980s will be utilized for new underground cable transmission line from Nagad S/S so that the circuit breaker, instrument transformers and their associated aluminum bus bar plates shall be replaced with new ones. The removal and dispose of them shall be conducted by Djibouti side and the installation of new facilities shall be made by Japan side. Lightning arrestors shall be additionally installed in the bay to protect equipment against surge entry.

The control, supervisory and protection panels shall be newly installed in the relay room adjacent to the bay and the necessary modification of the mosaic control panel in the central control room of the main building shall be made for remote control and monitoring.

The communication network for voice and data including protection relay signal shall be enlarged with Nagad S/S through the fiber optical cable which will be laid together with 63 kV transmission power cables.

(b) Technical Specifications of Major Equipment and Materials

Regarding electrical system and layout of the substation refer to attached drawings (DWG. No. E-01, E-04, E-05 and C-05 in Annex-II).

Technical specifications of major equipment and materials are shown in Table-2 of the Attachment.

(iii) Construction of Nagad S/S

(a) Outline of the Components

The 63 kV new switching station shall be constructed to interconnect the double circuits transmission lines from PK12 S/S and the single circuit underground cable line from Boulaos P/S both of which will be newly installed together and to supply electricity for the railway substation. The switchgear shall be installed in the building as same design policy as other substations in Djibouti city to avoid quick corrosion and deterioration against the coast environment.

The dead end gantry for two (2) overhead lines shall be constructed for PK12 S/S lines and cable pit between the gantry and switchgear building shall be made for power cable installation.

The control, supervisory and protection facilities shall be installed with the micro SCADA communication network and data of the station will be managed by the SCADA system which is planned to have the gateway interface with National Grid Control Center that will be constructed in neat future. The wide area communication network shall be enlarged including Nagad S/S through OPGW and fiber optic cable those of which will be laid with transmission lines among PK12 S/S, Boulaos P/S and Nagad S/S.

The transmission lines between PK12 S/S and Nagad S/S which is overhead line for full length shall have the rapid single phase auto reclosing function using the communication signal between protection relays of both stations. However, the line which is utilizing cable outside of station shall not apply the auto reclosing function.

The grounding system shall design to secure the human safety and to protect the facilities against the earth fault current so that the resistance of the substation site shall be determined in accordance with the IEEE 80-2000 standard.

(b) Technical Specifications of Major Equipment and Materials

Regarding electrical system and layout of the substation refer to attached drawings (DWG. No. E-01, E-06, E-07 and C-04 in Annex-II).

Technical specifications of major equipment and materials are shown in Table-3 of the Attachment.

(iv) Construction of 63kV Transmission Lines

(a) Outline of the Components

63 kV transmission line of double circuits and 11 .3 km long shall be constructed between PK12 substation and Nagad switching station.

The line passes through mostly flat lands as shown in Route Map of Transmission Line in Annex-III.

As for the design of 63kV transmission line, the maximum wind velocity of 66 knots (34m/s) is applied. The wind and gravity load of OPGW (optical grounding wire) shall be taken into consideration for the design of supporting structure such as transmission towers for completion of the Project.

Standard span length of support shall be 350 m and the sag is around 3%.

The material and size of conductors and overhead earthing wires are AAAC ASTER 366 and OPGW 100sq, respectively.

(b) Technical Specifications

Technical specifications of major materials are shown in Table-4 of the Attachment.

(v) Construction of 63kV Underground Line

(a) Outline of the Components

63 kV underground line of single circuit, about 7.5 km long shall be constructed between Nagad Switching station and the existing Boulaos S/S

The line passes through an urban area as shown in Route Map of Underground Line in Annex-III.

As for the design of 63 kV Underground line, EdD's standards (1x800sqmm2 XLPE single core with armored) shall be applied basically.

The standard depth of laying for underground cables shall be 1400mm.

(b) Technical Specifications

Technical specifications of major materials are shown in Table-5 of the Attachment.

(vi) Construction of Nagad-Boulaos S/S Underground communication Line

(a) Outline of the Components

Underground communication line, about 7.5 km long shall be constructed between Nagad Switching station and the existing Boulaos S/S

The line passes along 63 kV underground cables through an urban area as shown in Route Map of Underground Line in Annex-III.

As for Type and Number of optical fibers, EdD's standards (Loose Tube Fiber Optic Cable – Dry Core – Armored – Double Sheath, 24fibers) shall be applied basically.

(b) Technical Specifications

Technical specifications of major materials are shown in Table-6 of the Attachment.

Annex-III

Technical Specifications for Major Equipment and Materials

Table 1 Expansion of PK12 S/S

No.	Item / Equipment	Specifications	Quantity
1	230/63kV Transformer		1 Set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	230 kV	
	3) Rated secondary voltage	63 kV	
	4) Rated Capacity	50.4/63 MVA	
	5) Cooling type	ONAN/ONAF	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	230 kV +10 % to -10 %	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary : Star (neutral lead out) Secondary : Star (neutral lead out) Third : Delta YNyn0(d11)	
	12) Impedance	13.5 % at 63 MVA	
	13) Others	Parallel operation with existing two transformers (%Z=13.56 % & 13.46 %) shall be considered.	
2	230 kV Circuit Breaker		1 Set
	1) Type	Outdoor, SF6 gas insulated	
	2) Rated voltage	230 kV	
	3) Rated lightning impulse withstand voltage	1,050 kV	
	4) Frequency	50Hz	
	5) Rated current	3,150 A	
	6) Rated short-circuit breaking current	31.5 kA	
	7) Rated duration of short circuit	3 s	
3	230 kV Disconnecting Switch		2 Sets
	1) Type	Outdoor, pantographic, motor operation type	
	2) Rated voltage	230 kV	
	3) Rated lightning impulse withstand voltage	1,050 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	2,000 A	
	7) Rated short-time withstand current	31.5 kA	
	8) Rated duration of short circuit	3 s	
	9) Accessory	Operating box	
4	230 kV Current Transformer		6 Sets
	1) Type	Outdoor	
	2) Highest Voltage	245 kV	
	3) Rated lightning impulse withstand voltage	1,050 kV	
	4) Rated primary current	200-400-800 A	
	5) Rated secondary current	1 A	
	6) Thermal short time current	31.5 kA (1 s)	
	7) Number of cores	5 (one for measuring and four for protection)	
	8) Rated output	30 VA or above	
	9) Accuracy	0.2 and 10P30	
5	230 kV Lightning Arrestor		3 Sets
	1) Type	Outdoor, metal oxide type	
	2) Rated voltage	198 kV	
	3) Discharge current	20 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	

No.	Item / Equipment	Specifications	Quantity
6	230 kV Switchgear connecting materials		1 Lot
	1) Conductors	Al 36mm diameter conductor wire, etc.	
	2) Connecting materials	Clamps, connectors and fittings	
	3) Post insulators	Creepage distance: 31 mm/kV or above	
	4) Steel supports	For DSs, CTs, LAs, and post insulators	
	5) Marshaling kiosk	Outdoor, stainless steel enclosed	
7	63/20kV Transformer		1 Set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	63 kV	
	3) Rated secondary voltage	20 kV	
	4) Rated Capacity	32/40 MVA	
	5) Cooling type	ONAN/ONAF	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	63 kV +12.5 % to -12.5 %	
	9) Number of taps	21 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary : Star (neutral lead out) Secondary : Star (neutral lead out) Third : Delta YNyn0(d11)	
	12)Impedance	12 % at 40 MVA	
	13) Others	Parallel operation with existing transformer (%Z=11.96 % at tap 11 at 40 MVA)shall be considered.	
8	63 kV Circuit Breaker		4 Sets
	1) Type	Indoor, SF6 gas insulated	
	2) Rated voltage	63 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	1,250 A	
	7) Rated short-circuit breaking current	20 kA or above	
	8) Rated duration of short circuit	3 s	
	9) Rated operating sequence	O - 0.3 s - CO - 3 min. – CO Single phase rapid auto reclosing function shall be required for two transmission lines only.	
9	63 kV Disconnecting Switch		8 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A	
	7) Rated short-time withstand current	20 kA	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For bus connection	

No.	Item / Equipment	Specifications	Quantity
10	63 kV Disconnecting Switch with Earth Switch		4 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A	
	7) Rated short-time withstand current	20 kA	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For line feeder connection	
11	63 kV Current Transformer		12 Sets
	1) Type	Indoor	
	2) Highest Voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Rated primary current	400-800 A	
	5) Rated secondary current	1 A	
	6) Thermal short time current	20 kA (1 s)	
	7) Number of cores	4 (one for measuring and three for protection)	
	8) Rated output	30 VA	
	9) Accuracy	0.5 and 10P30	
12	63 kV Voltage Transformer		6 Sets
	1) Type	Indoor, Capacitor type	
	2) Highest Voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Rated primary voltage	$63/\sqrt{3}$ kV	
	5) Rated secondary voltage	$100/\sqrt{3}$ V	
	6) Number of cores	2	
	7) Rated output	100 VA	
	8) Accuracy	0.2/3P and 3P	
	9) Remarks	For line feeder	
13	63 kV Lightning Arrestor		24 Sets
	1) Type	Metal oxide type	
	2) Rated voltage	60 kV	
	3) Discharge current	10 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	
14	63 kV Power cable		1 Lot
	1) Type	Single core aluminum conductor, XLPE insulated, armored and PVC or PE outer sheath	
	2) Highest voltage	72.5 kV	
	3) Nominal conductor cross section	800 sq. mm	
	4) Place to be used	- From 63 kV SWGR to gantry for transmission lines (approx. 1,500 m) - From 230/63 kV Tr. to 63 kV SWGR (approx. 100 m) - From 63/20 kV Tr. to 63 kV SWGR (approx. 100 m)	
	5) Cable sealing end	With necessary accessories: 24 sets	

No.	Item / Equipment	Specifications	Quantity
15	63 kV Switchgear connecting materials 1) Conductors 2) Connecting materials 3) Post insulators 4) Steel supports 5) Marshaling kiosk	 Al 100mm*10mm plates for main and branch buses Al 36mm diameter conductor wires, etc. Terminals, connectors, etc. Creepage distance: 31 mm/kV or above For LA, DS, cable, post insulators, etc. Metal enclosed panel for each bay	1 Lot
16	Dead end gantry 1) Type 2) Size 3) Remarks	 Galvanized steel structure, for two transmission lines Width: 14 m (2*7 m span) Overall Height: 10.5 m from foundation Horizontal beam height: 8 m from foundation For 2 circuits 63 kV transmission lines to Nagad S/S	1 Set
17	20 kV Disconnecting Switch with Earth Switch 1) Type 2) Rated voltage 3) Rated lightning impulse withstand voltage 4) Number of phase 5) Frequency 6) Rated current 7) Rated short-time withstand current 8) Rated duration of short circuit 9) Accessory	 Outdoor, hand operation type 24 kV 125 kV 3 50Hz 1,250 A 20 kA 1 s Operating box	1 Set
18	20 kV Lightning Arrestor 1) Type 2) Rated voltage 3) Discharge current 4) Accessory	 Metal oxide type 24 kV 10 kA Discharge current monitor with counter for each arrestor	3 Sets
19	20 kV Grounding Resister 1) Type 2) Rated voltage 3) Resistance 4) Short-time rating	 Outdoor, metal enclosed $20/\sqrt{3}$ kV 40 ohm 10 s	1 Set
20	20 kV Capacitor Bank 1) Type 2) Rated voltage 3) Highest voltage 4) Bank power 5) Accessories 6) Cable entry	 Indoor type 20 kV 24 kV 12.6 Mvar (2 * 6.3 Mvar) Inrush reactor bottom	1 Set
21	20 kV Power cable 1) Type 2) Highest voltage 3) Nominal conductor cross section 4) Place to be used 5) Cable sealing end	 Single core copper conductor, XLPE insulated and PVC or PE outer sheath 24 kV 500 sq. mm - From 63/20 kV Tr. to 20 kV SWGR (approx. 1,000 m) - From 20 kV SWGR to Capacitor Bank (approx. 80 m) With necessary accessories: 24 sets	1 Lot

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No.	Item / Equipment	Specifications	Quantity
22	20 kV Switchgear connecting materials		1 Lot
	1) Conductors	Al 36mm diameter conductor wires, Copper plates, etc.	
	2) Connecting materials	Terminals, connectors, etc.	
	3) Steel supports	For LA, DS and cables	
23	Bay Control Panels		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Bays to be controlled	- 230/63 kV transformer bay: one - 63/20 kV transformer bay: one - 63 kV transmission line: two	
	3) Main equipment to be mounted	Bay Control Unit (BCU), control switches with indicator, selector switch, transformer tap voltage control unit (transformer bay panel only)	
	4) Remarks	The configuration and man-machine interface shall be same as the existing control panels.	
24	Mimic Control Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification of existing panel	The following bays of control and monitoring function shall be additionally equipped. - No. 3 230/63 kV transformer bay - No. 2 63/20 kV transformer bay	
	3) Additional Panel	The additional panel shall be installed beside the existing panel. The width shall be determined to equip additional six 63 kV bays with the same man-machine interface as the existing one. Supervisory equipment of 63kV double bus for six bays and two bays for transmission lines shall be mounted and the space for future four bays shall be secured.	
	4) Main equipment to be mounted	Control switches with indicator, mimic symbols, meters (P, Q, I & V)	
	5) Remarks	The supervisory function shall be well coordinated with the bay control panels.	
25	Micro SCADA system modification		1 Lot
	1) Modification	Supervisory function for the expanded four bays and 20 kV capacitor bank shall be additionally included. a) Communication hardware The existing network shall be expanded to connect new BCUs, protection relays and necessary communication equipment such as I/O modules HUB, network cables, connecters, etc. b) Software The supervisory software shall be modified to accommodate the new four bays and 20 kV capacitor bank.	
	2) Remarks	Easy accommodation of future 63 kV four bays shall be considered.	
26	Transformer Protection Relay Panel		2 Sets
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relay with differential and over current base function	
	3) Configuration	Duplex, two sets of one independent protection panel per one transformer	
	4) Digital relay communication	IEC 61850 for micro SCADA communication	
	5) Transformers to be protected	- No. 3 230/63 kV transformer - No. 2 63/20 kV transformer	

No.	Item / Equipment	Specifications	Quantity
27	Transmission Line Protection Relay Panel		2 Sets
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection) and over current base function	
	3) Auto reclosing	Single phase rapid auto reclosing and three phase auto reclosing shall be equipped. Communication through optic fiber (OPGW) with Nagad S/S shall be prepared.	
	4) Configuration	Single, one protection panel per one transmission line	
	5) Digital relay communication	IEC 61850 for micro SCADA communication	
	6) Transmission lines to be protected	- No. 1 transmission line to Nagad S/S - No. 2 transmission line to Nagad S/S	
28	230 kV Bus Protection Panels modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Bus bar differential protection with breaker failure protection (Siprotec 7SS52, Siemens is under use)	
	3) Configuration	Duplex, two sets of one independent protection panel	
	4) Modification	Modification for additional 230/63 kV transformer feeder - Additional bay units and necessary equipment - Panel inside wiring - Central unit modification - Necessary connection with the bay control and protection relay panels	
29	63 kV Bus Protection Panel modification		I Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Bus bar differential protection with breaker failure protection (Siprotec 7SS52, Siemens is under use)	
	3) Configuration	Single	
	4) Modification with additional panel installation	In order to accommodate additional four 63 kV feeders for the bus protection panel, additional one panel shall be installed beside the existing panel. - Additional bay units and necessary equipment - Panel inside wiring - Central unit modification - Necessary connection with the bay control and protection relay panels	
	5) Remarks	Four feeders in future shall be considered in the design of new additional panel.	
30	D.C. Distribution Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification	Additional D.C. control power supply for new facilities of additional bays -MCCBs, terminal blocks, wiring, name plates, etc.	
31	A.C. Distribution Panel modification		1 Lot
	1) Type	Indoor, self-stand and front side operation panel	
	2) Modification	Additional A.C. power supply for new facilities of additional bays and buildings -MCCBs, terminal blocks, wiring, name plates, etc.	

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No.	Item / Equipment	Specifications	Quantity
32	Communication Facilities		1 Lot
	1) General	Additional communication network shall be installed through fiber optical cable (OPGW) between PK12 S/S, Nagad S/S and Boulaous P/S. Voice and data communication including protection relay signal shall be secured among said stations.	
	2) Modification	Necessary equipment for Communication panels (Rack-1 & 2) to accommodate additional network shall be equipped.	
	3) Fiber optical cable	Lose tube fiber optic cable, dry core, armored and double sheath (IEC 60794-3-10) - Number of fibers: 24 - Place to be used: From the gantry of Nagad transmission line to communication room in the control building (approx. 200 m) - Necessary accessories for connection of cables	
	4) Fiber optical cable connection box	Boxes for connection between optical fibers (OPGW, fiber optical cable)	
33	Others		1 Lot
	1) Low voltage cables	- Power cables XLPE insulated - Control cables PVC insulated shield type	
	2) Grounding materials	- Copper conductors and PVC insulated cables 70sq. mm and 120sq. mm -Earthing rod 1.5 m length -Connectors	
	4) Lighting and sockets system	-Lighting fixtures and accessories -Switches, sockets and accessories	
	4) Cabling materials	-Conduits, junction boxes and fittings -Cable trays -Cable hangers	

Table 2 Expantion of Boulaos P/S (63 kV S/S)

No.	Item / Equipment	Specifications	Quantity
1	63 kV Circuit Breaker		1 Set
	1) Type	Indoor, SF6 gas insulated	
	2) Rated voltage	63 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	1,250 A	
	7) Rated short-circuit breaking current	20 kA or above	
	8) Rated duration of short circuit	3 s	
	9) Remarks	The existing old circuit breaker will be replaced with the breaker specified above.	
2	Combined Instrument transformer		3 Sets
	1) Type	Indoor	
	2) Highest voltage	72.5 kV	
	3) Rated lightning impulse withstand voltage	325 kV	
	4) Frequency	50 Hz	
	5) Thermal short time current	20 kA (1 s)	
	6) Voltage transformer	- Rated primary voltage: $63/\sqrt{3}$ kV - Rated secondary voltage: $100/\sqrt{3}$kV - Number of cores: 2 - Rated output: 50 VA - Accuracy: 0.5 and 3P	
	7) Current transformer	- Rated primary current: 400 - 800 A - Rated secondary current: 1 A - Number of cores: 3 (one for measuring and two for protection) - Rated output: 30 VA - Accuracy: 0.5 and 10P30	
	8) Remarks	The existing old instrument transformers will be replaced with the ones specified above.	
3	63 kV Lightning Arrestor		3 Sets
	1) Type	Metal oxide type	
	2) Rated voltage	60 kV	
	3) Discharge current	10 kA	
	4) Accessory	Discharge current monitor with counter for each arrestor	
4	63 kV Switchgear connecting materials		1 Lot
	1) Conductors	Al 80mm*5mm or greater plates for branch buses	
	2) Connecting materials	Terminals, connectors, etc.	
	3) Post insulators	Creepage distance: 31 mm/kV or above: 3 sets	
	4) Steel supports	For instrument transformers, LA, post insulators and disconnecting switch operating mechanism	
	5) Marshaling kiosk	Metal enclosed panel	
5	D.C distribution panel modification		1 Lot
	1) Type	Indoor, self-stand front door panel	
	2) Modification	Additional control power supply for the new transmission line bay facilities	
	3) Equipment to be mounted	Molded case circuit breaker, terminal block and wiring	

No.	Item / Equipment	Specifications	Quantity
6	Bay Control Panel		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Bays to be controlled	63 kV transmission line to Nagad S/S	
	3) Main equipment to be mounted	Bay Control Unit (BCU), control switches with indicator, selector switch, annunciation windows, meters (P, Q, V & I), energy meter, etc.	
	4) Remarks	The configuration and man-machine interface shall be same as the existing Palmeraie transmission line control panels.	
7	Transmission Line Protection Relay Panel		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection), current differential and over current base function Communication through optic fiber (OPGW) with Nagad S/S shall be prepared.	
	3) Configuration	Single, one protection panel per one transmission line	
	4) Transmission line to be protected	Transmission line to Nagad S/S (Cable Line)	
8	Mimic Control Panel modification		1 Lot
	1) Type	Indoor, mosaic block self-stand type	
	2) Modification	Supervisory function in the plant control room for new transmission line shall be achieved.	
	3) Main equipment to be mounted	Control switches, meters(I, V), annunciation windows, etc.	
9	Communication Facilities		1 Lot
	1) General	Additional communication network shall be installed through fiber optical cable (OPGW) between PK12 S/S, Nagad S/S and Boulaous P/S. Voice and data communication including protection relay signal shall be secured among said stations.	
	2) Modification	Necessary equipment for Communication panel (SDH (Synchronous Digital Hierarchy) cabinet) to accommodate additional network sball be equipped.	
	3) Fiber optical cable	Lose tube fiber optic cable, dry core, armored and double sheath (IEC 60794-3-10) - Number of fibers: 24 - Place to be used: From the relay room of 63 kV SWGR building to the relay room adjacent to control room in the building (approx. 130 m) - Necessary accessories for connection of cables	
	4) Fiber optical cable connection box	Boxes for connection between optical fibers	
10	Others		1 Lot
	1) Low voltage cables	- Power cables XLPE insulated - Control cables PVC insulated shield type	
	2) Grounding materials	- PVC insulated cables - Connectors	
	3) Cabling materials	- Conduits, junction boxes and fittings - Cable trays - Cable hangers	

Table 3 Construction of Nagad S/S

No.	Item / Equipment	Specifications	Quantity
1	63 kV Circuit Breaker		6 Sets
	1) Type	Indoor, SF6 gas insulated	
	2) Rated voltage	63 kV	
	3) Rated lightning impulse withstand voltage	325 kV or above	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	1,200 A or above: 5 sets 2,000 A or above: 1 set (Bus coupler)	
	7) Rated short-circuit breaking current	16 kA or above	
	8) Rated duration of short circuit	1 s	
	9) Rated operating sequence	O - 0.3 s - CO - 1 min. – CO (2 sets) Single phase rapid auto reclosing function shall be required for two transmission lines only. O - 1 min. - CO - 3 min. – CO (4 sets)	
2	63 kV Disconnecting Switch		12 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72 kV or above	
	3) Rated lightning impulse withstand voltage	325 kV or above	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A or above	
	7) Rated short-time withstand current	16 kA or above	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For bus connection	
3	63 kV Disconnecting Switch with Earth Switch		5 Sets
	1) Type	Indoor, motor operation type	
	2) Rated voltage	72 kV or above	
	3) Rated lightning impulse withstand voltage	325 kV or above	
	4) Number of phase	3	
	5) Frequency	50Hz	
	6) Rated current	800 A or above	
	7) Rated short-time withstand current	16 kA or above	
	8) Rated duration of short circuit	1 s	
	9) Accessory	Operating box	
	10) Remarks	For line feeder connection	
4	63 kV Current Transformer		18 Sets
	1) Type	Indoor	
	2) Highest Voltage	72 kV or above	
	3) Rated lightning impulse withstand voltage	325 kV or above	
	4) Rated primary current	400-800 A: for feeder 1,000-2,000 A: for bus coupler	
	5) Rated secondary current	1 A	
	6) Thermal short time current	16 kA or above (1 s)	
	7) Number of cores	4 (one for measuring and three for protection)	
	8) Rated output	30 VA	
	9) Accuracy	0.5 and 10P30	
	10) Remarks	Current transformers mounted in the busing pockets of circuit breaker can be acceptable instead of the independent installation type specified above.	

No.	Item / Equipment	Specifications	Quantity
5	63 kV Voltage Transformer 1) Type 2) Highest Voltage 3) Rated lightning impulse withstand voltage 4) Rated primary voltage 5) Rated secondary voltage 6) Number of cores 7) Rated output 8) Accuracy 9) Remarks	 Indoor, Capacitor type 72 kV or above 325 kV or above 63/√3 kV 100/√3 V 2 100 VA 0.5 and 3P For bus and line feeder	21 Sets
6	63 kV Lightning Arrestor 1) Type 2) Rated voltage 3) Discharge current 4) Accessory	 Metal oxide type 60 kV 10 kA Discharge current monitor with counter for each arrestor	21 Sets
7	63 kV Switchgear connecting materials 1) Conductors 2) Connecting materials 3) Post insulators 4) Steel supports 5) Marshaling kiosk	 Aluminum conductor plates for main and branch buses, Continuous current - 2,000 A or above (main bus & bus coupler) - 800 A or above (feeder) Configuration of the main bus bar shall be double and their length shall be sufficient for eight bays. Terminals, connectors, etc. Creepage distance: 31 mm/kV or above For LA, DS, cable, post insulators, etc. Metal enclosed panel for each bay	1 Lot
8	63 kV Power cable 1) Type 2) Highest voltage 3) Nominal conductor cross section 4) Place to be used 5) Cable sealing end	 Single core aluminum conductor, XLPE insulated, armored and PVC or PE outer sheath 72 kV or above 800 sq. mm - From 63 kV SWGR to the gantry for two Nagad S/S transmission lines (approx. 450 m) With necessary accessories: 12 sets	1 Lot
9	Dead end gantry 1) Type 2) Size 3) Remarks	 Galvanized steel structure, for two transmission lines Width: 14 m (2*7 m span) Overall Height: 10.5 m from foundation Horizontal beam height: 8 m from foundation For 2 circuits 63 kV transmission lines to PK12 S/S	1 Set
10	20kV Switchgear cubicle 1) Type 2) Rated voltage 3) Rated current 4) Primary circuit protection 5) Rated short-time withstand current 6) Load break switch 7) VT 8) Meter 9) Lightning arrestor 10) Purpose	 Indoor cubicle 24 kV 600 A or above Power fuse: 10 A, 12.5 kA or above 12.5kA or above (1 sec.) 600 A or above 3 phase -Primary voltage: 63/√3 kV -Secondary voltage: 100/√3 V Voltage indication of each phase 24 kV, 10kA Incoming from distribution line Outgoing to Auxiliary transformer for station service	1 Set

No.	Item / Equipment	Specifications	Quantity
11	20 kV Power cable		1 Lot
	1) Type	Single core copper conductor, XLPE insulated, armored and PVC or PE outer sheath	
	2) Highest voltage	24 kV	
	3) Nominal conductor cross section	70 sq. mm	
	4) Place to be used	- From 20 kV distribution line dead end pole vicinity of the switching station outside to 20 kV switchgear cubicle in the control building (approx. 200 m) - From 20 kV switchgear cubicle to Auxiliary Transformer (approx. 30 m)	
	5) Cable sealing end	With necessary accessories: 12 sets	
12	20kV Auxiliary Transformer Cubicle		1 Set
	1) Type	Indoor cubicle	
	2) Transformer	-Dry type -Insulation class: F or H -Cooling: AN -phase: 3 -Capacity: 250 kVA (tentative) -Primary voltage:20 kV +5% to -5% tap, 2.5% step -secondary voltage: 3 phase 4 wires, 400-230 V -Winding connection primary: delta, secondary: star (neutral lead out)	
13	Low voltage Distribution Panel		1 Panel
	1) Type	Indoor type	
	2) Voltage	3 phase 4 wires, 380/220V	
	3) Power circuit protection	Molded case circuit breakers	
	4) Meters to be mounted	V, I and energy(Wh)	
14	Battery (125 V and 48 V)		1 Set each
	1) Type	Lead acid, seal type	
	2) Voltage	125V and 48 V	
	3) Number of cell	- 60 cells for 125V - 23cells for 48V	
	4) Capacity (tentative)	- 600 AH/10 h for 125V - 200 AH/10 h for 48V	
15	Battery Charger (125 V and 48 V)		2 Sets each
	1) Type	Indoor, thirstier type	
	2) Charger rating (tentative)	- D.C.125 V (133.8V max.) 70A - D.C.48 V (51.3 V max.) 30A	
	3) Meters to be mounted	- A.C. input: V and I - D.C. output: V and I	
16	D.C. Distribution Panel		1 Panel
	1) Type	Indoor type	
	2) Voltage	D.C. 125 V	
	3) Power circuit protection	Molded case circuit breakers	
17	Bay Control Panels		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Bays to be controlled	- 63 kV transmission line: five - 63 kV bus coupler: one Future consideration for space - 63 kV transmission line: one - 63/20 kV transformer: one	
	3) Main equipment to be mounted	Bay Control Unit (BCU), control switches with indicator, selector switch, mimic bus, energy meter, etc.	
	4) BCU	IEC 61850 interface for micro SCADA communication	

No.	Item / Equipment	Specifications	Quantity
18	Micro SCADA system		1 Set
	1) Type	Microprocessor base station server type supervisory and data acquisition system	
	2) Main component	-Server computer: one -Operator workstation with display, keyboard and mouse: one -Maintenance workstation: one -Printer: two -UPS: one -Time server with GPS antenna: one -I/O module -Gateway for interface to National Grid Control Center -Communication facilities (HUB, cables, etc.) -Accessories -Software for supervisory function (Operating System and applications)	
	2) Main function	a)Monitoring -Status of CB, LS and ES -Indication of P, Q, V and I for each bus and feeder -Transformer tap position (future), etc. b)Control -Operation of CB, LS and ES c)Annunciation -Protection relay activation and CB trip -Abnormal of primary equipment -Abnormal of secondary equipment -Abnormal of common facilities, etc. d)Trend indication e)Data Logging -Hourly, daily, monthly log creation	
	3) Remarks	Future expansion of two 63 kV bays, one distribution transformer and 20kV Switchgear shall be considered in design for easy modification of system.	
19	Transmission Line Protection Relay Panel(1)		1 Sets
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection) and over current base function	
	3) Auto reclosing	Single phase rapid auto reclosing and three phase auto reclosing shall be equipped. Communication through optic fiber (OPGW) with PK12 S/S shall be prepared.	
	4) Digital relay communication	IEC 61850 interface for micro SCADA communication	
	5) Transmission lines to be protected	- No. 1 transmission line to PK12 S/S - No. 2 transmission line to PK12 S/S	
20	Transmission Line Protection Relay Panel(2)		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection) , current differential and over current base function Communication through optic fiber (OPGW) with Boulaos P/S shall be prepared.	
	3) Digital relay communication	IEC 61850 interface for micro SCADA communication	
	4) Transmission line to be protected	Transmission line to Boulaos P/S (Cable Line)	

No.	Item / Equipment	Specifications	Quantity
21	Transmission Line Protection Relay Panel(3)		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Digital relays with distance (impedance detection) and over current base function	
	3) Digital relay communication	IEC 61850 interface for micro SCADA communication	
	4) Transmission line to be protected	- No.1 Transmission line to Railway S/S - No.2 Transmission line to Railway S/S	
22	63 kV Bus Protection Panel		1 Set
	1) Type	Indoor, self-stand and front side operation panel	
	2) Protection	Bus bar differential protection with breaker failure protection	
	3) Digital relay communication	IEC 61850 interface for micro SCADA communication	
	4) Remarks	Two feeders in future shall be considered in the design.	
23	Communication Facilities		1 Lot
	1) General	Additional communication network shall be installed through fiber optical cable (OPGW) between PK12 S/S, Nagad S/S and Boulaous P/S. Voice and data communication including protection relay signal shall be secured among said stations.	
	2) Communication panel	SDH cabinet with communication equipment and necessary accessories	
	3) Telephone	Two telephone sets for voice communication among substations	
	4) Fiber optical cable	Lose tube fiber optic cable, dry core, armored and double sheath (IEC 60794-3-10) - Number of fibers: 24 - Place to be used: From the gantry of PK12 transmission line to communication room in the control building (approx. 120 m) and from the Boulaos P/S transmission line bay of 63 kV SWGR building to communication room in the control building (approx. 60 m) - Necessary accessories for connection of cables	
	5) Fiber optical cable connection box	Boxes for connection between optical fibers (OPGW, fiber optical cable)	
	Others		1 Lot
	1) Low voltage cables	- Power cables XLPE insulated - Control cables PVC insulated shield type	
	2) Grounding materials	- Copper conductors and PVC insulated cables -Earthing rod 1.5 m length -Connectors	
	3) Lighting and sockets system	-Lighting fixtures and accessories -Switches, sockets and accessories	
	4) Cabling materials	-Conduits, junction boxes and fittings -Cable trays -Cable hangers	

Table 4 Construction of 63kV transmission line

No.	Item / Materials	Specifications	Quantity
1	Type of support	Self-Supporting, ,lattice type steel towers with body and leg extensions	1 lot
2	Type and size of conductor	AAAC ASTER 366	1 lot
3	Type of optical fiber composite overhead ground wire (OPGW)	Stainless steel tube embedded in extruded aluminum	1 lot
	Section area of optical fiber composite overhead ground wire (OPGW)	100 mm^2	
	a) Mode	Dual Window Single Mode Fiber (ITU-T G.652)	
	b) Wavelength (nm)	1550	
	c) Number of optical fibers	48	
4	Type and number of suspension insulator	Disc type (aprox. 250mm), 6 pieces per unit	1 lot

Table 5 Construction of 63kV Underground line

No.	Item / Materials	Specifications	Quantity
1	Type	Single core cable with armored directly buried under the ground	1 lot
2	Conductor and insulation	Aluminum conductor and XLPE insulation	
3	Size of cable	800mm^2	

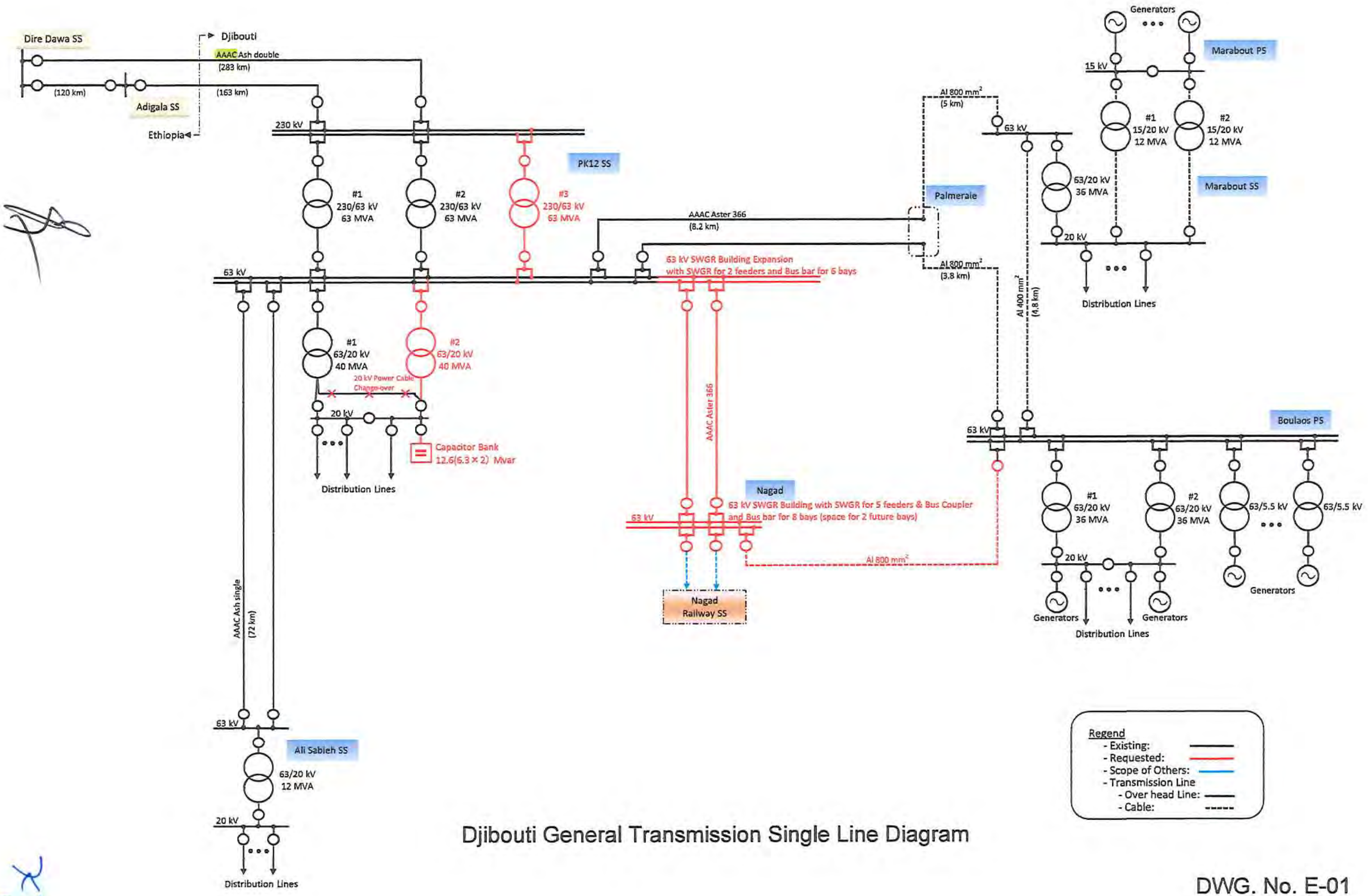
Table 6 Construction of Nagad-Boulaos SS communication line

No.	Item / Materials	Specifications	Quantity
1	Type of fiber cable	Loose Tube Fiber Optic Cable – Dry Core – Armored – Double Sheath	1 lot
	a) Mode	Dual Window Single Mode Fiber (ITU-T G.652)	
	b) Wavelength (nm)	1550	
	c) Number of optical fibers	24	

DRAWING LIST

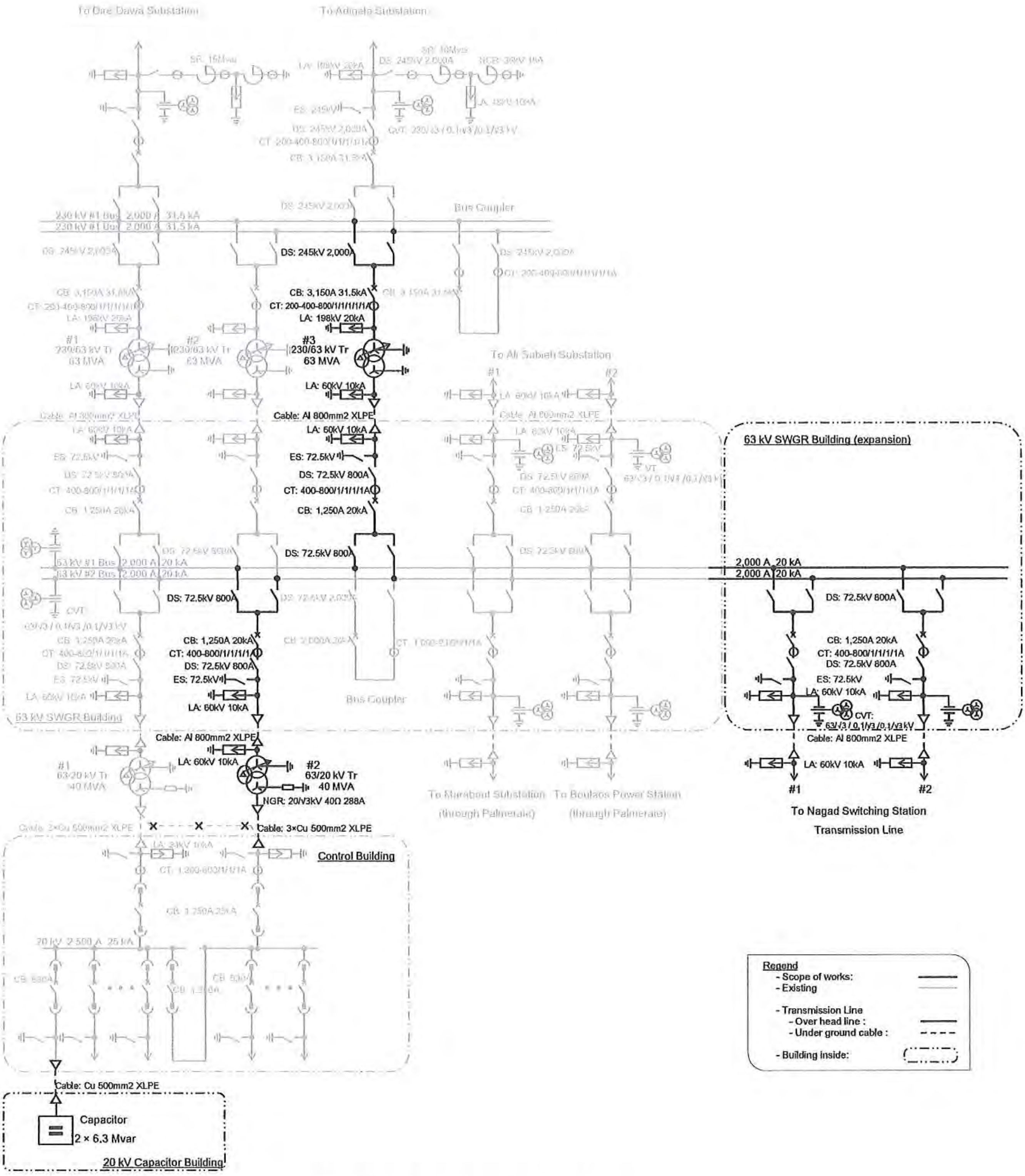
E-1	Djibouti General Transmission Single Line Diagram
E-2	PK12 Substation Single Line Diagram
E-3	PK12 Substation General Arrangement
E-4	Boulaos Power Station 63 kV Substation single Line Diagram
E-5	Boulaos Power Station 63 kV Substation Arrangement
E-6	Nagad Switching Station Single Line Diagram
E-7	Nagad Switching Station General Arrangement
T-1	63kV Self-Supporting lattice type steel towers with body and leg extensions (Tension Type)
T-2	63kV Self-Supporting lattice type steel towers with body and leg extensions (Suspension Type)
D-1	PK12 SITE PLAN
D-2	PK12 SWITCHGEAR BUILDING PROFILE
D-3	GROUND & FIRST FLOOR PLAN
D-4	ROOF PLAN, SECTION
D-5	ELEVATION, SECTION
D-6	PK12 CONDENSER BUILDING PROFILE
D-7	GROUND FL. & ROOF PLAN, ELEVARION, SECTION
D-8	NAGAD SITE PLAN
D-9	NAGAD SWITCHGEAR BUILDING PROFILE
D-10	GROUND & FIRST FLOOR PLAN
D-11	ROOF PLAN, SECTION
D-12	ELEVATION, SECTION
D-13	NAGAD CONTROL BUILDING PROFILE
D-14	GROUND & ROOF PLAN
D-15	ELEVATION, SECTION
D-16	NAGAD GUARD HOUSE PROFILE
D-17	GROUND FL. & ROOF PLAN, ELEVATION, SECTION

K7

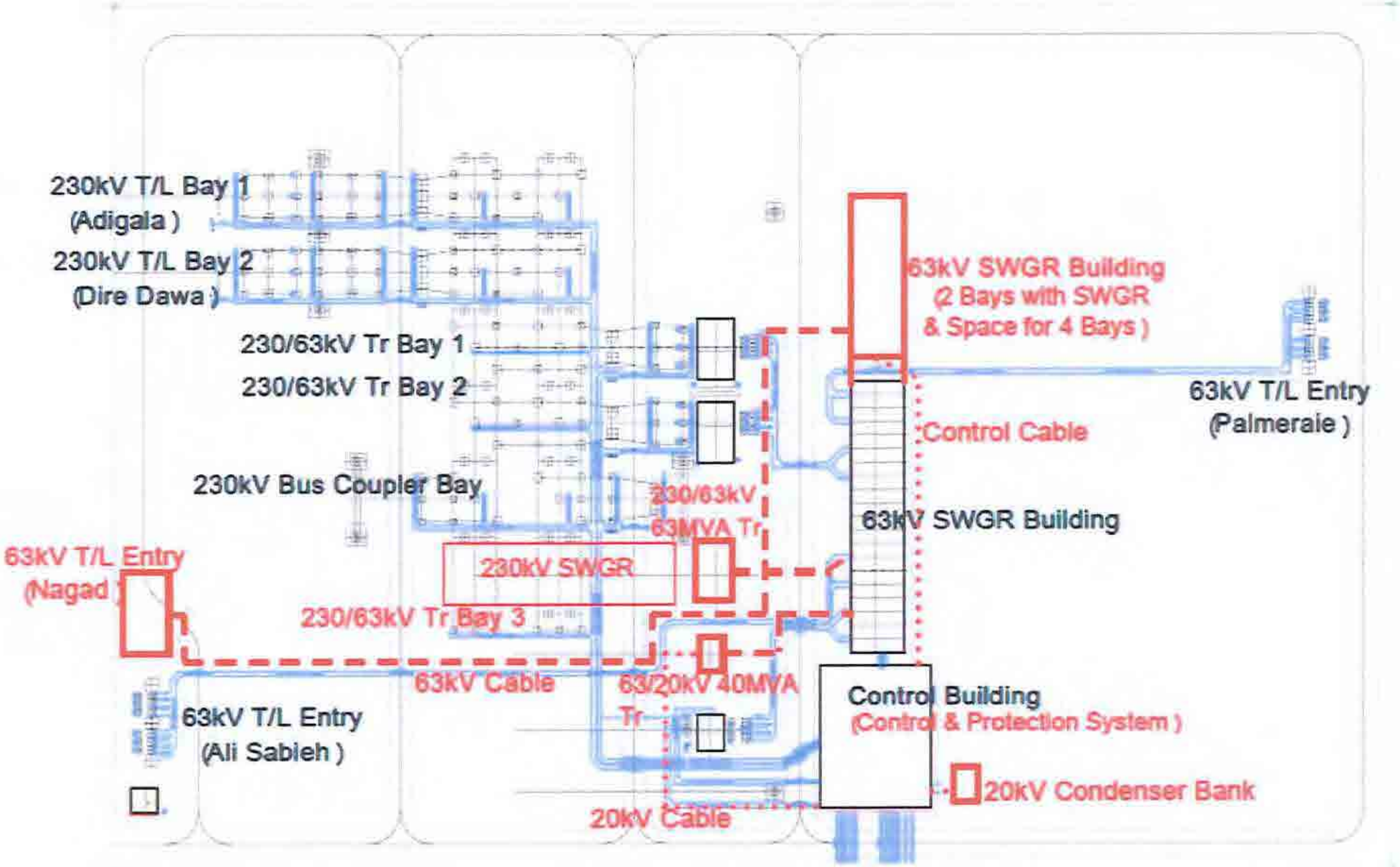


Djibouti General Transmission Single Line Diagram

DWG. No. E-01

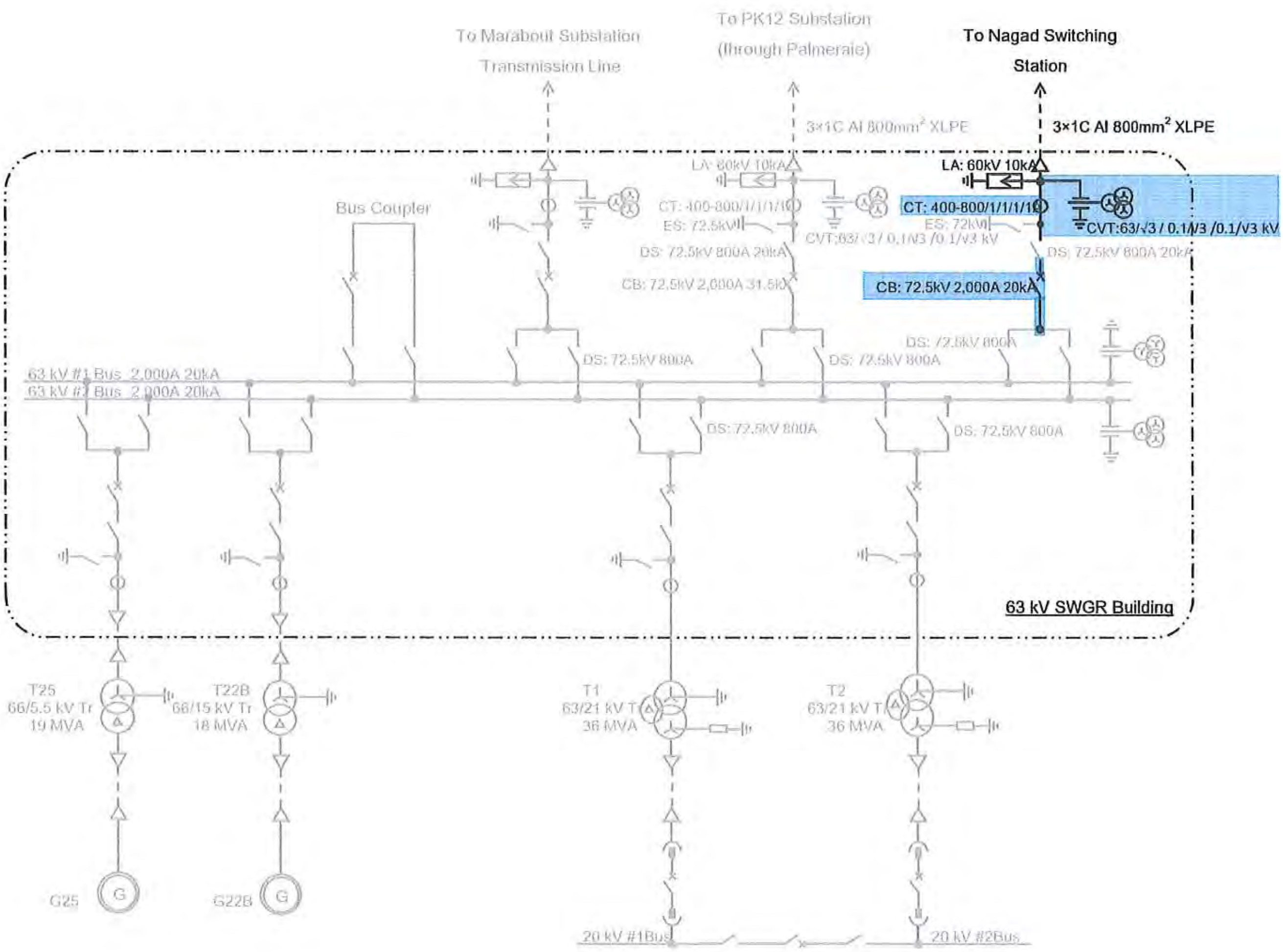


PK12 substation Single Line Diagram



PK12 Substation General Arrangement

DWG. No. E-03



Note;

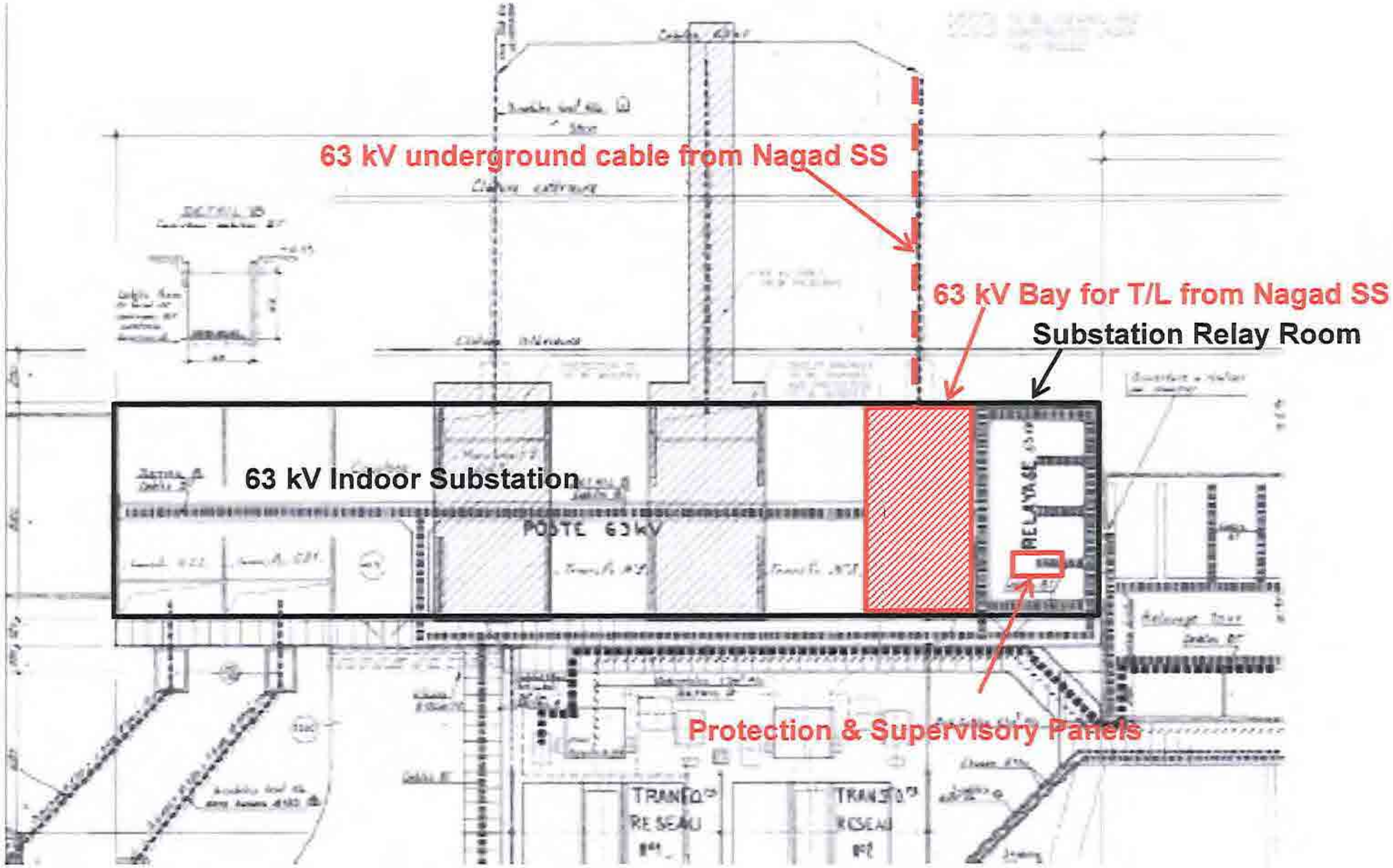
1. The equipment marked with 🟦 shall be replaced with new ones.
   CB: 72.5 kV, 2000 A, 31.5 kA
   VCT: 63/√3 / 0.1/√3 /0.1/√3 kV, 400-800/1/1/1 A
   Bus bars for new equipment connections: Al 80mm × 5mm or greater

Regend

- Scope of works: ——
- Existing: ——
- Transmission Line
  - Over head line : ——
  - Under ground cable : - - - -
- Building inside: (-··-··-)

Boulaos Power Station 63 kV Substation single Line Diagram

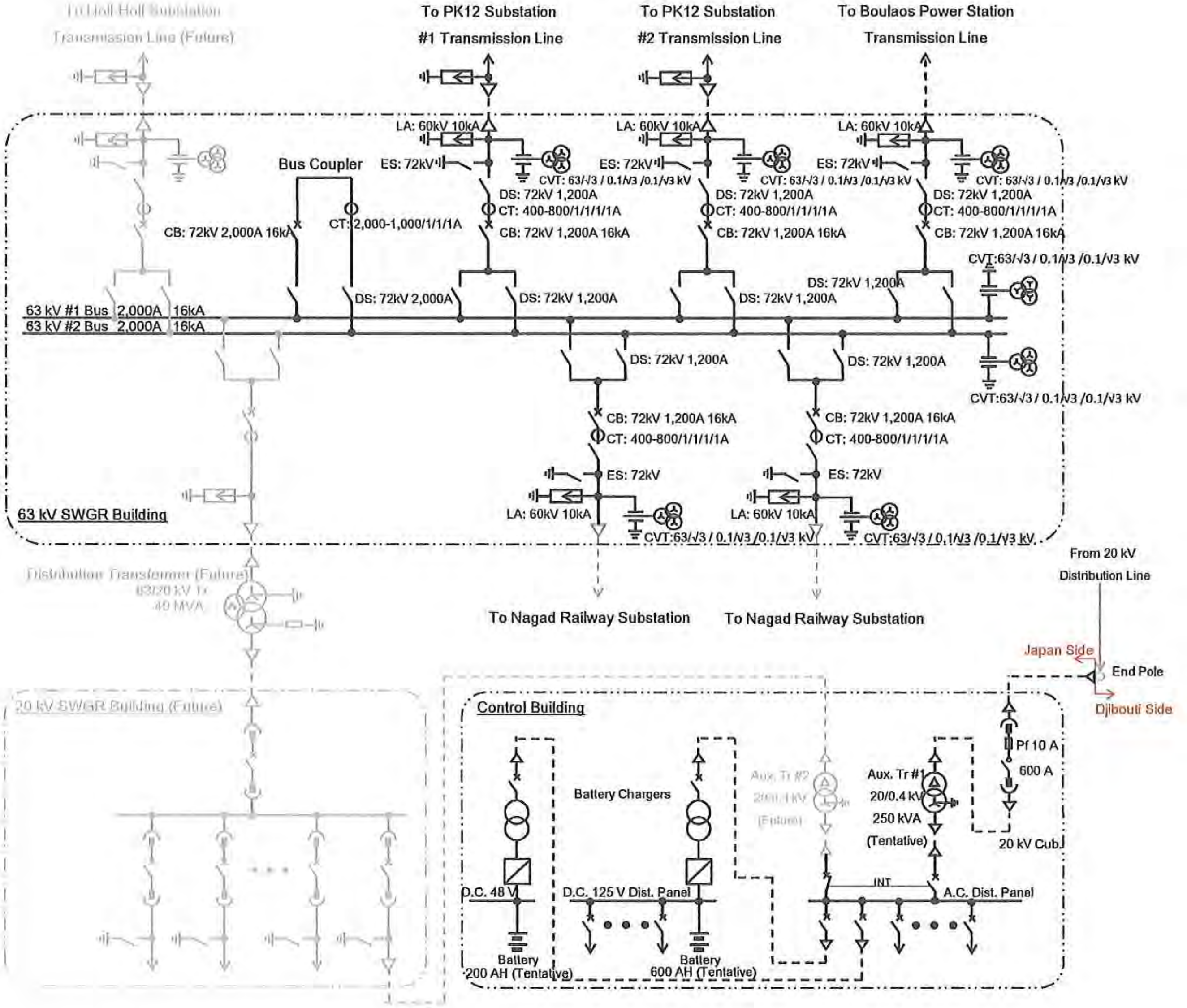
DWG. No. E-04



Boulous Power Station 63 kV Substation Arrangement

27

DWG. No. E-05



Note;

1. The house service power will be received from 20 kV EdD Distribution Line. The installation of end pole adjacent to the fence of Nagad Switching Station and the preparation of 20 kV distribution lines to the end pole will be conducted by Djibouti side.

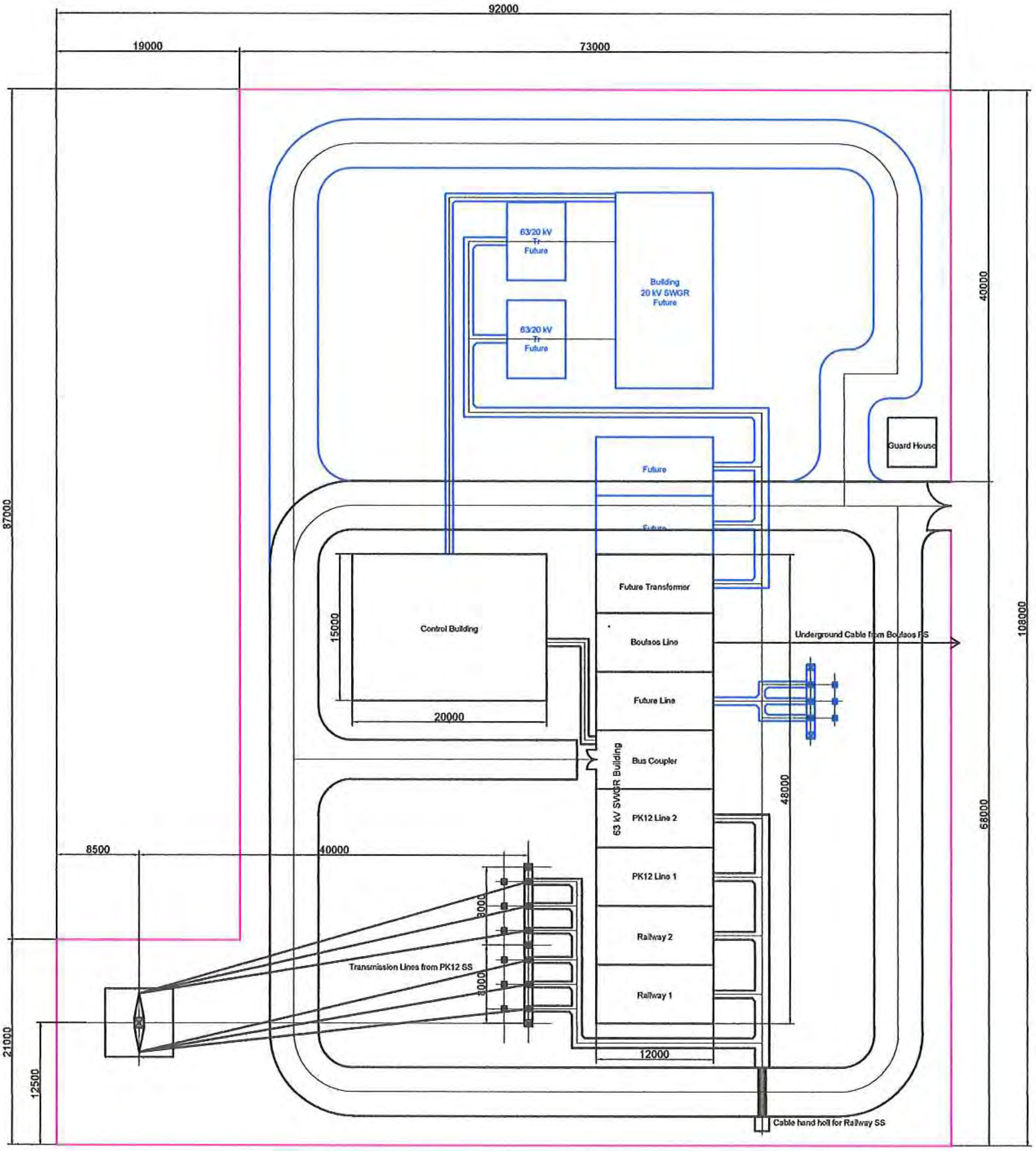
Regend

- Scope of works: ――
- Scope of Others (incl. future): ――
- Transmission Line
  - Over head line : ――
  - Under ground cable : - - - -
- Building inside: (-·-·-)

Nagad Switching Station Single Line Diagram

DWG. No. E-06

K7



: Fence

: Future Plan

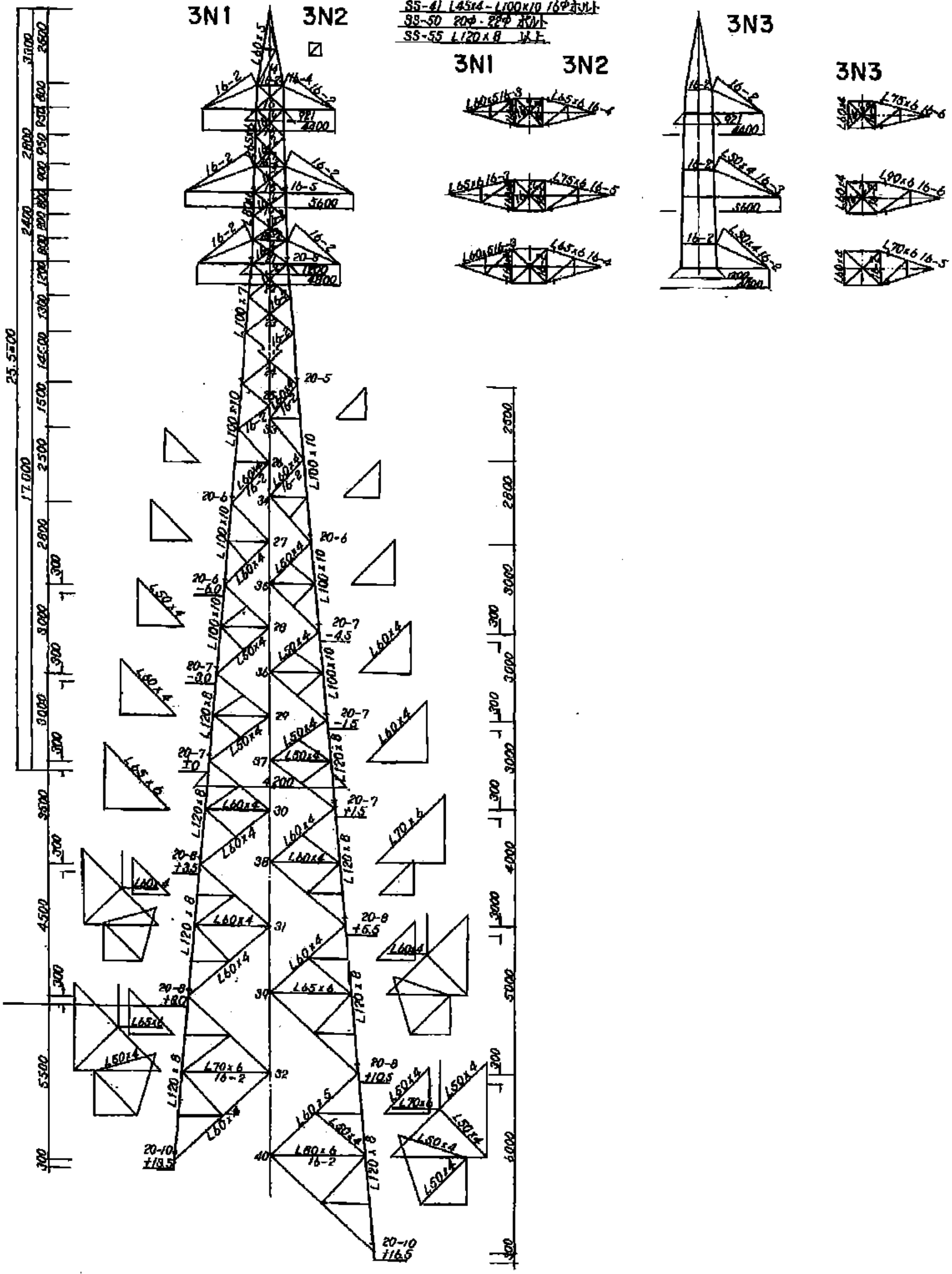
Nagad Switching Station General Arrangement

DWG. No. E-07

K7

3N1.3N2.3N3 型

注)
1.無記入鋼材 L45×4
2. 〃 ボルト 16-1
3.材質
SS-41 L45×4-L100×10 16φボルト
SS-50 20φ・22φ ボルト
SS-55 L120×8 以上



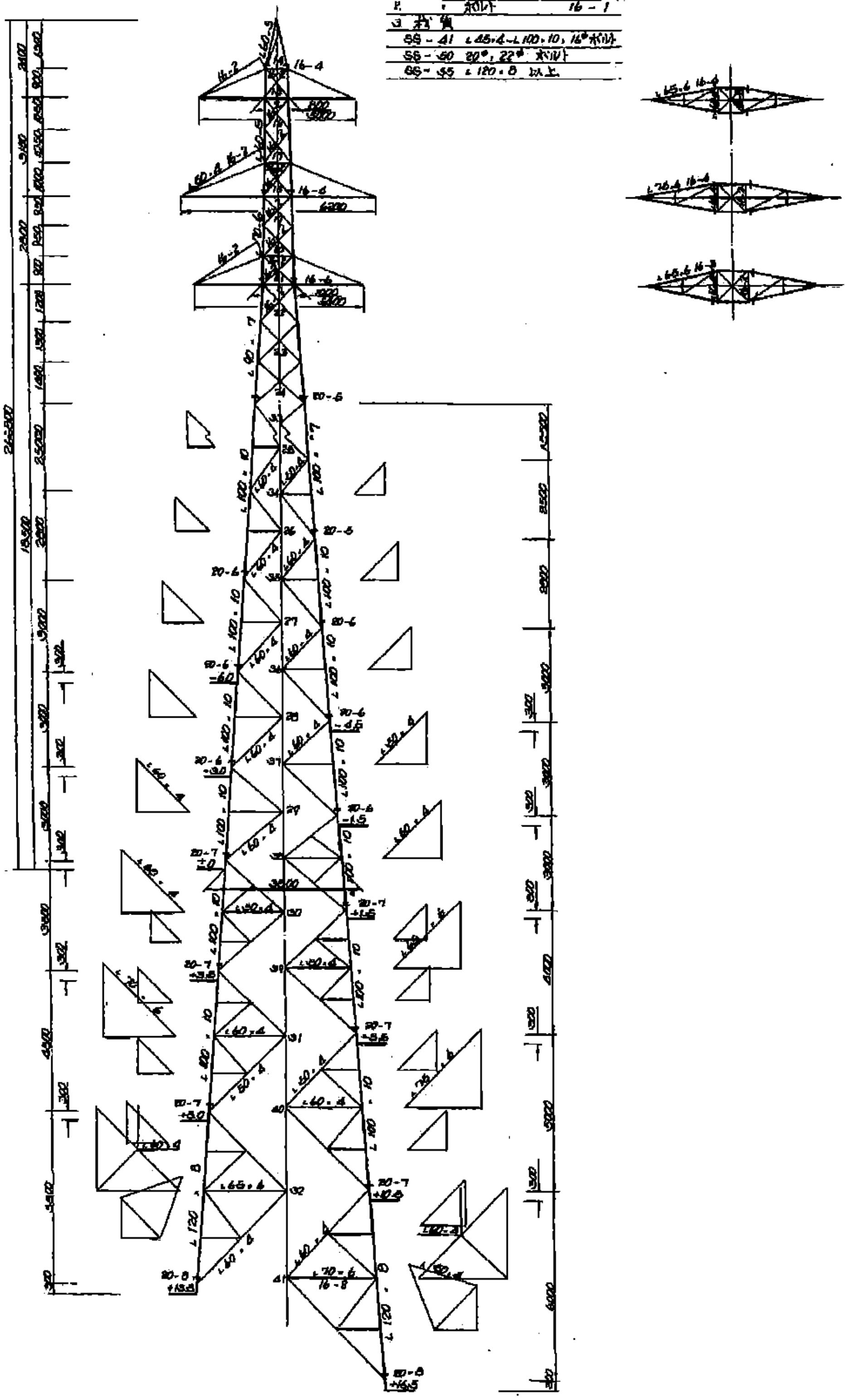
63kV Self-Supporting lattice type steel towers with body and leg extensions

(Tension Type)

DWG. No. T – 01

2C2 型

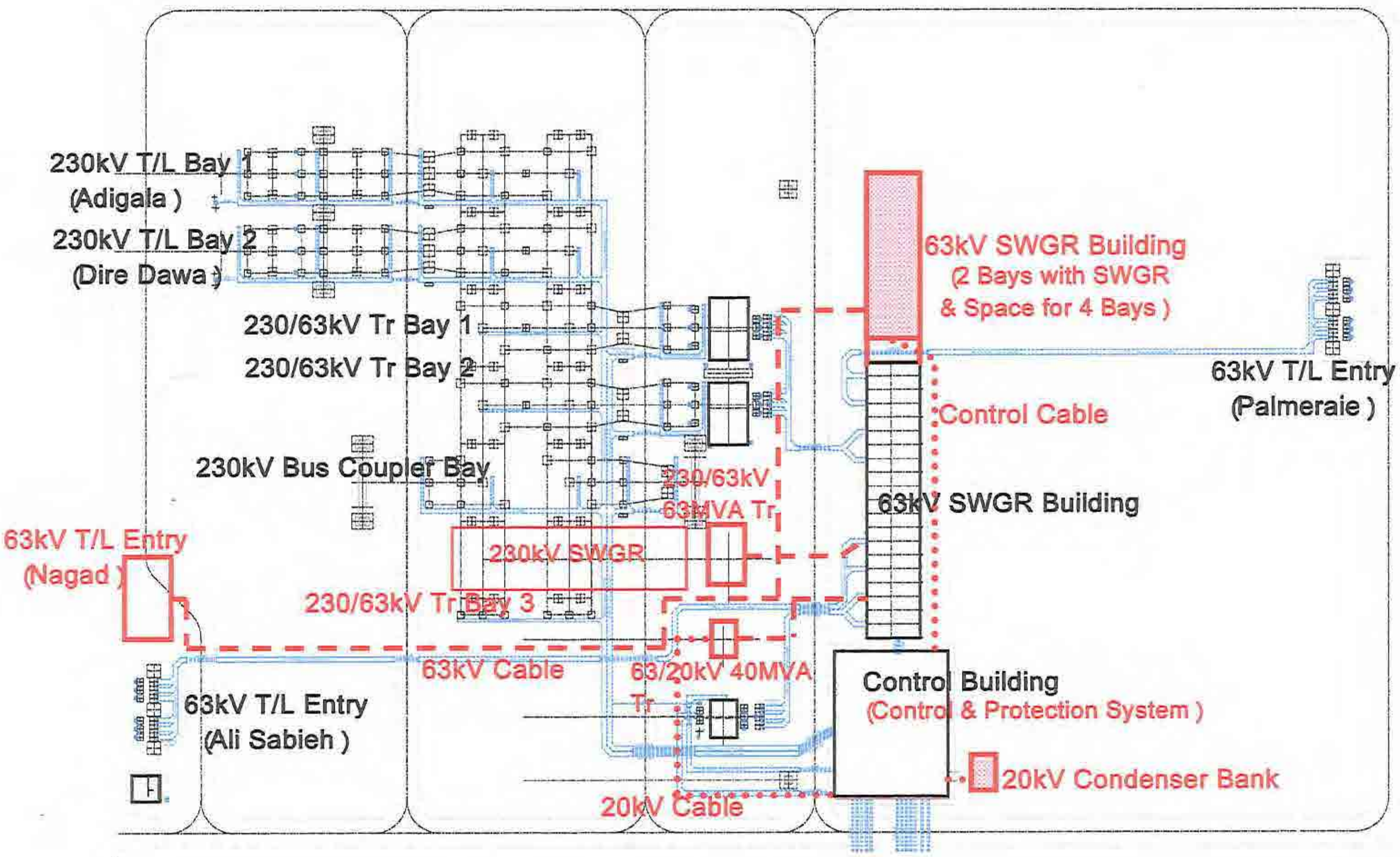
注)
1. 無記入部材 L45 × 4
2. 〃 ボルト 16 − 1
3. 材質
SS − 41 L45×4〜L100×10, 16φ ボルト
SS − 50 20φ, 22φ ボルト
SS − 55 L120×8 以上



63kV Self-Supporting lattice type steel towers with body and leg extensions

(Suspension Type)

DWG. No. T - 02



PK12 Substation Site Plan

DWG. No. D-01

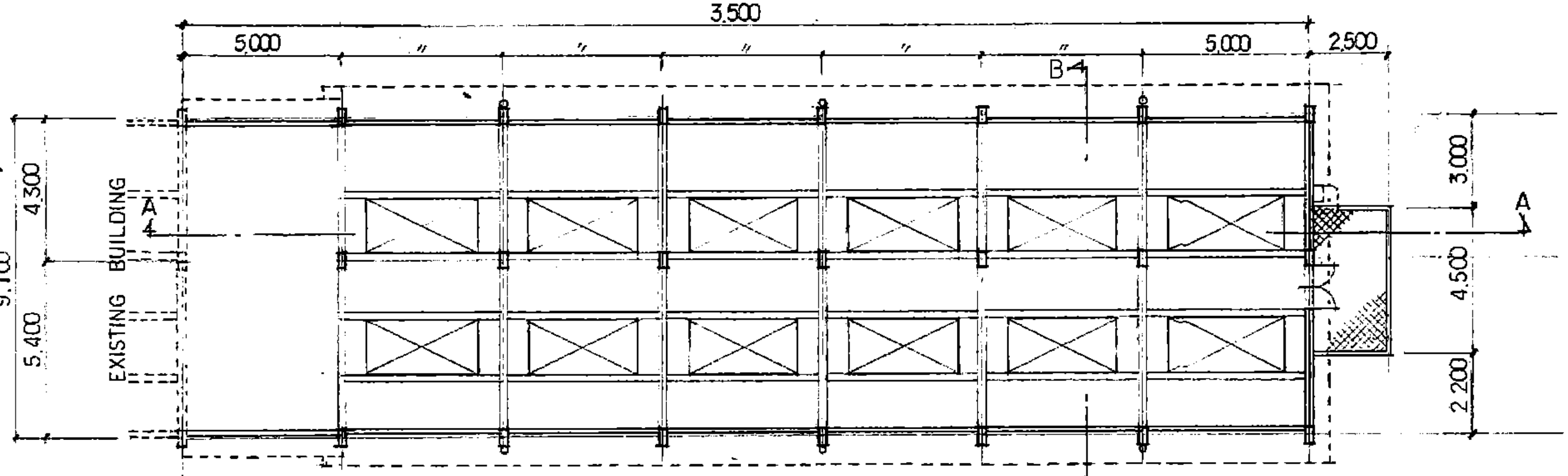
PK12 SWICTGEAR BUILDING PROFILE

1. STRUCTURE AND NUMBER OF STORY : REINFORCED CONCRETE STRUCTURE 2 STORY
2. FOUNDATION TYPE : SPREAD FOUNDATION
3. ALLOWABLE BEARING CAPACITY : 75 KN/m2
4. BUILDING FACILITY :

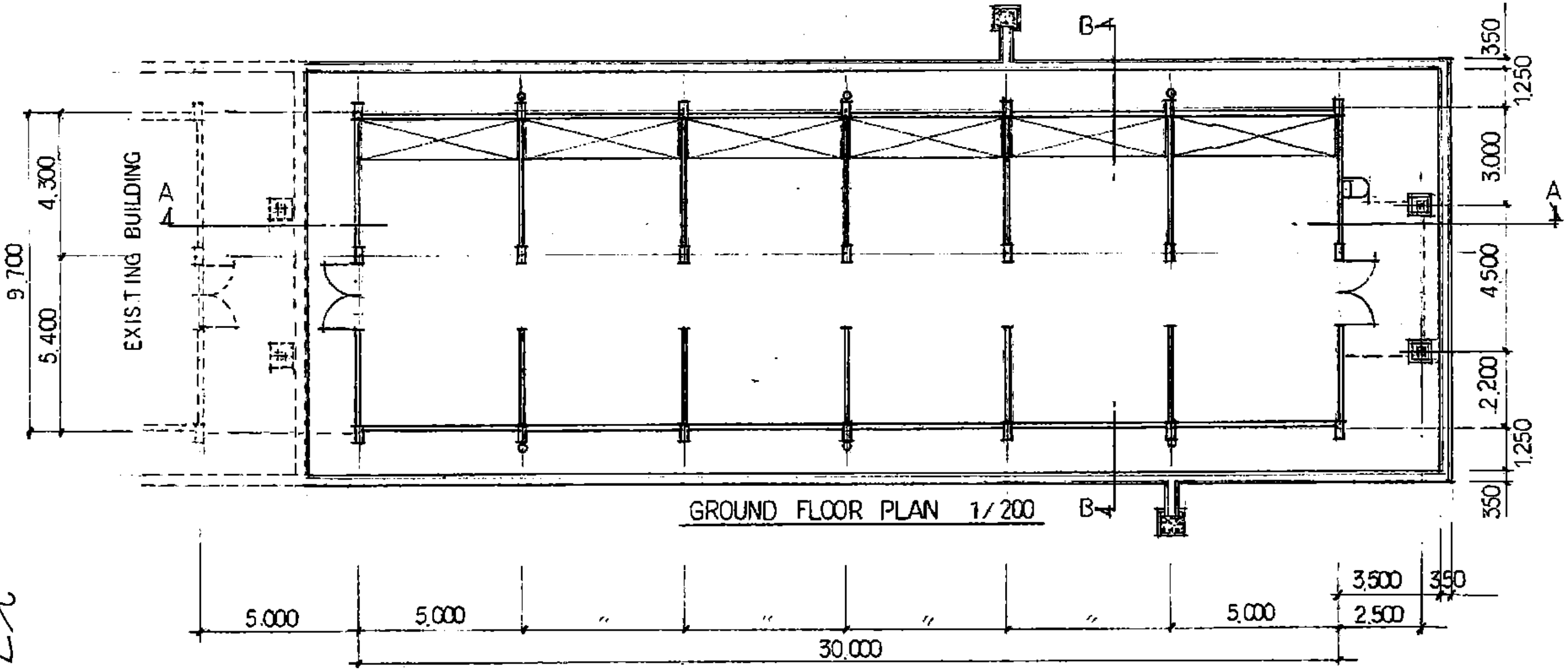
   ELECTRIC SERVICE : LIGHTING FIXTURE

   MECHANICAL SERVICE : ROOF DRAIN, DRAIGE DITCH

1. GENERAL	
BILDING AREA	339.50 m2
TOTAL FLOOR AREA	630.50 m2
FOUNDATION STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
UPPER GROUND STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
2. EXTERIOR FINISHING	
TOP ROOF	CONCRETE SLAB WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t-150 MORTAR TROWEL PAINTUNG FINISH (EP FOR EXTERNAL)
3. INTERIOR FINISHING	
ITEM (G AND 1ST.FLOOR)	FINISHING / SPECIFICATION
FLOOR WALL CEILING	CEMENT TROWELLING EP PAINTING FINISH ON MORTAR EP PAINTING FINISH

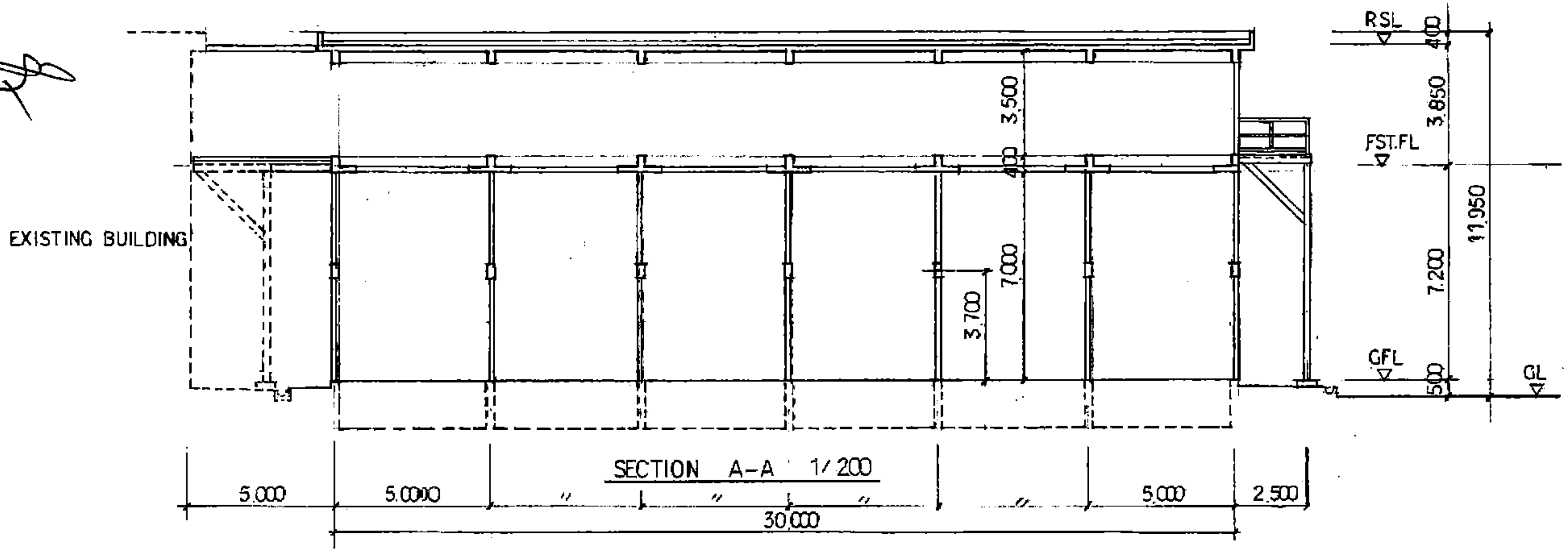


FIRST FLOOR PLAN 1/200

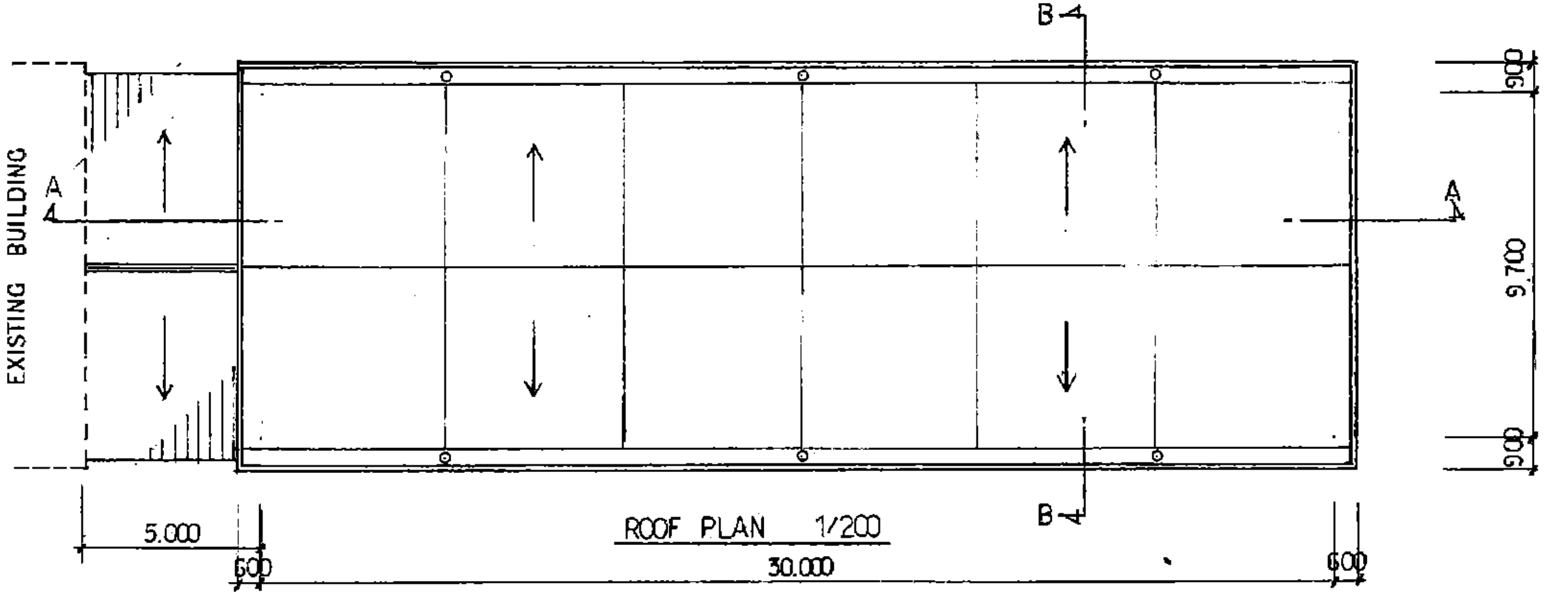


GROUND FLOOR PLAN 1/200

PK12 SWITCHGEAR BUILDING D-3



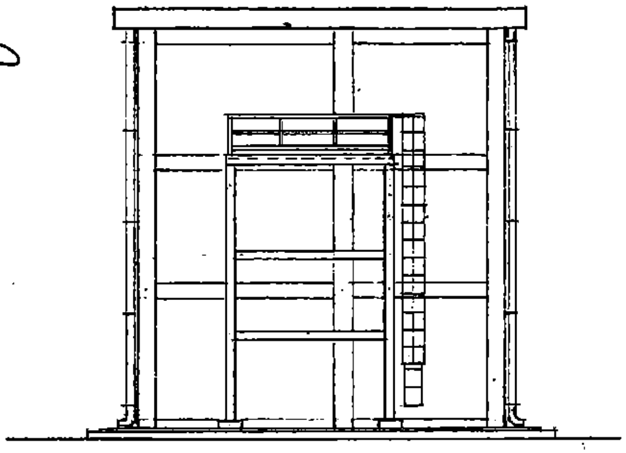
SECTION A-A 1/200



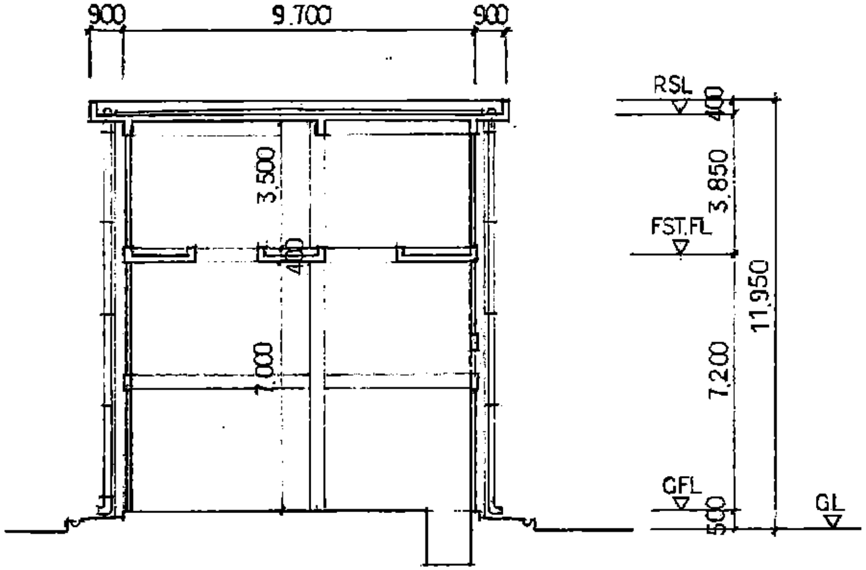
ROOF PLAN 1/200

PK12 SWITCHGEAR BUILDING

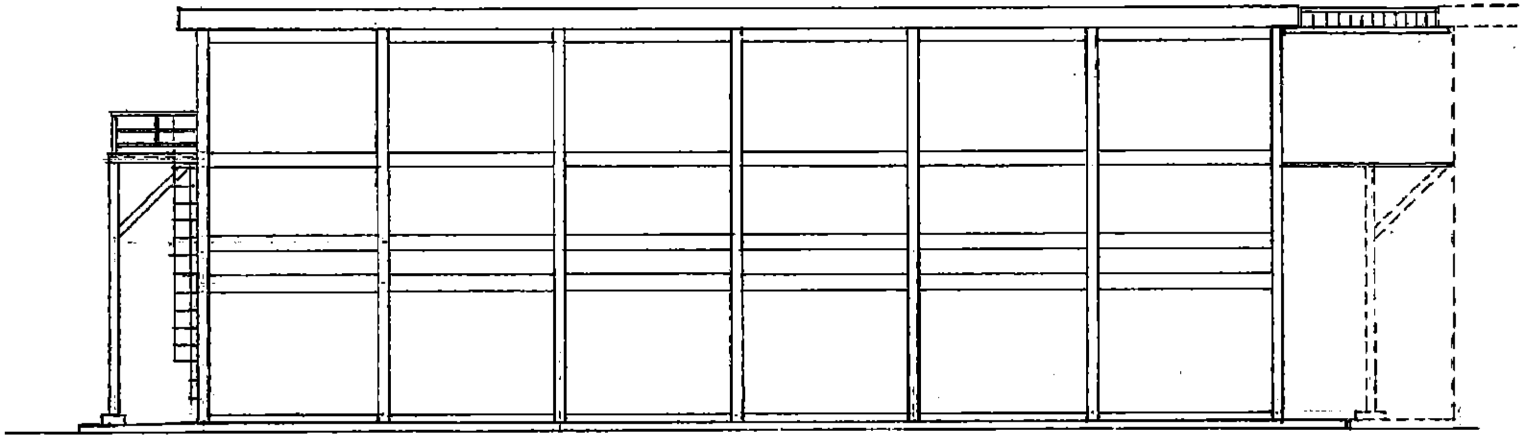
D-4



NORTHSIDE ELEVATION 1/200



SECTION B—B 1/200



WEST SIDE ELEVATION 1/200

PK12 SWITCHGEAR BUILDING D-5

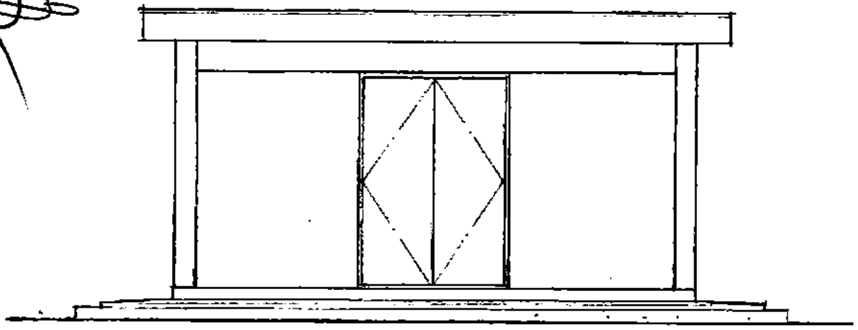
PK12 CONDENSER BUILDING PROFILE

1. STRUCTURE AND NUMBER OF STORY : REINFORCED CONCRETE STRUCTURE 1 STORY
2. FOUNDATION TYPE : SPREAD FOUNDATION
3. ALLOWABLE BEARING CAPACITY : 75 KN/m2
4. BUILDING FACILITY :

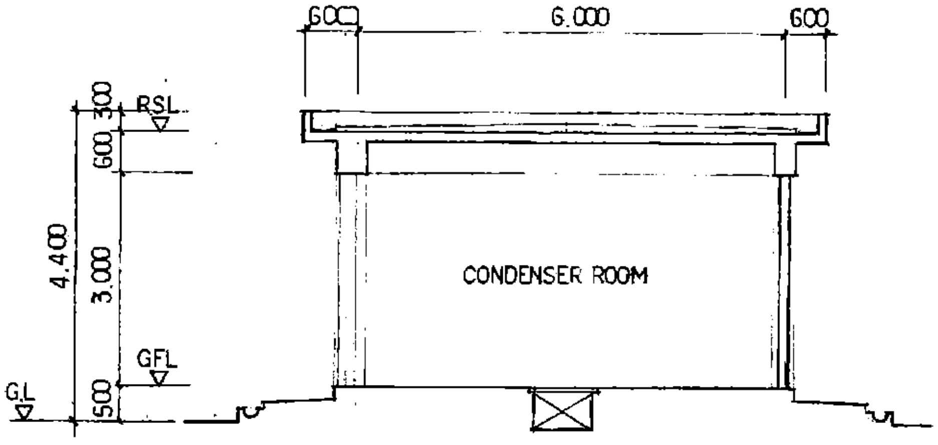
   ELECTRIC SERVICE : LIGHTING FIXTURE

   MECHANICAL SERVICE : ROOF DRAIN, DRAIGE DITCH

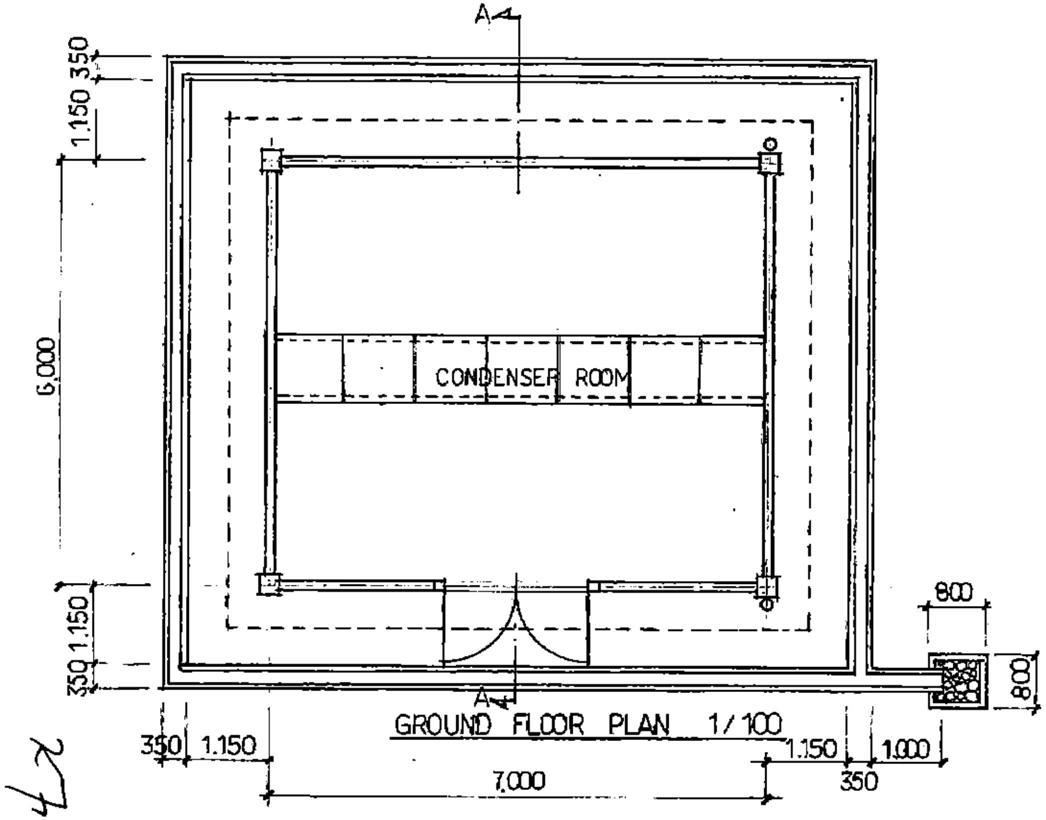
1. GENERAL	
BILDING AREA	42.00 m2
TOTAL FLOOR AREA	42.00 m2
FOUNDATION STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
UPPER GROUND STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
2. EXTERIOR FINISHING	
TOP ROOF	CONCRETE SLAB WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t-150 MORTAR TROWEL PAINTUNG FINISH (EP FOR EXTERNAL)
3. INTERIOR FINISHING	
ITEM	FINISHING / SPECIFICATION
FLOOR	CEMENT TROWELLING
WALL	EP PAINTING FINISH ON MORTAR
CEILING	EP PAINTING FINISH



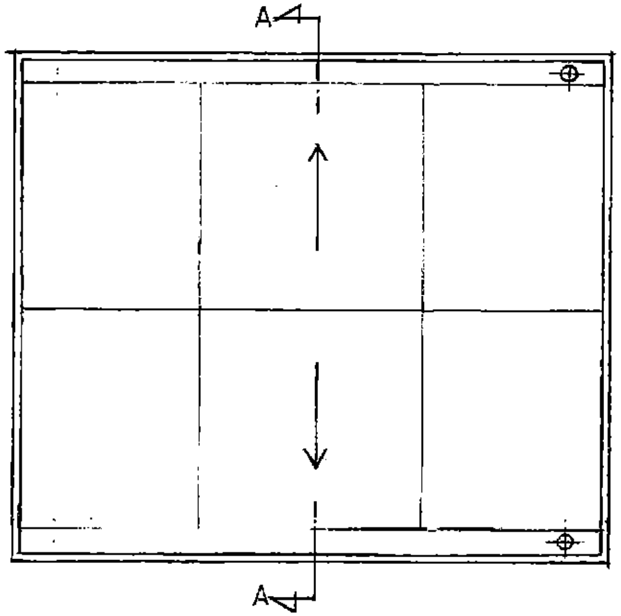
SOUTHSIDE ELEVETION 1/100



SECTION A-A 1/100



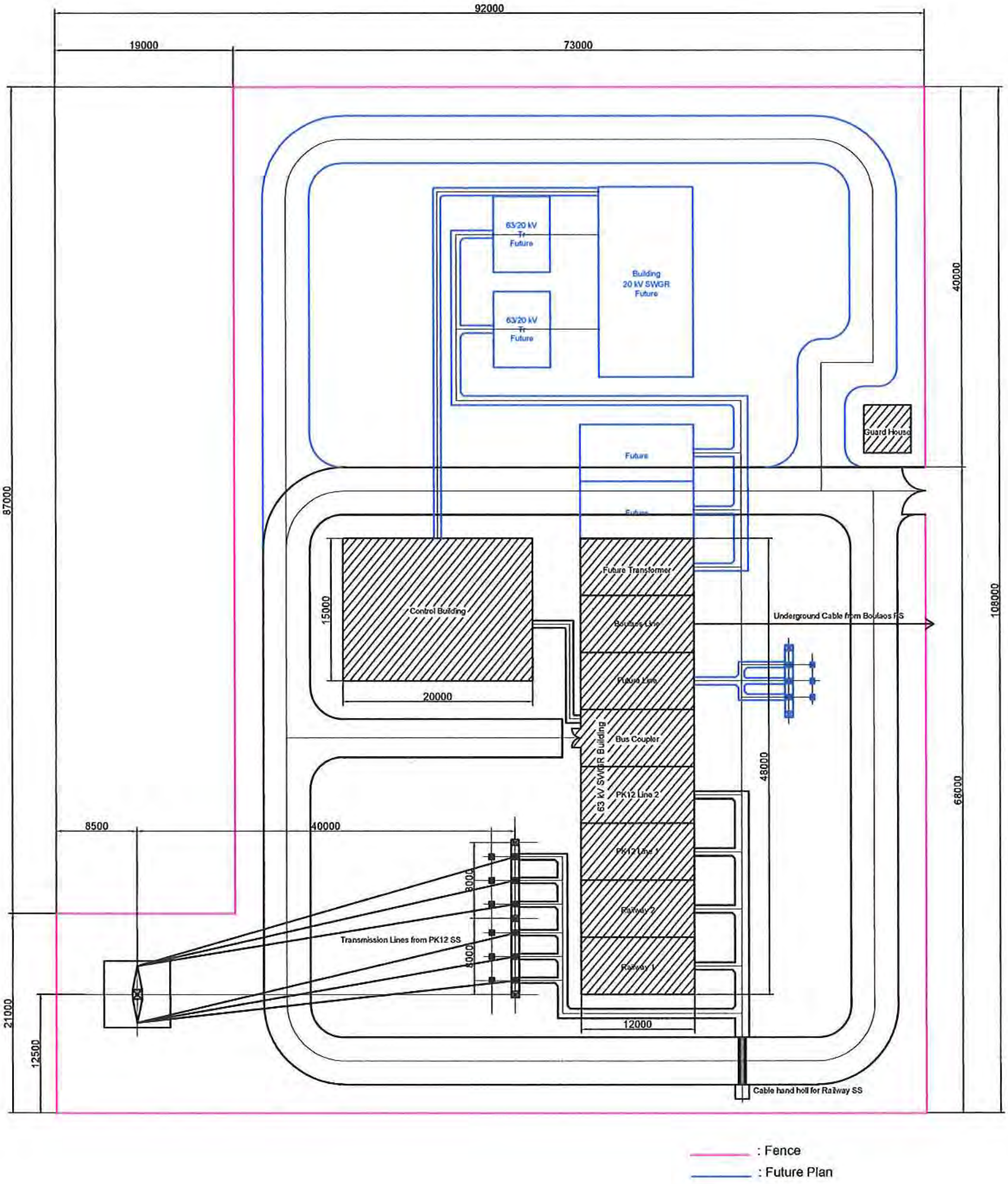
GROUND FLOOR PLAN 1/100



ROOF PLAN 1/100

PIK12 CONDENSER BUILDING

D-7



Nagad Switching Station Site Plan

DWG. No. D-08

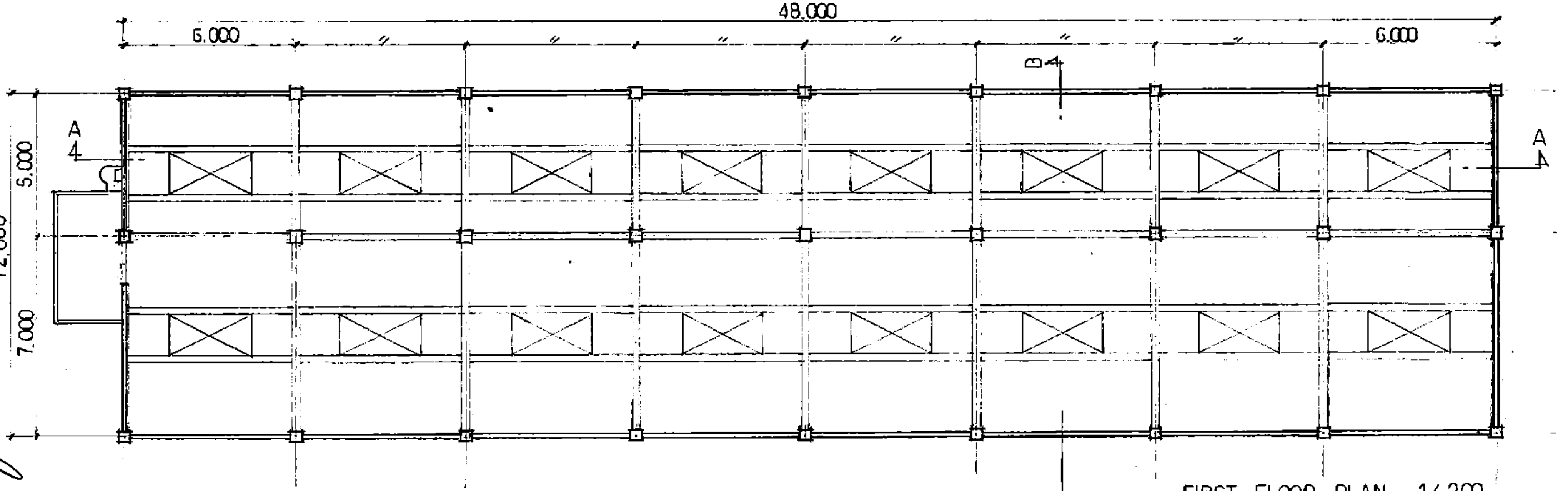
NAGAD SWITCHGEAR BUILDING PROFILE

1. STRUCTURE AND NUMBER OF STORY : REINFORCED CONCRETE STRUCTURE 2 STORY
2. FOUNDATION TYPE : SPREAD FOUNDATION
3. ALLOWABLE BEARING CAPACITY : 75 KN/m2
4. BUILDING FACILITY :

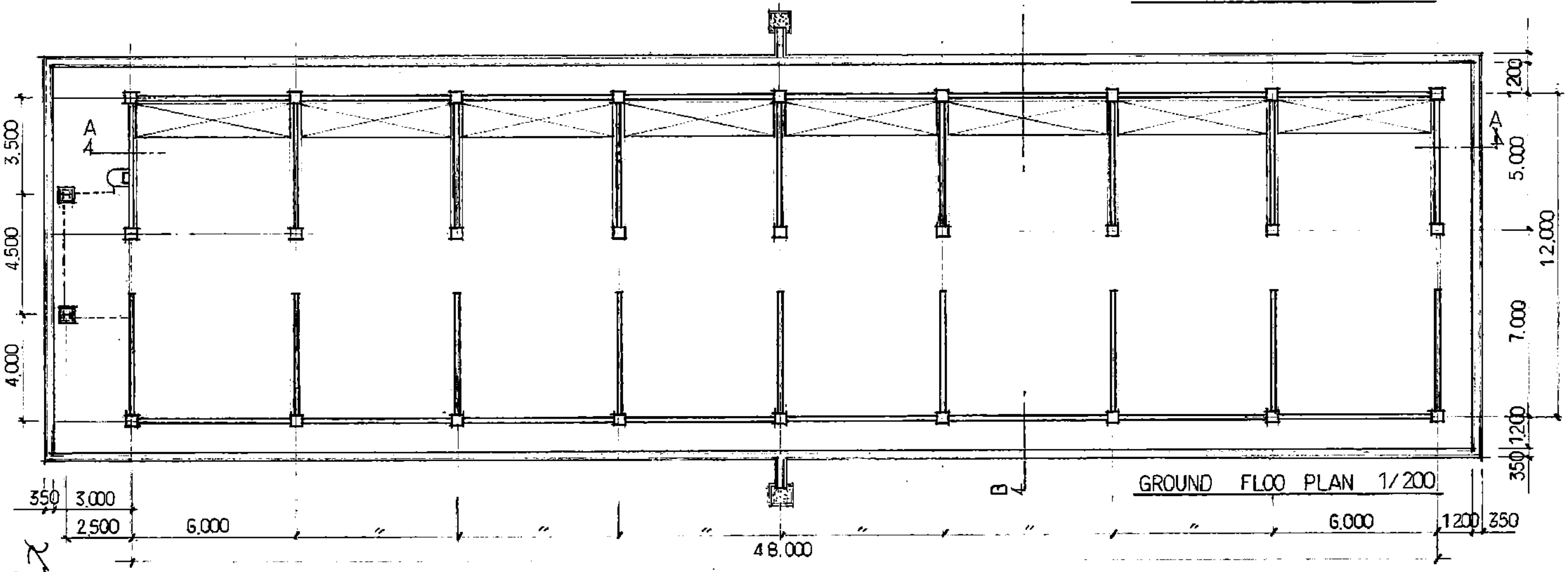
   ELECTRIC SERVICE : LIGHTING FIXTURE

   MECHANICAL SERVICE : ROOF DRAIN, DRAIGE DITCH

1. GENERAL	
BILDING AREA	576.00 m2
TOTAL FLOOR AREA	1,152.00 m2
FOUNDATION STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
UPPER GROUND STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
2. EXTERIOR FINISHING	
TOP ROOF	CONCRETE SLAB WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t-150 MORTAR TROWEL PAINTUNG FINISH (EP FOR EXTERNAL)
3. INTERIOR FINISHING	
ITEM (G AND 1ST.FLOOR)	FINISHING / SPECIFICATION
FLOOR WALL CEILING	CEMENT TROWELLING EP PAINTING FINISH ON MORTAR EP PAINTING FINISH

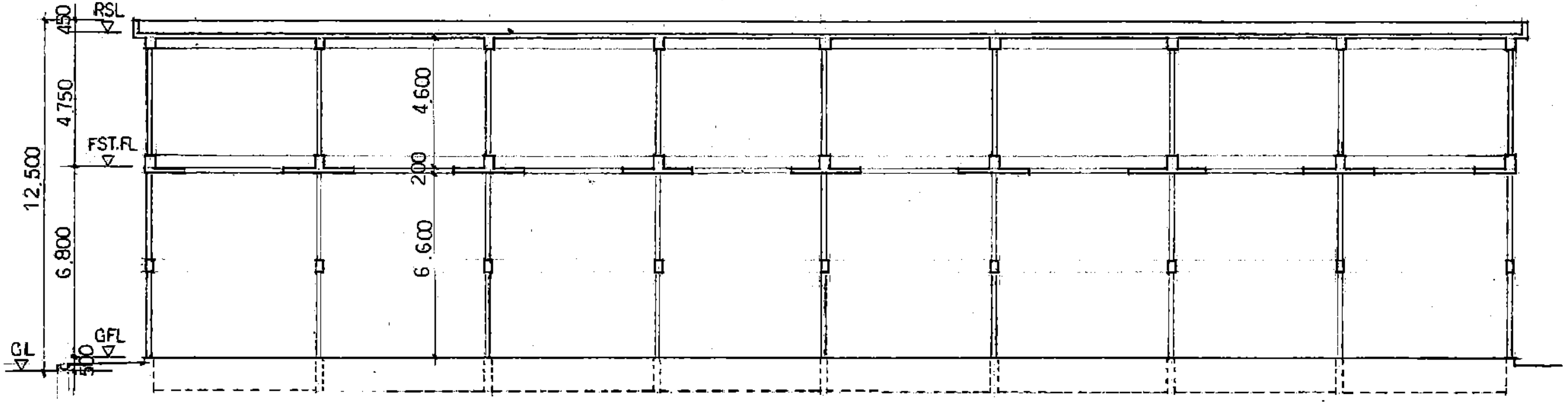


FIRST FLOOR PLAN 1/200

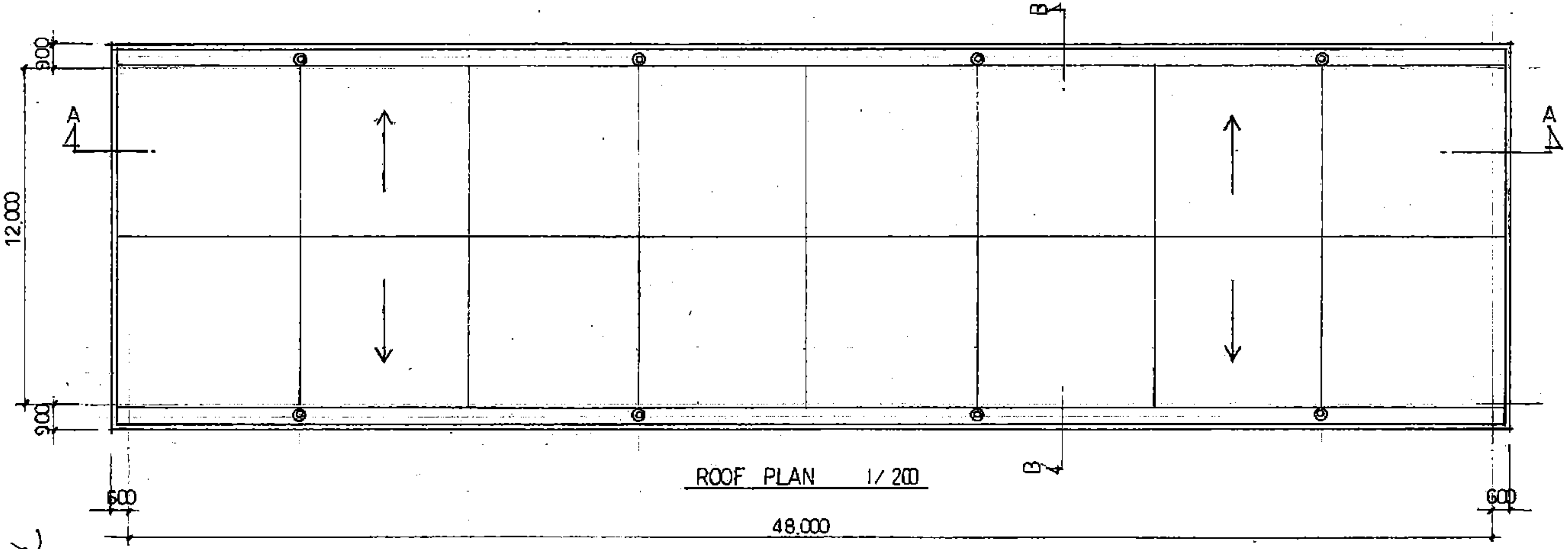


GROUND FLOO PLAN 1/200

NAGAD SWITCHGEAR BUILDING D-10

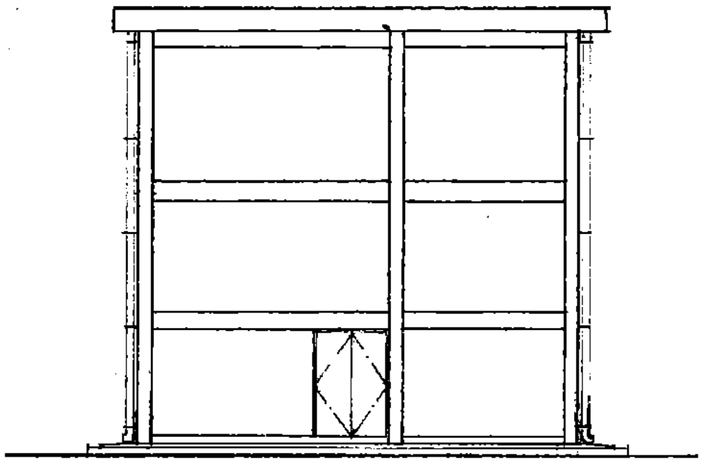


SECTION A-A 1/200

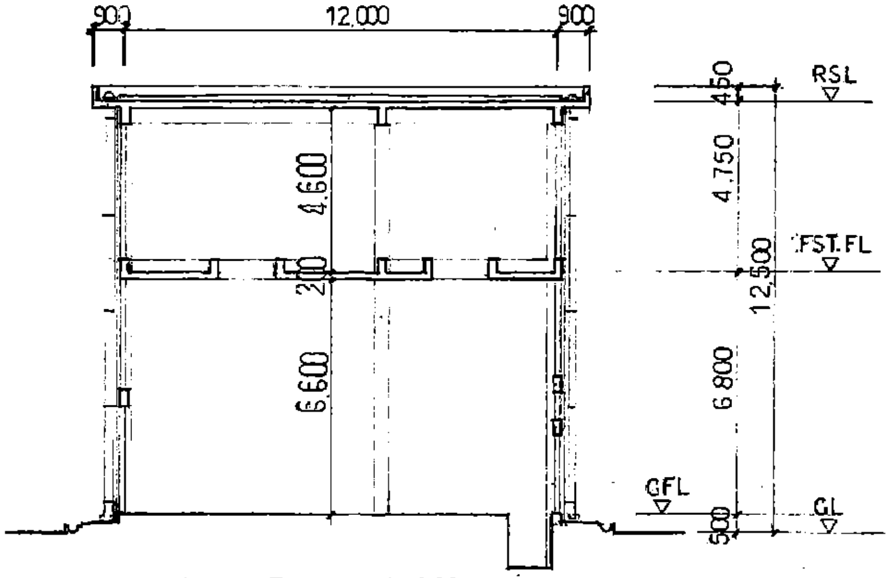


ROOF PLAN 1/200

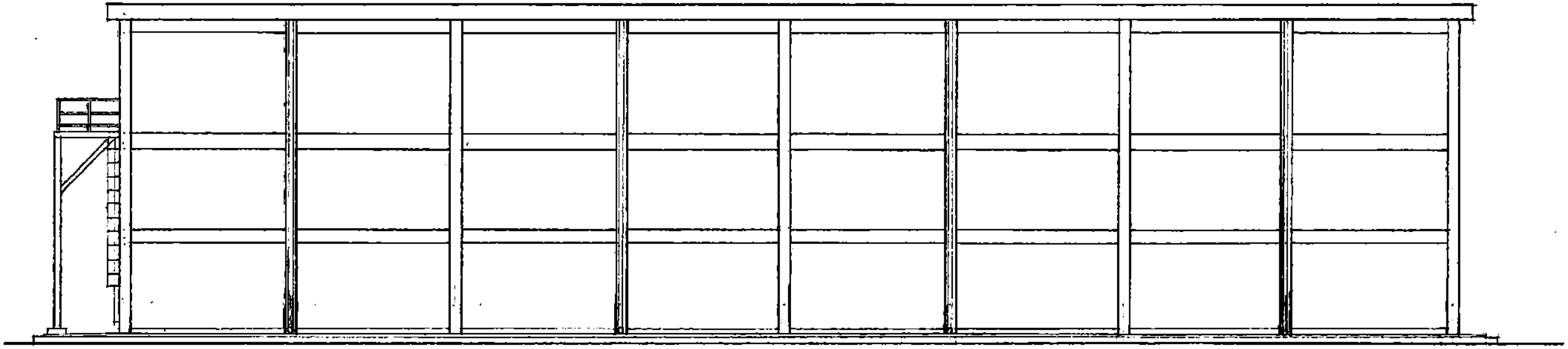
NAGAD SWITCHGEAR BUILDING D-11



NOUTHSIDE ELEVATION 1/200



B-B SECTION 1/200



EAST SIDE ELEVATION 1/200

NAGAD SWITCHGEAR BUILDING D-12

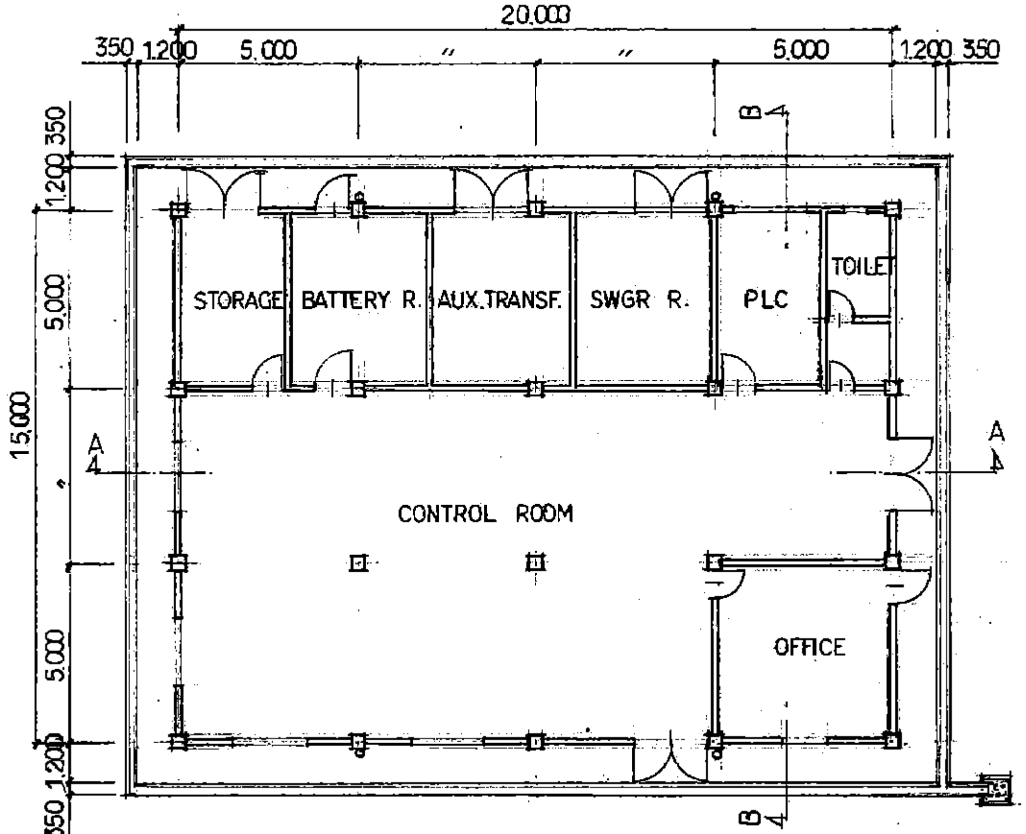
NAGAD CONTROL BUILDING PROFILE

1. STRUCTURE AND NUMBER OF STORY : REINFORCED CONCRETE STRUCTURE 1 STORY
2. FOUNDATION TYPE : SPREAD FOUNDATION
3. ALLOWABLE BEARING CAPACITY : 75 KN/m2
4. BUILDING FACILITY :

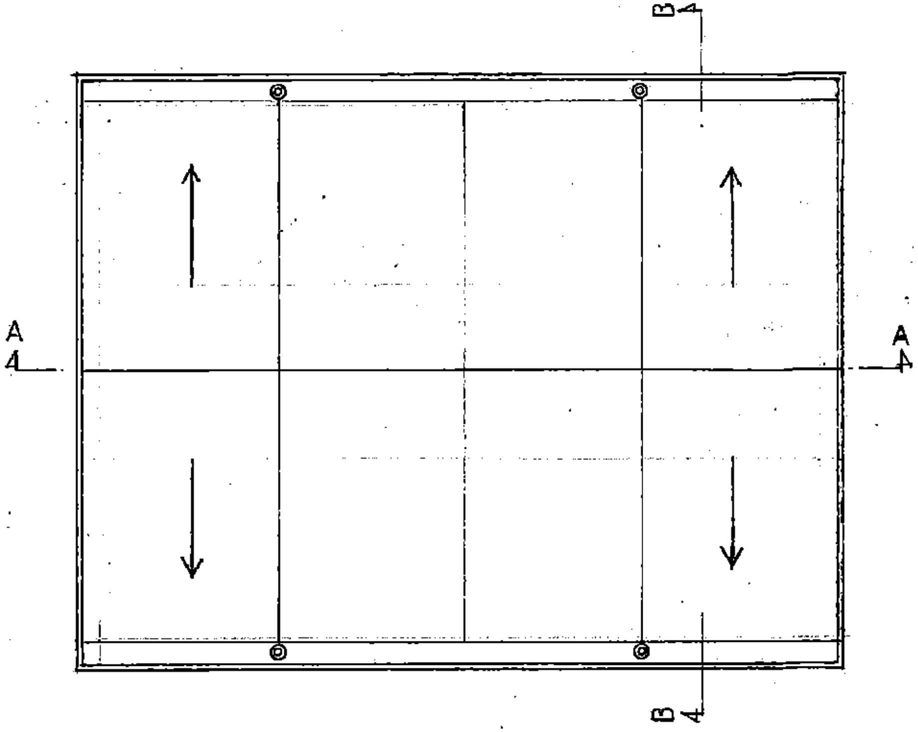
   ELECTRIC SERVICE : LIGHTING FIXTURE

   MECHANICAL SERVICE : ROOF DRAIN, DRAINAGE DITCH, PLUMBING, VENTILATION AND AIRCONDITIONING SYSTEM

1. GENERAL	
BILDING AREA	300.00 m2
TOTAL FLOOR AREA	300.00 m2
FOUNDATION STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
UPPER GROUND STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
2. EXTERIOR FINISHING	
TOP ROOF	CONCRETE SLAB WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t-150 MORTAR TROWEL PAINTUNG FINISH (EP FOR EXTERNAL)
3. INTERIOR FINISHING	
ITEM	FINISHING / SPECIFICATION
FLOOR WALL CEILING	CEMENT TROWELLING, TERRAZZO TILE (TOILET) EP PAINTING FINISH ON MORTAR, CERAMIC TILE (TOILET) EP PAINTING FINISH

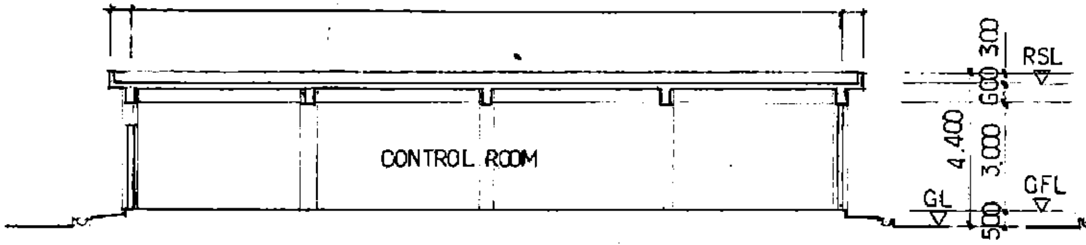


GROUND FLOOR PLAN 1/200

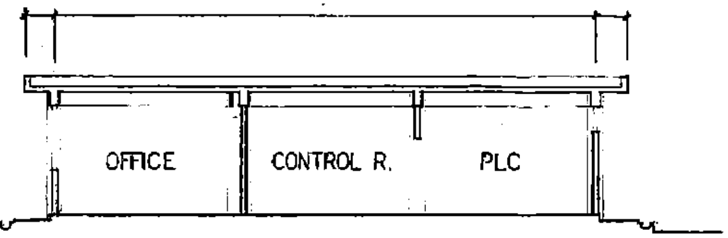


ROOF PLAN 1/200

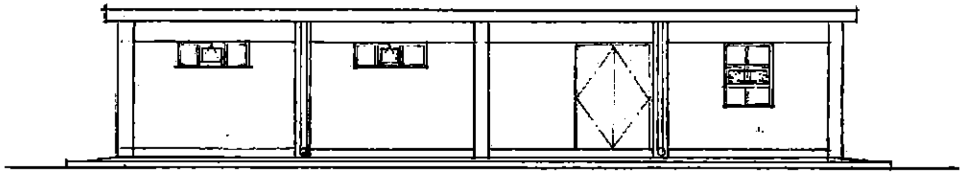
NAGAD CONTROL BUILDING D-14



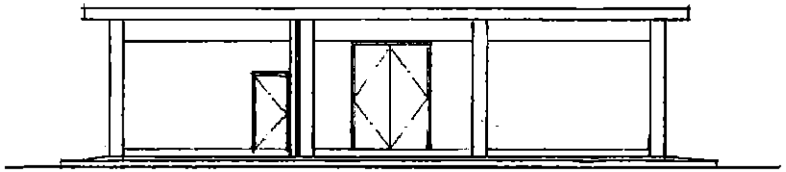
SECTION A-A 1/200



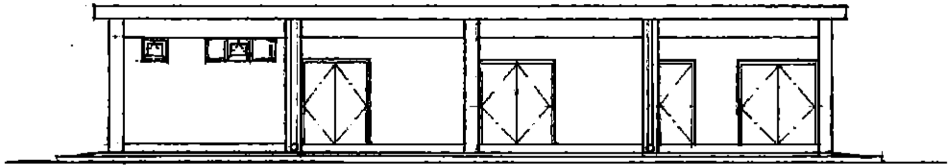
SECTION B-B 1/200



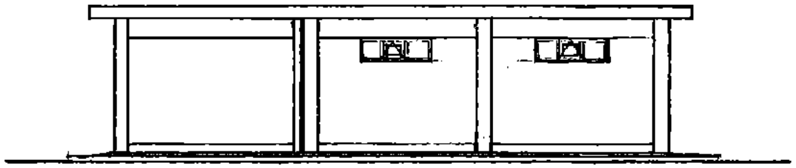
SOUTH SIDE ELEVATION 1/200



EAST SIDE ELEVATION 1/200



NOUTH SIDE ELEVATION 1/200



WEST SIDE ELEVATIO 1/200

NAGAD CONTROL BUILDING D-15

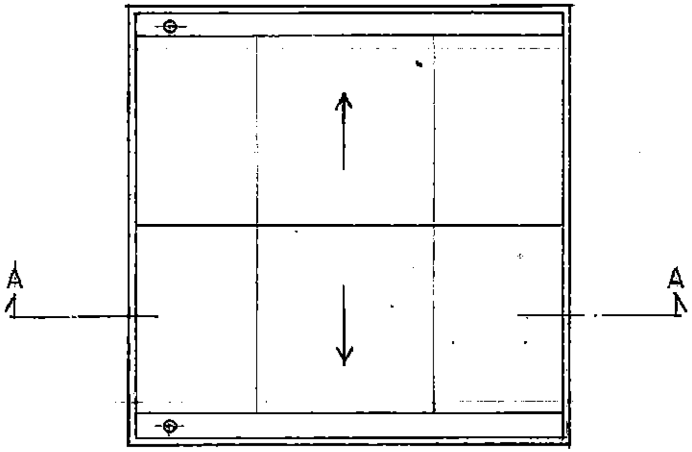
NAGAD GUARD HOUSE PROFILE

1. STRUCTURE AND NUMBER OF STORY : REINFORCED CONCRETE STRUCTURE 1 STORY
2. FOUNDATION TYPE : SPREAD FOUNDATION
3. ALLOWABLE BEARING CAPACITY : 75 KN/m2
4. BUILDING FACILITY :

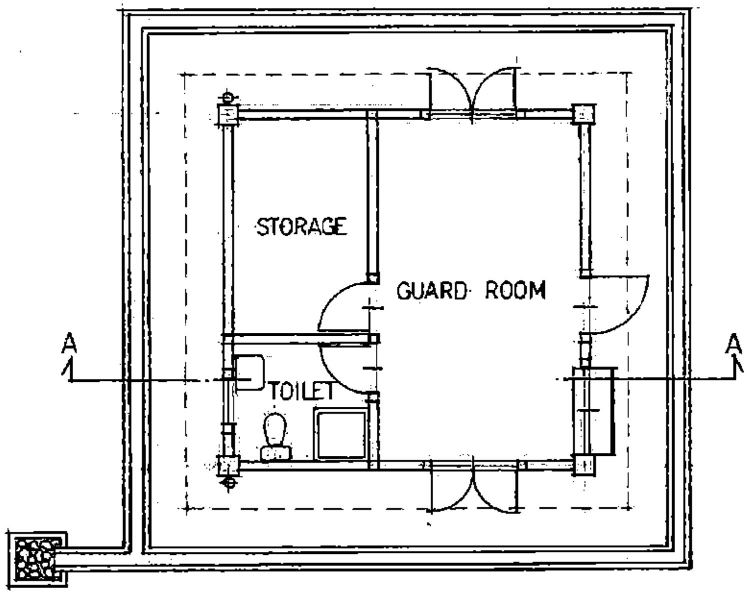
   ELECTRIC SERVICE : LIGHTING FIXTURE

   MECHANICAL SERVICE : ROOF DRAIN, DRAIGE DITCH, PLUMBING, VENTILATION AND AIRCONDITIONING SYSTEM

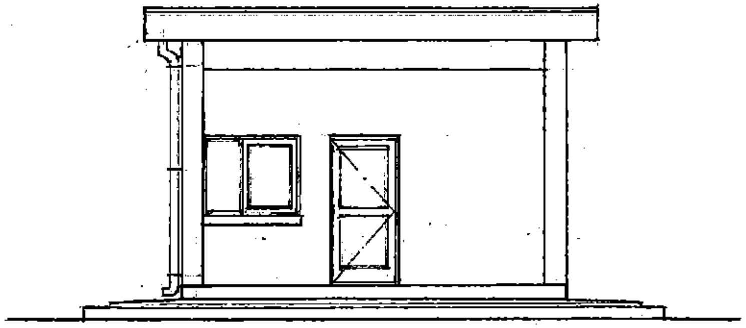
1. GENERAL	
BILDING AREA	25.00 m2
TOTAL FLOOR AREA	25.00 m2
FOUNDATION STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
UPPER GROUND STRUCTURE	REINFORCED CONCRETE CONSTRUCTION
2. EXTERIOR FINISHING	
TOP ROOF	CONCRETE SLAB WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t-150 MORTAR TROWEL PAINTUNG FINISH (EP FOR EXTERNAL)
3. INTERIOR FINISHING	
ITEM (G AND 1ST.FLOOR)	FINISHING / SPECIFICATION
FLOOR WALL CEILING	CEMENT TROWELLING, TERRAZZO TILE (TOILET) EP PAINTING FINISH ON MORTAR, CERAMIC TILE (TOILET) EP PAINTING FINISH



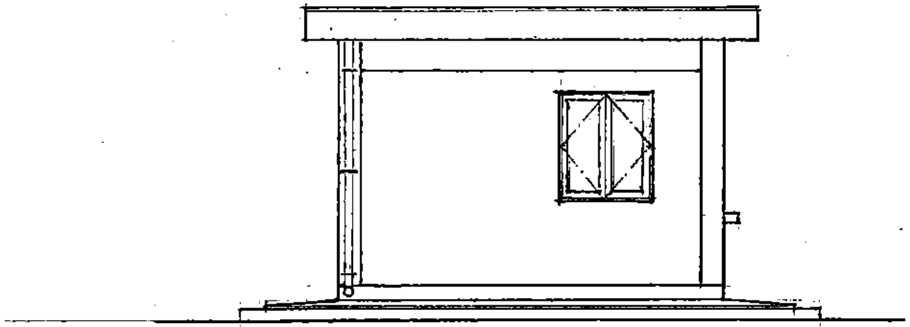
ROOF PLAN 1/100



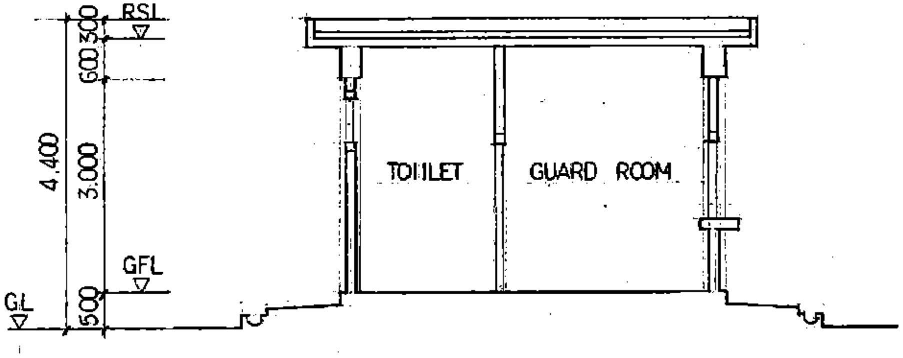
GROUND FLOOR PLAN 1/100



EAST SIDE ELEVATION 1/100



SOUTHSIDE ELEVATION 1/100

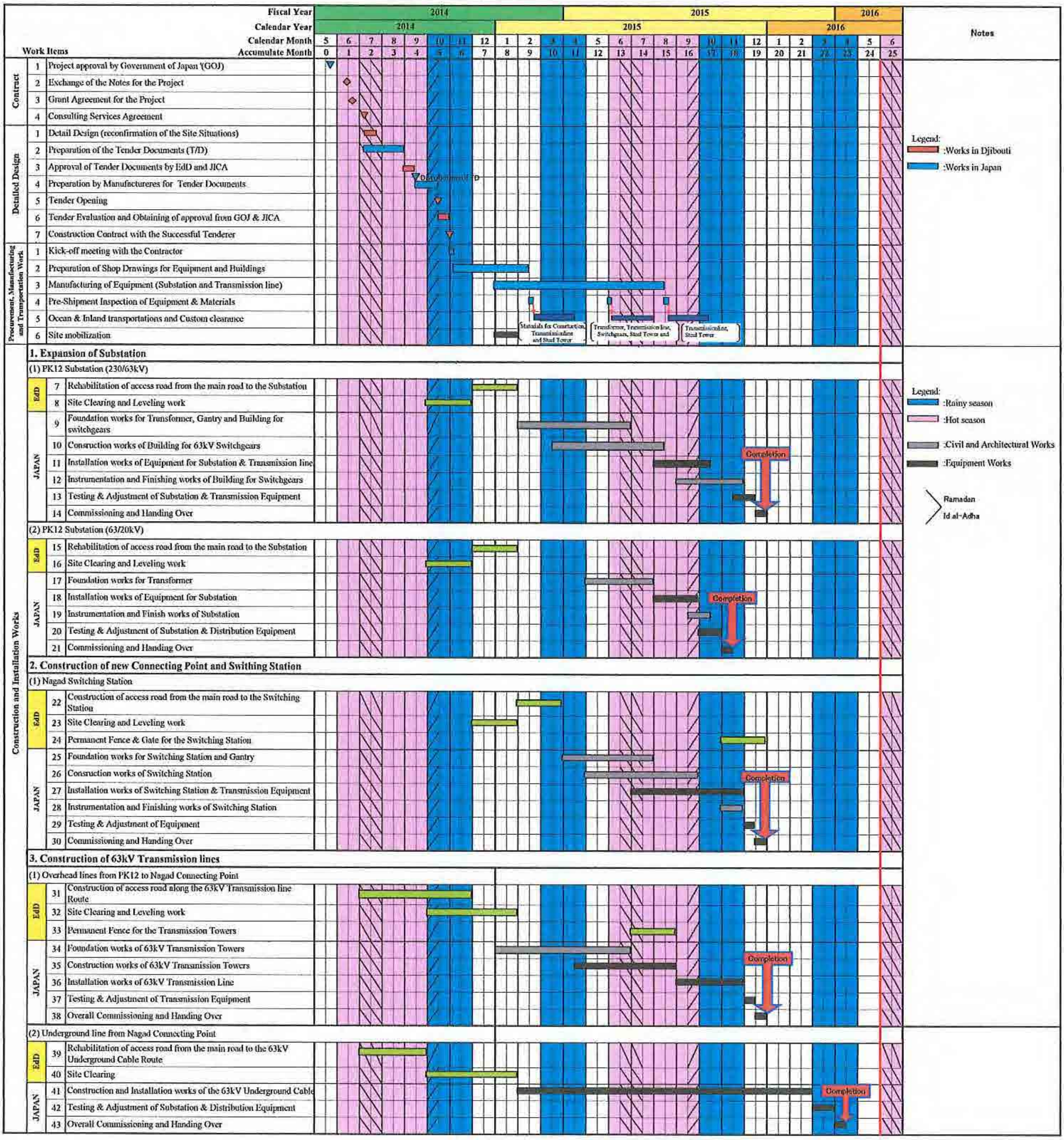


SECTION A-A 1/100

NAGAD GUARD HOUSE

D-17

Implementation Schedule (Tentative)



Work Items		No.	
Contract		1	Project approval by Government of Japan (GOJ)
		2	Exchange of the Notes for the Project
		3	Grant Agreement for the Project
		4	Consulting Services Agreement
Detailed Design		1	Detail Design (reconfirmation of the Site Situations)
		2	Preparation of the Tender Documents (T/D)
		3	Approval of Tender Documents by EdD and JICA
		4	Preparation by Manufactureres for Tender Documents
		5	Tender Opening
		6	Tender Evaluation and Obtaining of approval from GOJ & JICA
		7	Construction Contract with the Successful Tenderer
Procurement, Manufacturing and Transportation Work		1	Kick-off meeting with the Contractor
		2	Preparation of Shop Drawings for Equipment and Buildings
		3	Manufacturing of Equipment (Substation and Transmission line)
		4	Pre-Shipment Inspection of Equipment & Materials
		5	Ocean & Inland transportations and Custom clearance
		6	Site mobilization
Construction and Installation Works	**1. Expansion of Substation**		
	(1) PK12 Substation (230/63kV)		
	EdD	7	Rehabilitation of access road from the main road to the Substation
		8	Site Clearing and Leveling work
	JAPAN	9	Foundation works for Transformer, Gantry and Building for switchgears
		10	Consruction works of Building for 63kV Switchgears
		11	Installation works of Equipment for Substation & Transmission line
		12	Instrumentation and Finishing works of Building for Switchgears
		13	Testing & Adjustment of Substation & Transmission Equipment
		14	Commissioning and Handing Over
	(2) PK12 Substation (63/20kV)		
	EdD	15	Rehabilitation of access road from the main road to the Substation
		16	Site Clearing and Leveling work
	JAPAN	17	Foundation works for Transformer
		18	Installation works of Equipment for Substation
		19	Instrumentation and Finish works of Substation
		20	Testing & Adjustment of Substation & Distribution Equipment
		21	Commissioning and Handing Over
	2. Construction of new Connecting Point and Swithing Station		
	(1) Nagad Switching Station		
	EdD	22	Construction of access road from the main road to the Switching Station
		23	Site Clearing and Leveling work
		24	Permanent Fence & Gate for the Switching Station
	JAPAN	25	Foundation works for Switching Station and Gantry
		26	Consruction works of Switching Station
		27	Installation works of Switching Station & Transmission Equipment
		28	Instrumentation and Finishing works of Switching Station
		29	Testing & Adjustment of Equipment
		30	Commissioning and Handing Over
	3. Construction of 63kV Transmission lines		
	(1) Overhead lines from PK12 to Nagad Connecting Point		
	EdD	31	Construction of access road along the 63kV Transmission line Route
		32	Site Clearing and Leveling work
		33	Permanent Fence for the Transmission Towers
	JAPAN	34	Foundation works of 63kV Transmission Towers
		35	Construction works of 63kV Transmission Towers
		36	Installation works of 63kV Transmission Line
		37	Testing & Adjustment of Transmission Equipment
		38	Overall Commissioning and Handing Over
	(2) Underground line from Nagad Connecting Point		
	EdD	39	Rehabilitation of access road from the main road to the 63kV Underground Cable Route
		40	Site Clearing
	JAPAN	41	Construction and Installation works of the 63kV Underground Cable
		42	Testing & Adjustment of Substation & Distribution Equipment
		43	Overall Commissioning and Handing Over

Legend:
🟥 :Works in Djibouti
🟦 :Works in Japan

Legend:
🟦 :Rainy season
▨ :Hot season
▬ :Civil and Architectural Works
▬ :Equipment Works
Ramadan
Id al-Adha

TECHNICAL MEMORANDUM FOR THE 3rd PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

AGREED UPON BETWEEN
ELECTRICITE DE DJIBOUTI (EdD)
AND
JICA PREPARATORY SURVEY TEAM

Djibouti, 3rd April 2014

Mr. Kyoji FUJII Chief Consultant JICA Preparatory Survey Team Yachiyo Engineering Co., Ltd.	Mr. Ismael DIALLO Director of Interconnection Project Electricite de Djibouti

Electricite du Djibouti (hereinafter referred to as "EdD") and JICA Preparatory Survey Team for the Project for Improvement of Power Supply in the Republic of Djibouti (hereinafter referred to as "the Team") had series of technical discussion to form a mutual understanding on the scope of the Project, priority order and technical specifications of project components and items to be undertaken by each party. Both parties agreed to record the following points as a conclusion of the discussions.

1. Final priority order for Components of the Project

The Team explained to EdD that some components must be dropped from the scope of the project due to the limitation of the budget allocated from the government of Japan. Firstly, both sides agreed to drop 63/20kV transformer and 20kV capacitor banks at Jaban As substation in accordance with the priority order agreed on the 2nd Technical Memorandum. Still, the project cost largely overruns the budget. Then EdD offered to drop Nagad switching station because railway project requires 132kV power supply and 63kV is not necessary for it. Finally, both sides agreed on the final priority order for components of the Project as described in Table 1.

EdD strongly requested the Team to include components 1.(1) ①②③, 1.(2) and 2.(1) in the Project. EdD mentioned that if the final cost of the project components overruns the ceiling of the budget, EdD will bear the balance to supplement the project cost.

Table 1 Final priority order for components of the Project

Item	Candidate Components agreed on 2nd Technical Memorandum (5th November 2013)	Final priority order for components agreed on 3rd Technical Memorandum (3rd April 2014)
1. 63kV transmission line between Jaban As and Boulaos via Nagad	(1) 63kV Overhead Transmission Line from Jaban As substation to – Nagad switching station ● Length: 11.3km, double circuits	[Priority 1] (1) 63kV Overhead Transmission Line (Total length: 15km) ① From Jaban As substation to Nagad substation site ● Length: 11.1km, double circuits ② From Nagad substation site to Nagad connection point ● Length: 3.9km, single circuit ③ Nagad connection point
	(2) 63kV Underground Transmission Line from Nagad switching station to Boulaos substation ● Length: 7.5km, single circuit	[Priority 1] (2) 63kV Underground Transmission Line from Nagad connection point to Boulaos substation ● Length: 7.8km, single circuit
2. Expansion of Jaban As (PK12) substation	(1) Expansion of Jaban As substation (230/63kV side) ● 230/63kV, 63MVAx1unit	[Priority 2] Same as left

Item	Candidate Components agreed on 2nd Technical Memorandum (5th November 2013)	Final priority order for components agreed on 3rd Technical Memorandum (3rd April 2014)
	(2) Expansion of Jaban As substation (63/20kV side) ● 63/20kV, 40MVAx1unit	Dropped
	(3) 20kV Capacitor banks	Dropped
3. Nagad Switching Station	(1) 63kV switchgears, 20kV distribution panels, etc.	Dropped

2. Final transmission line route

Final transmission line route which was approved by Directione de l'Habitat et de l'Urbanisme and Direction des Domaines et de la Conservation Fonçlère is shown in Attachment-1. Details of overhead transmission line route near Jaban As area is shown in Attachment-2.

3. Modification of technical specifications from the 2nd Technical Memorandum

(1) Number of circuits for 63kV overhead transmission line

Number of circuits for 63kV overhead transmission line is modified as shown in Table 2. One circuit which ends at Nagad substation site will be terminated on a transmission tower and another single circuit will continue up to Nagad connection point.

EdD explained that new development projects around Nagad area, such as new airport (Aeroport de Chebeleh), Domestic animal exporting port (Port Betail) and metal factories in Damerdjog will require 63kV power supply from Nagad. This is the reason why double circuits are necessary from Jaban As to Nagad even though the 63kV overhead transmission line from Jaban As to Nagad does not supply power for railway. EdD will provide estimated power demand for those projects to the Team.

Table 2 Modification of number of circuits for overhead transmission line

Item	2nd Technical Memorandum (5th November 2013)	3rd Technical Memorandum (3rd April 2014)
63kV overhead transmission line between Jaban As and Nagad	Double circuits: from Jaban As substation to – Nagad switching station	(1) Double circuits: from Jaban As substation to Nagad substation site (2) Single circuit: from Nagad substation site to Nagad connection point

(2) Crossing point of existing 230kV, 63kV and new 63kV transmission lines

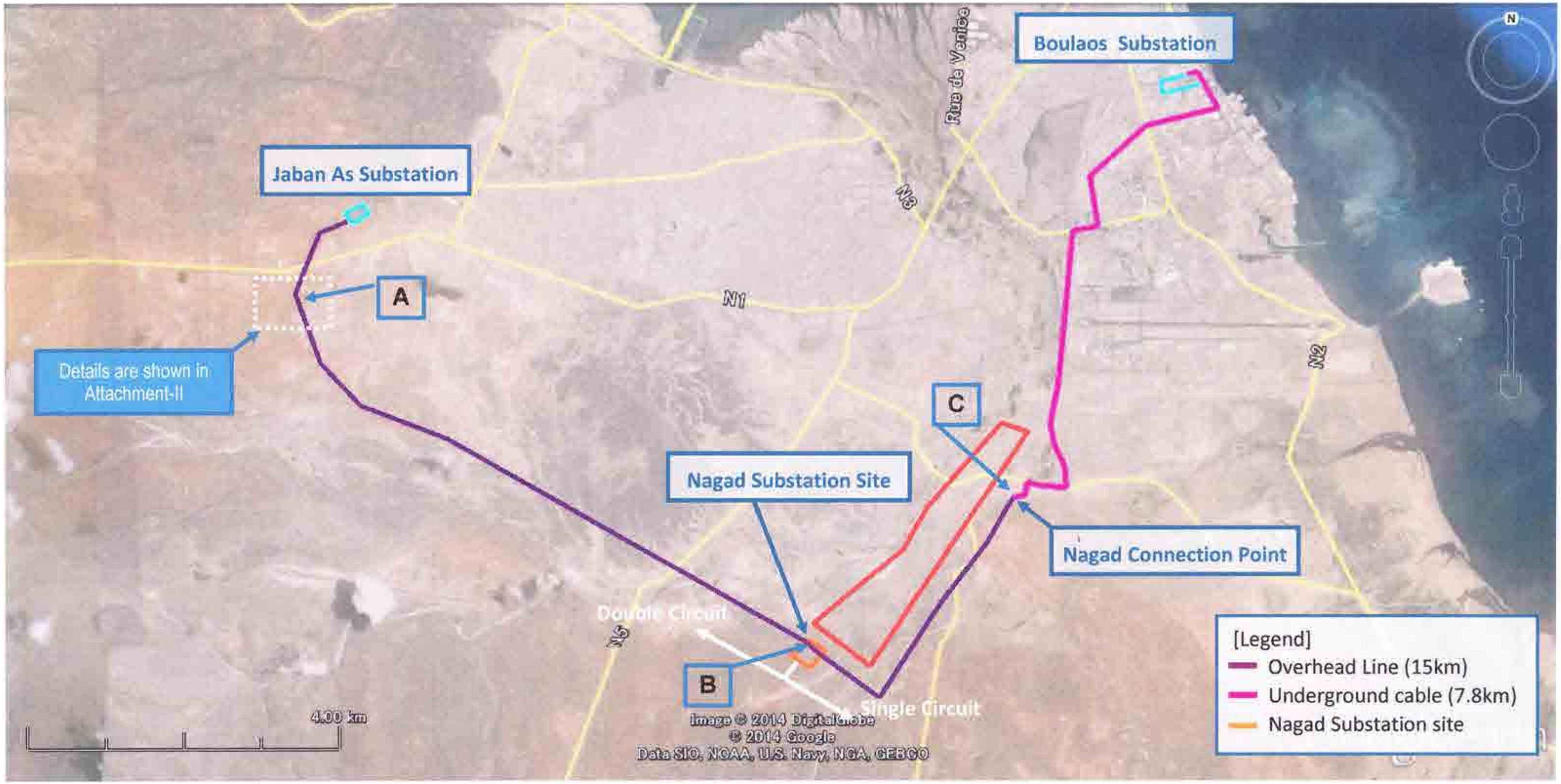
As shown in Attachment-II, new 63kV transmission line will go over or under the existing 230kV and 63kV transmission lines. The Team will study and propose the least cost method of line crossing.

K7

4. Land Acquisition for Transmission Corridor

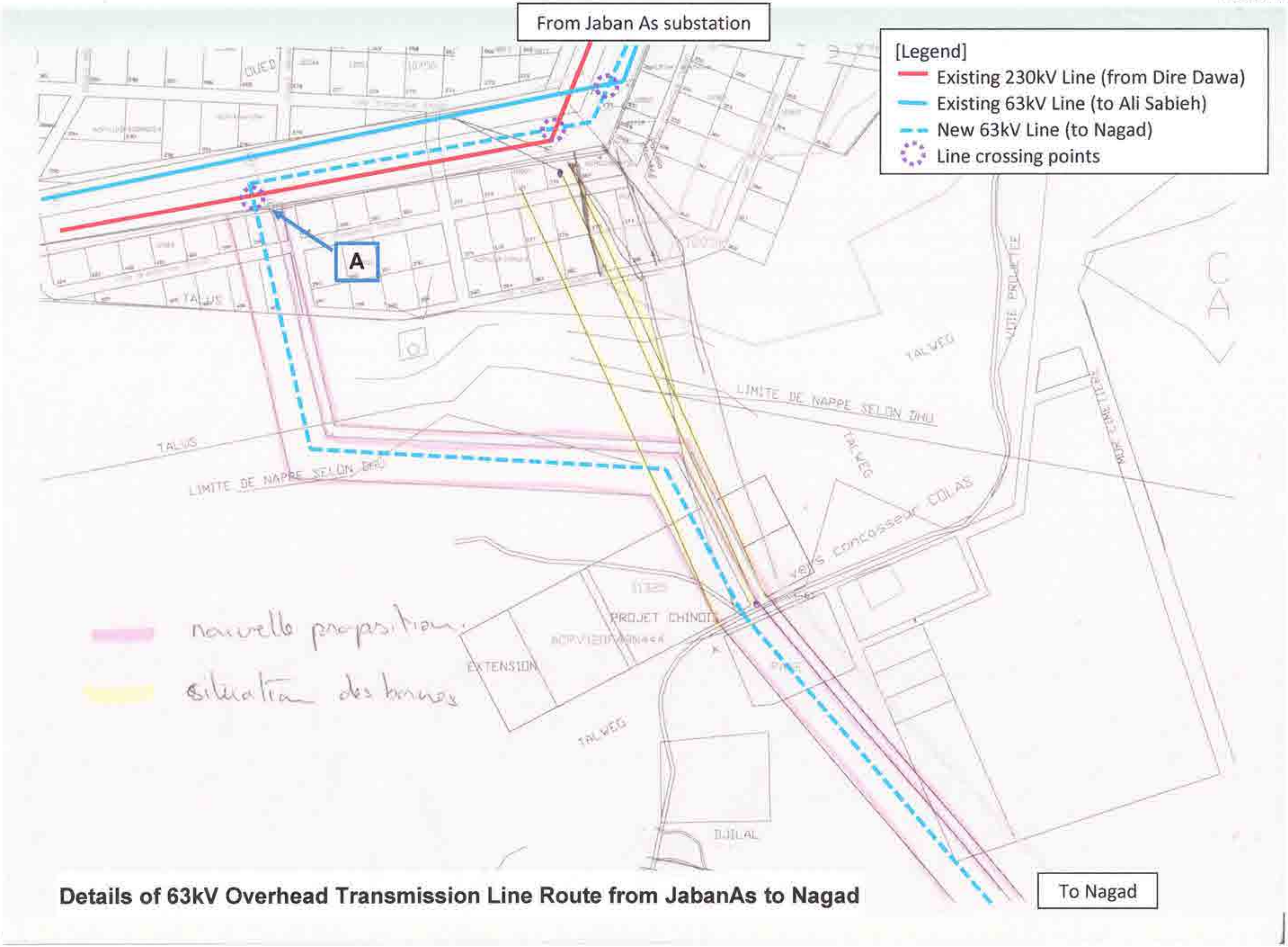
Since Direction des Domaines et de la Conservation Fonçlère agreed to provide necessary transmission line corridor to EdD and it assures that no private land is existing along the transmission line corridor, no land acquisition is required for the Project. Direction des Domaines et de la Conservation Fonçlère approved to allocate 100m width from point A to B and 24m width from B to C for exclusive transmission corridor to EdD. The points A, B and C are shown in Attachment-I and II.

End



Final Transmission Line Route

KJ



Details of 63kV Overhead Transmission Line Route from JabanAs to Nagad

A-6 Power Flow Analysis of the Grid

Appendix 6 Load Flow Analysis

I Input Data of Power System Model

Table 1 Generator

Unit	Location	Type	Commission Date	Rating				Service			Impedance (%: Rating capacity MVA Base) direct-axis subtransient		Fuel (Heavy or Light)	Fuel Consumption Ratio $^{2)}$ (g/kWh)
				(MW)	(KV)	(MVA)	PF (%)	Power (MW)	Hours (h)	Load Type	Xd"	Xd		
G21	Boulaos	G.M.T FINCANTIERI B550/18	1984	15.2	5.5	19.00	80	10.0	115025	Decommission	25.0 $^{1)}$	99 $^{1)}$	Heavy	221
G22B	Boulaos	Wartsila GMT 18V46	2007	17.0	15.0	21.35	80	14.0	21108	Base	22.2	205	Heavy	
G25	Boulaos	Wartsila 18V46	2000	14.4	5.5	18.00	80	13.4	59551	Base	19.6	175	Heavy	
G1	Boulaos	Alstom Pielstick 18PC2-2	1976	6.0	5.5	7.60	80	4.0	124435	Peak	25.0 $^{1)}$	99 $^{1)}$	Heavy	
G12	Boulaos	Caterpilar	2004	7.25	5.5	9.06	80	6.5	38296	Base	10.5	140	Heavy	
G13	Boulaos	Wartsila GMT 16VA32	2001	6.0	5.5	7.50	80	4.5	43535	Base	22.3	206	Heavy	
G14	Boulaos	Wartsila GMT 16VA32	2001	6.0	5.5	7.50	80	4.5	25957	Base	22.3	206	Heavy	
G15	Boulaos	Wartsila GMT 16VA32	2001	6.0	5.5	7.50	80	4.5	24387	Base	22.3	206	Heavy	
G16	Boulaos	Wartsila GMT 16VA32	2001	6.0	5.5	7.50	80	4.5	33559	Base	22.3	206	Heavy	
G17	Boulaos	Caterpilar	2003	7.25	5.5	9.06	80	6.5	35041	Decommission	10.5	140	Heavy	
G18	Boulaos	Caterpilar	2004	7.25	5.5	9.06	80	6.5	33405	Base	10.5	140	Heavy	
G23B	Boulaos	MAN 9L52/55A	2011	8.5	5.5	10.64	80	6.5	4474	Base	23.9	214	Heavy	
G24	Boulaos	MAN 9L52/55A	1988	5.5	10.5	6.88	80	4.5	106745	Base	25.0 $^{1)}$	99 $^{1)}$	Heavy	
G32	Boulaos	SEMT PIELSTICK PA6	2010	4.5	10.5	5.50	80	4.0	2593	Peak	25.0 $^{1)}$	99 $^{1)}$	Light	254
G31	Boulaos	SEMT PIELSTICK PA6	2010	4.5	10.5	5.50	80	4.0	1443	Peak	25.0 $^{1)}$	99 $^{1)}$	Light	
M6	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	23305	Peak	15.2	147	Light	
M4	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	26872	Peak	15.2	147	Light	
M2	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	33593	Peak	15.2	147	Light	
M5	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	30812	Peak	15.2	147	Light	
M3	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	30085	Peak	15.2	147	Light	
M1	Marabout	Wartsila GMT 16V25	1999	3.0	15.0	3.75	80	2.4	24079	Peak	15.2	147	Light	

Remarks: 1) Assumption, 2) Operation in 2012

Table 2 Transformer

Unit	Location			Manufacture, Type	Rating			Impedance (%:Rated Power MVA Base)	Load Tap Changer (%)			
		From	To		Voltage (kV) Prim.	Sec.	Power (MVA) Rated		Min. (%)	Max. (%)	Step (%)	Number
No1 PK/H	Jaban As	Jaban As_230kV	Jaban As_63kV	GETRA	230	63	63	13.56	-10	10	1.25	17
NO2 PK/H	Jaban As	Jaban As_230kV	Jaban As_63kV	GETRA	230	63	63	13.46	-10	10	1.25	17
No1 PK/L	Jaban As	Jaban As_230kV	Jaban As_40kV	GETRA	63	20	40	11.96	-12.5	12.5	1.25	21
No1 A/L	Ali Sabieh	Ali Sadieh_63kV	Ali Sadieh_20kV	GETRA	63	20	12	9.91	-12.5	12.5	1.25	21
No1 B/L	Boulaos	Boulaos_63kV	Boulaos_20kV	CEM	63	21	36	17.1	-12	12	1.500	17
No2 B/L	Boulaos	Boulaos_63kV	Boulaos_20kV	CEM	63	21	36	17	-12	12	1.500	17
No1 M/L	Marabout	Marabout_63kV	Marabout_20kV	CEM	63	21	36	17	-12	12	1.500	17
No1 M/G	Marabout	Marabout_20kV	Marabout_15kV	AREVA	21	15	12	7.97	-5	5	2.500	5
No2 M/G	Marabout	Marabout_20kV	Marabout_15kV	AREVA	21	15	12	9.85	-5	5	2.500	5
T21	Boulaos	Boulaos_63kV	G21	CEM	66	5.5	19	8.21	-7.5	7.5	3.75	5
T22B	Boulaos	Boulaos_63kV	G22B	AREVA	66	15	18	10.05	-7.5	7.5	3.75	5
T25	Boulaos	Boulaos_63kV	G25	IEC	66	5.5	18	11.48	-7.5	7.5	3.75	5
T32	Boulaos	Boulaos_20kV	G32	AREVA	21	10.5	6.7	6.07	-7.5	7.5	3.75	5
T31	Boulaos	Boulaos_20kV	G31	AREVA	21	10.5	6.7	6.7	-7.5	7.5	3.75	5
T11	Boulaos	Boulaos_20kV	G11	Metz	21	5.5	7.7	9.1 1)	-7.5	7.5	3.75	5
T12	Boulaos	Boulaos_20kV	G12	ALSTOM	21	5.5	9.1	8.21	-5	5	2.5	5
T13	Boulaos	Boulaos_20kV	G13	Usine de METZ	21	5.5	7.55	9.42	-5	5	5	3
T14	Boulaos	Boulaos_20kV	G14	Usine de METZ	21	5.5	7.55	9.42 2)	-5	5	5	3
T15	Boulaos	Boulaos_20kV	G15	Usine de METZ	21	5.5	7.55	9.42 2)	-5	5	5	3
T16	Boulaos	Boulaos_20kV	G16	Usine de METZ	21	5.5	7.55	9.42 2)	-5	5	5	3
T17	Boulaos	Boulaos_20kV	G17	ALSTOM	21	5.5	9.1	8.12	-5	5	2.5	5
T18	Boulaos	Boulaos_20kV	G18	ALSTOM	21	5.5	9.1	8.21	-5	5	2.5	5
T23B	Boulaos	Boulaos_20kV	G23B	AREVA	21	5.5	11	8.19	-5	5	2.5	5
T24	Boulaos	Boulaos_20kV	G24	ALSTOM	21	10.5	6.7	8.36	-7.5	7.5	3.75	5

Remarks: 1) Djibouti Transformer data by PB POWER, 2) asumption from T13

II Load Flow Chart

Table 1 List of Case Studies and Results (1/2)

Case			Base	Case1	Case2	Case3	Case4	Case5	Case6	Case7	Case8	Case9	Case10	Case11	Case12	Case13	Case14	Case15	Case16
Year			2012	2016	2017			2018	2019		2020		2021				2022	2023	2024
Operation Year			-4	-1	1			2	3		4		5				6	7	8
Ivent (●: Operation)																			
Demand																			
	Maximum		●	●	●	●		●	●	●	●		●	●	●		●	●	●
	Minimum						●					●				●			
The Project																			
	230/63kV Tr x 1 at Jaban As					●	●							●	●	●	●	●	●
	63kV Transmission Lines					●	●			●	●	●	●	●	●	●	●	●	●
Other Projects																			
	Semera International Transmission Line				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Palmeraie Substation			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Jaban As Power Station			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Master Plan																			
	63/20kV Tr x 1at Jaban As S/S														●	●	●	●	●
	No2 and No3 63/20kV Tr at Marabout																		
	No3 63/20kV Tr at Boulaos																		
	Capacitor at Jaban As, Marabout and Boulaos																		
Recommendation																			
	No.4 230/63kV Tr at Jaban As																		
Load Allocation																			
	Power Factor		0.94	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Marabout	MW	27.0	23.9	24.4	24.4	7.1	24.9	25.5	25.5	26.2	7.7	26.9	26.9	26.9	7.9	27.7	29.1	30.7
		MVar	9.8	11.6	11.8	11.8	3.5	12.0	12.4	12.4	12.7	3.7	13.0	13.0	13.0	3.8	13.4	14.1	14.9
		MVA	28.7	26.6	27.1	27.1	7.9	27.6	28.3	28.3	29.1	8.5	29.9	29.9	29.9	8.7	30.8	32.3	34.1
	Boulaos	MW	45.5	51.3	58.6	47.6	13.9	62.1	65.7	50.1	51.1	14.9	52.3	52.3	52.3	15.3	53.5	54.7	56.1
		MVar	16.5	24.8	28.4	23.1	6.7	30.1	31.8	24.3	24.7	7.2	25.3	25.3	25.3	7.4	25.9	26.5	27.2
		MVA	48.4	57.0	65.1	52.9	15.4	69.0	73.0	55.7	56.8	16.6	58.1	58.1	58.1	17.0	59.4	60.8	62.3
	Jaban As	MW	2.5	27.3	28.6	28.6	8.4	30.0	31.4	31.4	32.8	9.6	37.7	37.7	37.7	11.0	43.2	48.8	51.6
		MVar	0.9	13.2	13.9	13.9	4.0	14.5	15.2	15.2	15.9	4.6	18.3	18.3	18.3	5.3	20.9	23.6	25.0
		MVA	2.7	30.3	31.8	31.8	9.3	33.3	34.9	34.9	36.4	10.6	41.9	41.9	41.9	12.2	48.0	54.2	57.3
	New Nagad	MW	0.0	0.0	0.0	11.0	3.2	0.0	0.0	15.6	17.9	5.2	20.2	20.2	20.2	5.9	22.5	22.5	22.5
		MVar	0.0	0.0	0.0	5.3	1.6	0.0	0.0	7.6	8.7	2.5	9.8	9.8	9.8	2.9	10.9	10.9	10.9
		MVA	0.0	0.0	0.0	12.2	3.6	0.0	0.0	17.3	19.9	5.8	22.4	22.4	22.4	6.6	25.0	25.0	25.0
	Palmeraie	MW	0.0	15.1	15.4	15.4	4.5	15.8	16.1	16.1	16.6	4.8	17.0	17.0	17.0	5.0	17.5	18.0	18.5
		MVar	0.0	7.3	7.5	7.5	2.2	7.7	7.8	7.8	8.0	2.3	8.2	8.2	8.2	2.4	8.5	8.7	9.0
		MVA	0.0	16.8	17.1	17.1	5.0	17.6	17.9	17.9	18.4	5.4	18.9	18.9	18.9	5.5	19.4	20.0	20.6
	Ali Sabieh	MW	1.9	4.7	4.7	4.7	1.4	4.7	4.7	4.7	4.8	1.4	4.8	4.8	4.8	1.4	4.8	4.9	4.9
		MVar	0.7	2.3	2.3	2.3	0.7	2.3	2.3	2.3	2.3	0.7	2.3	2.3	2.3	0.7	2.3	2.4	2.4
		MVA	2.0	5.2	5.2	5.2	1.5	5.2	5.3	5.3	5.3	1.5	5.3	5.3	5.3	1.5	5.4	5.4	5.4
	Total	MW	76.9	122.3	131.7	131.7	38.5	137.5	143.4	143.4	149.4	43.6	158.9	158.9	158.9	46.4	169.2	178.0	184.3
		MVar	27.2	57.0	61.5	61.5	18.0	64.3	67.2	67.2	70.0	20.4	74.6	74.6	74.6	21.8	79.6	83.8	86.9
		MVA	81.8	135.9	146.3	146.3	42.7	152.7	159.4	159.4	166.0	48.5	176.5	176.5	176.5	51.5	188.0	197.8	204.8
Power Production																			
	Import	MW	57.7	91.7	98.8	98.8	28.8	103.1	107.6	107.6	112.0	32.7	119.2	119.2	119.2	34.8	126.9	133.5	138.2
		%	79	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
	Deasel Generator	MW	15.0	30.6	32.9	32.9	9.6	34.4	35.9	35.9	37.3	10.9	39.7	39.7	39.7	11.6	42.3	44.5	46.1
		%	21	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Total	MW	72.7	122.3	131.7	131.7	38.4	137.5	143.5	143.5	149.3	43.6	158.9	158.9	158.9	46.4	169.2	178.0	184.3
Transmission Loss																			
	Loss (Jaban As to 20kV Bus)	MW	1.12	2.62	3.05	1.83	0.18	3.38	3.73	2.13	2.33	0.21	2.56	2.48	2.39	0.22	2.61	2.83	3.01
		%	1.54	2.14	2.32	1.39	0.47	2.46	2.60	1.48	1.56	0.48	1.61	1.56	1.50	0.47	1.54	1.59	1.63

(2/2)

Case			Case17	Case18	Case19	Case20	Case21	Case22	Case23	Case24	Case25	Case26	Case27	Case28	Case29	Case30	Case31	Case32
Year			2025			2026	2027	2028	2029	2030	2031		2032		2033		2034	2035
Operation Year			9			10	11	12	13	14	15	15	16		17		18	19
Ivent (●: Operation)																		
Demand																		
	Maximum		●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
	Minimum				●													
The Project																		
	230/63kV Tr x 1 at Jaban As		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	63kV Transmission Lines		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Other Projects																		
	Semera International Transmission Line		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Palmeraie Substation		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Jaban As Power Station		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Master Plan																		
	63/20kV Tr x 1at Jaban As S/S		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	No2 and No3 63/20kV Tr at Marabout			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	No3 63/20kV Tr at Boulaos											●	●	●	●	●	●	●
	Capacitor at Jaban As, Marabout and Boulaos															●	●	●
Recommendation																		
	No.4 230/63kV Tr at Jaban As													●	●	●	●	●
Load Allocation																		
	Power Factor		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Marabout	MW	32.1	32.1	9.4	33.7	35.4	36.4	37.5	38.6	39.8	39.8	41.0	41.0	42.3	42.3	43.7	45.2
		MVar	15.5	15.5	4.5	16.3	17.1	17.6	18.2	18.7	19.3	19.3	19.9	19.9	20.5	20.5	21.2	21.9
		MVA	35.7	35.7	10.4	37.4	39.3	40.4	41.7	42.9	44.2	44.2	45.6	45.6	47.0	47.0	48.6	50.2
	Boulaos	MW	57.2	57.2	16.7	58.7	60.3	61.9	63.6	65.4	67.3	67.3	69.2	69.2	71.3	71.3	73.5	75.8
		MVar	27.7	27.7	8.1	28.4	29.2	30.0	30.8	31.7	32.6	32.6	33.5	33.5	34.5	34.5	35.6	36.7
		MVA	63.6	63.6	18.6	65.2	67.0	68.8	70.7	72.7	74.8	74.8	76.9	76.9	79.2	79.2	81.7	84.2
	Jaban As	MW	54.3	54.3	15.9	55.7	57.2	58.7	60.2	61.7	61.8	61.8	62.0	62.0	62.1	62.1	62.3	62.5
		MVar	26.3	26.3	7.7	27.0	27.7	28.4	29.2	29.9	29.9	29.9	30.0	30.0	30.1	30.1	30.2	30.3
		MVA	60.3	60.3	17.6	61.9	63.6	65.2	66.9	68.6	68.7	68.7	68.9	68.9	69.0	69.0	69.2	69.5
	New Nagad	MW	22.5	22.5	6.6	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
		MVar	10.9	10.9	3.2	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
		MVA	25.0	25.0	7.3	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
	Palmeraie	MW	19.0	19.0	5.6	19.6	20.2	20.8	21.5	22.2	23.0	23.0	23.8	23.8	24.6	24.6	25.5	26.4
		MVar	9.2	9.2	2.7	9.5	9.8	10.1	10.4	10.8	11.1	11.1	11.5	11.5	11.9	11.9	12.4	12.8
		MVA	21.2	21.2	6.2	21.8	22.4	23.1	23.9	24.7	25.6	25.6	26.4	26.4	27.3	27.3	28.3	29.3
	Ali Sabieh	MW	4.9	4.9	1.4	5.0	5.0	5.1	5.1	5.2	5.2	5.2	5.3	5.3	5.4	5.4	5.4	5.5
		MVar	2.4	2.4	0.7	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.7
		MVA	5.4	5.4	1.6	5.6	5.6	5.7	5.7	5.8	5.8	5.8	5.9	5.9	6.0	6.0	6.0	6.1
	Total	MW	190.0	190.0	55.5	195.2	200.6	205.4	210.4	215.6	219.6	219.6	223.8	223.8	228.2	228.2	232.9	237.9
		MVar	89.7	89.7	26.2	92.1	94.7	97.0	99.4	101.9	103.8	103.8	105.8	105.8	107.9	107.9	110.2	112.6
		MVA	211.2	211.2	61.7	216.9	222.9	228.2	233.8	239.6	244.0	244.0	248.7	248.7	253.6	253.6	258.8	264.3
Power Production																		
	Import	MW	142.5	142.5	41.6	146.4	150.5	154.1	157.8	161.7	164.7	164.7	167.9	167.9	171.2	171.2	174.7	178.4
		%	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
	Deasel Generator	MW	47.5	47.5	13.9	48.8	50.2	51.4	52.6	53.9	54.9	54.9	56.0	56.0	57.1	57.1	58.2	59.5
		%	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Total	MW	190.0	190.0	55.5	195.2	200.7	205.5	210.4	215.6	219.6	219.6	223.9	223.9	228.3	228.3	232.9	237.9
Transmission Loss																		
	Loss (Jaban As to 20kV Bus)	MW	3.26	3.06	0.24	3.32	3.23	3.37	3.66	3.83	4.07	3.86	4.11	3.95	4.11	3.86	4.04	4.30
		%	1.72	1.61	0.43	1.70	1.61	1.64	1.74	1.78	1.85	1.76	1.84	1.76	1.80	1.69	1.73	1.81

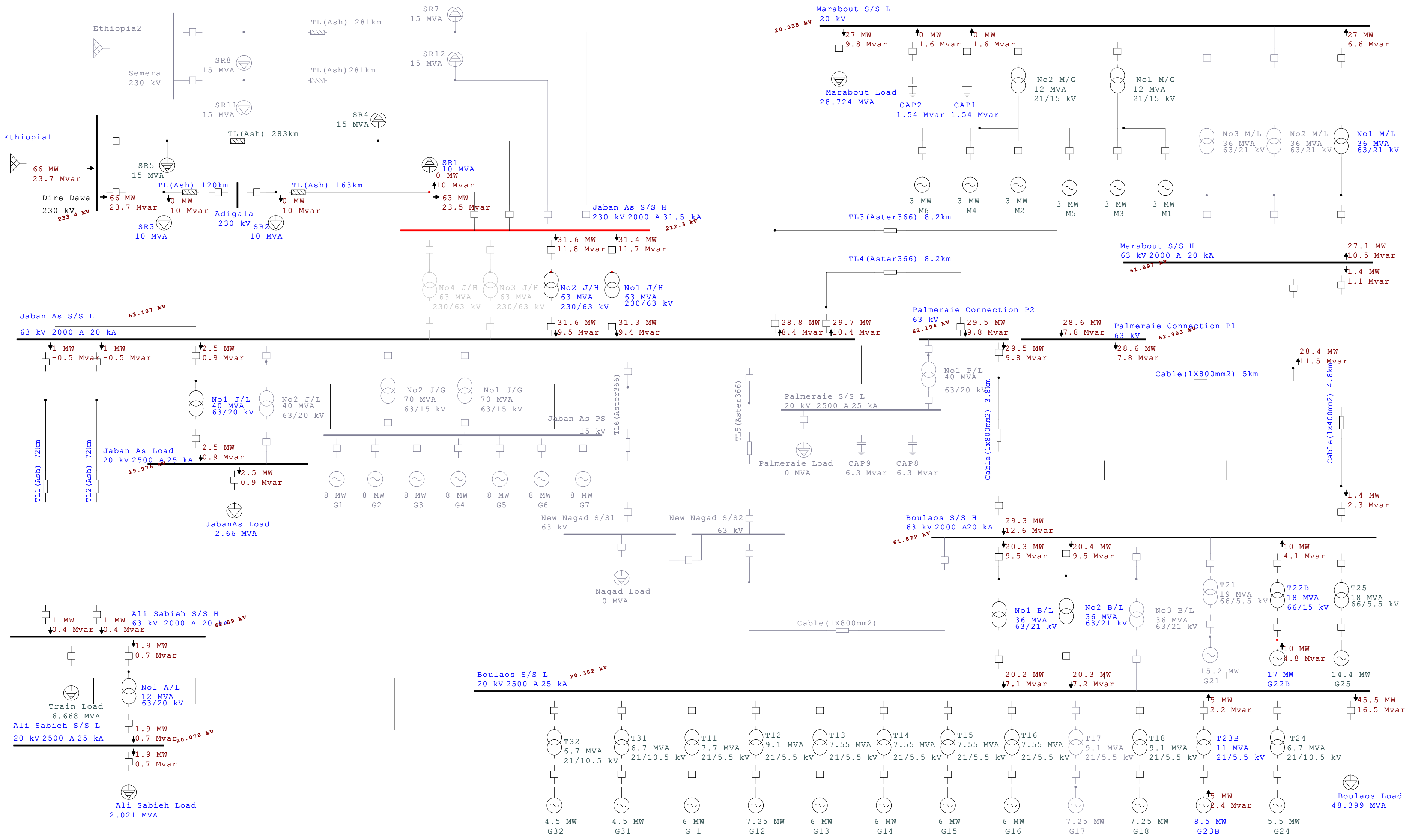


Fig.1 Load Flow Chart 2012 (Base)

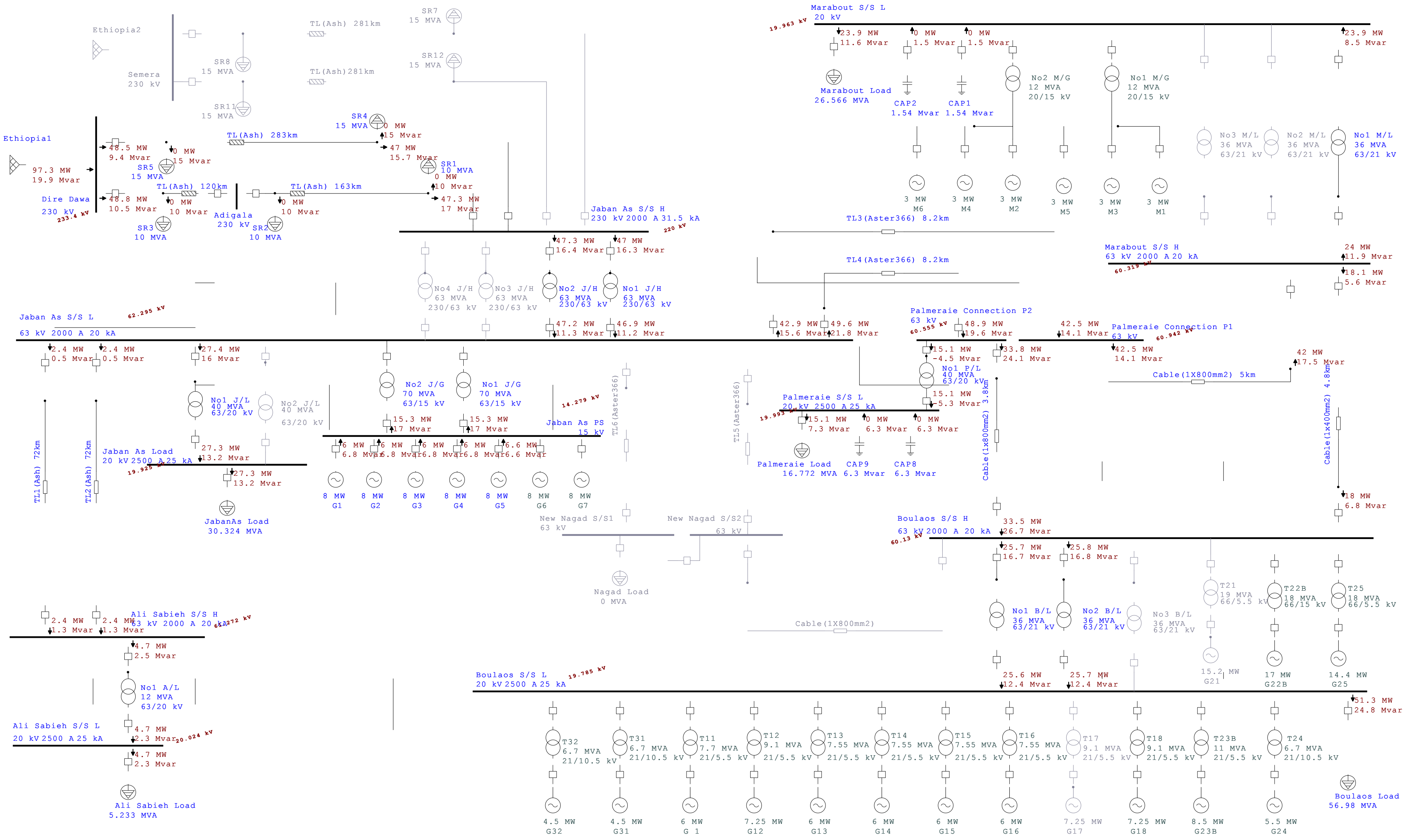


Fig.2 Load Flow Chart 2016 (Case1)

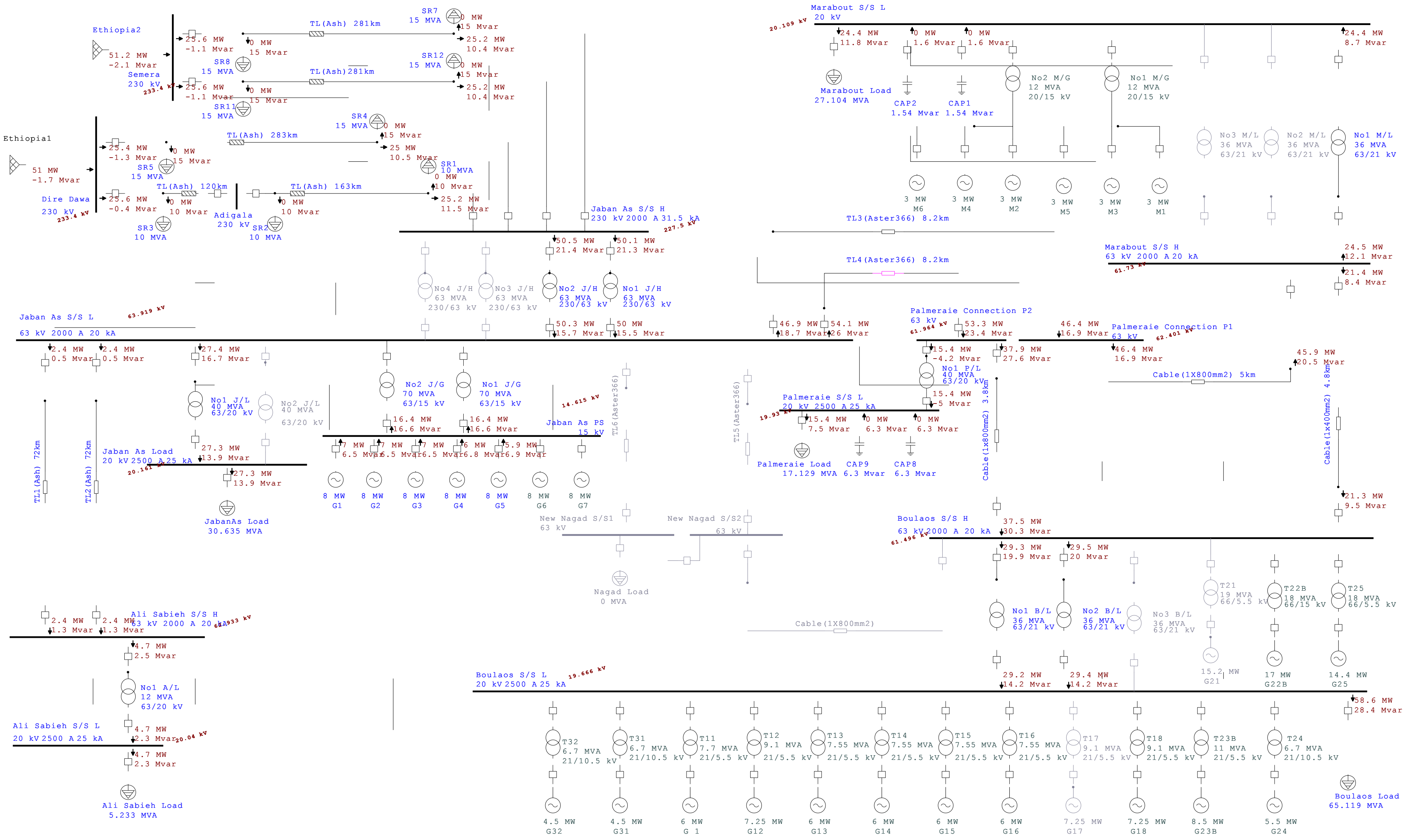


Fig.3 Load Flow Chart 2017 (Case2)

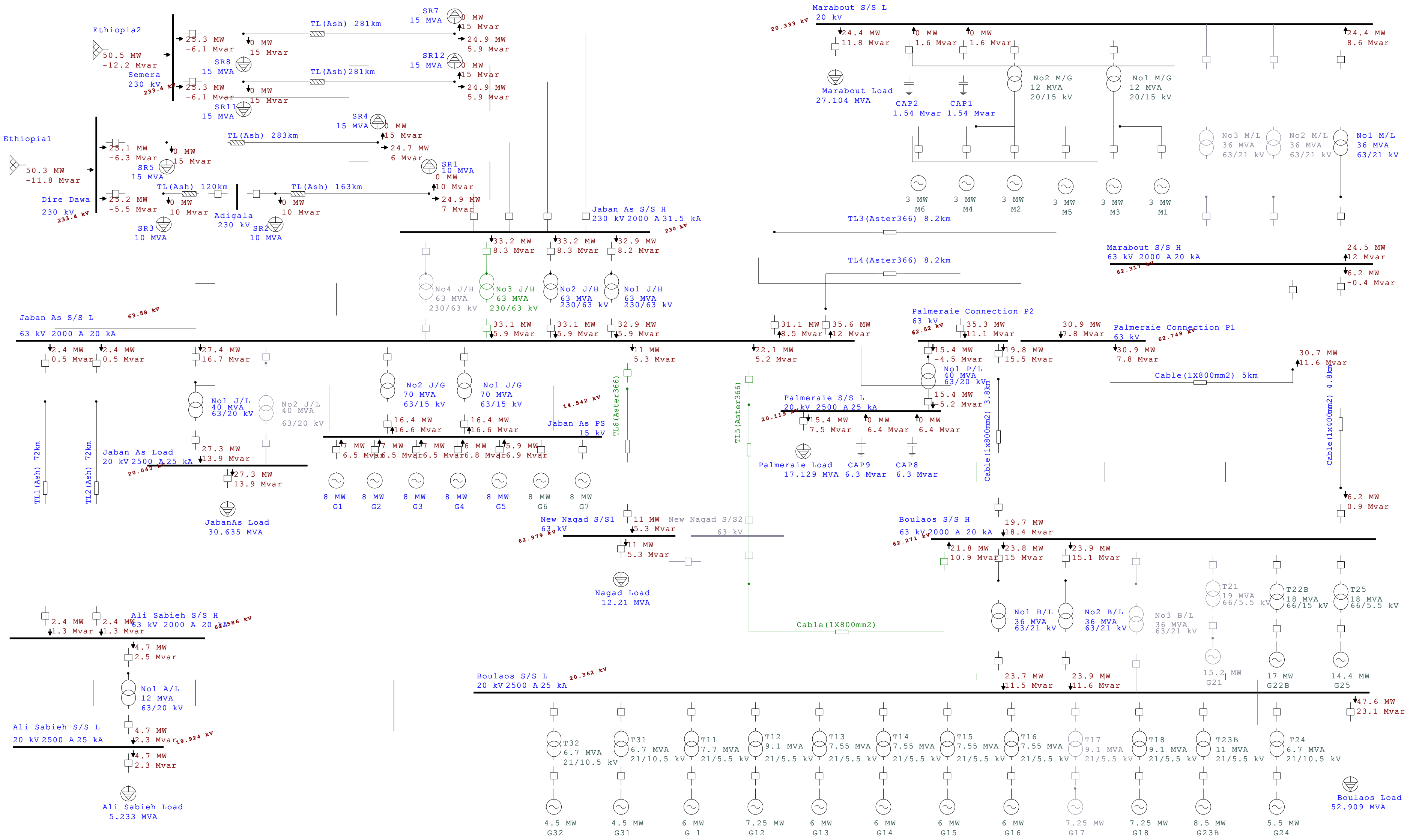


Fig.4 Load Flow Chart 2017 (Case3)

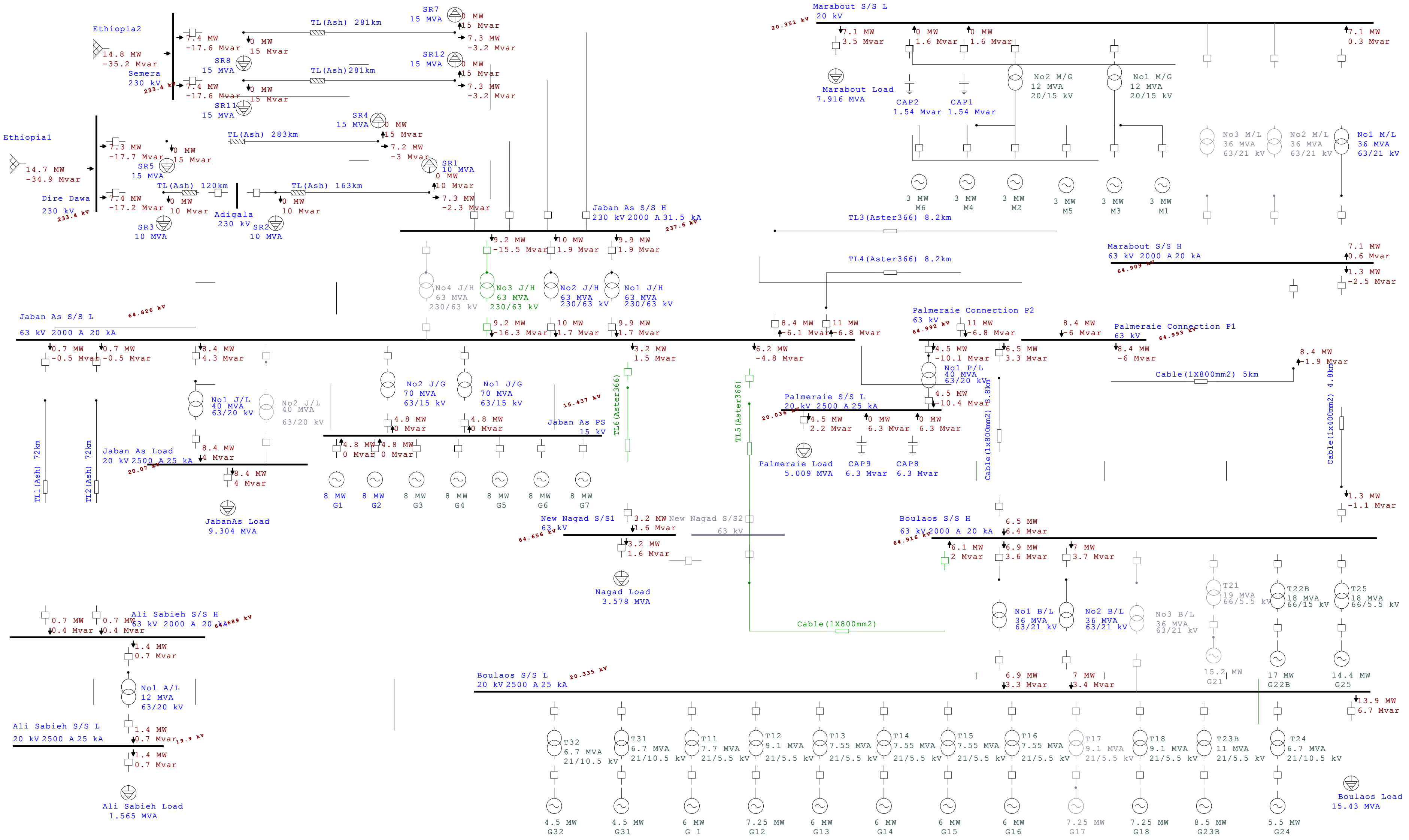


Fig.5 Load Flow Chart 2017 (Case4)

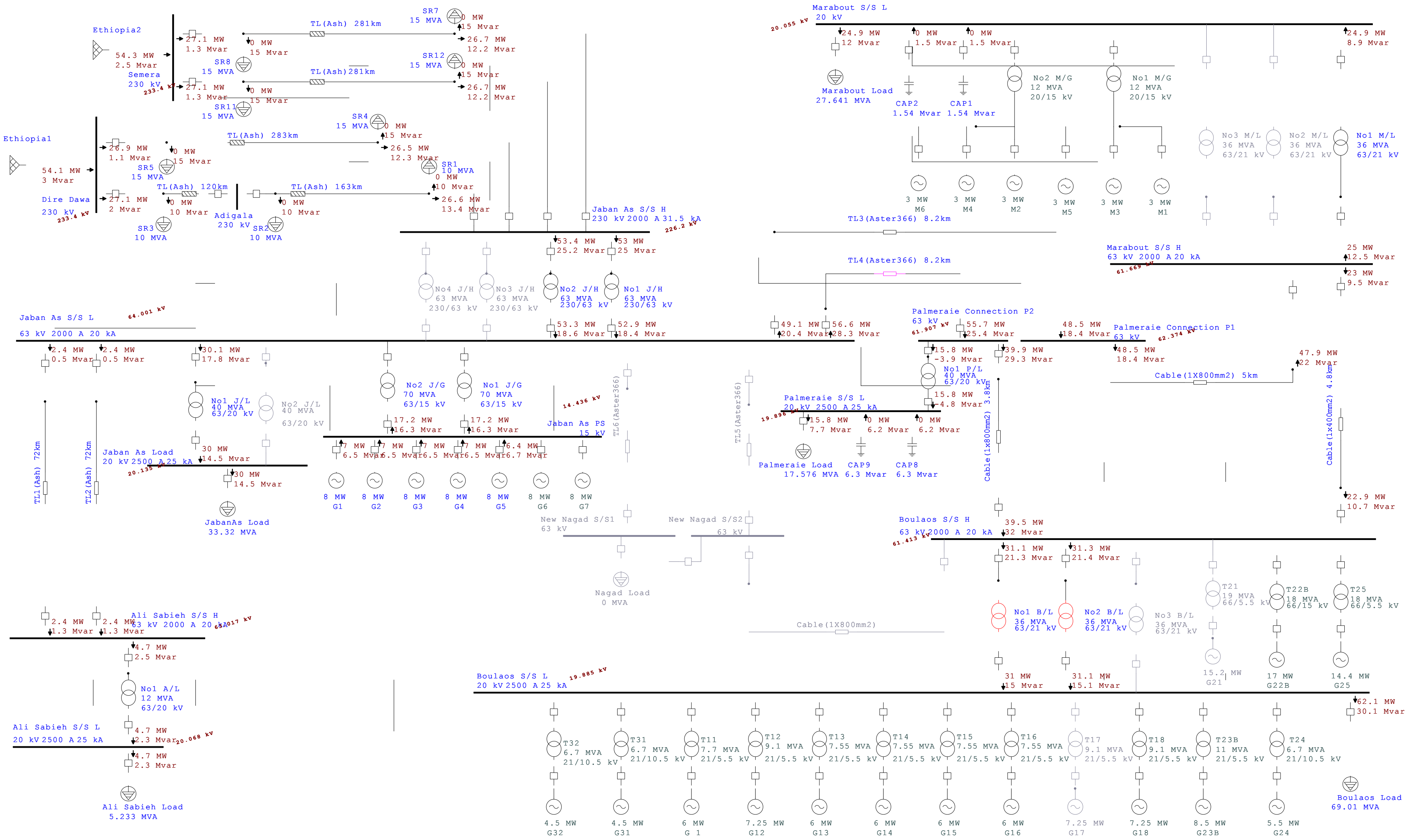


Fig.6 Load Flow Chart 2018 (Case5)

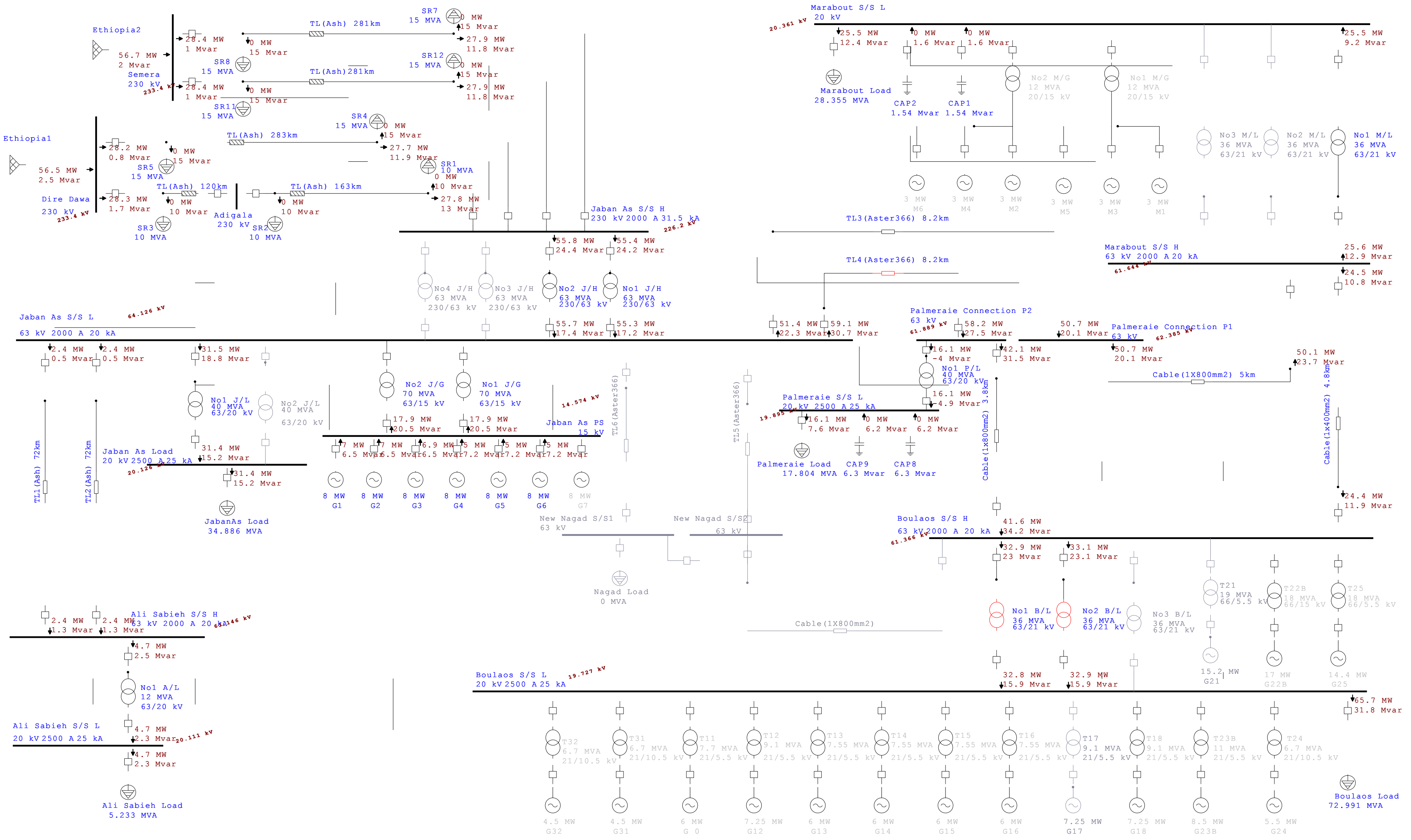


Fig.7 Load Flow Chart 2019 (Case6)

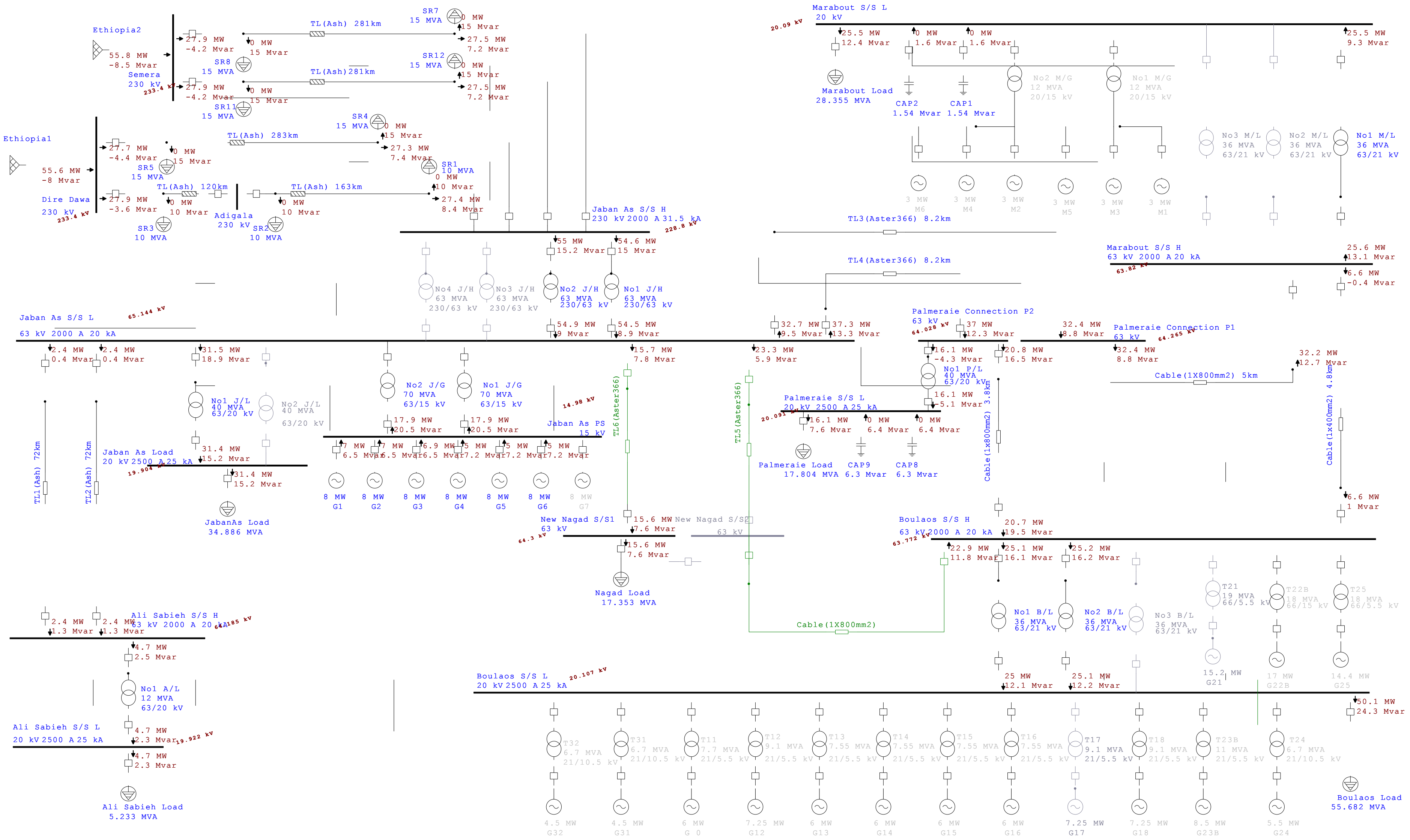


Fig.8 Load Flow Chart 2020 (Case7)

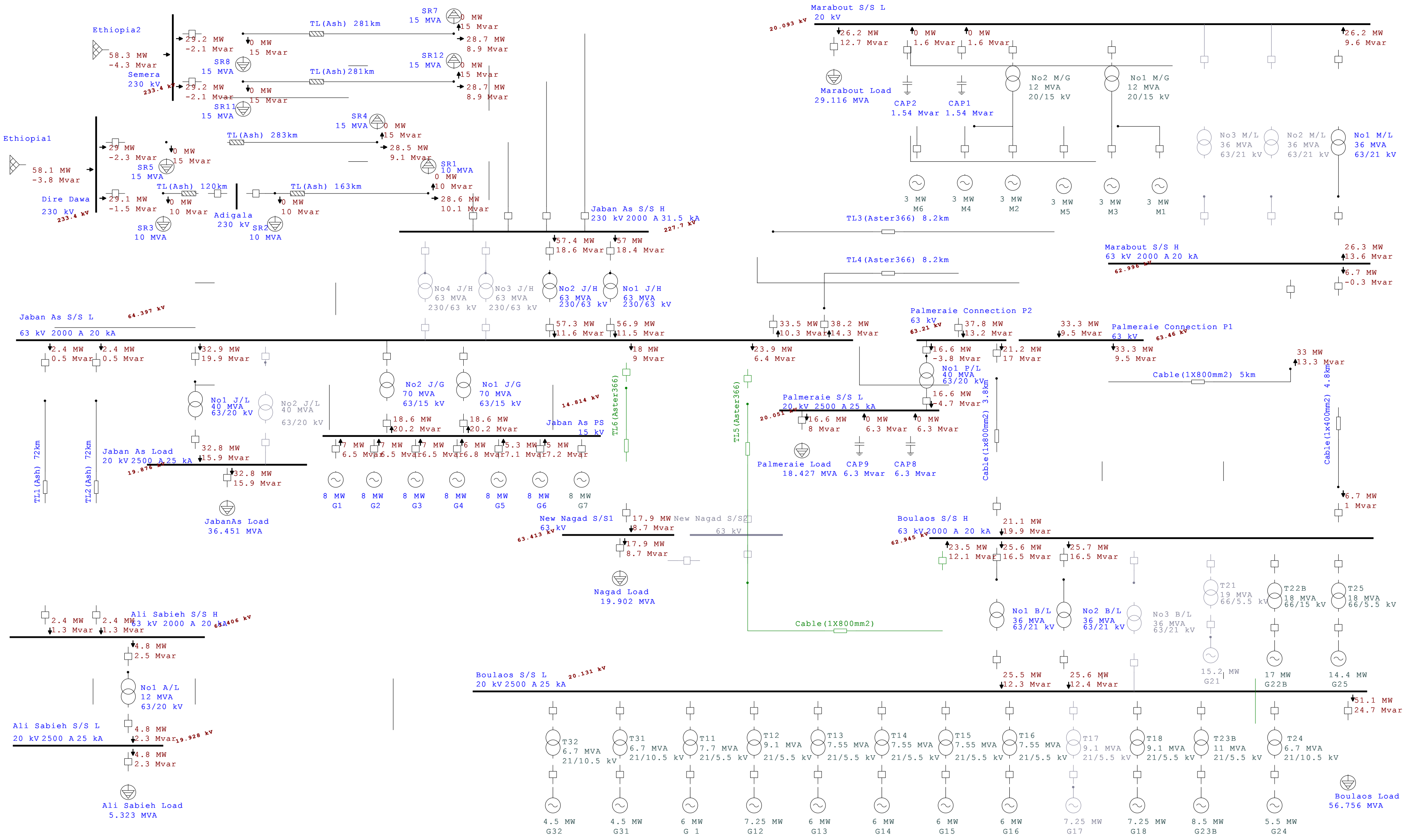


Fig.9 Load Flow Chart 2020 (Case8)

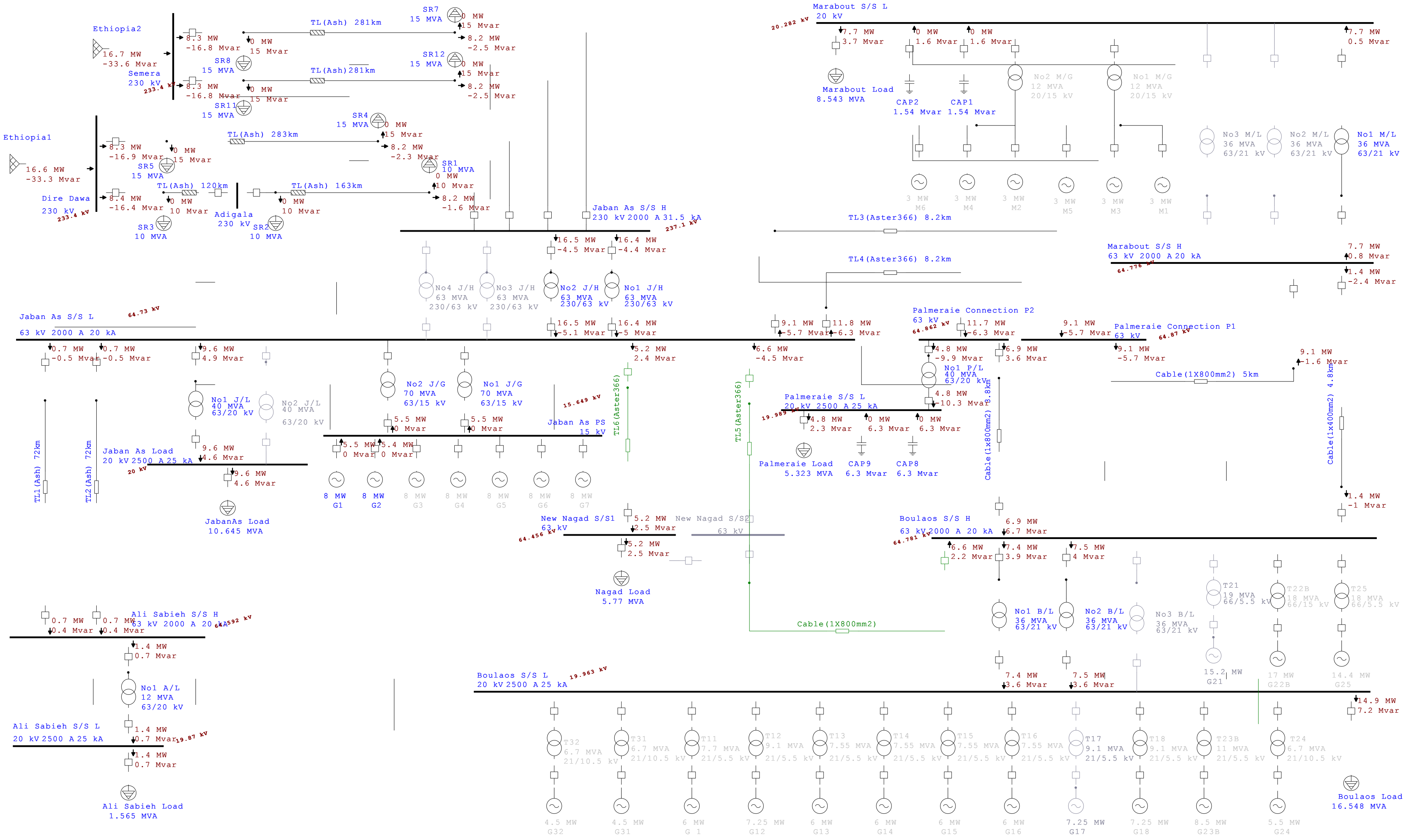


Fig.10 Load Flow Chart 2020 (Case9)

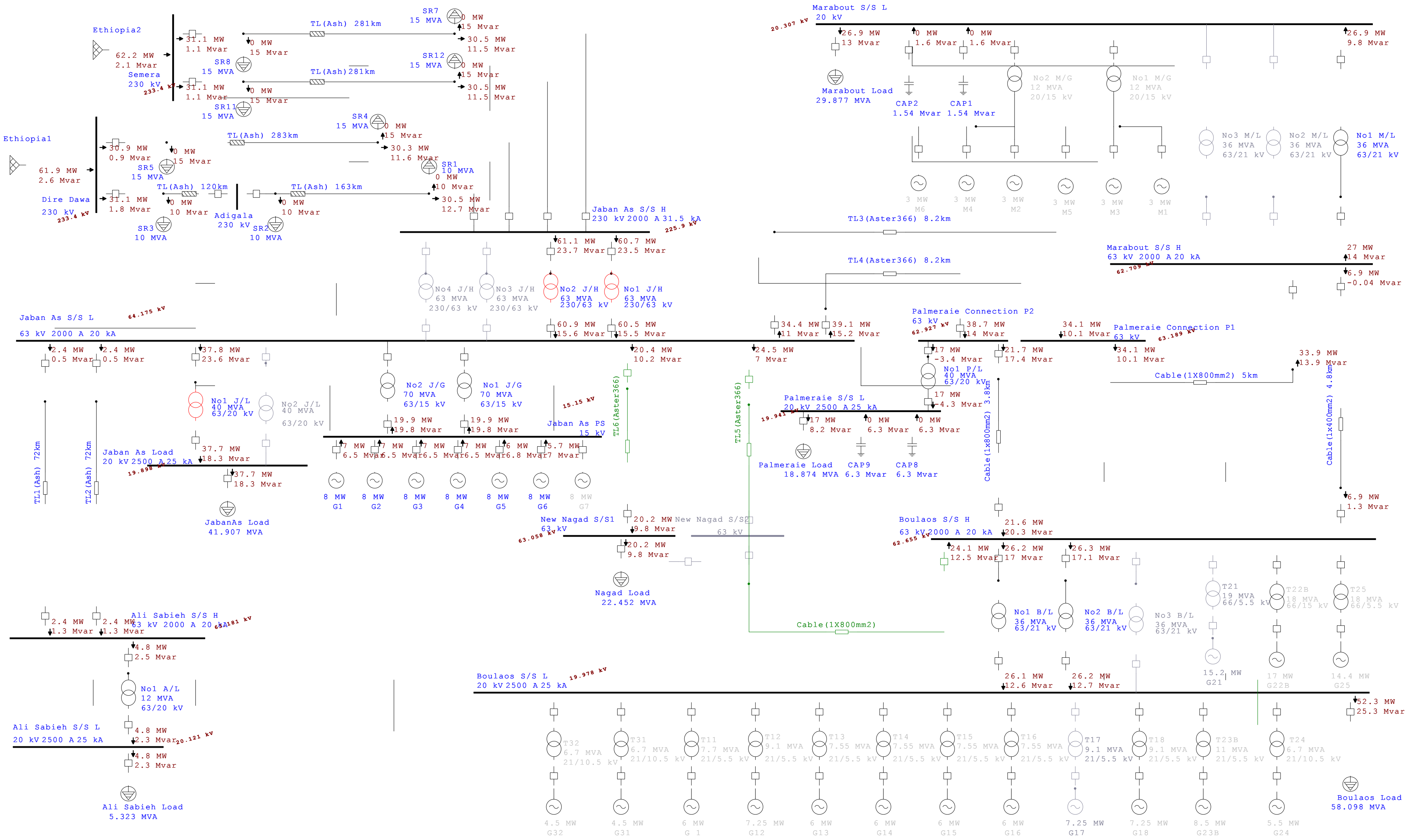


Fig.11 Load Flow Chart 2021 (Case10)

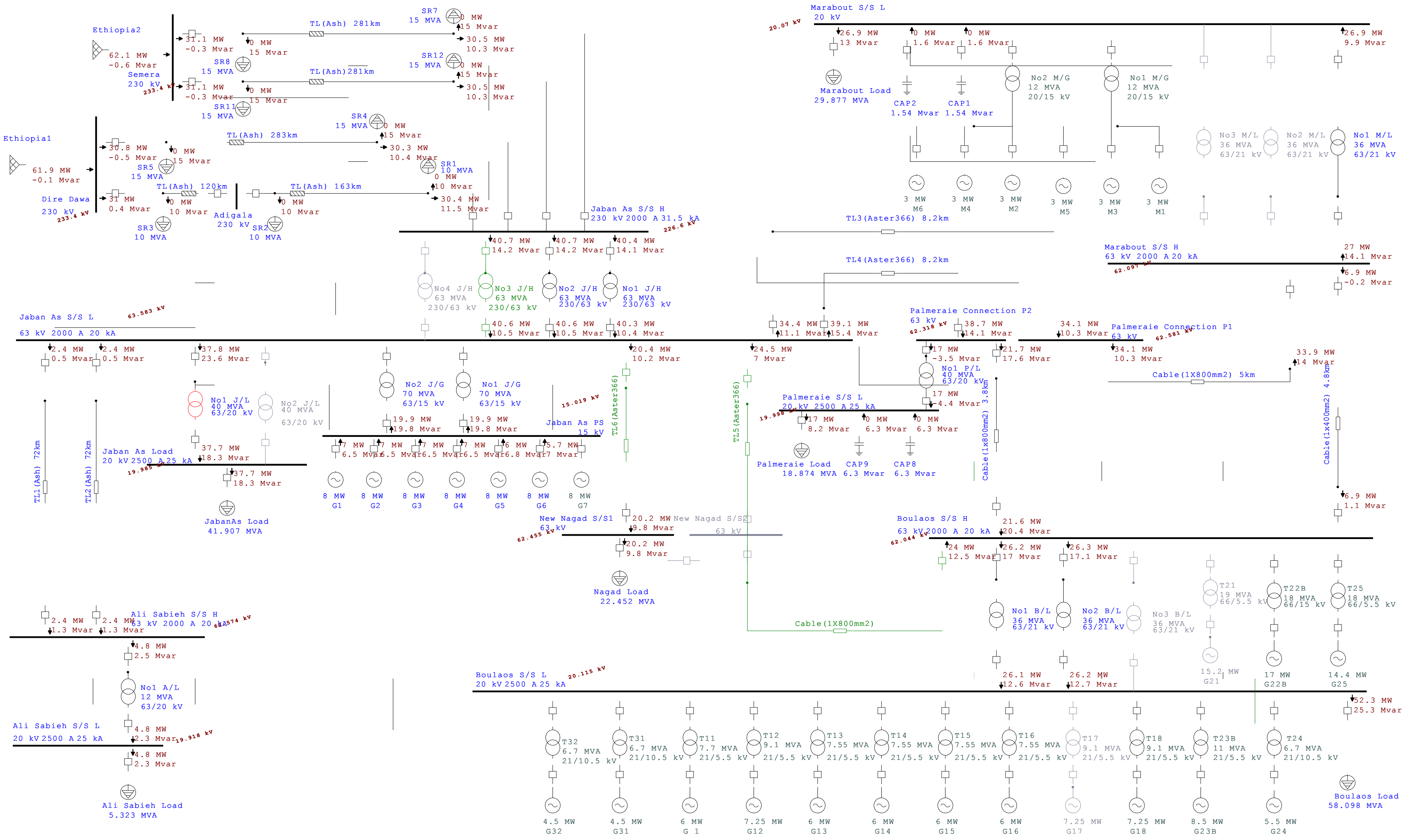


Fig.12 Load Flow Chart 2021 (Case11)

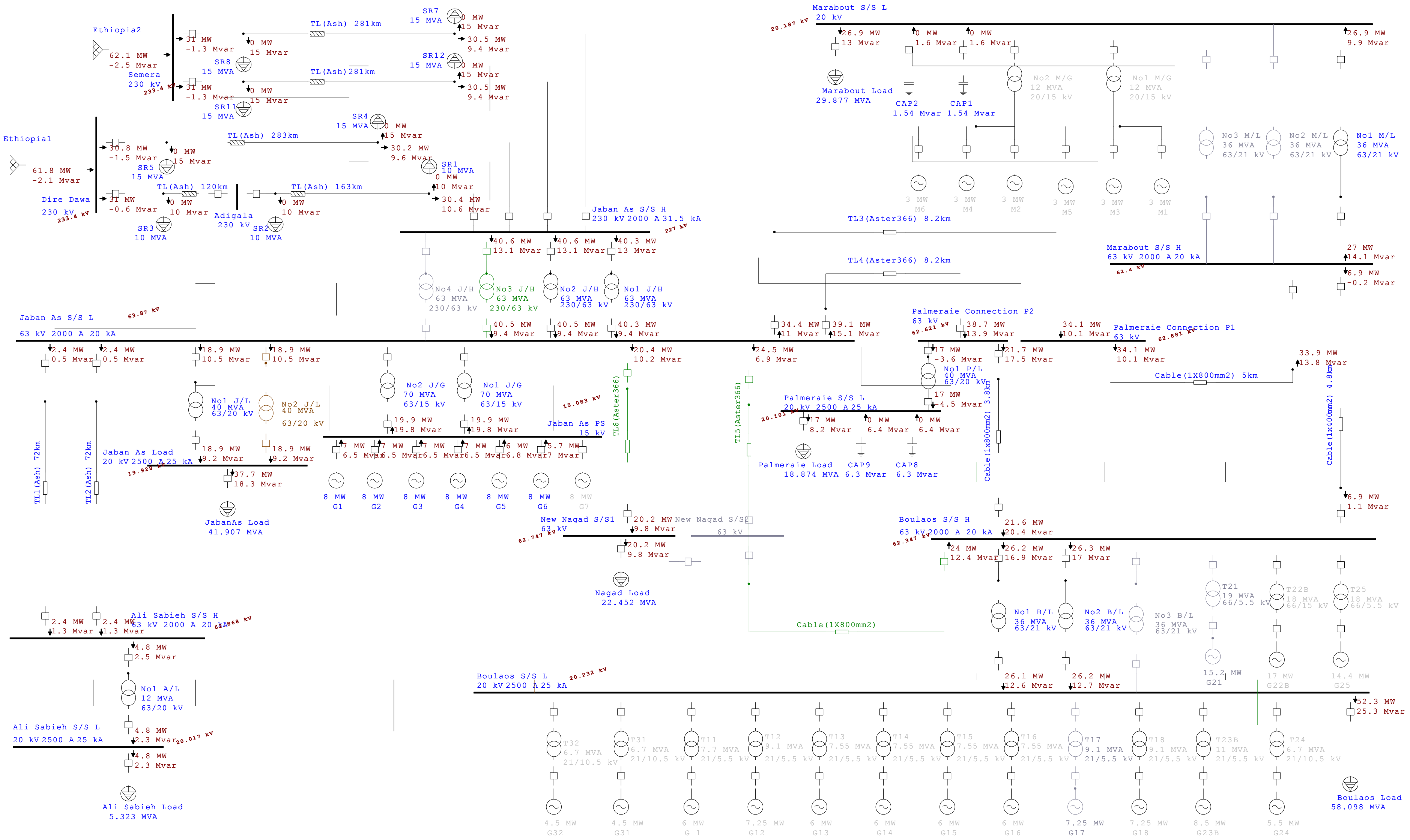


Fig.13 Load Flow Chart 2021 (Case12)

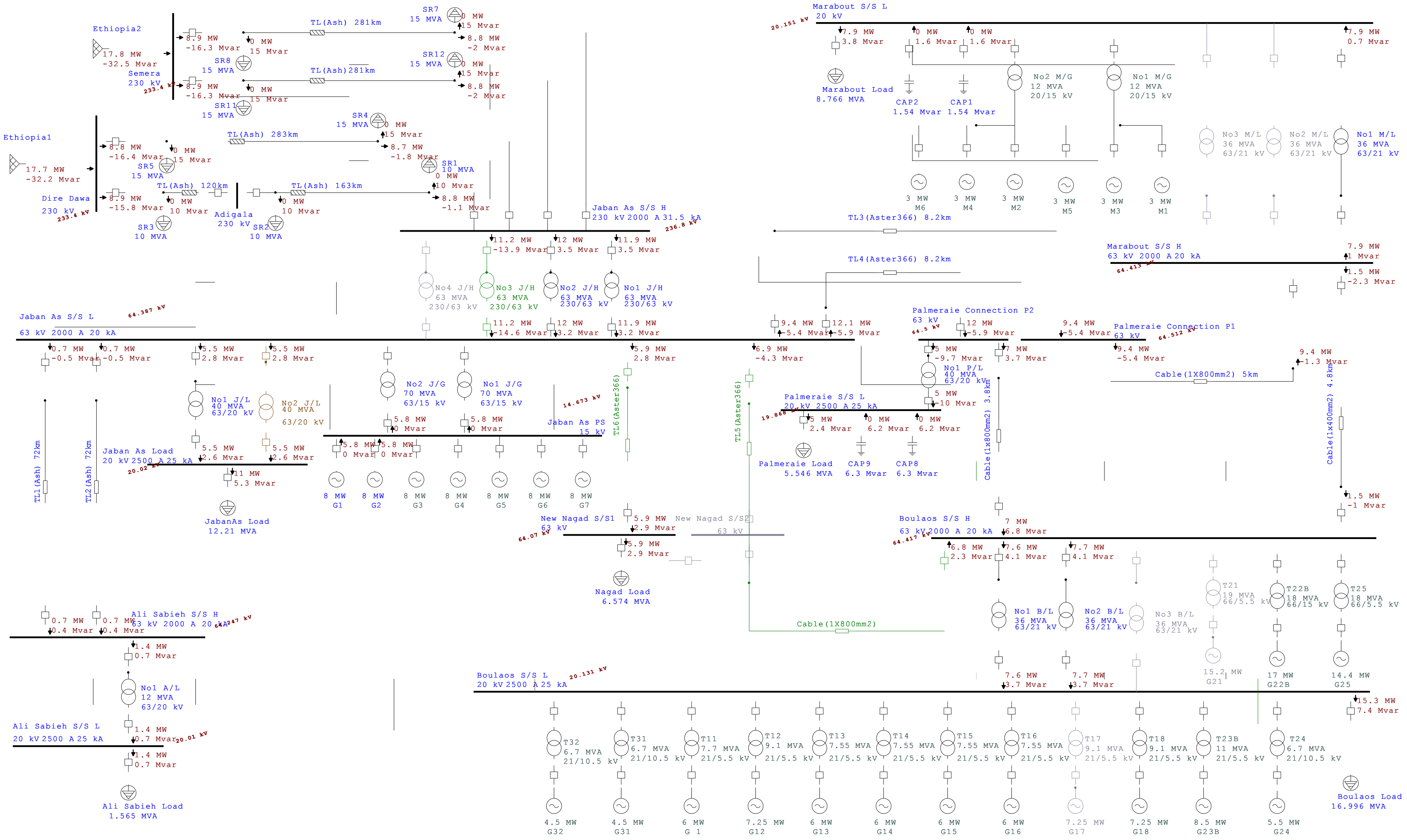


Fig.14 Load Flow Chart 2021 (Case13)

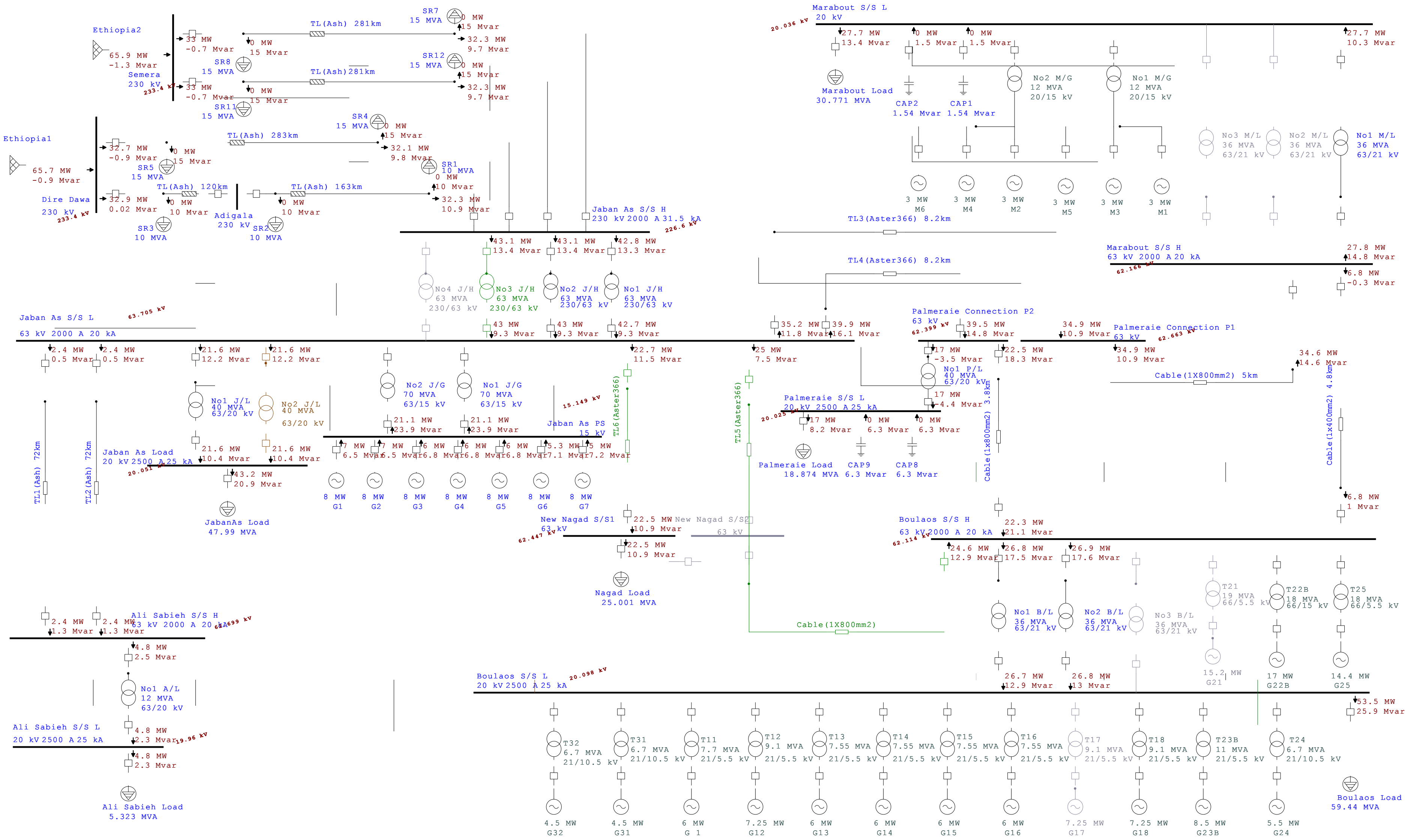


Fig.15 Load Flow Chart 2022 (Case14)

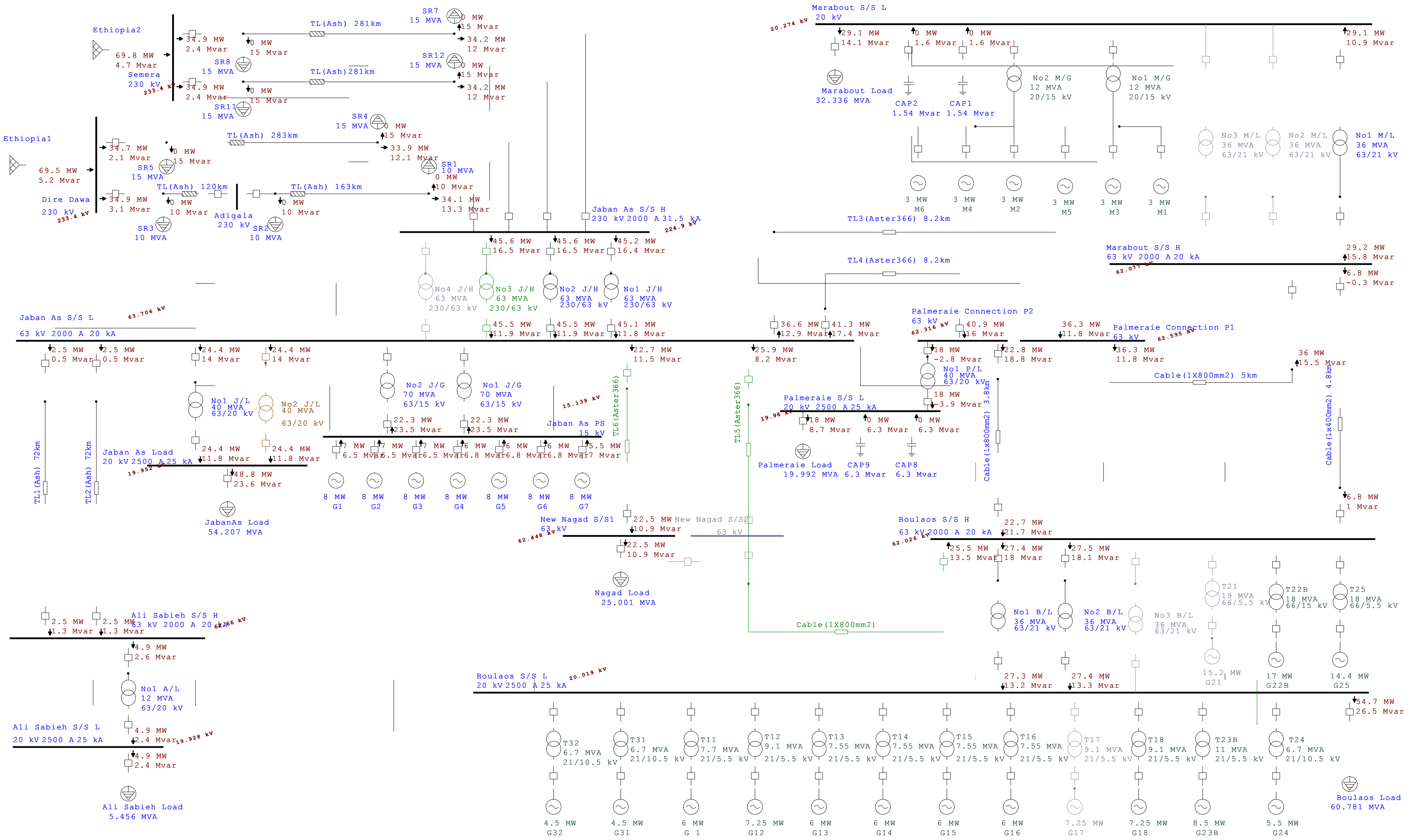


Fig.16 Load Flow Chart 2023 (Case15)

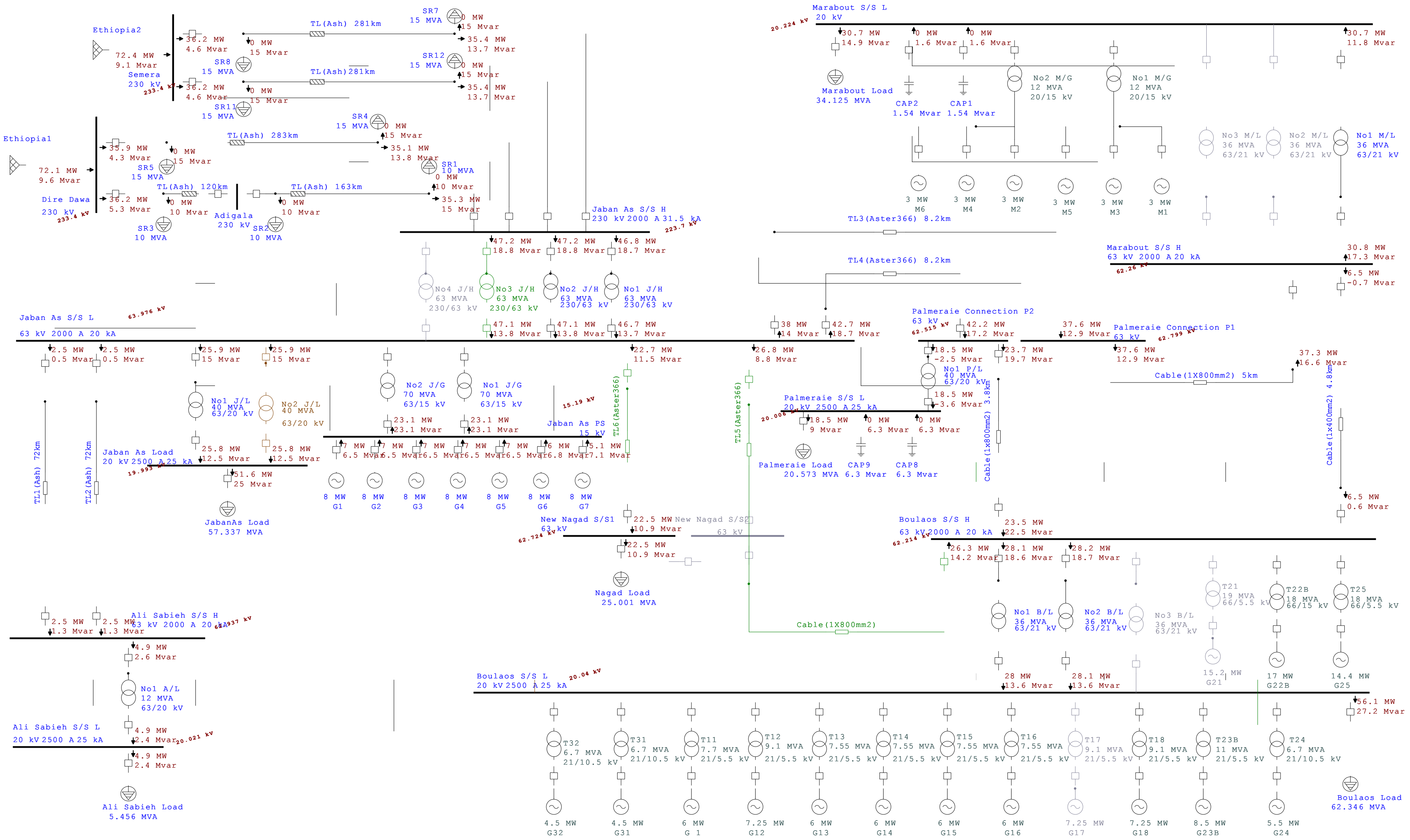


Fig.17 Load Flow Chart 2024 (Case16)

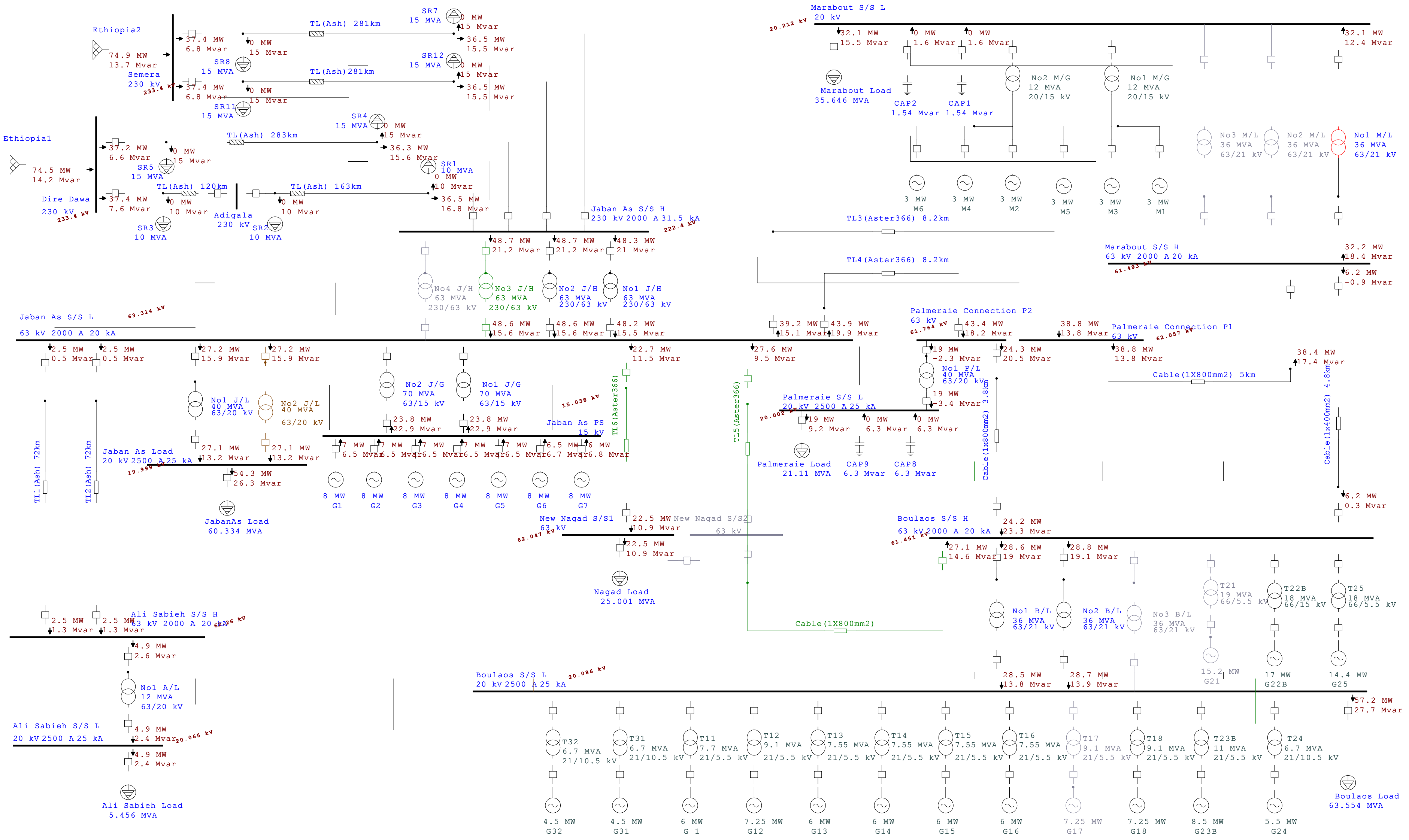


Fig.18 Load Flow Chart 2025 (Case17)

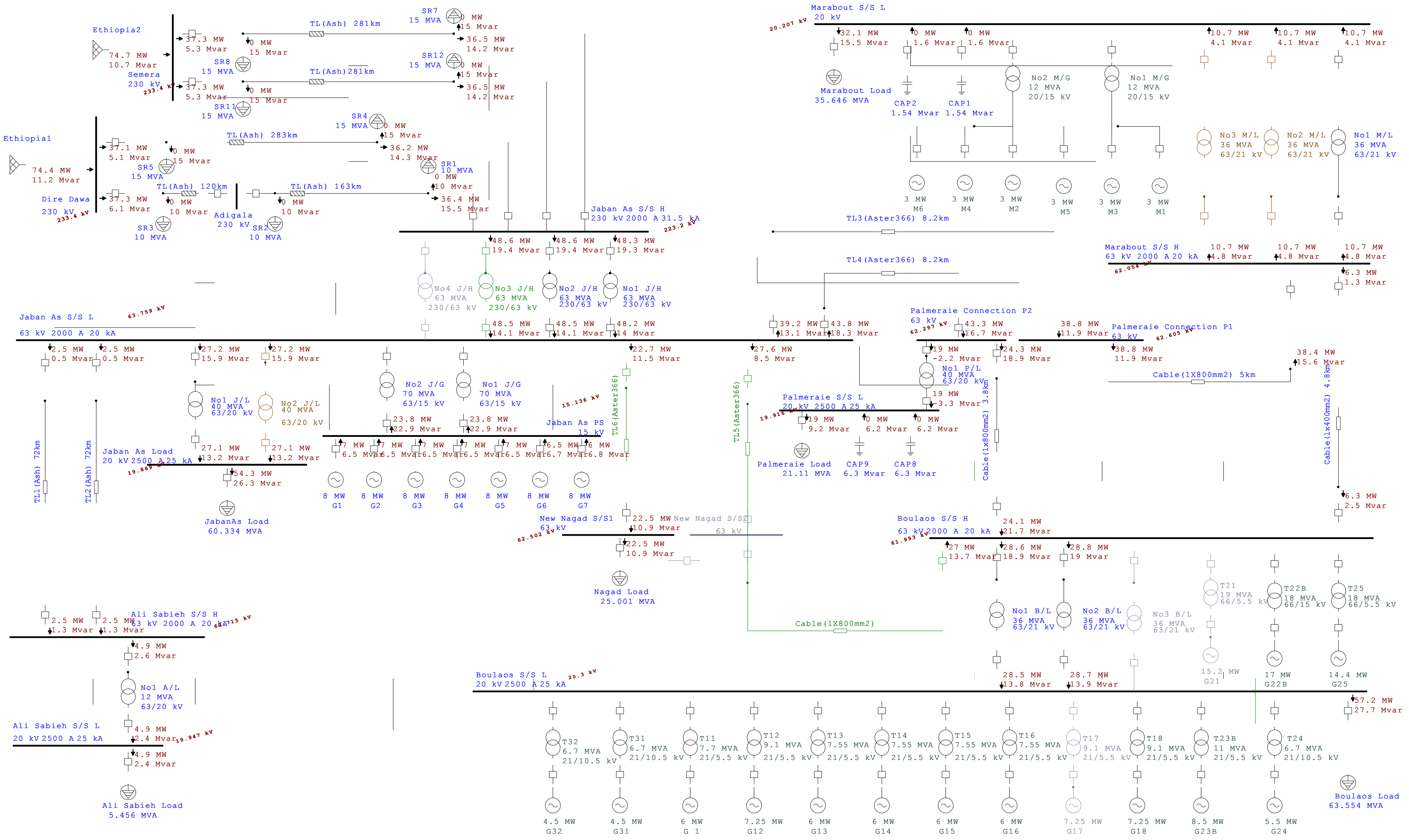


Fig.19 Load Flow Chart 2025 (Case18)

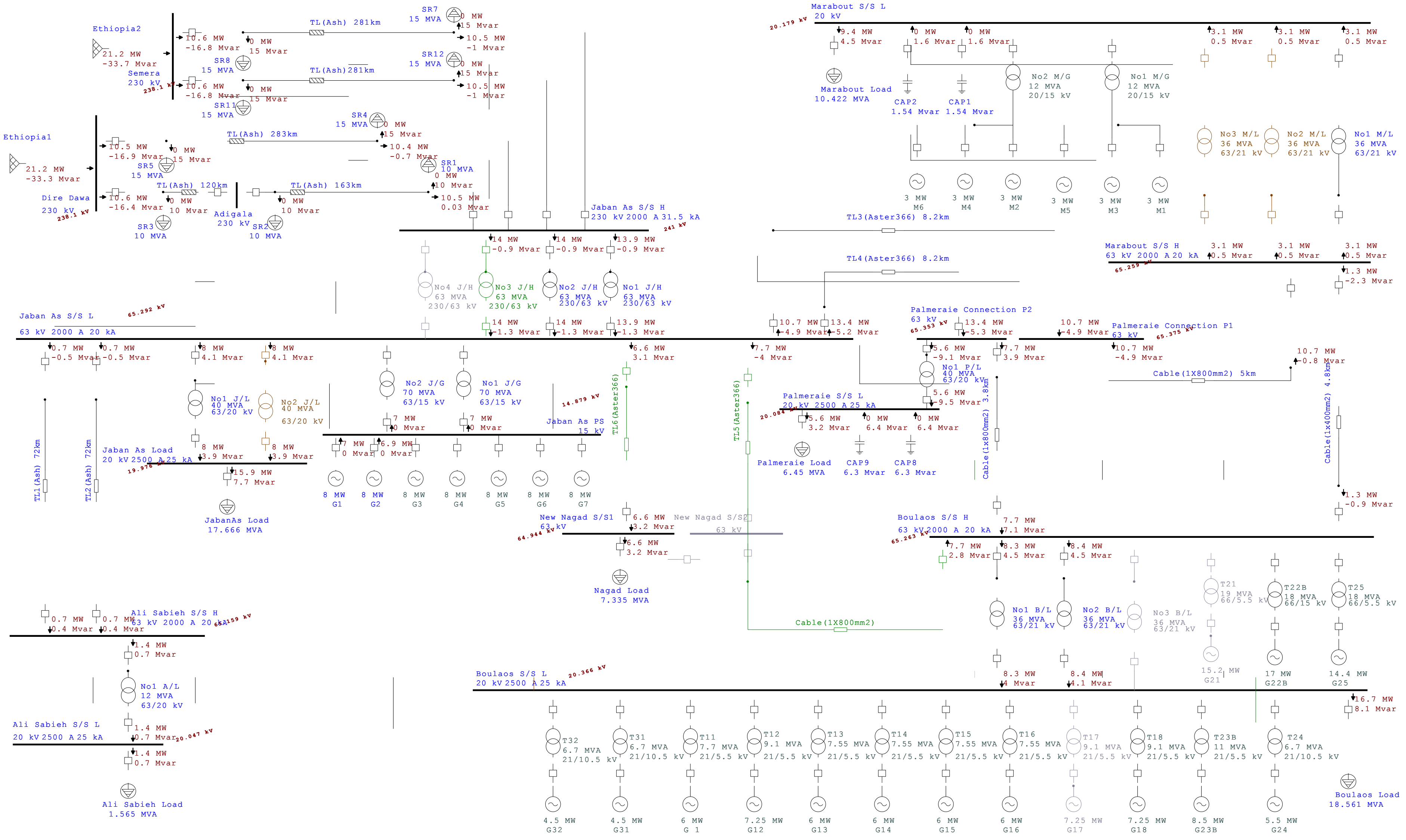


Fig.20 Load Flow Chart 2025 (Case19)

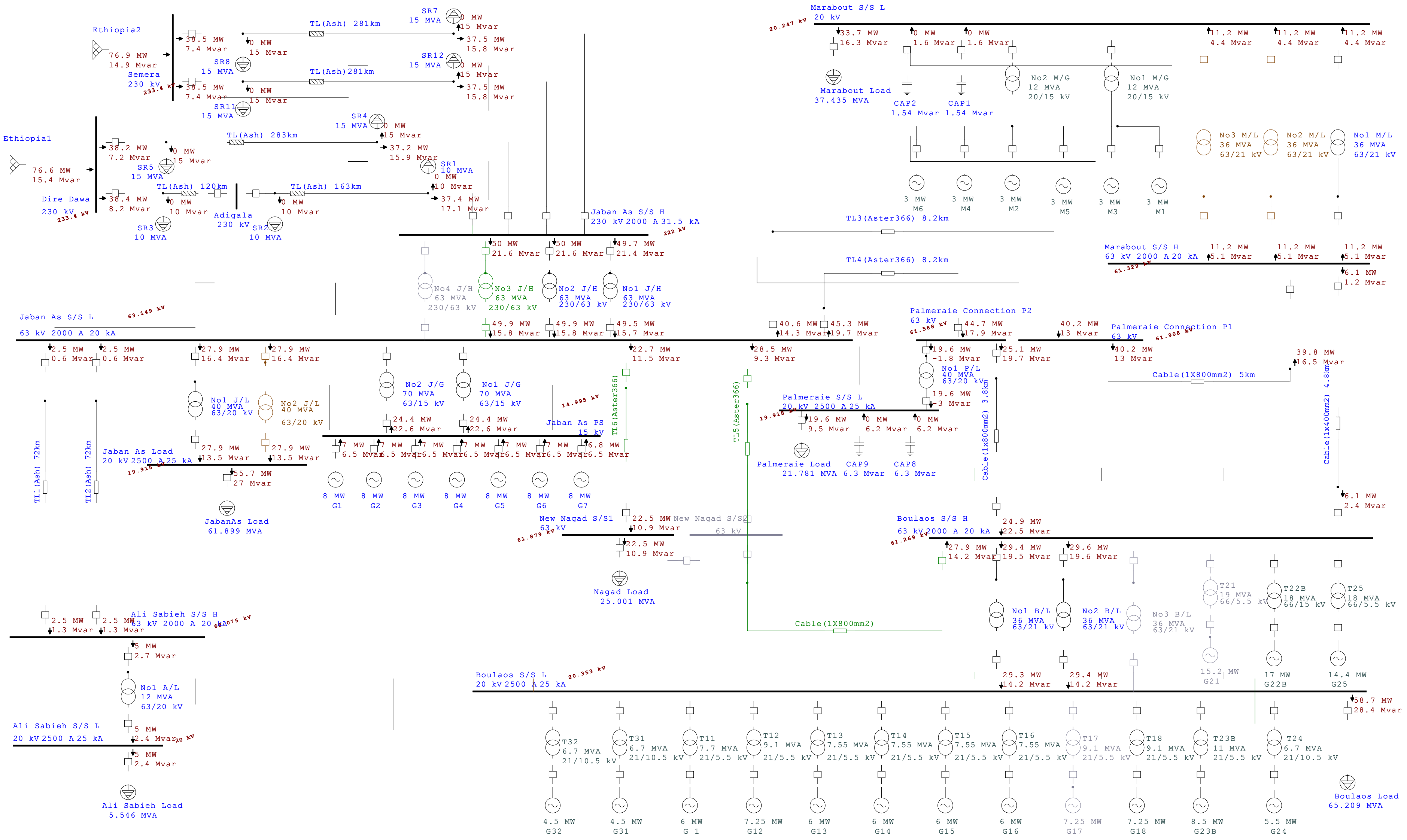


Fig.21 Load Flow Chart 2026 (Case20)

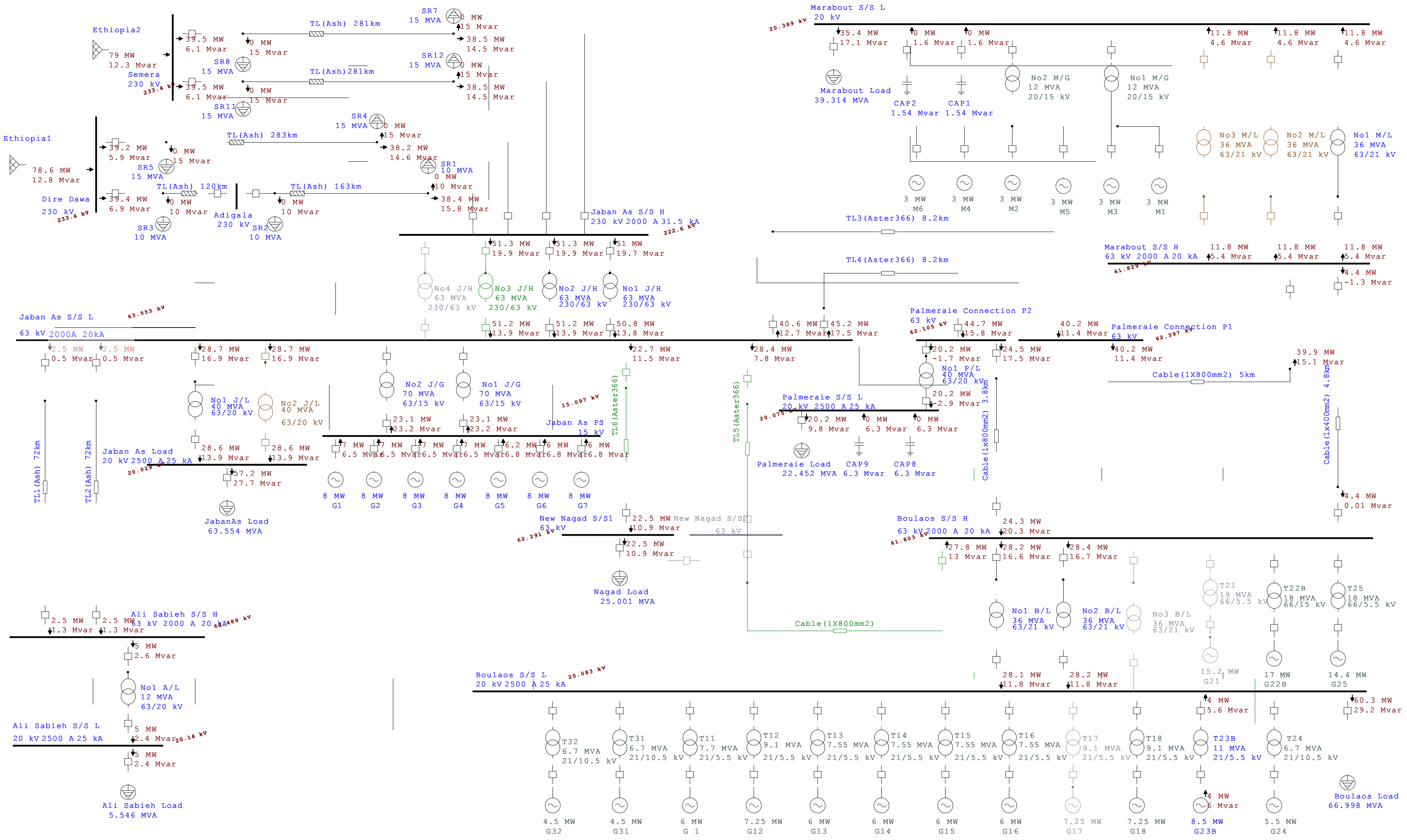


Fig.22 Load Flow Chart 2027 (Case21)

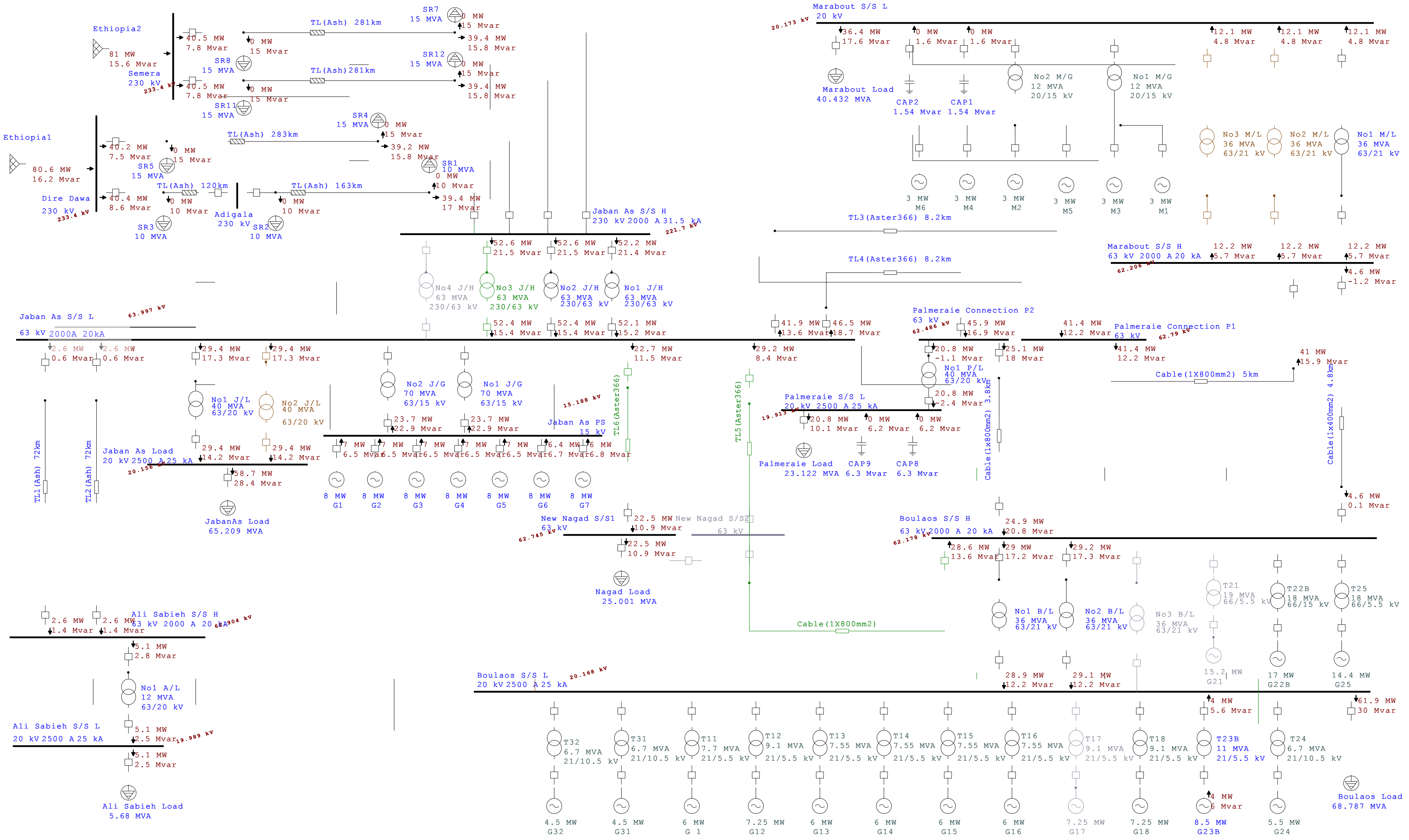


Fig. 23 Load Flow Chart 2028 (Case22)

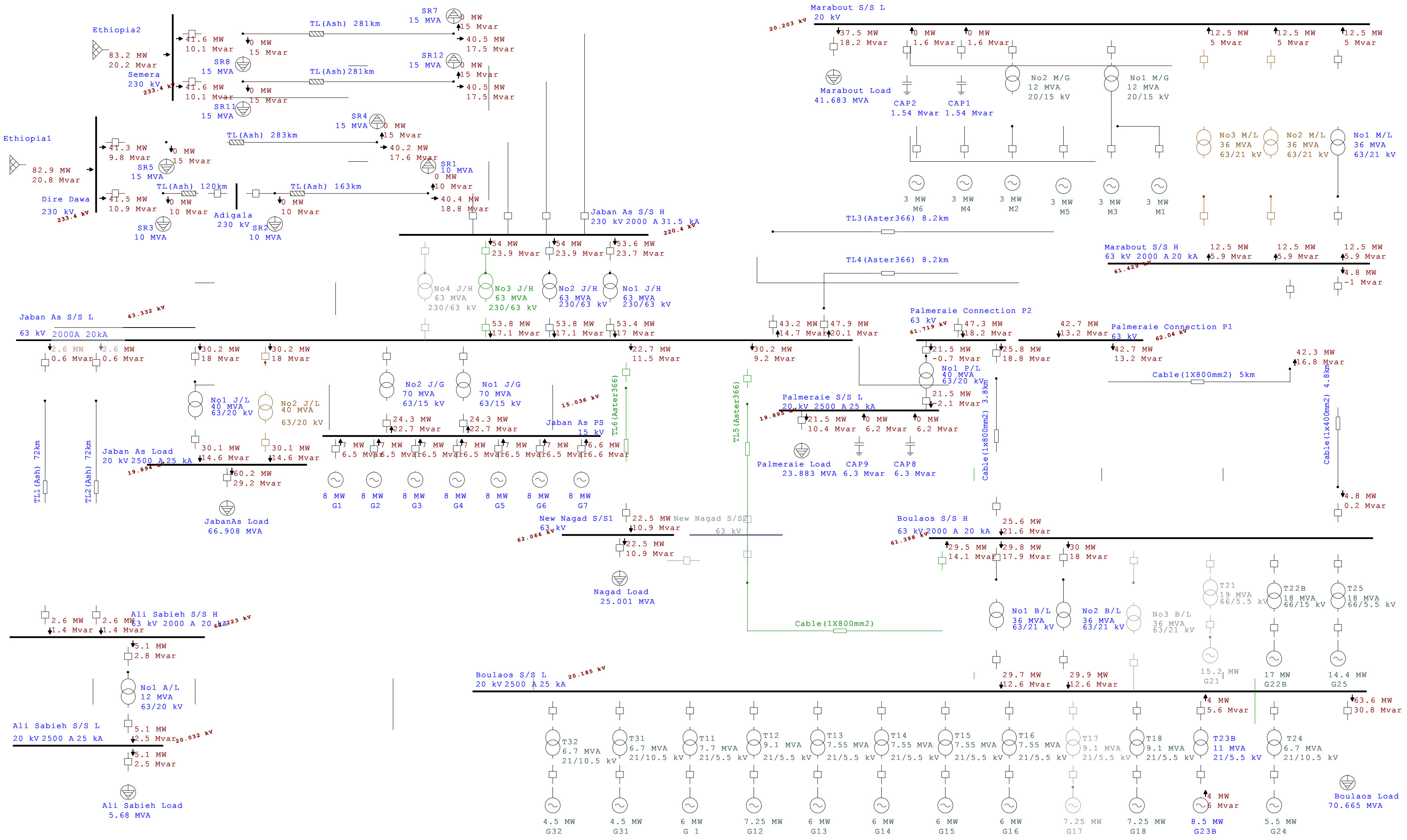


Fig.24 Load Flow Chart 2029 (Case23)

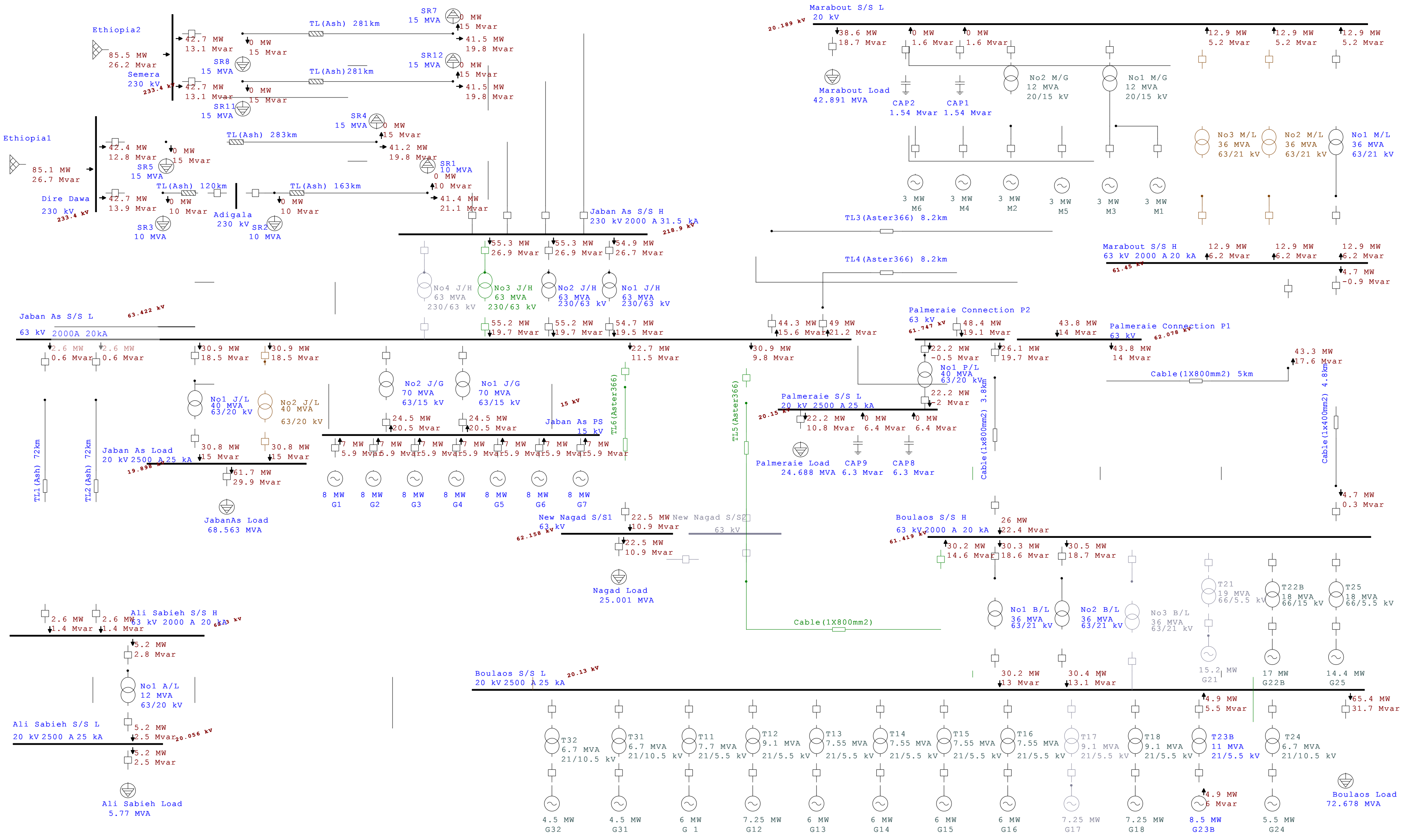


Fig.25 Load Flow Chart 2030 (Case24)

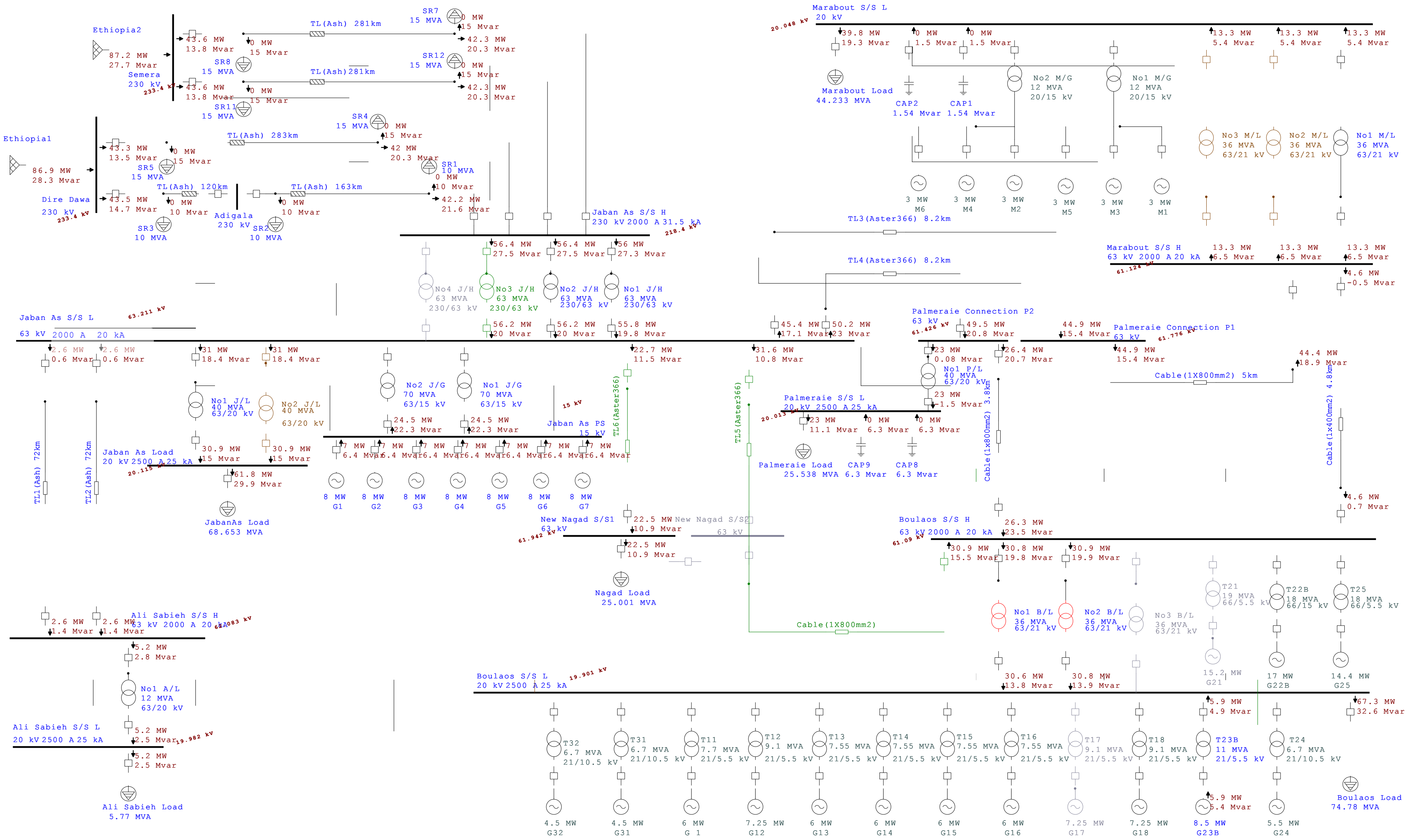


Fig.26 Load Flow Chart 2031 (Case25)

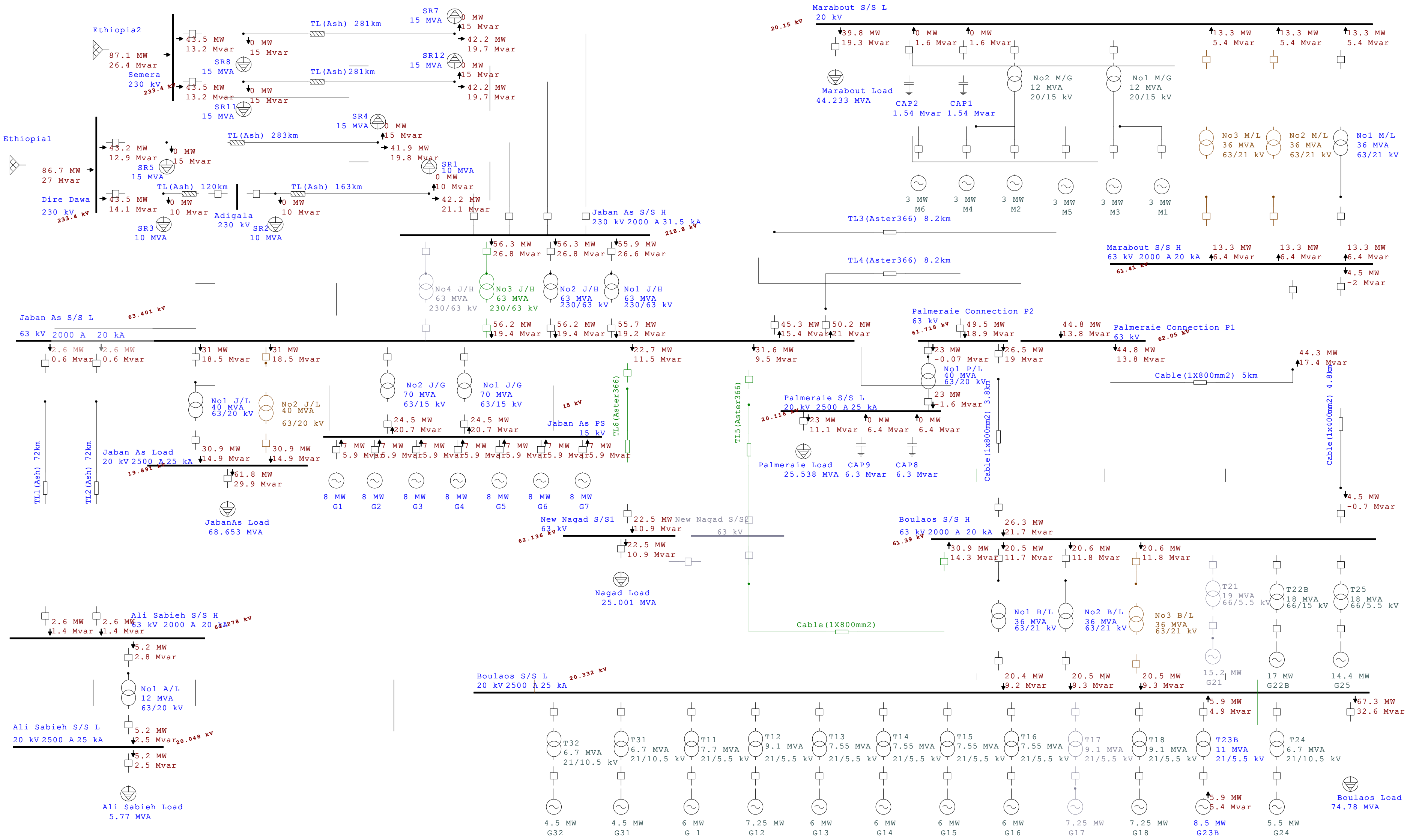


Fig.27 Load Flow Chart 2031 (Case26)

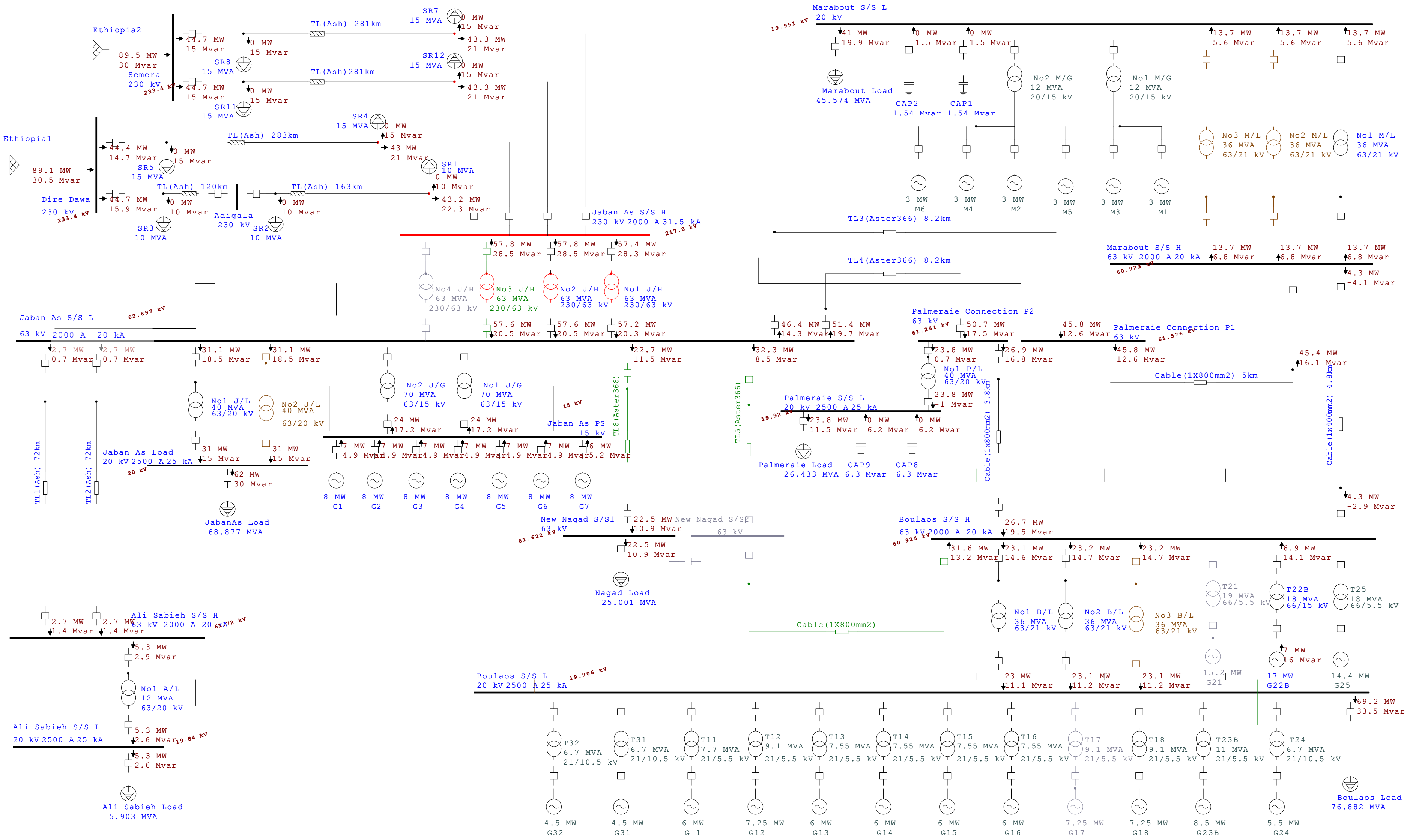


Fig.28 Load Flow Chart 2032 (Case27)

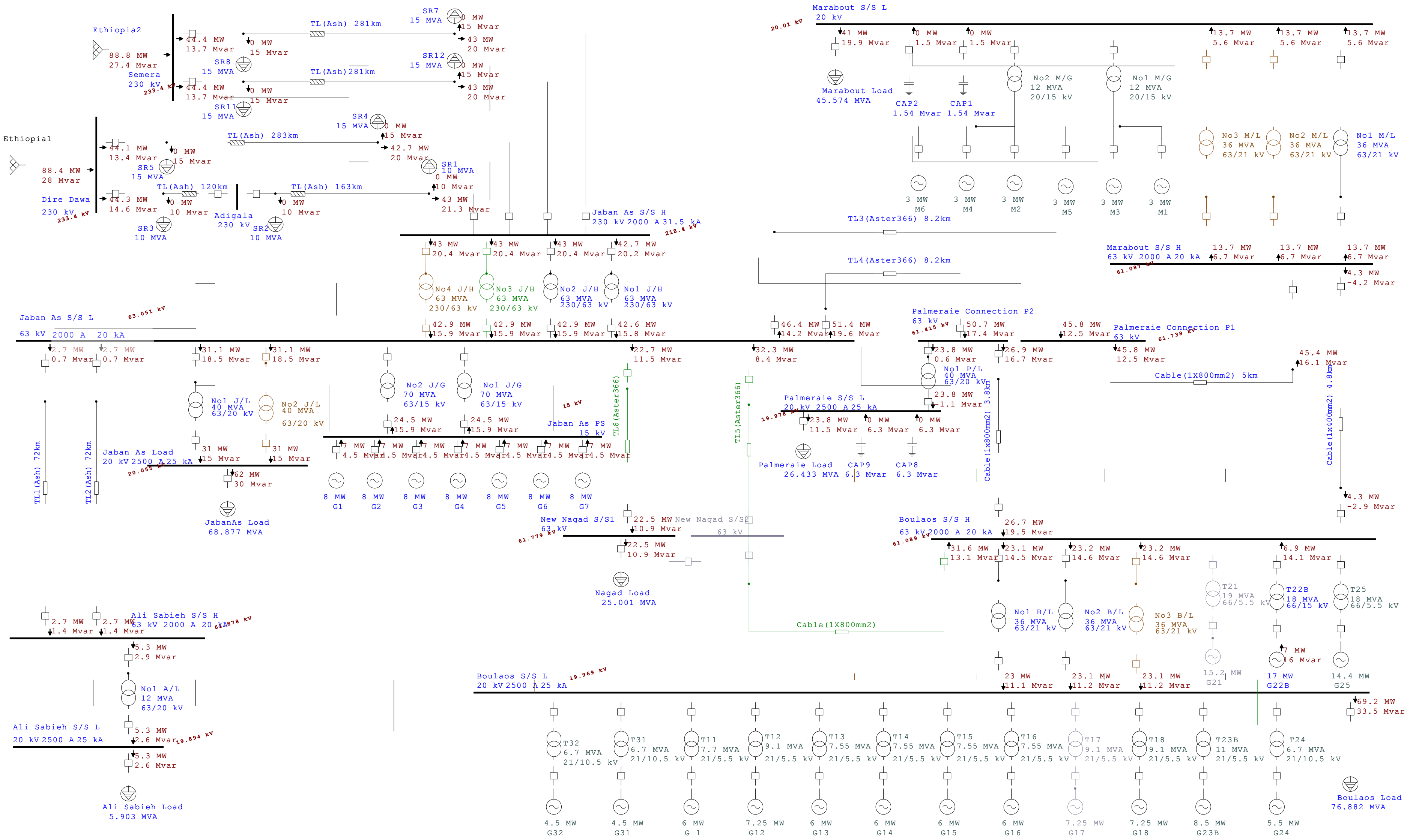


Fig.29 Load Flow Chart 2032 (Case28)

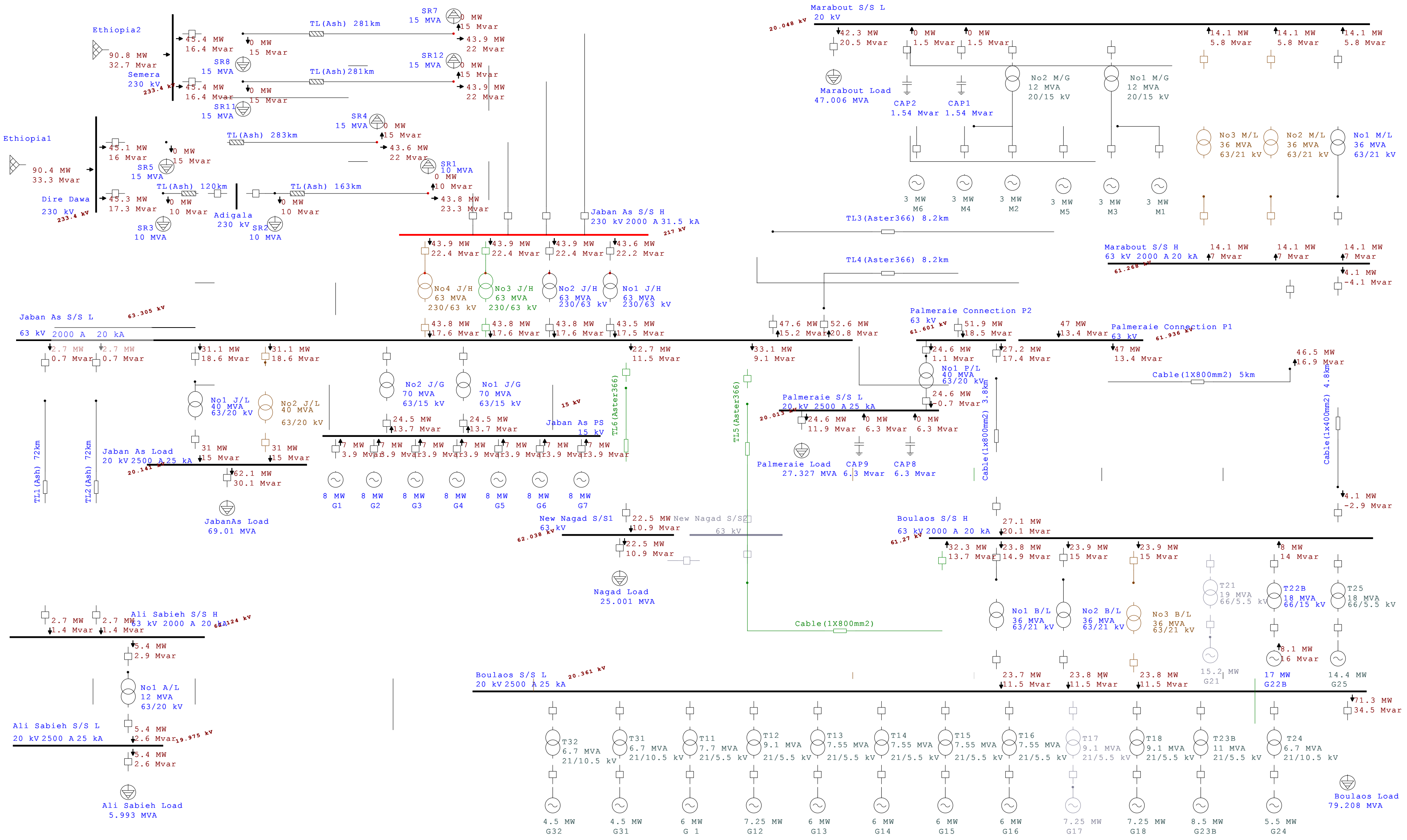


Fig.30 Load Flow Chart 2033 (Case29)

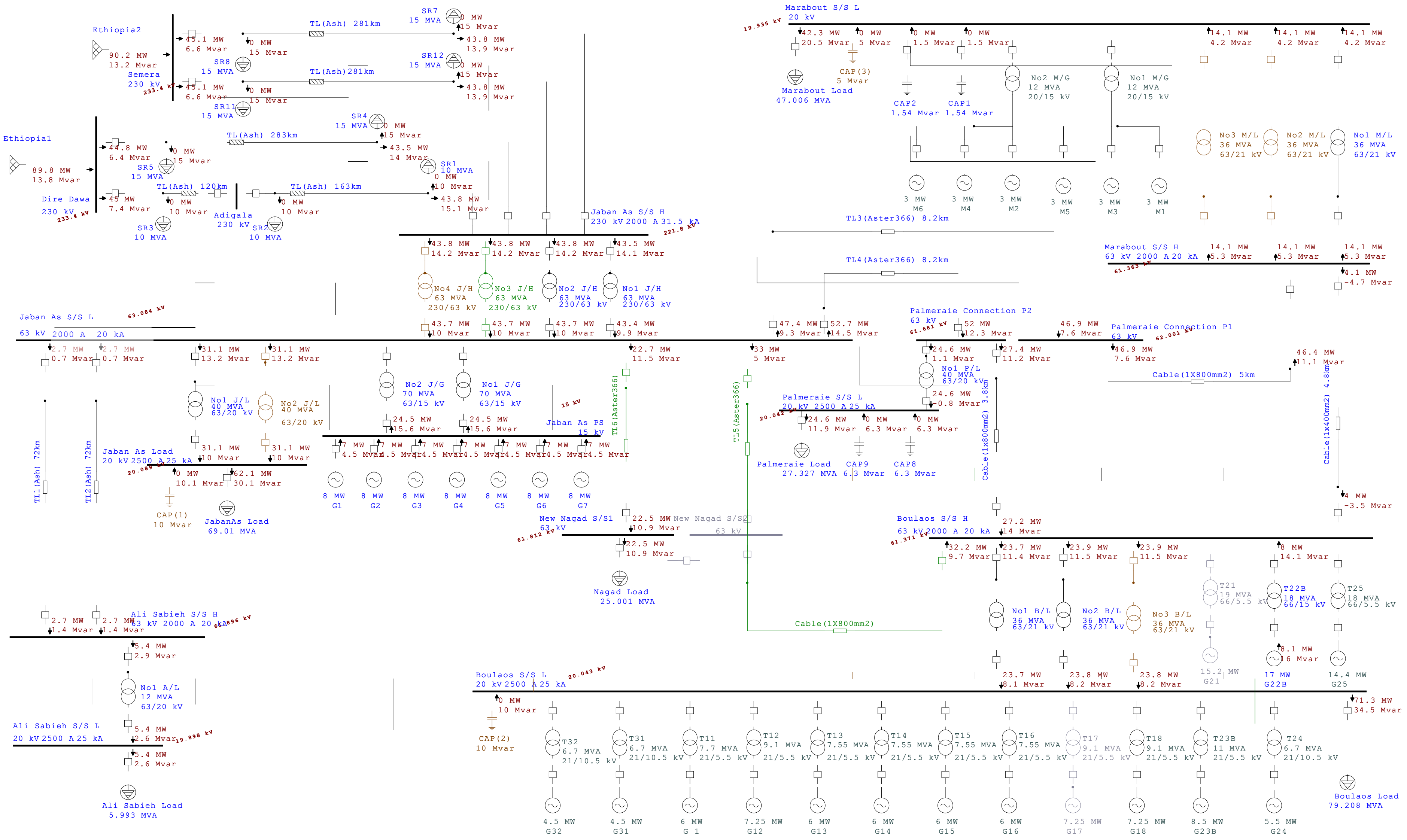


Fig.31 Load Flow Chart 2033 (Case30)

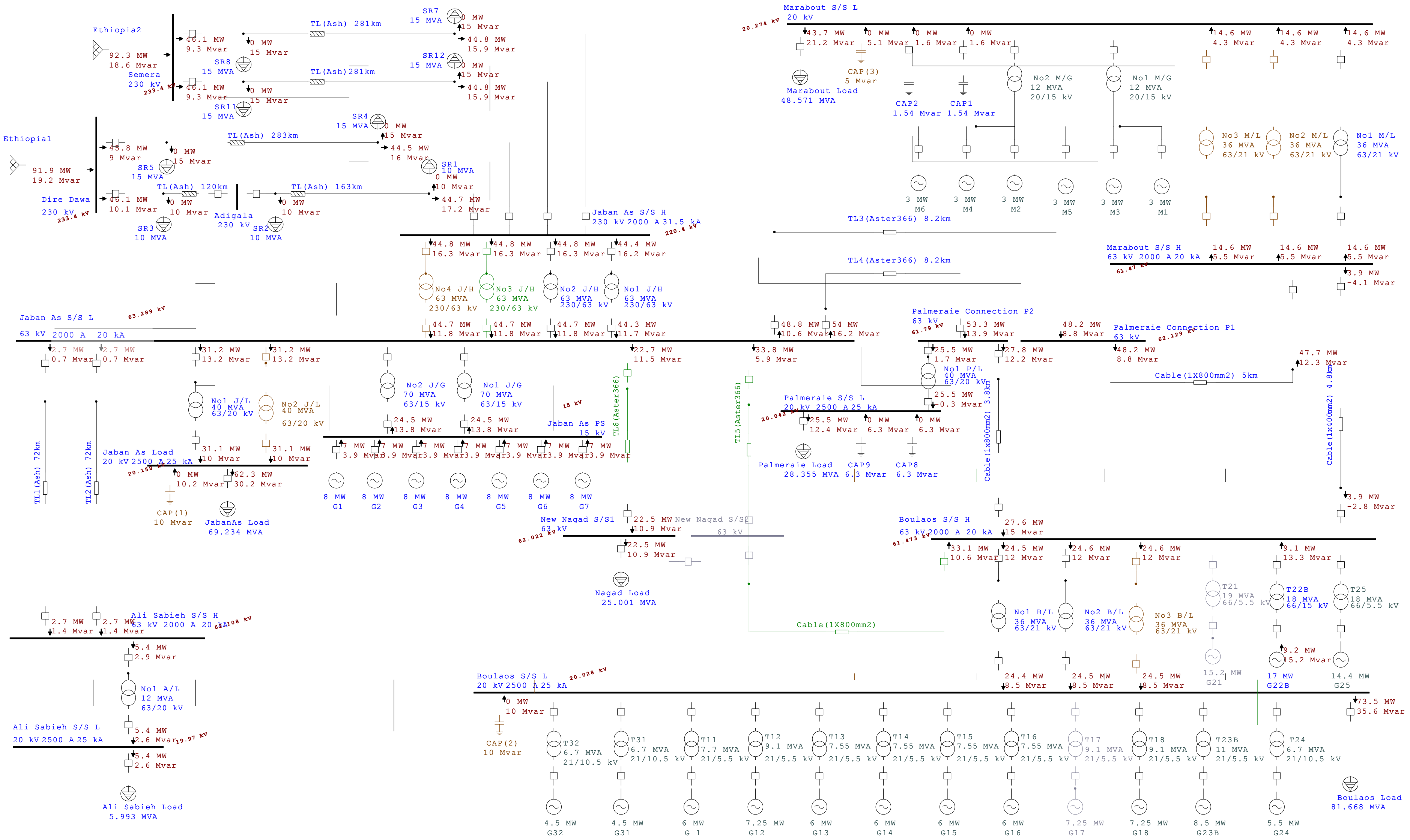


Fig.32 Load Flow Chart 2034 (Case31)

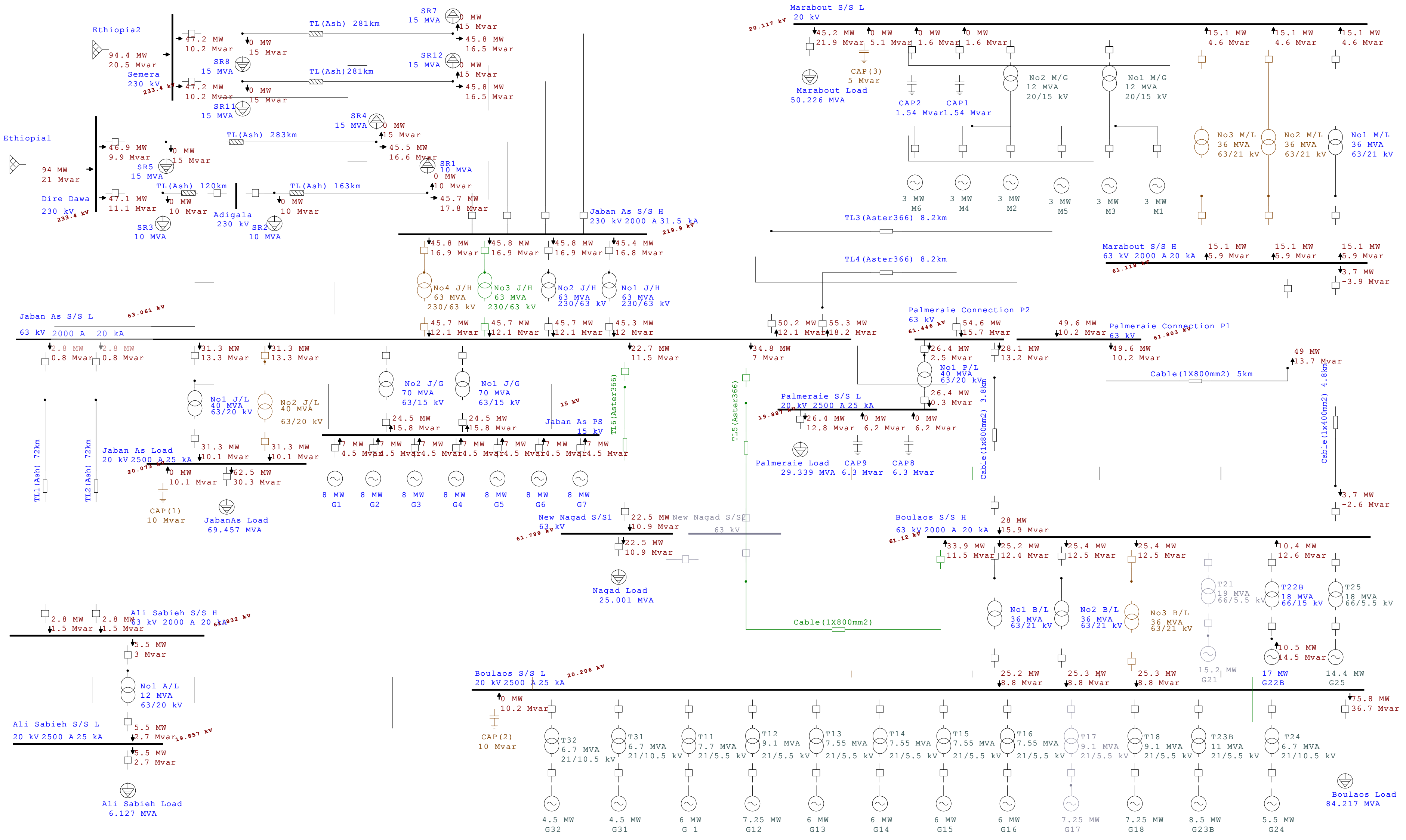


Fig.33 Load Flow Chart 2035 (Case32)

A-7 Soils Investigation Report
and
Topographic Survey Report

COSMEZZ S.a.r.l.
GEOTECHNICAL LABORATORY

IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Project

YEC YACHIYO ENGINEERING CO., LTD - JAPAN

Client

FINAL GEOTECHNICAL INVESTIGATIONS REPORT

Dossier

12.14.2014

Date

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IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI — Project

YEC YACHIYO ENGINEERING CO., LTD - JAPAN — Client

FINAL GEOTECHNICAL INVESTIGATIONS REPORT

Dossier

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Date

Version

Version 2

Prepared by:

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GEOTECHNICAL LABORATORY

December 14, 2014

Mr. Takayasu Kase
YEC – YASHIYO ENGINEERING CO., LTD
Tokyo, JAPAN
E-mail: kase@intl.yachiyo-eng.co.jp

Subject: GEOTECHNICAL INVESTIGATIONS REPORT, IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI - PK 12 SUBSTATION AND TRANSMISSION LINE ROUTE TO NAGAD.

Dear Mr. Kase:

COSMEZZ Sarl is pleased to submit our geotechnical engineering report for this project. This report includes tables, figures, and appendices with relevant data collected for this study. This study was performed in accordance with the scope of work defined in our proposal dated October 26, 2013 and our Agreement dated November 3, 2013 defines the scope of services for this project. Our revised proposal dated April 21, 2014 redefines the scope of services for this project and our agreement dated November 24, 2014.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,
COSMEZZ Sarl

THEOBARD NSHIMIYUMUREMYI
Geotechnical Laboratory Chief

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GEOTECHNICAL ENGINEERING REPORT
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND TRANSMISSION LINE ROUTE TO NAGAD.

1. EXECUTIVE SUMMARY

This report presents the results of subsurface exploration, laboratory testing, and geotechnical engineering analysis for the proposed PK-12 Substation, Overhead Transmission Line Route between PK-12 and NAGAD. We are providing this executive summary solely for purposes of overview. Any party that relies on this report must read the full report. This executive summary omits several details, any one of which could be very important to the proper application of the report.

- The subsurface conditions for the proposed PK-12 Substation, Overhead Transmission Line between PK-12 and NAGAD, Djibouti were explored via four boreholes to a maximum depth of 5.36 meters and 4 Test Pits (TPs) to a maximum depth of 4.20 meters.
  - PK-12 Substation: On the top ground level of the new proposed substation there was a layer of 10 cm to 15 cm of crushed gravels placed during the previous construction works of the PK-12 interconnexion. The soils encountered in the borings and Test Pits were composed predominantly of medium plasticity, moist silts sands (SM) and clayey sands (SC) with gravels, cobbles, boulders to a depth up to 1.10 m (FILL MATERIAL) deposited on a fractured basalt rock (Bed rock), very hard to excavate.
  - Overhead Transmission Line route: The soils encountered in the borings and test pits for the overhead transmission line route were composed predominantly of low to high plasticity clay, sandy elastic SILT (MH), clayey sand (SC) and silts Sand (SM) with gravels, cobbles, boulders to a depth variable from 0.0 m up to 4.0 meters. Bed rock (basalt) was encountered to a maximum depth of 4.0 meters.

- The proposed new substation at PK-12 and other loaded structures may be supported by isolated footings bearing on basalt rocks or existing compacted fill. A design allowable bearing pressure of 144 kPa (3000 psf) is recommended for isolated footings constructed on existing compacted fill or basalt rock. This recommended allowable bearing pressure may be increased by a factor of 1.33 to size foundations for transient loads (blast and seismic) as discussed herein. Undercutting of unsuitable materials to reach suitable bearing strata should be expected in some areas during construction. Estimated total settlements of spread footings designed as recommended above are not expected to exceed about 25 mm (1 in) and differential settlements are not expected to exceed half the total settlement.

- Floor slabs on-grade may be earth supported on suitable natural soils or compacted fill. Undercut floor slab subgrades should be backfilled with compacted fill or crushed stone. We recommend a modulus of subgrade reaction, k-value, of 65 kPa/mm for floor slabs constructed on suitable natural soils or new compacted fill. A minimum 100 mm (4 in) thick washed gravel or crushed stone layer should be placed below floor slabs.

- Compacted fill and backfill in building areas should consist of soil classifying as SC, SM, SP, SW, GC, GM, GP, or GW, or combinations thereof per ASTM D-2487. The fines portion of compacted fill and backfill soils should have a liquid limit less than 40 and a plasticity index less than 15. Excavated portions of the on-site soils may generally meet these criteria but careful screening will be necessary in Nagad transmission line areas where the existing soils have a liquid limit more than 40 and a plasticity index more than 15. These will be performed in order to separate unsuitable soils from suitable soils. Compacted fill and backfill should be compacted in lifts not exceeding 20 cm (8 in) in loose thickness. Fill should be compacted to at least 95 percent of the maximum dry density per ASTM D1557 (Modified Proctor).

- Earthwork and foundation construction should be observed by a geotechnical engineer or other qualified individual to verify that the work is performed in accordance with the recommendations contained within this report.

2. SCOPE OF SERVICES

Our proposal dated October 26, 2013 and our Agreement dated November 3, 2013 defines the scope of services for this project. Our revised proposal dated April 21, 2014 redefines the scope of services for this project. The scope of services for this geotechnical report includes the following:

1. Field test and sampling logs.
2. Soil laboratory test results.
3. Calculation of the allowable bearing capacity.
4. Recommendation of foundation system.
5. Evaluation of estimated subsurface conditions below the proposed improvements based on the results of the subsurface exploration and other available subsurface data. Included is a description of the subsurface exploration procedures and special site preparation requirements.
6. A project site description; plan drawing indicating boring, test pit, and Standard penetration test (SPT) locations relative to planned improvements.
7. Recommendations for site preparation and construction of earthwork including an assessment of excavated on-site soils for use as fill in building areas.
8. Comments regarding geotechnical construction considerations for use in development of the design and construction plans and specifications.

3. DESCRIPTION OF SITE AND PROPOSED CONSTRUCTION

3.1. Site Description

The project consists of the construction of the Substation at PK 12, Overhead Transmission Line between PK-12 and NAGAD in the Republic of Djibouti.

3.2. PK-12 Substation

The new PK-12 Substation is located to the north side of existing building at PK 12 Djibouti-Ethiopia power interconnexion; road service to the west and north side and opened gravel yard to the east side.

The PK 12 Substation site generally slopes gently downward to the east from approximate EL 93.88 m at the southwest corner to approximate EL 92.35 m at the northeast corner. A drainage channel bisects the site from southwest to northeast. A drainage channel has also been constructed along the western and northern limits of the new PK 12 Substation area as a part of the previous project. The site covered by crushed gravel, and poor draining areas are present to the eastern.

3.3. Overhead Transmission Line

The site for the overhead Transmission line is a desert boundary between PK 12 and NAGAD areas bounded by the National Road No.1 (RN1) to the north, existing PK 12 plants to the west, the Chebelley boundary to the south, and the National Road No.5 (RN5) and Nagad plants to the east. Existing site grades are erratic but generally decrease from west to east at the western limit of the National Road No.5, and back down at the southern limit of Chebelley boundary where the river (OUED) is passing. Existing site grades also generally flat in the middle near PK 12 Plants (industries).

A Site Vicinity Map is included as Figure 1.

3.4. Proposed construction

3.5. PK 12 Substation

We understand that the new PK 12 Substation will consists of earthwork and the construction of new building, structures, utilities, site drainage and other site preparations.

The new PK 12 Substation will be located in the northwestern portion of the site.

3.6. Overhead Transmission Line

The overhead Transmission Line will provide a new Djibouti-Ethiopie power extension to the existing infrastructures and will extend to the east of PK 12 Substation and end at the Nagad area. The planned overhead transmission line will consists of construction of reinforced poles foundations, steel poles, electrical works, and other site preparations.

3.7. Regional Geology

Based on our review of available data and our experience in the area, Djibouti is located at the convergence of the Gulf of Aden and the Red Sea. The region reportedly consists of silt sandy-clays medium to high plasticity underlain of basalt rocks and basalt rocks (boulders) in surface of existing site between PK 12 substation and Nagad site. The new PK 12 substation site is covered by crushed gravel and soil profile composed of silt sandy-clay mixture with basaltic boulders. There was no observed or reported evidence of surface faulting or ground rupture associated with seismic activities in the project area. However, extensive damage including ground fissures have been reported in the town of Djibouti and it’s port from past earthquake events Recent seismic activities in Djibouti have had epicenters near the Ethiopian border and in the submerged area of the Gulf of Tadjoura. A maximum intensity of VII has been reported for several events in the Djibouti. The natural terrain is essentially plane with low slop going to the eastern south. There is no erosion channels observed at the time of soil exploration.

An active volcano associated with continental rifting is present approximately 100 km west of Djibouti. The volcano reportedly last erupted in 1978 covering an area approximately 3 square km with about 12x106 cubic m of lava.

A Geologic Map is included as Figure 2.

4. SUBSURFACE EXPLORATION PROGRAMM

We performed and observed a subsurface exploration and field testing program performed by COSMEZZ sarl, we were contracted by the YEC – YACHIYO ENGINEERING CO.,LTD of JAPAN.

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Our subsurface exploration was performed to identify the soil conditions underlying the site and to evaluate the geotechnical properties of the materials encountered. This program included test borings, test pits, and Standard Penetration Tests (SPT).

Exploration methods used are discussed in subsequent sections. The appendices to this report contain the results of the exploration.

4.1. Previous explorations by others

We understand that a geotechnical investigation was performed for the previous construction of the PK 12 Djibouti-Ethiopie interconnexion substation but not engineering report was present during our preparation of this geotechnical exploration report. Two (2) others geotechnical engineering reports were prepared by us for the adjacent projects of JABAN'AS – Construction of a power plant and World Food Programme Humanitarian Logistics Base at PK 20.

4.2. Subsurface Exploration and Field Testing

In order to supplement the existing subsurface information within the project sites, test borings, Test pits and SPT tests were performed by COSMEZZ GEOTECHNICAL LABORATORY, under observations of the Client representative (YEC-EDD).

4.3. Test Borings

Cosmezz drilled four (4) test borings under client's observation between December 7, 2013 and April 26, 2014. The Standard Penetration Test (SPT) was conducted at selected depths in the borings. Two (2) test borings within the new PK 12 Substation area and two (2) to the overhead transmission line area.

Appendix A includes specific observations, remarks, and logs for the borings, classification criteria, drilling methods, and sampling protocols. Figure A1, included at the end of this report, indicates the test boring locations.

4.4. Test Pits

Cosmezz excavated two (2) test pits within the new PK 12 Substation area and two (2) test pits within the overhead transmission line area under YEC-EDD's observation on December 31, 2013 and between May 11, 2014. Appendix A includes specific observations, remarks, and logs for the test pit classification criteria, excavation methods, sampling protocols. Figure A1, included at the end of this report, indicates the test pit locations.

5. LABORATORY TESTING

Our laboratory located in Djibouti, Rue de Venise – Salines Ouest, conducted testing on selected samples obtained during our subsurface exploration.
The testing aided in the classification of materials encountered in our subsurface exploration and provided data for use in the development of recommendations for design of foundations and earthwork. The results of the laboratory testing are presented in Appendix B. The testing is also summarized in the following sections.
Please note that the soil laboratory testing was assigned by us and all testing was performed by us. We can rely on the soil laboratory test results provided by us to develop the recommendations included herein.

5.1. Soils Testing

5.2. Index Testing

Natural moisture content, Atterberg Limit, and gradation tests on bag samples, bulk samples, and undisturbed samples were performed to provide soil classifications and to provide parameters for use with published correlations with soil properties.

5.3. Compaction and CBR Testing

COSMEZZ laboratory conducted three (3) Modified Proctor Compaction and CBR tests of soil samples representing Strata between 0.15 m and 2.30 meters depth.

6. SITE GEOLOGY AND SUBSURFACE CONDITIONS

6.1. Generalized Subsurface Stratigraphy

We characterized the following generalized subsurface stratigraphy based on the exploration and laboratory test data developed from our recent subsurface explorations.

Stratum F (Fill): Below the ground surface or ground cover to depths of up to 0.7 m within the PK 12 substation site, encountered in borings BH-1 and BH-2. Light brown; SILTY SAND (SM) with gravel, very hard; natural moisture contents of 7.4 to 9.1 percent; a liquid limit of 39.4 to 41.6; a plasticity Index of 12 to 14; SPT N-values of more than 50 blows per 30 cm.

Stratum A1 (Fine Grained Alluvium): Below the ground surface or fill and interlayered with Stratum A2 to depths up to 2.75 m. Encountered in borings BH-3, BH-4 and in test pits TP-3 and TP-4. Reddish brown, light brown; sandy LEAN CLAY (CL) with varying amounts of sand, gravel, dry to very stiff; natural moisture contents of 6.8 to 15 percent; a liquid limit of 37.5; a plasticity Index of 9.7; SPT N-values of 27 to 50+ blows per 30 cm.

Stratum A2 (Coarse Grained Alluvium): Below the ground surface or fill interlayered with Stratum A1 to depths up to 4.0 m. Observed in borings BH-3, BH-4 and test pit TP-4. Light brown, sandy GRAVEL (GW), clayey SAND (SC) with varying amounts of sand, gravel, cobbles, very dense; natural moisture contents of 5.9 percent; a liquid limit of 41.4; a plasticity index of 16.5; SPT N-values of more 50 blows per 30 cm.

Stratum B (Basalt Rock): Below the ground surface, Stratum A1, or Stratum A2 to depths up to 5.36 m, the maximum depth explored. This stratum was observed in all borings and Test pits, BASALT ROCK (RK) with cobbles, boulders, gravel, moderately hard rock, little fractured, very hard to excavate; RQD of 27 to 65 %.

Significant amounts of topsoil were not observed in the borings or test pits performed, but may be present in other locations at the site.

COSMEZZ laboratory conducted eleven (3) modified Proctor Compaction tests and eleven (3) CBR tests on bulk samples representing Strata A1 and A2 obtained within the sites for the PK 12 substation and overhead transmission Line. The CBR testing was reportedly performed in accordance with ASTM D1883. The soil samples were compacted to varying densities per modified Proctor (ASTM D1557); soaked for four (4) days with a default surcharge of 4.5 kg (10 lb); and penetrated under surcharge with readings taken at intervals per the ASTM D1883. The 4.5 kg (10 lb) default surcharge was used at the time of testing. A summary of the compaction and CBR testing is presented in Table 1 at the end of this report. Swell values measured during CBR testing of the soils of Strata A1 and A2 were between 0.21

and 4.28 percent under an approximate 2.4 kPa (50 psf) surcharge. The higher surcharge pressures and additional confinement will likely result in even lower swell values than those measured during CBR testing. Thus, we do not believe that the planned improvements will be impacted by swell potential of the existing site soils.

6.2. Site Geology

The predominant soils are silt sandy-clays medium to high plasticity and basalt rocks in surface of the existing site. During the geotechnical investigation at site, PK 12 Substation site was covered by crushed gravel. The overhead transmission line sites are composed of silt sandy-clay mixed with basaltic boulders. The dense or hard sand, silt, and gravel soils of Stratum A1 and A2 are believed to be ALLUVIUM. Basalt bedrock was encountered in the borings but at various depths.

There was no observed or reported evidence of surface faulting or ground rupture associated with seismic activities in the project area. However, extensive damage including ground fissures have been reported in the town of Djibouti and it’s port from past earthquake events Recent seismic activities in Djibouti have had epicenters near the Ethiopian border and in the submerged area of the Gulf of Tadjoura. A maximum intensity of VII has been reported for several events in the Djibouti. The natural terrain is essentially plane with low slop going to the east side.

6.3. Groundwater

Groundwater was not observed during or after drilling in recent borings and test pits and the previous borings and test pits performed by us.

6.4. Seismic site Classification

Based on available information, the seismic hazard at the site is considered to be moderate (equivalent UBC Seismic Zone designation of 3).

We evaluated the Seismic Site Class and Seismic Site Coefficients for this project according to the International Building Code (IBC) Section 1613 and our experience in the area. Commonly, we use SPT N-values and/or shear strength data collected during the geotechnical subsurface exploration extrapolated to a depth of 30 m (100 ft) to evaluate the seismic site class as allowed by the International Building Code (IBC). Performing seismic site class evaluation this way results in a Seismic Site Class C per Section 1613 of the IBC.

Seismic site parameters determined from Unified Facilities Criteria manual UFC 3-310-01/04 and the 2006 International Building Code appear to be appropriate for the project based on the results of this exploration and past seismic design in the same area. Seismic Structural design should be done using a Peak Ground Acceleration of 0.15g.

7. RECOMMANDATIONS

7.1. General

Based on the subsurface data obtained from the site and our engineering analysis of the subsurface conditions and project information, the following recommendations are provided for the basis of design.

7.2. Foundation recommendations

We based our geotechnical engineering analysis on the information collected during our subsurface exploration and the results of the soil laboratory testing, as well as the existing subsurface data presented on previous site project, project development plans, site plans, and structural loading information provided to us. We recommend square isolated footings of (1.0m x 1.0m) for support of the proposed PK 12 Substation building and other minor structures associated with this project. Based on Laboratory test results of the soils samples from boreholes and test pits, the CBR values of the encountered soils can be estimated in the range of about 5 to 18. No test was performed on the encountered basalt rock stratum. But a penetration speed equal to 7 cm/minute for simple core barrel was observed at basaltic rock with an RQD (Rock Quality Designation) = 65% at borehole BH-1 located at proposed new PK 12 Substation. Other geotechnical design parameters are in previous sections and the following sections or laboratory test results summary attached on this report.

The following sections of the report provide our detailed recommendations.

7.3. Isolated footings

We consider isolated footings suitable for support of the proposed PK 12 substation building and other lightly loaded structures.

Footings should be founded on suitable natural soils or basalt bed rock. Footings supported on suitable natural soils or compacted fill may be designed considering a net allowable soil bearing pressure of 145 kPa (3,000 psf).

We anticipate suitable natural soils will be encountered at shallow depths (less than 1.5 m) below the finished floor grade of the building. However, some of the near surface natural soils were observed to be loose in their natural state. Additionally, high plasticity soils may be encountered at footing subgrade at Nagad overhead transmission line site. Loose or soft soils and high plasticity soils are unsuitable for

direct support of footings. If encountered, the high plasticity soils should be entirely removed from beneath footings. Unsuitable loose or soft soils and high plasticity soils should be undercut in their entirety or a minimum depth of 1 m below foundation bearing elevation, whichever is less. Undercut subgrades should be backfilled with compacted fill or crushed stone in accordance the applicable specifications.
Finished site grades should be set to permit positive drainage of surface water away from the building. Actual foundation subgrades and undercutting should be observed in the field by a qualified geotechnical engineer or other qualified individual.

7.4. Floor Slab recommendations

The proposed floor slabs should be supported on suitable natural soils or compacted fill. A modulus of subgrade reaction, k, of 65 kPa/mm should be used in design of floor slabs.
A 100 mm (4 in) crushed stone or washed gravel capillary barrier should underlie floor slabs on grade. The material should consist of an open graded crushed stone such as AASHTO No. 57 stone. The Contractor should compact the stone in place using suitable compaction equipment. A minimum 10-mil thick impermeable plastic membrane should be placed over the under slab stone layer to serve as a vapor barrier and to prevent infiltration of concrete into the crushed stone during concrete placement. Loose, or high plasticity soils or the existing fill soils observed at floor slab subgrade should be undercut to a minimum depth of 0.6 m or in their entirety, whichever is less. Undercut floor slab subgrades should be backfilled with compacted fill or crushed stone.

The Contractor should compact floor slab subgrades to repair any disturbance that may occur due to construction operations before placing capillary barrier materials. Since floors will be slab-on-grade, footing and utility excavations should be backfilled with compacted fill in accordance with applicable standards.

7.5. Other Geotechnical Design parameters

The following general soil properties may be assumed for the upper existing soils when placed and compacted properly:

- Moist Unit Weight, (kN/m3): 19.7
- Friction Angle (φ): ………………………………… 30
- Lateral bearing (kPa): ……………………………. 7.18
- Cohesion Strength C (το)…………………………. 192 kPa
- Seismic Site Class per Section 1613 of the IBC: …. C
- Peak Ground Acceleration……………………………. 0.15g

7.6. Site Grading and Earthwork

Based on our discussions with the design team of the project, proposed building and site grades associated with the UNDERGROUND & OVERHEAD TRANSMISSION LINE ROUTE will require cuts of up to 1.5 m for the proposed pole foundations and underground utilities. Proposed site grades within the PK 12 Substation will require placement of minimal new compacted fill and minimal cuts.

Recommendations for compacted fill subgrade preparation, compacted fill placement are presented in subsequent sections.

7.7. Compacted Fill

Compacted fill and backfill in building areas should consist of suitable material classifying as SC, SM, SP, SW, GC, GM, GP, GW, or combinations thereof according to ASTM D2487. In addition, fill materials should exhibit Liquid Limit and Plasticity Index values of less than 40 and 15, respectively.
Fill materials should not contain particles larger than 8 cm. Excavated portions of the on-site soils may generally meet these criteria but careful screening and stockpiling will be necessary to separate unsuitable soils from suitable soils.
Compacted fill should be placed in maximum 20 cm thick horizontal, loose lifts. Fill should be compacted to at least 95 percent of the maximum dry density per ASTM D1557 (Modified Proctor).

Soil moisture contents at the time of compaction should be within plus or minus 4 percent of the soils optimum moisture content (e.g. if the optimum moisture content is 16%, allowable moisture range is 12% to 20%). This acceptable range of moisture contents may need to be adjusted in the field depending on results.

Backfill placed in excavations, trenches, and other areas that large compaction equipment cannot access should be placed in maximum 15 cm thick, loose lifts. Backfill should meet the material, placement, and compaction requirements outlined above.
Successful re-use of the excavated, on-site soils and imported soils as compacted fill will depend on the soil type and natural moisture content during placement. Laboratory test results indicate most on site soils encountered are generally little dry of the optimum moisture content.

Soils used for compacted fill placement should be evaluated during construction for conformance with the project specifications and the recommendations included herein. Specifically, evaluation should include soil index, modified Proctor, and CBR tests at the frequencies indicated in the project specification, amongst the other required evaluations.

7.8. Engineering Services During Construction

Variations in soil conditions will be encountered during construction. To permit correlation between the subsurface exploration data and actual soil conditions, an onsite geotechnical engineer or other qualified individual must provide observations during construction. Construction services should include: observation of foundation bearing materials and shallow foundation construction; evaluation of the suitability of subgrade materials for fill placement; stabilization methods for subgrades, floor slab support, and pavement support; compacted fill and backfill placement and compaction; and consultation on matters related to foundations and earthwork.

8. LIMITATIONS

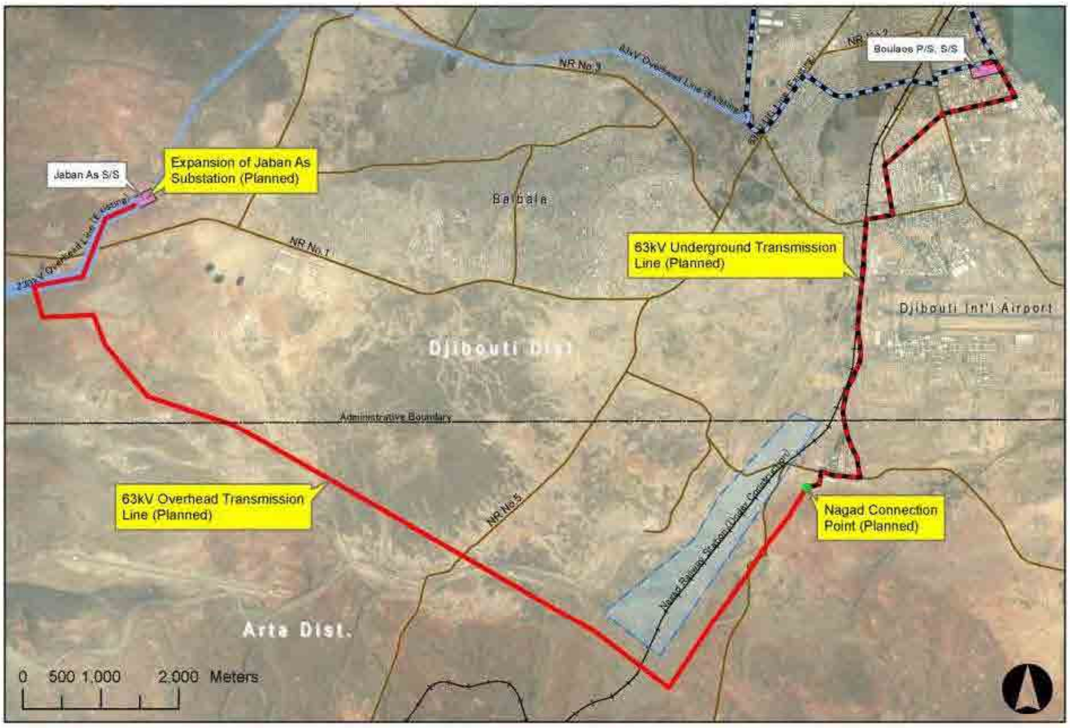
We based the analyses and recommendations presented in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project. We based our recommendations on information on the site and proposed construction as described in this report. Substantial changes in loads, locations, or grades should be brought to our attention so we can modify our recommendations as needed. We would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit our comments to you based on this review.

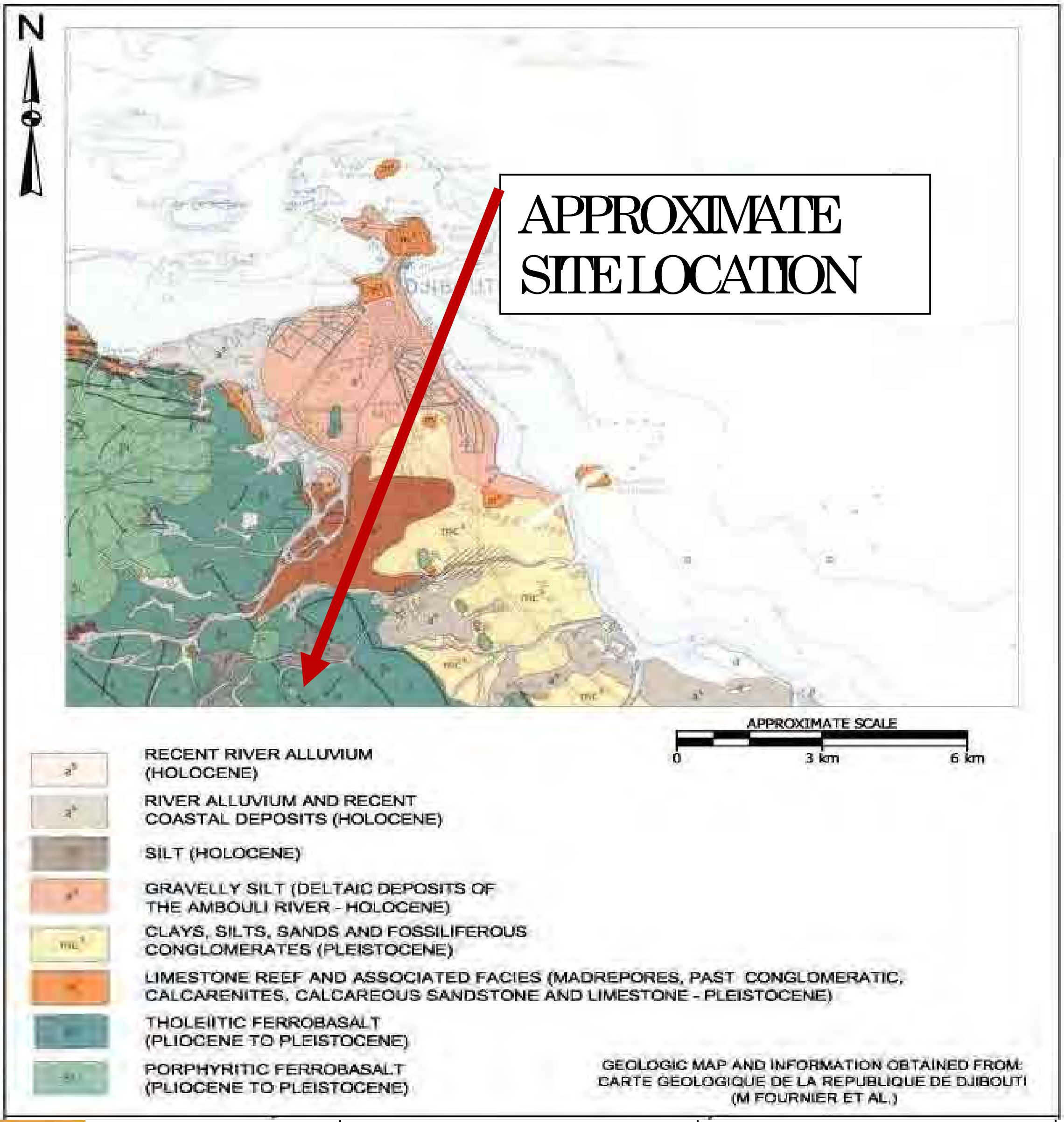
An allowance should be established to account for possible additional costs that may be required to construct earthwork and foundations as recommended in this report. Additional costs may be incurred for a variety of reasons including variation of soil between test locations, excavation of existing fill or soft or loose soils, difficulty in acquiring suitable fill material, moisture conditioning of on-site soils, obstructions, etc.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or other instrument of service.

FIGURES



GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	SITE VICINITY MAP Figure 1



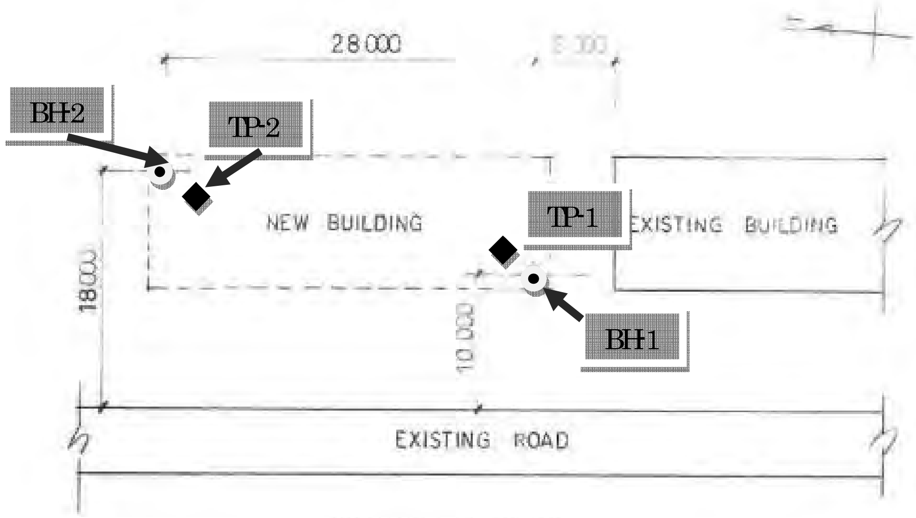
GEOLOGIC MAP AND INFORMATION OBTAINED FROM:
CARTE GEOLOGIQUE DE LA REPUBLIQUE DE DJIBOUTI
(M FOURNIER ET AL.)

COSMEZZ GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	GEOLOGIC MAP Figure 2

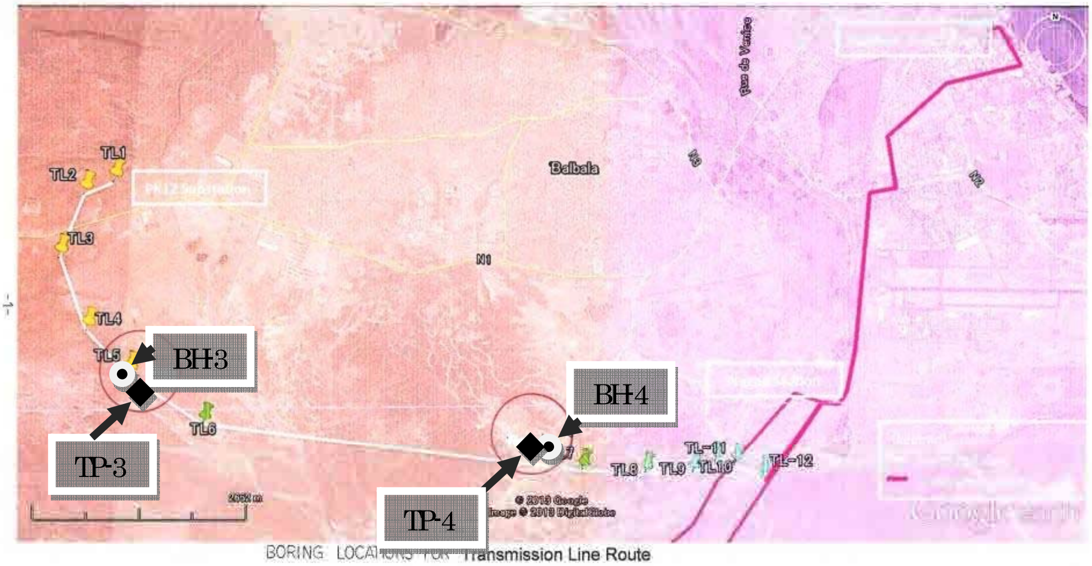
APPENDIX A

SUBSURFACE EXPLORATION DATA

Figure A1: Boring and Test Pit Location Plan
Subsurface Exploration Procedures
General Notes for Subsurface Exploration Logs
Boring Logs (4 sheets)
Test Pit Logs (4 sheets)



BORING LOCATIONS
PK 12 SUBSTATION 1/500



BORING LOCATIONS FOR Transmission Line Route

LEGEND:

FIGURE A1

TP-1: TEST PIT-1 BH-1: BOREHOLE-1

SUBSURFACE EXPLORATION PROCEDURES

Test Borings – Cased Borings

The borings by Cosmezz were advanced by driving casing (pipe) to the sampling depth. Soil within the casing is cleaned out by chopping or rotary drilling, using wash water to remove cuttings. Samples are obtained using standard methods.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a 2-inch O.D., 1⅜-inch I.D. split-spoon sampler 6 inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first 6 inches are considered a seating interval. The total of the number of blows for the second and third 6-inch intervals is the SPT "N value." The Standard Penetration Test is conducted according to ASTM D1586.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Boring and Test Pit Locations

Boring and test pit locations were staked and surveyed by YEC. Boring and test pit locations are shown on Figure A1. Boring and test pit locations were provided by YEC and are indicated on the boring and test pit logs. Locations and elevations should be considered no more accurate than the methods used to determine them.

GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1⅜-inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6 inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.

2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 100 blows for 2 inches or less of penetration.

4. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.

5. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

6. Key to symbols and abbreviations:

◪ SPT	Standard Penetration Test
5+10+1	Number of blows in each 6-inch increment
☒ S-1	Sample No.,
Rec=24", 100%	Recovery in inches, Percent Recovery
LL	Liquid Limit
MC	Moisture Content (percent)
PL	Plastic Limit
%Passing#200 (0.075 mm)	Percent by weight passing a No. 200 Sieve (0.075 mm)

GEOTECHNICAL LABORATORY	**BORING LOG** Boring No. **BH-1**	Client: **YEC, JAPAN**	Project Number:
Project: **IMPROVEMENT OF POWER SUPPLY IN DJIBOUTI** Location: **PK 12 SUBSTATION**		Drilling Contractor: **COSMEZZ SARL**	Drill Rig Type: **CMV MK 600JET (Rotary drilling)**
Logged By: **THEOBARD N.**	Date Started: **7-Dec-13 1150H**	Bit Type:	Diameter: **101 mm**
Drill Crew: **COSMEZZ SARL**	Completed **8-Dec-13 0945H**	Hammer Type: **MANUAL**	
Drilling Operator: **JOEMAR T.**	Backfilled: **8-Dec-13**	Hammer Weight: **63.5 KGS**	Hammer Drop: **75 cm**
Drilling Supervisor: **THEOBARD NSHIMI.**	Groundwater Depth: **Not encountered**	Elevation: -	Total Depth of Boring: **3.20 m**

Depth (m)	Sample Type	Sample Number	Blow Counts (blows/foot)	Graphic Log	**Lithology** **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	Fines (%)	Moisture Content (%)	Additional Test
				▦	Top layer of **crushed gravel material 10/50 mm (0.0 - 0.15m)**			
	☒	SS-1		▨	**SILTY SAND (SM)** with gravel, very hard, light brown. From 0.5m: More gravelly. (REC=100%)	41.5	8.6	LL=40.3 PI=12.1
1.0	◩	SPT-1	16-18-50+	▩	**Basalt ROCK (RK)**, Moderately hard rock, little fractured from 1.50m to 2.00m. Penetration speed ˜7 cm/min	47.0	9.1	LL=39.4 PI=12.3 RQD=65%
					BOTTOM OF BORING **BORING TERMINATED @ 3.20 meters**			
5								
10								

COSMEZZ GEOTECHNICAL LAB

Boring Log: Sheet 1 of 1

◩ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

▥ Shelby Tube

▤ CPP Sampler

▼ Stabllized Ground water

▽ Groundwater At time of Drilling

GEOTECHNICAL LABORATORY

BORING LOG

Boring No. **BH-2**

Client: **YEC, JAPAN**

Project Number:

Project: **IMPROVEMENT OF POWER SUPPLY IN DJIBOUTI**
Location: **PK 12 SUBSTATION**

Drilling Contractor: **COSMEZZ SARL**

Drill Rig Type: **CMV MK 600JET (Rotary drilling)**

Logged By: **THEOBARD N.**	Date: Started: **8-Dec-13 1115H**	Bit Type:	Diameter: **101 mm**
Drill Crew: **COSMEZZ SARL**	Date: Completed **9-Dec-13 0718H**	Hammer Type: **MANUAL**	
Drilling Operator: **JOEMAR T.**	Date: Backfilled: **9-Dec-13**	Hammer Weight: **63.5 KGS**	Hammer Drop: **75 cm**
Drilling Supervisor: **THEOBARD NSHIMI.**	Groundwater Depth: **Not encountered**	Elevation: -	Total Depth of Boring: **5.36 m**

Depth (m)	**Sample Type**	**Sample Number**	**Blow Counts (blows/foot)**	**Graphic Log**	**Lithology** **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	**Fines (%)**	**Moisture Content (%)**	**Additional Test**
					Top layer of **Crushed gravel material 10/50 mm (0.0 - 0.10m)**			
	☒	SS-1			**SILTY SAND (SM)** with gravel, very hard, light brown.	35.8	7.4	LL=41.6 PI=14.1
					Basalt ROCK (RK), Moderately hard rock, fractured. From 0.70 m to 1.4 m: Fractured From 1.4 m to 5.36 m: Continous rock.			
5								
					BOTTOM OF BORING **BORING TERMINATED @ 5.36 meters**			
10								

COSMEZZ GEOTECHNICAL LAB

Boring Log: Sheet 1 of 1

◩ Standard Penetration Split Spoon Sampler (SPT)
☒ Bulk/ Bag Sample
▥ Shelby Tube
▤ CPP Sampler

▼ Stabllized Ground water
▽ Groundwater At time of Drilling

GEOTECHNICAL **LABORATORY**	**BORING LOG** Boring No. **BH-3**	Client: **YEC, JAPAN**	Project Number:
Project: **IMPROVEMENT OF POWER SUPPLY IN DJIBOUTI** Location: **PK 12 TRANSMISSION LINE ROUTE**		Drilling Contractor: **COSMEZZ SARL**	Drill Rig Type: **CMV MK 600JET**
Logged By: **THEOBARD N.**	Date: Started: **15-Dec-13 1535H**	Bit Type:	Diameter: **101 mm**
Drill Crew: **COSMEZZ SARL**	Date: Completed **16-Dec-13 1005H**	Hammer Type: **MANUAL**	
Drilling Operator: **JOEMAR T.**	Date: Backfilled: **16-Dec-13**	Hammer Weight: **63.5 KGS**	Hammer Drop: **75 cm**
Drilling Supervisor: **THEOBARD NSHIMI.**	Groundwater Depth: **Not encountered**	Elevation: -	Total Depth of Boring: **4.80 m**

Depth (m)	**Sample Type**	**Sample Number**	**Blow Counts (blows/foot)**	**Graphic Log**	**Lithology** **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	**Fines (%)**	**Moisture Content (%)**	**Additional Test**
0.45	◩	SPT-1	10-12-15-21	▧	Sandy **LEAN CLAY (CL)**, very stiff, dry, reddish brown. REC=100%	82.6	6.8	LL=37.5 PI=9.7
1.5	◩	SPT-2	28-50+	▧	1.5m to 1.65m: Become gravelly-sandy, and very hard. REC=100%	56.4	15.0	
				▨	**Basalt ROCK (RK)**, with cobbles, boulders and some gravel. 2.30m to 3.0m: Big rock. RQD=27%			
5					**BOTTOM OF BORING** **BORING TERMINATED @ 4.80 meters**			
10								

◩ Standard Penetration Split Spoon Sampler (SPT)

☒ Bulk/ Bag Sample

▥ Shelby Tube

▤ CPP Sampler

▼ Stabllized Ground water

▽ Groundwater At time of Drilling

GEOTECHNICAL LABORATORY	# BORING LOG Boring No. **BH-4**	Client: **YEC, JAPAN**	Project Number:
Project: **IMPROVEMENT OF POWER SUPPLY IN DJIBOUTI** Location: **NAGAD - TRANSMISSION LINE**		Drilling Contractor: **COSMEZZ SARL**	Drill Rig Type: **CMV MK 600JET (Rotary drilling)**
Logged By: **THEOBARD N.**	Date Started: **26-Apr-14 0940H**	Bit Type:	Diameter: **101 mm**
Drill Crew: **COSMEZZ SARL**	Completed **26-Apr-13 1620H**	Hammer Type: **MANUAL**	N= **1274057.0** E= **292291.0**
Drilling Operator: **JOEMAR T.**	Backfilled: **26-Apr-14**	Hammer Weight: **63.5 KGS**	Hammer Drop: **75 cm**
Drilling Supervisor: **THEOBARD NSHIMI.**	Groundwater Depth: **Not encountered**	Elevation: -	Total Depth of Boring: **4.80 m**

Depth (m)	**Sample Type**	**Sample Number**	**Blow Counts (blows/foot)**	**Graphic Log**	**Lithology** **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.	**Fines (%)**	**Moisture Content (%)**	**Additional Test**
0.0	◪	SPT-1	8-50+	▨	Clayey **SAND-GRAVEL (GC)**, very dense, dry pinkish.			REC=28cm
				▨	Fractured **Basalt rock** (**RK**), From 0.28 to 0.80 m.			
				▨	Coarse **GRAVEL (GW).** From 0.80 to 1.30 m.			
2	☒	SS-1		▨	Sandy, **LEAN CLAY (CL)**, light brown,dry, very stiff.	NA	NA	Specific Grav=2.60
2.75	◪	SPT-2	20-45-50+	▨	Sandy, Cemented **SILT (SM)** with some gravel, very hard, dry, reddish. From 2.75m to 3.30 m			REC=30cm
3.5	☒	SS-2		▨	Clayey**, SAND (SC),** with some gravel, very dense, light brown, fine to coarse sand. From 3.30m to 4.0 m	NA	NA	Specific Grav=2.684
4.0	◪	SPT-3	50+	▨	Sandy **GRAVEL (GW**), with trace clay, dry, very dense.			REC=19cm
5				▨	**BASALT BED ROCK**			
					BOTTOM OF BORING **BORING TERMINATED @ - 4.80 meters**			
10								

COSMEZZ GEOTECHNICAL LAB

Boring Log: Sheet 1 of 1

◪	Standard Penetration Split Spoon Sampler (SPT)
☒	Bulk/ Bag Sample
▥	Shelby Tube
☰	CPP Sampler
▼	Stabllized Ground water
▽	Groundwater At time of Drilling

COSMEZZ
GEOTECHNICAL LABORATORY
"Certified by USACE"

TEST PIT LOG No: TP-1

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION - DJIBOUTI

Initial Depth : **0,00 m** N= Date start excav : **31-DEC-2013** Time: 07H25
Final Depth : **- 1,05m** E= Date finish excav: **31-DEC-2013** Time: 08H10
SURFACE ELEVATION : ELEV= Weather conditions: **SUNNY**
DRILLER: **COSMEZZ s.a.r.l. LABORATORY** Location: **See the location plan** Sheet NO.: **1** of **1**

Type of exploration: TEST PIT

EQUIPMENT : **EXCAVATOR (HYUNDAI / Rolex 200W-7)** Method of sampler: **SELECT SAMPLE**

DEPTH, m	SCALE	STRATIGRAPHY	DESCRIPTION OF MATERIAL	SAMPLE	GROUNDWATER LEVEL@ TIME OF BORING	TESTS	REMARKS
0.00			**Top layer of Gravel 10/50mm (0.0-0.15m)**				
-0.20							Sample collected for Proctor, CBR, AL & SA.
-0.40			**Clayey-Silty SAND (SC-SM),** with gravel, hard and light brown (FILL MATERIAL)	☒ SS-1 (0.15-0.75m)		See test reports	
-0.60							
-0.80							
-1.00			**Cobbles, boulders, and trace clay (Fractured basalt rock): 0.75 - 1.05 m**				
-1.20			BOTTOM OF TEST PIT Excavation terminated @ -1.10 meters.				
-1.40							
-1.60							
-1.80							
-2.00							
-2.20							
-2.40							
-2.60							
-2.80							
-3.00							
-3.20							
-3.40							
-3.60							
-3.80							
-4.00							
-4.20							
-4.40							
-4.60							
-4.80							
-5.00							
-5.20							

GROUNDWATER DEPTH at TIME OF EXCAVATION, m: ----
STABILISED GROUND WATER DEPTH, m: -----

LOGGED By: **THEOBARD N.**

COSMEZZ

GEOTECHNICAL LABORATORY

"Certified by USACE"

TEST PIT LOG No: TP-2

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION - DJIBOUTI

Initial Depth : **0,00 m**
N=
Date start excav : **31-DEC-2013**
Time: 08H20

Final Depth : **- 1,10m**
E=
Date finish excav: **31-DEC-2013**
Time: 08H42

SURFACE ELEVATION :
ELEV=
Weather conditions: **SUNNY**

DRILLER: **COSMEZZ s.a.r.l. LABORATORY**
Location: **See the location plan**
Sheet NO.: **1** of **1**

Type of exploration: TEST PIT

EQUIPMENT : **EXCAVATOR (HYUNDAI / Rolex 200W-7)**

Method of sampler: **SELECT SAMPLE**

DEPTH, m	SCALE	STRATIGRAPHY	DESCRIPTION OF MATERIAL	SAMPLE	GROUNDWATER LEVEL@ TIME OF BORING	TESTS	REMARKS
0.00		▨	**Top layer of Gravel 10/50mm (0.0-0.15m)**				
-0.20		▨					
-0.40		▨	**Clayey Silty SAND (SC-SM),** with gravel, hard and light brown (FILL MATERIAL)	☒ SS-1 (0.15-0.65m)		See test reports	
-0.60		▨					
-0.80		▨					
-1.00		▨	**Cobbles, boulders, fractured basalt rock**				Bed rock at 1.10 m
-1.20			BOTTOM OF TEST PIT Excavation terminated @ -1.10 meters.				
-1.40							
-1.60							
-1.80							
-2.00							
-2.20							
-2.40							
-2.60							
-2.80							
-3.00							
-3.20							
-3.40							
-3.60							
-3.80							
-4.00							
-4.20							
-4.40							
-4.60							
-4.80							
-5.00							
-5.20							

GROUNDWATER DEPTH at TIME OF EXCAVATION, m: ----

STABILISED GROUND WATER DEPTH, m: -----

LOGGED By: **THEOBARD N.**

COSMEZZ
GEOTECHNICAL LABORATORY
"Certified by USACE"

TEST PIT LOG No: TP-3

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 - OVERHEAD TRANSMISSION LINE

Initial Depth : **0,00 m** N= Date start excav : **31-DEC-2013** Time: 09H05
Final Depth : **- 2,25m** E= Date finish excav: **31-DEC-2013** Time: 09H40
SURFACE ELEVATION : ELEV= Weather conditions: **SUNNY**
DRILLER: **COSMEZZ s.a.r.l. LABORATORY** Location: **See the location plan** Sheet No.: **1** of **1**

Type of exploration: TEST PIT

EQUIPMENT : **EXCAVATOR (HYUNDAI / Rolex 200W-7)** Method of sampler: **SELECT SAMPLE**

DEPTH, m	SCALE	STRATIGRAPHY	DESCRIPTION OF MATERIAL	SAMPLE	GROUNDWATER LEVEL@ TIME OF BORING	TESTS	REMARKS
0.00 -0.20 -0.40 -0.60 -0.80 -1.00 -1.20 -1.40		▧	**LEAN CLAY (CL),** Reddish brown, loose and dry.	☒ SS-1 (1.0-1.50m)		see test reports	
-1.60 -1.80 -2.00 -2.20		▩	**Basalt rock** with cobbles, boulders and gravel very hard to excate.				Very hard to excavate
-2.40 -2.60 -2.80 -3.00 -3.20 -3.40 -3.60 -3.80 -4.00 -4.20 -4.40 -4.60 -4.80 -5.00 -5.20			BOTTOM OF TEST PIT Excavation terminated @ -2.25 meters.				Bed rock at 2.25 m

GROUNDWATER DEPTH at TIME OF EXCAVATION, m: ----
STABILISED GROUND WATER DEPTH, m: -----

LOGGED By: **THEOBARD N.**

COSMEZZ

GEOTECHNICAL LABORATORY

"Certified by USACE"

TEST PIT LOG No: TP-4

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: NAGAD - OVERHEAD TRANSMISSION LINE ROUTE

Initial Depth : **0,00 m**

Final Depth : **- 2,25m**

SURFACE ELEVATION :

DRILLER: **COSMEZZ s.a.r.l. LABORATORY**

N=

E=

ELEV=

Location: **See the location plan**

Date start excav : **31-DEC-2013** Time: 09H05

Date finish excav: **31-DEC-2013** Time: 09H40

Weather conditions: **SUNNY**

Sheet No.**: 1** of **1**

Type of exploration: TEST PIT

EQUIPMENT : **EXCAVATOR (HYUNDAI / Rolex 200W-7)**

Method of sampler: **SELECT SAMPLE**

DEPTH, m	SCALE	STRATIGRAPHY	DESCRIPTION OF MATERIAL	SAMPLE	GROUNDWATER LEVEL@ TIME OF BORING	TESTS	REMARKS
0.00		▨	**LEAN CLAY (CL),** Reddish brown, loose and dry.	☒ SS-1 (1.0-1.50m)		See test reports	Very hard to excavate
-0.20							
-0.40							
-0.60							
-0.80							
-1.00							
-1.20							
-1.40							
-1.60		▩	**Basalt rock** with cobbles, boulders and gravel very hard to excate.				
-1.80							
-2.00							
-2.20							
-2.40			BOTTOM OF TEST PIT Excavation terminated @ -2.25 meters.				Bed rock at 2.25 m
-2.60							
-2.80							
-3.00							
-3.20							
-3.40							
-3.60							
-3.80							
-4.00							
-4.20							
-4.40							
-4.60							
-4.80							
-5.00							
-5.20							

GROUNDWATER DEPTH at TIME OF EXCAVATION, m: ----

STABILISED GROUND WATER DEPTH, m: -----

LOGGED By: **THEOBARD N.**

APPENDIX B

LABORATORY TEST RESULTS

Summary of Soil Laboratory Tests
Laboratory Test Reports:

- Sieve Analysis
- Atterberg Limits
- Moisture Content
- Proctor Test
- CBR Test
- Specific Gravity

The soil laboratory testing was assigned by us, sample preparation and testing was performed by us. We based on the soil laboratory test results provided by us to develop the recommendations included herein.

GEOTECHNICAL LABORATORY

Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION, TRANSMISSION LINE AND NAGAD SWITCHING SUBSTATION**
Contractor: **COSMEZZ SARL**
Client: *Yec* **YACHIYO ENGINEERING CO., LTD - JAPAN**

COSMEZZ SARL
Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
Tel.+253 21356142
E-mail: cosmezz@mezzgroup.com

GEOTECHNICAL EXPLORATION

Date: 14-Dec-14

LABORATORY TEST RESULTS SUMMARY

DATE SAMPLED	SAMPLE / BOREHOLE	SAMPLE DEPTH (m)	LAB SAMPLE NUMBER	SAMPLE TYPE	USCS CLASS.	IN SITU MOISTURE CONTENT (%)	SIEVE ANALYSIS		PROCTOR TEST		SOAKED CBR VALUE (%)		ATTERBERG LIMITS			SPECIFIC GRAVITY (g/cm^3)	NATURAL(IN PLACE) DENSITY (g/cm^3)	DRY DENSITY (g/cm^3)	OBSERVATIONS
							% FINES(< 0,075mm)	D max (mm)	MDD (kg/m^3)	OMC (%)	at 95% of MDD	SWELL(%)	LL	PL	PI				
07-Dec-13	BH-1/SS-1	(0.50 - 0.60m)	SOIL 001/YEC	SS	SM	8.6	41.5	12.5	-	-	-	-	40.3	28.2	12.1	-	-	-	PK-12 SUBSTATION
07-Dec-13	BH-1/SPT-1	(1.00 - 1.45m)	SOIL 002/YEC	SPT	SM	9.1	47.0	19.0	-	-	-	-	39.4	27.1	12.3	-	-	-	PK-12 SUBSTATION
08-Dec-13	BH-2/SS-1	(0.50 - 0.60m)	SOIL 003/YEC	SS	SM	7.4	35.8	37.5	-	-	-	-	41.6	27.5	14.1	-	-	-	OVERHEAD TRANSMISSION LINE
15-Dec-13	BH-3/SPT-1	(0.45 - 1.05m)	SOIL 004/YEC	SPT	CL	6.8	82.6	2.36	-	-	-	-	37.5	27.8	9.7	-	-	-	OVERHEAD TRANSMISSION LINE
15-Dec-13	BH-3/SPT-2	(1.50 - 1.65m)	SOIL 005/YEC	SPT	ML	15.0	56.4	9.50	-	-	-	-	NV	NP	-	-	-	-	OVERHEAD TRANSMISSION LINE
26-Apr-14	BH-4/SPT-1	(0.0-0.30m)	SOIL 006/YEC	SPT	SC-SM	4.2	49.2	19.0					37.0	23.8	13.2				NAGAD TRANSMISSION LINE
26-Apr-14	BH-4/SPT-2	2.75m	SOIL 007/YEC	SPT	MH	15.8	58.0	12.5					55.2	35.7	19.5				NAGAD TRANSMISSION LINE
26-Apr-14	BH-4/SPT-3	4.0 m	SOIL 008/YEC	SPT	SW-SC	5.9	5.9	25					41.4	24.9	16.5				NAGAD TRANSMISSION LINE
31-Dec-13	TP-1/SS-1	0.15-0.75 m	SOIL 009/YEC	SS	SC	9.6	37.7	37.5	1974.0	13.5	18.2	0.21	38.1	24.4	13.7				PK-12 SUBSTATION
31-Dec-13	TP-2/SS-1	0.15-0.65 m	SOIL 010/YEC	SS	SC	7.9							39.0	25.7	13.3				PK-12 SUBSTATION
31-Dec-13	TP-3/SS-2	0.00-1.50 m	SOIL 011/YEC	SS	MH		80.3	2.36	1867.0	15.5	4.5	4.28	50.6	27.4	23.2				PK-12 OVERHEAD TRANSMISSION LINE
31-Dec-13	TP-3/SS-1	1.00-1.50 m	SOIL 012/YEC	SS	SW-SC	8.2													PK-12 OVERHEAD TRANSMISSION LINE
31-Dec-13	TP-3/SS-3	1.50-2.25 m	SOIL 013/YEC	SS	SM	7.8	31.2	50.0					43.4	29.6	13.8				PK-12 OVERHEAD TRANSMISSION LINE

GEOTECHNICAL LABORATORY
Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION, TRANSMISSION LINE AND NAGAD SWITCHING SUBSTATION**
Contractor: **COSMEZZ SARL**
Client: **Yec YACHIYO ENGINEERING CO., LTD - JAPAN**

COSMEZZ SARL
Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
Tel.+253 21356142
E-mail: cosmezz@mezzgroup.com

GEOTECHNICAL EXPLORATION

Date: 14-Dec-14

LABORATORY TEST RESULTS SUMMARY

DATE SAMPLED	SAMPLE / BOREHOLE	SAMPLE DEPTH (m)	LAB SAMPLE NUMBER	SAMPLE TYPE	USCS CLASS.	IN SITU MOISTURE CONTENT (%)	SIEVE ANALYSIS		PROCTOR TEST		SOAKED CBR VALUE (%)		ATTERBERG LIMITS			SPECIFIC GRAVITY (g/cm^3)	NATURAL(IN PLACE) DENSITY (g/cm^3)	DRY DENSITY (g/cm^3)	OBSERVATIONS
							% FINES(<0,075mm)	D max (mm)	MDD (kg/m^3)	OMC (%)	at 95% of MDD	SWELL(%)	LL	PL	PI				
11-May-14	TP-4	1.40-2.30 m	SOIL 014/YEC	BAG	MH	15.4	37.9	37.5	1533.0	22.2	6.5	3.27	60.3	42.1	18.2				NAGAD OVERHEAD TRANSMISSION LINE
MINIMUM						4.2	5.9	2.36					37.0	23.8	9.7				
MAXIMUM						15.8	82.6	50.00					60.3	42.1	23.2				
AVERAGE						9.4	47.0	22.06					43.7	28.7	15.0				

Remarks: Tests performed in accordance with applicable ASTM test standards.

Reported by :

Theobard N.
Geotech. Lab Mngr
COSMEZZ SARL

COSMEZZ GEOTECHNICAL LABORATORY Certified by U.S. Army Corps of Engineers	GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN Contractor : COSMEZZ SARL	COSMEZZ SARL Rue de Venise, Salines Ouest B.P.1331-Djibouti-R.D.D. E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **18-Dec-13**

Sample no : **BH-1/SPT-1**

Sample Description : ***Silty SAND*** *(SM), with gravel, light brown, very hard*

Date sampled: **7-Dec-13**

Sampled by : **THEO**

Source : **Borehole#BH-1: PK-12 SUBSTATION**

Tested by : **HOUSSEIN**

Sample Depth : **1,00 - 1,45m**

Designation		***unit***	1	
N° of container			F	
Weight of wet soil + container	**A**	***grs***	948.62	
Weight of Dry soil + container	**B**	***grs***	904.79	
Weight of container	**C**	***grs***	420.85	
Weight of water	**D=A-B**	***grs***	43.83	
Weight of Dry	**E=B-C**	***grs***	483.94	
Water content	**W=D/E*100**	***%***	**9.1**	

Remarks :

Reported by :

Theobard N.
Geotech. Lab. Mngr
COSMEZZ SARL

GEOTECHNICAL LABORATORY
Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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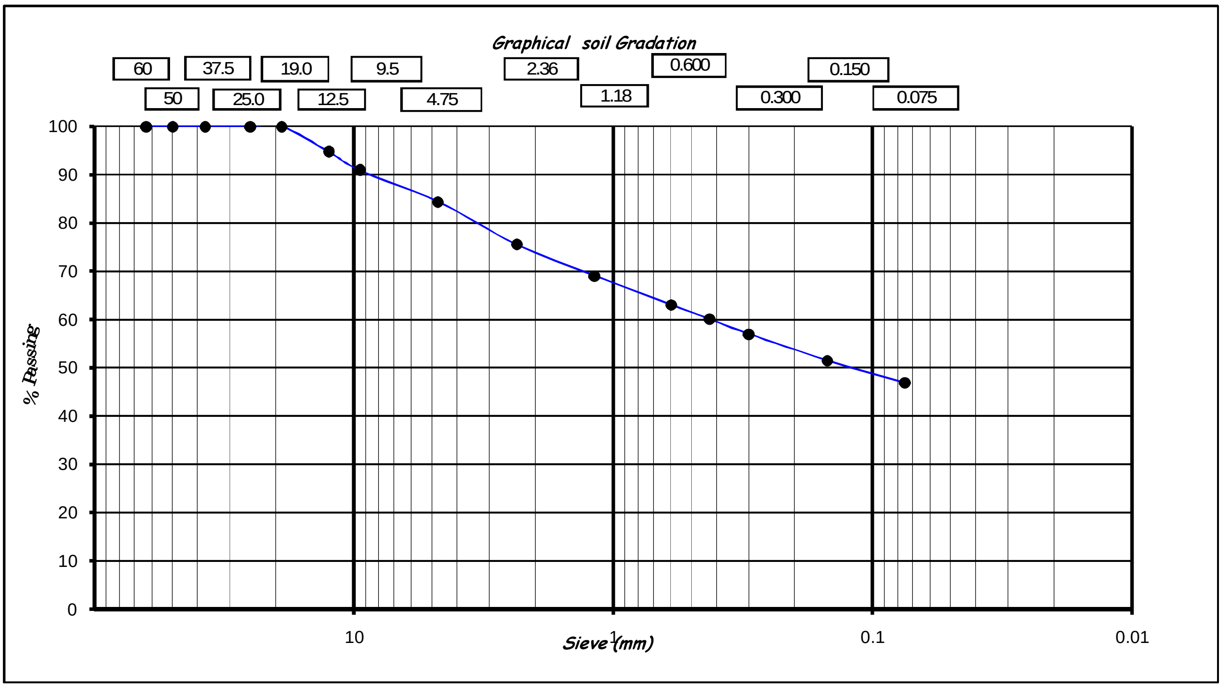
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-1/SPT-1**
Project No.:
Date of Sampling : **07-Dec-13**
Sample source: **Borehole #BH-1: PK-12 SUBSTATION**
Date of Test : **21-Dec-13**
Sample Description : **Silty SAND (SM), with gravel, light brown, very hard**
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **1.00 - 1.45 m**
Weight (grs): **483.94**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	25.50	25.5	5.3	**94.7**
3/8	**9,5**	18.38	43.9	9.1	**90.9**
No.4	**4,75**	31.56	75.4	15.6	**84.4**
No.8	**2,36**	42.56	118.0	24.4	**75.6**
No.16	**1,18**	31.63	149.6	30.9	**69.1**
No.30	**0,600**	28.84	178.5	36.9	**63.1**
No.40	**0,425**	14.42	192.9	39.9	**60.1**
No.50	**0,300**	15.11	208.0	43.0	**57.0**
No.100	**0,150**	26.36	234.4	48.4	**51.6**
No.200	**0,075**	22.34	256.7	53.0	**47.0**
Can	**0**				



Remarks :
Gravel: **15.6%**
Sand: **37.5%**
Fines: **47.0%**

Submitted By :

Theobard N.
GEOTECH. LAB. MNGR
COSMEZZ SARL

COSMEZZ

GEOTECHNICAL LABORATORY

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Ycc YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
Rue de Venise, Salines Ouest
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E-mail: cosmezz@mezzgroup.com

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **17-Dec-13**

Sample no : **BH-1/SPT-1**

Sample Description : **Silty SAND (SM)**, with gravel, light brown, very hard

Date sampled : **7-Dec-13**

Sample Depth: **1.00 - 1.45 m**

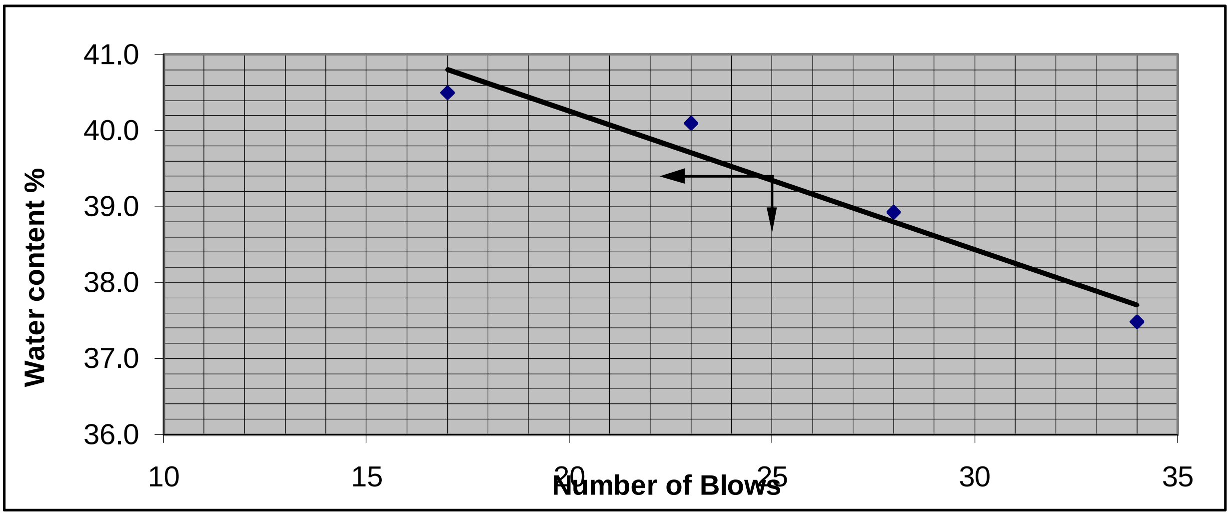
Source : **Borehole#BH-1: PK-12 SUBSTATION**

Tested by: **MANZI**

Sampled by: **THEO / MOH**

LL: **39.4** **PL:** **27.1** **PI:** **12.3**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	17	23	28	34	**Test n°1**	**Test n°2**
N° of container	E	K	D	G	A	Q
Weight of wet soil + container(A)	42.10	46.34	43.00	46.17	40.84	41.24
Weight of Dry soil + container(B)	38.56	42.25	39.31	42.29	38.97	39.32
Weight of container©	29.82	32.05	29.83	31.94	32.02	32.27
Weight of water D=A-B	3.54	4.09	3.69	3.88	1.87	1.92
Weight of Dry soil (E)=(B-C)	8.74	10.2	9.48	10.35	6.95	7.05
Water content (W)=D/E*100	40.5	40.1	38.9	37.5	26.9	27.2
LL @25Blows and Average PL	**39.4**				**27.1**	



Remarks:

Submitted By :

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COSMEZZ SARL

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **18-Dec-13**

Sample no : **BH-1/SS-1**

Date sampled: **7-Dec-13**

Sample Description : ***Silty SAND*** *(SM), with gravel, light brown, very hard*

Sampled by : **THEO**

Source : **Borehole#BH-1: PK-12 SUBSTATION**

Tested by : **HOUSSEIN**

Sample Depth : **0.50 - 0.60m**

Designation		***unit***	1	
N° of container			P	
Weight of wet soil + container	**A**	***grs***	903.48	
Weight of Dry soil + container	**B**	***grs***	869.25	
Weight of container	**C**	***grs***	473.15	
Weight of water	**D=A-B**	***grs***	34.23	
Weight of Dry	**E=B-C**	***grs***	396.1	
Water content	**W=D/E*100**	***%***	**8.6**	

Remarks :

Submitted by :

Theobard N.
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COSMEZZ SARL

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Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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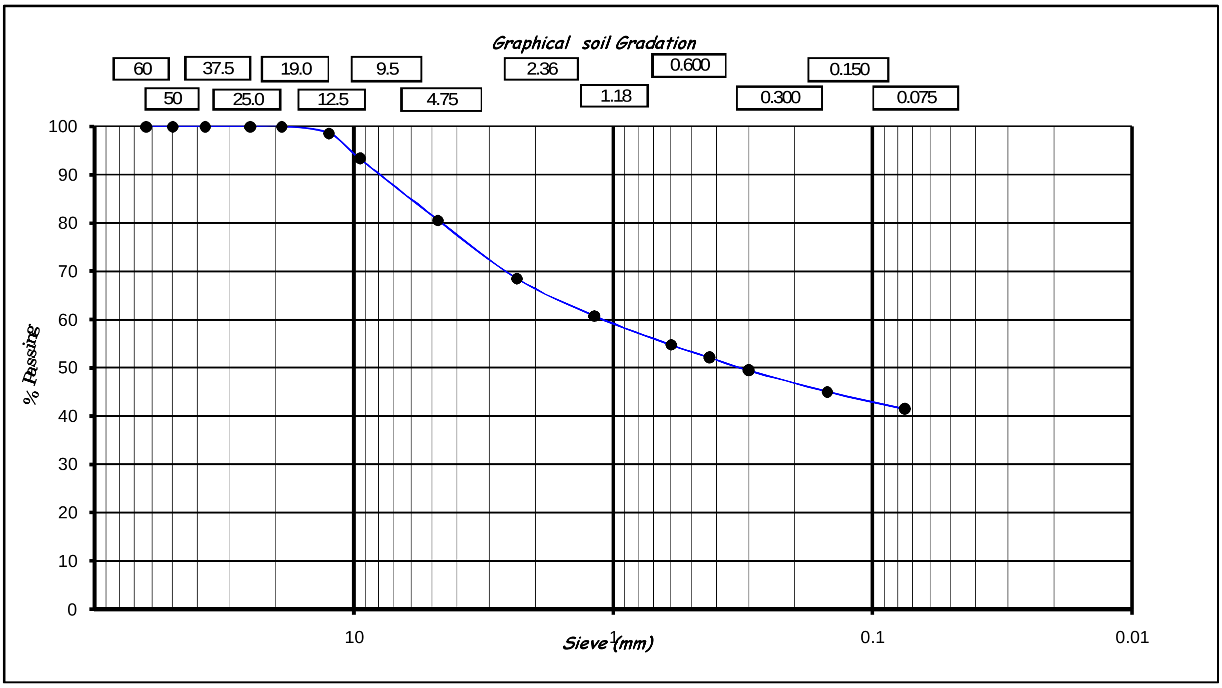
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-1/SS-1**
Project No.:
Date of Sampling : **07-Dec-13**
Sample source: **Borehole #P1: PK-12 SUBSTATION**
Date of Test : **18-Dec-13**
Sample Description : Silty SAND (SM), with gravel, light brown, very hard
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.50 - 0.60 m**
Weight (grs): **396.10**
Sampled by : **THEO/HOUSSEIN**
Tested by: **HOUSSEIN**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	5.48	5.5	1.4	**98.6**
3/8	**9,5**	20.89	26.4	6.7	**93.3**
No.4	**4,75**	50.38	76.8	19.4	**80.6**
No.8	**2,36**	47.77	124.5	31.4	**68.6**
No.16	**1,18**	30.83	155.4	39.2	**60.8**
No.30	**0,600**	23.61	179.0	45.2	**54.8**
No.40	**0,425**	10.71	189.7	47.9	**52.1**
No.50	**0,300**	10.53	200.2	50.5	**49.5**
No.100	**0,150**	17.37	217.6	54.9	**45.1**
No.200	**0,075**	14.27	231.8	58.5	**41.5**
Can	**0**				



Remarks :
Gravel: **19.4%**
Sand: **39.2%**
Fines: **41.5%**

Submitted By :

Theobard N.
GEOTECH. LAB. MNGR
COSMEZZ SARL

COSMEZZ

GEOTECHNICAL LABORATORY

Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **17-Dec-13**

Sample no : **BH-1/SS-1**

Sample Description : **Silty SAND (SM)**, with gravel, light brown, very hard

Date sampled : **7-Dec-13**

Sample Depth: **0.50 - 0.60 m**

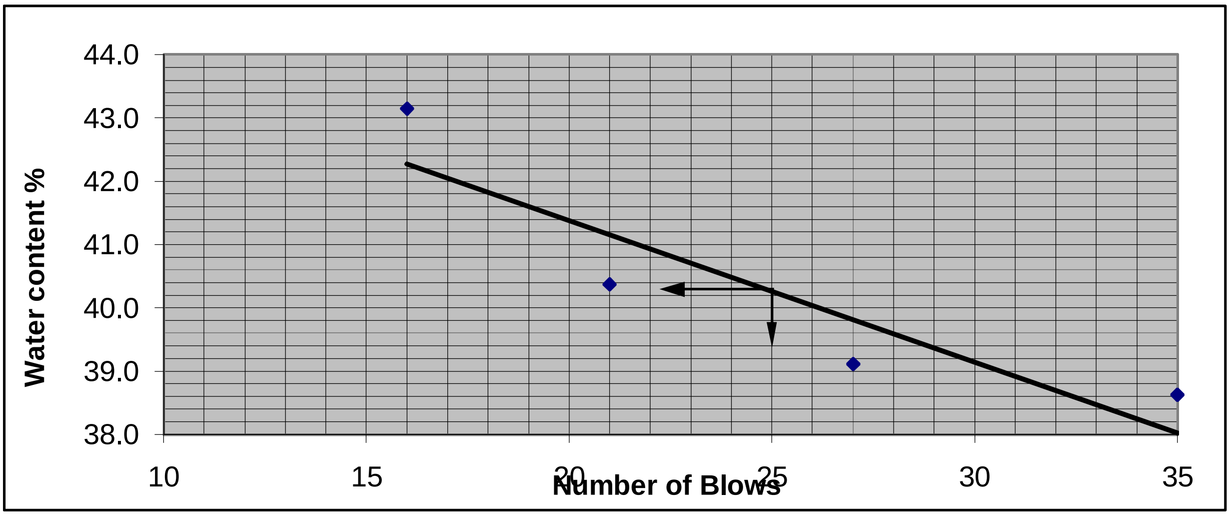
Source : **Borehole#BH-1: PK-12 SUBSTATION**

Tested by: **MANZI**

Sampled by: **THEO / MOH**

LL: 40.3 **PL: 28.2** **PI: 12.1**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	16	21	27	35	**Test n°1**	**Test n°2**
N° of container	U	N	R	11	12	13
Weight of wet soil + container(A)	40.43	46.66	45.22	47.61	39.38	40.01
Weight of Dry soil + container(B)	37.88	42.51	41.43	43.26	37.7	38.21
Weight of container©	31.97	32.23	31.74	32.00	31.74	31.81
Weight of water D=A-B	2.55	4.15	3.79	4.35	1.68	1.8
Weight of Dry soil (E)=(B-C)	5.91	10.28	9.69	11.26	5.96	6.4
Water content (W)=D/E*100	43.1	40.4	39.1	38.6	28.2	28.1
LL @25Blows and Average PL	**40.3**				**28.2**	



Remarks:

Submitted By :

Theobard N.
GEOTECHNICAL LAB. MNGR
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GEOTECHNICAL LABORATORY

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

Contractor : COSMEZZ SARL

COSMEZZ SARL

Rue de Venise, Salines Ouest

B.P.1331-Djibouti-R.D.D.

E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **18-Dec-13**

Sample no : **BH-2/SS-1**

Sample Description : ***Silty SAND*** *(SM), with gravel, light brown, very hard*

Date sampled: **8-Dec-13**

Sampled by : **THEO**

Source : **Borehole#BH-2: PK-12 SUBSTATION**

Tested by : **HOUSSEIN**

Sample Depth : **0.50 - 0.60m**

Designation		***unit***	1	
N° of container			X	
Weight of wet soil + container	**A**	***grs***	966.66	
Weight of Dry soil + container	**B**	***grs***	932.94	
Weight of container	**C**	***grs***	479.83	
Weight of water	**D=A-B**	***grs***	33.72	
Weight of Dry	**E=B-C**	***grs***	453.11	
Water content	**W=D/E*100**	***%***	**7.4**	

Remarks :

Submitted by :

Theobard N.

Geotech. Lab. Mngr

COSMEZZ SARL

GEOTECHNICAL LABORATORY
Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

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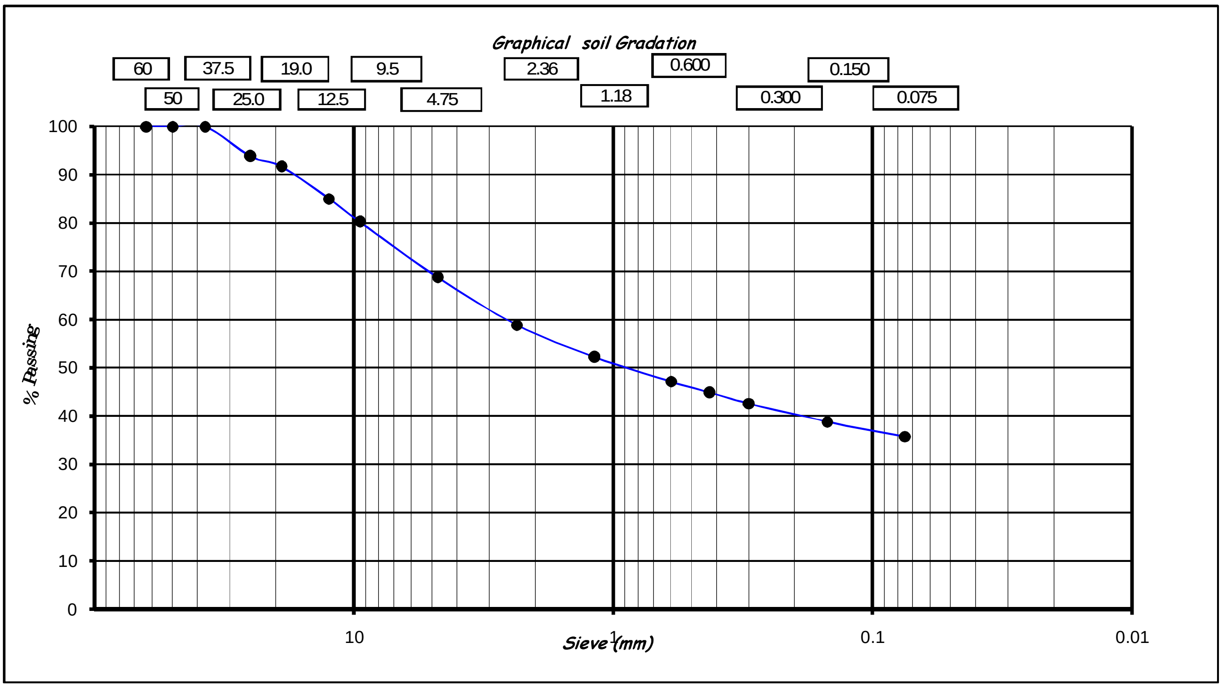
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-2/SS-1**
Project No.:
Date of Sampling : **08-Dec-13**
Sample source: **Borehole #BH-2: PK-12 SUBSTATION**
Date of Test : **21-Dec-13**
Sample Description : Silty SAND (SM), with gravel, light brown, very hard
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.50 - 0.60 m**
Weight (grs): **453.11**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	28.00	28.0	6.2	**93.8**
3/4	**19**	9.70	37.7	8.3	**91.7**
1/2	**12,5**	30.02	67.7	14.9	**85.1**
3/8	**9,5**	21.72	89.4	19.7	**80.3**
No.4	**4,75**	52.28	141.7	31.3	**68.7**
No.8	**2,36**	44.43	186.2	41.1	**58.9**
No.16	**1,18**	30.20	216.4	47.7	**52.3**
No.30	**0,600**	22.87	239.2	52.8	**47.2**
No.40	**0,425**	10.41	249.6	55.1	**44.9**
No.50	**0,300**	10.31	259.9	57.4	**42.6**
No.100	**0,150**	17.01	277.0	61.1	**38.9**
No.200	**0,075**	13.95	290.9	64.2	**35.8**
Can	**0**				



Remarks :
Gravel: **31.3%**
Sand: **32.9%**
Fines: **35.8%**

Submitted By :

Theobard N.
GEOTECH. LAB. MNGR
COSMEZZ SARL

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **17-Dec-13**

Sample no : **BH-2/SS-1**

Date sampled : **8-Dec-13**

Sample Description : **Silty SAND (SM)**, with gravel, light brown, very hard

Sample Depth: **0.50 - 0.60 m**

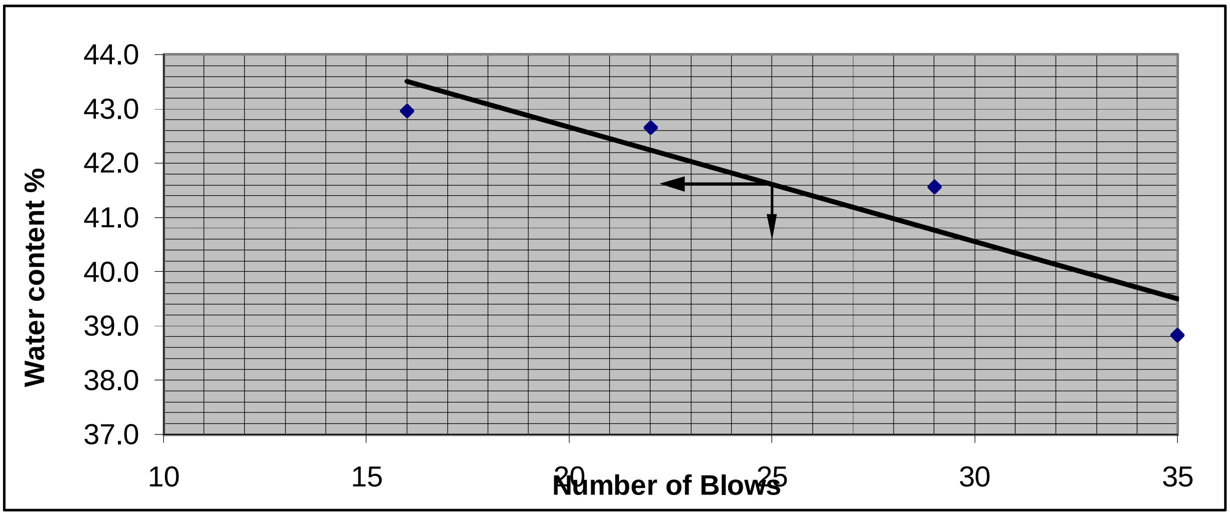
Source : **Borehole#BH-2: PK-12 SUBSTATION**

Tested by: **MANZI**

Sampled by: **THEO / MOH**

LL: 41.6 **PL: 27.5** **PI: 14.1**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	16	22	29	35	**Test n°1**	**Test n°2**
N° of container	A1	O	10	Y	W	V
Weight of wet soil + container(A)	41.47	44.34	44.03	48.58	39.15	39.78
Weight of Dry soil + container(B)	38.60	40.62	40.41	43.94	37.59	38.05
Weight of container©	31.92	31.9	31.70	31.99	31.91	31.75
Weight of water D=A-B	2.87	3.72	3.62	4.64	1.56	1.73
Weight of Dry soil (E)=(B-C)	6.68	8.72	8.71	11.95	5.68	6.3
Water content (W)=D/E*100	43.0	42.7	41.6	38.8	27.5	27.5
LL @25Blows and Average PL	**41.6**				**27.5**	



Remarks:

Submitted By :

Theobard N.
GEOTECHNICAL LAB. MNGR
COSMEZZ SARL

COSMEZZ

GEOTECHNICAL LABORATORY

Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

Contractor : COSMEZZ SARL

COSMEZZ SARL
Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **18-Dec-13**

Sample no : **BH-3/SPT1**

Date sampled: **15-Dec-13**

Sample Description : ***LEAN CLAY (CL),*** *with sand, reddish, Loose and dry*

Sampled by : **THEO**

Source : **Borehole#BH-3: PK-12 SUBSTATION**

Tested by : **HOUSSEIN**

Sample Depth : **0,45 - 1,05m**

Designation		***unit***	1	
N° of container			Z	
Weight of wet soil + container	**A**	***grs***	659.63	
Weight of Dry soil + container	**B**	***grs***	632	
Weight of container	**C**	***grs***	226.02	
Weight of water	**D=A-B**	***grs***	27.63	
Weight of Dry	**E=B-C**	***grs***	405.98	
Water content	**W=D/E*100**	***%***	**6.8**	

Remarks :

Submitted by :

Theobard N.
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GEOTECHNICAL LABORATORY
Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND TRANSMISSION LINE ROUTE
Client: YEC YACHIYO ENGINEERING CO., LTD - JAPAN

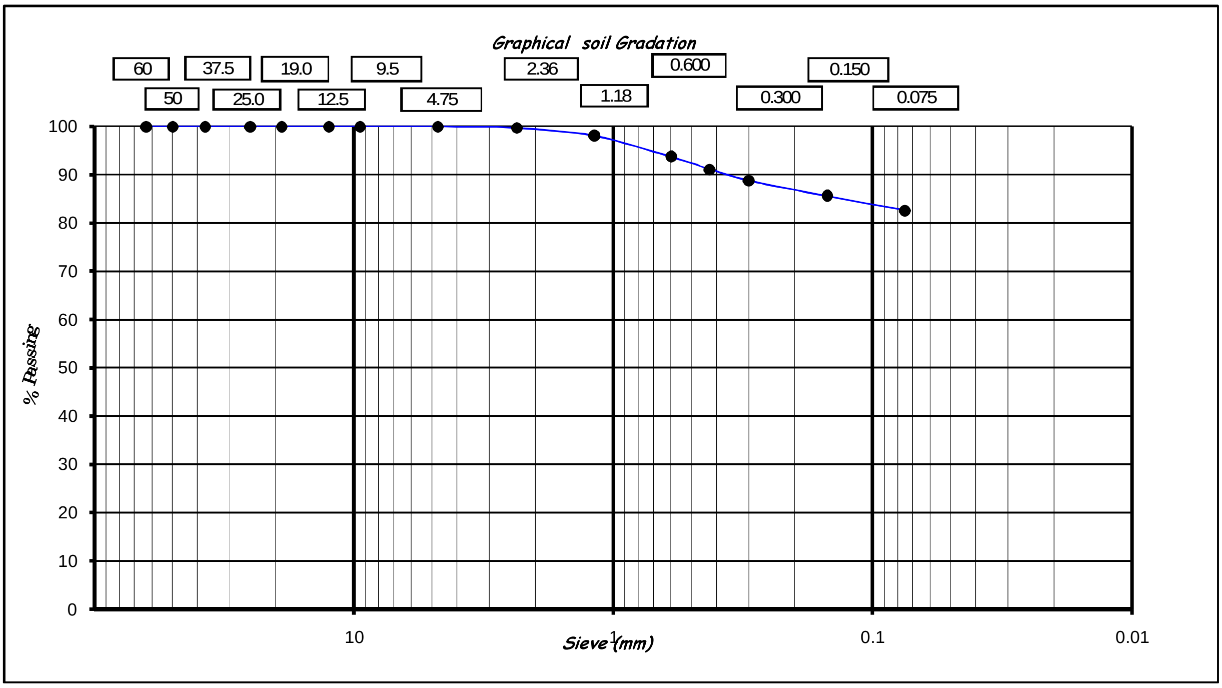
COSMEZZ SARL
Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
E-mail: cosmezz@mezzgroup.com

COSMEZZ GEOTECHNICAL LABORATORY - B.P. 1331 Rue de Venise - Djibouti. Phone: +253 21356142 - Email: cosmezz@mezzgroup.com

SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-3-SPT1**
Project No.:
Date of Sampling : **15-Dec-13**
Sample source: **Borehole #BH-3: PK-12 TRANSMISSION LINE**
Date of Test : **21-Dec-13**
Sample Description : LEAN CLAY (CL), with sand, dry, reddish
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.45 - 1.05 m**
Weight (grs): **405.98**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	0.00	0.0	0.0	**100.0**
3/8	**9,5**	0.00	0.0	0.0	**100.0**
No.4	**4,75**	0.00	0.0	0.0	**100.0**
No.8	**2,36**	1.17	1.2	0.3	**99.7**
No.16	**1,18**	6.80	8.0	2.0	**98.0**
No.30	**0,600**	17.54	25.5	6.3	**93.7**
No.40	**0,425**	10.52	36.0	8.9	**91.1**
No.50	**0,300**	9.42	45.5	11.2	**88.8**
No.100	**0,150**	13.07	58.5	14.4	**85.6**
No.200	**0,075**	11.99	70.5	17.4	**82.6**
Can	**0**				



Remarks :
Gravel: **0.0%**
Sand: **17.4%**
Fines: **82.6%**

Submitted By :

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GEOTECH. LAB. MNGR
COSMEZZ SARL

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GEOTECHNICAL LABORATORY

Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **21-Dec-13**

Sample no : **BH-3/SPT1**

Sample Description : **LEAN CLAY (CL),** with sand, dry, reddish

Date sampled : **15-Dec-13**

Sample Depth: **0.45 - 1.05 m**

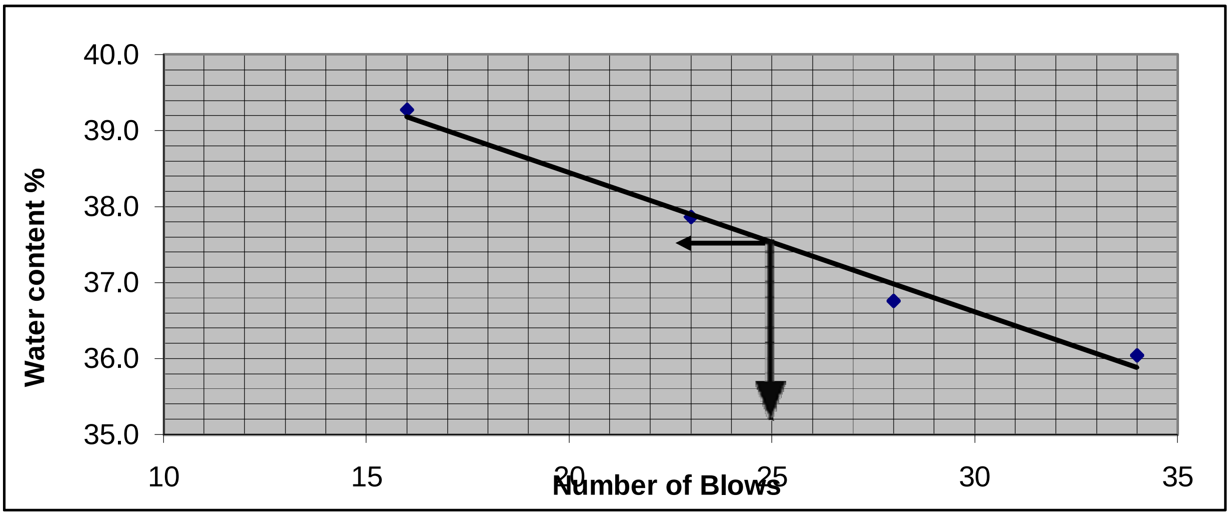
Source : **Borehole#BH-3: PK-12 TRANSMISSION LINE**

Tested by: **MANZI**

Sampled by: **THEO / MOH**

LL: 37.5 **PL: 27.8** **PI: 9.7**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	16	23	28	34	**Test n°1**	**Test n°2**
N° of container	T	S	X	J	F	N
Weight of wet soil + container(A)	51.51	56.87	55.64	48.61	37.7	40.44
Weight of Dry soil + container(B)	46.02	50.16	49.27	44.22	36.16	38.64
Weight of container©	32.04	32.44	31.94	32.04	30.65	32.14
Weight of water D=A-B	5.49	6.71	6.37	4.39	1.54	1.8
Weight of Dry soil (E)=(B-C)	13.98	17.72	17.33	12.18	5.51	6.5
Water content (W)=D/E*100	39.3	37.9	36.8	36.0	27.9	27.7
LL @25Blows and Average PL	**37.5**				**27.8**	



Remarks:

Submitted By :

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COSMEZZ Geotechnical Laboratory Certified by USACE	GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN Contractor : COSMEZZ SARL	COSMEZZ SARL Rue de Venise, Salines Ouest B.P.1331-Djibouti-R.D.D. E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **18-Dec-13**

Sample no : **BH-3/SPT2**

Date sampled: **15-Dec-13**

Sample Description : ***Sandy SILT(ML)***, *Brown*

Sampled by : **THEO**

Source : **Borehole#BH-3: PK-12 SUBSTATION**

Tested by : **HOUSSEIN**

Sample Depth : **1,50 - 1,65m**

Designation		*unit*	1	
N° of container			A	
Weight of wet soil + container	**A**	*grs*	433.3	
Weight of Dry soil + container	**B**	*grs*	406.23	
Weight of container	**C**	*grs*	225.48	
Weight of water	**D=A-B**	*grs*	27.07	
Weight of Dry	**E=B-C**	*grs*	180.75	
Water content	**W=D/E*100**	*%*	**15.0**	

Remarks :

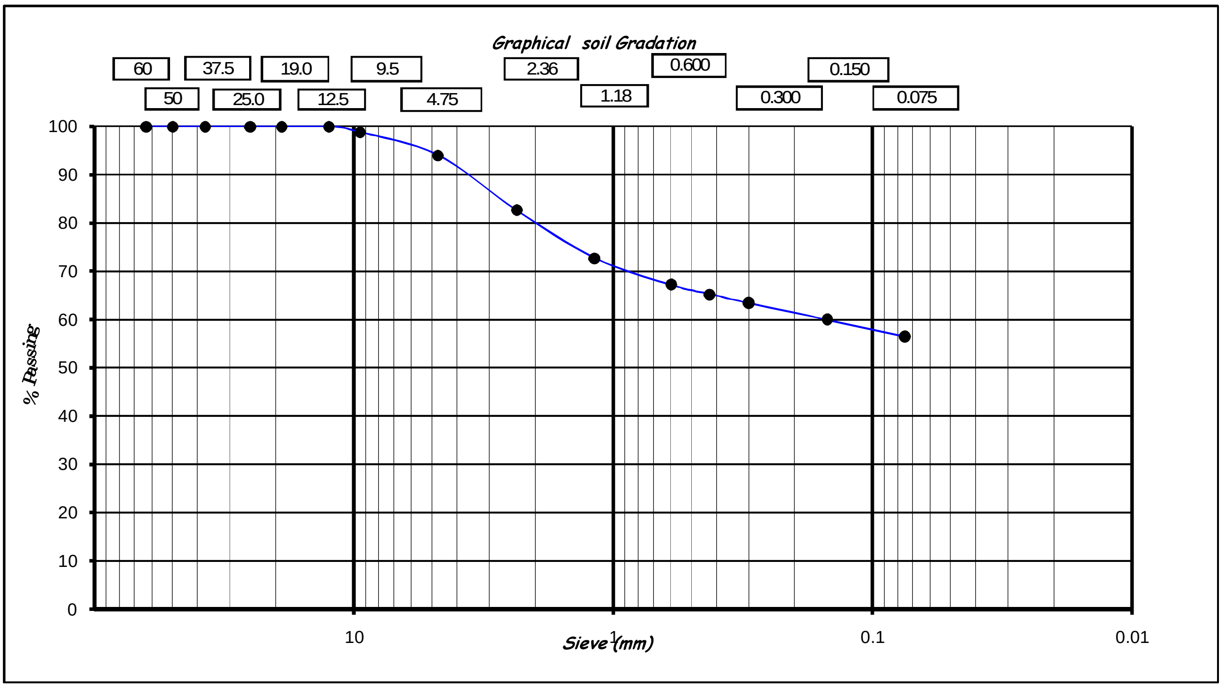
Submitted by :

Theobard N.
Geotech. Lab. Mngr
COSMEZZ SARL

SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-3/SPT-2**
Project No.:
Date of Sampling : **15-Dec-13**
Sample source: **Borehole #BH-3: PK-12 SUBSTATION**
Date of Test : **21-Dec-13**
Sample Description : **Sandy SILT(ML)**, Brown
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **1.50 - 1.65 m**
Weight (grs): **180.75**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	0.00	0.0	0.0	**100.0**
3/8	**9,5**	2.01	2.0	1.1	**98.9**
No.4	**4,75**	8.76	10.8	6.0	**94.0**
No.8	**2,36**	20.46	31.2	17.3	**82.7**
No.16	**1,18**	18.08	49.3	27.3	**72.7**
No.30	**0,600**	9.93	59.2	32.8	**67.2**
No.40	**0,425**	3.52	62.8	34.7	**65.3**
No.50	**0,300**	3.38	66.1	36.6	**63.4**
No.100	**0,150**	6.17	72.3	40.0	**60.0**
No.200	**0,075**	6.47	78.8	43.6	**56.4**
Can	**0**				



Remarks :

Gravel: **6.0%**

Sand: **37.6%**

Fines: **56.4%**

Submitted By :

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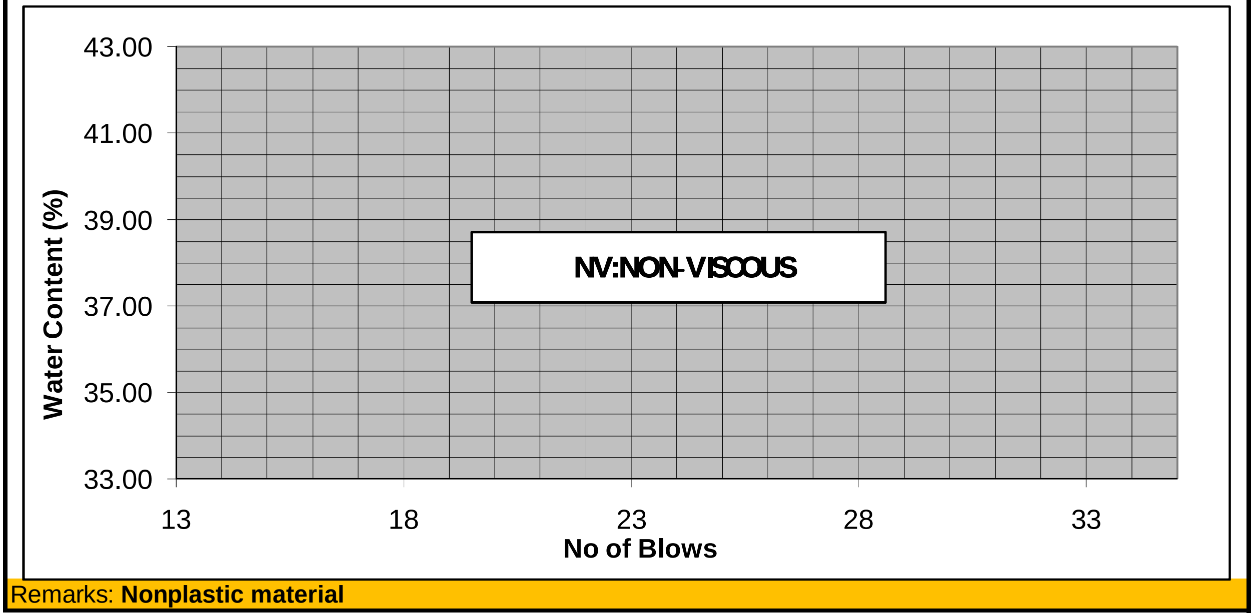
LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **21-Dec-13**
Date sampled : **15-Dec-13**
Sample Depth: **1.50 - 1.65 m**
Tested by: **HOUSSEIN**

Sample no : **BH-3/SPT-2**
Sample Description : **Sandy SILT(ML)**, Brown
Source : **Borehole#BH-3: PK-12 TRANSMISSION LINE**
Sampled by: **THEO**

LL: 0.0 **PL: 0.0** **PI: 0.0**

LIQUID LIMIT					**PLASTIC LIMIT**	
No of Blows					**Test n°1**	**Test n°2**
N° of container						
Weight of wet soil + container						
Weight of Dry soil + container		**NV:NON-VISCOUS**			**NP:NON-PLASTIC**	
Weight of container						
Weight of water						
Weight of Dry						
Water content						
Average						



Remarks: **Nonplastic material**

Submitted By :

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COSMEZZ GEOTECHNICAL LABORATORY Certified by USACE	GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN Contractor : COSMEZZ SARL	COSMEZZ SARL Rue de Venise, Salines Ouest B.P.1331-Djibouti-R.D.D. E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **27-Apr-14**

Date sampled: **26-Apr-14**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **BH4/SPT1**

Sample Description : **SILTY, CLAYEY SAND (SC-SM)**, with trace of gravel, dry, pinkish

Source : **Borehole#BH4:NAGAD TRASMISSION LINE**

Sample Depth : **0.0 - 0.30m**

Designation		*unit*	1	
N° of container			X	
Weight of wet soil + container	**A**	*grs*	456.88	
Weight of Dry soil + container	**B**	*grs*	444.66	
Weight of container	**C**	*grs*	150.22	
Weight of water	**D=A-B**	*grs*	12.22	
Weight of Dry	**E=B-C**	*grs*	294.44	
Water content	**W=D/E*100**	*%*	**4.2**	

Remarks :

Submitted by :

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Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

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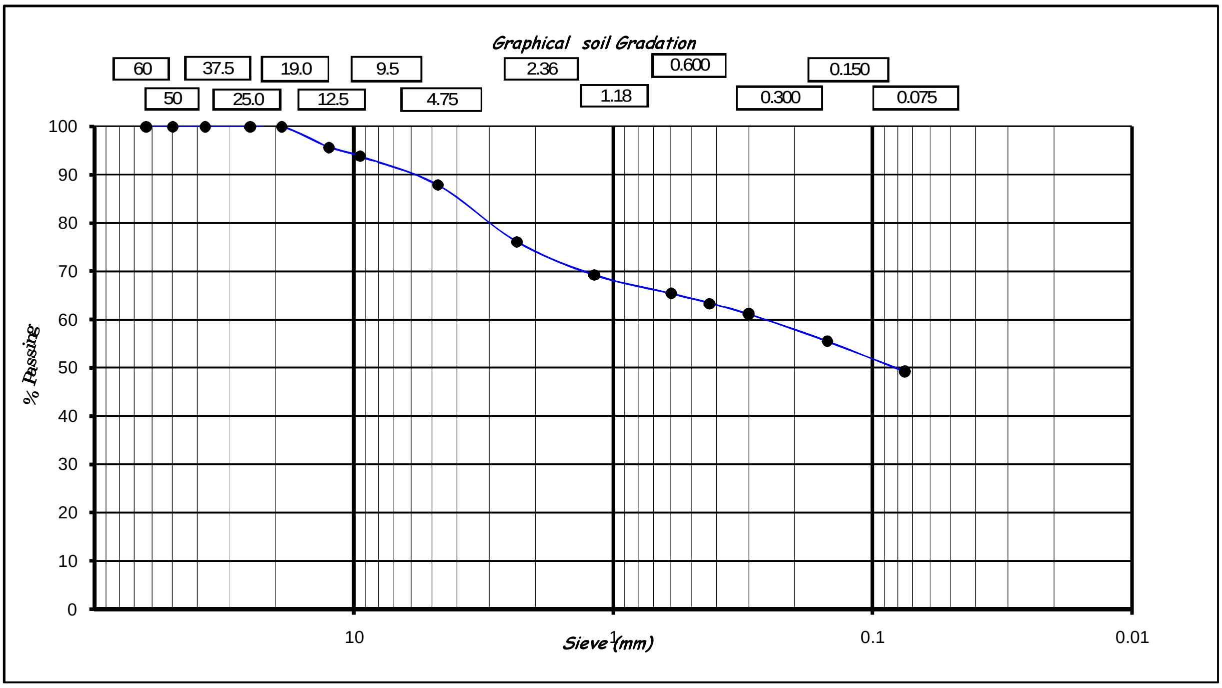
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH4-SPT1**
Project No.:
Date of Sampling : **26-Apr-14**
Sample source: **Borehole #BH4: NAGAD TRANSMISSION LINE**
Date of Test : **28-Apr-14**
Sample Description : SILTY, CLAYEY SAND (SC-SM), with little gravel, dry, pinkish
Station : **NAGAD**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.00 - 0.30 m**
Weight (grs): **294.44**
Sampled by : **THEO**
Tested by: **SIMANE**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	12.73	12.7	4.3	**95.7**
3/8	**9,5**	5.30	18.0	6.1	**93.9**
No.4	**4,75**	17.60	35.6	12.1	**87.9**
No.8	**2,36**	34.53	70.2	23.8	**76.2**
No.16	**1,18**	20.29	90.5	30.7	**69.3**
No.30	**0,600**	11.25	101.7	34.5	**65.5**
No.40	**0,425**	6.20	107.9	36.6	**63.4**
No.50	**0,300**	6.59	114.5	38.9	**61.1**
No.100	**0,150**	16.35	130.8	44.4	**55.6**
No.200	**0,075**	18.77	149.6	50.8	**49.2**
Can	**0**				



Remarks :
Gravel: **12.1%**
Sand: **38.7%**
Fines: **49.2%**

Submitted By :

Theobard N.
GEOTECH. LAB. MNGR
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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: YEC YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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E-mail: cosmezz@mezzgroup.com

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **29-Apr-14**

Sample no : **BH-4/SPT-1**

Sample Description : **SILTY, CLAYEY SAND (SC-SM),** with little gravel, dry, pinkish

Date sampled : **26-Apr-14**

Sample Depth: **0.00 - 0.30 m**

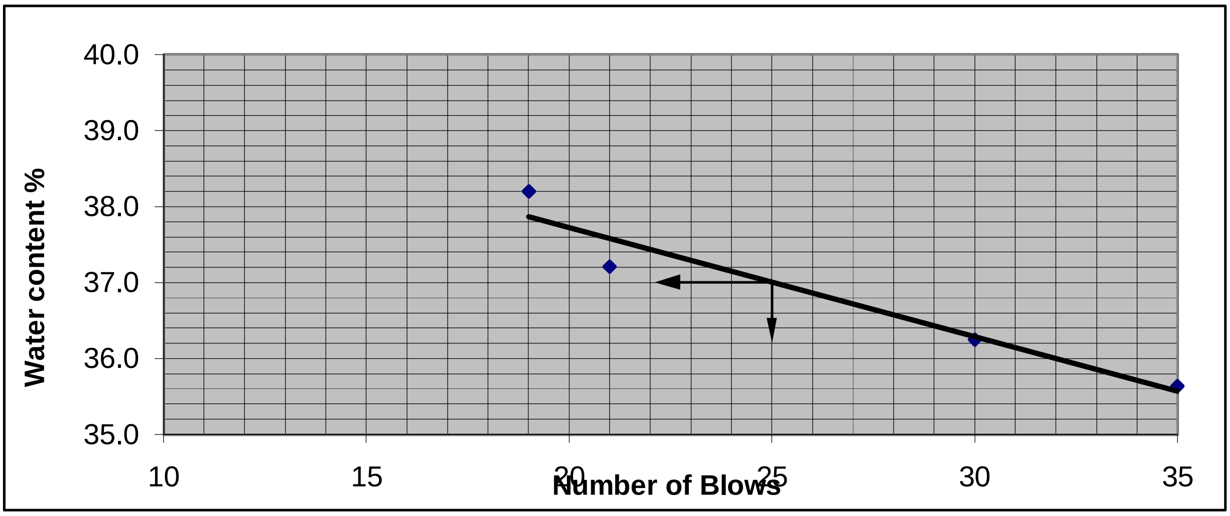
Source : **Borehole#BH-4: NAGAD TRANSMISSION LINE**

Tested by: **HOUSSEIN**

Sampled by: **THEO / MOH**

LL: 37.0 **PL: 23.8** **PI: 13.2**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	19	21	30	35	**Test n°1**	**Test n°2**
N° of container	20	21	22	23	24	25
Weight of wet soil + container(A)	42.91	46.26	41.95	45.42	36.72	38.01
Weight of Dry soil + container(B)	39.85	42.39	39.3	41.91	35.63	37.06
Weight of container©	31.84	31.99	31.99	32.06	30.90	33.18
Weight of water D=A-B	3.06	3.87	2.65	3.51	1.09	0.95
Weight of Dry soil (E)=(B-C)	8.01	10.40	7.31	9.85	4.73	3.88
Water content (W)=D/E*100	38.2	37.2	36.3	35.6	23.0	24.5
LL @25Blows and Average PL	**37.0**				**23.8**	



Remarks:

Submitted By :

Theobard N.
GEOTECHNICAL LAB. MNGR
COSMEZZ SARL

COSMEZZ Geotechnical Laboratory	Project : IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI Contract #: Client:Yec YACHIYO ENGINEERING CO., LTD - JAPAN	COSMEZZ SARL Rue de Venise, Salines Ouest B.P. 1331, Djibouti - RDD Phone: +253 21356142 E-mail: cosmezz@mezzgroup.com

SPECIFIC GRAVITY OF SOIL SOLIDS (ASTM D 854)

LABORATORY DATA SHEET

DATE TESTED : **25-May-14** TESTED BY : **HOUSSEIN D.**

DATE SAMPLED : **26-Apr-14** SAMPLED BY : **COSMEZZ SARL LAB**

SAMPLE NUMBER : **SS-1** SAMPLE DEPTH : **- 2.0 m**

SAMPLE SOURCE : **BH-4**

SAMPLE DESCRIPTION: **Sandy LEAN CLAY (CL),** light brown, dry, very stiff

Specimen number	1	
Pycnometer bottle number	SM	
M_0=Mass of dry soil (grams)	48.28	
M_P=Mass of empty, clean pycnometer (grams)	438.7	
M_{PS}=Mass of empty, clean pycnometer +dry soil (grams)	486.98	
M_b=Mass of pycnometer+dry soil +water (grams)	1174	
M_a=Mass of pycnometer +water (grams)	1144.29	
Specific Gravity of soil solids **(G_s)** g/cm^3	**2.600**	
Water temperature (^{o}C)	20.5	
Correction factor (K)	0.9981	
Specific Gravity of soil solids at 20^{o}C (G_{s20})	**2.595**	

Equation and Calculations:

$$G_s = \frac{M_0}{M_0 + (M_a - M_b)}$$

$$G_{s20} = Gs.K$$

Submitted by :

THEOBARD N.

Geotech. Lab. Mngr

COSMEZZ SARL

Geotechnical Laboratory
Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN
Contractor : COSMEZZ SARL

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NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **27-Apr-14**

Sample no : **BH-4/SPT-2**

Date sampled: **26-Apr-14**

Sample Description : **Sandy elastic silt (MH),** with gravel

Source : **Borehole#BH4:NAGAD TRASMISSION LINE**

Sampled by : **THEO**

Tested by : **THEO**

Sample Depth : **2.75 m**

Designation		*unit*	1	
N° of container			z	
Weight of wet soil + container	**A**	***grs***	554.47	
Weight of Dry soil + container	**B**	***grs***	530.06	
Weight of container	**C**	***grs***	375.45	
Weight of water	**D=A-B**	***grs***	24.41	
Weight of Dry	**E=B-C**	***grs***	154.61	
Water content	**W=D/E*100**	***%***	**15.8**	

Remarks :

Submitted by :

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Geotech. Lab. Mngr
COSMEZZ SARL

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
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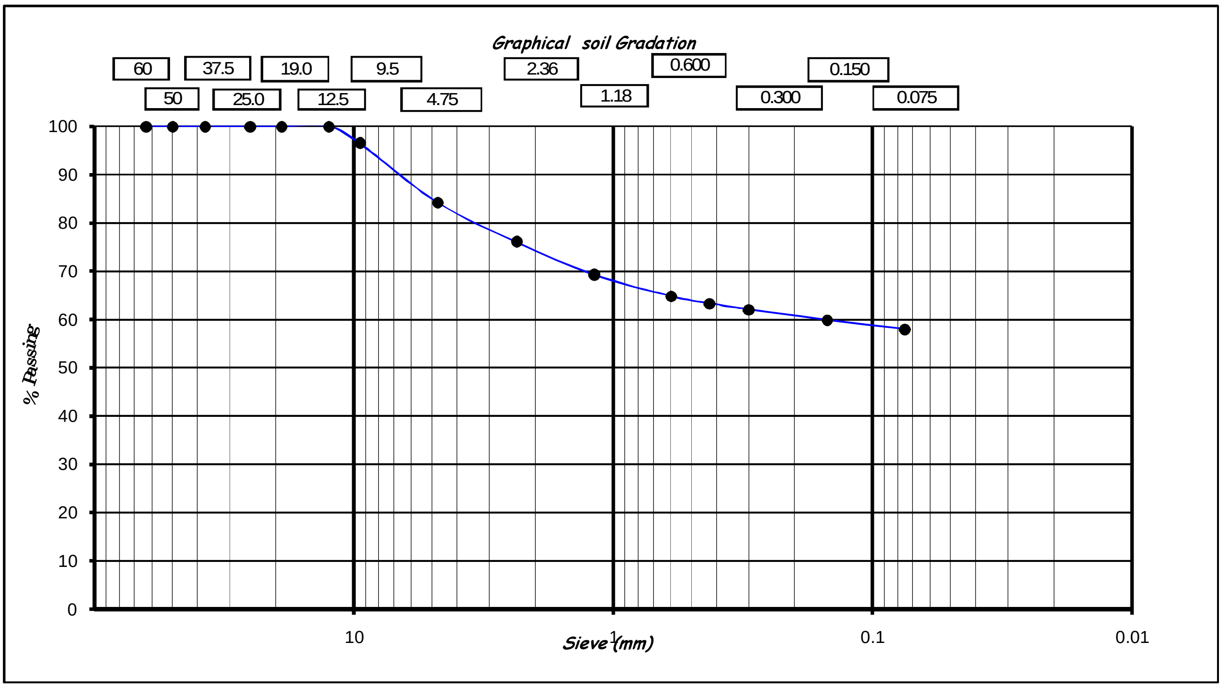
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-4/SPT-2**
Project No.:
Date of Sampling : **26-Apr-14**
Sample source: **Borehole #BH4: NAGAD TRANSMISSION LINE**
Date of Test : **28-Apr-14**
Sample Description : **Sandy elastic silt (MH)**, with gravel, reddish
Station : **NAGAD**
Test Method: **ASTM C 117 / C136**
Sample Depth : **2.75 m**
Weight (grs): **154.61**
Sampled by : **THEO**
Tested by: **HOUSSEIN / SIMANE**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	0.00	0.0	0.0	**100.0**
3/8	**9,5**	5.42	5.4	3.5	**96.5**
No.4	**4,75**	18.95	24.4	15.8	**84.2**
No.8	**2,36**	12.58	37.0	23.9	**76.1**
No.16	**1,18**	10.63	47.6	30.8	**69.2**
No.30	**0,600**	6.75	54.3	35.1	**64.9**
No.40	**0,425**	2.30	56.6	36.6	**63.4**
No.50	**0,300**	1.97	58.6	37.9	**62.1**
No.100	**0,150**	3.40	62.0	40.1	**59.9**
No.200	**0,075**	2.89	64.9	42.0	**58.0**
Can	**0**				



Remarks :
Gravel: **15.8%**
Sand: **26.2%**
Fines: **58.0%**

Submitted By :

Theobard N.
GEOTECH. LAB. MNGR
COSMEZZ SARL

COSMEZZ

Geotechnical Laboratory
Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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B.P.1331-Djibouti-R.D.D.
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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **29-Apr-14**

Sample no : **BH-4/SPT-2**

Sample Description : **Sandy elastic silt (MH),** with gravel, reddish

Date sampled : **26-Apr-14**

Sample Depth: **2.75 m**

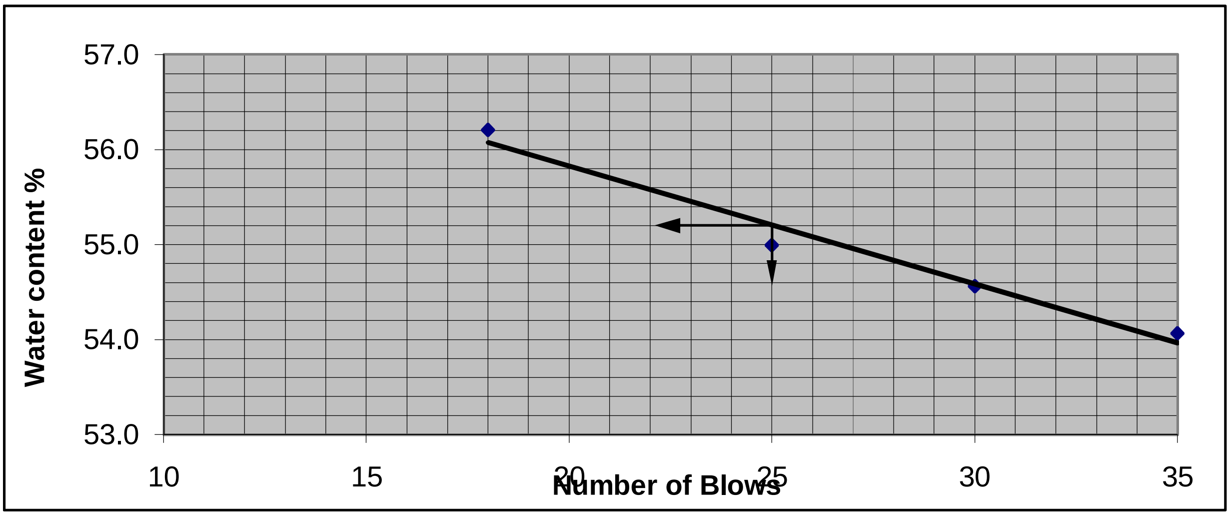
Source : **Borehole#BH-4: NAGAD TRANSMISSION LINE**

Tested by: **HOUSSEIN**

Sampled by: **THEO**

LL: 55.2 **PL: 35.7** **PI: 19.5**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	18	25	30	35	**Test n°1**	**Test n°2**
N° of container	14	15	16	17	18	19
Weight of wet soil + container(A)	40.94	40.98	40.52	42.62	38.32	36.54
Weight of Dry soil + container(B)	37.77	37.73	37.59	38.83	36.67	35.31
Weight of container©	32.13	31.82	32.22	31.82	32.00	31.9
Weight of water D=A-B	3.17	3.25	2.93	3.79	1.65	1.23
Weight of Dry soil (E)=(B-C)	5.64	5.91	5.37	7.01	4.67	3.41
Water content (W)=D/E*100	56.2	55.0	54.6	54.1	35.3	36.1
LL @25Blows and Average PL	**55.2**				**35.7**	



Remarks:

Submitted By :

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NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **27-Apr-14**

Date sampled: **26-Apr-14**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **BH-4/SPT-3**

Sample Description : **Well-graded Sand (SW-SC),** dry, with clay and gravel

Source : **Borehole#BH4:NAGAD TRASMISSION LINE**

Sample Depth : **4.0 m**

Designation		*unit*	1	
N° of container			w	
Weight of wet soil + container	**A**	*grs*	306.92	
Weight of Dry soil + container	**B**	*grs*	302.44	
Weight of container	**C**	*grs*	226.54	
Weight of water	**D=A-B**	*grs*	4.48	
Weight of Dry	**E=B-C**	*grs*	75.9	
Water content	**W=D/E*100**	*%*	**5.9**	

Remarks :

Submitted by :

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Geotech. Lab. Mngr
COSMEZZ SARL

COSMEZZ
Geotechnical Laboratory

Project : IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Contract #:
Client:Yec YACHIYO ENGINEERING CO LTD - JAPAN

COSMEZZ SARL
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SPECIFIC GRAVITY OF SOIL SOLIDS (ASTM D 854)

LABORATORY DATA SHEET

DATE TESTED : **25-May-14**

TESTED BY : **HOUSSEIN D.**

DATE SAMPLED : **26-Apr-14**

SAMPLED BY : **COSMEZZ SARL LAB**

SAMPLE NUMBER : **SS-2**

SAMPLE DEPTH : **- 3.5 m**

SAMPLE SOURCE : **BH-4**

SAMPLE DESCRIPTION: **Clayey SAND (SC),** with some gravel, very hard, dry, reddish

Specimen number	1	
Pycnometer bottle number	P4	
M_0=Mass of dry soil (grams)	51.48	
M_P=Mass of empty, clean pycnometer (grams)	438.74	
M_{PS}=Mass of empty, clean pycnometer +dry soil (grams)	490.22	
M_b=Mass of pycnometer+dry soil +water (grams)	1176.52	
M_a=Mass of pycnometer +water (grams)	1144.22	
Specific Gravity of soil solids **(G_s)** g/cm^3	**2.684**	
Water temperature (°C)	22.8	
Correction factor (K)	0.99759	
Specific Gravity of soil solids at 20°C (G_{s20})	**2.678**	

Equation and Calculations:

$$G_s = \frac{M_0}{M_0 + (M_a - M_b)}$$

$$G_{s20} = Gs.K$$

Submitted by :

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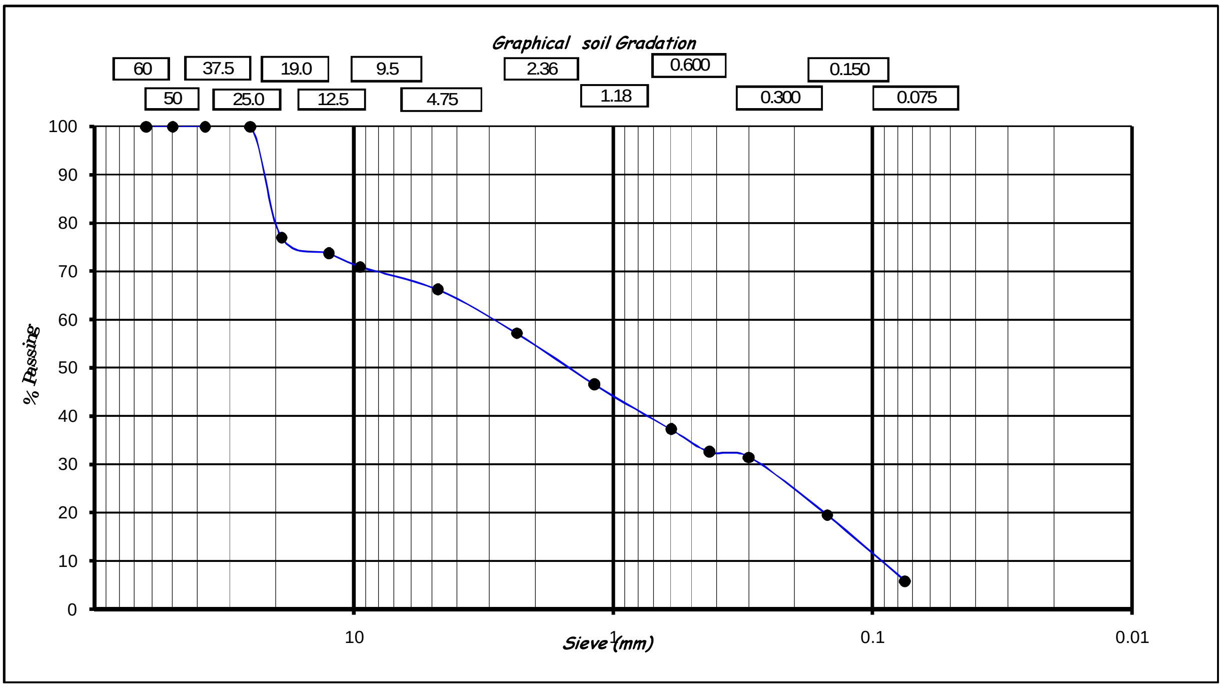
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **BH-4/SPT-3**
Project No.:
Date of Sampling : **26-Apr-14**
Sample source: **Borehole #BH4: NAGAD TRANSMISSION LINE**
Date of Test : **28-Apr-14**
Sample Description : **Well-graded Sand (SW-SC)**, with clay and gravel
Station : **NAGAD**
Test Method: **ASTM C 117 / C136**
Sample Depth : **4.0 m**
Weight (grs): **75.90**
Sampled by : **THEO**
Tested by: **HOUSSEIN / SIMANE**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	17.44	17.4	23.0	**77.0**
1/2	**12,5**	2.53	20.0	26.3	**73.7**
3/8	**9,5**	2.06	22.0	29.0	**71.0**
No.4	**4,75**	3.63	25.7	33.8	**66.2**
No.8	**2,36**	6.80	32.5	42.8	**57.2**
No.16	**1,18**	8.12	40.6	53.5	**46.5**
No.30	**0,600**	7.01	47.6	62.7	**37.3**
No.40	**0,425**	3.58	51.2	67.4	**32.6**
No.50	**0,300**	0.78	52.0	68.4	**31.6**
No.100	**0,150**	9.09	61.0	80.4	**19.6**
No.200	**0,075**	10.37	71.4	94.1	**5.9**
Can	**0**				



Remarks :
Gravel: **33.8%**
Sand: **60.3%**
Fines: **5.9%**

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: YEC YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **28-Apr-14**

Sample no : **BH-4/SPT-3**

Sample Description :**Well-graded Sand (SW-SC)**, with clay and gravel

Date sampled : **26-Apr-14**

Sample Depth: **4.0 m**

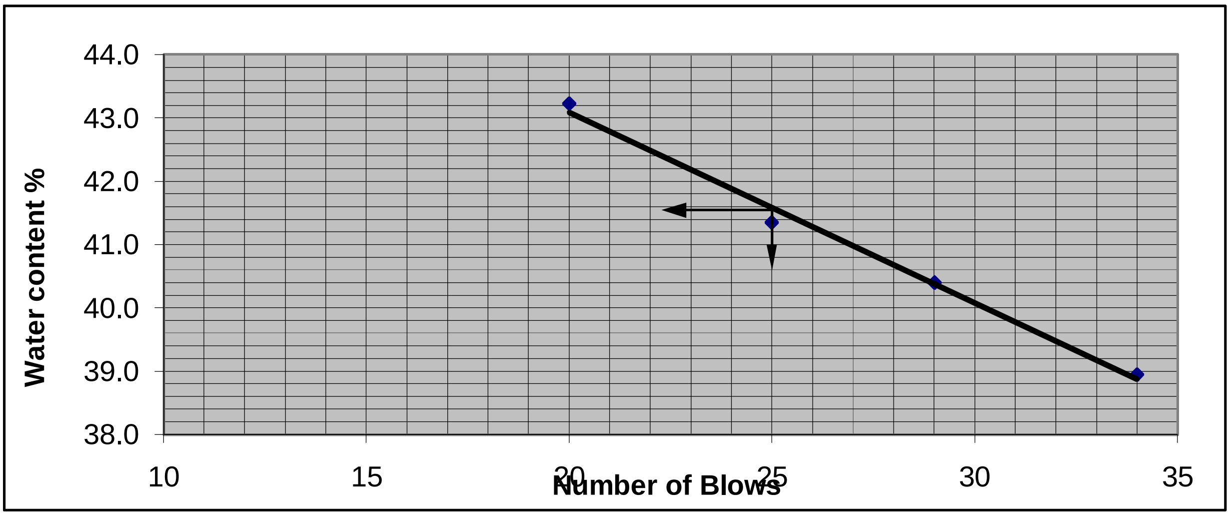
Source : **Borehole#BH-4: NAGAD TRANSMISSION LINE**

Tested by: **HOUSSEIN**

Sampled by: **THEO**

LL: 41.4 **PL: 24.9** **PI: 16.5**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	20	25	29	34	**Test n°1**	**Test n°2**
N° of container	4	b	v	d	a	q
Weight of wet soil + container(A)	34.30	34.74	32.26	33.12	37.9	36.68
Weight of Dry soil + container(B)	33.63	33.88	31.65	32.75	36.79	35.73
Weight of container©	32.08	31.80	30.14	31.8	32.30	31.93
Weight of water D=A-B	0.67	0.86	0.61	0.37	1.11	0.95
Weight of Dry soil (E)=(B-C)	1.55	2.08	1.51	0.95	4.49	3.8
Water content (W)=D/E*100	43.2	41.3	40.4	38.9	24.7	25.0
LL @25Blows and Average PL	**41.4**				**24.9**	



Remarks:

Submitted By :

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GEOTECHNICAL INVESTIGATIONS
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI

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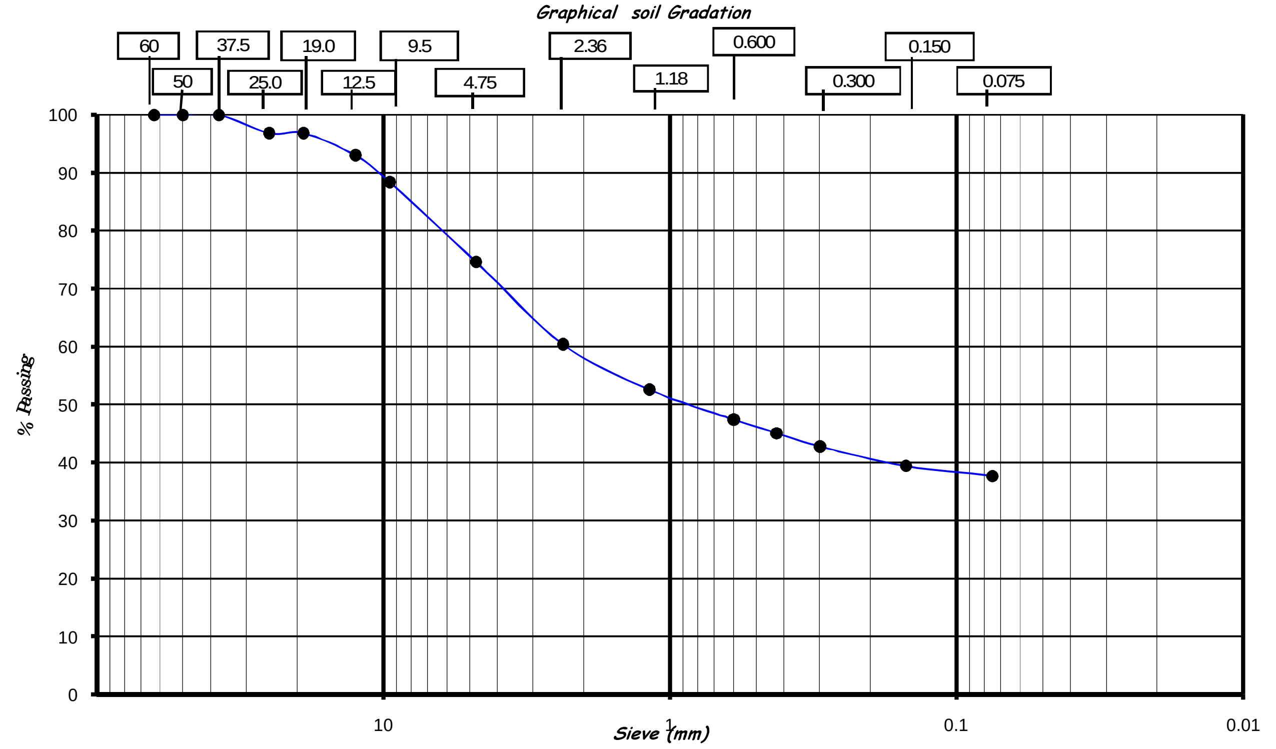
GEOTECHNICAL EXPLORATION FOR THE EXISTING SOIL

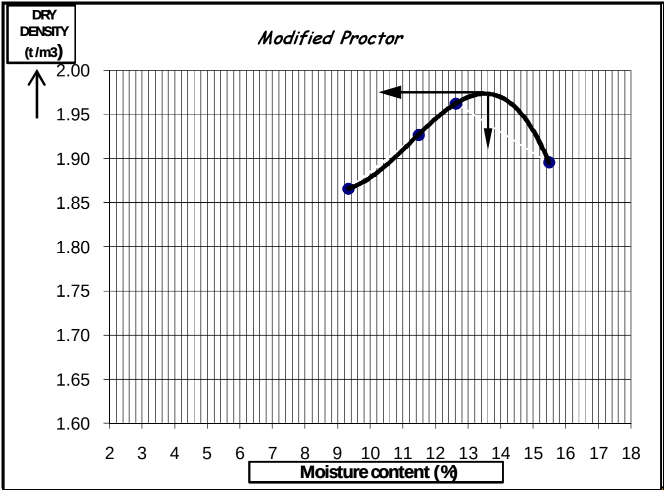
Project No:
Sample n°: **TP-1**

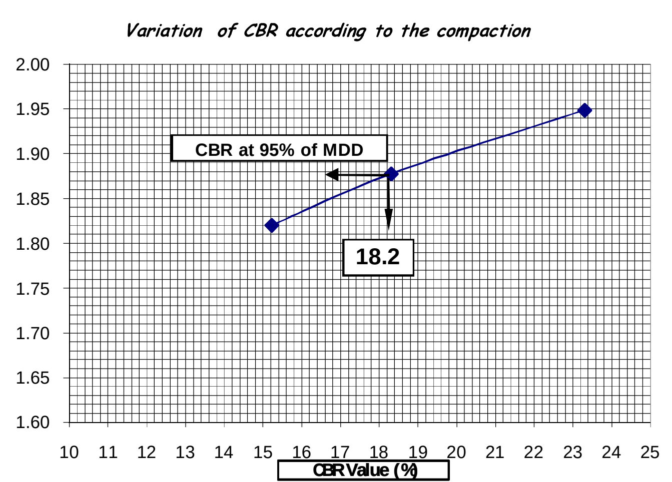
		CLASSIFICATION		
LL	**38.1**	H-R-B	U S C S	**Clayey SAND (SC) with gravel**
PI	**13.7**	**A-6**	**SC**	
%<0,075mm	**37.7**			

Test Method : **ASTM D 1883; D 1557; D 4318; C 136; C 117**
Source : PK-12 SUBSTATION (TEST PIT #TP1)
Date Sampled : **31-Dec-13** Sample Depth: **0.15 - 0.75 m**
Date Completed Testing : **11-Jan-14**



PROCTOR TEST		Natural Moisture content (%)	No of Blows	Compaction	DD (t/m^3)	**Soaked CBR**	W Soaking	Swell (%)
MDD(t/m^3) =	**1.974**		56 Blows	98.7%	1.949	**23.3**	4 days	
OMC (%)=	**13.5**		25 Blows	95.1%	1.878	**18.3**	4 days	**0.21**
ρ_{sd} =		**9.6**	10 Blows	92.2%	1.820	**15.2**	4 days	





Remarks: 1). Soaked CBR Value @95% of MDD for this material equal to **18.2%**

Submitted By :

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GEOTECHNICAL LABORATORY
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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI**
Contract #: **N 33191-12-C-0620**

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Phone: +253 21356142, E-mail: cosmezz@mezzgroup.com

SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-1**

Date Tested: **06-Jan-14**

Method used for preparation and compaction : **D 1557**

Sample Description : **Clayey SAND (SC) with gravel**

Source : **PK-12 SUBSTATION (TEST PIT # TP-1)**

Sample Depth : **0.15 - 0.75 m**

Tested by: **MOHAMED / ABDI**

Project number :

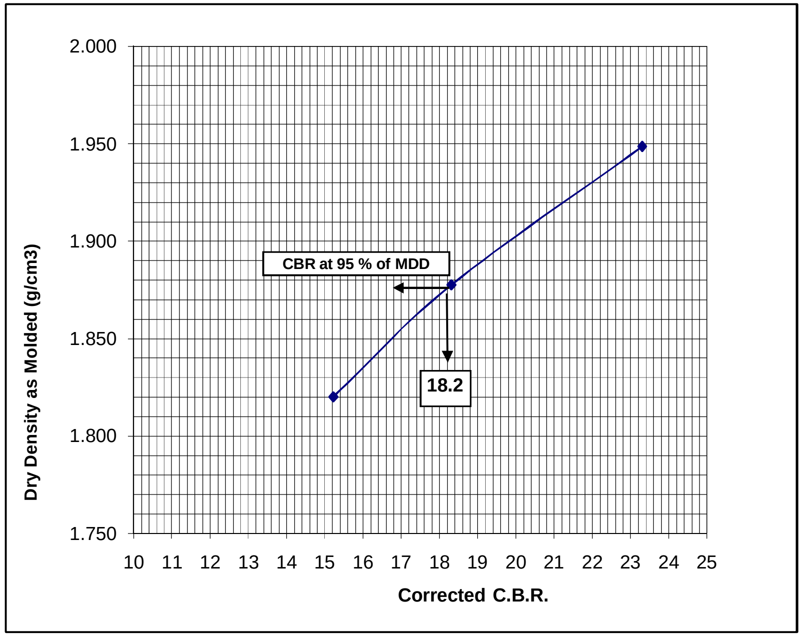
Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	653.27		719.02
W. of Dry soil + Container	605.28		662.65
W. Of container	230.48		233.47
W. Of water	47.99		56.37
W. Of Dry soil	374.80		429.18
Water content %	**12.8**	**13.0**	**13.1**

DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J4	J6	J7
W. Of Wet soil + Mold	(gram)	11455.8	11240.2	11331.4
W. Of Mold	(gram)	6795.4	6745.6	6970.8
W.Of Wet soil	(gram)	4660.4	4494.6	4360.6
Volume of Mold	(gram)	2117.2	2119.0	2120.8
Wet Density	(g/cm^3)	2.201	2.121	2.056
Water content %	(%)	13.0	13.0	13.0
Dry Density	(g/cm^3)	1.949	1.878	1.820
MDD	(g/cm^3)	1.974	1.974	1.974
% of Compaction	(%)	**98.7**	**95.1**	**92.2**



WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	686.36	884.57	643.58
W. of Dry soil + Container	635.38	809.73	593.99
W. Of container	229.13	231.72	233.30
W. Of water	50.98	74.84	49.59
W. Of Dry soil	406.25	578.01	360.7
Water content %	**12.5**	**12.9**	**13.7**

PENETRATION

Date: **10-Jan-14**

N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.040	**4.59**	0.030	**3.45**	0.020	**2.30**
1.27	0.080	**9.19**	0.060	**6.89**	0.050	**5.74**
1.91	0.110	**12.63**	0.090	**10.34**	0.070	**8.04**
2.54	0.140	**16.08**	0.110	**12.63**	0.085	**9.76**
3.18	0.170	**19.52**	0.130	**14.93**	0.095	**10.91**
3.81	0.190	**21.82**	0.150	**17.23**	0.105	**12.06**
4.45	0.210	**24.12**	0.160	**18.38**	0.110	**12.63**
5.08	0.230	**26.41**	0.170	**19.52**	0.120	**13.78**
7.62	0.290	**33.31**	0.220	**25.27**	0.150	**17.23**

SWELL (1/100mm)

Blows Date	56	25	10
06-Jan-14		0.00	
07-Jan-14		0.19	
08-Jan-14		0.22	
09-Jan-14		0.23	
10-Jan-14		0.24	
Total mm		0.24	
Total %		**0.21**	

No.of Blows	**2.54 mm**	**5.08 mm**	CBR@2.5mm
56	23.3	25.6	**23.3**
25	18.3	19.0	**18.3**
10	15.2	13.8	**15.2**

1.777 1.875 1.974

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI**
Contract #: **N 33191-12-C-0620**

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Phone: +253 21356142, E-mail: cosmezz@mezzgroup.com

SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-1**

Date Tested: **06-Jan-14**

Method used for preparation and compaction : **D 1557**

Sample Description : **Clayey SAND (SC) with gravel**

Source : **PK-12 SUBSTATION (TEST PIT # TP-1)**

Sample Depth : **0.15 - 0.75 m**

Tested by: **MOHAMED / ABDI**

Project number :

Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	653.27		719.02
W. of Dry soil + Container	605.28		662.65
W. Of container	230.48		233.47
W. Of water	47.99		56.37
W. Of Dry soil	374.80		429.18
Water content %	**12.8**	**13.0**	**13.1**

WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	686.36	884.57	643.58
W. of Dry soil + Container	635.38	809.73	593.99
W. Of container	229.13	231.72	233.30
W. Of water	50.98	74.84	49.59
W. Of Dry soil	406.25	578.01	360.69
Water content %	**12.5**	**12.9**	**13.7**

SWELL (1/100mm)

Blows Date	56	25	10
06-Jan-14		0.00	
07-Jan-14		0.19	
08-Jan-14		0.22	
09-Jan-14		0.23	
10-Jan-14		0.24	
Total mm		0.24	
Total %		**0.21**	

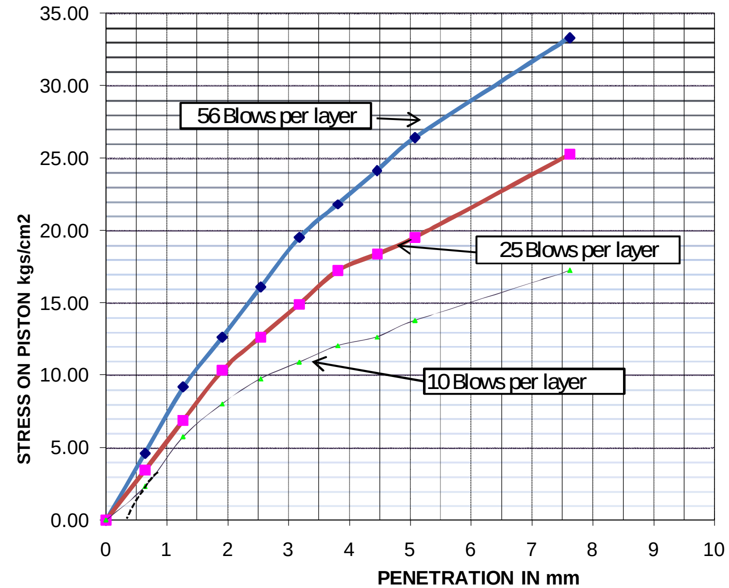
DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J4	J6	J7
W. Of Wet soil + Mold	(gram)	11455.8	11240.2	11331.4
W. Of Mold	(gram)	6795.4	6745.6	6970.8
W.Of Wet soil	(gram)	4660.4	4494.6	4360.6
Volume of Mold	(gram)	2117.2	2119.0	2120.8
Wet Density	(g/cm^3)	2.201	2.121	2.056
Water content %	(%)	13.0	13.0	13.0
Dry Density	(g/cm^3)	1.949	1.878	1.820
MDD	(g/cm^3)	1.974	1.974	1.974
% of Compaction	(%)	**98.7**	**95.1**	**92.2**

PENETRATION

Date: **10-Jan-14** N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.040	**4.59**	0.030	**3.45**	0.020	**2.30**
1.27	0.080	**9.19**	0.060	**6.89**	0.050	**5.74**
1.91	0.110	**12.63**	0.090	**10.34**	0.070	**8.04**
2.54	0.140	**16.08**	0.110	**12.63**	0.085	**9.76**
3.18	0.170	**19.52**	0.130	**14.93**	0.095	**10.91**
3.81	0.190	**21.82**	0.150	**17.23**	0.105	**12.06**
4.45	0.210	**24.12**	0.160	**18.38**	0.110	**12.63**
5.08	0.230	**26.41**	0.170	**19.52**	0.120	**13.78**
7.62	0.290	**33.31**	0.220	**25.27**	0.150	**17.23**



Correction of Load - Penetration Curves

No.of Blows	**2.54 mm**	**5.08 mm**	**Max stress**
56	16.08	26.41	26.41
25	12.63	19.52	19.52
10	10.50	14.20	14.20

1.777 1.875 1.974

Submitted By :

Theobard N.
GEOTECHNICAL LAB MNGR
COSMEZZ SARL

GEOTECHNICAL LABORATORY
Certified by U.S. Army Corps of Engineers

Project: IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI
Contract # : --------------

COSMEZZ SARL
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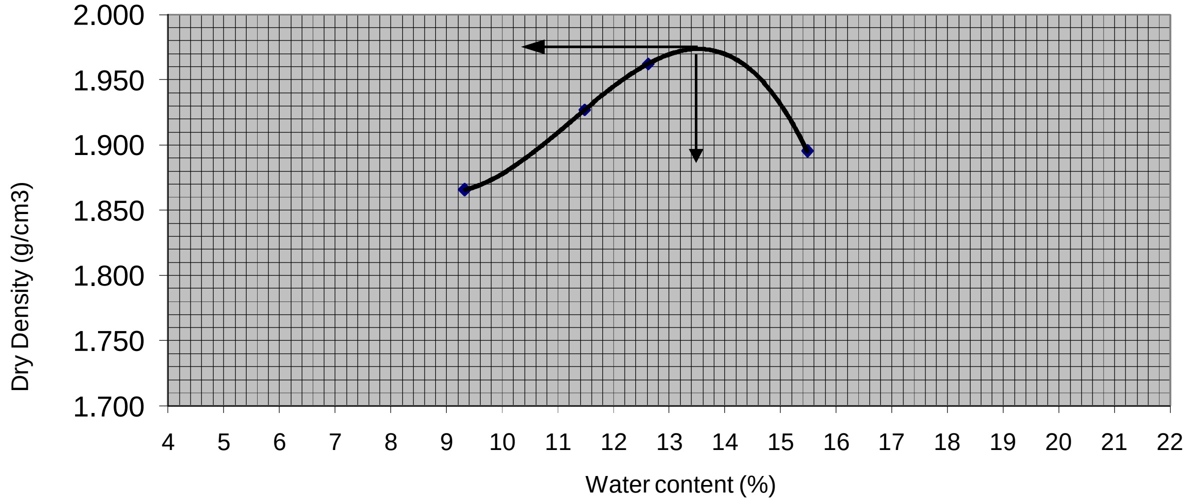
COSMEZZ GEOTECHNICAL LABORATORY - B.P. 1331, Rue de Venise - Djibouti, Phone: +253 21356142 - Email: cosmezz@mezzgroup.com

MODIFIED PROCTOR TEST - ASTM D 1557

Method used: **C**
Type of Rammer: **Manual**
% of Retained on 19mm Sieve: **3.1%**
Sample Description : **Clayey SAND (SC) with gravel**
Date Sampled : **31-Dec-13**
Sample n° : **TP-1**
Date Tested : **04-Jan-14**
Sample Source : PK-12 SUBSTATION
Sample Depth : **0.15 - 0.75 m**
Tested by : **ABDI / HOUSSSEIN**
Sampled By : **THEO / MOHAMED**

Determination N°	Units	1	2	3	4
% of Water added	%	4	6	8	10
WET DENSITY DETERMINATION					
Weight of soil + Mold	(grs)	8,896.2	9,125.6	9,256.0	9,211.6
Weight of Mold	(grs)	4,574.4	4,574.4	4,574.4	4,574.4
Weight of soil	(grs)	4,321.8	4,551.2	4,681.6	4,637.2
Volume of Mold	(cm^3)	2,118.7	2,118.7	2,118.7	2,118.7
Wet Density	(g/cm^3)	2.040	2.148	2.210	2.189
MOISTURE CONTENT DETERMINATION					
Weight of Wet soil + Container	(grs)	915.67	897.06	632.82	673.00
Weight of Dry soil + Container	(grs)	878.83	848.01	587.87	614.22
Weight of Water	(grs)	36.84	49.05	44.95	58.78
Weight of container	(grs)	483.79	420.74	231.66	234.53
Weight of Dry soil	(grs)	395.04	427.27	356.21	379.69
Water Content	%	**9.3**	**11.5**	**12.6**	**15.5**
DRY DENSITY					
Dry Density	(g/cm^3)	**1.866**	**1.927**	**1.962**	**1.895**

Corrected Maximum Dry Density (C-MDD)
Corrected Optimum Moisture Content (C-OMC)
MDD (g/cm^3): 1.974
OMC (%) : 13.5



Remarks:

Submitted By :

THEOBARD N.
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Certified by USACE

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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E-mail: cosmezz@mezzgroup.com

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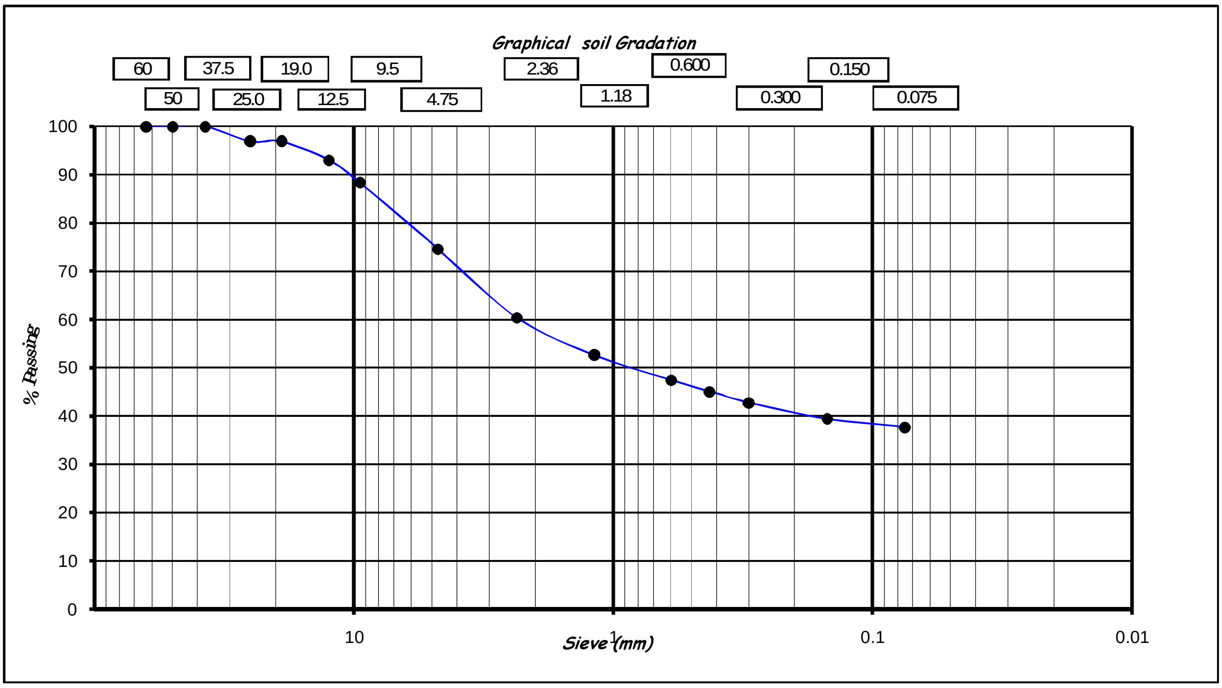
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **TP-1**
Project No.:
Date of Sampling : **31-Dec-13**
Sample source: **TEST PIT (TP-1): PK-12 SUBSTATION**
Date of Test : **1-Jun-14**
Sample Description : **Clayey SAND (SC)** with gravel
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.15 - 0.75 m**
Weight (grs): **6069.40**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
$2^{1/2}$	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
$1^{1/2}$	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	190.33	190.3	3.1	**96.9**
3/4	**19**	0.00	190.3	3.1	**96.9**
1/2	**12,5**	231.60	421.9	7.0	**93.0**
3/8	**9,5**	280.39	702.3	11.6	**88.4**
No.4	**4,75**	837.14	1539.5	25.4	**74.6**
No.8	**2,36**	861.84	2401.3	39.6	**60.4**
No.16	**1,18**	473.69	2875.0	47.4	**52.6**
No.30	**0,600**	312.91	3187.9	52.5	**47.5**
No.40	**0,425**	144.81	3332.7	54.9	**45.1**
No.50	**0,300**	137.61	3470.3	57.2	**42.8**
No.100	**0,150**	204.17	3674.5	60.5	**39.5**
No.200	**0,075**	105.13	3779.6	62.3	**37.7**
Can	**0**				



Remarks :
Gravel: **25.4%**
Sand: **36.9%**
Fines: **37.7%**

Submitted By :

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Geotechnical Laboratory
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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: YEC YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **6-Jan-14**

Sample no : **TP-1**

Date sampled : **31-Dec-13**

Sample Description : **Clayey SAND (SC)** with gravel

Sample Depth: **0.15 - 0.75 m**

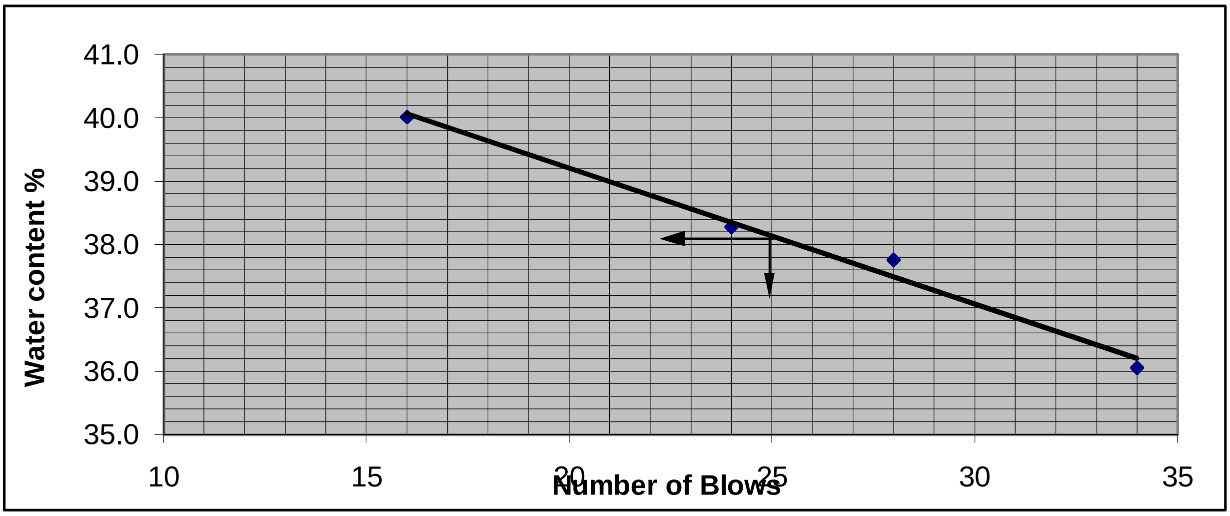
Source : **PK 12 SUBSTATION**

Tested by: **HOUSSEIN D.**

Sampled by: **THEO / MOH**

LL: 38.1 **PL: 24.4** **PI: 13.7**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	16	24	28	34	**Test n°1**	**Test n°2**
N° of container	10	11	13	O	R	W
Weight of wet soil + container(A)	62.07	62.75	65.52	56.54	34.49	36.50
Weight of Dry soil + container(B)	53.4	54.24	56.28	50.01	33.96	35.58
Weight of container©	31.73	32.01	31.81	31.9	31.73	31.91
Weight of water D=A-B	8.67	8.51	9.24	6.53	0.53	0.92
Weight of Dry soil (E)=(B-C)	21.67	22.23	24.47	18.11	2.23	3.67
Water content (W)=D/E*100	40.0	38.3	37.8	36.1	23.8	25.1
LL @25Blows and Average PL	**38.1**				**24.4**	



Remarks:

Submitted By :

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Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

Contractor : COSMEZZ SARL

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Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
E-mail: cosmezz@mezzgroup.com

NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **31-Dec-13**

Date sampled: **31-Dec-13**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **TP-2/SS-1**

Sample Description :**Clayey SAND (SC) with gravel**

Source : **TEST PIT#TP-2: PK 12 SUBSTATION**

Sample Depth : **0.15 - 0.65 m**

Designation		*unit*	1	
N° of container			T	
Weight of wet soil + container	**A**	*grs*	1043.83	
Weight of Dry soil + container	**B**	*grs*	983.72	
Weight of container	**C**	*grs*	225.5	
Weight of water	**D=A-B**	*grs*	60.11	
Weight of Dry	**E=B-C**	*grs*	758.22	
Water content	**W=D/E*100**	*%*	**7.9**	

Remarks :

Submitted by :

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **6-Jan-14**

Sample no : **TP-2/SS-1**

Date sampled : **31-Dec-13**

Sample Description : **Clayey SAND (SC)** with gravel

Sample Depth: **0.15 - 0.65 m**

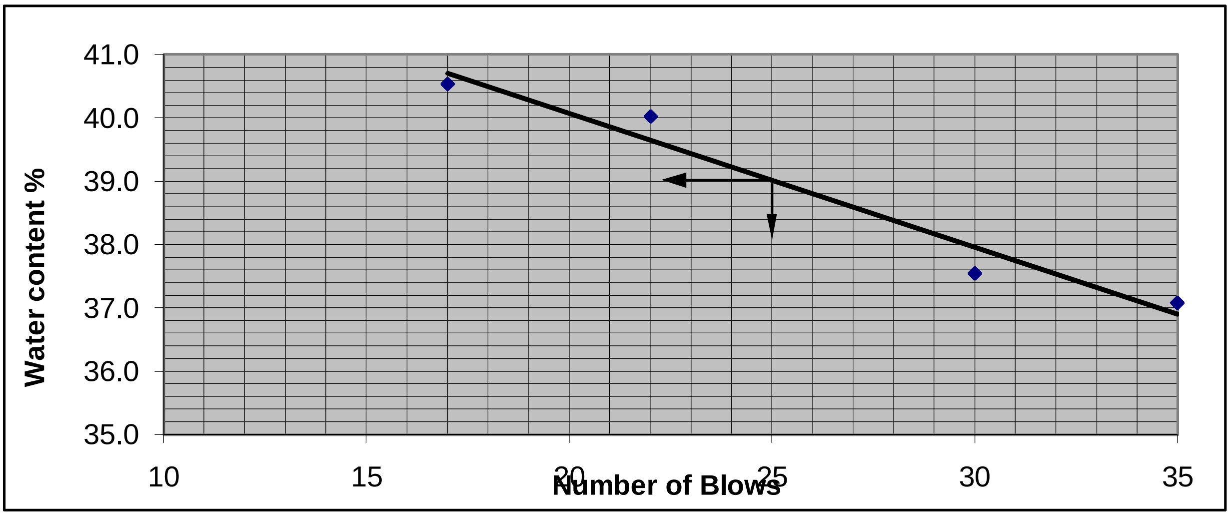
Source : **PK 12 SUBSTATION**

Tested by: **HOUSSEIN D.**

Sampled by: **THEO / MOH**

LL: 39.0 **PL: 25.7** **PI: 13.3**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	17	22	30	35	**Test n°1**	**Test n°2**
N° of container	N	12	T	R	X	Y
Weight of wet soil + container(A)	55.28	52.99	54.54	52.85	36.72	35.24
Weight of Dry soil + container(B)	48.64	46.91	48.39	47.15	35.75	34.56
Weight of container©	32.26	31.72	32.01	31.78	31.9	31.97
Weight of water D=A-B	6.64	6.08	6.15	5.7	0.97	0.68
Weight of Dry soil (E)=(B-C)	16.38	15.19	16.38	15.37	3.85	2.59
Water content (W)=D/E*100	40.5	40.0	37.5	37.1	25.2	26.3
LL @25Blows and Average PL	**39.0**				**25.7**	



Remarks:

Submitted By :

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GEOTECHNICAL INVESTIGATIONS
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI

COSMEZZ SARL
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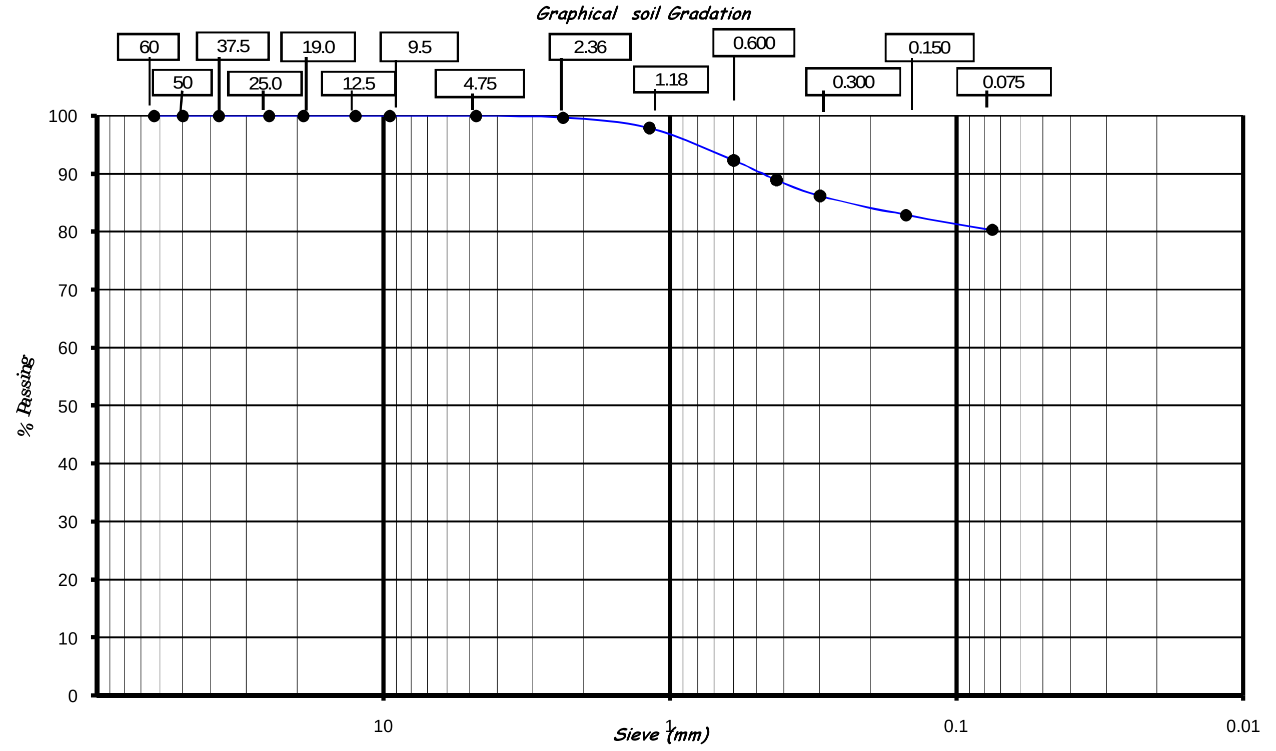
E-mail:cosmezz@mezzgroup.com

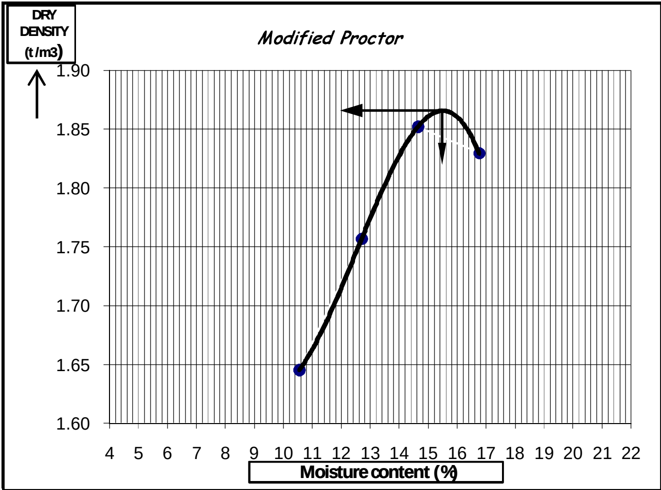
GEOTECHNICAL EXPLORATION FOR THE EXISTING SOIL

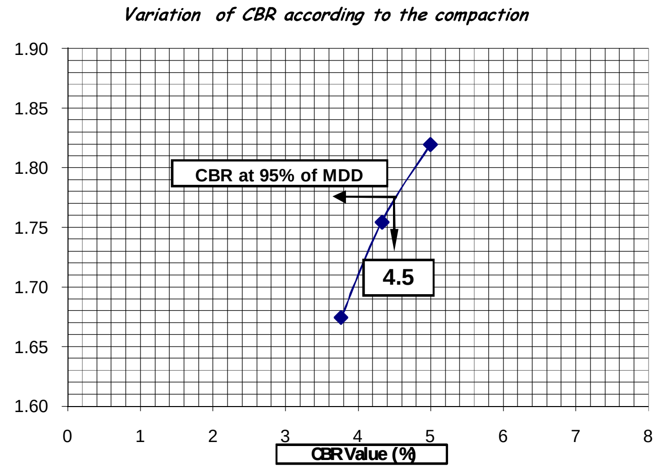
Project No:
Sample n°: **TP-3/SS-2**
Test Method : **ASTM D 1883; D 1557; D 4318; C 136; C 117**
Source : PK-12 OVERHEAD TRANSMISSION LINE (TP-3)
Date Sampled : **31-Dec-13** Sample Depth: **0.00 - 1.50 m**
Date Completed Testing : **11-Jan-14**

		CLASSIFICATION		
LL	**50.6**	H-R-B	U S C S	**Sandy elastic SILT (MH), Reddish-brown**
PI	**23.2**	**A-7-5**	**MH**	
%<0,075mm	**80.3**			



PROCTOR TEST		Natural Moisture content (%)	No of Blows	Compaction	DD (t/m^3)	Soaked CBR	W Soaking	Swell (%)
MDD(t/m^3) =	**1.867**		56 Blows	97.4%	1.819	**5.0**	4 days	
OMC (%)=	**15.5**		25 Blows	94.0%	1.755	**4.3**	4 days	**4.28**
ρ_{sd} =			10 Blows	89.7%	1.674	**3.8**	4 days	





Remarks: 1). Soaked CBR Value @95% of MDD for this material equal to **4.5%**

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI**
Contract #: **N 33191-12-C-0620**

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Phone: +253 21356142, E-mail: cosmezz@mezzgroup.com

SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-3/SS-2**
Date Tested: **06-Jan-14**
Method used for preparation and compaction : **D 1557**
Sample Description : **Sandy elastic SILT (MH), Reddish-brown**
Source : **PK-12 OVERHEAD TRANSMISSION LINE (TEST PIT # TP-3)**
Sample Depth : **0.0 - 1.50 m**
Tested by: **MOHAMED / ABDI**
Project number :
Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	578.73		909.23
W. of Dry soil + Container	530.30		843.32
W. Of container	229.15		420.74
W. Of water	48.43		65.91
W. Of Dry soil	301.15		422.58
Water content %	**16.1**	**15.8**	**15.6**

DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J1	J2	J5
W. Of Wet soil + Mold	(gram)	10755.2	11269.6	10866.8
W. Of Mold	(gram)	6290.8	6961.2	6735.4
W.Of Wet soil	(gram)	4464.4	4308.4	4131.4
Volume of Mold	(gram)	2118.4	2119.8	2130.2
Wet Density	(g/cm^3)	2.107	2.032	1.939
Water content %	(%)	15.8	15.8	15.8
Dry Density	(g/cm^3)	1.819	1.755	1.674
MDD	(g/cm^3)	1.867	1.867	1.867
% of Compaction	(%)	**97.4**	**94.0**	**89.7**

WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	743.48	664.42	672.95
W. of Dry soil + Container	667.35	594.31	603.44
W. Of container	225.64	226.35	226.10
W. Of water	76.13	70.11	69.51
W. Of Dry soil	441.71	367.96	377.3
Water content %	**17.2**	**19.1**	**18.4**

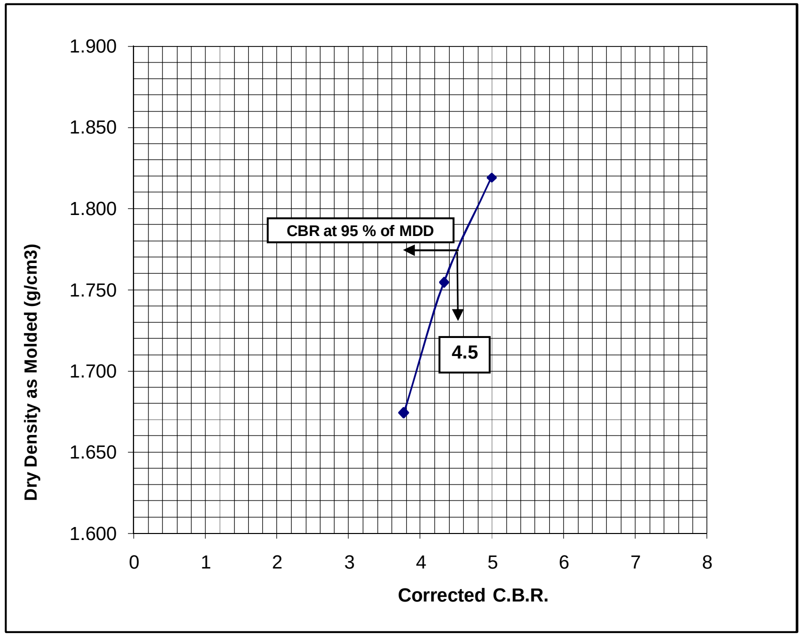
SWELL (1/100mm)

Blows / Date	56	25	10
06-Jan-14		0.00	
07-Jan-14		4.42	
08-Jan-14		4.81	
09-Jan-14		4.93	
10-Jan-14		4.97	
Total mm		4.97	
Total %		**4.28**	

PENETRATION

Date: **10-Jan-14**
N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.010	**1.15**	0.008	**0.92**	0.004	**0.46**
1.27	0.020	**2.30**	0.016	**1.84**	0.010	**1.15**
1.91	0.025	**2.87**	0.022	**2.53**	0.014	**1.61**
2.54	0.030	**3.45**	0.026	**2.99**	0.020	**2.30**
3.18	0.035	**4.02**	0.030	**3.45**	0.024	**2.76**
3.81	0.040	**4.59**	0.035	**4.02**	0.027	**3.10**
4.45	0.045	**5.17**	0.040	**4.59**	0.030	**3.45**
5.08	0.050	**5.74**	0.045	**5.17**	0.032	**3.68**
7.62	0.060	**6.89**	0.052	**5.97**	0.040	**4.59**



No.of Blows	**2.54 mm**	**5.08 mm**	CBR@2.5mm
56	5.0	5.6	**5.0**
25	4.3	5.0	**4.3**
10	3.8	3.7	**3.8**

1.680 1.774 1.867

Submitted By :

Theobard N.
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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Contract #: N 33191-12-C-0620

COSMEZZ SARL
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Phone: +253 21356142, E-mail: cosmezz@mezzgroup.com

SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-3/SS-2**

Date Tested: **06-Jan-14**

Method used for preparation and compaction : **D 1557**

Sample Description : **Sandy elastic SILT (MH), Reddish-brown**

Source : **PK-12 OVERHEAD TRANSMISSION LINE (TEST PIT # TP-3)**

Sample Depth : **0.0 - 1.50 m**

Tested by: **MOHAMED / ABDI**

Project number :

Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	578.73		909.23
W. of Dry soil + Container	530.30		843.32
W. Of container	229.15		420.74
W. Of water	48.43		65.91
W. Of Dry soil	301.15		422.58
Water content %	**16.1**	**15.8**	**15.6**

DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J1	J2	J5
W. Of Wet soil + Mold	(gram)	10755.2	11269.6	10866.8
W. Of Mold	(gram)	6290.8	6961.2	6735.4
W.Of Wet soil	(gram)	4464.4	4308.4	4131.4
Volume of Mold	(gram)	2118.4	2119.8	2130.2
Wet Density	(g/cm^3)	2.107	2.032	1.939
Water content %	(%)	15.8	15.8	15.8
Dry Density	(g/cm^3)	1.819	1.755	1.674
MDD	(g/cm^3)	1.867	1.867	1.867
% of Compaction	(%)	**97.4**	**94.0**	**89.7**

WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	743.48	664.42	672.95
W. of Dry soil + Container	667.35	594.31	603.44
W. Of container	225.64	226.35	226.10
W. Of water	76.13	70.11	69.51
W. Of Dry soil	441.71	367.96	377.34
Water content %	**17.2**	**19.1**	**18.4**

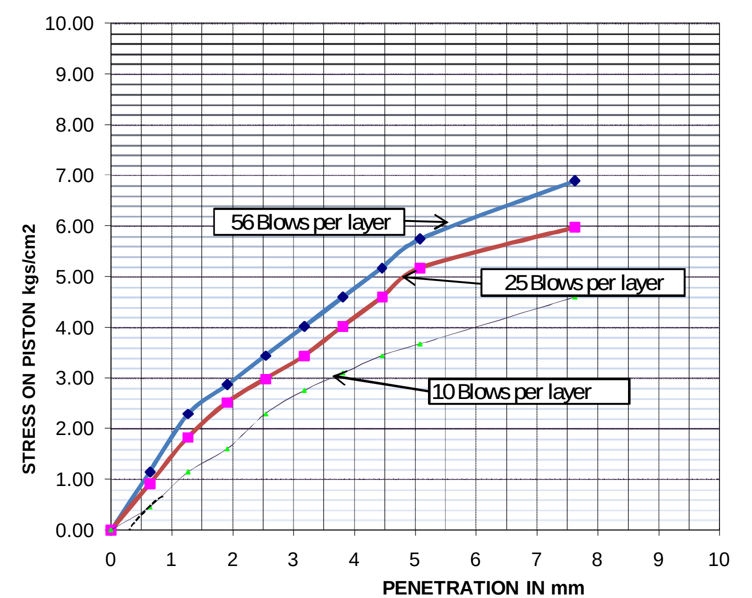
SWELL (1/100mm)

Blows Date	56	25	10
06-Jan-14		0.00	
07-Jan-14		4.42	
08-Jan-14		4.81	
09-Jan-14		4.93	
10-Jan-14		4.97	
Total mm		4.97	
Total %		**4.28**	

PENETRATION

Date: **10-Jan-14** N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.010	**1.15**	0.008	**0.92**	0.004	**0.46**
1.27	0.020	**2.30**	0.016	**1.84**	0.010	**1.15**
1.91	0.025	**2.87**	0.022	**2.53**	0.014	**1.61**
2.54	0.030	**3.45**	0.026	**2.99**	0.020	**2.30**
3.18	0.035	**4.02**	0.030	**3.45**	0.024	**2.76**
3.81	0.040	**4.59**	0.035	**4.02**	0.027	**3.10**
4.45	0.045	**5.17**	0.040	**4.59**	0.030	**3.45**
5.08	0.050	**5.74**	0.045	**5.17**	0.032	**3.68**
7.62	0.060	**6.89**	0.052	**5.97**	0.040	**4.59**



Correction of Load - Penetration Curves

No.of Blows	2.54 mm	5.08 mm	Max stress
56	3.45	5.74	5.74
25	2.99	5.17	5.17
10	2.60	3.80	3.80

1.680 1.774 1.867

Submitted By :

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GEOTECHNICAL LABORATORY
Certified by U.S. Army Corps of Engineers

Project: IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI
Contract # : --------------

COSMEZZ SARL
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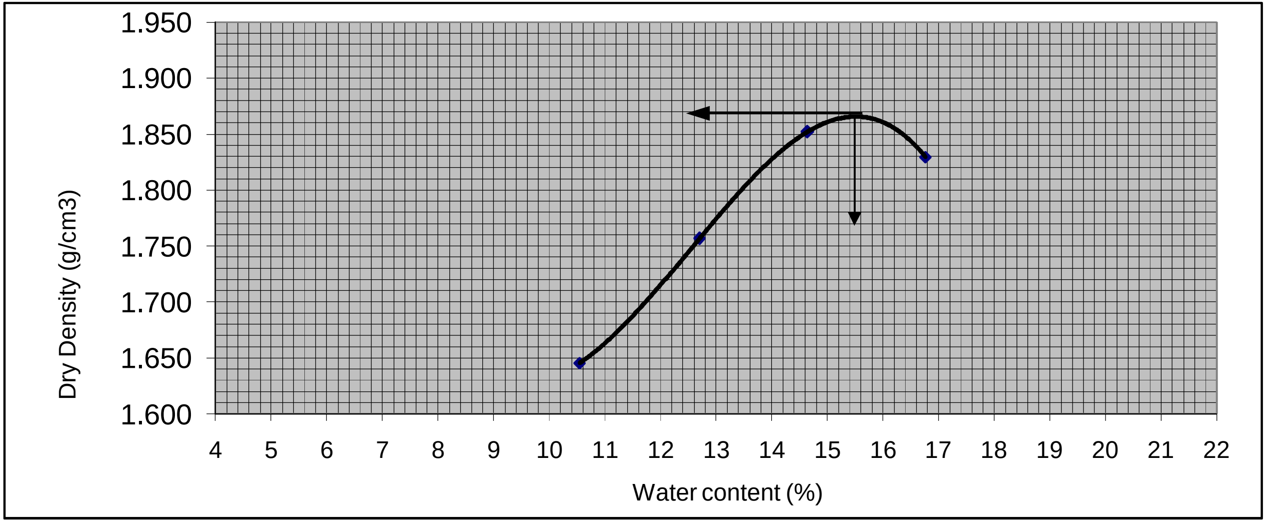
MODIFIED PROCTOR TEST - ASTM D 1557

Method used: **C**
Type of Rammer: **Manual**
% of Retained on 19mm Sieve: **---**
Sample Description : **Sandy elastic SILT (MH), Reddish-brown**
Date Sampled : **31-Dec-13**
Sample n° : **TP-3 / SS-2**
Date Tested : **05-Jan-14**
Sample Source : PK-12 OVERHEAD TRANSMISSION LINE
Sample Depth : **0.00 - 1.50 m**
Tested by : **ABDI / HOUSSSEIN**
Sampled By : **THEO / MOHAMED**

Determination N°	Units	1	2	3	4
% of Water added	%	4	6	8	10
WET DENSITY DETERMINATION					
Weight of soil + Mold	(grs)	8,425.4	8,766.2	9,070.0	9,097.2
Weight of Mold	(grs)	4,571.8	4,571.8	4,571.8	4,571.8
Weight of soil	(grs)	3,853.6	4,194.4	4,498.2	4,525.4
Volume of Mold	(cm^3)	2,118.7	2,118.7	2,118.7	2,118.7
Wet Density	(g/cm^3)	1.819	1.980	2.123	2.136
MOISTURE CONTENT DETERMINATION					
Weight of Wet soil + Container	(grs)	609.72	563.53	816.13	738.62
Weight of Dry soil + Container	(grs)	573.15	525.87	765.63	666.27
Weight of Water	(grs)	36.57	37.66	50.50	72.35
Weight of container	(grs)	226.35	229.25	420.68	234.55
Weight of Dry soil	(grs)	346.80	296.62	344.95	431.72
Water Content	%	**10.5**	**12.7**	**14.6**	**16.8**
DRY DENSITY					
Dry Density	(g/cm^3)	**1.645**	**1.757**	**1.852**	**1.829**

Corrected Maximum Dry Density (C-MDD) — **MDD (g/cm^3):** **1.867**
Corrected Optimum Moisture Content (C-OMC) — **OMC (%) :** **15.5**



Remarks:

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

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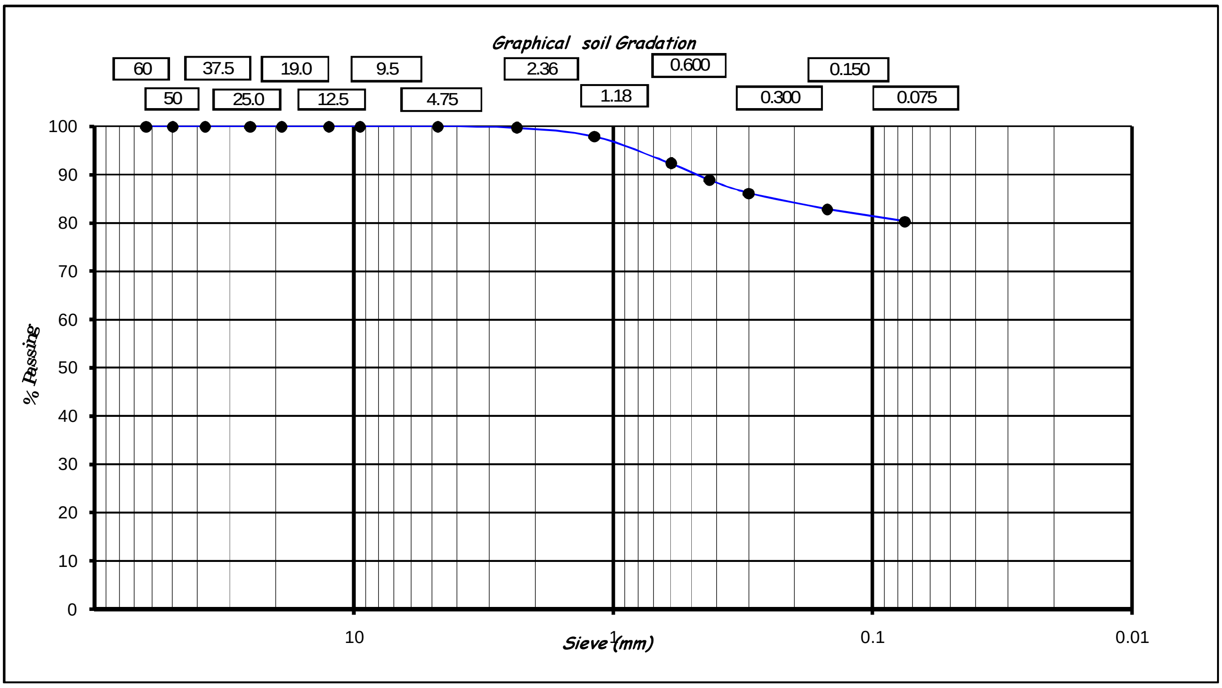
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **TP-3 / SS-2**
Project No.:
Date of Sampling : **31-Dec-13**
Sample source: **PK-12 OVERHEAD TRANSMISSION LINE**
Date of Test : **6-Jan-14**
Sample Description : **Sandy elastic SILT (MH), Reddish-brown**
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **0.00 - 1.50 m**
Weight (grs): **726.91**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	0.00	0.0	0.0	**100.0**
3/4	**19**	0.00	0.0	0.0	**100.0**
1/2	**12,5**	0.00	0.0	0.0	**100.0**
3/8	**9,5**	0.00	0.0	0.0	**100.0**
No.4	**4,75**	0.00	0.0	0.0	**100.0**
No.8	**2,36**	2.36	2.4	0.3	**99.7**
No.16	**1,18**	12.68	15.0	2.1	**97.9**
No.30	**0,600**	40.72	55.8	7.7	**92.3**
No.40	**0,425**	24.72	80.5	11.1	**88.9**
No.50	**0,300**	19.81	100.3	13.8	**86.2**
No.100	**0,150**	24.18	124.5	17.1	**82.9**
No.200	**0,075**	18.63	143.1	19.7	**80.3**
Can	**0**				



Remarks :
Gravel: **0.0%**
Sand: **19.7%**
Fines: **80.3%**

Submitted By :

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Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: YEC YACHIYO ENGINEERING CO., LTD - JAPAN

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **8-Jan-14**

Sample no : **TP-3/SS-2**

Date sampled : **31-Dec-13**

Sample Description : **Sandy elastic SILT (MH), Reddish-brown**

Sample Depth: **0.00 - 1.50 m**

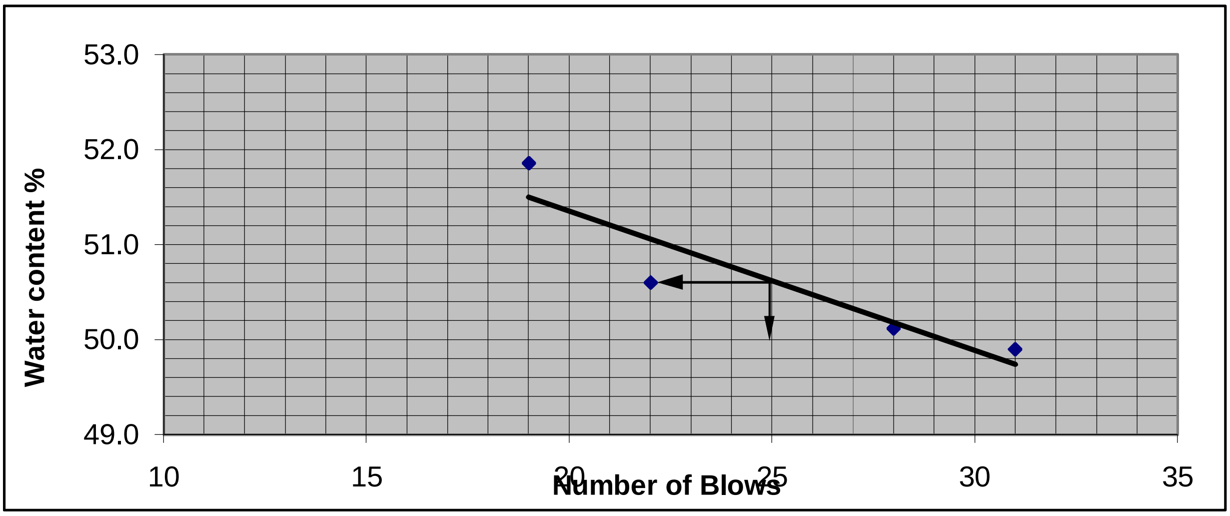
Source : **PK 12 OVERHEAD TRANSMISSION LINE**

Tested by: **HOUSSEIN D.**

Sampled by: **THEO / MOH**

LL: 50.6 **PL: 27.4** **PI: 23.2**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	19	22	28	31	**Test n°1**	**Test n°2**
N° of container	A1	N	T	U	X	Y
Weight of wet soil + container(A)	47.38	44.77	44.92	46.84	37.06	36.14
Weight of Dry soil + container(B)	42.111	40.56	40.62	41.89	35.94	35.27
Weight of container©	31.95	32.24	32.04	31.97	31.91	32.04
Weight of water D=A-B	5.27	4.21	4.3	4.95	1.12	0.87
Weight of Dry soil (E)=(B-C)	10.161	8.32	8.58	9.92	4.03	3.23
Water content (W)=D/E*100	51.9	50.6	50.1	49.9	27.8	26.9
LL @25Blows and Average PL	**50.6**				**27.4**	



Remarks:

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

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Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

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Contractor : COSMEZZ SARL

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NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **31-Dec-13**

Date sampled: **31-Dec-13**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **TP-3/SS-1**

Sample Description : **Well-graded Sand (SW-SC),** dry, with clay and gravel

Source : **TEST PIT#TP-3:PK 12 OVERHEAD TRASMISSION LINE**

Sample Depth : **1.00 - 1.50 m**

Designation		***unit***	1	
N° of container			C	
Weight of wet soil + container	**A**	***grs***	960.97	
Weight of Dry soil + container	**B**	***grs***	905.31	
Weight of container	**C**	***grs***	226.05	
Weight of water	**D=A-B**	***grs***	55.66	
Weight of Dry	**E=B-C**	***grs***	679.26	
Water content	**W=D/E*100**	***%***	**8.2**	

Remarks :

Submitted by :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
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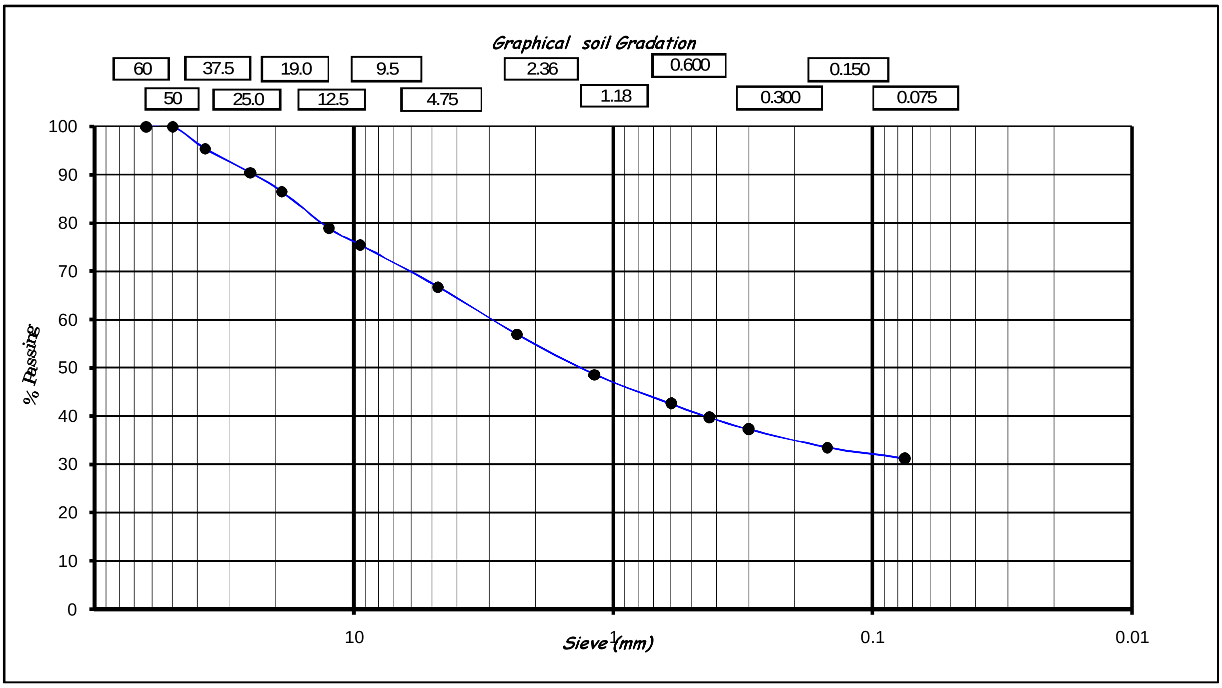
SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **TP-3 / SS-3**
Project No.:
Date of Sampling : **31-Dec-13**
Sample source: **PK-12 OVERHEAD TRANSMISSION LINE**
Date of Test : **6-Jan-14**
Sample Description : **Silty SAND (SM) with gravel**
Station : **PK12**
Test Method: **ASTM C 117 / C136**
Sample Depth : **1.50 - 2.25 m**
Weight (grs): **4657.60**
Sampled by : **THEO/MOH**
Tested by: **HOUSSEIN D.**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	213.52	213.5	4.6	**95.4**
1"	**25**	231.41	444.9	9.6	**90.4**
3/4	**19**	182.38	627.3	13.5	**86.5**
1/2	**12,5**	356.02	983.3	21.1	**78.9**
3/8	**9,5**	155.18	1138.5	24.4	**75.6**
No.4	**4,75**	408.87	1547.4	33.2	**66.8**
No.8	**2,36**	454.78	2002.2	43.0	**57.0**
No.16	**1,18**	388.40	2390.6	51.3	**48.7**
No.30	**0,600**	283.37	2673.9	57.4	**42.6**
No.40	**0,425**	135.45	2809.4	60.3	**39.7**
No.50	**0,300**	112.25	2921.6	62.7	**37.3**
No.100	**0,150**	173.98	3095.6	66.5	**33.5**
No.200	**0,075**	109.34	3205.0	68.8	**31.2**
Can	**0**				



Remarks :
Gravel: **33.2%**
Sand: **35.6%**
Fines: **31.2%**

Submitted By :

Houmis

Theobard N.
GEOTECH. LAB. MNGR
COSMEZZ SARL

COSMEZZ GEOTECHNICAL LABORATORY Certified by U.S. Army Corps of Engineers	GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN	COSMEZZ SARL Rue de Venise, Salines Ouest B.P.1331-Djibouti-R.D.D. E-mail: cosmezz@mezzgroup.com

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **7-Jan-14**

Sample no : **TP-3/SS-3**

Date sampled : **31-Dec-13**

Sample Description : **Silty SAND (SM) with gravel**

Sample Depth: **1.50 - 2.25 m**

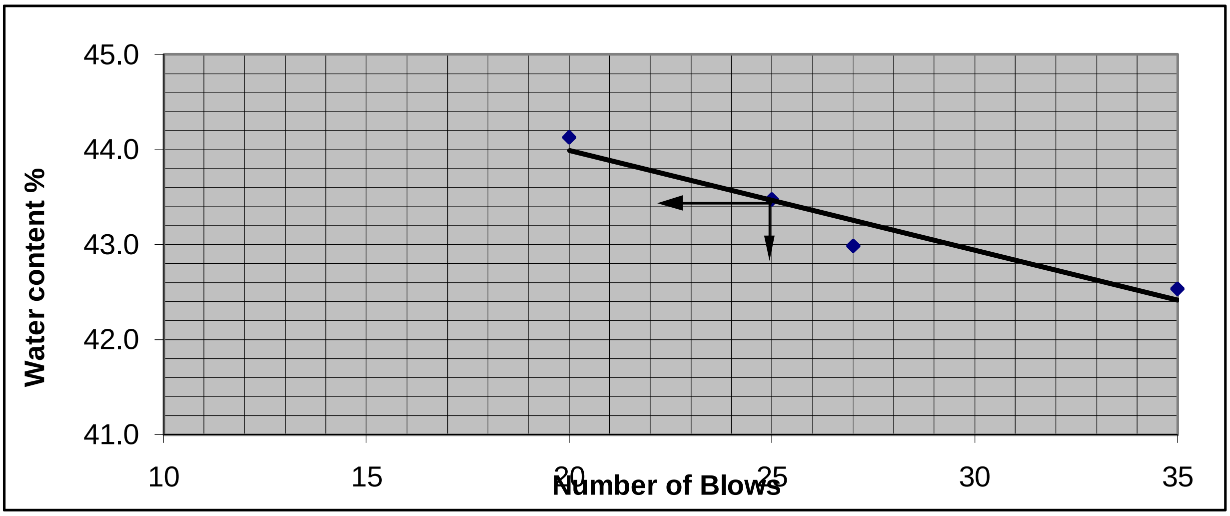
Source : **PK 12 OVERHEAD TRANSMISSION LINE**

Tested by: **HOUSSEIN D.**

Sampled by: **THEO / MOH**

LL: 43.4 **PL: 29.6** **PI: 13.8**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	20	25	27	35	**Test n°1**	**Test n°2**
N° of container	A	J	G	U	K	Y
Weight of wet soil + container(A)	50.19	54.15	46.24	50.25	36.23	36.01
Weight of Dry soil + container(B)	44.63	47.45	41.95	44.78	35.29	35.07
Weight of container©	32.03	32.04	31.97	31.92	32.03	31.97
Weight of water D=A-B	5.56	6.7	4.29	5.47	0.94	0.94
Weight of Dry soil (E)=(B-C)	12.6	15.41	9.98	12.86	3.26	3.1
Water content (W)=D/E*100	44.1	43.5	43.0	42.5	28.8	30.3
LL @25Blows and Average PL	**43.4**				**29.6**	



Remarks:

Submitted By :

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GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

Contractor : COSMEZZ SARL

COSMEZZ SARL

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NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **31-Dec-13**

Date sampled: **31-Dec-13**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **TP-3/SS-2**

Sample Description : **Silty SAND (SM) with gravel**

Source : **TEST PIT#TP-3:PK 12 OVERHEAD TRASMISSION LINE**

Sample Depth : **1.50 - 2.25 m**

Designation		***unit***	1	
N° of container			P	
Weight of wet soil + container	**A**	***grs***	1404.08	
Weight of Dry soil + container	**B**	***grs***	1318.79	
Weight of container	**C**	***grs***	225.6	
Weight of water	**D=A-B**	***grs***	85.29	
Weight of Dry	**E=B-C**	***grs***	1093.19	
Water content	**W=D/E*100**	***%***	**7.8**	

Remarks :

Submitted by :

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NATURAL MOISTURE CONTENT (%) - ASTM D 2216

Date Tested : **11-May-14**

Date sampled: **11-May-14**

Sampled by : **THEO**

Tested by : **THEO**

Sample no : **TP-4**

Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**

Source : **TEST PIT#TP-4: NAGAD OVERHEAD TRASMISSION LINE**

Sample Depth : **1.40 - 2.30 m**

Designation		***unit***	1	
N° of container			V	
Weight of wet soil + container	**A**	***grs***	942.85	
Weight of Dry soil + container	**B**	***grs***	873.11	
Weight of container	**C**	***grs***	420.54	
Weight of water	**D=A-B**	***grs***	69.74	
Weight of Dry	**E=B-C**	***grs***	452.57	
Water content	**W=D/E*100**	***%***	**15.4**	

Remarks :

Submitted by :

Theobard N.

Geotech. Lab. Mngr

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GEOTECHNICAL LABORATORY
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GEOTECHNICAL INVESTIGATIONS
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI

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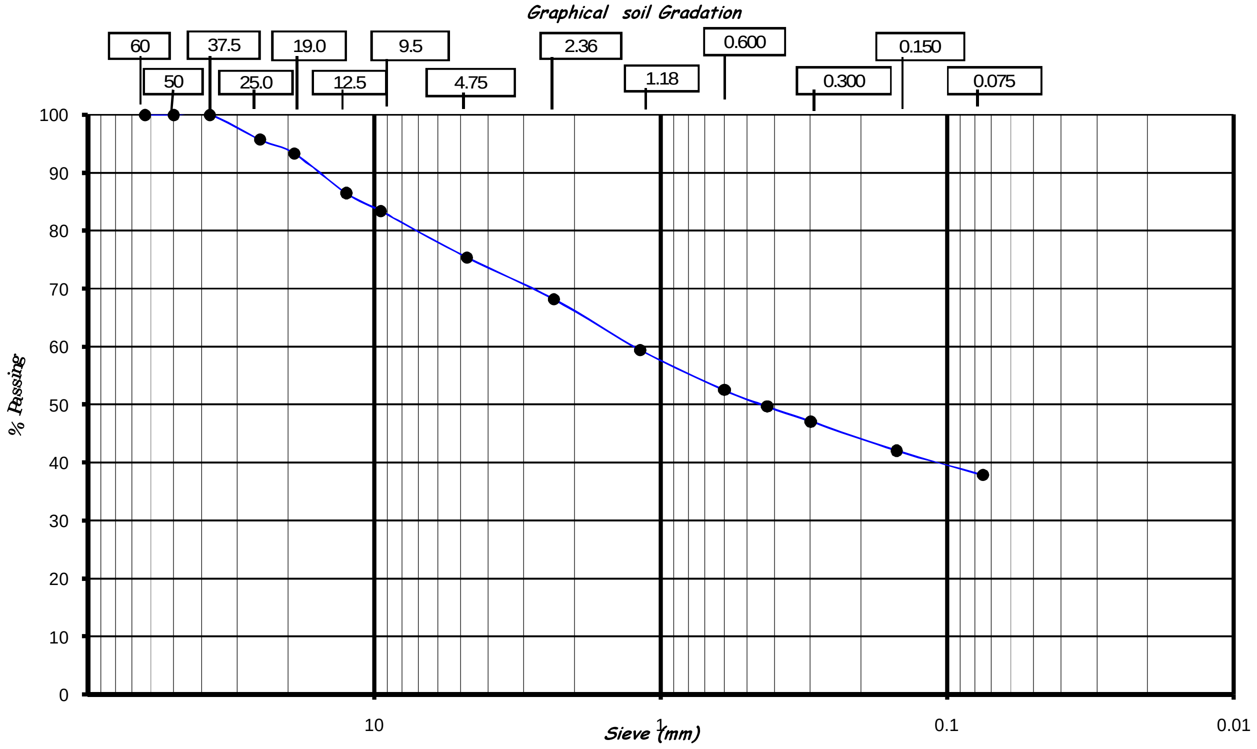
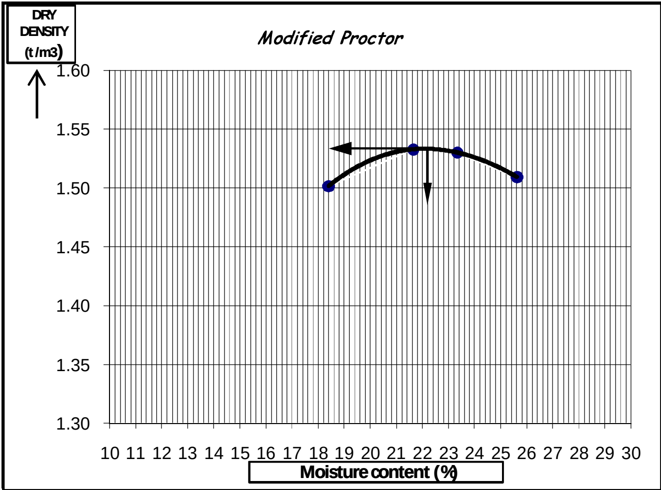
GEOTECHNICAL EXPLORATION FOR THE EXISTING SOIL

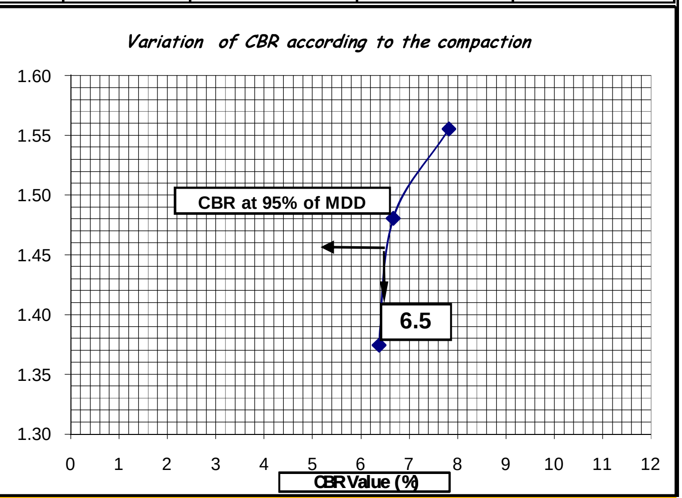
Project No:
Sample n°: **TP-4**
Test Method : **ASTM D 1883; D 1557; D 4318; C 136; C 117**
Source : NAGAD OVERHEAD TRANSMISSION LINE (TP-4)
Date Sampled : **11-May-14** Sample Depth: **1.40 - 2.30 m**
Date Completed Testing : **16-May-14**

		CLASSIFICATION		
LL	**60.3**	H-R-B	U S C S	**Sandy elastic SILT (MH) with gravel, light brown**
PI	**18.2**	**A-7-5**	**MH**	
%<0,075mm	**37.9**			



PROCTOR TEST		Natural Moisture content (%)	No of Blows	Compaction	DD (t/m^3)	**Soaked CBR**	W Soaking	Swell (%)
MDD(t/m^3) =	**1.533**		56 Blows	101.5%	1.555	**7.8**	4 days	
OMC (%)=	**22.2**		25 Blows	96.6%	1.480	**6.7**	4 days	3.27
ρ_{sd} =		**15.4**	10 Blows	89.6%	1.374	**6.4**	4 days	





Remarks: 1). Soaked CBR Value @95% of MDD for this material equal to **6.5%**

Reported By :

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"Certified by U.S. Army Corps of Engineers"

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI
Contract #: N 33191-12-C-0620

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SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-4**

Date Tested: **12-May-14**

Method used for preparation and compaction : **D 1557**

Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**

Source : **NAGAD OVERHEAD TRANSMISSION LINE (TEST PIT # TP-4)**

Sample Depth : **1.4 - 2.30 m**

Tested by: **HOUSSEIN / ABDI**

Project number :

Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	804.75		
W. of Dry soil + Container	734.49		
W. Of container	420.38		
W. Of water	70.26		
W. Of Dry soil	314.11		
Water content %	**22.4**	**22.4**	

DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J1	J2	J5
W. Of Wet soil + Mold	(gram)	10233.4	10551.0	10298.2
W. Of Mold	(gram)	6201.8	6711.4	6716.2
W.Of Wet soil	(gram)	4031.6	3839.6	3582.0
Volume of Mold	(gram)	2118.4	2119.8	2130.2
Wet Density	(g/cm^3)	1.903	1.811	1.682
Water content %	(%)	22.4	22.4	22.4
Dry Density	(g/cm^3)	1.555	1.480	1.374
MDD	(g/cm^3)	1.533	1.533	1.533
% of Compaction	(%)	**101.5**	**96.6**	**89.6**

WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	804.75	831.20	671.18
W. of Dry soil + Container	685.12	679.63	539.02
W. Of container	233.15	230.22	151.09
W. Of water	119.63	151.57	132.2
W. Of Dry soil	451.97	449.41	387.9
Water content %	**26.5**	**33.7**	**34.1**

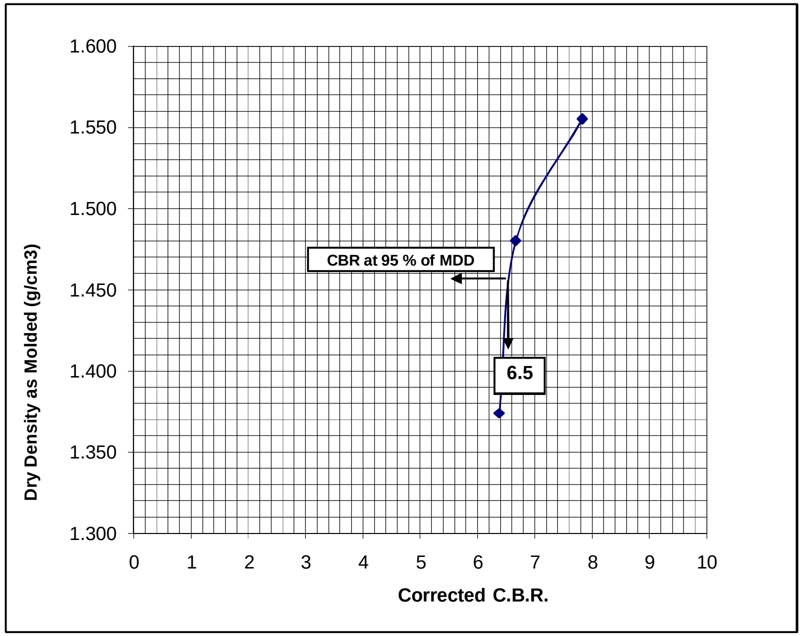
SWELL (1/100mm)

Blows / Date	56	25	10
12-May-14	0.00	0.00	0.00
13-May-14	2.92	3.45	2.5
14-May-14	3.66	3.71	2.51
15-May-14	3.79	3.76	2.52
16-May-14	3.83	3.79	2.53
Total mm	3.83	3.79	2.53
Total %	**3.30**	**3.27**	**2.18**

PENETRATION

Date: **16-May-14** N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.005	**0.57**	0.005	**0.57**	0.005	**0.57**
1.27	0.010	**1.15**	0.010	**1.15**	0.010	**1.15**
1.91	0.020	**2.30**	0.020	**2.30**	0.015	**1.72**
2.54	0.035	**4.02**	0.030	**3.45**	0.025	**2.87**
3.18	0.045	**5.17**	0.040	**4.59**	0.035	**4.02**
3.81	0.050	**5.74**	0.045	**5.17**	0.040	**4.59**
4.45	0.055	**6.32**	0.050	**5.74**	0.045	**5.17**
5.08	0.060	**6.89**	0.055	**6.32**	0.050	**5.74**
7.62	0.080	**9.19**	0.060	**6.89**	0.055	**6.32**



No.of Blows	**2.54 mm**	**5.08 mm**	CBR@2.5mm
56	7.8	7.3	**7.8**
25	6.7	6.3	**6.7**
10	6.4	5.8	**6.4**

1.380 1.456 1.533

Submitted By :

Theobard N.
GEOTECHNICAL LAB MNGR
COSMEZZ SARL

GEOTECHNICAL LABORATORY
"Certified by U.S. Army Corps of Engineers"

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY
Project: **IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI**
Location: **PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION - DJIBOUTI**
Contract #: **N 33191-12-C-0620**

COSMEZZ SARL
Rue de Venise, Saline Ouest - Djibouti
B.P. 1331 - DJIBOUTI - R.D.D
Phone: +253 21356142, E-mail: cosmezz@mezzgroup.com

SOAKED C.B.R. TEST - ASTM D 1883

Sample no : **TP-4**
Date Tested: **12-May-14**
Method used for preparation and compaction : **D 1557**
Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**
Source : **NAGAD OVERHEAD TRANSMISSION LINE (TEST PIT # TP-4)**
Sample Depth : **1.4 - 2.30 m**
Tested by: **HOUSSEIN / ABDI**
Project number :
Surcharge weight (kg): **4.5**

WATER CONTENT OF COMPACTION

No. Of Blows	56	25	10
N° of container	BEFORE	Average	AFTER
W. of Wet soil + Container	804.75		
W. of Dry soil + Container	734.49		
W. Of container	420.38		
W. Of water	70.26		
W. Of Dry soil	314.11		
Water content %	**22.4**	**22.4**	

DRY DENSITY

No.of Blows		56	25	10
N° of Mold		J1	J2	J5
W. Of Wet soil + Mold	(gram)	10233.4	10651.0	10298.2
W. Of Mold	(gram)	6201.8	6711.4	6716.2
W.Of Wet soil	(gram)	4031.6	3939.6	3582.0
Volume of Mold	(gram)	2118.4	2119.8	2130.2
Wet Density	(g/cm^3)	1.903	1.858	1.682
Water content %	(%)	22.4	22.4	22.4
Dry Density	(g/cm^3)	1.555	1.519	1.374
MDD	(g/cm^3)	1.533	1.533	1.533
% of Compaction	(%)	**101.5**	**99.1**	**89.6**

WATER CONTENT AFTER SOAKING (4 days)

No. Of Blows	56	25	10
N° of container			
W. of Wet soil + Container	804.75	831.20	671.18
W. of Dry soil + Container	685.12	679.63	539.02
W. Of container	233.15	230.22	151.09
W. Of water	119.63	151.57	132.16
W. Of Dry soil	451.97	449.41	387.93
Water content %	**26.5**	**33.7**	**34.1**

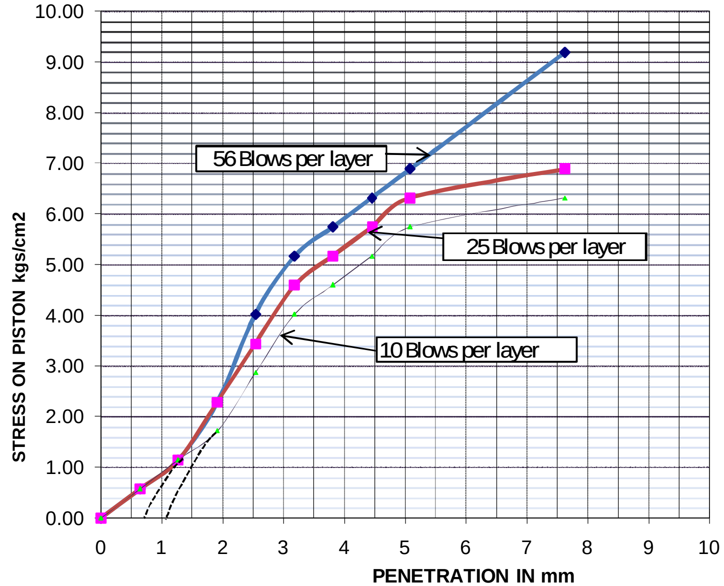
SWELL (1/100mm)

Blows / Date	56	25	10
12-May-14	0.00	0.00	0.00
13-May-14	2.92	3.45	2.5
14-May-14	3.66	3.71	2.51
15-May-14	3.79	3.76	2.52
16-May-14	3.83	3.79	2.53
Total mm	3.83	3.79	2.53
Total %	**3.30**	**3.27**	**2.18**

PENETRATION

Date: **16-May-14** N° of LOAD RING: **S370-10S-ZI-0001**

Penetr.	56 Blows		25 Blows		10 Blows	
mm	Reading	Stress	Reading	Stress	Reading	Stress
0.00	0.000	**0.00**	0.000	**0.00**	0.000	**0.00**
0.64	0.005	**0.57**	0.005	**0.57**	0.005	**0.57**
1.27	0.010	**1.15**	0.010	**1.15**	0.010	**1.15**
1.91	0.020	**2.30**	0.020	**2.30**	0.015	**1.72**
2.54	0.035	**4.02**	0.030	**3.45**	0.025	**2.87**
3.18	0.045	**5.17**	0.040	**4.59**	0.035	**4.02**
3.81	0.050	**5.74**	0.045	**5.17**	0.040	**4.59**
4.45	0.055	**6.32**	0.050	**5.74**	0.045	**5.17**
5.08	0.060	**6.89**	0.055	**6.32**	0.050	**5.74**
7.62	0.080	**9.19**	0.060	**6.89**	0.055	**6.32**



Correction of Load - Penetration Curves

No.of Blows	**2.54 mm**	**5.08 mm**	**Max stress**
56	5.40	7.50	7.50
25	4.60	6.50	6.50
10	4.40	6.00	6.00

1.380 1.456 1.533

Reported By :

Theobard N.
GEOTECHNICAL LAB MNGR
COSMEZZ SARL

GEOTECHNICAL LABORATORY
Certified by U.S. Army Corps of Engineers

Project: IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI
Location: PK 12 SUBSTATION AND NAGAD - DJIBOUTI
Contract # : --------------

COSMEZZ SARL
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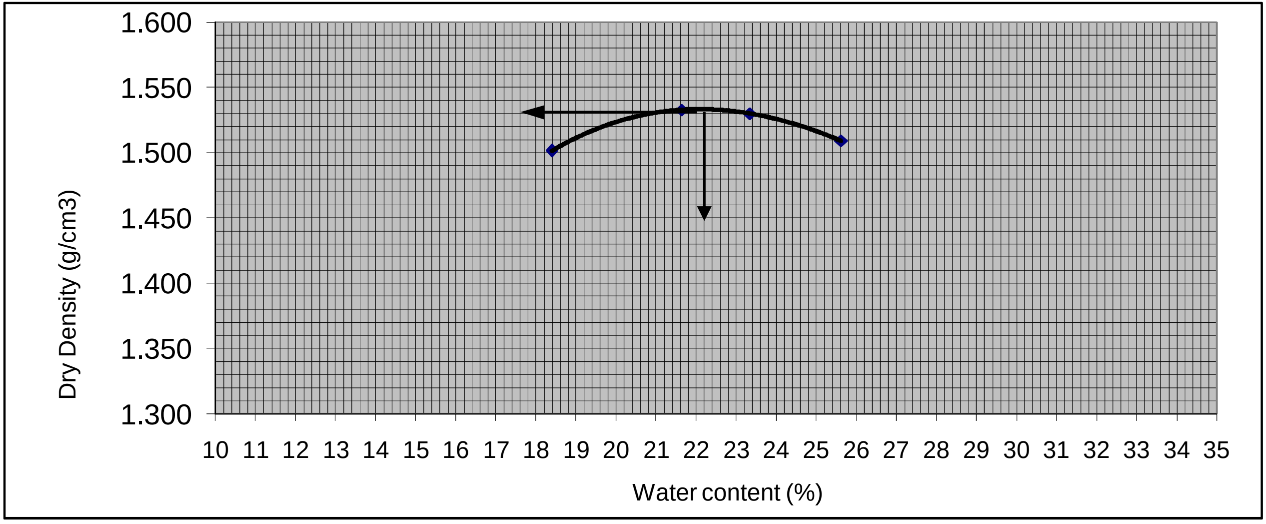
COSMEZZ GEOTECHNICAL LABORATORY - B.P. 1331, Rue de Venise - Djibouti, Phone: +253 21356142 - Email: cosmezz@mezzgroup.com

MODIFIED PROCTOR TEST - ASTM D 1557

Method used: **C**
Type of Rammer: **Manual**
% of Retained on 19mm Sieve: **---**
Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**
Date Sampled : **11-May-14**
Sample n° : **TP-4**
Date Tested : **11-May-14**
Sample Source : NAGAD OVERHEAD TRANSMISSION LINE
Sample Depth : **1.40 - 2.30 m**
Tested by : **ABDI / MERITO**
Sampled By : **THEO**

Determination N°	Units	1	2	3	4
% of Water added	%	2	4	6	8
WET DENSITY DETERMINATION					
Weight of soil + Mold	(grs)	8,326.2	8,510.0	8,557.8	8,576.2
Weight of Mold	(grs)	4,560.0	4,560.0	4,560.0	4,560.0
Weight of soil	(grs)	3,766.2	3,950.0	3,997.8	4,016.2
Volume of Mold	(cm^3)	2,118.7	2,118.7	2,118.7	2,118.7
Wet Density	(g/cm^3)	1.778	1.864	1.887	1.896
MOISTURE CONTENT DETERMINATION					
Weight of Wet soil + Container	(grs)	677.32	611.98	677.39	652.05
Weight of Dry soil + Container	(grs)	608.30	543.84	592.08	565.22
Weight of Water	(grs)	69.02	68.14	85.31	86.83
Weight of container	(grs)	233.08	228.95	226.55	226.25
Weight of Dry soil	(grs)	375.22	314.89	365.53	338.97
Water Content	%	**18.4**	**21.6**	**23.3**	**25.6**
DRY DENSITY					
Dry Density	(g/cm^3)	**1.501**	**1.533**	**1.530**	**1.509**

Corrected Maximum Dry Density (C-MDD) — **MDD (g/cm^3):** **1.533**
Corrected Optimum Moisture Content (C-OMC) — **OMC (%) :** **22.2**



Remarks:

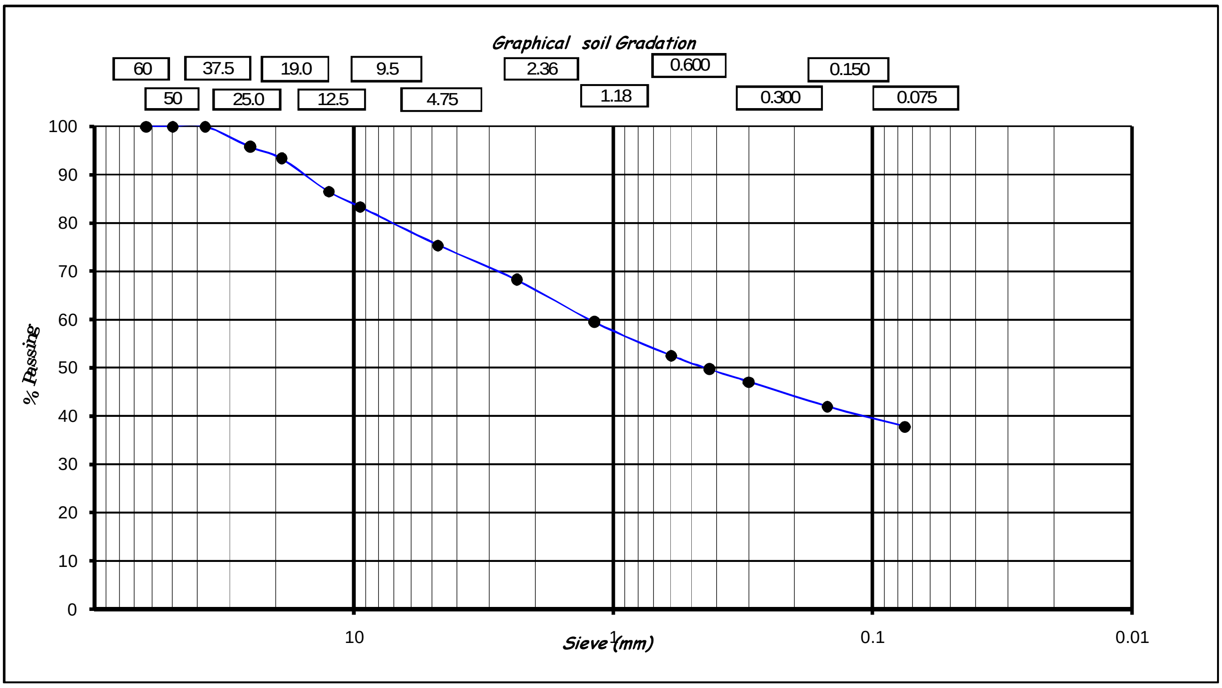
Submitted By :

THEOBARD N.
Geotechnical Lab. Mngr
COSMEZZ SARL

SIEVE ANALYSIS - ASTM C117/C136

Sample N°: **TP-4**
Project No.:
Date of Sampling : **11-May-14**
Sample source: **NAGAD OVERHEAD TRANSMISSION LINE**
Date of Test : **12-May-14**
Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**
Station : **NAGAD**
Test Method: **ASTM C 117 / C136**
Sample Depth : **1.40 - 2.30 m**
Weight (grs): **3169.80**
Sampled by : **THEO/MOH**
Tested by: **ABDI**

Sieve Number	Sieve(mm)	Retained (gr)	Cumulative Retained (gr)	Cumulative Retained (%)	Passing (%)
2 1/2	**63,0**	0	0	0	**100.0**
2"	**50,0**	0.0	0.0	0.0	**100.0**
1 1/2	**37,5**	0.00	0.0	0.0	**100.0**
1"	**25**	135.55	135.6	4.3	**95.7**
3/4	**19**	75.38	210.9	6.7	**93.3**
1/2	**12,5**	216.37	427.3	13.5	**86.5**
3/8	**9,5**	99.22	526.5	16.6	**83.4**
No.4	**4,75**	253.65	780.2	24.6	**75.4**
No.8	**2,36**	227.02	1007.2	31.8	**68.2**
No.16	**1,18**	277.59	1284.8	40.5	**59.5**
No.30	**0,600**	219.25	1504.0	47.4	**52.6**
No.40	**0,425**	90.46	1594.5	50.3	**49.7**
No.50	**0,300**	81.45	1675.9	52.9	**47.1**
No.100	**0,150**	160.07	1836.0	57.9	**42.1**
No.200	**0,075**	132.85	1968.9	62.1	**37.9**
Can	**0**				



Remarks :
Gravel: **24.6%**
Sand: **37.5%**
Fines: **37.9%**

Submitted By :

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COSMEZZ

GEOTECHNICAL LABORATORY

Certified by U.S. Army Corps of Engineers

GEOTECHNICAL INVESTIGATIONS & TOPOGRAPHICAL SURVEY

Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI

Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION

Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN

COSMEZZ SARL
Rue de Venise, Salines Ouest
B.P.1331-Djibouti-R.D.D.
E-mail: cosmezz@mezzgroup.com

COSMEZZ GEOTECHNICAL LABORATORY - B.P. 1331, Rue de Venise - Djibouti, Phone: +253 21356142 - Email: cosmezz@mezzgroup.com

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX - ASTM D 4318

Date Tested : **13-May-14**

Sample no : **TP-4**

Sample Description : **Sandy elastic SILT (MH) with gravel, light brown**

Date sampled : **11-May-14**

Sample Depth: **1.40 - 2.30 m**

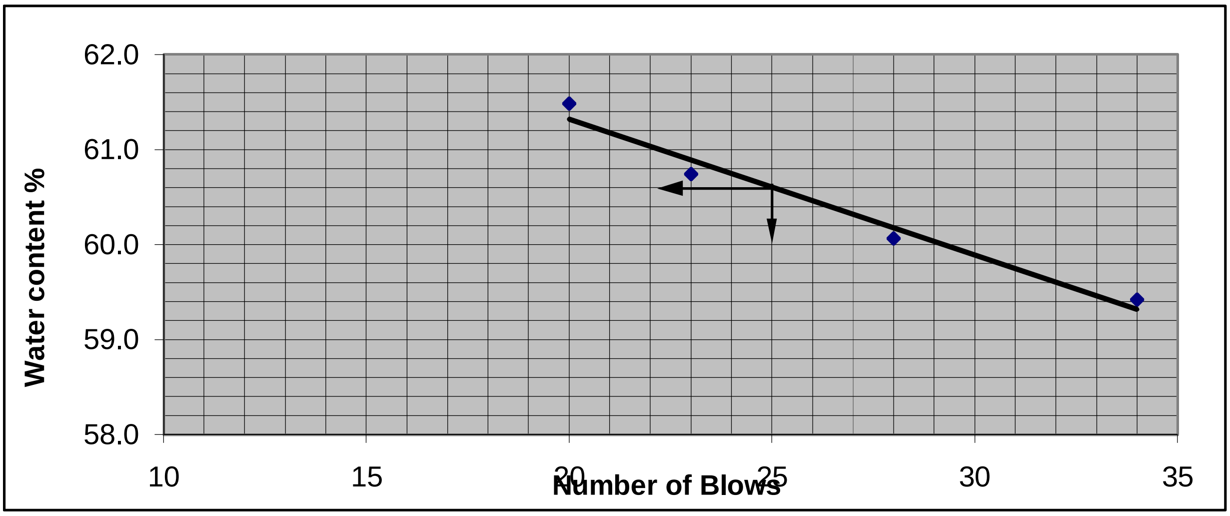
Source : **NAGAD/OVERHEAD TRANSMISSION LINE**

Tested by: **HOUSSEIN D.**

Sampled by: **THEO / MOH**

LL: 60.3 **PL: 42.1** **PI: 18.2**

LIQUID LIMIT (LL)					**PLASTIC LIMIT (PL)**	
No of Blows	20	23	28	34	**Test n°1**	**Test n°2**
N° of container	16	17	18	19	15	20
Weight of wet soil + container(A)	43.00	42.21	42.27	41.08	36.56	36.55
Weight of Dry soil + container(B)	38.85	38.28	38.42	37.20	35.16	35.18
Weight of container©	32.1	31.81	32.01	30.67	31.83	31.93
Weight of water D=A-B	4.15	3.93	3.85	3.88	1.4	1.37
Weight of Dry soil (E)=(B-C)	6.75	6.47	6.41	6.53	3.33	3.25
Water content (W)=D/E*100	61.5	60.7	60.1	59.4	42.0	42.2
LL @25Blows and Average PL	**60.3**				**42.1**	



Remarks:

Submitted By :

Theobard N.
GEOTECHNICAL LAB. MNGR
COSMEZZ SARL

APPENDIX C

CALCULATIONS FOR BEARING CAPACITY OF FOUNDATION

As requested by YEC, we have done calculations for Bearing Capacity of Shallow Foundations at three levels based on the general soil design parameters obtained during soil investigations of this Project.

GEOTECHNICAL LABORATORY Certified by U.S. Army Corps of Engineers (USACE)	GEOTECHNICAL INVESTIGATIONS Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI Location: PK 12 SUBSTATION AND NAGAD SWITCHING SUBSTATION Client: Yec YACHIYO ENGINEERING CO., LTD - JAPAN	COSMEZZ SARL Rue de Venise, Salines Ouest B.P.1331-Djibouti-R.D.D. E-mail: cosmezz@mezzgroup.com www.mezz.biz

BEARING CAPACITY CALCULATION OF SHALLOW FOUNDATIONS

TERZAGHI & VESIC Bearing Capacity Equations

BEARING CAPACITY OF SHALLOW FOUNDATIONS

Terzaghi and Vesic Methods

Date January 18, 2015

Identification Foundation Level=1.0 m

Input

Units of Measurement

	SI	SI or E

Foundation Information

Shape	SQ	SQ, CI, CO, or RE
B =	1.5	m
L =	1.5	m
D =	1	m

Soil Information

c =	20	kPa
phi =	30	deg
gamma =	19.7	kN/m^3
Dw =		m

Factor of Safety (FS)

F =	3

Results

	Terzaghi	Vesic
Bearing Capacity		
q ult =	1,308 kPa	1,672 kPa
q a =	436 kPa	557 kPa
Allowable Column Load		
P =	981 kN	1,254 kN

TERZAGHI: Q ult= 1.3 c Nc + γ D Nq + 0.4 γ B Nγ

q ult = 1,308 kPa

q a= Q ult / FS

q a = 436 kPa

P = q a x B x L

P = 436 kPa x 1.5 m x 1.5 m

P= 981 kN

VESIC: Q ult= c Nc sc dc + σ_{zD}' Nq sq dq + 0.5 γ B Nγ sγ dγ

q ult = 1,672 kPa

q a= Q ult / FS

q a = 557 kPa

P = q a x B x L

P = 557 kPa x 1.5 m x 1.5 m

P= 1254 kN

Unit conversion	1
Gamma w =	9.8
phi (radians)	0.5235988
Terzaghi Computations	
a theta =	3.3508015
Nc =	37.16
Nq =	22.46
N gamma =	20.12
gamma' =	9.9
coefficient #1 =	1.3
coefficient #3 =	0.4
sigma zD' =	9.9
Vesic Computation	
Nc =	30.14
sc =	1.61
dc =	1.27
Nq =	18.40
sq =	1.58
dq =	1.19
N gamma =	22.40
s gamma =	0.60
d gamma =	1.00
B/L =	1
k =	0.6666667
W sub f	0

TERZAGHI: Q ult= 1.3 c Nc + γ D Nq + 0.4 γ B Nγ

VESIC: Q ult= c Nc sc dc + σ_{zD}' Nq sq dq + 0.5 γ B Nγ sγ dγ

Where:

Q ult:	Ultimate bearing capacity
c:	Soil Cohesion
Gamma (γ):	Soil Bulk unit weight (KN/m^3)
B:	Width of foundation (m)
FS:	Factor of Safety
N_c, N_γ, N_q:	Terzaghi's Bearing capacity Factors
sc, sγ, sq:	VESIC's shape factors
dc, dq, dγ:	VESIC's depth factors
q a:	Allowable Bearing Capacity
σzD':	Vertical Effective Stress at Depth D Below Ground Surface
(phi) ϕ:	Friction Angle for Soil Beneath Foundation

Computed by:

THEOBARD NSHIMIYUMUREMYI

Geotechnical Lab Chief

COSMEZZ Sarl

BEARING CAPACITY OF SHALLOW FOUNDATIONS

Terzaghi and Vesic Methods

Date December 13, 2014
Identification Foundation Level=1.0 m

Input

Units of Measurement
SI SI or E

Foundation Information
Shape SQ SQ, CI, CO, or RE
B = 1.5 m
L = 1.5 m
D = 1 m

Soil Information
c = 20 kPa
phi = 30 deg
gamma = 19.7 kN/m^3
Dw = m

Factor of Safety
F = 3

Results

	Terzaghi	Vesic
Bearing Capacity		
q ult =	1,308 kPa	1,672 kPa
q a =	436 kPa	557 kPa
Allowable Column Load		
P =	981 kN	1,254 kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at PK 12 SUBSTATION area

BEARING CAPACITY OF SHALLOW FOUNDATIONS
Terzaghi and Vesic Methods

Date December 13, 2014
Identification Foundation Level=1.5 m

Input

Units of Measurement
SI SI or E

Foundation Information
Shape SQ SQ, CI, CO, or RE
B = 1.5 m
L = 1.5 m
D = 1.5 m

Soil Information
c = 300 kPa
phi = 30 deg
gamma = 26.5 kN/m^3
Dw = m

Factor of Safety
F = 3

Results

	Terzaghi		Vesic	
Bearing Capacity				
q ult =	15,257	kPa	21,492	kPa
q a =	5,086	kPa	7,164	kPa
Allowable Column Load				
P =	11,443	kN	16,119	kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at PK 12 SUBSTATION area

BEARING CAPACITY OF SHALLOW FOUNDATIONS
Terzaghi and Vesic Methods

Date	December 13, 2014
Identification	Foundation Level=2.0 m

Input

Units of Measurement

SI	SI or E

Foundation Information

Shape	SQ	SQ, CI, CO, or RE
B =	1.5	m
L =	1.5	m
D =	2	m

Soil Information

c =	300	kPa
phi =	30	deg
gamma =	26.5	kN/m^3
Dw =		m

Factor of Safety

F =	3

Results

	Terzaghi		Vesic	
Bearing Capacity				
q ult =	15,445	kPa	21,361	kPa
q a =	5,148	kPa	7,120	kPa
Allowable Column Load				
P =	11,584	kN	16,021	kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at PK 12 SUBSTATION area

BEARING CAPACITY OF SHALLOW FOUNDATIONS

Terzaghi and Vesic Methods

Date	December 13, 2014
Identification	Foundation Level=1.0 m

Input

Units of Measurement

	SI	SI or E

Foundation Information

Shape	SQ	SQ, CI, CO, or RE
B =	1.5	m
L =	1.5	m
D =	1	m

Soil Information

c =	0	kPa
phi =	33	deg
gamma =	21	kN/m^3
Dw =		m

Factor of Safety

F =	3

Results

	Terzaghi	Vesic
Bearing Capacity		
q ult =	585 kPa	746 kPa
q a =	195 kPa	249 kPa
Allowable Column Load		
P =	438 kN	559 kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at TRANSMISSION area

BEARING CAPACITY OF SHALLOW FOUNDATIONS
Terzaghi and Vesic Methods

Date	December 13, 2014
Identification	Foundation Level=1.5 m

Input

Units of Measurement		
	SI	SI or E
Foundation Information		
Shape	SQ	SQ, CI, CO, or RE
B =	1.5	m
L =	1.5	m
D =	1.5	m
Soil Information		
c =	10	kPa
phi =	20	deg
gamma =	19	kN/m^3
Dw =		m
Factor of Safety		
F =	3	

Results

	Terzaghi	Vesic
Bearing Capacity		
q ult =	357 kPa	478 kPa
q a =	119 kPa	159 kPa
Allowable Column Load		
P =	268 kN	358 kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at TRANSMISSION area

BEARING CAPACITY OF SHALLOW FOUNDATIONS

Terzaghi and Vesic Methods

Date	December 13, 2014
Identification	Foundation Level=2.0 m

Input

Units of Measurement		
	SI	SI or E
Foundation Information		
Shape	SQ	SQ, CI, CO, or RE
B =	1.5	m
L =	1.5	m
D =	2	m
Soil Information		
c =	10	kPa
phi =	20	deg
gamma =	19	kN/m^3
Dw =		m
Factor of Safety		
F =	3	

Results

	Terzaghi		Vesic	
Bearing Capacity				
q ult =	391	kPa	521	kPa
q a =	130	kPa	174	kPa
Allowable Column Load				
P =	293	kN	391	kN

Calculated by: THEOBARD / COSMEZZ Sarl

NOTE: To be applied at TRANSMISSION area

APPENDIX D

PHOTOS LOG

PHOTOGRAPH 1:

Photo taken: 07-Dec-2013

Location: PK 12 SUBSTATION
BH-1

Comments:

Cosmezz drilling rig (CMV MK 600JET) performing washed rotary drilling

PHOTOGRAPH 2:

Photo taken: 07-Dec-2013

Location: PK 12 SUBSTATION
BH-1

Comments:

Cosmezz Split Spoon Sampler

COSMEZZ GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

PHOTOGRAPH 3:

Photo taken: 07-Dec-2013

Location: PK 12 SUBSTATION
BH-2

Comments:

Existing site conditions during soil investigations

PHOTOGRAPH 4:

Photo taken: 07-Dec-2013

Location: PK 12 SUBSTATION
BH-1

Comments:

Core samples from BH-1

COSMEZZ GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

PHOTOGRAPH 5:

Photo taken: 15-Dec-2013

Location: TRANSMISSION LINE ROUTE
BH-3

Comments:

Existing site conditions during soil investigations at Transmission Line Route near PK 12 Plants.

PHOTOGRAPH 6:

Photo taken: 15-Dec-2013

Location: TRANSMISSION LINE ROUTE
BH-3

Comments:

COSMEZZ Rotary Drilling Rig during soil exploration at BH-3.

GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

PHOTOGRAPH 7:

Photo taken: 16-Dec-2014

Location: TRANSMISSION LINE ROUTE
BH-3

Comments:

Core samples from BH-3.

PHOTOGRAPH 8:

Photo taken: 15-Dec-2014

Location: TRANSMISSION LINE ROUTE
BH-3

Comments:

Looking in the south-east of BH-3.

COSMEZZ GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

PHOTOGRAPH 9:

Photo taken: 26-April-2014

Location: TRANSMISSION LINE ROUTE
BH-4

Comments:

COSMEZZ Rotary Drilling Rig during soil exploration at NAGAD.

PHOTOGRAPH 10:

Photo taken: 26-April-2014

Location: TRANSMISSION LINE ROUTE
BH-4

Comments:

Core samples from BH-4 at Nagad.

GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

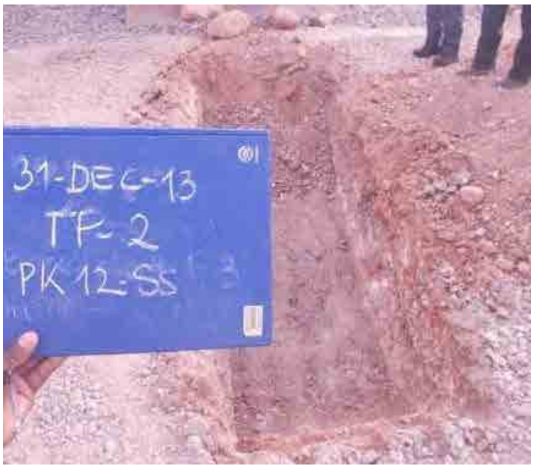
PHOTOGRAPH 11:

Photo taken: 31-Dec-2013

Location: PK 12 SUBSTATION
TP-2 (Test Pit-2)

Comments:

During Test Pit excavation at PK 12 Substation.



PHOTOGRAPH 12:

Photo taken: 31-Dec-2013

Location: PK 12 SUBSTATION
TP-2

Comments:

Test Pit-2.

GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

PHOTOGRAPH 13:

Photo taken: 31-Dec-2013

Location: TRANSMISSION LINE ROUTE
TP-3 (Test Pit-3)

Comments:

After test pit excavation of TP-3 near PK 12 Plants (COLAS Plants and NAEL).

PHOTOGRAPH 14:

Photo taken: 11-May-2014

Location: TRANSMISSION LINE (NAGAD)
TP-4

Comments:

Test Pit-4.

GEOTECHNICAL LAB	Project: IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI – PK 12 SUBSTATION & TRANSMISSION LINE ROUTE TO NAGAD	PHOTOS LOG

A-８　Outline Design Drawings

Single Line Diagram

Dwg. No.	Title
DWG No. SS-E-01	Jaban As Substation Single Line Diagram
DWG No. SS-E-02	Boulaos 63kV Substation Single Line Diagram

General Layout Plan

Dwg. No.	Title
DWG No. SS-L-01	Jaban As Substation General Layout
DWG No. SS-L-02	Jaban As Substation 63kV Switchgear Room Building
DWG No. SS-L-03	Jaban As Substation Control Building Layout
DWG No. SS-L-04	Boulaos Power Station 63kV Substation Building Layout
DWG No. SS-L-05	Boulaos Power Station 63kV Substation Relay Room Layout

Transmission Line Tower

Dwg. No.	Title
DWG No. T-01	Transmission Line Tower Type A (Double circuit)
DWG No. T-02	Transmission Line Tower Type B,C (Double circuit)
DWG No. T-03	Transmission Line Tower Type R (Double circuit)
DWG No. T-04	Transmission Line Tower Type ZZ (Double circuit)
DWG No. T-05	Transmission Line Tower Type A (Single circuit)
DWG No. T-06	Transmission Line Tower Type B,C (Single circuit)
DWG No. T-07	Transmission Line Tower Type R (Single circuit)
DWG No. T-08	Transmission Line Tower Type ZZ (Single circuit)

Steel Structure

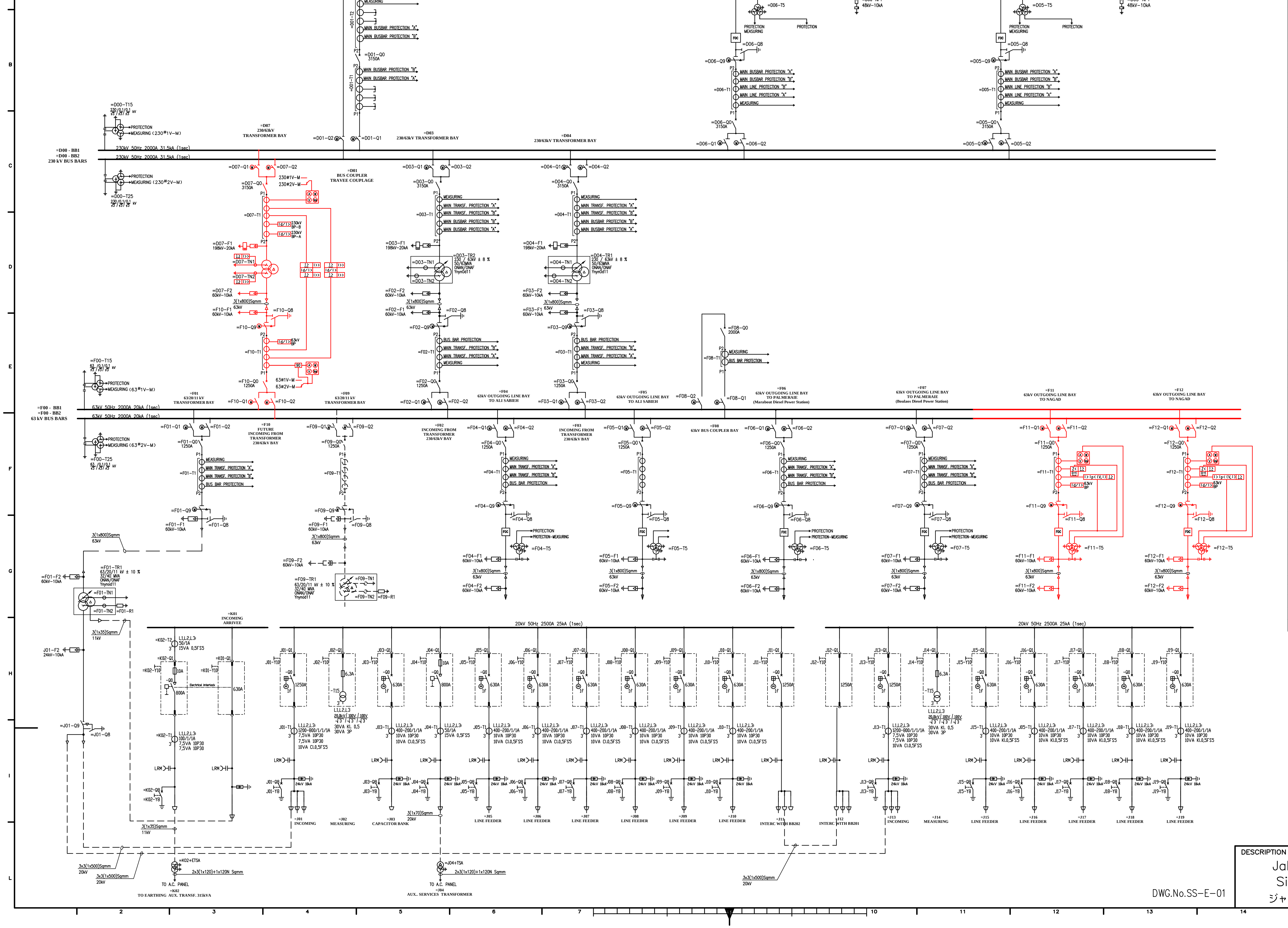
Dwg. No.	Title
DWG No. P-01	Steel Structure Type A
DWG No. P-02	Steel Structure Type B
DWG No. P-03	Steel Structure Type C
DWG No. P-04	Steel Structure Type D
DWG No. P-05	Steel Structure Type E
DWG No. P-06	Steel Structure Type F
DWG No. P-07	Steel Structure Type G
DWG No. P-08	Steel Structure Type H
DWG No. P-09	Steel Structure Type I
DWG No. P-10	Steel Structure Type J

Cable Trench and Foundation Plan

Dwg. No.	Title
DWG No. AR	Jaban As Substation Cable Trench and Equipment Foundation Plan

VT's CHARACTERISTICS

IDENTIFICATION	DESCRIPTION	CORE	RATIO	VA	CLASS
=D00 -T15 =D00 -T25 =D05 -T5 =D06 -T5	230 kV BUS BARS OUTGOING FEEDER BAY	2	$\frac{230}{\sqrt{3}} / \frac{0,1}{\sqrt{3}} - \frac{0,1}{\sqrt{3}}$ kV	100 100	0.2/3P 3P
=F00 -T15 =F00 -T25 =F04 -T5 =F05 -T5 =F06 -T5 =F07 -T5	63 kV BUS BARS OUTGOING FEEDER BAY	2	$\frac{63}{\sqrt{3}} / \frac{0,1}{\sqrt{3}} - \frac{0,1}{\sqrt{3}}$ kV	100 100	0.5/3P 3P



DWG.No.SS-E-01

CT's CHARACTERISTICS

IDENTIFICATION	DESCRIPTION	CORE	RATIO	VA	CLASS
=D01 -T1 =D01 -T2	BUS COUPLER	5	200-400-800/1A 200-400-800/1A 200-400-800/1A 200-400-800/1A 200-400-800/1A	30 35 35 30 30	0.2 10P30 10P30 10P30 10P30
=D03 -T1 =D04 -T1 =D05 -T1 =D06 -T1	OHL LINES AND TRANSFORMER BAYS	5	200-400-800/1A 200-400-800/1A 200-400-800/1A 200-400-800/1A 200-400-800/1A	30 35 35 30 30	0.2 10P30 10P30 10P30 10P30
=D03 -TN1 =D04 -TN1 =D07 -TN1 =D03 -TN2 =D04 -TN2 =D07 -TN2	TRANSFORMER FEEDER BAY	1 1	100/1A 100/1A	15 15	10P20 10P20
=D05 -T2 =D06 -T2	OHL LINES BAYS	3	100/1A 200-400-800/1A 200-400-800/1A	10 15 15	1 10P20 10P20
=D05 -T3 =D06 -T3	OHL LINES BAYS	2	200-400-800/1A 200-400-800/1A	15 15	10P20 10P20
=D05 -T4 =D06 -T4	OHL LINES BAYS	2	100/1A 100/1A	15 15	10P20 10P20
=F01 -T1 =F09 -T1 =F02 -T1 =F10 -T1 =F03 -T1 =F11 -T1 =F06 -T1 =F12 -T1 =F07 -T1	TRANSFORMER AND LINE BAYS 63kV SIDE	4	400-800/1A 400-800/1A 400-800/1A 400-800/1A	30 30 30 30	0.5 10P30 10P30 10P30
=F04 -T1 =F05 -T1	ALI SABIEH 63kV LINE BAYS	4	400-800/1A 400-800/1A 400-800/1A 400-800/1A	30 40 40 30	0.5 10P30 10P30 10P30
=F08 -T1	BUS COUPLER	2	1000-2000/1A 1000-2000/1A	30 30	0.5 10P30
=F01 -TN1 =F01 -TN2		2	200/1A 100/1A	15 15	10P20 10P20

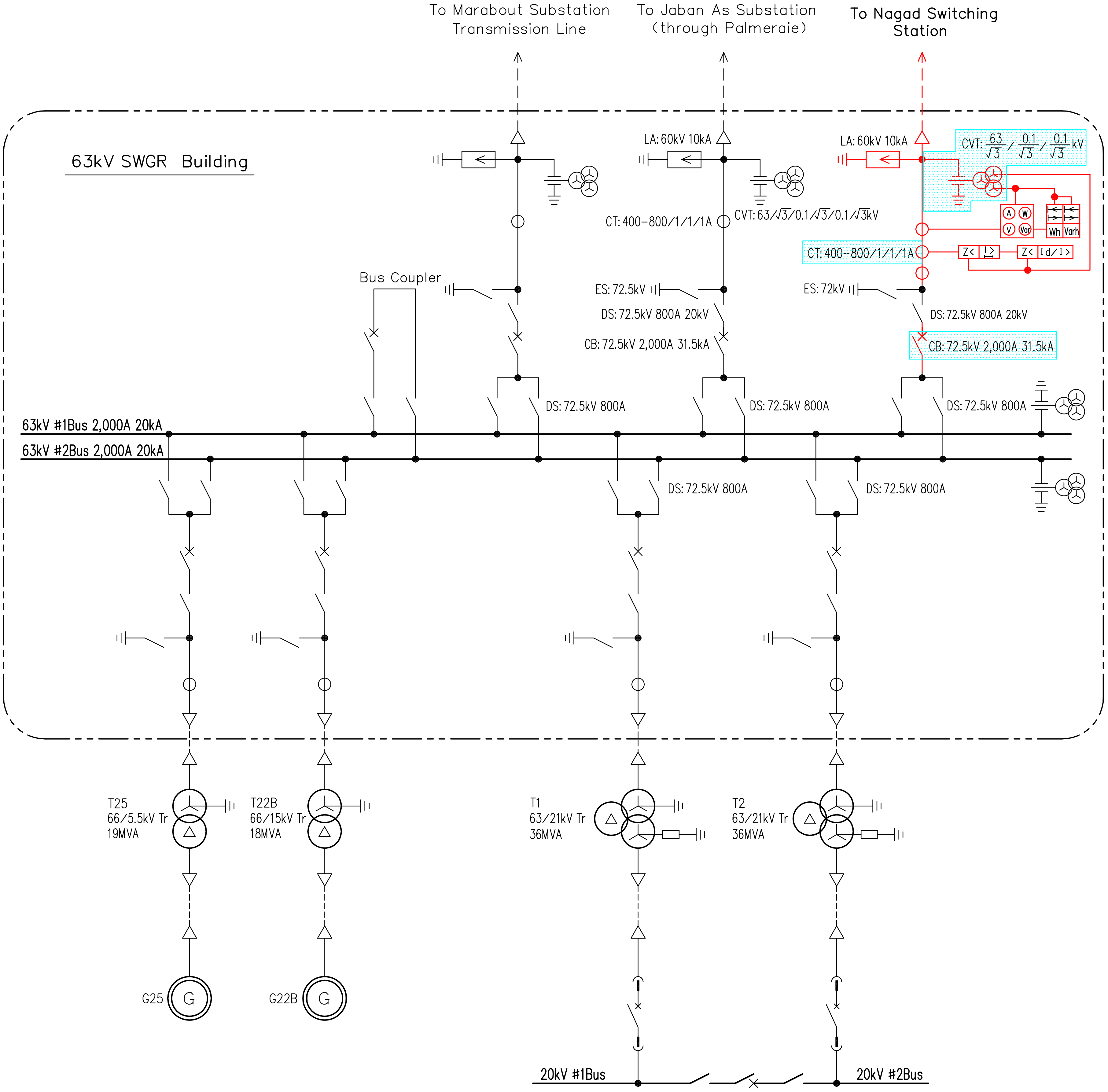
MAIN EQUIPMENT CHARACTERISTICS

IDENTIFICATION	DESCRIPTION	PERFORMANCE
=D03 -TR1 15MVA =D04 -TR1 10MVAR	POWER TRANSFORMER	230±8x1.25%/63kV 50/63MVA ONAN/ONAF YNyn0d11 - ....%
=D05 -SR =D06 -SR	SHUNT REACTOR	230 15MVAR ONAN YN 230 10MVAR ONAN YN
=D05 -NCR =D06 -NCR	NEUTRAL COMPENSATOR REACTOR	36kV - 15A ONAN
=F01 -TR1	POWER TRANSFORMER	63±10x1.25%/20/11kV 32/40MVA ONAN/ONAF Ynynod11 - ....%
=D01 -Q0 =D03 -Q0 =D04 -Q0	CIRCUIT BREAKER	THREE POLE MECHANISM 3150A - 31.5kA
=D05 -Q0 =D06 -Q0	CIRCUIT BREAKER	UNI-THREE POLE MECHANISM 3150A - 31.5kA
=F01 -Q0 =F02 -Q0 =F03 -Q0 =F06 -Q0 =F07 -Q0	CIRCUIT BREAKER	THREE POLE MECHANISM 1250A - 20kA
=F08 -Q0	CIRCUIT BREAKER	THREE POLE MECHANISM 2000A - 20kA
=F04 -Q0 =F05 -Q0	CIRCUIT BREAKER	UNI-THREE POLE MECHANISM 1250A - 20kA
=D01 -Q1-Q2 =D03 -Q1-Q2 =D04 -Q1-Q2 =D05 -Q1-Q2 =D06 -Q1-Q2	BUS BAR DISCONNECTOR SWITCH	245kV 2000A - 40kA
=F01 -Q1-Q2 =F09 -Q1-Q2 =F02 -Q1-Q2 =F10 -Q1-Q2 =F03 -Q1-Q2 =F11 -Q1-Q2 =F04/F05 -Q1-Q2 =F12 -Q1-Q2 =F06 -Q1-Q2 =F07 -Q1-Q2	BUS BAR DISCONNECTOR SWITCH	72.5kV 800A - 20kA
=F08 -Q1-Q2	BUS BAR DISCONNECTOR SWITCH	72.5kV 2000A - 20kA
=D05 -Q8-Q9 =D06 -Q8-Q9	LINE DISCONNECTOR WITH E. B.	245kV 2000A - 31.5kA
=D05 -Q1.1 =D06 -Q1.1	LINE DISCONNECTOR	245kV 2000A - 31.5kA
=F01 -Q8-Q9 =F09 -Q8-Q9 =F02 -Q8-Q9 =F10 -Q8-Q9 =F03 -Q8-Q9 =F11 -Q8-Q9 =F04/F05 -Q8-Q9 =F12 -Q8-Q9 =F06 -Q8-Q9 =F07 -Q8-Q9	LINE DISCONNECTOR WITH E. B.	72.5kV 800A - 20kA
=J01 -Q8-Q9	LINE DISCONNECTOR WITH E. B.	24kV 1250A - 20kA
=D03/F04 -F1 =D04 -F1 =D05 -F1 =D06 -F1	SURGE ARRESTER	198kV 20kA
=F01 -F1 =F09 -F1 =F02 -F1 =F10 -F1 =F03 -F1 =F11 -F1 =F04/F05 -F1 =F12 -F1 =F06 -F1 =F07 -F1	SURGE ARRESTER	60kV 10kA
=F01 -F2 =F09 -F2 =F04 -F2 =F10 -F2 =F05 -F2 =F11 -F2 =F06 -F2 =F12 -F2 =F07 -F2	SURGE ARRESTER	60kV 10kA
=J01 -F2	SURGE ARRESTER	24kV 10kA
=D05 -NF1 =D06 -NF1	SURGE ARRESTER	48kV 10kA
=K02 +ETSA	EARTHING AUXILIARY SERVICE TRANSFORMER	11±2x2.5%/0,4kV 315MVA Dyn1 - 6%
=J04 +TSA	AUXILIARY SERVICE TRANSFORMER	20±2x2.5%/0,4kV 315MVA Dyn1 - 6%
=F01 -R1 =F09 -R1	NEUTRAL EARTHING RESISTOR	40 Ω ±10% 20 /√3 kV 288 A

DESCRIPTION

Jaban As Substation
Single Line Diagam
ジャバナス 変電所 単線結線図

Formato originale A0



Note;

1.The equipment marked with ▨ shall be replaced with new ones

CB: 72.5kV、2000A、31.5kA ▨ 印付の設備は新品と取り替えを実施する。

CVT: 63/√3/0.1/√3/0.1/√3kV ,400-800/1/1/1A

Bus bars for new equipment connections: Al 80mm×5mm or greater

新設備と接続する母線材: アルミニウム製 80mm×5mm厚以上

Regend

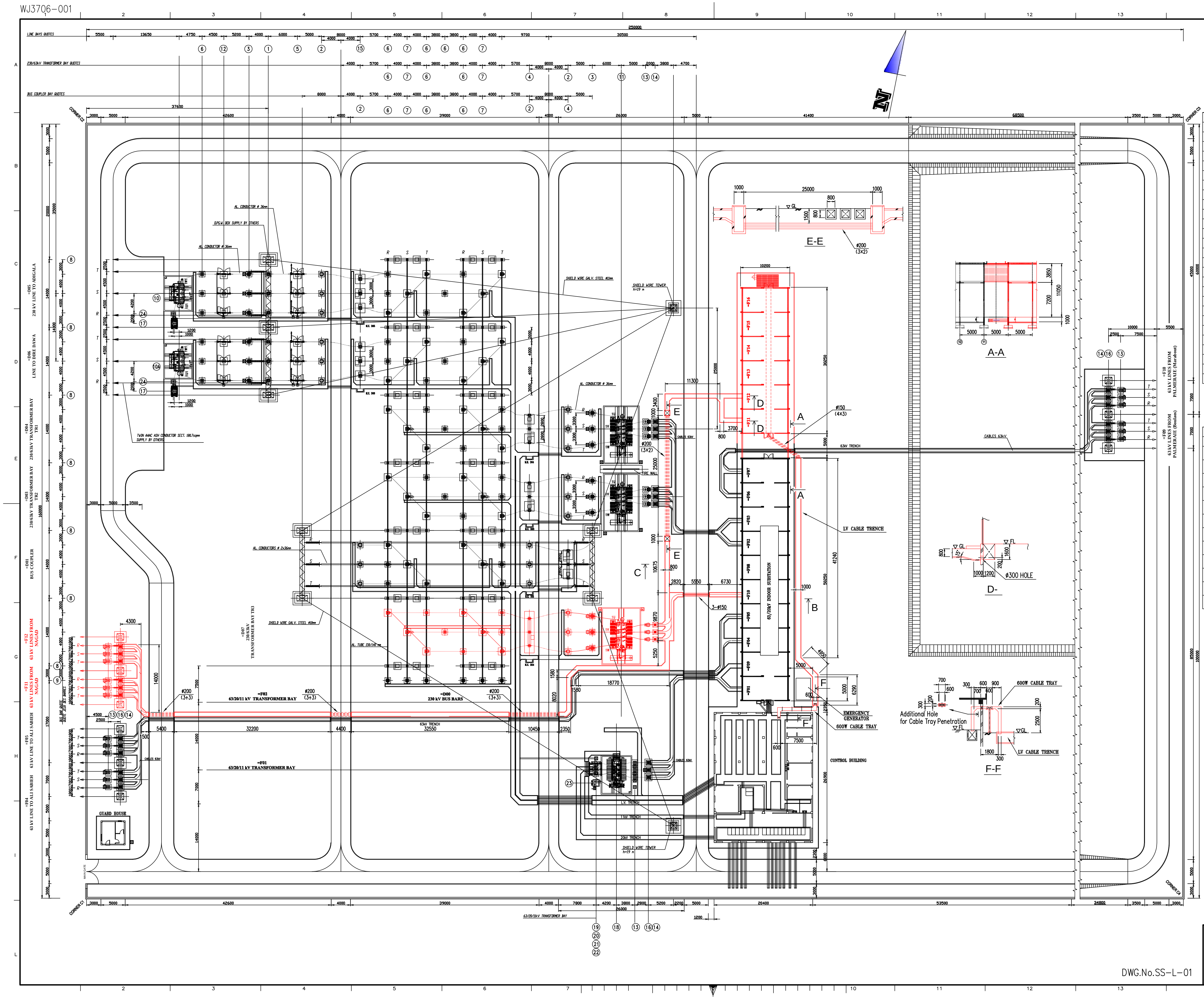
凡例

- Scope of works: 🟥
- 今回所掌範囲:
- Existing: ―
- 既設
- Transmission Line
- 送電線
  - Over head Line: ―
  - 架空線:
  - Under ground cable: --------
  - 地中埋設ケーブル:
- Building inside: ▭
- 建屋内設置:

DWG.No.SS-E-02

Boulaos 63kV Substation
Single Line Diagram
ブラオス発電所 63kV 変電所 単線結線図

WJ3706-001



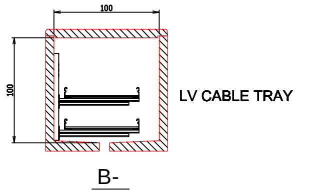
DWG.No.SS-L-01

EQUIPMENTS LEGEND 装置名称	
No.	DESCRIPTION 名称
①	230kV CAPACITOR VOLTAGE TRANSFORMER 230kV コンデンサ型計器用変圧器
②	230kV CURRENT TRANSFORMER 230kV 計器用変流器
③	230kV LIGHTNING ARRESTER 230kV 避雷器
④	230kV THREE POLE CIRCUIT BREAKER 230kV 遮断器
⑤	230kV THREE POLE DISCONNECTING SWITCH WITH EARTHING BLADES 230kV 接地開閉器付断路器
⑥	230kV POST INSULATOR 230kV 支持碍子
⑦	230kV BUS BAR THREE POLE DISCONNECTOR PANTOGRAPH 230kV 母線用断路器
⑧	230kV BUS BAR POST TYPE INSULATOR SUPPORT 230kV 母線支持碍子用架台
⑨	230kV BUSBAR CAPACITOR VOLTAGE TRANSFORMER 230kV 母線用コンデンサ型計器用変圧器
⑩	230kV 10MVAr SHUNT REACTOR 230kV 10MVar 分路リアクトル
(10A)	230kV 15MVAr SHUNT REACTOR 230kV 15MVar 分路リアクトル
⑪	230/63kV POWER TRANSFORMER 230/63kV 変圧器
⑫	230kV THREE POLE DISCONNECTING SWITCH 230kV 断路器
⑬	63kV LIGHTNING ARRESTER 63kV 避雷器
⑭	63kV TERMINAL CABLE 63kV ケーブル端末
⑮	230kV UNI-THREE POLE CIRCUIT BREAKER 230kV 遮断器
⑯	63kV POST INSULATOR 63kV 支持碍子
⑰	NEUTRAL COMPENSATOR REACTOR 中性点補償リアクトル
⑱	63/20/11kV POWER TRANSFORMER 63/20/11kV 変圧器
⑲	20kV LIGHTNING ARRESTER 20kV 避雷器
⑳	20kV THREE POLE DISCONNECTING SWITCH WITH EARTH BLADES 20kV 接地開閉器付断路器
㉑	20kV POST INSULATOR 20kV 支持碍子
㉒	20kV CABLE SEALING END 20kV ケーブル端末
㉓	20kV NEUTRAL GROUNDING RESISTOR 20kV 中性点接地抵抗器
㉔	33kV LIGHTNING ARRESTER FOR NEUTRAL COMPENSATOR REACTOR 33kV 中性点補償リアクトル用避雷器

63kV BAYS LEGEND 63kV 区画名称	
BAY 区画	DESCRIPTION 名 称
=F01	OUTGOING TO TRANSFORMER 63/20/11kV BAY 63/20/11kV 変圧器1
=F09	OUTGOING TO TRANSFORMER 63/20/11kV BAY 63/20/11kV 変圧器2
=F04	OUTGOING LINE BAY 63kV TO ALI SABIEH 63kV アリサビエ送電線1
=F05	OUTGOING LINE BAY 63kV TO ALI SABIEH 63kV アリサビエ送電線2
=F10	INCOMING TRANSFORMER TR3 230/63kV BAY 230/63kV 変圧器受電3
=F08	63kV BUS COUPLER BAY 63kV 母線連絡
=F02	INCOMING TRANSFORMER TR2 230/63kV BAY 230/63kV 変圧器受電2
=F03	INCOMING TRANSFORMER TR1 230/63kV BAY 230/63kV 変圧器受電1
=F06	OUTGOING LINE BAY 63kV TO PLAMERAIE (Marabout) 63kV パルメレ（マラブ）送電線
=F07	OUTGOING LINE BAY 63kV TO PLAMERAIE (Boulaos) 63kV パルメレ（ブラオス）送電線
=F11	OUTGOING LINE BAY 63kV TO NAGAD ナガド送電線1
=F12	OUTGOING LINE BAY 63kV TO NAGAD ナガド送電線2

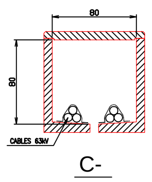
LV CABLE WAY

TRENCH 100xH100cm



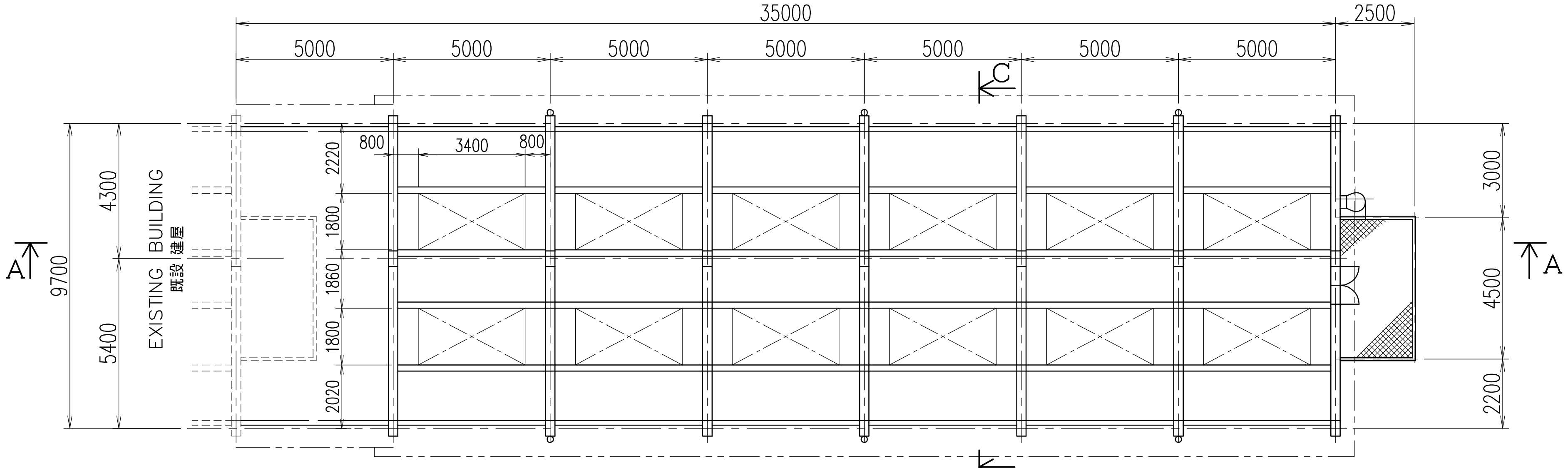
63kV CABLE WAY

TRENCH 80xH80cm



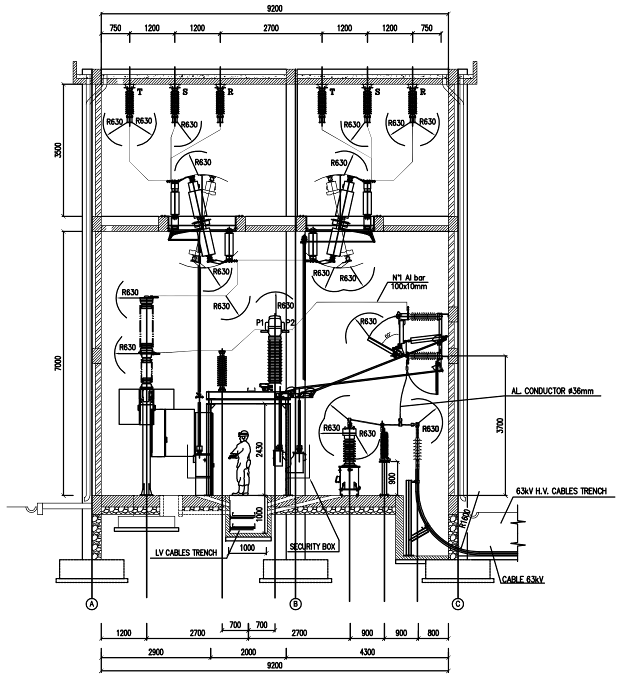
Jaban As Substation
General Layout
ジャバナス変電所 全体配置図

WJ3706-004

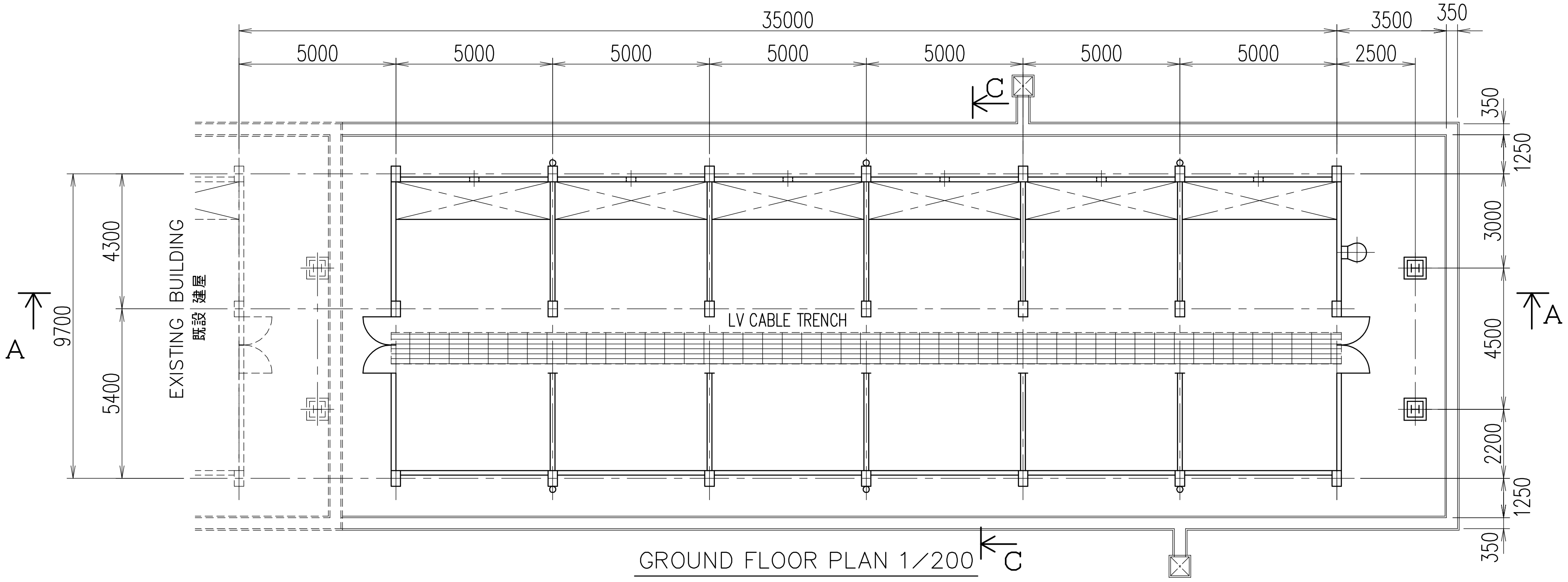


FIRST FLOOR PLAN 1/200

2階床計画

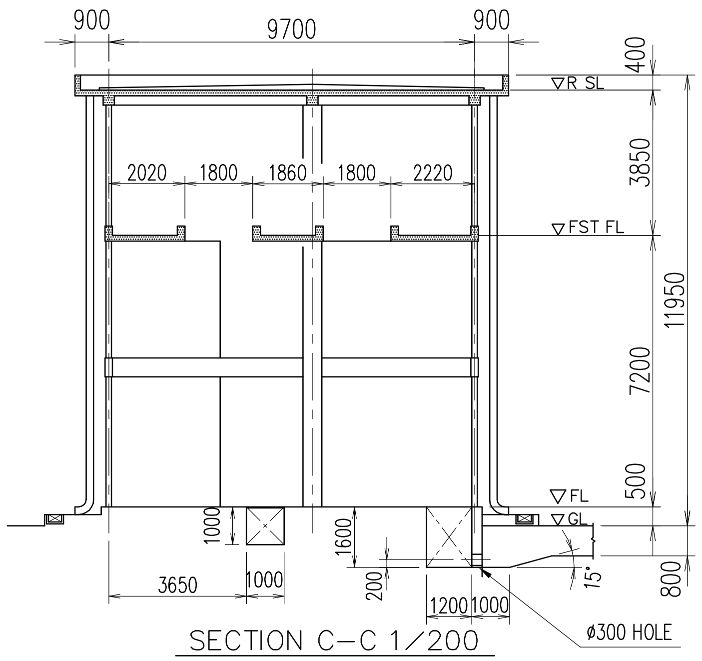


SECTION C–C

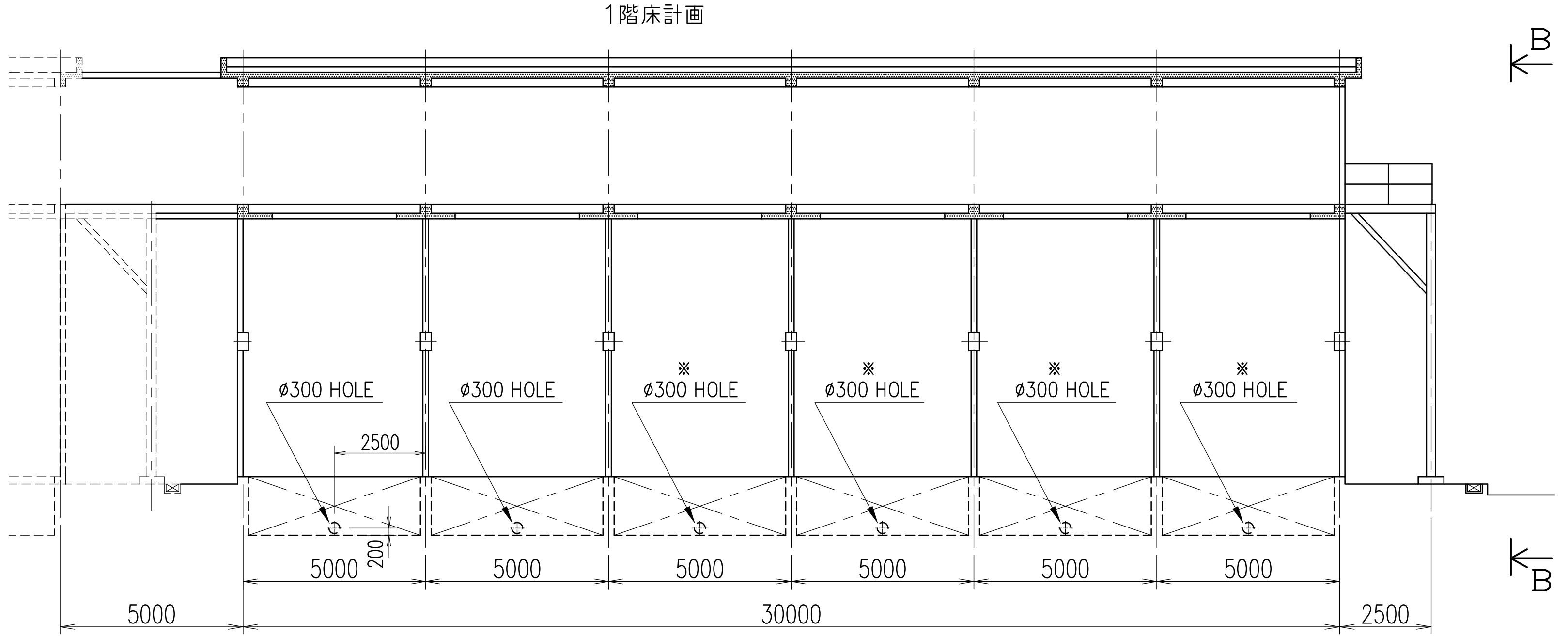


GROUND FLOOR PLAN 1/200

1階床計画



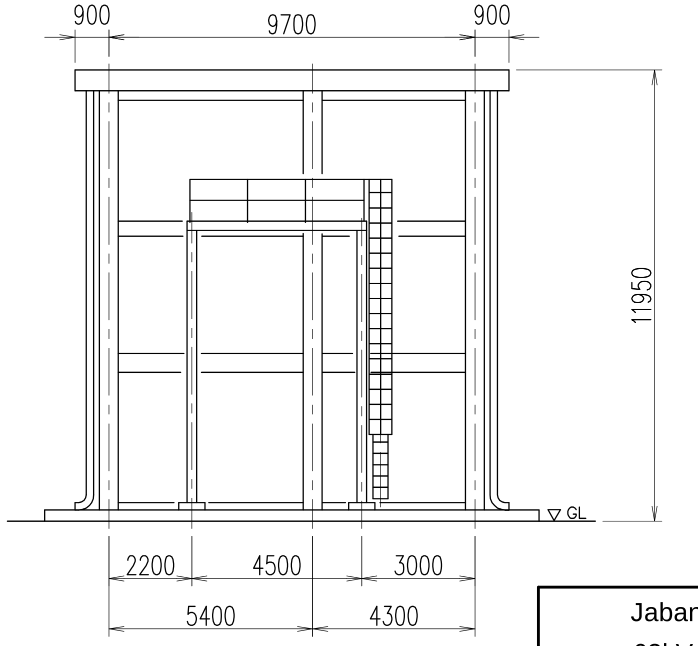
SECTION C–C 1/200



SECTION A–A 1/200

※:Back up material to be filled in for future use

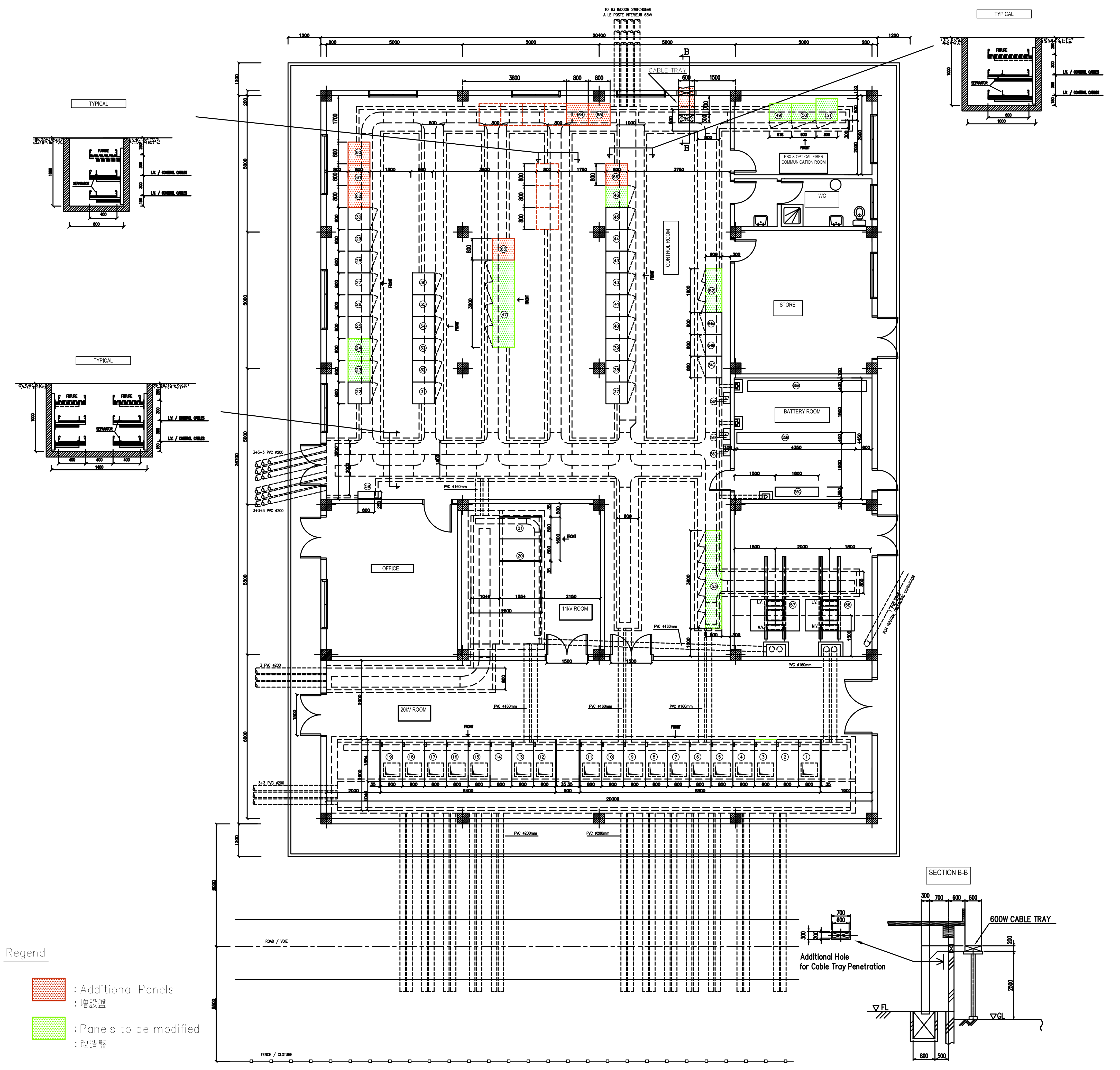
※:将来用の穴はバックアップ材充填



SECTION B–B 1/200

DWG.No.SS–L–02

Jaban As Substation
63kV SWGR Building
ジャバナス変電所 63kV 開閉装置建屋 配置図



Regend

🟥 : Additional Panels
: 増設盤

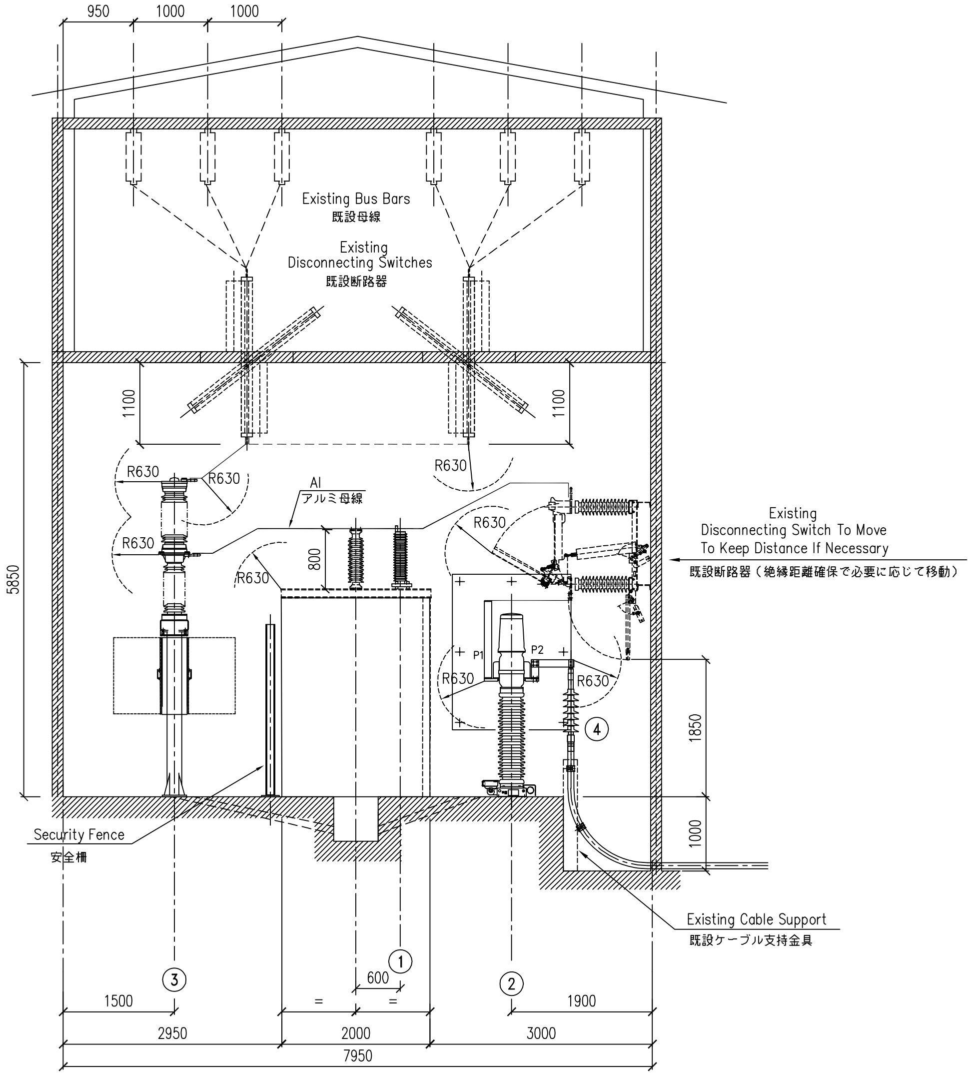
🟩 : Panels to be modified
: 改造盤

EQUIPMEXNT NAME／装置名称

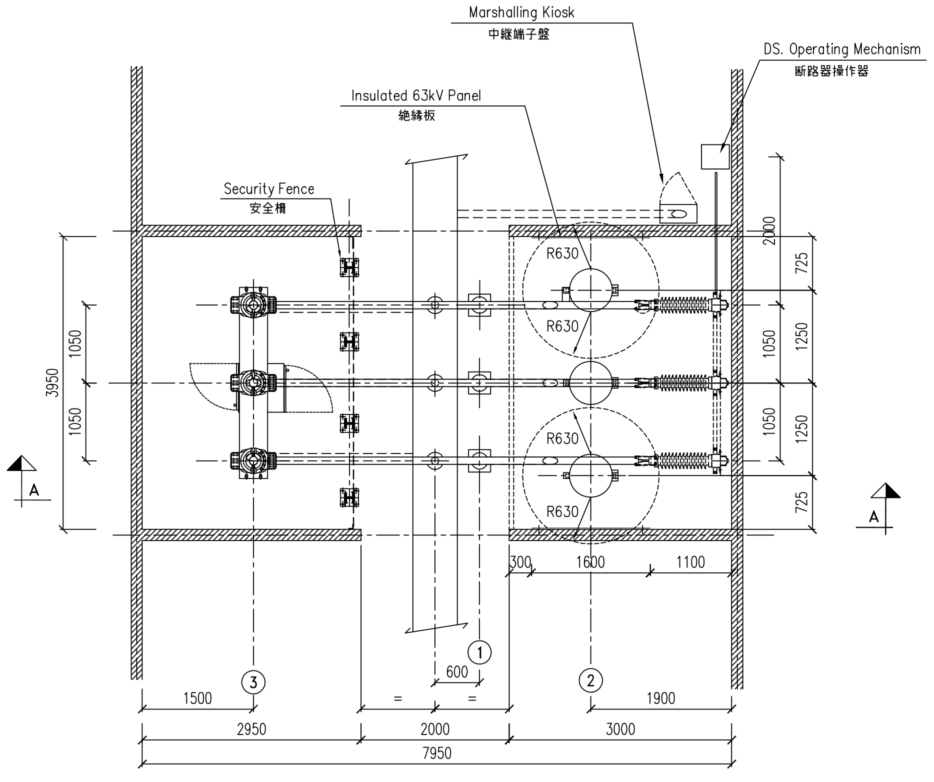
POS.	DESCRIPTION	
①	20kV AIS 201 / =J01 INCOMING CUBICLE 受電用キュービクル	
②	20kV AIS 201 / =J02 MEASURE CUBICLE 計測用キュービクル	
③	20kV AIS 201 / =J03 CAPACITOR BANK CUBICLE コンデンサバンク用キュービクル	
④	20kV AIS 201 / =J04 AUX. TRANSFORMER CUBICLE 補助トランス用キュービクル	
⑤	20kV AIS 201 / =J05 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑥	20kV AIS 201 / =J06 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑦	20kV AIS 201 / =J07 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑧	20kV AIS 201 / =J08 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑨	20kV AIS 201 / =J09 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑩	20kV AIS 201 / =J10 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑪	20kV AIS 201 / =J11 INTERCONNECTION WITH BUS BAR 202 CUBICLE 202母線接続用キュービクル	
⑫	20kV AIS 202 / =J12 INTERCONNECTION WITH BUS BAR 201 CUBICLE 201母線接続用キュービクル	
⑬	20kV AIS 202 / =J13 INCOMING CUBICLE 受電用キュービクル	
⑭	20kV AIS 201 / =J14 MEASURE CUBICLE 計測用キュービクル	
⑮	20kV AIS 202 / =J15 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑯	20kV AIS 202 / =J16 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑰	20kV AIS 202 / =J17 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑱	20kV AIS 202 / =J18 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑲	20kV AIS 202 / =J19 LINE FEEDER CUBICLE フィーダ用キュービクル	
⑳	11kV AIS / =K01 AUX. TRANSFORMER CUBICLE 補助トランス用キュービクル	
㉑	11kV AIS / =K02 INCOMING CUBICLE 受電用キュービクル	
㉒	230KV CONTROL PANEL / =D01+W1 – 230kV BUS COUPLER 230KV 母線連絡制御盤	
🟩 ㉓	230KV PROTECTION PANEL / =D00+R1 – 230kV BUS BARS 230KV 母線保護盤1	J–21
🟩 ㉔	230KV PROTECTION PANEL / =D00+R2 – 230kV BUS BARS 230KV 母線保護盤2	J–21
㉕	230KV CONTROL PANEL / =D03+W1 & =F02+W1 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器連絡制御盤	
㉖	230KV PROTECTION PANEL / =D03+R1 & =F02+R1 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器保護盤1	
㉗	230KV PROTECTION PANEL / =D03+R2 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器保護盤2	
㉘	230KV CONTROL PANEL / =D04+W1 & =F03+W1 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器区画制御盤	
㉙	230KV PROTECTION PANEL / =D04+R1 & =F03+R1 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器保護盤1	
㉚	230KV PROTECTION PANEL / =D04+R2 – 230/63kV TRANSFORMER BAY 230／63KV 変圧器保護盤2	
㉛	230KV CONTROL PANEL / =D06+W1 – 230kV INCOMING LINE FROM DIRE DAWA 230KV ディレダワ線制御盤	
㉜	230KV PROTECTION PANEL / =D06+R1 – 230kV INCOMING LINE FROM DIRE DAWA 230KV ディレダワ線保護盤1	
㉝	230KV PROTECTION PANEL / =D06+R2 – 230kV INCOMING LINE FROM DIRE DAWA 230KV ディレダワ線保護盤2	
㉞	230KV CONTROL PANEL / =D05+W1 – 230kV INCOMING LINE FROM ADIGALA 230KV アディゲラ線制御盤	
㉟	230KV PROTECTION PANEL / =D05+R1 – 230kV INCOMING LINE FROM ADIGALA 230KV アディゲラ線保護盤1	
㊱	230KV PROTECTION PANEL / =D05+R2 – 230kV INCOMING LINE FROM ADIGALA 230KV アディゲラ線保護盤2	
㊲	63KV CONTROL PANEL / =F01+W1 – OUTGOING TRANSFORMER 63/20/11kV BAY 63／20KV 変圧器制御盤	
㊳	63KV PROTECTION PANEL / =F01+R1 – OUTGOING TRANSFORMER 63/20/11kV BAY 63／20KV 変圧器保護盤1	
㊴	63KV PROTECTION PANEL / =F01+R2 – OUTGOING TRANSFORMER 63/20/11kV BAY 63／20KV 変圧器保護盤2	
㊵	63KV CONTROL PANEL / =F04+W1 – 63kV OUTGOING LINE BAY TO ALI SABIEH & =F08+W1 BUS CUPLER 63KV アリサビィエ線・母線連絡制御盤	
㊶	63KV PROTECTION PANEL / =F04+R1 – 63kV OUTGOING LINE BAY TO ALI SABIEH & =F08+R1 BUS COUPLER 63KV アリサビィエ線・母線連絡保護盤	
㊷	63KV CONTROL PANEL / =F05+W1 – 63kV OUTGOING LINE BAY TO ALI SABIEH 63KV アリサビィエ線制御盤	
㊸	63KV PROTECTION PANEL / =F05+R1 – 63kV OUTGOING LINE BAY TO ALI SABIEH 63KV アリサビィエ線保護盤	
㊹	63KV CONTROL PANEL / =F06+W1 & =F07+W1 – 63kV OUTGOING LINE BAYS TO PALMERAIE (Marabout–Boulaos) 63KV パルメレ線（マシブ＋グラオス）制御盤	
㊺	63KV PROTECTION PANEL / =F06+R1 & =F07+R1– 63kV OUTGOING LINE BAYS TO PALMERAIE (Marabout–Boulaos) 63KV パルメレ線（マシブ＋グラオス）保護盤	
🟩 ㊻	63KV PROTECTION PANEL / =F00+R1 – 63kV BUS BARS 63KV 母線保機盤1	J–22
🟩 ㊼	230/63kV SUBSTATION MOSAIC CONTROL PANEL 230／63KV 変電所モザイク制御盤	J–17
㊽		
🟩 ㊾	RACK–1 SDH/PDH EQUIPMENT (COMUNICATION PANEL) 通信装置盤（ラック1）	J–25
🟩 ㊿	RACK–2 PABX (DIGITAL TELEPHONE EXCHANGE) デジタル電話変換器盤（ラック2）	J–25
🟩 (51)	SCADA PANEL =D00+SC SCADAサーバ盤	J–18
🟩 (52)	DC PANEL +BUA / +BUB 直流分電盤	J–23
🟩 (53)	AC PANEL +BJT 交流分電盤	J–24
(54A)	BATTERY CHARGER (FOR 125V BATTERY) +BTLA 充電器盤（DC125V蓄電池）	
(54B)	BATTERY CHARGER (FOR 125V BATTERY) +BTLB 充電器盤（DC125V蓄電池）	
(54C)	BATTERY CHARGER (FOR 48V BATTERY) +BTLC 充電器盤（DC48V蓄電池）	
(55A)	BATTERY 125V +BTA 蓄電池 125V	
(55B)	BATTERY 125V +BTB 蓄電池 125V	
(55C)	BATTERY 48V +BTC 蓄電池 48V	
(56A)	FUSE BOX (FOR 125V BATTERY +BUA) ヒューズ箱（DC125V蓄電池）	
(56B)	FUSE BOX (FOR 125V BATTERY +BUB) ヒューズ箱（DC125V蓄電池）	
(56C)	FUSE BOX (FOR 48V BATTERY +BUC) ヒューズ箱（DC48V蓄電池）	
(57)	11/0,4/0,23KV – 315KVA AUX. TRANSFORMER (DRY TYPE) 11／0.4／0.23KV 315KVA 乾式補助トランス	
(58)	20/0,4/0,23KV – 315KVA AUX. TRANSFORMER (DRY TYPE) 20／0.4／0.23KV 315KVA 乾式補助トランス	
(59)	LIGHTING DISTRIBUTION PANEL LP–CB 照明用分電盤	
🟥 (60)	230/63KV TRANSFORMER PROTECTION PANEL 230／63KV 変圧器保護盤2	J–19
🟥 (61)	230/63KV TRANSFORMER PROTECTION PANEL 230／63KV 変圧器保護盤1	J–19
🟥 (62)	230KV CONTROL PANEL 230/63kV TRANSFORMER BAY 230／63KV 変圧器制御盤	J–16
🟥 (63)	63KV MOSAIC CONTROL PANEL 63KV モザイク制御盤	(J–17)
🟥 (64)	63KV CONTROL PANEL 63kV OUTGOING LINE BAYS TO NAGADO 63KV ナガド線制御盤	J–16
🟥 (65)	63KV PROTECTION PANEL 63kV OUTGOING LINE BAYS TO NAGADO 63KV ナガド線保護盤	J–20
🟥 (66)	63KV PROTECTION PANEL 63kV BUS BARS 63KV 母線保護盤2	(J–22)

Jaban As Substation
Control Building Layout
ジャバナス変電所 コントロール建屋内配置図

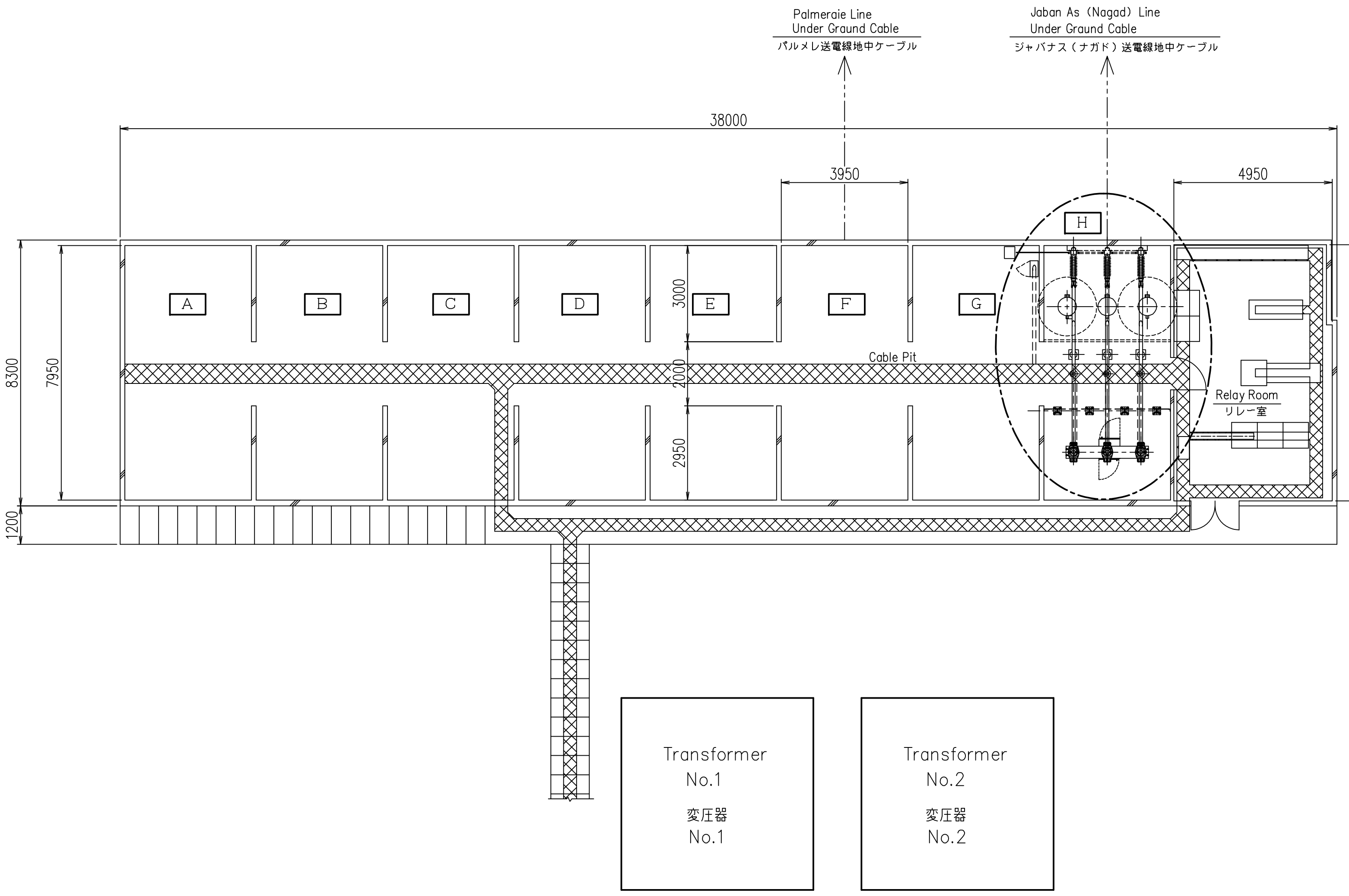
DWG.No.SS–L–03



SECTION A-A



LAYOUT PLAN

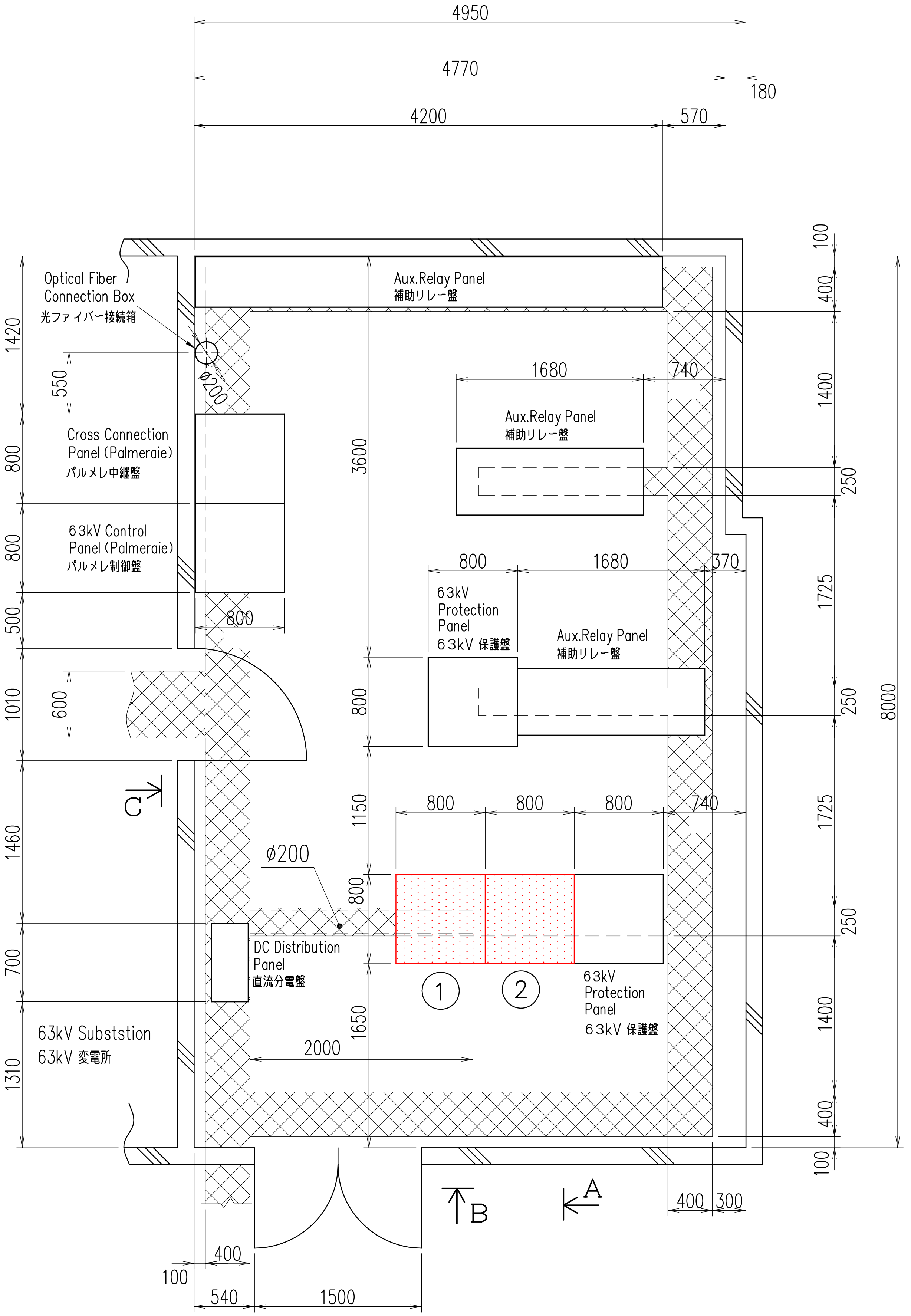


No.	DESCRIPTION / 名称
①	63kV Lightning Arrester 63kV 避雷器
②	63kV Measure Combined Transformer 63kV 計器用変流変圧器
③	63kV Three Pole Circuit Breaker 63kV 遮断器
④	63kV Cable Sealing End 63kV ケーブル端末

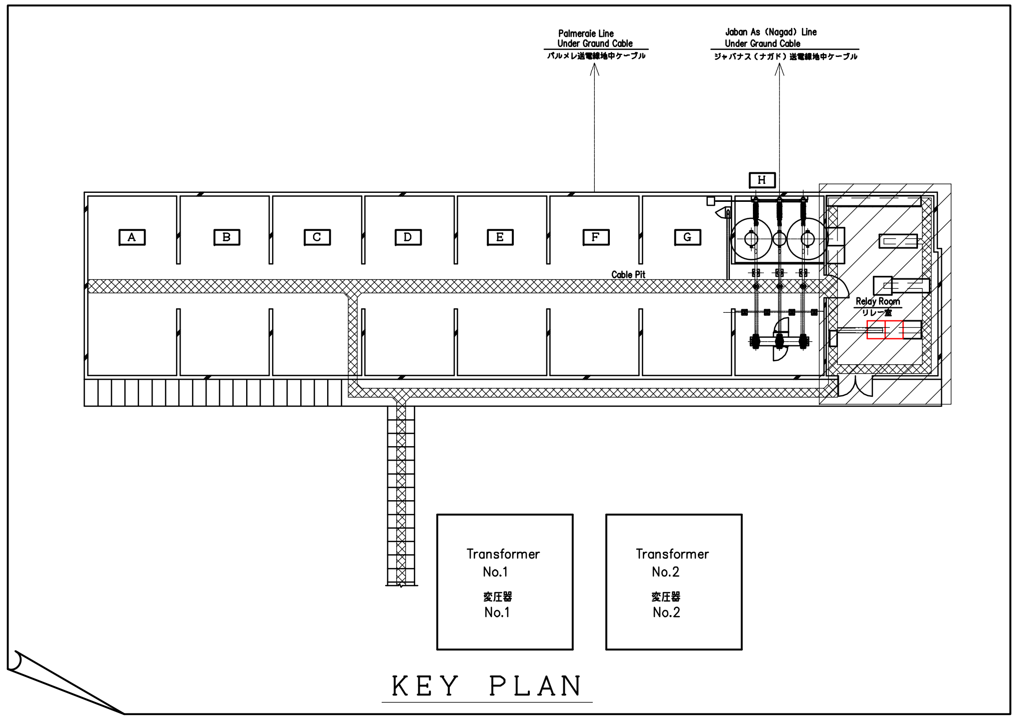
No.	DESCRIPTION / 名称
A	No.25 Generator Bay No.25 発電機区画
B	No.22 Generator Bay No.22 発電機区画
C	Bus Conpler Bay 母線連絡区画
D	Marabout Line Bay マウブ送電線区画
E	Spare 予備
F	Palmeraie Line Bay パルメレ送電線区画
G	Spare 予備
H	Jaban As（Nagad） ジャバナス（ナガド）

Boulaos Power Station 63kV Substation
Building Layout
ブラオス発電所 63kV 変電所 建屋内配置図

DWG.No.SS-L-04

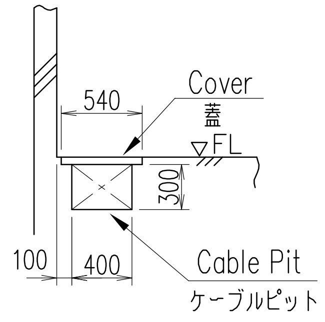


Ceiling Hight: 2990mm
天井高さ

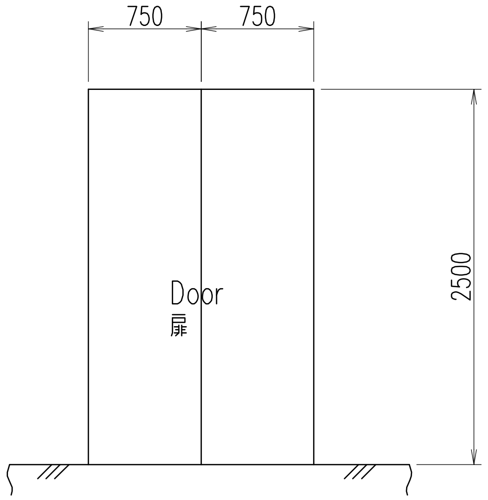


KEY PLAN

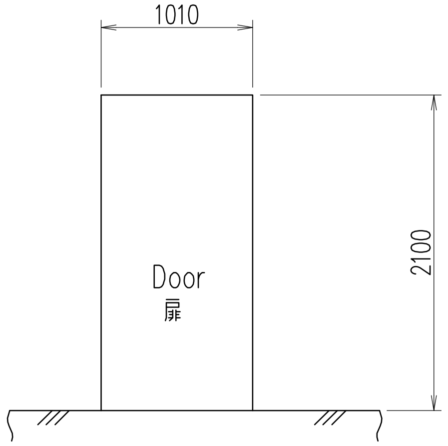
	PANEL NAME 盤名称
①	63kV Control Panel 63kV 制御盤 63kV Outgoing Line Bay To Nagad 63kV ナガド向送電線区画
②	63kV Protection Panel 63kV 保護盤 63kV Outgoing Line Bay To Nagad 63kV ナガド向送電線区画



SECTION A– 1/50



SECTION B– 1/50

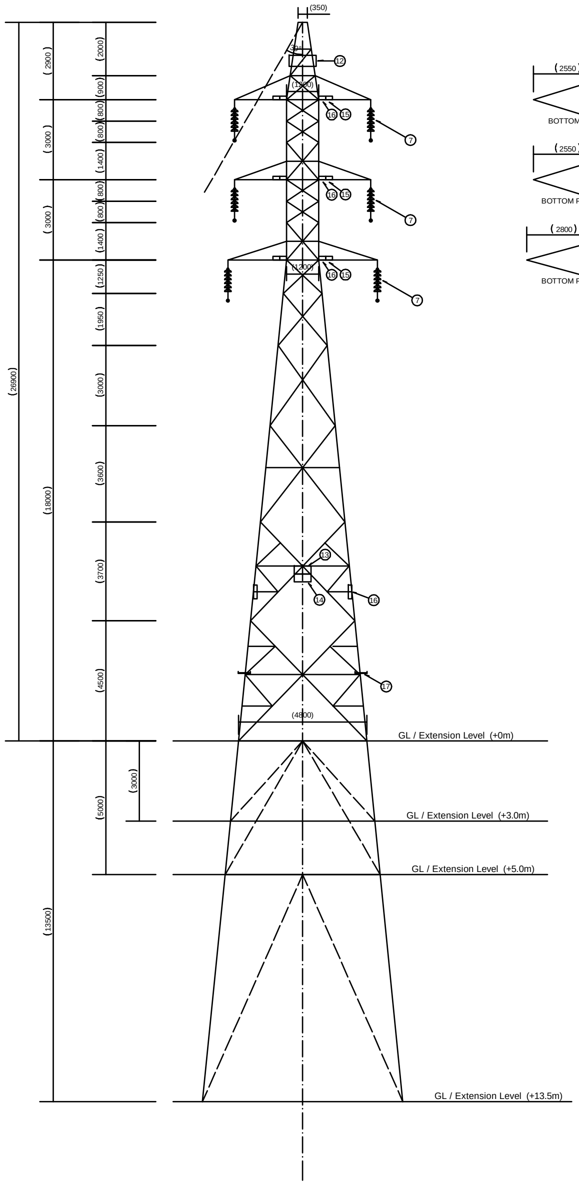


SECTION C– 1/50

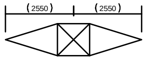
DWG.No.SS–L–05

Boulaos Power Station
63kV Substation
Relay Room Layout
ブラオス発電所 63kV 変電所 リレー室 配置図

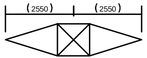
Tower Type A



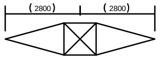
Transverse Face



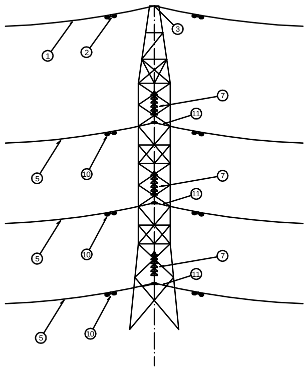
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	2 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 5°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	1 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	0 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	0 pcs
⑦		懸垂碍子装置，クランプ Suspension Insulator Set, Clamp	6 sets
⑧		耐張碍子装置，クランプ Tension Insulator Set, Clamp	0 set
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	6 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	6 sets
⑯		回線識別札 Circuit Plate	8 sets
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

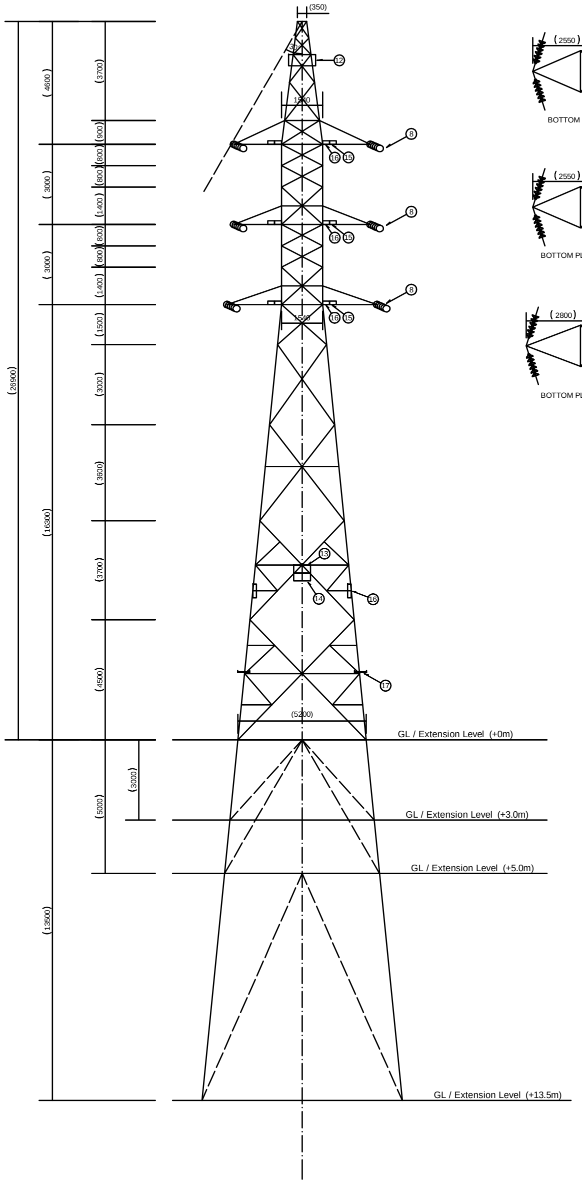
Title
Transmission Line Tower : Type A

DWG. No.
T-01

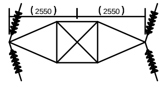
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

yec YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

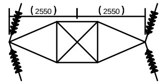
Tower Type B, C



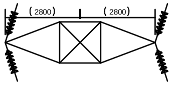
Transverse Face



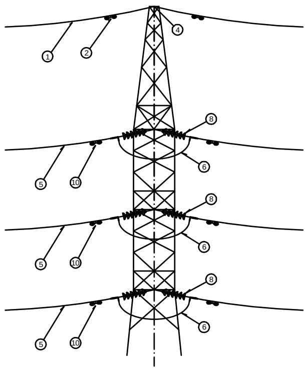
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	2 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 35°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	6 pcs
⑦		懸垂碍子装置，クランプ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置，クランプ Tension Insulator Set, Clamp	12 sets
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	6 sets
⑯		回線識別札 Circuit Plate	8 sets
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

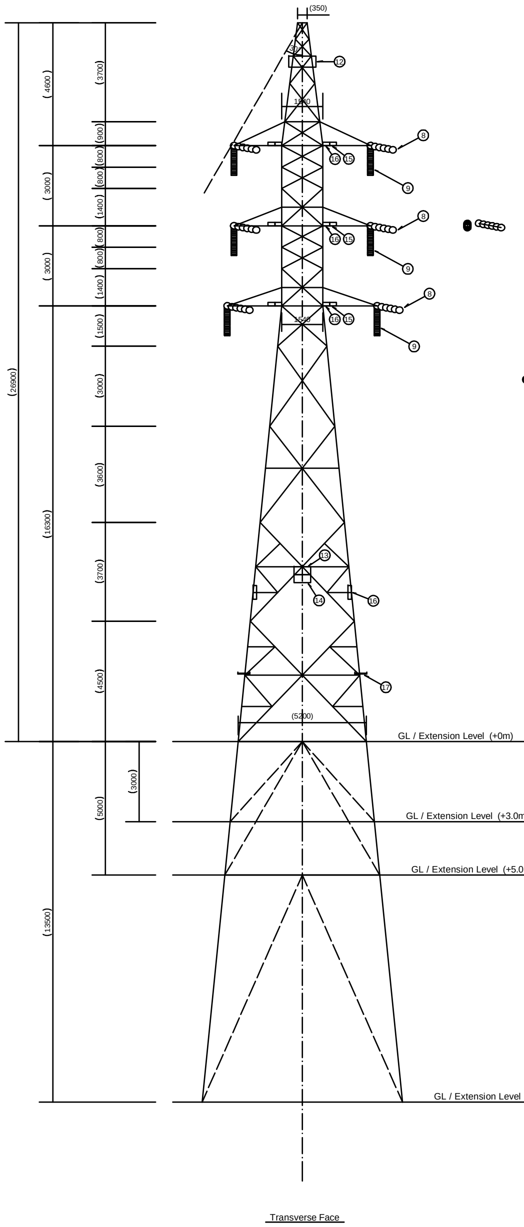
Title
Transmission Line Tower : Type B, C

DWG. No.
T-02

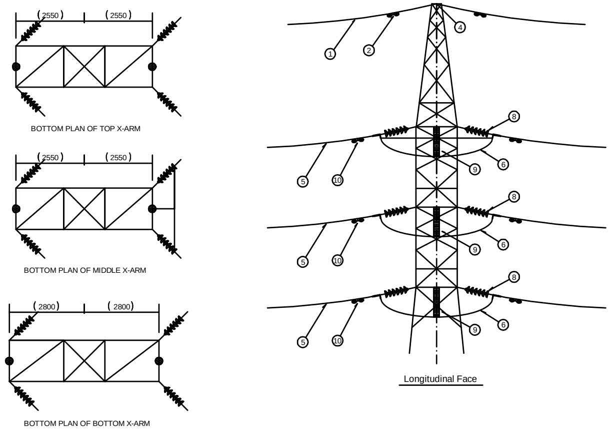
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

yec *YACHIYO ENGINEERING CO., LTD.*
TOKYO, JAPAN

Tower Type R



Transverse Face



BOTTOM PLAN OF TOP X-ARM

BOTTOM PLAN OF MIDDLE X-ARM

BOTTOM PLAN OF BOTTOM X-ARM

Longitudinal Face

General Design Condition / Criteria

Voltage	63kV
Circuit	2 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 90°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	6 pcs
⑦		懸垂碍子装置, クランプ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置, クランプ Tension Insulator Set, Clamp	12 sets
⑨		支持碍子 Jumper Support Insulator	6 sets
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	6 sets
⑯		回線識別札 Circuit Plate	8 sets
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

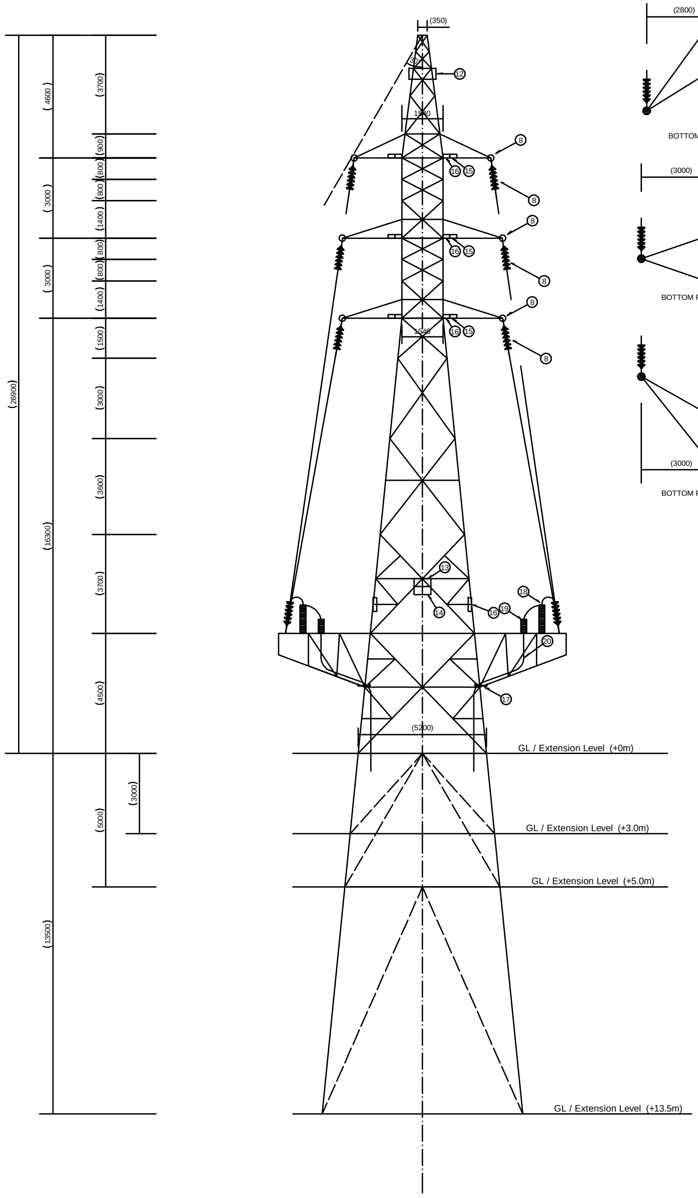
Title
Transmission Line Tower : Type R

DWG. No.
T-03

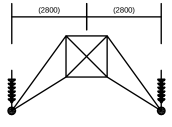
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

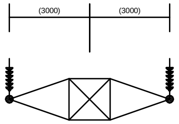
Tower Type ZZ



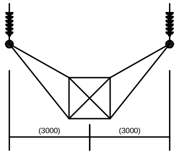
Transverse Face



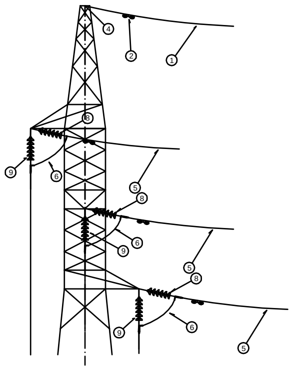
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	2 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 5°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	6 pcs
⑦		懸垂碍子装置，クランプ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置，クランプ Tension Insulator Set, Clamp	18 sets
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	6 sets
⑯		回線識別札 Circuit Plate	8 sets
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot
⑱		避雷器 Lightning Arrester with Terminal	6 sets
⑲		ケーブル接続ヘッド Cable Head with Terminal	6 sets
⑳		地中線ケーブル Underground Cable	-

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

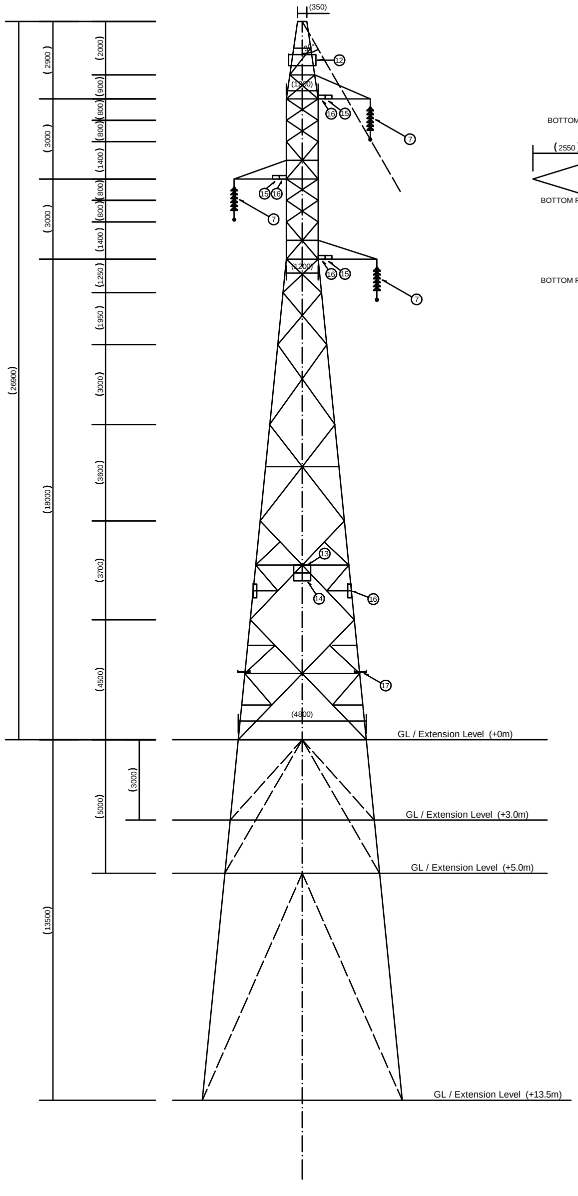
Title
Transmission Line Tower : Type ZZ
(with Arresters and Cableheads)

DWG. No.
T-04

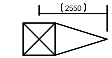
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

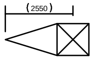
Tower Type A
(Single Circuit)



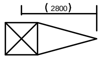
Transverse Face



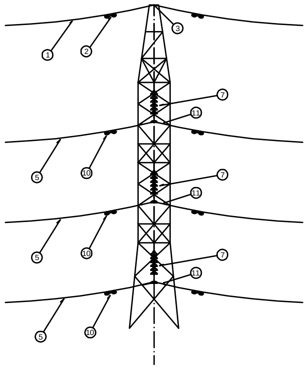
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria

Voltage	63kV
Circuit	1 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 5°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ﾌｧｲﾊﾞ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ﾌｧｲﾊﾞ複合架空地線振動抑制ﾀﾞﾝﾊﾟ装置 Damper for OPGW	1 lot
③		光ﾌｧｲﾊﾞ複合架空地線用懸垂保持装置 Suspension Set for OPGW	1 set
④		光ﾌｧｲﾊﾞ複合架空地線用耐張引留装置 Tension Set for OPGW	0 set
⑤		電力線（全ｱﾙﾐ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ｼﾞｬﾝﾊﾟｰ線 Jumper	0 pcs
⑦		懸垂碍子装置，ｸﾗﾝﾌﾟ Suspension Insulator Set, Clamp	3 sets
⑧		耐張碍子装置，ｸﾗﾝﾌﾟ Tension Insulator Set, Clamp	0 set
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ﾀﾞﾝﾊﾟ装置 Damper for Conductor	1 lot
⑪		ｱｰﾏｰﾛｯﾄﾞ Armor Rod	3 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	3 sets
⑯		回線識別札 Circuit Plate	0 set
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

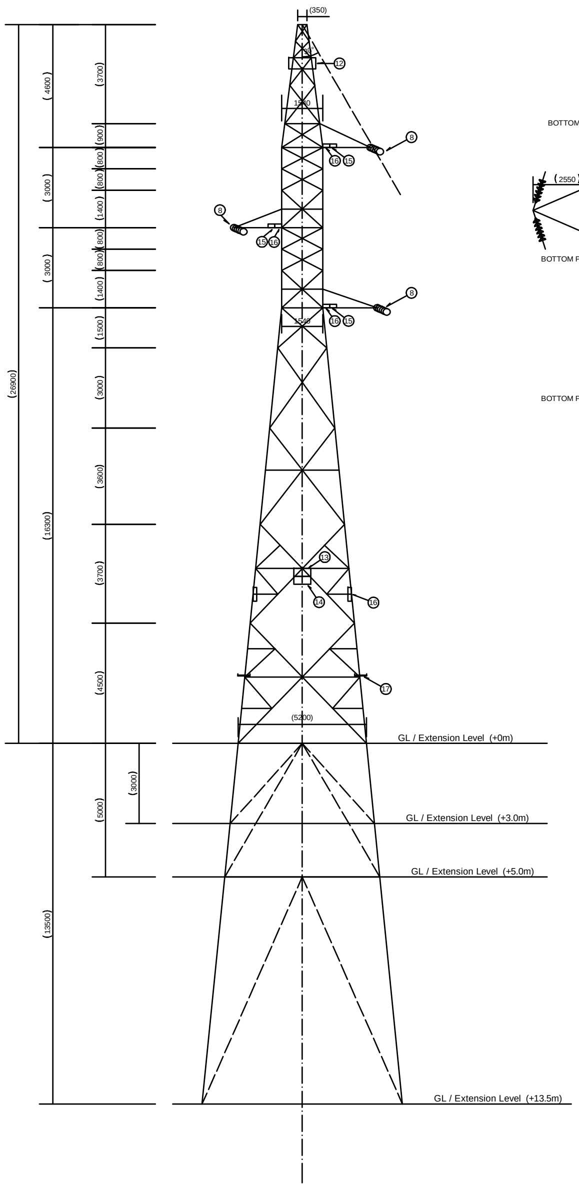
Title
Transmission Line Tower : Type A
(Single circuit)

DWG. No.
T-05

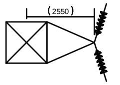
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

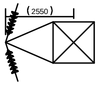
Tower Type B, C
(Single Circuit)



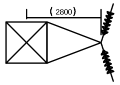
Transverse Face



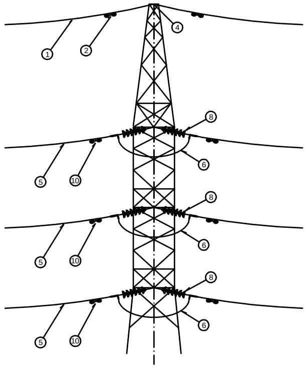
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	1 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 35°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	3 pcs
⑦		懸垂碍子装置，クランプ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置，クランプ Tension Insulator Set, Clamp	6 sets
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	3 sets
⑯		回線識別札 Circuit Plate	0 set
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

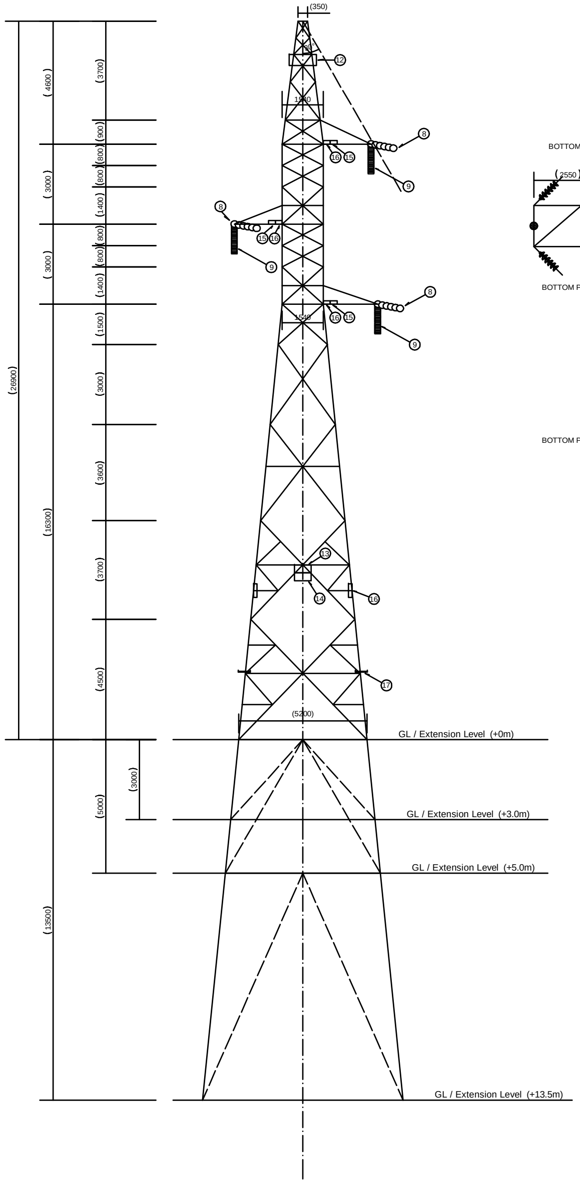
Title
Transmission Line Tower : Type B, C
(Single circuit)

DWG. No.
T-06

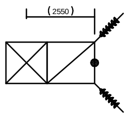
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

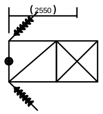
Tower Type R
(Single Circuit)



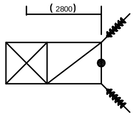
Transverse Face



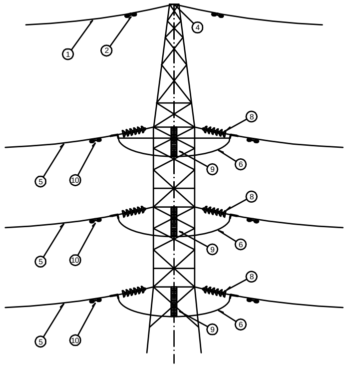
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	1 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 90°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ファイバ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ファイバ複合架空地線振動抑制ダンパ装置 Damper for OPGW	1 lot
③		光ファイバ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ファイバ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全アルミ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ジャンパー線 Jumper	3 pcs
⑦		懸垂碍子装置, クランプ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置, クランプ Tension Insulator Set, Clamp	6 sets
⑨		支持碍子 Jumper Support Insulator	3 sets
⑩		電力線振動抑制ダンパ装置 Damper for Conductor	1 lot
⑪		アーマーロッド Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	3 sets
⑯		回線識別札 Circuit Plate	0 set
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:200

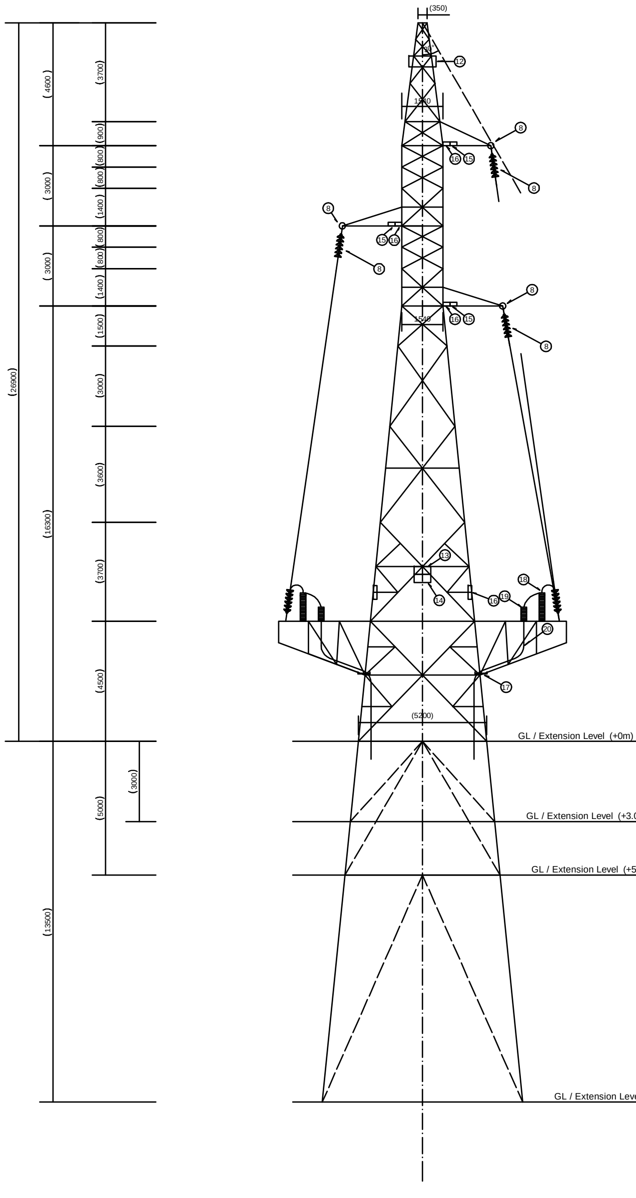
Title
Transmission Line Tower : Type R
(Single circuit)

DWG. No.
T-07

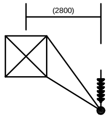
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

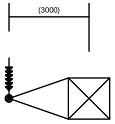
Tower Type ZZ
(Single Circuit)



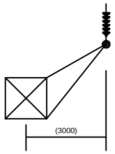
Transverse Face



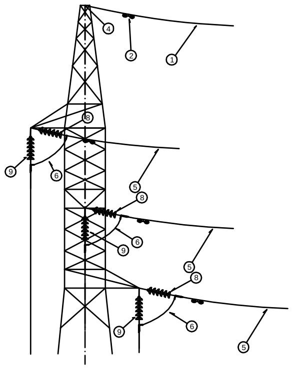
BOTTOM PLAN OF TOP X-ARM



BOTTOM PLAN OF MIDDLE X-ARM



BOTTOM PLAN OF BOTTOM X-ARM



Longitudinal Face

General Design Condition / Criteria	
Voltage	63kV
Circuit	2 cct.
Standard Ruling Span	350m
Horizontal Angle	0° - 5°
Vertical Angle	Σtanα = ±0.1
Wind Load	241kg/sq.m
Insulator	
Type	Ball Socket 250 / Fog
Number	6pcs / set
Weight	Approx. 100kg / set
Wind Load	102kg/sq.m
Conductor	
Type	ASTER366
Unit Weight	1.050kg/m
Overall Diameter	24.85mm
Max. Working Tension	46.0kN
Wind Load	68kg/sq.m
Grounding Wire	
Type	OPGW100 or equivalent
Number of Fibers	48 optical fibers
Unit Weight	0.555kg/m
Overall Diameter	14.50mm
Max. Working Tension	29.8kN
Wind Load	74kg/sq.m
Reference	
Seismic Load	0.15G
Horizintal Seismic Coef.	0.15G

No.	Equipment	Description	Q'ty
①		架空地線(光ﾌｧｲﾊﾞ複合架空地線) Grounding Wire (OPGW)	1 lot
②		光ﾌｧｲﾊﾞ複合架空地線振動抑制ﾀﾞﾝﾊﾟ装置 Damper for OPGW	1 lot
③		光ﾌｧｲﾊﾞ複合架空地線用懸垂保持装置 Suspension Set for OPGW	0 set
④		光ﾌｧｲﾊﾞ複合架空地線用耐張引留装置 Tension Set for OPGW	1 set
⑤		電力線（全ｱﾙﾐ合金より線） Conductor（AAAC ASTER)	1 lot
⑥		ｼﾞｬﾝﾊﾟｰ線 Jumper	3 pcs
⑦		懸垂碍子装置，ｸﾗﾝﾌﾟ Suspension Insulator Set, Clamp	0 set
⑧		耐張碍子装置，ｸﾗﾝﾌﾟ Tension Insulator Set, Clamp	9 sets
⑨		支持碍子 Jumper Support Insulator	0 set
⑩		電力線振動抑制ﾀﾞﾝﾊﾟ装置 Damper for Conductor	1 lot
⑪		ｱｰﾏｰﾛｯﾄﾞ Armor Rod	0 set
⑫		航空識別用支持物番号札 Aerial Plate	1 set
⑬		支持物番号札 Number Plate	1 set
⑭		危険警告札 Danger Plate	1 set
⑮		相表示札 Phase Plate	3 sets
⑯		回線識別札 Circuit Plate	0 set
⑰		昇塔防止装置 Anti-Climbing Guard	1 lot
⑱		避雷器 Lightning Arrester with Terminal	3 sets
⑲		ｹｰﾌﾞﾙ接続ﾍｯﾄﾞ Cable Head with Terminal	3 sets
⑳		地中線ｹｰﾌﾞﾙ Underground Cable	-

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

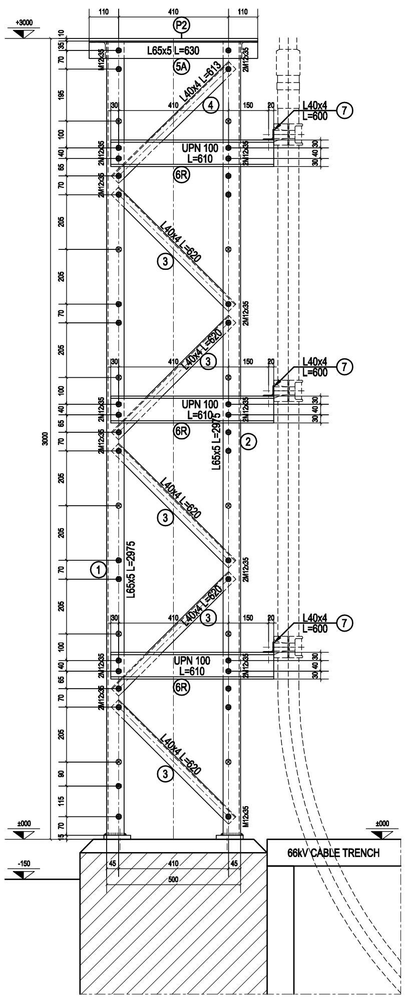
SCALE
1:200

Title
Transmission Line Tower : Type ZZ
(with Arresters and Cable heads)
(Single circuit)

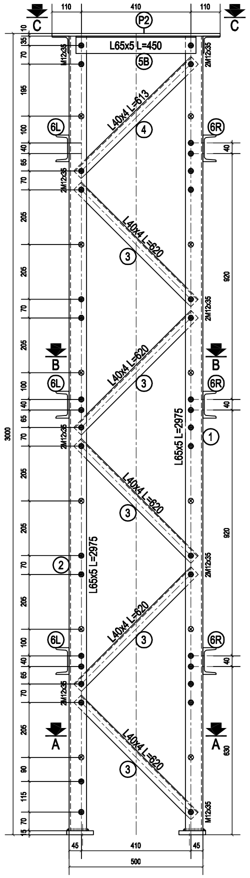
DWG. No.
T-08

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

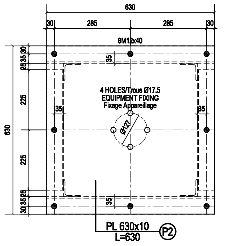


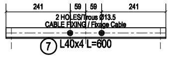
FRONT VIEW / vue frontale



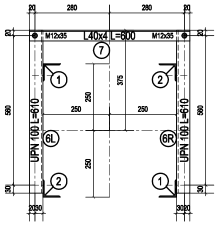
LATERAL VIEW / vue latérale

SECTION / coupe C-C

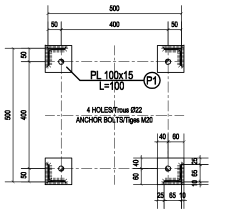


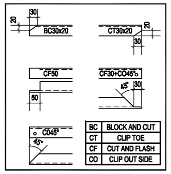


SECTION / coupe B-B



SECTION / coupe A-A

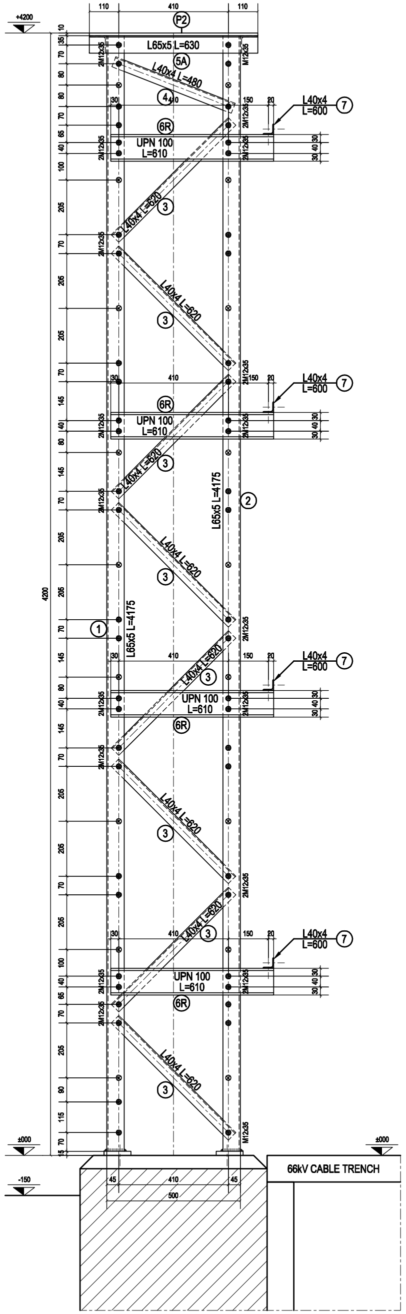




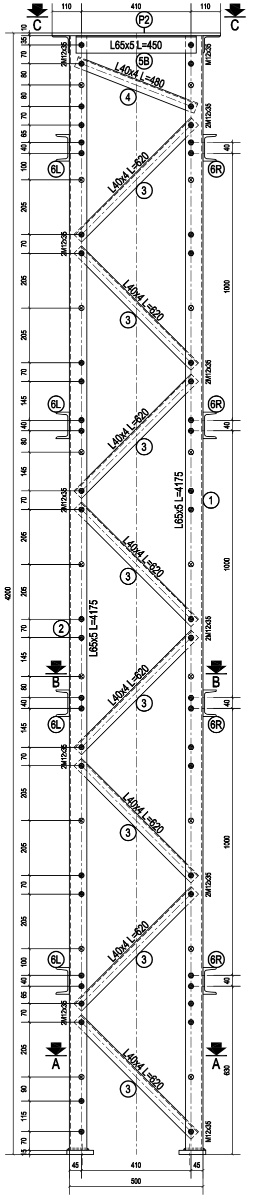
THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI	**SCALE** 1:20
Title STEEL STRUCTURE 66kV CABLE SEALING END (LINE BAY) TYPE A	**DWG. No.** P-01

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

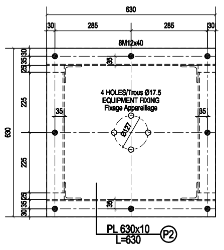


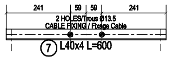
FRONT VIEW / vue frontale



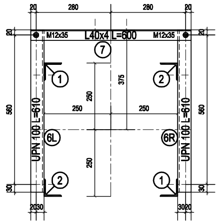
LATERAL VIEW / vue latérale

SECTION / coupe C-C

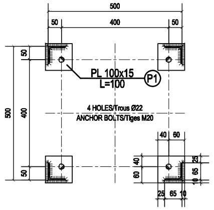


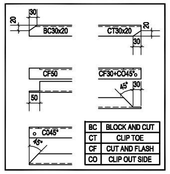


SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:20

Title
STEEL STRUCTURE
66kV CABLE SEALING END (TRANSFORMER BAY)
TYPE B

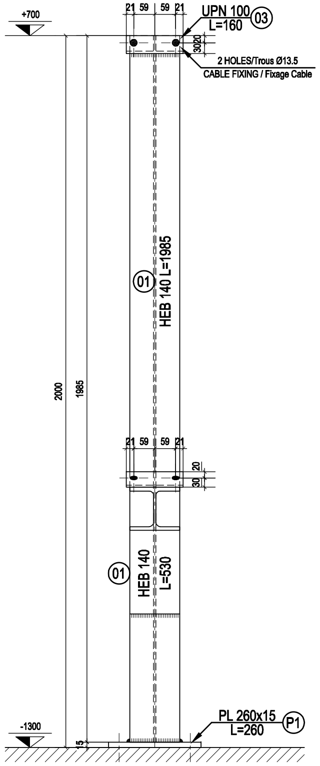
DWG. No.
P-02

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

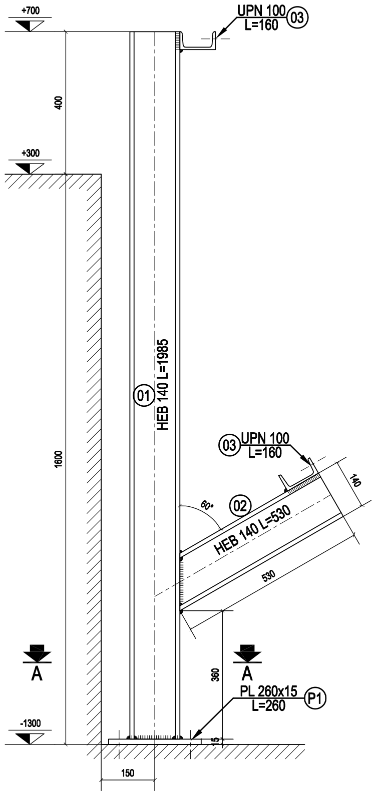
YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

boite de extemitè
CABLE SEALING END

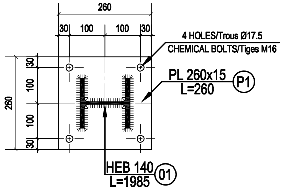
FRONT VIEW / vue frontale



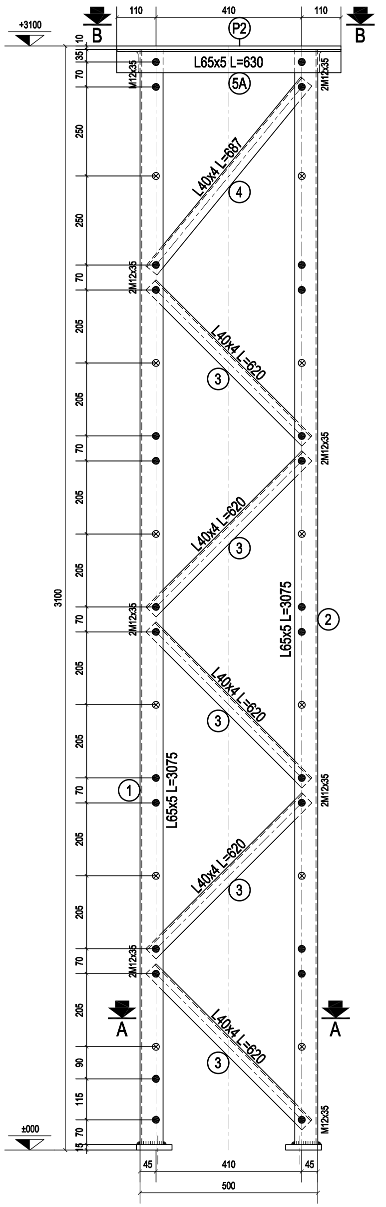
LATERAL VIEW / vue latérale



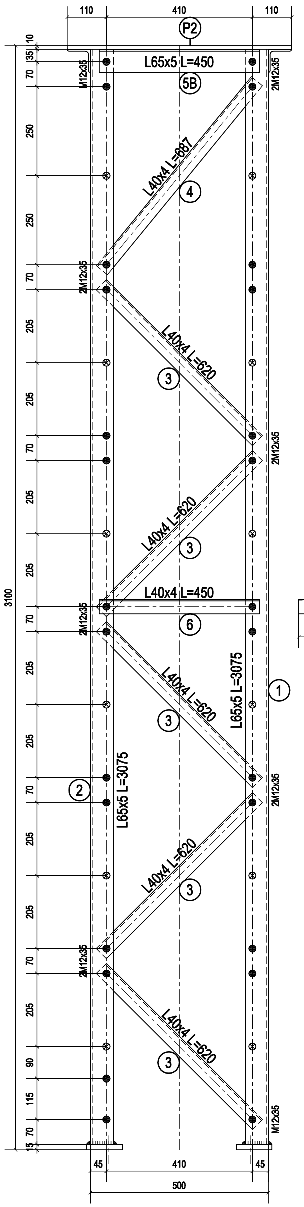
SECTION / coupe A-A



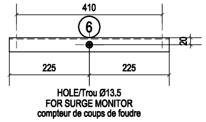
THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI				SCALE 1:15
Title STEEL STRUCTURE 66kV CABLE SEALING END (INDOOR) TYPE C				DWG. No. P-03
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	
yec YACHIYO ENGINEERING CO., LTD. TOKYO, JAPAN				



LATERAL VIEW / vue latérale

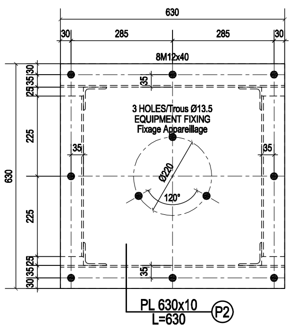


FRONT VIEW / vue frontale

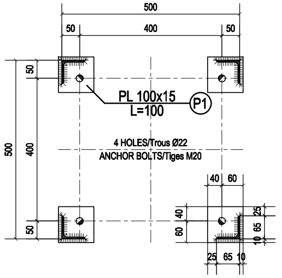


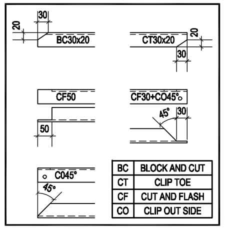
HOLE/Trou Ø13.5
FOR SURGE MONITOR
compteur de coups de foudre

SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:15

Title
STEEL STRUCTURE
66kV SURGE ARRESTER (LINE BAY)
TYPE D

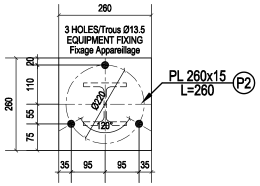
DWG. No.
P-04

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

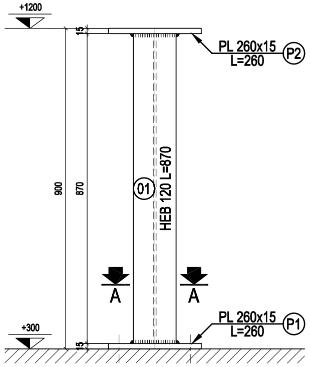
YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

parafoudre niveau +300
SURGE ARRESTER AT +300

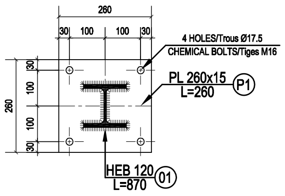
TOP VIEW / vue en plan



FRONT VIEW / vue frontale



SECTION / coupe A-A



THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

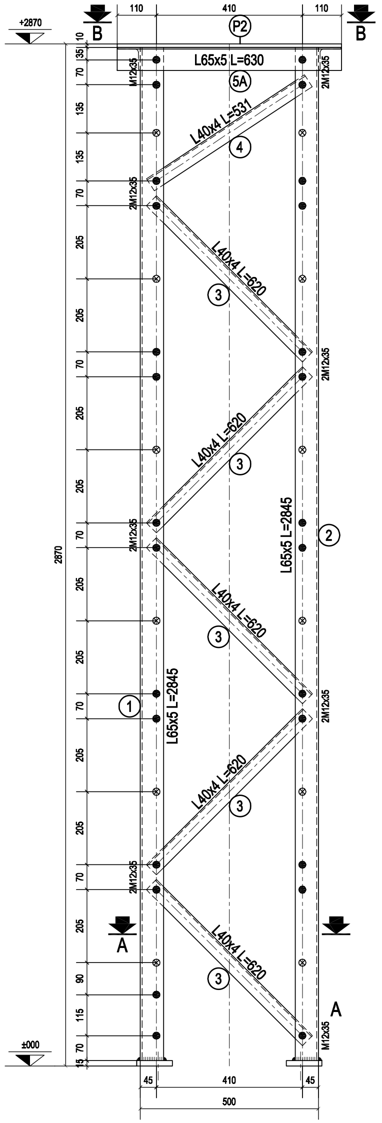
SCALE
1:15

Title
STEEL STRUCTURE
66kV SURGE ARRESTER AT+300 (INDOOR)
TYPE E

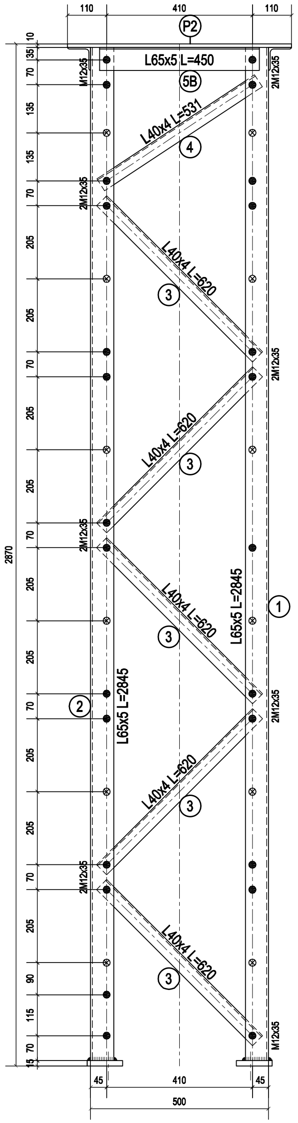
DWG. No.
P-05

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

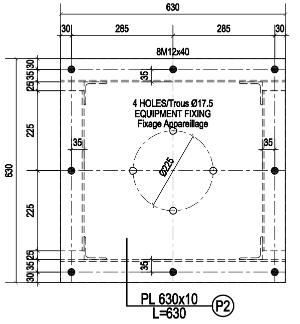


FRONT VIEW / vue frontale

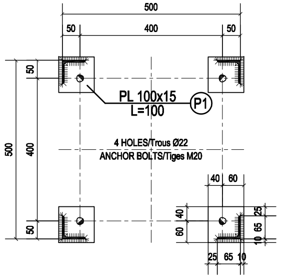


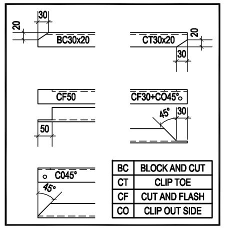
LATERAL VIEW / vue latérale

SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:15

Title
STEEL STRUCTURE
230kV POST INSULATOR
TYPE F

DWG. No.
P-06

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

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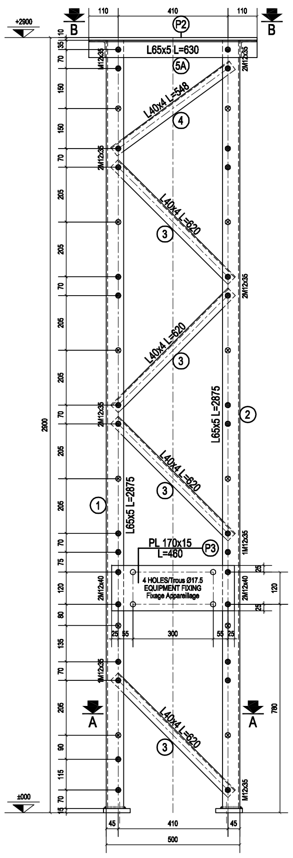
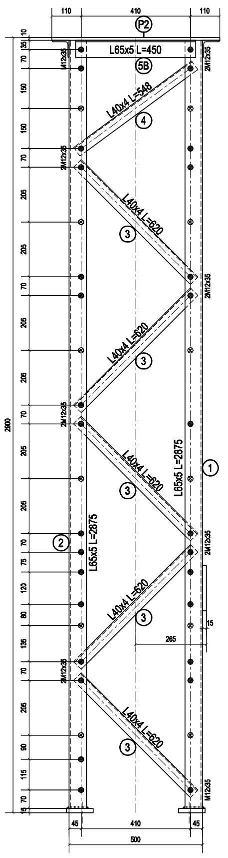
TOKYO, JAPAN

CENTRAL POLE / pôle central

LATERAL POLES / pôles laterals

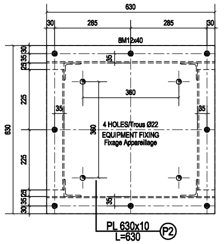


FRONT VIEW / vue frontale

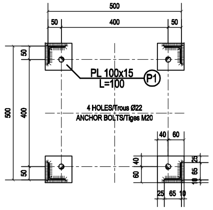


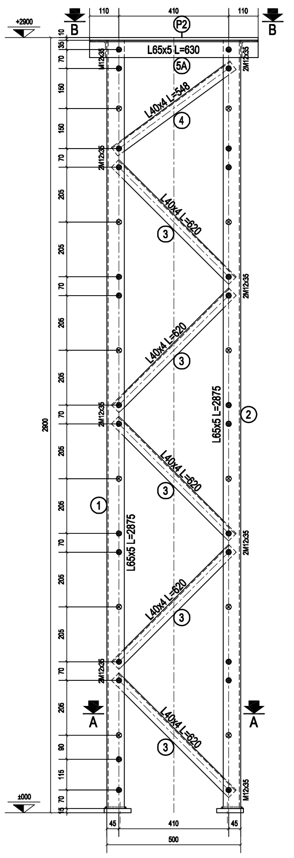
LATERAL VIEW / vue latérale

SECTION / coupe B-B

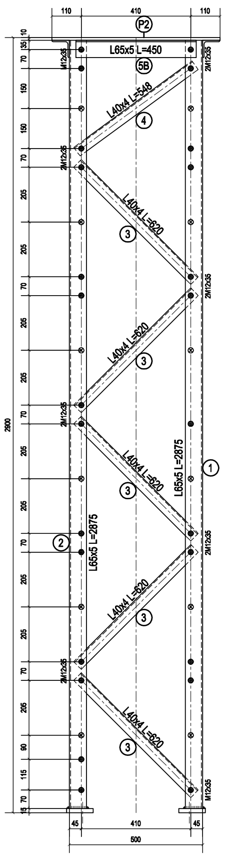


SECTION / coupe A-A





FRONT VIEW / vue frontale



LATERAL VIEW / vue latérale

THE PROJECT FOR IMPROVEMENT OF POWER SUPPLY IN THE REPUBLIC OF DJIBOUTI				SCALE 1:20
Title STEEL STRUCTURE 230kV DISCONNECTOR TYPE G				DWG. No. P-07
DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

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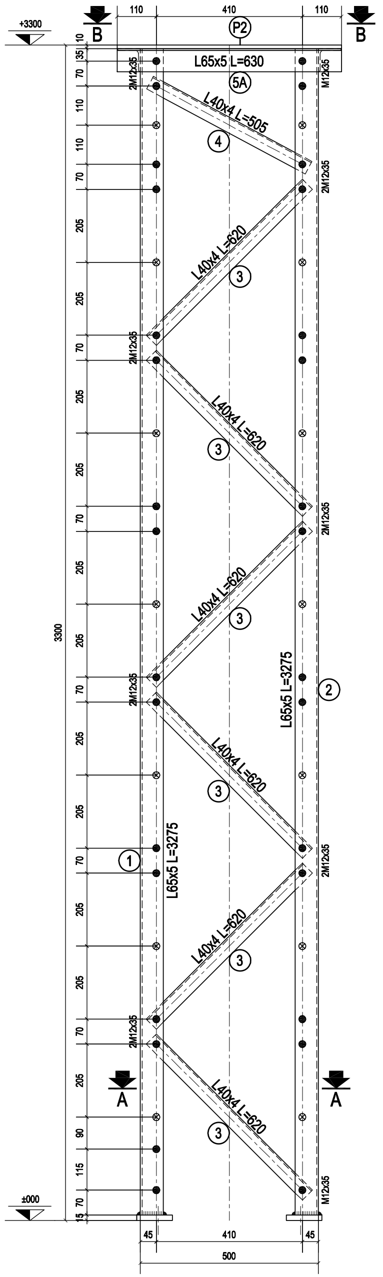
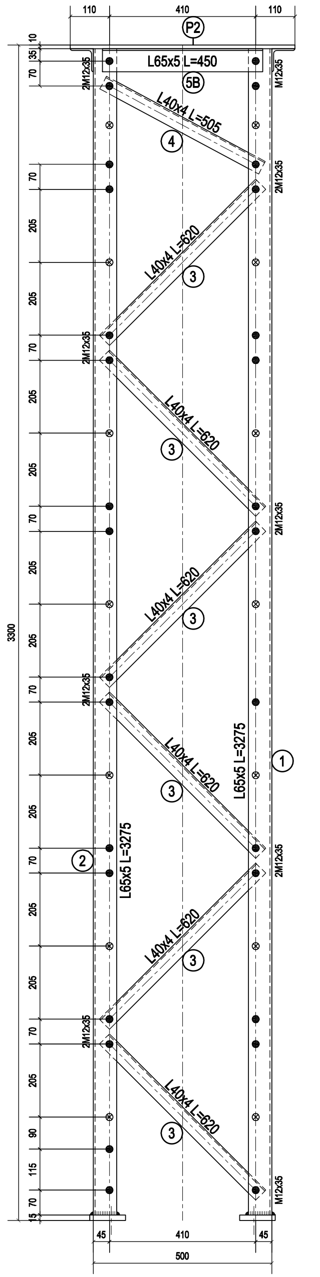
TOKYO, JAPAN

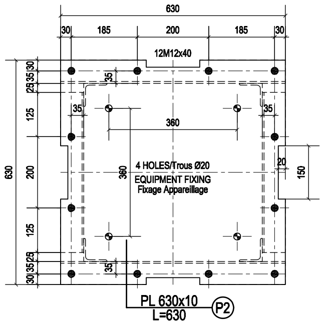


FRONT VIEW / vue frontale

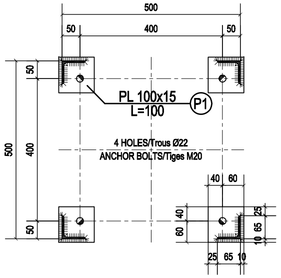


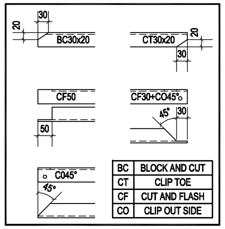
LATERAL VIEW / vue latérale

SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE
1:15

Title
STEEL STRUCTURE
230kV CURRENT TRANSFORMER
TYPE H

DWG. No.
P-08

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

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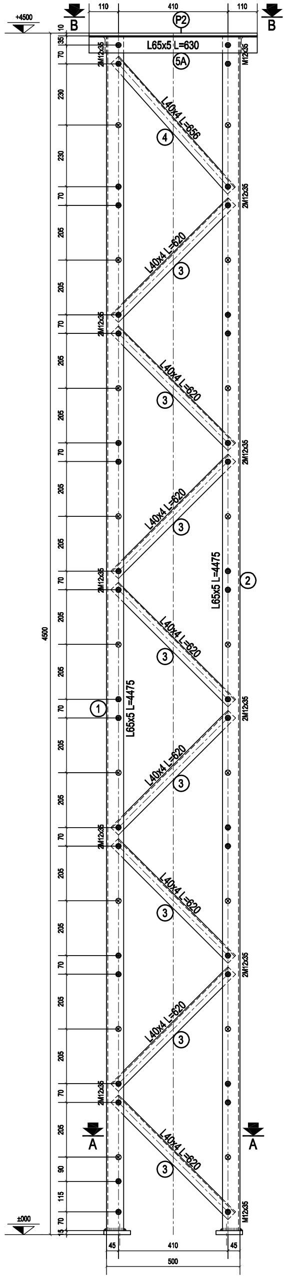
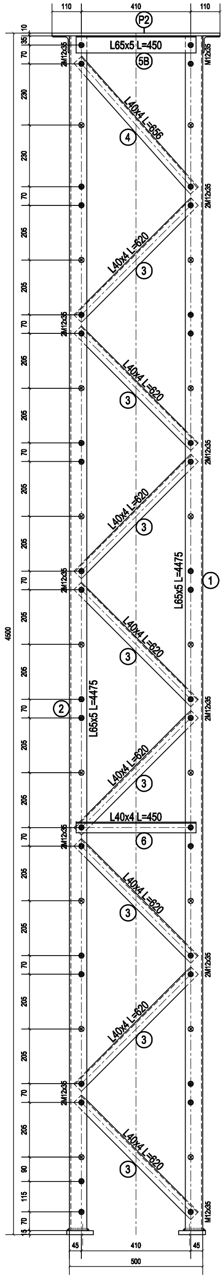
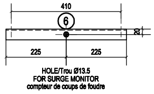
TOKYO, JAPAN



FRONT VIEW / vue frontale

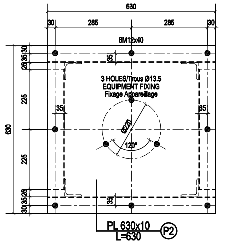


LATERAL VIEW / vue latérale

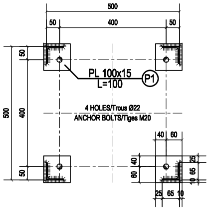


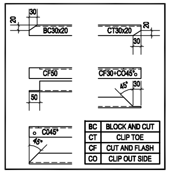
HOLE/Trou Ø13.5
FOR SURGE MONITOR
compteur de coups de foudre

SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

REFERENCE DRAWING - List des dessins	
Description	N.
GENERAL LAYOUT OF CIVIL WORKS Plan Génie Civil	00700-K-C001
SETTING TEMPLATE AND ANCHOR BOLTS Tiges d'ancrages	00700-K-M034

NOTES

1) - ALL DIMENSIONS ARE IN CENTIMETERS, EXCEPT WHERE INDICATED
Toutes les mesures sont en centimètres sauf ou indiqué
2) - ANCHOR BOLTS, PLATES AND SHAPE S 275 JR (Eurocode 3)
Tiges d'ancrages, plates et profils S 275 JR (Eurocode 3)
3) - SCREWS 6.8 - NUTS 6
Vis 6.8 - Écrous 6
4) - DOUBLE HOT-DIP GALVANIZING SHAPES AND PLATES
Plats et profils: double galvanisation à chaude
5) - MINIMUM BEAD WELD THICKNESS = 0.7 SMALLEST THICKNESS TO JOINT
Soudures avec côté du cordon égal a le 0.7 de l'épaisseur minimal a joindre
6) - ALL STEEL ANGLES ARE DRILLED IN THE MIDDLE OF THE FLANGE EXCEPT WHERE INDICATED
Axe de trusquinage des cornières égal a la moitié des ailes sauf ou indiqué
7) - ⊗ HOLES / trous Ø22 - Bolts / boulons M20
⊕ HOLES / trous Ø17.5 - Bolts / boulons M16 - EDGE DIST. / pince 25mm
● HOLES / trous Ø13.5 - Bolts / boulons M12 - EDGE DIST. / pince 20mm
⊗ HOLES / trous Ø10

FOR/pour CONSTRUCTION

SHAPE/profil						N	LENGHT Long.	WIDTH Larg.	TH. Ep.	UNIT WEIGHT Masse	TOTAL
Dimensions	Pos.	Type		Mat.	UNI						
L65x5	1	Equal Angles	Ailes égales	S275JR	EN 10056	2	4475			4,97	44,5
L65x5	2	Equal Angles	Ailes égales	S275JR	EN 10056	2	4475			4,97	44,5
L40x4	3	Equal Angles	Ailes égales	S275JR	EN 10056	32	620			2,42	48,0
L40x4	4	Equal Angles	Ailes égales	S275JR	EN 10056	4	656			2,42	6,4
L65x5	5A	Equal Angles	Ailes égales	S275JR	EN 10056	2	630			4,97	6,3
L65x5	5B	Equal Angles	Ailes égales	S275JR	EN 10056	2	450			4,97	4,5
L40x4	6	Equal Angles	Ailes égales	S275JR	EN 10056	1	450			2,42	1,1
PLATE	P1	Plate	Plat	S275JR	EN 10025	4	100	100	15	7850	4,7
PLATE	P2	Plate	Plat	S275JR	EN 10025	1	630	630	10	7850	31,2
M12x140		Equip. Fix.	Total Thread			3				0,13	0,4
M12x40		Screws	Vis	6.8	EN ISO 4016	8				0,06	0,4
M12x35		Screws	Vis	6.8	EN ISO 4016	81				0,05	4,2
M12		Nuts	Écrous	6	5592	92				0,02	2,
R13		Washers	Rondelle	-	EN ISO 7089	184				0,01	1,2
LN M12		Lock Nuts	[illegible]	-	-	92				-	0,0
TOTAL											199,6
TOTAL with HOT-DIP GALVANIZING / Total avec Galvanization à chaude (~6%)											211,6

TOTAL SUPPORTS = 6
MARK: K-SA1

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

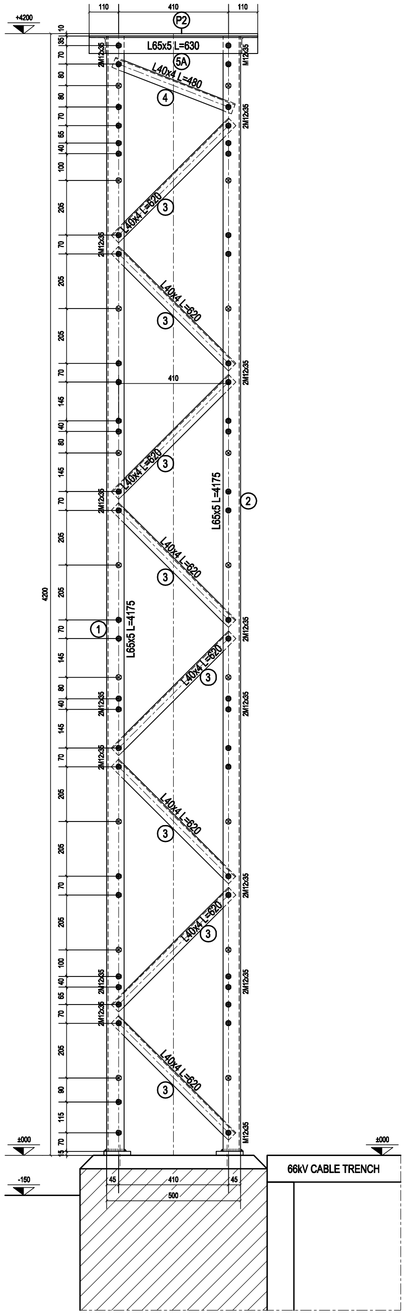
SCALE
1:20

Title
STEEL STRUCTURE
230kV SURGE ARRESTER
TYPE I

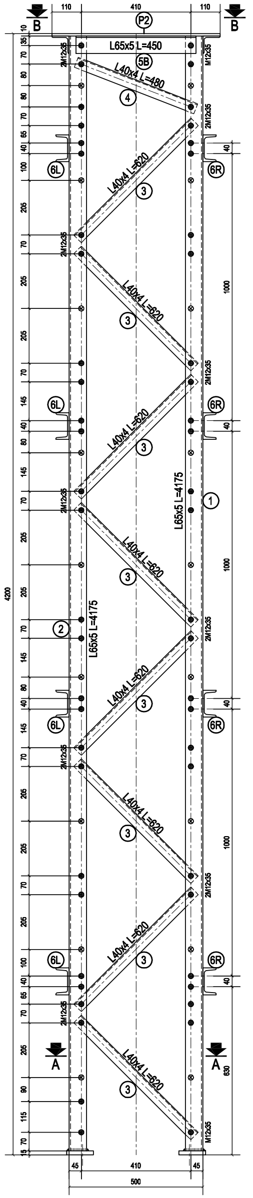
DWG. No.
P-09

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

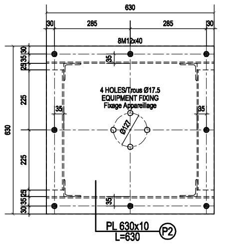


FRONT VIEW / vue frontale

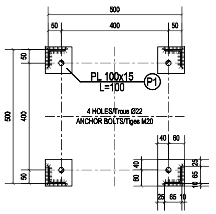


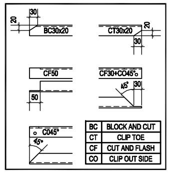
LATERAL VIEW / vue latérale

SECTION / coupe B-B



SECTION / coupe A-A





BC	BLOCK AND CUT
CT	CLIP TOE
CF	CUT AND FLASH
CO	CLIP OUT SIDE

THE PROJECT FOR
IMPROVEMENT OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

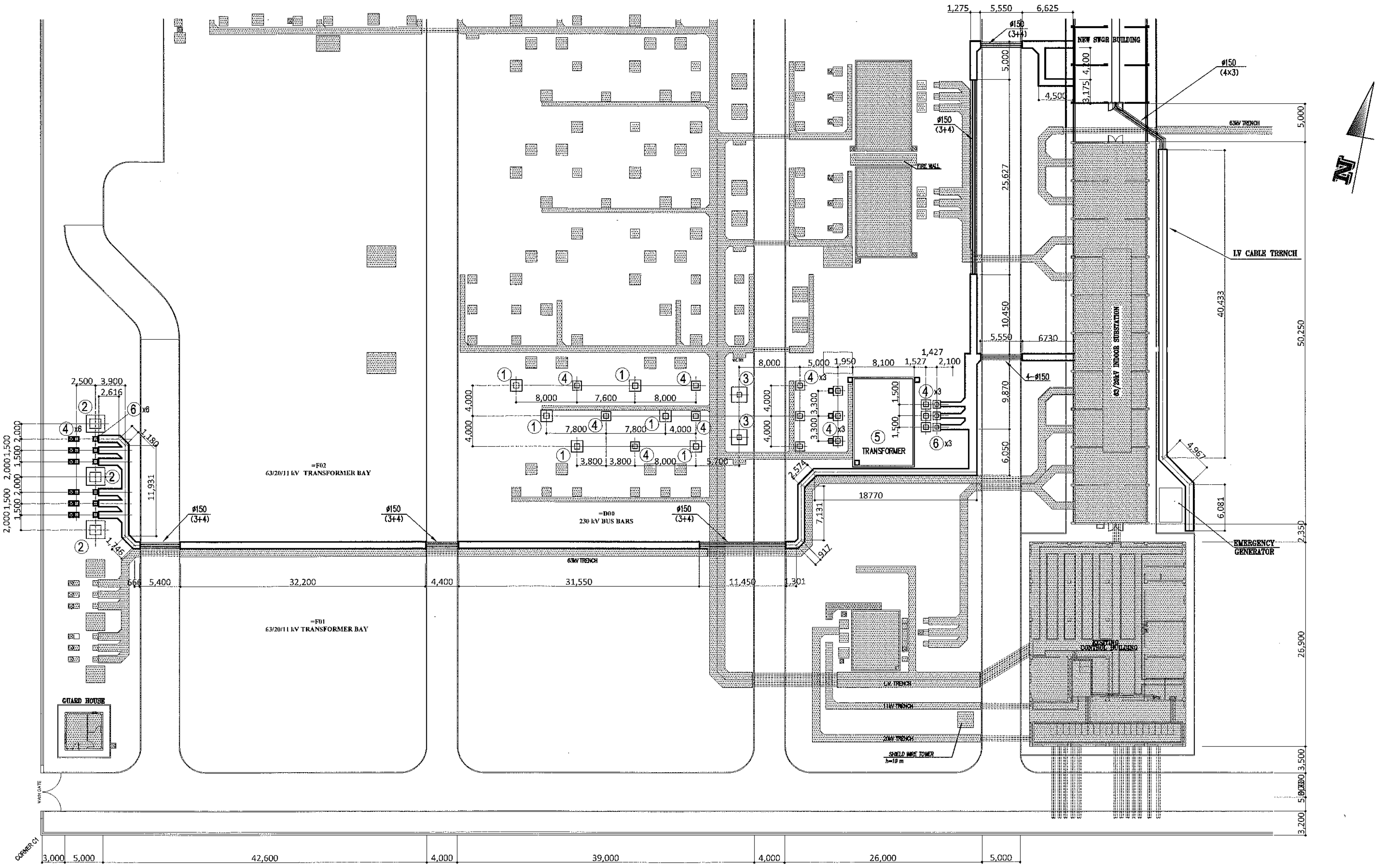
SCALE
1:20

Title
STEEL STRUCTURE
66kV ARRESTER (TRANSFORMER BAY)
TYPE J

DWG. No.
P-10

DATE	DESIGNED	CHECKED	APPROVED	REVISION
	*******	*******	*******	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN



NOTES

▨ EXISTING EQUIPMEN FOUNDATION OR BUILDING OR CABLE TRENCH

THE PROJECT FOR IMPROVEMENT
OF POWER SUPPLY
IN THE REPUBLIC OF DJIBOUTI

SCALE

1:500

Title

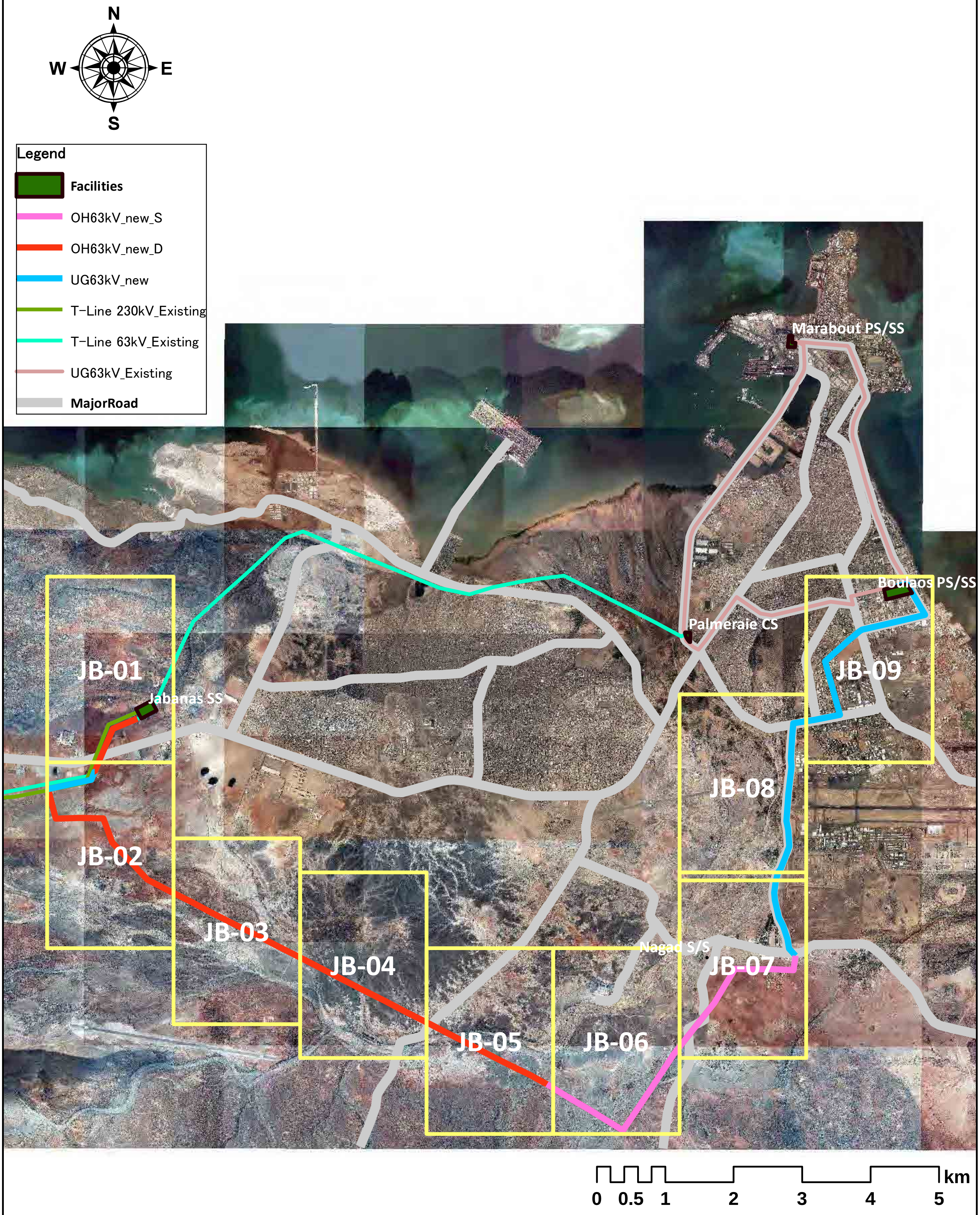
JABAN'AS SUBSTATION SWGR BUILDING
CABLE TRENCH AND
EQUIPMENT FOUNDATION PLAN

DWG. No.

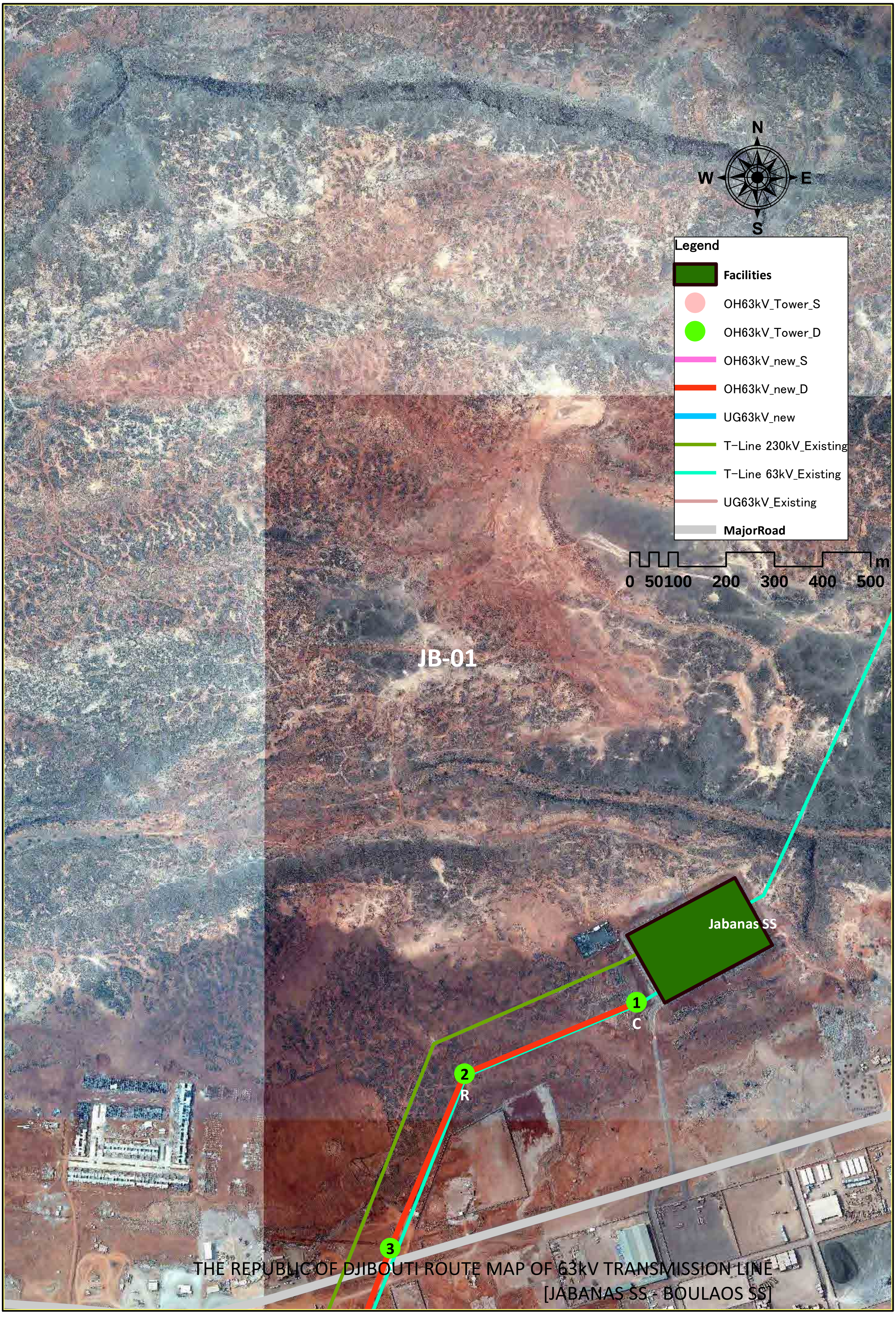
DATE	DESIGNED	CHECKED	APPROVED	REVISION

YACHIYO ENGINEERING CO., LTD.

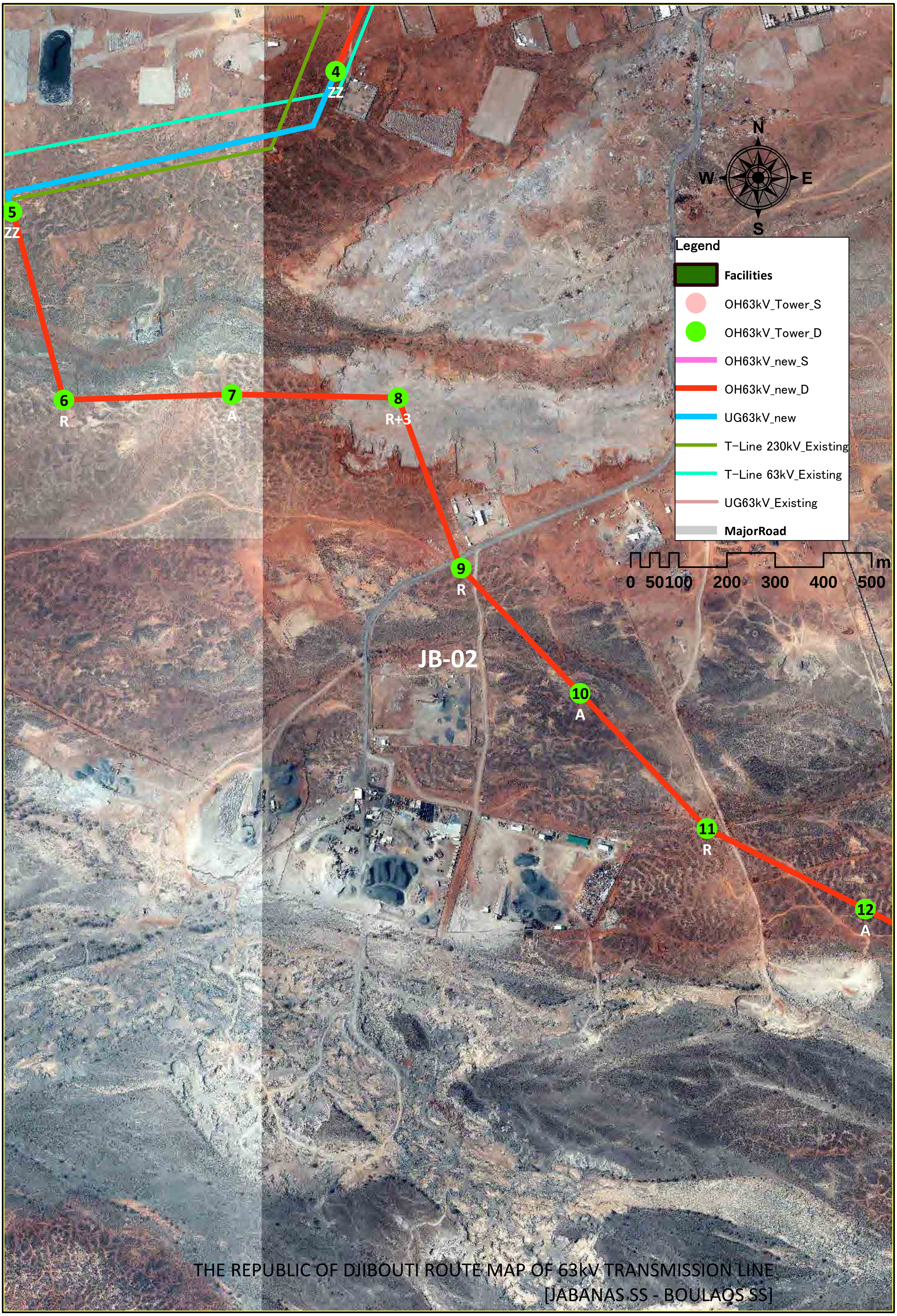
A-9 Transmission Line Route



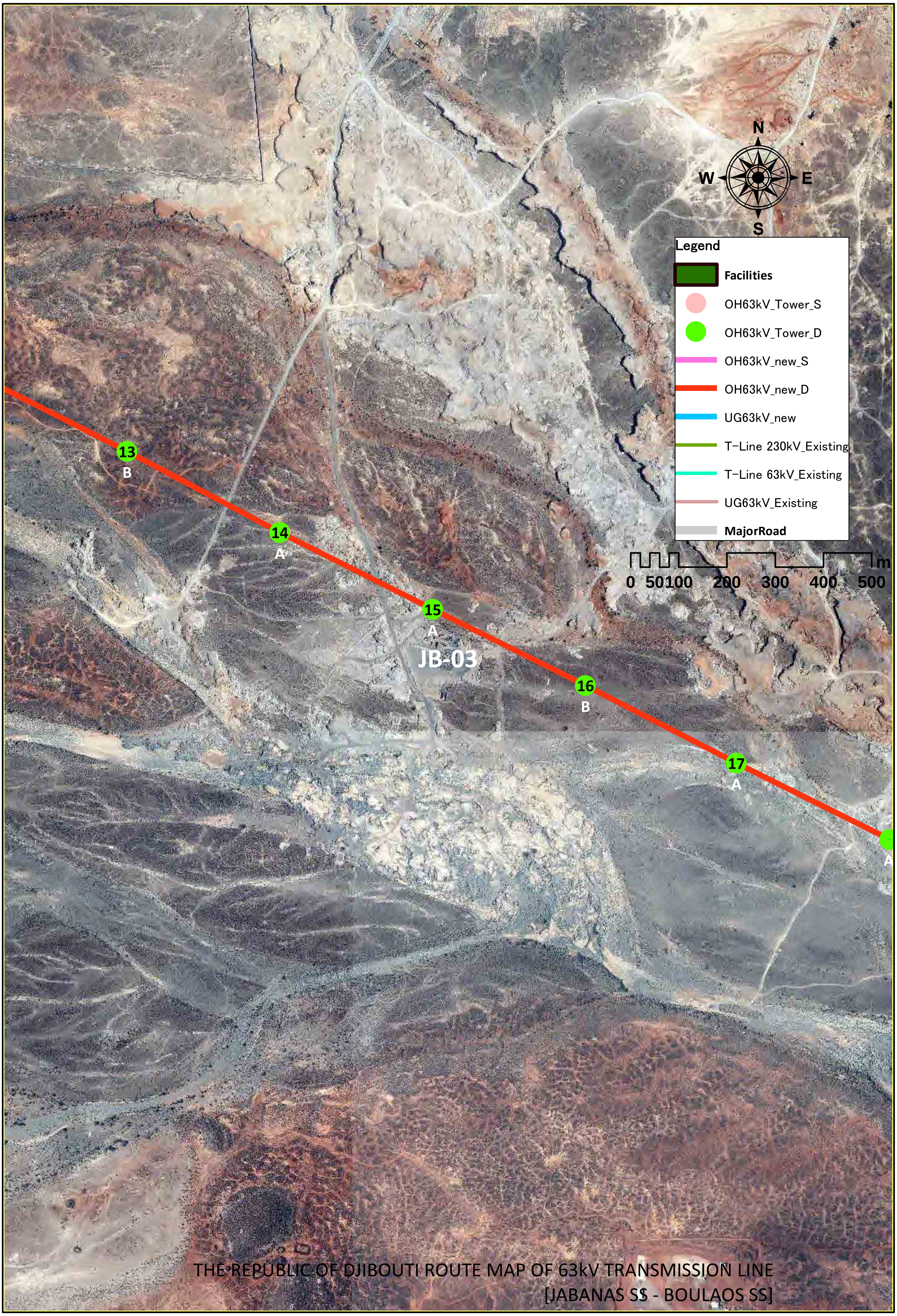
THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]



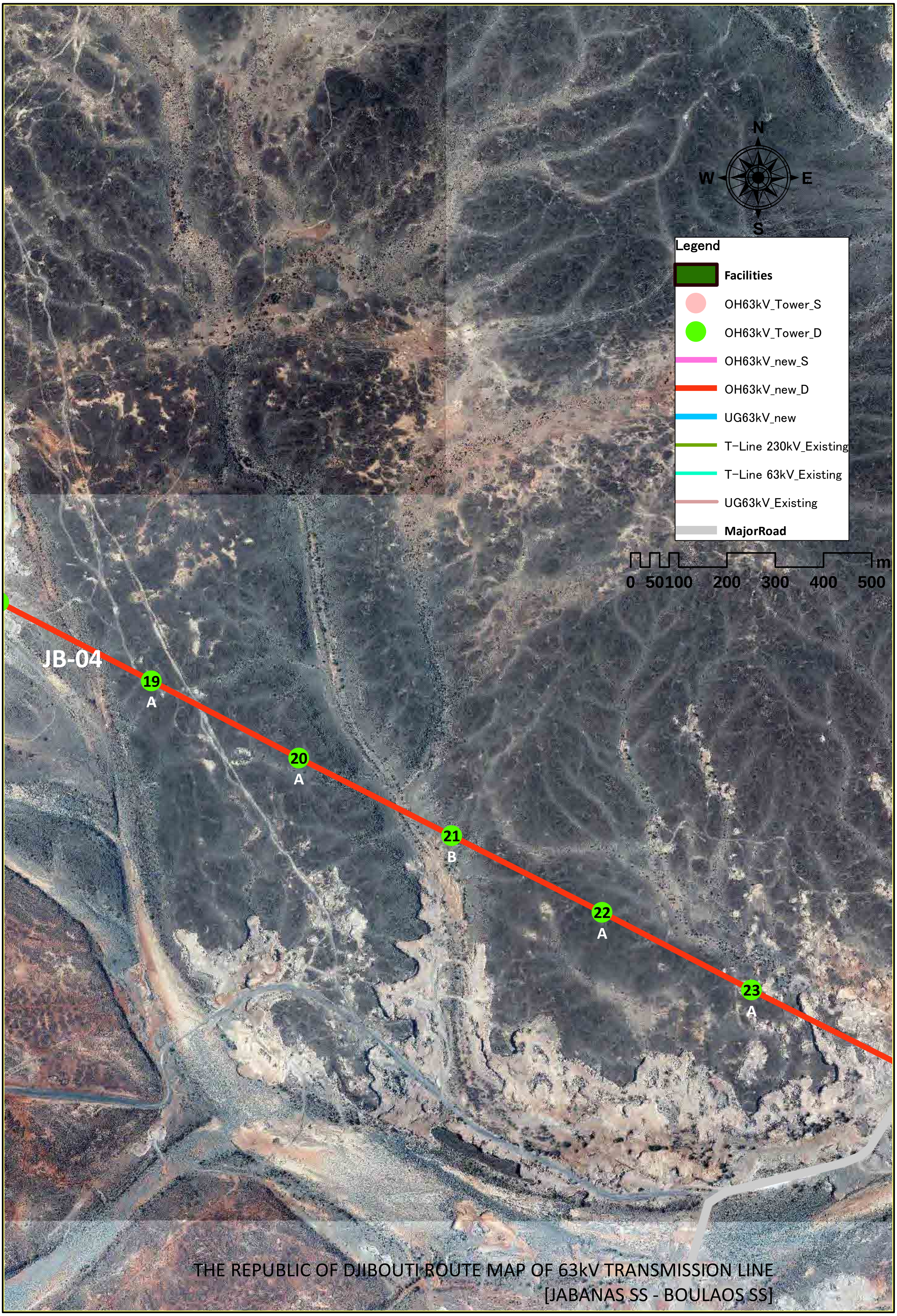
THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]



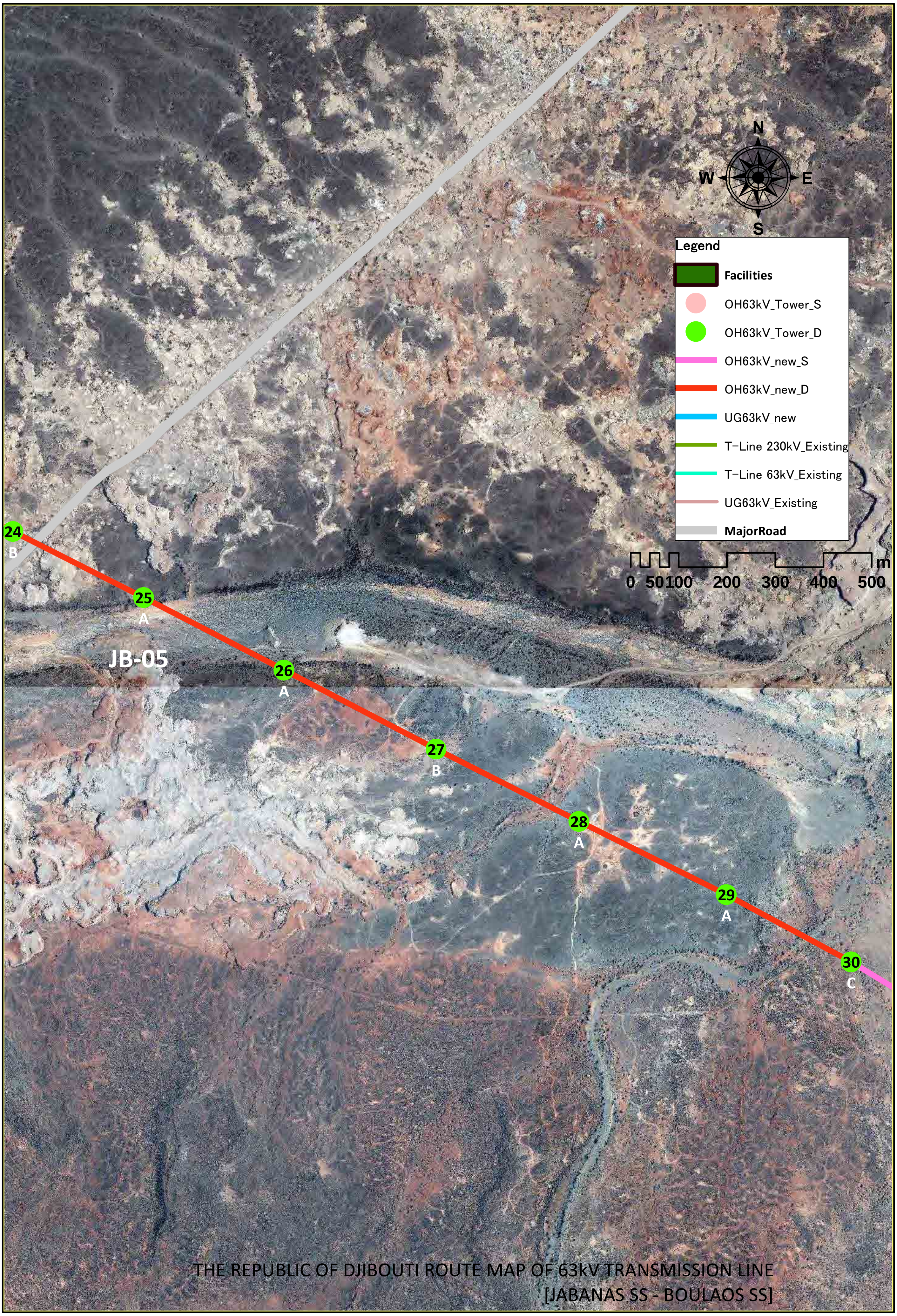
THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]



THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]

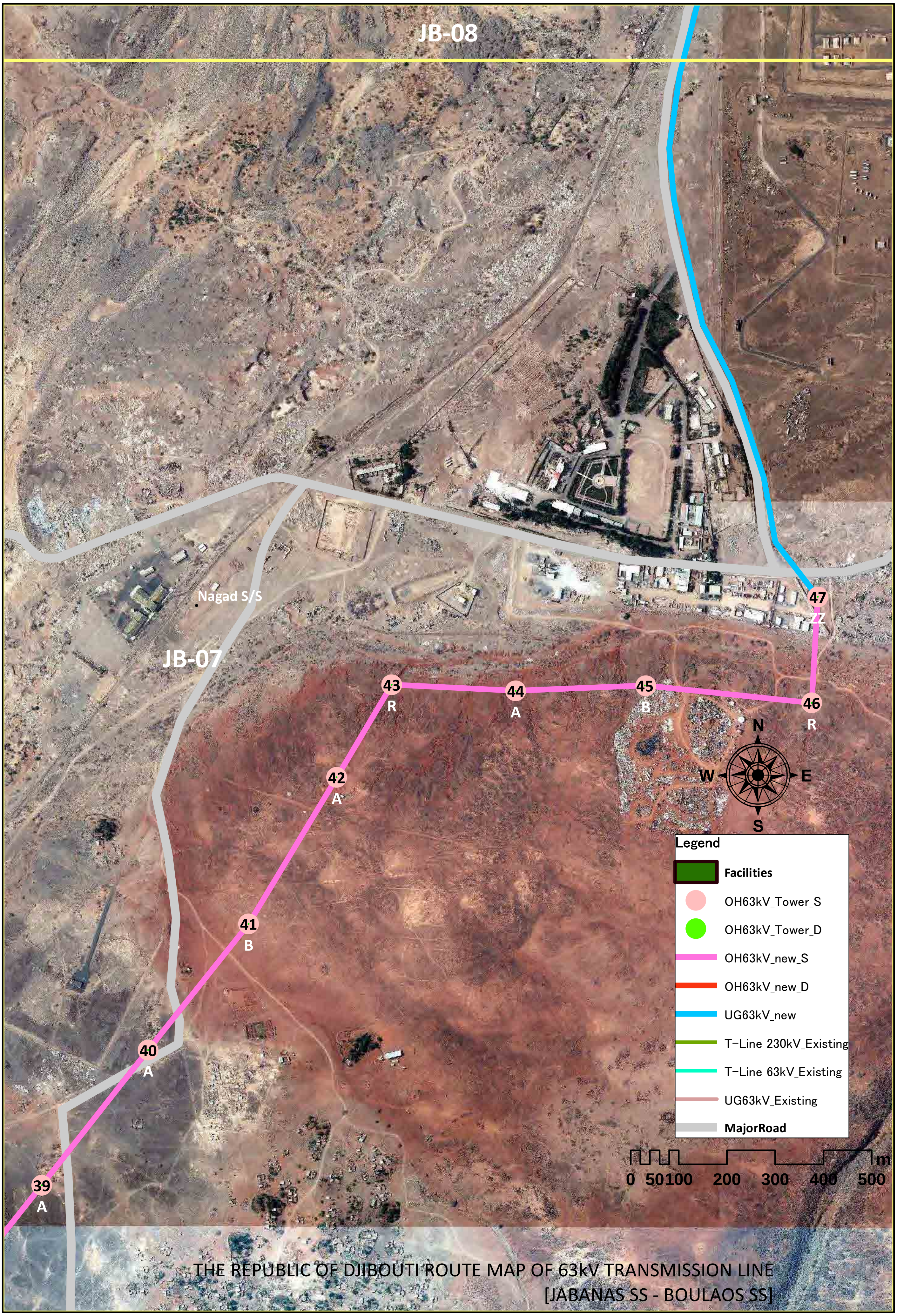


THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]



THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]

THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]



THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]

THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]

THE REPUBLIC OF DJIBOUTI ROUTE MAP OF 63kV TRANSMISSION LINE
[JABANAS SS - BOULAOS SS]

A-10 Letters of Environmental and Social Consideration

- DRG
- DRCA
- Dcello

Appendix 10.1

بسم الله الرحمن الرحيم

REPUBLIQUE DE DJIBOUTI
UNITE – ÉGALITE – PAIX

MINISTERE DE L'HABITAT, DE L'URBANISME
ET DE L'ENVIRONNEMENT

DIRECTION DE L'AMENAGEMENT
DU TERRITOIRE ET DE L'ENVIRONNEMENT

جمهورية جيبوتي
الوحدة - المساواة - السلام

وزارة الإسكان والتعمير والبيئة

إدارة التهيئة الترابية والبيئة

REÇU LE 30 AOUT 2014
DIRECTION

DIRECTION GENERALE EDD
ENREGISTRÉ
Le 30 AUG 2014
Sous le N° 2604

Djibouti, le 30/08/14
N°270/DATE/14

Le DIRECTEUR

A Monsieur le Directeur Général de l'E D D

Objet : Projet de renforcement du système des distributions d'énergie à Djibouti-ville
Réf : V/L n°1680/MA/2014/DPED en date du 27/08/2014.

Monsieur le Directeur Général,

Faisant suite à votre courrier ci-haut référencé relatif au projet de renforcement du système de distribution d'énergie à Djibouti-ville par la mise en place d'une lige de 63 Kv et suite à notre réunion de concertation avec notre département sur ledit projet dans laquelle toutes les informations nécessaires ont été fournies, j'ai l'honneur de vous informer que ledit projet ne nécessite pas la réalisation d'une étude d'impact environnemental. Toutefois durant la construction de cette ligne, les mesures environnementales les plus appropriées doivent être observées.

Directeur

HOUSSEIN RIRACHE ROBLEH

Ampliation
- MHUE
- SG

☎ +253 35-10-20
+253 35-10-97

📠 +253 35-48-37

✉ BP 2091

@ metade@intnet.dj

Appendix 10.2

RÉPUBLIQUE DE DJIBOUTI
UNITÉ - ÉGALITÉ - PAIX
جمهورية جيبوتي
الوحدة - المساواة - السلام

MINISTERE DU BUDGET

Direction des Domaines et
de la Conservation Foncière

Le Directeur

وزارة الميزانية

ادارة أملاك الدولة
و الشؤون العقارية

المدير

No 339 / DDCF

رقم :

Djibouti, le 10 MARS 2014

صادر في جيبوتي :

A

Monsieur le Directeur Général de
L'Electricité de Djibouti

Objet: Servitudes lignes HT
Réf : V. L N° 406/MA/2013/DPIED/EDD
P.J. : Extrait de Plan

Monsieur le Directeur Général,

Faisant suite à votre courrier cité en référence, par lequel vous demandez les parcelles impacté par la servitude de la ligne HT, je porte à votre connaissance que les lots touchés sont les suivants :

- Lots 371,370 (une partie) objet du TF 10807 appartenant à Mr NEIMA ABDI SAID
- Une partie du TF 11325 appartenant Djibouti Logistique and Trading Center
- Les lots 377, 376, 375, 383, 382,381 et 380 ces lots sont sans maître et vacantes.

Vous en souhaitant bonne réception, veuillez agréer **Mr le Directeur Général**, l'expression de ma considération distinguée.

HOUSSEIN MAHAMOUD BARREH

Ampliation :

- SDD
- Chrono DDCF

▬ nouvelle proposition.

situation des bornes

ELECTRICITE DE DJIBOUTI
ETABLISSEMENT PUBLIC

BP. 175 - TEL.35 28 51
Email: direction-edd@edd.dj
TELECOPIE: (253) 35 43 96

REPUBLIQUE DE DJIBOUTI

UNITE - EGALITE - PAIX

إدارة الكهرباء
ص.ب ١٧٥
تلفون ٣٥٢٨٥١
تلكس ٥٨٤٢ جيبوتي
تلكوبي (٢٥٣) ٣٥٤٣٩٦
....
رقم ك • ج

Appendix 10.3

Réf. N°...638...... **/MAF/2014/DPIED/EDD**

Objet : Sevitudes et terrains
Pj : Image Google Eart

Djibouti, le 19 AVR 2014

A,
MONSIEUR LE DIRECTEUR DES DOMAINES
ET DE LA CONSERVATION FONCIERE

◆

Monsieur le Directeur,

Suite à votre proposition lors de la visite de terrain du **01/04/2014** dans la zone de PK13, nous vous prions de nous faire établir l'implantation des corridors des éléments ci-dessous :

Pour la ligne de transport électrique **230 kV** et la ligne **63 KV JABAN'AS-NAGAD**, une servitude de **100 m** allant :

- Du point **A** jusqu'au point **B**

Pour la ligne aérienne **63 kV JABAN'AS-NAGAD** un corridor de **24 m** allant :

- Du point **B** au point **C**

Pour la ligne souterraine **63 kV NAGAD-BOULAOS** :

- Un terrain de **15x15** pour la descente aéro-souterraine
- Une emprise de **6 m** du point **C** au point **D**

Pour le poste NAGAD, un terrain de 8 ha.

Une fois l'implantation terminée nous vous prions de bien vouloir nous notifier les nouvelles propriétés et de faire établir l'arrêté d'affectation des corridors.

Veuillez agréer, **Monsieur le Directeur**, l'expression de nos salutations distinguées. "

LE DIRECTEUR GENERAL DE L'ELECTRICITE DE DJIBOUTI

Le Directeur Général

DJAMA ALI GUELLEH

MINISTERE DU BUDGET

République de Djibouti
Unité - Egalité - Paix

Visa : Premier Ministre

Le Premier Ministre

Ministre du Budget

Le Ministre

Vu [illegible]

17/09/14
1889

Décret n° 2014-252/PR/MB

Portant affectation au profit du Ministère de l'Energie et des Ressources Naturelles, une parcelle de terrain constituée d'un ensemble de corridors pour l'alimentation en électricité du secteur de Nagad.

LE PRÉSIDENT DE LA RÉPUBLIQUE,
CHEF DU GOUVERNEMENT

VU La constitution n° 92-01102/PRE du 15 septembre 1992 ;

VU La Loi n°173/AN/91/2ème L du 10 Octobre 1991 portant organisation du Domaine Privé de l'Etat ;

VU La Loi n° 160/AN/12/6em L MEFIP du 09/06/12 portant réorganisation du Ministère de l'Economie et des Finances chargée de l'Industrie et de la Planification.

VU Le décret n°2013-044/PRE du 31 mars 2013 portant nomination du Premier Ministre ;

VU Le décret n°2013-045/PRE du 31 mars 2013 portant nomination des membres du Gouvernement ;

VU Le Décret n°2013-058/PRE du 14 avril 2013 fixant les attributions des membres du Gouvernement ;

VU La lettre n°980/MA/2014/DP/ED/EDD du 23 juin 2014 du Directeur Général de l'électricité du Djibouti ;

SUR Proposition du Ministre du Budget ;

Le conseil des Ministres entendu en sa séance du 09 Septembre 2014.

DECRETE

Article 1 : Il est affecté au Ministère de l'Energie et des Ressources Naturelles, une parcelle de terrain constituée d'un ensemble de corridors reliant la centrale de JABANASS de PK 12 au secteur de la Gare-Station Nagad.

Article 2 : La dite parcelle sera mise à la disposition de l'Electricité de Djibouti et est destinée à une zone de sécurité dont l'emprise servira de passage de toutes les lignes électriques de 63 et 230 KV.

Article 3 : Son itinéraire est constituée d'une longueur totale d'environ 13,52 km avec des largueurs d'emprise variant entre 6, 15, 24, 100 et 283 selon les différents secteurs dont les descriptions sont indiquées suivants les plans ci-annexés.
Des servitudes de voiries pourront traverser lesdits corridors aux besoins de l'Etat.

Article 4 : Dans les vingt jours de la date du présent décret, le Ministre du budget, par l'entremise du Directeur des Domaines et de la Conservation Foncière, fera remise de la dite parcelle au Directeur de l'Electricité de Djibouti.

Article 5 : Les formalités d'enregistrements du présent décret sont gratuites.

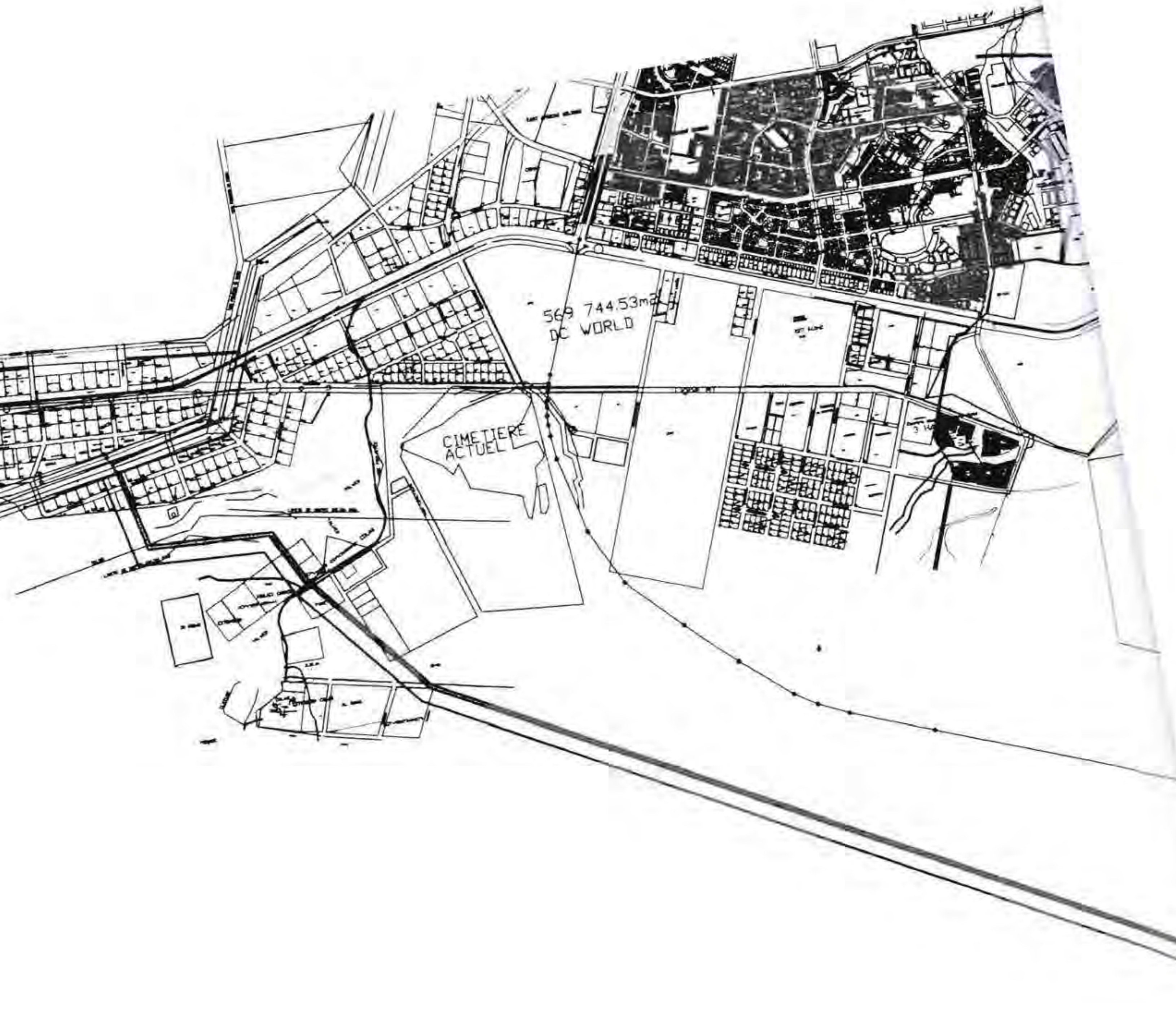
Article 6 : Le présent décret sera enregistré, publié, et communiqué partout ou besoin sera.

Fait à Djibouti, le 16 SEP 2014

Le Président de la République,
Chef du Gouvernement

ISMAÏL OMAR GUELLEH

LE PRESIDENT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DC WORLD
CIMETIERE
ACTUEL


CCA
COMPLEXE SPORTIF
B
HOPITAL PNEUMO-PHTISIOLOGIE
CITE D'AMENAGEMENT
LYCEE
Faculté d'ingénierie
FASTEC
EXTENSION FASTEC
UNIVERSITE
CITE D'AMENAGEMENT
D
E
Poste
dagad
Corridor de 24 m
Futur roc