Ministry of Energy and Mineral Development (MEMD)
Uganda Electricity Transmission Company Limited (UETCL)
The Republic of Uganda

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
IMPROVEMENT OF QUEENSWAY SUBSTATION
IN
THE REPUBLIC OF UGANDA

JANUARY 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Yachiyo Engineering Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Uganda, and conducted a field investigation. 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 the Republic of Uganda for their close cooperation extended to the survey team.

January 2015

Takumi UESHIMA
Director General,
Industrial Development and Public Policy Department
Japan International Cooperation Agency

SUMMARY

SUMMARY

① Overview of the Country

The Republic of Uganda (hereinafter referred to as “Uganda”), an inland country covering an area of approx. 241,000 km^2, is located in the East Africa with its population of approx. 36.3 million (2012, the World Bank). It has the third largest lake in the World, Lake Victoria, and shares its borders with Kenya, Tanzania, Rwanda, Democratic Republic of Kongo, and South Sudan. Although Uganda is located right on the equator, since most of the land is between 800m and 1,300m above sea level, its climate is rather moderate with the average temperature between 21 ℃ and 25 ℃ . Its primary industry is agriculture with producing farming products such as coffee, cotton and tobacco. Farming products thus account for approx. 25% of the GDP.

Although Uganda has its large development potential with fertile land and mineral resources, its economic development was relatively slow in 1970s due to the economic control conducted by the military government. In the beginning of 1980s, the inflation rate per year was more than 200%. Moreover, due to the expansion of domestic unrest, the GDP growth rate was recorded as minus 6.5% in 1984. Current government promotes the structural adjustment policy with the assistances of World Bank and IMF such as the reduction of military and government workers and liberalization of markets on agricultural products. As a result the domestic economy has been gradually recovering, recording more than 7% of annual GDP growth rate in 2000s. Along with the economic development, power demand has also been increasing by 9.7% annually from 2007 to 2012. Although the power supply in 2013 was approximately 560 MW (Facility capacity 820 MW), it is forecasted to reach approx. 1,000 MW in 2020.

② Background and outline of the Project

In response to the increasing power demand, the Government of Uganda regards the improvement of power generation is an urgent issue and Uganda has been promoting the power generation development plan, such as hydropower, thermal and geothermal. On the other hand, the development of transmission and distribution network is lagging behind and it provides negative effects to the economic development, public administration and people’s lives in Kampala through the unstable power supply and/or frequent planned power outage.

Uganda Electricity Transmission Company Limited (UETCL) formulated the Grid Development Plan 2012-2028 in October 2012 to determine a mid- to long-term distribution facility plan for the entire country. It serves as the upper-level plan of the Project. UETCL revises the plan in October every year for the following 15 years and it is currently revising the October 2013 version (2013-2029).

However, since this Plan is originally formulated for the entire country, power development plan of each area has not been carried out smoothly. In Kampala metropolitan area, the central area

requires large power demand, but electricity is distributed from a 33 kV substation situating at the northern part of Kampala area through 33 kV distribution line because there is no 132 kV substation in the central area. It causes unstable power supply such as large distribution loss. Moreover, since the capacity of existing 132 kV substations connecting to 33 kV distribution lines in Kampala area is not sufficient, it is forecasted that the present capacity of 132 kV substation facilities will not satisfy the power demand in a few years.

The Government of Uganda concerns the above situation and requested the project for the improvement of Queensway Substation to the Government of Japan to realize the sustainable social development.

③ Outline of the Study findings and Project Contents

JICA dispatched the Preparatory Survey Team to Uganda from April 10 to May 14, 2014 (First Field Survey). During this dispatch, the Team reconfirmed the contents of the request and discussed the contents of implementation with related officials on the Ugandan side (Responsible Ministry: the Ministry of Energy and Mineral Development (MEMD), and implementing agency: Uganda Electricity Transmission Company Limited (UETCL)), surveyed and investigated the project site and collected related data and materials.

On returning to Japan, based on the data and materials obtained in the field investigation, the Team conducted examination on the necessity of the Project, its social and economic effects and its validity and compiled findings into the Preparatory Survey Report (Draft). JICA dispatched the Team to Uganda again from August 20 to September 10, 2014 to explain and discuss the Preparatory Survey Report (draft) and reach a basic agreement with the related officials on the Ugandan side.

As a result of the study, the contents of the Project includes the procurement and installation of 132/33 kV substation facilities, 132 kV transmission facilities at Queensway Substation located at Kampala metropolitan area to improve the power condition of this area, undergoing the overload. The outline of the project is shown below:

Outline of the Basic Plan

	Plan Contents	Quantity
Procurement and installation	1. Substation facilities	
	- 132/33 kV Transformer	40 MVA x 3 units
	- 132 kV Gas Insulated Switchgears	8 units
	- 33 kV Gas Insulated Switchgears	14 units
	- 132 kV Control and Protection Panel	9 units
	- Other control panels	2 units
	- Low voltage facilities	3 units
	- 33 kV distribution lines	1 unit
	- Earthing system	1 unit
	2. Transmission facilities	
	- 132 kV overhead lines	450 m
	- 132 kV underground cables	2,310 m
	- Telecommunication lines	500 m
Procurement	3. Maintenance tools for procured items	1 lot
	4. Spare parts for procured items	1 lot
Construction	5. Civil and Construction	
	- Foundations for items (Gas Insulated Switchgears, transformers, towers)	1 lot
	- Control building (Total floor area: 680 m^2)	1 building

④ Project implementation period and rough project cost

In the case where the Project is implemented under the Government of Japan's Grant Aid scheme, the total project cost will be approx. (**confidential**) yen (Japan's burden: approximately: (**confidential**) yen, Uganda's burden: approx. 559 million yen). The main items to be handled by the Ugandan side will be the compensation of the project site (154 million yen), obtaining the Environment Permit (27 million yen), site filling and leveling at 132/33 kV Queensway substation site (25 million yen), installation of concrete culverts for water drainage (10 million yen). The Project implementation period including the detailed design and the tendering periods will be approximately 26.0 months.

⑤ Project Evaluation

(1) Relevance of the Project

This Project helps to achieve Ugandan national energy and power polices. Also, it will contribute to the reduction of the risk of scheduled power outage and stable power supply. Consequently, the result will affect not only economic aspect but also various aspects such as public administrative, welfare, educational and medical fields. Thus the relevance of this Project is considered to be high.

(2) Effectiveness of the Project

The impacts expected from the implementation of the Project are as follows:

1) Quantitative Impacts

Outcome indicator	Base value (2014) (Current value)	Target value (2020) (3 years after the completion of the Project)	Reference Value (2020) Without the Project
1. Facility capacity of 132 kV Transformers at Kampala metropolitan area（MVA）	460	700	580
2. Voltage drop ratio of the power receiving end at Queensway Substation (%)	4.43	4.02	6.25
3. Transmission and distribution loss at Kampala metropolitan area (MW)	17.3	22.1	24.8

2) Qualitative Impacts

The following table shows impacts of each component of the Project.

Present Status and Problems	Project Countermeasures (Grant Aid Project)	Extent of Project Effects and Improvement
1. In Uganda, the power demand has been rapidly increasing, but the present capacity of power transformer is not sufficient and aging. It is a major cause of the unstable power supply and transmission and distribution network loss.	Procurement and installation of the following equipment: **1. 132/33 kV Substation equipment** • 120 MVA＝40 MVA×3 banks **2. 132 kV Transmission equipment** • Two 132 kV Steel towers • 132 kV underground cable (0.35 km)	By the construction of new 132/33 kV substation, the loads on neighboring 132 kV substations, Lugogo Substation and Mutundwe Substation will be reduced. Through this, the risk of unstable power supply and transmission and distribution network will be decreased.
2. In Uganda, unstable power supply and power shortage is remarkable especially in Kampala and it causes the bottlenecks of economic, public administrative, social and welfare activities. However, it is difficult to construct new substations due to the limitation of available land for the construction of new substations.	This Project will utilize the Gas Insulated Switchgears, as 132 kV power facilities, which can reduce the offset distance compared to conventional facilities. Through this, the new substation will be constructed in a narrow area.	Gas Insulated Switchgear enables to reduce the required space to construct compact-type substation.
3. Existing 33/11 kV Queensway Substation mainly supplies power to the central area of Kampala City. However, power supply system has become unstable as planned power	Installation of 132/33 kV substation facilities to Queensway Substation.	The power supply will become stable through the direct power supply from the 132 kV transmission network to the center of Kampala City by this Project. Thus, it is

Present Status and Problems	Project Countermeasures (Grant Aid Project)	Extent of Project Effects and Improvement
outages have been frequently carried out due to the increase of power demand		anticipated that the duration of planned power outage (1776.7 hours in 2013) will be improved and contribute to the people's daily lives. (It is expected that the planned power outage will be reduced to approx. 950 hours based on the demand and substation capacity of 2013. However, since it is difficult to forecast the future demand, it is quite difficult to identify the reduction of planned power outage in 2020.)

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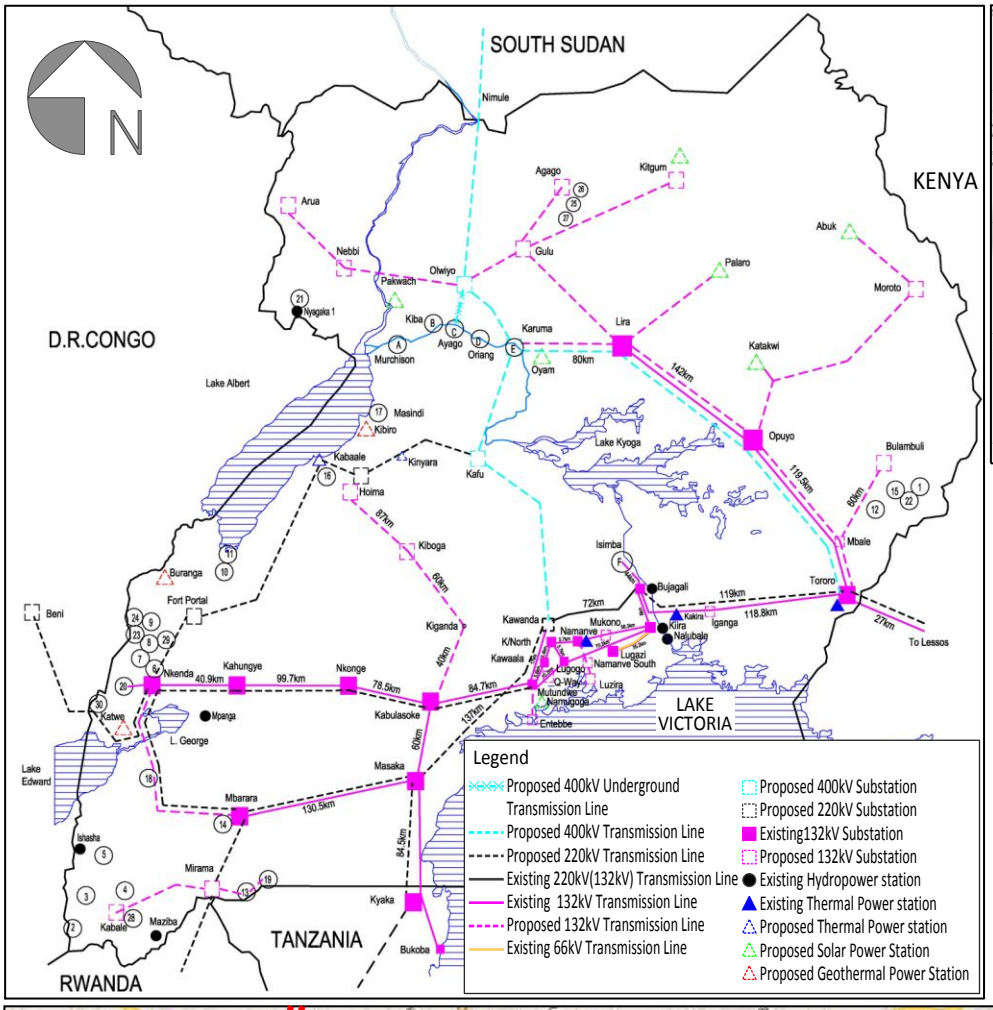
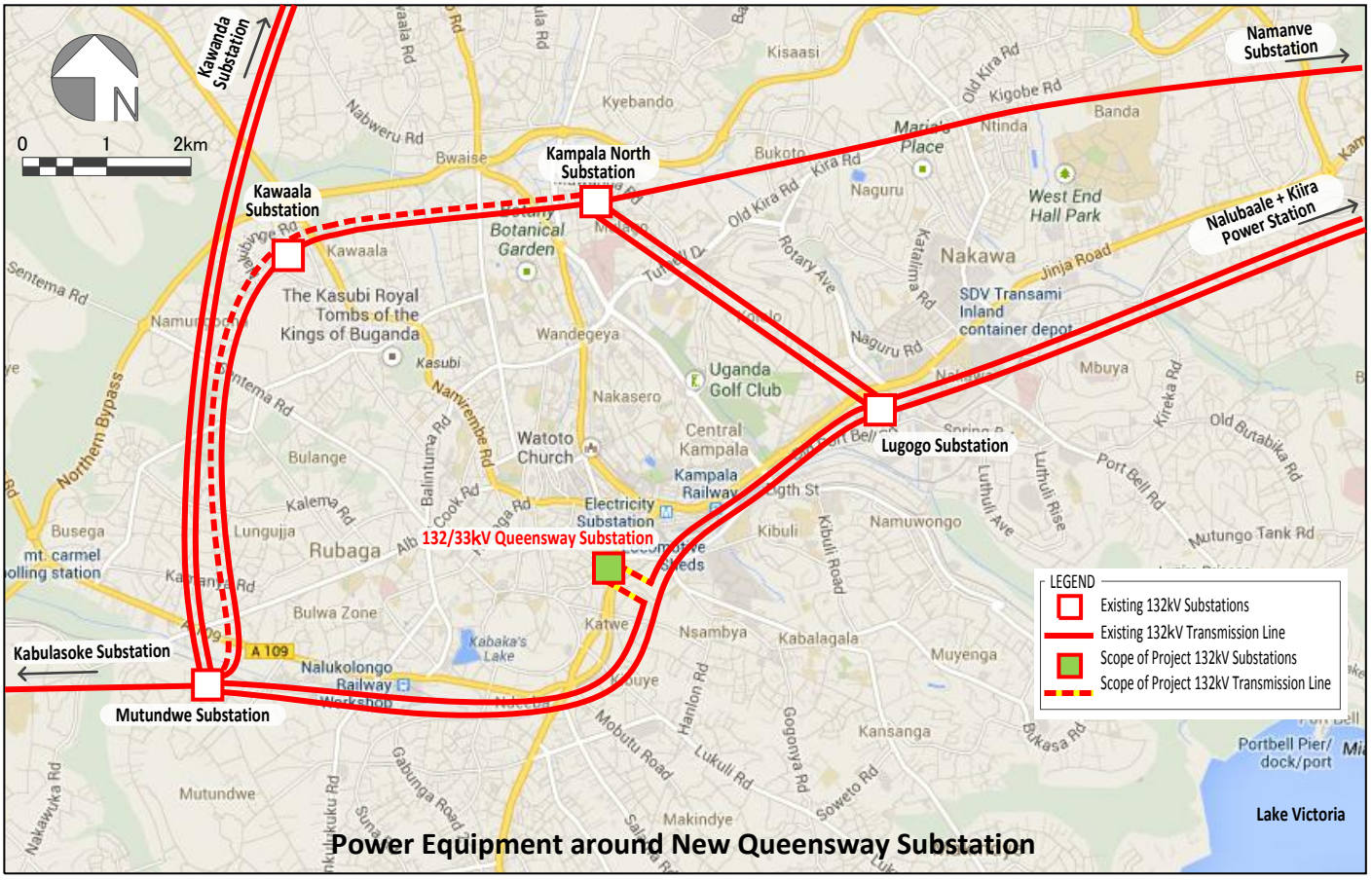


■Location of the Republic of Uganda in Africa

■National Transmission Network in Uganda



Power Equipment around New Queensway Substation

Location Map of the Project Site

Perspective of the 132/33 kV Queensway Substation

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ABBREVIATIONS

ACSR	Aluminum Conductor Steel Reinforced
COMESA	Common Market for Eastern and Southern Africa
E/N	Exchange of Notes
EAPP	Eastern African Power Pool
EP	Environmental Permit
G/A	Grant Agreement
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
IMF	International Monetary Fund
IPP	Independent Power Producer
IREMP	Indicative Rural Electrification Master Plan
JEC	Japanese Electrotechnical Committee
JICA	Japan International Cooperation Agency
M/D	Minutes of Discussions
MCCB	Molded Case Circuit Breaker
MEMD	Ministry of Energy and Mineral Development
MoFPED	Ministry of Finance, Planning and Economic Development
NEMA	National Environment Management Authority
NGO	Non-governmental Organization
O&M	Operation and Maintenance
ODF	Optical Cable Distribution Frame
OJT	On the Job Training
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
PEAP	Poverty Eradication Action Plan
RTU	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition System
UEDCL	Uganda Electricity Distribution Company Limited
UETCL	Uganda Electricity Transmission Company Limited

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

Uganda has achieved rapid economic growth recording approx. 7 percent of growth rate and power demand is also growing at an annual rate of 9.7 percent (national average) from 2007 to 2012. Although the Government of Uganda and public power companies have been developing power sources mainly utilizing abundant water resources, they have been having difficulties in the development of power grid to meet the demand increase as it requires huge costs.

Uganda Electricity Transmission Company Limited (UETCL) formulated the Grid Development Plan 2012-2028 in October 2012 to determine a mid- to long-term distribution facility plan for the entire country. UETCL revises the plan in October every year for the following 15 years and it is currently revising the October 2013 version (2013-2029).

However, since this Plan is originally formulated for the entire country, power development plan of each area has not been carried out smoothly. In Kampala metropolitan area, 33 kV power is distributed from Kampala North Substation to the central area through the distribution line outside of the central area (15 km away from Queensway Substation) due to the shortage of substation capacity around the central area, making a severe situation causing the large power distribution losses.

The Government of Uganda concerns the above situation and requested the project for the improvement of Queensway Substation to the Government of Japan to realize the sustainable social development.

1-2 Natural Conditions

(1) Location, Features and Topography of the Planned Area

The planned site of Queensway Substation is situated close to an intersection of the circumferential road slightly off the central Kampala in the administrative district on a hill. It is eight kilometers away from Lake Victoria at 1,134 meters above sea level or more than 20 meters higher than the lake at 1,155 meters to 1,156 meters above sea level. The site is in a district between Queensway Road and Katwe Road both running northward, surrounded by a green park owned by Pan-African Movement. The site and green park are bordered by a 6-meter-wide drainage path. Rainwater and city wastewater from the surrounding hilly area gathers in the drainage ditch and runs from a holding basin on the opposite side of Queensway Road to be connected to the downstream via two underground drainpipes with a diameter of 80 centimeters. Thus, the underground drainage capacity is insufficient in torrential rains and it gets flooded in the surrounding area. The ground level of the existing Queensway Substation adjacent to the planned site was raised by 1.5 meters as a flood countermeasure. Although the existing substation has never been flooded since its construction, more careful measures are needed to be prepared for climate change and increasing urban population.

(2) Site Area

The premises of the planned substation covers a rectangular area of approx. 2,340 square meters with a long side of 75 meters and a short side from 35 meters to 25 meters becoming narrower due to the waterway. The existing substation is located adjacent to the site and will be operated as a 33/11 kV substation by UMEME after the completion of the new substation.

The site is 1,155 meters to 1,156 meters above sea level. It is mostly flat and a drainage ditch from Queensway Road on the east side runs across the center of the premises to connect to be connected to a 6-meter-wide drainage path on the west side. All the trees on the premises will be transplanted to the adjacent green park owned by Pan-African Movement.

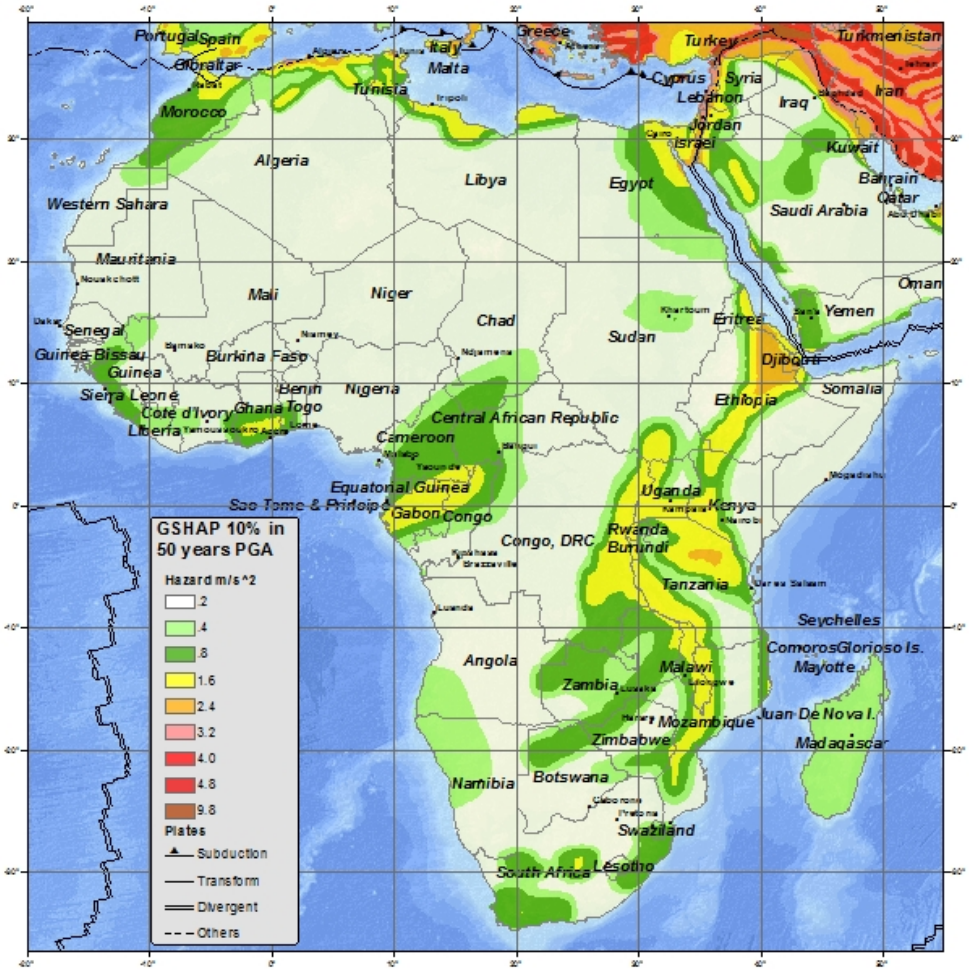
(3) Geological Survey

The ground of the planned site is mainly composed of sandy silt, silt sand, clay, rocks and weathered rocks and solid rockbed is confirmed from the depth of 12 meters of the lower level. The ground water levels are GL-0.8 to 0.9 meter when the boring survey was conducted (April 28, 2014). As for the foundation of the facility, humid soil on the soft surface will be removed to be replaced with broken stones as ground improvement work or pile foundation work will be carried out.

(4) Earthquakes

UETCL reported an earthquake as recent as 1996.

As the estimated seismic intensity value, the locally used 0.15 will be used in the interest of safety. Figure 1-2.1 shows the earthquake hazard map of the African Continent.



[Source] Home Page of U.S. Geological Survey

Figure 1-2.1 USGS African Hazard Map

(5) Ground Water Quality

Sulfides from urban drainage have been confirmed in ground water. The impacts of sulfides must be accounted for in designs of underground structures.

1-3 Environmental and Social Considerations

1-3-1 Environmental Impact Evaluation

1-3-1-1 Project Components

The detail of the project component is shown in the Chapter 2 and its outline is indicated in the Table 2-1.1. The main purpose is to construct new 132/33 kV substation next to the area of existing Queensway Substation and installation of 132 kV transmission line which connect existing 132 kV transmission line to the substation. Works borne by the Ugandan side includes removal of existing facilities on the project site, installation of power cable into 33 kV switchgears of existing Queensway Substation.

Detail of 132 kV transmission line route is shown in T-01 '132 kV Transmission Line and Underground Cable Route Map to Queensway Substation'.

1-3-1-2 Outlines of the Project Site

The Project site covers not only the site next to the existing 33/11 kV Queensway Substation, but also a transmission line route from the steel tower which will be constructed between No 19 and No. 20 towers between 132/33 kV Mutundwe Substation and 132/33 kV Lugogo Substation to the substation. In fact, in addition to the steel tower, the dead end steel tower which will connect the 132 kV overhead lines to the 132 kV underground cables will be constructed. This underground cable will cross underneath of Queensway Road and a side road in front of the Queensway Substation. The project site is surrounded by Queensway Road and Katwe Road which have frequent transportation such as bikes and vehicles regardless of daytime and nighttime. The project site is situated at the central area of Kampala. There is no natural reserve or historically or culturally valued areas around the site.

1-3-1-3 Institution and Organization of Environmental and Social Considerations in Uganda

(1) Legal Framework for Environmental and Social Considerations in Uganda

Table 1-3-1-3.1 summarizes the legal framework for environmental and social considerations in Uganda. The National Environment Act by NEMA legislated in 1995 is the fundamental law to implement Environmental Impact Assessment (EIA). The Environmental Impact Assessment Regulations in 1997 and the Environmental Impact Assessment Regulations in 1998 were also legislated to stipulate the procedure of EIA, methods, screening criteria, scoping process, public consultations as the baseline of EIA implementation.

In the power sector, the Environmental Impact Assessment Guidelines for the Energy Sector was formulated in 2004 and it has been used to apply environmental certificate to NEMA.

Table 1-3-1-3.1 Legal Framework for Environmental and Social Considerations in Uganda

Category	Title	Year of Enforcement	Competent Body
Environmental Impact Assessment	National Environment Act	1995	NEMA
	Guidelines for Environmental Impact Assessment in Uganda	1997	NEMA
	Environmental Impact Assessment Regulations	1998	NEMA
	Environmental Impact Assessment Guidelines for the Energy Sector	2004	NEMA
	Energy for Rural Transformation (ERT) Environment and Social Management Framework	2006	REA
Protected Area	Wildlife Act	1996	UWA
	National Forestry Policy	2001	NFA
	The National Forestry and Tree Planting Act	2003	NFA
Water Resource Management	The Water Act	1997	GOU
	The National Environment (Wetlands, Riverbanks and Lakeshores Management) Regulations	2000	NEMA

Category	Title	Year of Enforcement	Competent Body
Land Acquisition and Resettlement	The Constitution of the Republic of Uganda	1995	GOU
	Land Act	1998	GOU
	Electricity Act	1999	GOU
	Land Acquisition Act	1965	GOU

［Source］Preparatory Study Team

(2) Organizational Structure for Environmental Impacts Assessment in Uganda

NEMA, National Environmental Management Agency, is responsible for environmental management in Uganda, which was established on National Environment Act, Cap. 153 in 1995. NEMA coordinates, monitors and supervises all activities in the field of the environment mainly with the following activities.

- to coordinate the implementation of Government policy and the decisions of the policy committee
- to ensure the integration of environmental concerns in overall national planning through coordination with the relevant Ministries, departments and agencies of the Government
- to liaise with the private sector, intergovernmental organisations, nongovernmental agencies and governmental agencies of other States on issues relating to the environment
- to propose environmental policies and strategies to the policy committee;
- to initiate legislative proposals, standards and guidelines on the environment in accordance with National Environment Act, Cap. 153
- to review and approve environmental impact assessments and environmental impact statements submitted in accordance with National Environment Act, Cap. 153

Policy Committee on the Environment (PCE) consists of the following departments and Environmental Monitoring and Compliance Department (D/EMC) is responsible for the EIA evaluation.

- District Support Coordination and Public Education Department (D/DSCPE)
- Environmental Monitoring and Compliance Department (D/EMC)
- Policy, Planning and Information Department (D/PPI)
- Finance and Administration Department (D/F&A)

(3) EIA Procedure in Uganda

1) Procedure to Obtain an Environmental Certificate

The procedure of the environmental assessment is shown as below. First of all, applicants need to submit the Project Brief to NEMA, which describes project outline, environmental situation, assumed impacts on the environment and mitigation measures.

Environmental Assessment Procedure

i) Submission of Project Brief to NEMA

ii) Consultation on Project Brief by NEMA and Lead Agencies (screening 1: whether project is exempt from EIA), screening 2: whether project requires mandatory EIA, screening 3: whether adequate mitigation measures have been incorporated)

iii) Certificate of approval of EIA if EIA is not required through the screening

iv) If EIA is required through the screening, TORs of EIA is made after scoping and Stakeholder Consultations on Scope

v) TORs are reviewed with NEMA, Lead Agencies and Stakeholders Consultations

vi) Environment Impact Study (EIS), Collection of Information, and Public and Stakeholder Consultations are made.

vii) NEMA reviews and comment on EIS with lead agency and public comments

viii) Approval of EIS, Certificate of Approval of the EIA

ix) Action by developer with the certificate

x) Developer monitors the project with monitoring plan in EIS, NEMA and lead agencies monitor developer's activities

2) IEE Study

When a project brief is screened by NEMA whether an EIA is exempt or not, they assess environmental mitigation measures, management and monitoring plans are adequately studied or not with project descriptions, environmental condition in project sites and evaluation of impacts. The contents of project brief can be regarded an Initial Environmental Examination (IEE) although the Ugandan Guideline does not state the IEE study is necessary for the project brief. This means that the preparation of project brief requires the implementation of study for the actual IEE. It is necessary for UETCL to submit the project outline in conformity with the Ugandan environmental law..

1-3-1-4 Scoping

This project is considered that the negative effects on the environment caused by the construction of substation and transmission lines are nominal. Therefore this project is categorized as 'C' under the JICA Guidelines for Environmental and Social Considerations

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Outline of the Project

Uganda Electricity Transmission Company Limited (UETCL) formulated the Grid Development Plan 2012-2028 in October 2012 to determine a mid- to long-term distribution facility plan for the entire country. It serves as the upper-level plan of the Project. UETCL revises the plan in October every year for the following 15 years and it is currently revising the October 2013 version (2013-2029).

However, the country is struggling to conduct power development projects in line with the upper-level plan and the Government of Uganda requested Japan for a Grant Aid Project, Project for Improvement of Queensway Substation, to realize self-reliant sustainable socioeconomic development, which is hindered by the power distribution facilities in the metropolitan area.

If 132/33 kV Queensway Substation does not start its operation in 2017 on schedule, the power demand in 2017 (407 MW) can not be sustained by the existing equipment capacity (400 MW). The goal of the Project is to enhance the equipment capacity of substation at the area to improve the current situation that the economic activities are suffered by the shortage of substation capacity and its aging. The overall targeted area by the Project is shown in Figure 2-1.1.

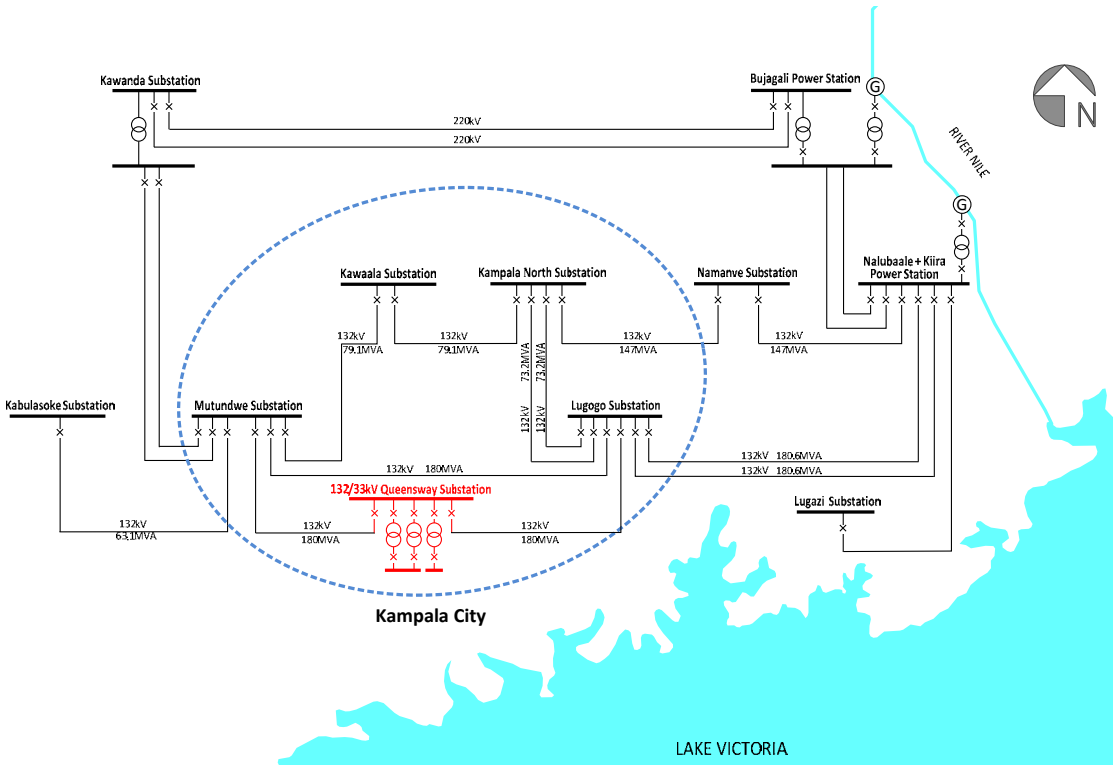


Figure 2-1.1 Area targeted by the Project

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

This project primarily targets higher level power distribution facilities in the Uganda power system. Still, in the absence of medium-to-long-term system plans, there are concerns that operation of lower level power facilities and even supply stability may also be impacted as the development plan targets Kampala area experiencing significant growth.

Along with being an urgent Grant Aid Project, in light of the above point, this Project must avoid equipment being replaced before the facilities reach their service life once in service. Thus, the target years for project evaluation and facility planning are to be set carefully.

2-2-1-2 Plan for Natural Conditions

(1) Temperature and Humidity Conditions

In Kampala where the Project site is situated, the rainy season is from March to May and the light rainy season is from September to November. It is relatively cool dry season from June to August and hot dry season from December to February. Kampala is situated at 1,190 meters above sea level with the average high temperature of January at 28℃ and July at 25℃. The annual rainfall is 1,178 millimeters. It has clearly divided dry and wet seasons. The above temperature, humidity and altitude will be given consideration for the substation facilities for the Project. Attention will be paid so that external air temperatures, temporary temperature increase from direct sunlight and high humidity will not disrupt proper equipment operation or O&M of the facilities. Space heaters will also be used for closed plate equipment in order to prevent condensation to be caused by temperature differences.

(2) Plan for Rainfalls and Lightning

Although the annual rainfall in Kampala where the Project site is situated is around 1,200 millimeters, there are squalls in certain areas. As such, the current ground level will be raised by 1.5 meters and the foundations of substation facilities will be raised by another 0.5 meter as flood countermeasures in consideration of possible flooding of adjacent drainage path. Because of frequent lightning during the rainy season in the Project area, shielding for overhead ground wires on transmission line towers will be installed at the UETCL standard angle of 15 degrees to keep a 95% shielding rate. Given the danger of a lightning strike during steel tower construction and overhead line work, safety precautions are to be taken, such as temporary suspension of work when thunder is heard in the distance.

The Project site is at 1,155 meters to 1,156 meters above sea level. To ensure stable power supply, the number of suspension and tension insulators shall be noted carefully, along with surface leakage distances for insulators used with 132 kV overhead transmission lines and

132kV transmission lines.

(3) Plan for Earthquakes

As mentioned in Section 1-2, Uganda is prone to earthquakes. As the estimated seismic intensity value, G=0.15 will be used for structure design.

2-2-1-3 Plan for Socioeconomic Conditions

The substation improvement work requires power outage for switching cables at the 33 kV switchboard of the existing substation. It should be planned to minimize the duration of power outage so that the impacts on users of the substation will be minimized. 132 kV transmission lines are constructed within the way leave of the existing132 kV transmission line route. Uganda side is responsible for removing obstacles on the route. Because some sections of the route are road reserve for an arterial road and private lots, Uganda shall fully inform the roads authority and land owners and local residents of the Project contents in advance. Foundation work for substation and transmission line construction and drilling work for cable installation should be carried out carefully not to obstruct such buried infrastructure as telephone, water and drainage facilities. Overhead line work should be designed and carried out in a way to avoid interference with existing infrastructure, maintaining safe separation distances from existing distribution lines, telephone lines, railways and roads, in compliance with Ugandan laws and regulations.

2-2-1-4 Plan for Construction Conditions

The Project area in the capital of Uganda generally has good construction conditions. There is much construction activity for various large commercial facilities and office buildings, and multiple contractors which handle such construction work, including electrical contractors. With multiple contractors that can handle work on the ultra-high voltage substation and transmission facilities for the Project, project policy will be to assume that Kampala contractors will be used as sub-contractors.

Because there is no steel production in Uganda, steel construction is expensive and no ordinary building has steel structure. Meanwhile, there are four or five ready-mixed concrete plants in Kampala and reinforced concrete structures are popular. Thus, the control building, foundations of transformer and 132kV Gas Insulated Switchgear, and covered wire conduit will be designed to be reinforced concrete structures.

2-2-1-5 Plan for Using Local Contractors, Equipment and Materials

Interviews with local contractors and past work order data from the implementing agency suggest that construction workers, work vehicles, construction equipment and materials can be procured in Uganda with relative ease. As the skilled labor and regular workers for the construction and work for substation facilities, civil works, buildings and transmission lines for the Project can be ordered with local contractors, local contractors will be hired for the Project implementation plan.

Also note that as the aggregate, cement, rebar and other materials to be used in the civil works and construction for the substation and foundation work for the transmission towers can be purchased locally, equipment and materials are to be purchased locally to the extent possible in this Project. However, most of substation facilities and transmission equipment and materials for the scale equivalent to the project to be procured are not manufactured in the country and thus they will be procured from Japan or third countries in consideration of past introduction of the existing facilities and O&M capacity of Implementing Agency.

2-2-1-6 Plan for O&M Capacity of Implementing Agency

UETCL that is responsible for O&M of the substation after its completion has a certain level of technical capacity in system operation and has steadily handled O&M for key substations and transmission network across the country. Although the Project includes a 132kV Gas Insulated Switchgear that has been introduced only once in the country, skills necessary for their operation methods, system protection functionality and other O&M issues do not greatly exceed the technical levels for equipment used in Uganda even their interior structure differs from that of traditional switchgears. Thus, it is fair to conclude that UETCL has the O&M capacity for the substation and transmission facilities to be procured in the Project. However, still, Japanese engineers will conduct OJT for O&M inspection of the facility during the construction period, provide necessary replacements, testing equipment, maintenance tools and O&M manuals, and suggest O&M structure as UETCL's engineers and O&M workers may not have fully understood the skills necessary for 132kV Gas Insulated Switchgears.

2-2-1-7 Planned Scopes for Facilities and Equipment and Setting Grades

In light of the conditions described above, materials and equipment to be purchased for the Project, as well as installation scope and technical standards will be determined based upon the following policies.

(1) Planned Scope for Facilities and Equipment

The Project is power facility improvement work for stable power supply for public and other facilities in Kampala based on the estimated power demand in the target year of 2027. The Japanese side will be responsible for procurement and installation of minimum required facilities and the Ugandan side will be concurrently responsible for procurement and installation of equipment of which it is capable to help them perform continued O&M of electric power facilities by themselves. In order to keep the designs economical, equipment specifications will use standard products conforming to international standards when possible, selecting the minimum required equipment configurations and specifications.

(2) Plan for Setting Grades

Care will be taken not to deviate from the technical levels of UETCL when designing the power distribution facilities built, procured and installed in the Project, conforming to existing facility

configurations, UETCL technical standards and work manuals.

2-2-1-8 Plan for Construction and Procurement Methods and Work Period

As this Project will be performed based on the Japan's Grant Aid scheme, installation must be completed within the time limit. In order to complete the work within the specified construction period and achieve the results expected from the key substation construction, the Japanese and Ugandan work schedules should be planned in a coordinated manner and in consideration of land transportation route, means of transportation, duration, and other various procedures.

With concurrent construction of the substation and 132 kV transmission lines, care must be taken to keep scheduling efficient. Work teams need to be formed appropriately; the construction methods used need to be well known to local contractors and engineers, and the implementation system must be structured so that work progresses safely and swiftly.

2-2-2 Basic Plan

2-2-2-1 Prerequisites for the Project

(1) Purpose of Power Demand Forecast for the Project

The main project components are construction of 132/33 kV Queensway Substation (facility capacity of 40 MVA x 3 units) and upgrading of 132 kV transmission lines to the substation (one bound for Lugogo and one bound for Mutundwe) in order to improve power distribution within the Kampala metropolitan area.

The purpose of the power demand forecast in the preparatory study is to clarify project prerequisites by estimating power demand in the Kampala area. It will serve as base data to verify project relevance and effectiveness in light of the power distribution facility plan, including flow analysis and evaluations on how well the project coordinates with other development projects.

(2) Target Year of the Project

Relevance and effectiveness of the Project as a Japan's Grant Aid Project, including its urgency and benefit, will be confirmed through the preparatory study. This Project primarily targets higher level power distribution facilities in the Uganda power system. Still, in the absence of medium-to-long-term system plans, there are concerns that operation of lower level power facilities and even supply stability may also be impacted as the project targets a Kampala area experiencing significant growth.

According to the preparatory study report for the Project for Reinforcement of Power Distribution in Dar es Salaam in Tanzania, which is a similar project to this, the discussions with relevant Japanese agencies resulted in the suggestion that the target year for project evaluation is three years after the beginning of the service and the target year for facility plan is 10 years after that.

The target year for facility planning will be ten years after service starts. This Project must avoid equipment being replaced before the facilities reach their service life once in service, and the ten year figure is consistent with other similar Japan's Grant Aid projects. Meanwhile, as this Project is a Grant Aid project of urgent need, the target year for evaluating the project and its benefits will be three years after service start.

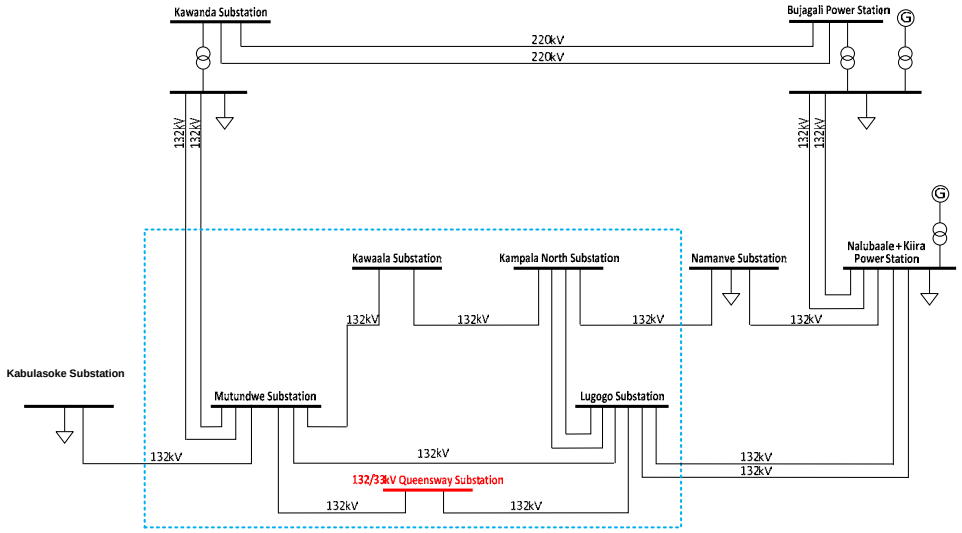
Target year for project evaluation: Three years from start of service

Target year for facility plan: Ten years from start of service

(3) Conditions of Power Facilities, Power Demand and System Load Factor

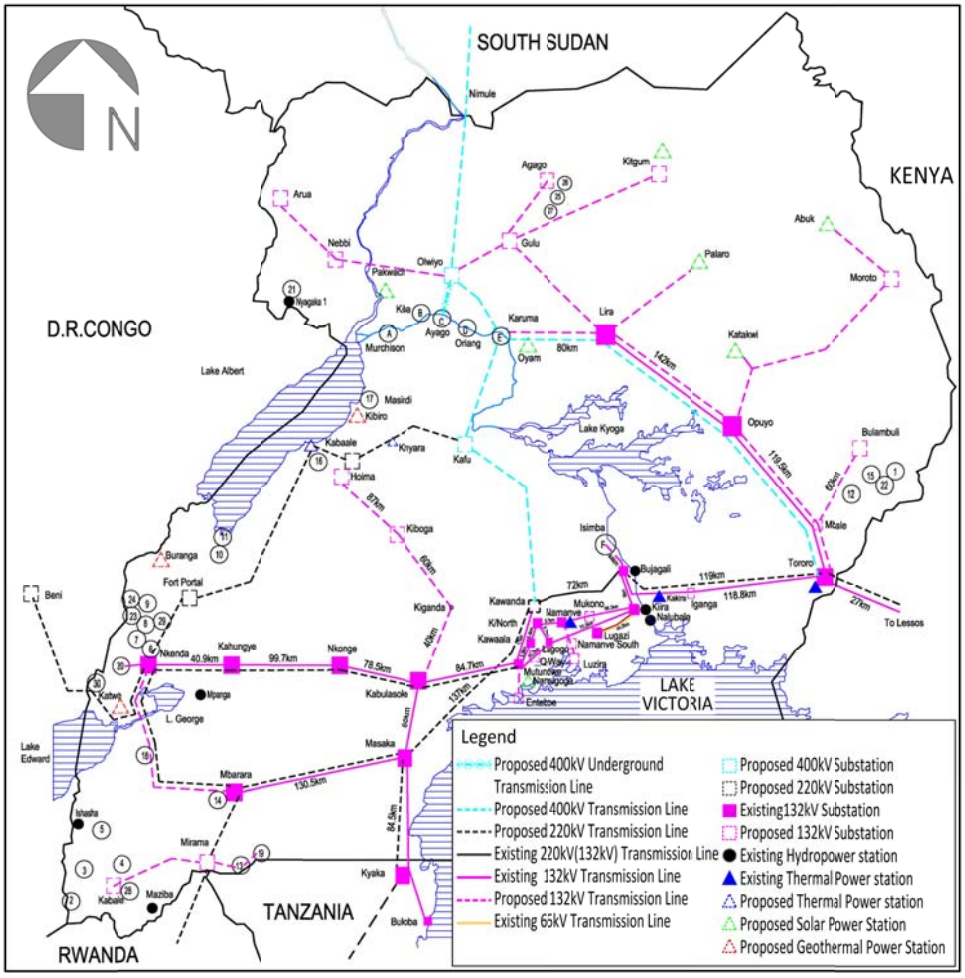
1) Power facilities conditions

Figure 2-2-2-1.1 gives an outline of the power distribution facilities in the Kampala metropolitan area. Currently, the Lugogo, Mutundwe, Kampala North and Kawaala substations are responsible for supplying power to the metropolitan area. As shown in the Figure, power is supplied mainly by Kiira-Nalubaale Hydro Plant and Bujagali Hydro Plant constructed on the headwaters of the Victoria Nile. As shown in Figure 2-2-2-1.2, the Karuma Hydro Plant and Ayago Hydro Plant are planned to be constructed in northern Uganda by around 2028 to expand the power interchange with neighboring Kenya, Tanzania and Rwanda that form the Eastern Africa Power Pool.



［Source］Preparatory Study Team

Figure 2-2-2-1.1 Overview of Power Distribution Facilities in the Kampala Metropolitan Area



［Source］ Preparatory Study Team

Figure 2-2-2-1.2　UETCL System Plan

The hydro plant locations and transmission line development plan in Figure 2-2-2-1.2 show that connecting Karuma Hydro Plant and Ayago Hydro Plant far from the consumption sites to the system via higher-voltage transmission lines will help transmission loss and they can be operated as if they were in the same distance with Kiira-Nalubaale Hydro Plant and Bujagali Hydro Plant that are relatively close to the consumption sites.

As shown in Figure 2-2-2-1.2, three system are assumed to be operated for supplying power in the metropolitan area after the expansion of power interchange via the above international interconnection system as follows:　a) As the current system, power is supplied via 132 kV transmission lines by Kiira-Nalubaale Hydro Plant and Bujagali Hydro Plant. b) Power is supplied via 220 kV transmission lines via Kawanda Substation by Kiira-Nalubaale Hydro Plant and Bujagali Hydro Plant. c) Power is supplied via 400kV transmission lines via Kawanda Substation by Karuma Hydro Plant and Ayago Hydro Plant. Because the current in the metropolitan area differs significantly by the system operation, there is need to confirm the facility capacity, scale of power interchange and system operation to make sure that the Project is consistent with the surrounding power facility capacity.

Table 2-2-2-1.1 shows an outline of the power distribution facilities of Lugogo Substation,

Mutundwe Substation, Kampala North Substation and Kawaala Substation in the Kampala metropolitan area.

Table 2-2-2-1.1 Existing 132kV Substations in Kampala Metropolitan Area

No.	Name	Voltage kV	Capacity MVA	Impedance %Z	Vector group	Year
1.	Lugogo Substation	132/11	40	Approx. 10%	YNyn0	1997
		132/33	40	Approx.13.50%	YNyn0	1998
		132/33	40	Approx.13.50%	YNyn0	1998
		132/11	40	Approx.10%	YNyn0+(d)	1991
2.	Kampala North Substation	132/33	40	Approx.13.50%	YNyn0	1995
		132/11	40	Approx.10%	YNyn0+(d)	2006
		132/11	40	Approx.10%	YNyn0+(d)	2006
		132/33	40	Approx. 13.50%	YNyn0+(d1)	2011
3.	Mutundwe Substation	132/33	40	Approx. 13.50%	YNyn0+(d)	1991
		132/33	40	Approx. 13.50%	YNyn0	1995
		132/11	20	Approx. 10%	YNyn0+(d)	2003
		132/11	20	Approx. 10%	YNyn0+(d)	2003
4.	Kawaala Substation	132/11	20	Approx. 10%	Yy0d1	1972
	Total		460			

［Source］Preparatory Study Team

2) Power Demand Conditions in Kampala metropolitan Area

Uganda introduced the system control and supervisory system (SCADA system) for data management in 2005. The load of 132/33 kV substations and load peak of 132/11 kV substations in the Kampala metropolitan area from 2005 to 2013 are shown in Table 2-2-2-1.2.

Ugandan real GDP during the same period grew steadily. (The trend of real GDP is shown later in Table 2-2-2-1.8.) The table also shows the qualitative trend of steady power demand in the metropolitan area in line with the active economic activities of the country.

A simultaneous utilization rate must be applied to the simplified total of the bus load of each substation as shown in Table 2-2-2-1.2 to calculate actual power demand in the Kampala metropolitan area. The Grid Development Plan 2012-2028 that serves as the upper-level plan of the Project uses 83 percent as the simultaneous utilization rate for the national power demand forecast. In consideration of local characteristics, 85 percent is used for power demand forecast in the area in the preparatory study in response to the strong request from UETCL. With the value, the power demand in the metropolitan area is estimated to be around 297 MW in 2012.

Table 2-2-2-1.2 Total Value of Yearly Peak Loads of 132 kV Bus in Kampala Metropolitan Area

(Unit: MW)

No.	**Year**	2005	2006	2007	2008	2009	2010	2011	2012	*2013
1.	**Lugogo Substation**	**61**	**65**	**67**	**67**	**78**	**90**	**90**	**107**	**113**
	(132/33 kV Substation Equipment)	27	27	29	27	31	38	37	50	53
	(132/11 kV Substation Equipment)	34	38	38	40	47	52	53	57	60
2.	**Kampala North Substation**	**83**	**87**	**87**	**90**	**104**	**113**	**115**	**125**	**132**
	(132/33 kV Substation Equipment)	45	45	46	47	53	53	61	66	70
	(132/11 kV Substation Equipment)	38	42	41	43	51	60	54	59	62
3.	**Mutundwe Substation**	**66**	**68**	**69**	**74**	**79**	**80**	**82**	**110**	**95**

	(132/33 kV Substation Equipment)	50	52	51	54	57	55	56	79	65
	(132/11 kV Substation Equipment)	16	16	18	20	22	25	26	30	30
4.	**Kawaala Substation**	**6**	**6**	**6**	**6**	**7**	**7**	**8**	**8**	**9**
	Kampala metropolitan area Total	**216**	**226**	**229**	**237**	**267**	**290**	**294**	**350**	**348**
	Kampala metropolitan area Demand	**183**	**192**	**195**	**201**	**227**	**247**	**250**	**297**	**296**

［Source］UETCL and UMEME

［Note］*: As the data for 2013 is yet to be completed, the value used in the table is the maximum value marked in July.

Power demand forecast based on econometric approaches requires chronological data for a period at least almost same as that of the forecast. As shown in Table 2-2-2-1.2, there is not sufficient chronological data of power demand in the Kampala metropolitan area to estimate that in the target years for the project evaluation and facility plan.

Thus, as it is difficult to forecast the power demand in the area with the chronological data, there is need to estimate the demand in the area indirectly using the power demand of the entire country for which chronological data is available as shown in Table 2-2-2-1.3, while giving consideration to the power demand (297 MW) in 2012 in the metropolitan area.

Table 2-2-2-1.3 Chronological Data of Annual Power Demand in Uganda

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Power consumed [GWh]	1053	1091	1172	1260	1382	1388	1484	1642	1741	1480	1971	2072	2213	2420	2639
Peak demand [MW]	173	172	N/A	236	303	309	350	407	418	471	380	380	394	424	446
Load factor	70%	72%	N/A	61%	52%	51%	48%	46%	48%	36%	59%	62%	64%	65%	68%

［Source］UETCL

3) System load factor in Uganda

The Grid Development Plan 2012-2028 estimates that the system load factor, that is currently around 70 percent, will increase gradually until 2028 to reach 75 percent as shown in Table 2-2-2-1.4. However, no factor that shows drastic improvement of the load factor was not found out in the preparatory study, moving at around 65 percent as shown in Table 2-2-2-1.3. Thus, the system load factor is assumed to be 65 percent in the Project based on the past value.

Table 2-2-2-1.4 Future Load Factor Estimate in Grid Development Plan 2012-2028

Year	2002-2008	2009 - 2011	2012 - 2013	2014 - 2017	2018 - 2020	2021 - 2028
Load factor	**65%**	**68%**	**70%**	**71%**	**73%**	**75%**

［Source］UEDCL

(4) Development Plan related to the Project and Existing Power Demand Forecast

1) Upper-level plan of the Project

UETCL formulated the Grid Development Plan 2012-2028 in October 2012 as a distribution facility plan for the entire country from mid- to long-term perspectives. The plan serves as the upper-level plan of the project. However, the development plan covers the entire country and thus development projects such as this one for the Kampala metropolitan area and other regions must reconfirm the system structure, facility capacity, demand distribution and other regional details and break down the upper level plans while adapting them to local features.

The target year for the plan is 2028 and the target years for project evaluation (three years after the beginning of the service: 2020 if the operation starts in 2017) and facility plan (10 years after service starts: 2027 if the operation starts in 2017) of the project are within the plan period. Mutual verification of the plan and project enables to ensure the evaluation of the relevance and effectiveness of the Project.

2) Existing power demand forecast

As described earlier, UETCL formulated the Grid Development Plan 2012-2028 and is developing power distribution facilities. The construction of new Queensway Substation of the Project is also based on the plan. Although the plan also estimates power demand in Uganda, it does not include the demand forecast in the Kampala metropolitan area or other regions. The supply-demand balance forecast in the plan until the target year of 2028 is shown in Table 2-2-2-1.5.

As preconditions for producing the table, the following values are used: system load factor at 70 percent and annual GDP growth rate at 7.0 percent in 2011 are assumed to reach 75 percent and 7.5 percent, respectively, in the target year. The household electrification rate in regional areas is currently around 12 percent and it is assumed to reach around 22 percent in 2021.

Table 2-2-2-1.5 Supply-Demand Balance Estimate in Grid Development Plan 2012-2028

(Unit: MW)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Kiira and Nalubaale	170	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Bujagali		240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
Karuma							200	300	400	400	450	500	600	600	600	600	600	600
Isimba							50	150	150	150	150	150	180	180	180	180	180	180
Ayago										100	100	100	100	300	300	500	500	500
Karuma B																		177
Oriang																		
Murchison																		
Achwa							40	80	80	80	80	80	80	80	80	80	80	80
Large Hydro Total	170	440	440	440	440	440	730	970	1070	1170	1220	1270	1400	1600	1600	1800	1800	1977
Mini hydro Total	24	31	38	38	111	111	132	132	132	132	132	132	132	132	132	133	134	135
Hydro Total	194	471	478	478	551	551	862	1102	1202	1302	1352	1402	1532	1732	1732	1933	1934	2112
Thermal and Solar Generation Subtotal	116	68	150	150	336	336	286	286	286	286	286	286	286	286	286	286	286	286
Cogeneration	14	14	24	37	37	72	72	72	72	72	72	72	72	72	72	72	72	72
Total Power Production	324	552	651	665	924	959	1220	1460	1560	1660	1710	1760	1890	2090	2090	2291	2292	2470
Domestic Demand Medium	455	547	622	746	869	940	984	1067	1124	1179	1271	1373	1463	1561	1685	1799	1947	2081
Reserve margin	46	55	62	75	87	94	98	107	112	118	127	137	146	156	168	180	195	208
Required generation capacity	501	602	684	821	956	1034	1082	1174	1236	1297	1398	1510	1609	1717	1853	1979	2142	2289
Kenya	0	0	0	0	20	20	30	50	100	100	100	100	100	100	100	100	100	100
Tanzania	10	11	12	13	20	20	20	20	50	50	70	80	100	120	120	120	120	120
Rwanda	1	1	0	0	10	20	20	50	50	50	50	50	50	50	50	25	25	25
D.R Congo	0	0	0	0	3	25	25	30	30	40	40	50	50	50	50	50	50	50
South Sudan								0	20	20	20	20	20	20	20	20	20	20
Total Exports	11	12	12	13	53	85	95	150	250	260	280	300	320	340	340	315	315	315
Generation requirement	512	614	696	834	1009	1119	1177	1324	1486	1557	1678	1810	1929	2057	2193	2294	2457	2604
Power Excess/ Deficit(Domestic)	−177	−50	−33	−156	−32	−75	137	286	323	363	312	250	281	373	236	312	150	181
Power Excess/ Deficit(Domestic + Export)	−188	−62	−45	−169	−85	−160	42	136	73	103	32	−50	−39	33	−104	−3	−165	−134

［Source］Grid Development Plan 2012-2028

The demand forecast based on the preconditions described above with Table 2-2-2-1.5 resulted in the annual average demand increase of 8.8 percent for the entire country from 2012 to 2028. Also from the table, it is forecast that the national demand will be met only with the domestic production by 2017 when the operation of Karuma, Isimba and Achwa Hydro Plants begins if the country continues to promote hydro power generation development utilizing its abundant water resources of the Nile water system. (The domestic supply-demand balance turns to positive figures.)

Table 2-2-2-1.6 is a list of projects related to the Grid Development Plan 2012-2028, which was

revised together with UETCL in the preparatory study based on the latest moves of other donor assistance and other factors. The Table shows that the power plan in Uganda has been implemented largely in three stages based on the following ideas: to realize inexpensive power price utilizing abundant water resources in stage 1, develop and upgrade the domestic power grid and increase pressure to meet current increase in order to distribute power from hydro plants without losses in the metropolitan area and other heavy-load areas in stage 2, and develop international interconnected power system in line with the progress of hydro development.

The progress of projects around the metropolitan area shown in Figure 2-2-2-1.1 (indicated in boldface in the table), among the projects in Table 2-2-2-1.6, requires special attention as they are closely related to the Project.

Table 2-2-2-1.6 Project List of UETCL

(Unit of the cost: million USD)

Year	Category	Voltage	Contents	Projects	Specifications	Donor	Scheme	Cost
2014	Transmission	132 kV	Upgrading	Mutundwe - Kabulasoke Line	AAAC125 to 200, 84.7 km	GoU	GoU	1.500
2015	Transmission	220 kV	Construction	Mbarara - Mirama - Birembo (Rwanda) Line	2 circuits, duplex, 66 km	JICA/AfDB	Loan	69.671
				Bujagali - Tororo - Lessos (Kenya) Line	2 circuits, duplex, 127 km	JICA/AfDB	Loan	85.470
		132 kV	Construction	Mbarara - Nkenda Line	2 circuits single. 160 km	AfDB	Loan	*1 55.730
			Upgrading	Tororo – Mbale – Opuyo - Lira Line	wooden pole to tower, 260 km	AfDB	Loan	40.356
	Substation	220/132 kV	Upgrading	Substation Equipment at Bujagali Power Station	125 MVA x 2 banks	JICA/AfDB	Loan	22.441
		132/33 kV	Construction	Fort Portal Substation	20 MVA x 2 banks	AfDB	Loan	*1 -
2016	Transmission	220 kV	Construction	Nkenda - Fort Portal - Hoima Line	2 circuits, duplex, 226 km	Norway/FAD	Loan	*2 81.429
		132 kV	Construction	Iganga (Nalubale - Tororo) T-off Line	2 circuits, single, 12 km	China	Loan	7.342
				Namanve - Namambe South Line	1 circuit, duplex, 10 km	China	Loan	7.664
				Namambe South - Luzira Line	1 circuit, duplex, 31 km	China	Loan	21.526
				Mukono (Nalubale - Namanve) T-off Line	1 circuit, duplex, 5 km	China	Loan	2.993
	Substation	132/33 kV	Construction	Namambe South Substation	60 MVA x 3 banks	China	Loan	15.108
				Mukono Substation	60 MVA x 3 banks	China	Loan	11.514
				Luzira Substation	40 MVA x 2 banks	China	Loan	12.325
				Iganga Substation	40 MVA x 2 banks	China	Loan	11.514
				Hoima Substation	40 MVA x 2 banks	Norway/FAD	Loan	*2 -
			Upgrading	Kawanda Substation	40 MVA x 1 bank	N/A		6.979
		132/11 kV	Upgrading	**Kawaala Substation**	20 MVA x 1 bank	N/A		4.500
2017	Transmission	400 kV	Construction	Karuma - Kawanda Line	2 circuits, duplex, 248 km	China	Loan	128.414
				Karuma - Olwiyo Line	2 circuits, duplex, 54.2 km	China	Loan	30.681
		220 kV	Construction	Kawanda - Masaka Line	2 circuits, duplex, 137 km	WB	Grant	*3 87.309
		132 kV	Construction	Mutundwe - Entebbe Line	2 circuits, single, 35 km	KfW	Loan	*4 29.936
				Karuma - Lira Line Construction	2 circuits, single, 75.5 km	China	Loan	18.590
				Bujagali - Ishimba Line Construction	2 circuits, single, 40 km	China	Loan	19.162
				Mbale - Bulambuli Line Construction	2 circuits, single, 60 km	N/A		48.418
				Lira - Gulu - Agago Line Construction	1 circuit (wooden pole), 175 km	GoU	GoU	43.957
				Kabulasoke - Kiboga - Hoima Line Construction	1 circuit (wooden pole), 190 km	GoU	GoU	33.629
				Opuyo - Moroto Line Construction	2 circuits, single, 157 km	IsDB	Loan	80.728
				Mirama - Kikagati - Nsongezi Line Construction	2 circuits, single, 55 km	Norway	Loan	42.584
				Mirama - Kabale Line Construction	2 circuits, single, 76 km	IsDB	Loan	33.486

Year	Category	Voltage	Contents	Projects	Specifications	Donor	Scheme	Cost
			Upgrading	Bujagali - Tororo Line	2 circuits, single, 3 km	N/A		N/A
				Nalubale - Bujagali Line	2 circuits, single, 3 km	N/A		2.874
				Owenfalls - Namanve - Kampala North Line	1 to 2 circuits, duplex, 68.8 km	N/A		31.793
	Substation	220/132 kV	Construction	Kawanda Substation	125 MVA x 2 banks			*3 -
		132/33 kV	Construction	Kabulasoke Substation	20 MVA x 2 banks	N/A		4.500
				Mbale Substation	40 MVA x 2 banks	N/A		16.176
				Kabale Substation	40 MVA x 2 banks	IsDB	Loan	0.583
				Entebbe Substation	50 MVA x 2 banks			*4 -
			Upgrading	**Kampala North Substation**	40 MVA×1 bank	N/A		4.521
				Tororo Substation	40 MVA x 1 bank	N/A		1.824
				Opuyo Substation	20 MVA×1 bank	N/A		1.150
				Mutundwe Substation	60 MVA x 2 banks	N/A		12.485
				Lira Substation	20 MVA x 1 bank	N/A		6.099
				Lugogo Substation	60 MVA x 2 banks	N/A		12.485
				Nkenda Substation	20 MVA x 1 bank	N/A		4.500
				Nkonge Substation	20 MVA x 1 bank	N/A		4.600
				Queensway Substation	40 MVA x 3 banks	JICA	Grant	17.926
		132/11 kV	Upgrading	*5 **Mutundwe Substation**	60 MVA x 2 banks	N/A		12.485
				*6 **Lugogo Substation**	60 MVA x 2 banks	N/A		12.485
2018	Transmission	400 kV	Construction	Olwiyo - Nimule (South Sudan) Line	2 circuits, duplex, 190 km	N/A		76.650
		220 kV	Construction	Hoima - Kafu Line	2 circuits, duplex, 92 km	Norway		46.962
				Masaka - Mbarara Line	2 circuits, duplex, 135 km	N/A		88.780
				Masaka - Mwanza (Tanzania) Line	2 circuits, duplex, 85 km	N/A		42.129
				Nkenda - Mpondwe (DRC) Line	2 circuits, duplex 70 km	N/A		50.441
		132 kV	Construction	Lira - Gulu - Olwiyo - Nebbi - Arua Line	2 circuits, single, 349 km	N/A		135.485
				Nalubale - Lugazi Line	2 circuits, single, 38 km	N/A		*7 20.277
				Gulu - Kitgum Line	2 circuits, single, 110 km	N/A		45.432
				Kawanda - Bombo Line	2 circuits, single, 70 km	N/A		28.741
			Upgrading	**Kampala North - Mutundwe Line**	10 km	N/A		1.000
	Substation	220/132 kV	Upgrading	Nkenda Substation	60 MVA x 2 banks	N/A		28.741
		132/33 kV	Upgrading	*8 Mbarara North Substation	40 MVA x 2 banks	N/A		4.500
				Masaka West Substation	40 MVA x 2 banks	N/A		4.500
		132/11 kV	Upgrading	Lugazi Substation	40 MVA x 2 banks			*7 -
		66/11 kV	Upgrading	Lugazi Substation	20 MVA x 1 bank	N/A		4.800

Year	Category	Voltage	Contents	Projects	Specifications	Donor	Scheme	Cost
		33 kV	Upgrading	Namanve South Substation Capacitor Bank Installation	15 MVar x 1 bank	N/A		0.300
				Queensway Substation Capacitor Bank Installation	5 MVar x 1 bank	N/A		0.050
				Lugogo Substation Capacitor Bank Installation	15 MVar x 1 bank	N/A		0.600
				Kampala North Substation Capacitor Bank Installation	15 MVar x 1 bank	N/A		0.600
2019	Transmission	132 kV	Construction	Mbarara - Ishaka Line	1 circuit, duplex, 100 km	N/A		59.852
2020	Transmission	400 kV	Construction	Ayago - Olwiyo Line	2 circuits, underground, 28 km	N/A		48.760
		220 kV	Construction	Mutundwe - Kabulasoke - Nkonge – Kahungye - Nkenda Line	2 circuits, duplex, 300 km	N/A		269.996
2021	Transmission	400 kV	Construction	Karuma - Tororo Transmission Line	2 circuits, duplex, 345 km	N/A		222.968
	Substation	132/33 kV	Upgrading	Nkonge Substation	20 MVA x 1 bank	N/A		5.141
2024	Substation	400/220/132 kV	Upgrading	Kafu Substation	125 kVA x 2 banks Third winding 60 MVA x 2 banks	N/A		64.780
		220/132 kV	Upgrading	Fortportal Substation	60 MVA x 2 banks	N/A		12.730
				Hoima Substation	60 MVA x 2 banks	N/A		21.994
2027	Transmission	220 kV	Construction	Mbarara - Nkenda Line	160 km	N/A		N/A

[Note]

*1, *2, *3, *4,and *7: Each is one project respectively.

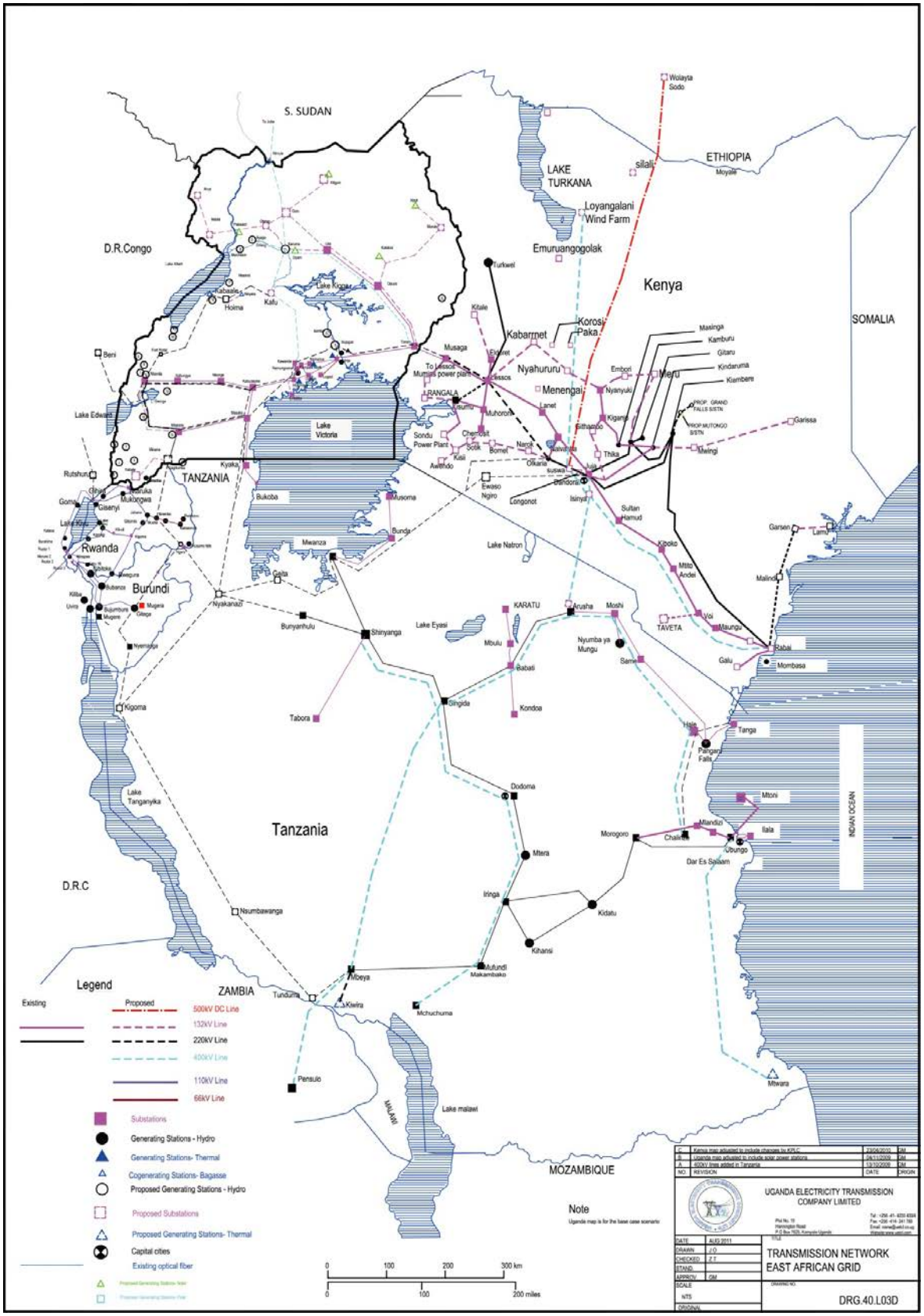
*5 and *6: Existing 2 banks will be decommissioned and removed. Then, new 2 banks will be installed.

*8: Mbarara North Substation is existing. 220/ 132 kV new Mbarara Substation and Mbarara North Substation are connected in 132 kV Transmission Line by the Project of *1.

The Eastern Africa Power Pool Master Plan is formulated as an extensive-area upper-level plan. A total of 19 eastern and southern African countries formed the Common Market for Eastern and Southern Africa (COMESA) in December 1994 with the aim to create a stable economic and trade zone in the region. COMESA established the Eastern Africa Power Pool in 2005 in order to promote sharing of power facilities, stable supply and electrification in eastern Africa. As of 2012, the member countries are Burundi, the Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, Libya and Uganda and its headquarters are in Addis Ababa, the capital of Ethiopia.

Uganda intends to enhance the international interconnected power system with neighboring Kenya, Tanzania and Rwanda based on the Eastern Africa Power Pool Master Plan. The development plan of the international interconnected power system among the four countries is shown in Figure 2-2-2-1.3.

As shown in Figure 2-2-2-1.3, electricity generated at Karuma Hydro Plant and Ayago Hydro Plant that serve as Ugandan major power plants will be distributed to Kenya via the transmission lines between Lira-Opuyo-Tororo, to Tanzania via the transmission lines between Kafu-Kawanda-Masaka, and to Rwanda via the transmission lines between Kafu-Hoima-Nkenda-Mbarara-Mirama. Demand forecast of power interchange is shown by country in Table 2-2-2-1.5.



［Source］Grid Development Plan 2012-2028

Figure 2-2-2-1.3　Interconnection Development Plan between Uganda and its Neighboring Countries

3) Power demand forecast methods for the Project

Methodology for power demand forecasts will be divided into the two methods given in Table 2-2-2-1.7. As with the Grid Development Plan 2012-2028 mentioned above, forecasts will use econometric approaches to build models and estimate power demand by gathering chronological data of GDP, population and other macroeconomic indicators.

Table 2-2-2-1.7 Methods and Characteristics of Power Demand Forecast

Method	Data	Advantage	Disadvantage
Engineering approach	Details of facilities specification Facilities Efficiency Facilities Operation Data (Load factor, Demand factor, etc.)	Easy interpretation of the result's background because it is based on numerous data and documents	Necessary of numerous data such as Facilities conditions, Facilities planning, Operation Planning, etc.
Econometric approach	Time series data such as GDP and Electricity Tariff, etc.	Easy forecast by collecting Explanatory variable (exogenous variable)	・ Complicate interpretation of the result's background because of forecast based on Explanatory variable (exogenous variable) ・ Necessary for data on reasonable period

［Source］ Preparatory Study Team

As described earlier, power demand in the Kampala metropolitan area cannot be forecast based on econometric approaches because of lack of chronological data. Thus, it is forecast indirectly using the power demand of the entire country for which chronological data is available, while giving consideration to the power demand (297 MW) in 2012 in the metropolitan area.

First of all, relevance of the power demand forecast policy shown in the Grid Development Plan 2012-2028 is verified based on econometric approaches with the chronological data of power demand in Uganda obtained through the preparatory study.

Power demand in the Kampala metropolitan area will be then forecast in the following three scenarios based on the current power demand in the area: standard scenario of assuming power demand growth rate equivalent to that in entire Uganda, low-growth scenario in which demand growth rate in the metropolitan area slows down assuming improvement of regional electrification rate, and rapid-growth scenario in which the situation is opposite from that of low-growth scenario.

4) Power demand forecast model

The target area of the project is the Kampala metropolitan area where government agencies, head offices of private sector firms are situated, making it the location which most clearly reflects the socioeconomic conditions of the country. Based on this, power demand in the area is forecast in the indirect approach described above based on econometric approaches after forecasting national power demand with the chronological data obtained through the preparatory study.

The Grid Development Plan 2012-2028 estimates the power demand based on the assumption of correlation between annual energy consumption and real GDP in Uganda as shown in the formula below. (***a1***, ***a2*** and ***a3*** are constants.) The correlation is also assumed for the Project and power demand forecast models are created and its relevance is verified to forecast future power demand.

$$\boldsymbol{Ln}(\text{annual energy consumption}_{i}) =$$

$$\boldsymbol{a1} + \boldsymbol{a2} \times \boldsymbol{Ln}(\text{real GDP}_{i}) + \boldsymbol{a3} \times \boldsymbol{Ln}(\text{annual energy consumption}_{i-1})$$

(5) Socio-economic Conditions and Economic Growth Scenarios

1) Socio-economic conditions in Uganda for power demand forecast

The Ugandan socioeconomic indicators which apply to project power demand forecast are given in Table 2-2-2-1.8. This table takes 2005 as the standard year for real GDP.

Table 2-2-2-1.8 Uganda's Population and Real GDP

Year	Population (Million)	Population at Urban area (Million)	Real GDP (constant 2005 US$) (Million US$)
1991	18.16	2.03	3,658
1992	18.79	2.13	3,783
1993	19.43	2.22	4,098
1994	20.08	2.32	4,361
1995	20.74	2.42	4,863
1996	21.41	2.51	5,304
1997	22.08	2.61	5,575
1998	22.78	2.71	5,848
1999	23.51	2.82	6,319
2000	24.28	2.93	6,518
2001	25.09	3.09	6,856
2002	25.94	3.26	7,454
2003	26.84	3.43	7,937
2004	27.77	3.61	8,477
2005	28.72	3.81	9,014
2006	29.71	4.05	9,986
2007	30.73	4.31	10,826
2008	31.78	4.57	11,769
2009	32.86	4.86	12,622
2010	33.99	5.15	13,362
2011	35.15	5.48	14,247
2012	36.35	5.82	14,733

［Source］World Bank

2) Uganda's economic growth scenarios

In order to maintain consistency with the upper-level plans, earlier mentioned Grid Development Plan 2012-2028 will also be used for Ugandan economic growth scenarios. The economic growth rate in the plan is used as the standard scenario for power demand forecast. The economic growth rate for the last 22 years (1991-2012) was 6.9 percent and a similar value of 7.0 percent is used as the growth rate for the low-growth scenario and 8.0 percent is used for

the rapid-growth scenario. The economic growth scenarios are shown in Table 2-2-2-1.9.

Population is in a relatively gentle increase trend and the Grid Development Plan 2012-2028 assumes a 3.5 percent growth rate. Three scenarios will be also set for the population growth rate with the rate as the standard scenario and ± 0.5 percent as high growth and low growth scenarios.

Table 2-2-2-1.9 Uganda's Economic Growth Scenarios

Items	High growth	General growth	Low growth
Real GDP growth rate	+ 8.0%	+ 7.5%	+ 7.0%
Population growth rate	+ 4.0%	+ 3.5%	+ 3.0%

［Source］Preparatory Study Team

(6) Modeling Test of Power Demand Forecast

The econometric model used in power demand forecasts was built with Simple E (Ver. 2008, Expanded), economic forecasting simulation software developed by the Institute of Energy Economics, Japan (IEEJ) and used in power demand forecasting in ASEAN countries. As econometric models are generally built as aggregates of many estimation and definition formulae, relevance of the model must be tested. The relevance of the power demand forecasting model for this preparatory study will be verified using the following indicators. It should be confirmed that the coefficient of determination is in excess of 0.90 for ensuring sufficient correlation between real GDP and Ugandan power demand.

- Coefficient of determination (R^2): 0.9 or higher
- Durbin-Watson statistic: 1.00 – 3.00 (target value)
- Coefficient sign test: checked as correlation with economic principle

(7) Kampala Metropolitan Area Power Demand Forecast

The approximation formula for power demand estimations obtained using the aforementioned software based on the above policies is as follows here. The approximation formula maintained an R2 of 0.943, confirming that the correlation between real GDP and Kampala area power demand is roughly as strong as that between real GDP and Ugandan power demand. Also, a value of 2.26 was reached for the Durbin-Watson statistic. Given the extreme proximity of this value to 2, this confirms that there are no serial correlations between disturbances in the built model.

From the above verification results, approximation model relevance was confirmed as shown in the following approximation formula:

Ln (annual energy consumption $_i$) =
-0.78053 + ***0.87257*** × ***Ln*** (real GDP $_i$) + ***0.033403*** × ***Ln*** (annual energy consumption $_{i-1}$)

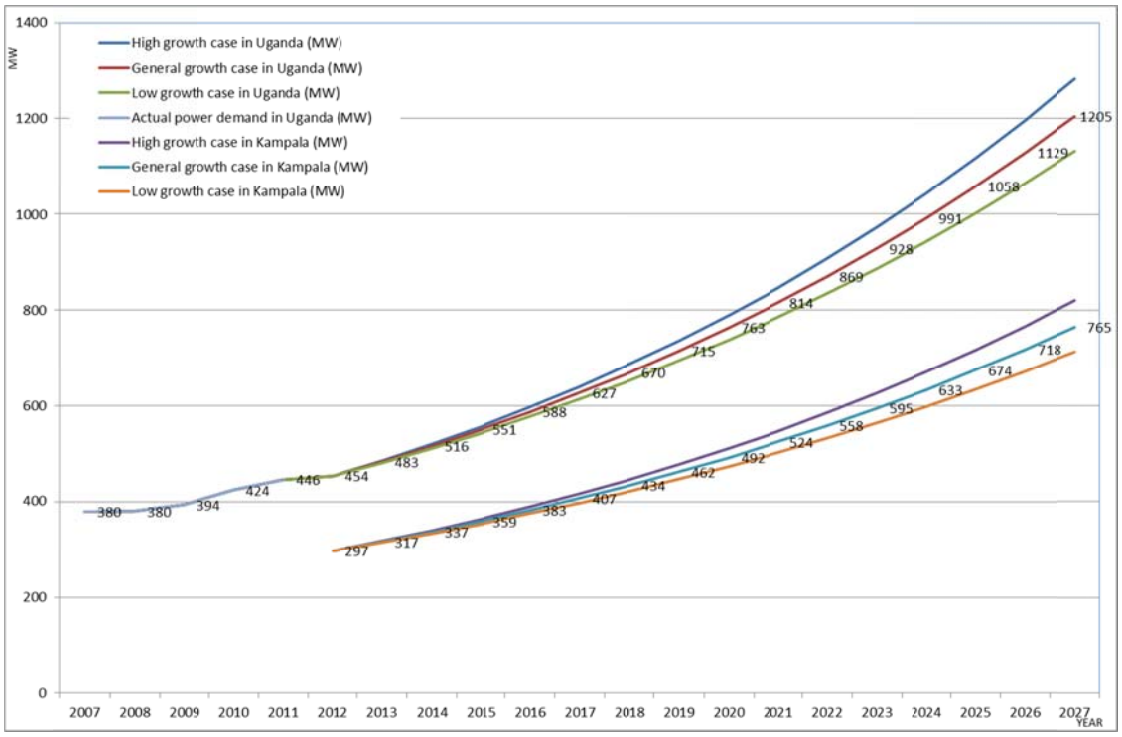
Calculating from this approximation formula based on the economic growth scenario in Table 2-2-2-1.9, power demands of Uganda were estimated as shown in Figure 2-2-2-1.4 for a load ratio of 65 percent. The power demand growth rate in Uganda after 2012 calculated from the

figure is shown in Table 2-2-2-1.10. Based on the national growth rate in the table, three growth scenarios for the Kampala metropolitan area—standard scenario of assuming power demand growth rate equivalent to that in entire Uganda, low-growth scenario in which demand growth rate in the metropolitan area slows down assuming improvement of regional electrification rate, and rapid-growth scenario in which the situation is opposite from that of low-growth scenario—are set and the power demand increase scenarios are also shown in the table.

Table 2-2-2-1.10 Power Demand Increase Scenarios in Kampala Metropolitan Area

Item	High growth	General growth	Low growth
Power demand growth rate in Uganda	+ 7.2%	+ 6.7%	+ 6.3%
Power demand growth rate in Kampala metropolitan area	+ 7.0%	+ 6.5%	+ 6.0%

［Source］ Preparatory Study Team



［Source］ Preparatory Study Team

Figure 2-2-2-1.4 Power Demand Forecast in Uganda and Kampala Metropolitan Area

In the Project, the estimated Kampala area power demand is taken as the base data for evaluating project relevance and effectiveness through flow analysis and evaluations on how well the project coordinates with other development projects.

The power demand in the Kampala metropolitan area is forecast as follows based on the power demand increase shown in Table 2-2-2-1.10: Power demand in the target year for project evaluation (2020) and target year for facility plan (2027) is 492 MW and 765 MW, respectively, in the standard scenario.

The gap between the demand growth rate assumed in the Grid Development Plan 2012-2028 and the growth rate obtained based on the demand forecast method in the plan based on the data

obtained in the preparatory study (Table 2-2-2-1.3) is shown in Table 2-2-2-1.11. As the table indicates, the master plan assumes the growth rate to be 8.8 percent after 2012 and it assumes that the demand will increase hugely—3.6 times as much as that in 2012—in the target year for facility plan in 2027.

Table 2-2-2-1.11 Gap of Uganda's Power Demand Growth Rate after 2012 in Different Scenarios

Item	High growth	General growth	Low growth
Growth rate shown in the Grid Development Plan (2012-2028)	—	+ 8.8%	—
Growth rate based on the data obtained by the preparatory survey	+ 7.2%	+ 6.7%	+ 6.3%

［Source］ Preparatory Study Team

All the capital investment plans in the Grid Development Plan 2012-2028 need to be carried out for its realization. However, the country still faces severe fiscal conditions with no other choice but to depend financially on donors and there are many projects for which fund sources are yet to be decided. In consideration of this, the power demand growth rate will be the one in the lower column in Table 2-2-2-1.11 obtained with econometric approaches based on past chronological data. The Project will use power demand forecast in the Kampala metropolitan area shown in Figure 2-2-2-1.4 as base data for its planning.

On the other hand, there is also uncertain factors that the demand may increase at the rate assumed in the Grid Development Plan 2012-2028 if the donors of projects therein that are yet to be decided are decided one after another. Thus, UETCL needs to review the demand forecast and be careful to ensure consistency of the Project facility and surrounding systems if the Project is adopted.

(8) Power Distribution Facility Plan in Kampala Metropolitan Area

Table 2-2-2-1.12 shows the results of careful examination of the Grid Development Plan 2012-2028 for the Kampala metropolitan area conducted with UETCL through the preparatory study. Figure 2-2-2-1.5 shows the power demand in the metropolitan assumed through the preparatory study and the supply-demand balance based on the plan in the table.

Table 2-2-2-1.12 Upgrading Plan of Existing 132kV Substation in Kampala Metropolitan Area

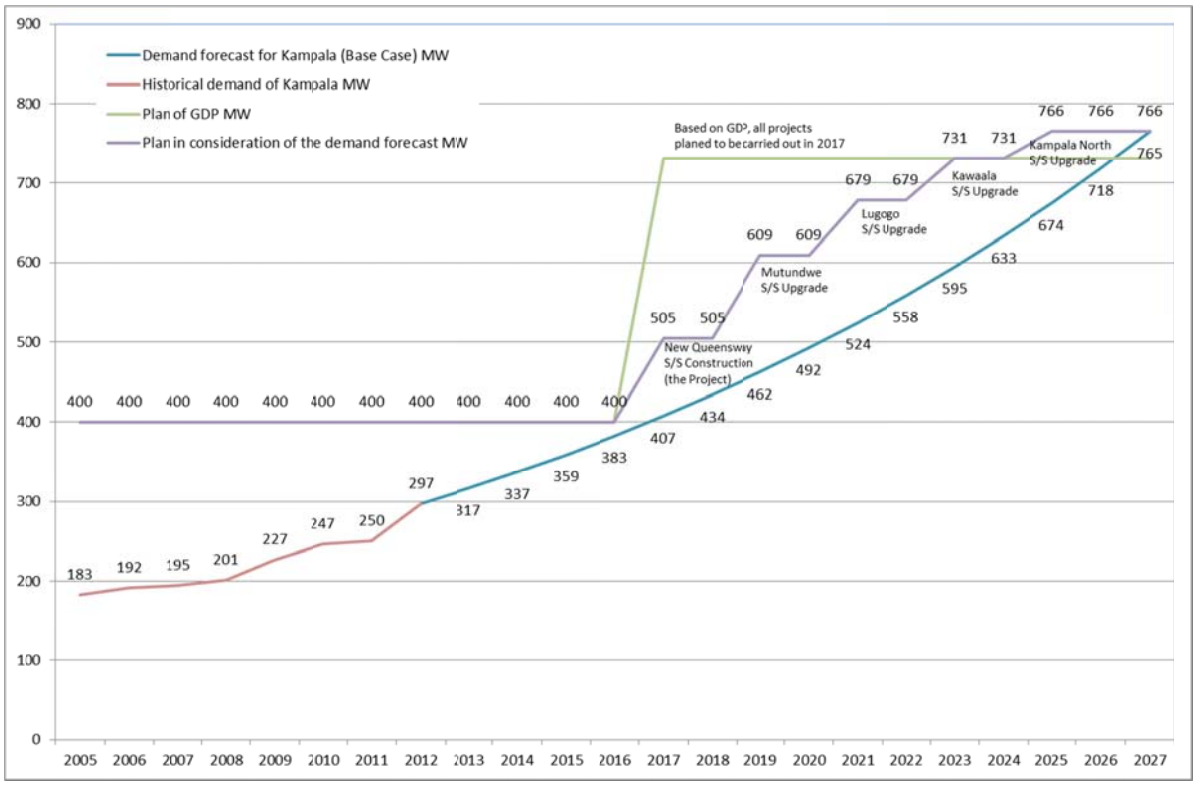
No.	Name	Voltage kV	Capacity MVA	Impedance %Z	Vector group	Year
1.	Lugogo Substation	132/11	60	Approx. 10%	YNyn0	2017
		132/33	60	Approx. 13.50%	YNyn0	2017
		132/33	60	Approx. 13.50%	YNyn0	2017
		132/11	60	Approx. 10%	YNyn0+(d)	2017
2.	Kampala North Substation	132/33	40	Approx. 13.50%	YNyn0	Existing
		132/11	40	Approx. 10%	YNyn0+(d)	Existing
		132/11	40	Approx. 10%	YNyn0+(d)	Existing
		132/33	40	Approx. 13.50%	YNyn0+(d1)	Existing
		132/33	40	Approx. 13.50%	YNyn0+(d1)	2017
3.	Mutundwe Substation	132/33	60	Approx. 13.50%	YNyn0+(d)	2017
		132/33	60	Approx. 13.50%	YNyn0	2017
		132/11	60	Approx. 10%	YNyn0+(d)	2017

No.	Name	Voltage kV	Capacity MVA	Impedance %Z	Vector group	Year
		132/11	60	Approx. 10%	YNyn0+(d)	2017
4.	Kawaala Substation	132/11	20	Approx. 10%	Yy0d1	2016 (Upgrading)
5.	**132/33 kV Queensway Substation (The Project)**	**132/33**	**40**	**Approx. 13.50%**	**YNyn0**	**2017**
		132/33	**40**	**Approx. 13.50%**	**YNyn0**	**2017**
		132/33	**40**	**Approx. 13.50%**	**YNyn0**	**2017**
	Total	-	820	-	-	-

［Source］ Preparatory Study Team

The power distribution facilities of Lugogo Substation, Kampala North Substation, Mutundwe Substation, and Kawaala Substation in the Kampala metropolitan area, not subject to the Project, are also planned to be upgraded. However, as explained earlier in Table 2-2-2-1.6, donors and funding of the projects are yet to be decided.

If the Exchange of Notes for the new Queensway Substation is concluded in 2014, the operation will begin in 2017 as the tender and construction work require 26.0 months. In consideration of the fiscal conditions of UETCL and the fact that the donors of other upgrading projects are yet to be decided, the operation will likely begin later than planned sometime between 2017 and 2027.



［Source］ Compiled by Preparatory Study Team based on information from UETCL
Note: Power demand of past and future (estimated) is shown in the green color.

Figure 2-2-2-1.5 Power Plan in Kampala Metropolitan Area

In light of the pressed situation in which sufficient generation reserve margin for upgrading of multiple substations while conducting planned power outage is not secured in the Kampala metropolitan area, it is reasonable to increase the substation facility capacity gradually in accordance with the demand increase rather than concentrating all the upgrading work in 2017. It is appropriate to carry out the upgrading work for stable supply in such an order as Mutundwe Substation where the supply-demand balance is the tightest first and then Lugogo Substation, for example.

As shown in Figure 2-2-2-1.5, it is confirmed that power demand in the metropolitan area cannot be satisfied in the target year for the facility plan (2027) or the target year of the upper-level plan of the Grid Development Plan 2012-2028 (2028) (The standard Kampala scenario exceeds the existing facility plan in 2027.), even if the Project is carried out to achieve the total facility capacity of 120MVA (=40MVA-facility capacity x 3 banks) as requested and all the substation facilities in the metropolitan area are upgraded as planned by UETCL.

Thus, if the total facility capacity of the scope of the Japanese side is responsible for is 80MVA (=40MVA-facility capacity x 2 banks), the Ugandan side will need to develop a bank of substation facility with the facility capacity of 40MVA urgently after Japan implements the Project. In such a case, Uganda cannot choose a conventional substation facility that is less expensive than a Gas Insulated Switchgear for one bank of 40MVA facility capacity because this type of switchgear is a must for the site restrictions. The Ugandan side will need to develop one bank of substation facility with a Gas Insulated Switchgear. Although it will be in a slightly smaller scale than the Project, it still requires UETCL to make a large amount of capital investment with its own funding source urgently.

If the Ugandan side agrees to carry out the construction work, there still remains some concern over the rational division of responsibilities of the donor and recipient countries in such aid projects as the supervisor and engineers of the work need to be hired redundantly, for example, if each side carries out the substation construction work independently.

In consideration of the above, a power distribution facility plan for the Kampala metropolitan area suggested in the Project is shown in Table 2-2-2-1.13 and the supply-demand balance that reflects the plan is shown in Figure 2-2-2-1.5. (See “Facility Plan based on Demand Forecast.”) Power development in the area in line with the plan will enable gradual upgrade of substation facility capacity in accordance with demand increase and ensuring stable supply, while securing power supply in the target year for the project facility plan (2027). (Changes from the existing distribution facility plan are indicated in boldface and also shaded in the table.)

Table 2-2-2-1.13 Proposed 132kV Substation Upgrading Plan in Kampala Metropolitan Area

No.	Name	Voltage kV	Capacity MVA	Impedance %Z	Vector group	Year
1.	Lugogo Substation	132/11	60	Approx. 10%	YNyn0	**2019**
		132/33	60	Approx. 13.50%	YNyn0	**2019**
		132/33	60	Approx. 13.50%	YNyn0	**2019**
		132/11	60	Approx.10%	YNyn0+(d)	**2019**
2.	Kampala North Substation	132/33	40	Approx.13.50%	YNyn0	Existing
		132/11	40	Approx.10%	YNyn0+(d)	Existing
		132/11	40	Approx.10%	YNyn0+(d)	Existing
		132/33	40	Approx.13.50%	YNyn0+(d1)	Existing
		132/33	40	Approx.13.50%	YNyn0+(d1)	**2025**
3.	Mutundwe Substation	132/33	60	Approx.13.50%	YNyn0+(d)	**2019**
		132/33	60	Approx.13.50%	YNyn0	**2019**
		132/11	60	Approx.10%	YNyn0+(d)	**2019**
		132/11	60	Approx.10%	YNyn0+(d)	**2019**
4.	Kawaala Substation	**132/33**	**40**	Approx.10%	Yy0d1	**2023**
		132/33	**40**	Approx.10%	Yy0d1	**2023**
5.	132/33 kV Substation	132/33	40	Approx.13.50%	YNyn0	**2017**
		132/33	40	Approx.13.50%	YNyn0	**2017**
		132/33	40	Approx.13.50%	YNyn0	**2017**
	Total		920			

［Source］ Preparatory Study Team

2-2-2-2 Load Flow Analysis

Load flow analysis was performed for the first 10 years after the service begins (2017 to 2027) in order to examine the relevance and effectiveness of the Project for Improvement of Queensway Substation. (The analysis was also performed for the first one year to evaluate the impact of the Project.)

(1) Basic Plan for Load Flow Analysis in the Study

The basic plan of the load flow analysis is shown in Table 2-2-2-2.1. The target area is the Kampala metropolitan area (area from Kiira-Nalubaale and Bujagali Hydro Plant east of the metropolitan area to Kabulasoke Substation west of the area). The entire country was simulated for the analysis to examine the load flow from the east and west to the metropolitan area. However, the voltage was adjusted mainly in the metropolitan area. An overview of the scope of the load flow analysis is shown in Figure 2-2-2-1.1.

Table 2-2-2-2.1 Basic Plan for Load Flow Analysis

Area	- Kampala metropolitan area (Figure 2-2-2-1.1) (Computing area is the whole country)
Voltage	- Transmission system in the Area (132 kV and 220 kV Substation and transmission lines) (It considers 33 kV and 11 kV secondary side of substations)
Demand	- Forecasted based on the present power demand and Actual DGP (Refer to Appendix7-1: Demand distribution of Uganda) - Power factor 95%※1
Major aspects of analysis	- Assumed commission year (2017) - Target year for the evaluation of effectiveness of the Project (2020)

	- Target year for the design of the Project (2027)
Evaluation	- Overload of substations and transmission line (within 100% during the normal condition) - Voltage of bus bar is within +/- 5%※2 - Three phase short circuit at Queensway Substation

※1 Average power factor obtained based on the actual peak demand.
※2 We used the appropriate range of the maximum voltage of ±6 percent for the voltage in the remote area from the metropolitan area.
［Source］ The Electricity (Primary Grid Code) Regulations, 2003

(2) Basic Data on Load Flow Analysis

1) Demand forecast

Power demand and real GDP and other data gathered in the first field study was used as chronological data based on the policy of the Grid Development Plan 2012-2028 formulated by UETCL to forecast the demand until 2027.

2) Supply-demand balance forecast

Uganda's power development plan was sorted out to forecast the supply-demand balance together with UETCL through the field survey based on the Grid Development Plan 2012-2028 and the latest trend found in the field survey. [Appendix A-7-2: Supply-Demand Balance of Uganda]

3) Supply facility

The facility plan gathered in the first field survey was incorporated based on the load flow analysis model data formulated by UETCL. (System analysis software: Siemens PSS/E)

[Appendix A-7-3: Power Generation Facility Plan, Appendix A-7-4: Transmission Facility Plan, and Appendix A-7-5: Substation Facility Plan]

Table 2-2-2-2.2 Demand Forecast in Kampala Metropolitan Area

(Unit: MW)

Name of Substation	Voltage [kV]	2016	2017 Before the Project	2017 After the Project	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Lugogo	11	68	72	56	60	53	56	81	86	85	90	92	98	104
	33	51	55	56	60	53	57	81	86	85	91	92	98	104
Kampala North	11	68	72	56	60	53	56	53	57	57	60	62	65	70
	33	51	55	56	60	53	57	53	58	57	61	92	98	104
Mutundwe	11	34	36	29	30	79	84	81	86	85	90	92	98	104
	33	67	71	57	60	79	84	81	86	85	91	92	98	104
Kawaala	33	14	15	14	15	13	14	13	14	55	60	61	65	71
Queensway	33	31	32	84	90	79	84	81	86	85	90	92	98	104
Demand at Kampala	-	384	408	408	435	462	492	524	559	594	633	675	718	765
Kawanda	33	18	19	19	19	20	20	21	21	22	23	23	24	24
Namanve	33	8	3	3	5	6	8	9	12	13	14	17	19	21
Namanve South	33	8	9	9	10	11	12	13	14	16	18	20	22	25
Lugila	33	4	5	5	6	7	8	9	10	11	12	13	14	15
Mukono	33	8	9	9	10	11	12	13	14	16	18	20	22	25
Entebbe	33		5	5	5	5	5	5	5	5	5	5	5	5
Demand outside of Kampala	-	46	50	50	55	60	65	70	76	83	90	98	106	115
Nalbale	33	28	23	23	23	24	25	26	28	30	32	34	38	42
Lugazi	33	9	15	15	16	17	18	19	20	21	22	23	24	25
Demand at eastern area	-	37	38	38	39	41	43	45	48	51	54	57	62	67
Total demand	-	467	496	496	529	563	600	639	683	728	777	830	886	947

4) Switch Shunt

The capacitor or reactor is input if necessary for operation to maintain the appropriate voltage range with the switch shunt of load flow analysis model data (2013, 2015, 2018 and 2020) formulated by UETCL as the existing facility. [Appendix A-7-6: Switch Shunt]

5) Short Circuit

The constant set in the load flow analysis model data is used as the constant data of the power generator necessary to calculate the short-circuit current. (It is regarded reasonable as there is no significant difference with the constant used as the standard in Japan.)

(3) Power System Model

The system model of the Kampala metropolitan area around the Queensway Substation is created with the system analysis software, Seamens PSS/E, based on the basic data described above. Consideration is given to examine the relevance and effectiveness of the urgency and technical impacts as a Grant Aid Project provided by Japan while examining the consistency with the future demand and power development plan of Uganda.

(4) Load Flow Analysis

The load flow analysis was performed for the 11 years from one year before the beginning of operation (2016) as the condition before the Project to 10 years after the beginning (2027) in order to examine the impact of the Project.

1) Analysis results and relevance and effectiveness evaluation of the Project

The losses calculated based on the load flow analysis results are shown in Table 2-2-2-2.3. The cross-sectional load flow analysis results (current diagram) of each year are shown in Figures from 2-2-2-2.1 to 2-2-2-2.13.

Table 2-2-2-2.3 Calculation Results of Losses in Load Flow Analysis

			2016	2017 Before the Project	2017 After the Project	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Kampala															
Demand※1 [MW]	Demand in Kampala metropolitan area	A	384	408	408	435	462	492	524	559	594	633	675	718	765
	Demand outside of metropolitan area	B	46	50	50	55	60	65	70	76	83	90	98	106	115
	Demand of eastern area (Partly)	C	37	38	38	39	41	43	45	48	51	54	57	62	67
	Total demand[A+B+C]	D	467	496	496	529	563	600	639	683	728	777	830	886	947
Generation	Generation in metropolitan area [MW] ※2	E	482	532	532	632	632	632	632	632	662	662	662	662	662
Power supplied [MW]	Bujagali 220 kV	-	50.8	2.6	0.8	-25.8	-57.8	-69.2	-25.6	-12.4	-4.8	7.6	19.0	26.8	40.8
	Bujagali 132 kV	-	-23.0	-30.6	-31.8	-50.2	-58.0	-60.2	-51.4	-46.8	-46.8	-42.2	-37.6	-33.4	-28.2
	Eastern area ※3 : Total power supplied	F	27.8	-28.0	-31.0	-76.0	-115.8	-129.4	-77.0	-59.2	-51.6	-34.6	-18.6	-6.6	12.6
	Kabulasoke 220kV	-	-	-	-	-	-	31.4	35.0	37.0	41.4	46.4	52.0	58.4	70.4
	Kabulasoke 132kV	-	-21.1	37.0	37.1	25.8	27.2	23.1	21.4	23.7	18.8	21.3	26.4	34.3	39.1
	Western area ※3 : Total power supplied	G	-21.1	37.0	37.1	25.8	27.2	54.5	56.4	60.7	60.2	67.7	78.4	92.7	109.5
	Kawanda 400kV	-	-	-	-	25.8	123.6	159.2	167.8	208.6	243.0	285.4	322.0	343.2	391.0
	Kawanda 220kV	-	-	-25.4	-25.4	-56.4	-82.0	-94.2	-115.4	-132.0	-154.8	-170.8	-178.8	-167.6	-187.4
	Northern area ※3 : Total power	H	-	-25.4	-25.4	-30.6	41.6	65.0	52.4	76.6	88.2	114.6	143.2	175.6	203.6

			2016	2017 Before the Project	2017 After the Project	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
	supplied														
	Total power supplied[F+G+H]	I	6.7	-16.4	-19.3	-80.8	-47.0	-9.9	31.8	78.1	96.8	147.7	203.0	261.7	325.7
Generation and supplied power	Generation + Supplied power [MW] [E+I]	J	488.7	515.6	512.7	551.2	585.0	622.1	663.8	710.1	758.8	809.7	865.0	923.7	987.7
Loss	Loss of metropolitan area [MW] [J-D]	K	21.7	19.6	16.7	22.2	22.0	22.1	24.8	27.1	30.8	32.7	35.0	37.7	40.7
	Loss factor [%] [K/D]	L	4.65	3.95	3.37	4.20	3.91	3.68	3.88	3.97	4.23	4.21	4.22	4.26	4.30
Uganda as a whole															
Demand	Demand[MW]	M	588	627	627	670	715	763	814	869	928	991	1058	1129	1205
Generation	Total power generation [MW]	-	567	708	708	1050	1150	1350	1350	1400	1480	1780	1780	1981	1981
Loss	Loss of Uganda [MW]※4	N	37.3	34.4	31.5	42.8	47.2	46.2	52.7	58.6	71	68.5	72.6	77.7	83.9
	Loss factor [%] [N/M]		6.34	5.49	5.02	6.39	6.6	6.06	6.47	6.74	7.65	6.91	6.86	6.88	6.96

※1 Details are shown in Attached Table 2-2-2-2.2 Demand Forecast in Metropolitan Area.

※2 Bujagali Phdro Plant (250MW) + Kiira-Nalubaale Hydro Plant 200MW) + Kakira Hydro Plant (32MW) + Isimba Hydro Plant (The output can vary by year.)

※3 It shows the direction of power reception and transmission to the metropolitan area (Reception to the metropolitan area is positive.)

※4 The losses of entire Uganda are shown from the PSS/E load flow analysis results.

[1] 2016 cross-section (Figure 2-2-2-2.1)

【Nalubaale demand is transferred to Iganga】

・ The operation requires attention as there may be excessive loading (102%) due to imbalance between the output of Kakira Hydro Plant and Nalubaale Hydro Plant and demand of Nalubaale at the Kiira-Nalubaale Hydro Plant (132/33 kV: 20 MVA x 2 banks) that is the supply route to the metropolitan area. There are transformers that exceed rating capacity of 90 percent in the substations in the metropolitan area (Kampala North, Lugogo and Mutundwe).

[2] Immediately before operation of 132/33 kV Queensland Substation in 2017 (Figure 2-2-2-2.2)

【2 132 kV enhanced lines in metropolitan area ➔ 4 lines: north-south route in the eastern side [Nalubaale-Bujagali]】

【1 132 kV enhanced line in metropolitan area → 2 lines: east-west route [Naluubale-Namanve-Kampala North]】

・ As there is excessive loading (111%) of transformers at the Lugogo Substation (132/33 kV: 40 MVA x 2 banks), power supply to the Kampala metropolitan area is interfered. Because there are transformers that exceed rating capacity of 95 percent in the substations in the metropolitan area (Kampala North, Lugogo and Mutundwe), power supply is in extremely difficult situations.

[3] Beginning of operation of 132/33 kV Queensland Substation in 2017 (Figure 2-2-2-2.3)

【Beginning of operation of 132/33 kV Queensland Substation】

・ The implementation of the Project solved the problem of power supply to the Kampala metropolitan area caused by excessive loading of substations.

・ Regardless of the demand increase by 160 percent at the Queensland Substation, voltage improved by 1.31 percent. It is the improvement of 2.31 percent if the demand is the same amount.

Table 2-2-2-2.4 Voltage in Kampala Metropolitan Area

Queensway Substation	2017 Before the Project	2017 After the Project※1	2017 After the Project
Demand[MW]	32	32	84
Voltage of busbar：33kV[kV]	31.14	31.86	31.55

※1 When demand is assumed to be the same as that before operation.

・ Losses to the demand in the Kampala metropolitan area is cut by 0.58 percent. (Tables 3-2-2-2.3 and 3-2-2-2.5)

Table 2-2-2-2.5 Loss Rate in Kampala Metropolitan Area (excerpt from Table 2-2-2-2.3)

Kampala metropolitan area	2017 Before the Project	2017 After the Project
Load[MW]	496	496
Loss[MW]	19.6	16.7
Loss factor [%]※1	3.95	3.37

※1 Loss rate = loss/load

[4] 2018 cross-section (Figure 2-2-2-2.4)

【Beginning of operation of Karma Hydro Plant (200 MW)】

【Power output increase at Simba Hydro Plant (50 MW→150 MW)】

・ Power reception from the eastern side of the metropolitan area increases in line with the power output increase at Isimba Hydro Plant. However, it does not affect the Kampala metropolitan area and does not interfere with power supply. The beginning of operation of Karuma Hydro Plant does not have any impact on the metropolitan area.

[5] 2019 cross-section (Figure 2-2-2-2.5)

【Power output increase at Karuma Hydro Plant (200 MW→300 MW)】

【Mutundwe Substation enhancement (80 MVA [33 kV]+40 MVA [11 kV]→120 MVA+120 MVA)】

【Transfer of demand in the metropolitan area as a result of Mutundwe Substation enhancement】

・ Power reception from the northern side due to increase at Karuma in line with the power demand increase of Mutundwe. However, it does not affect the Kampala metropolitan area and does not interfere with power supply.

[6] 2020 cross-section (Figure 2-2-2-2.6)

【Beginning of operation of Ayago Hydro Plant】

【Increase of 220kV transmission line routes in western area (east-west) from the metropolitan area [Mutundwe-Kabulasoke-Nkenda]】

・ Although power reception from the western side increases as a result of increase in 220kV transmission lines in the route of Mutundwe- Kabulasoke-Nkenda, it does not affect the metropolitan area and power supply is not interfered. The operation of Ayago Hydro Plant does not affect the area, either.

[7] 2021 cross-section (Figure 2-2-2-2.7)

【Increase of 400kV transmission lines from northern to eastern areas [Karuma-Tororo]】

【Lugogo Substation enhancement (80 MVA [33 kV]+80 MVA [11 kV]→120 MVA+120 MVA)】

【Transfer of demand in metropolitan area as a result of Lugogo Substation enhancement】

・ Power transmission from the metropolitan area to the eastern area decreases and the transmission from the eastern side to the metropolitan area increases as a result of increase of 400kV transmission lines between Karuma and Tororo. Although this causes the

transmission capacity in part of 132kV transmission lines between Bujagali and Nalubaale to be 92 percent, it does not interfere power supply to the metropolitan area.

[8] 2022 cross-section (Figure 2-2-2-2.8)

【Output increase at Karuma Hydro Plant (400 MW→450 MW)】

- Because supply from the eastern side increases as a result of demand increase, part of 132kV transmission lines between Bujagali and Nalubaale becomes 99 percent of transmission capacity. However, it does not interfere supply to the metropolitan area. Although the supply from the western side also increases as a result of output increase (400 MW→450 MW) at Karuma Hydro Plant, it does not have any impact.

[9] 2023 cross-section (Figure 2-2-2-2.9)

【Power output increase at Isimba Hydro Plant (150 MW→180 MW)】

【Power output increase at Karuma Hydro Plant (450 MW→500 MW)】

【Enhancement of Kawala Substation (20 MVA [33 kV]+20 MVA [11 kV]→40 MVA+40 MVA)】

【Transfer of demand in metropolitan area as a result of Kawala Substation enhancement】

- Supply from the eastern side increases as a result of demand increase in the metropolitan area and output increase at Isimba Hydro Plant (150 MW→180 MW) and there is excessive loading (109%) in part of 132kV transmission lines between Bujagali and Nalubaale to interfere the supply in the metropolitan area. There is need to transfer demand at the low-voltage side (33kV) or enhance the applicable 132kV transmission lines to solve excessive loading.
- Although supply from the western side of the metropolitan area increases as a result of output increase at Karuma Hydro Plant (450 MW→500 MW), it has no impact.

[10] 2024 cross-section (Figure 2-2-2-2.10)

【Output increase at Karuma Hydro Plant (500 MW→600 MW)】

【Output increase at Ayago Hydro Plant (100 MW→300 MW)】

- There is excessive loading in part of 132kV transmission lines between Bujagali and Nalubaale (continuation from 2023 cross-section).
- Although supply from eastern side and northern + western route increases as a result of demand increase, it does not interfere power supply to the Kampala metropolitan area excluding the excessive loading mentioned above.

[11] 2025 cross-section (Figure 2-2-2-2.11)

【No major plan】

- There is excessive loading in part of 132kV transmission lines between Bujagali and Nalubaale (continuation from 2023 cross-section).
- Although supply from eastern side and northern + western route increases as a result of demand increase, it does not interfere power supply to the Kampala metropolitan area excluding the excessive loading mentioned above. However, attention is called for as the 132kV transmission line of Kiira/Nalubaale-Namanve becomes 90 percent of transmission

capacity.

[12] 2026 cross-section (Figure 2-2-2-2.12)

【Output increase at Ayago Hydro Plant (300 MW→500 MW)】

- There is excessive loading in part of 132kV transmission lines between Bujagali and Nalubaale (continuation from 2023 cross-section).
- Although supply from eastern side and northern + western route increases as a result of demand increase, it does not interfere power supply to the Kampala metropolitan area excluding the excessive loading mentioned above. However, attention is called for as the transmission line connected to the Queensway substation becomes 90 percent of transmission capacity due to demand increase of the substation.

[13] 2027 cross-section (Figure 2-2-2-2.13)

【No major plan】

- Excessive loading (101%) occurs to all 132kV transmission lines between Bujagali and Nalubaale (continuation from 2023 cross-section + new excessive loading (101%) in 2027).
- As supply from the eastern side increases in line with demand increase, there is excessive loading (102%) of 132 kV transmission lines between Kiira/Nalubaale and Namanve in addition to the excessive loading mentioned above. This interferes power supply to the Kampala metropolitan area. As it exceeds 90 percent of transformer capacity at all substations in the metropolitan area (Kampala North, Kawala, Lugogo and Mutundwe), it is an extremely difficult cross-section.

2) Confirming short circuit current

Three-phase short-circuit current was calculated in the condition of all power generation plants in Uganda put in parallel (2027). The three-phase short-circuit current in 2017 and 2020 was also calculated for reference. Table 2-2-2-2.6 shows short-circuit current results. It is within 31.5 [kA] that is the indicator of short-circuit current and thus there is no problem in the project facility.

Table 2-2-2-2.6 Short Circuit

Substation	Busbar voltage [kV]	Short circuit current [kA]		
		2017 After the Project	2020	2027
132/33 kV Queensway Substation	132	6.80	9.17	9.75
	33	16.61	19.71	20.50

(5) Policy on Relevance and Recommendations

1) Confirmation of relevance and effectiveness

- As the operation of Lugogo Substation is excessively loaded and other substations in the metropolitan area exceeds 95 percent of rating capacity before the implementation of the

Project in 2017, 2017 is appropriate as the time of its implementation.

- As the operation of substations in the area becomes below 80 percent of the rating capacity after the implementation of the Project, the excessive loading is improved (Figure 2-2-2-2.3). Voltage drop (Table 2-2-2-2.5) and transmission losses (Table 2-2-2-2.6) also improved. For the grounds, the Project is essential to meet the increasing demand in the Kampala metropolitan area.
- Although two 132kV transmission lines between Lugogo and Mutundwe are stopped for the construction work of the Project, it does not interfere supply to the metropolitan area during the period (before implementation of the Project in 2016 and 2017).
- As the required interrupting capacity does not exceed the indicator of 31.5kA in 2027 shown in Table 2-2-2-2.6, there is no problem in the facility plan.

2) Recommendations on items to be borne by Uganda

- As the transformer of the Kiira/Nalubale Substation (132 kV/33 kV: 20 MVA x 2 banks) are likely to be excessively loaded in some situations due to the imbalance of supply and demand of the secondary 33kV in 2016 before the implementation, attention is called for in operation.
- When one transmission line in the Kampala metropolitan area is stopped during the construction period of the Project, attention is called for the following:

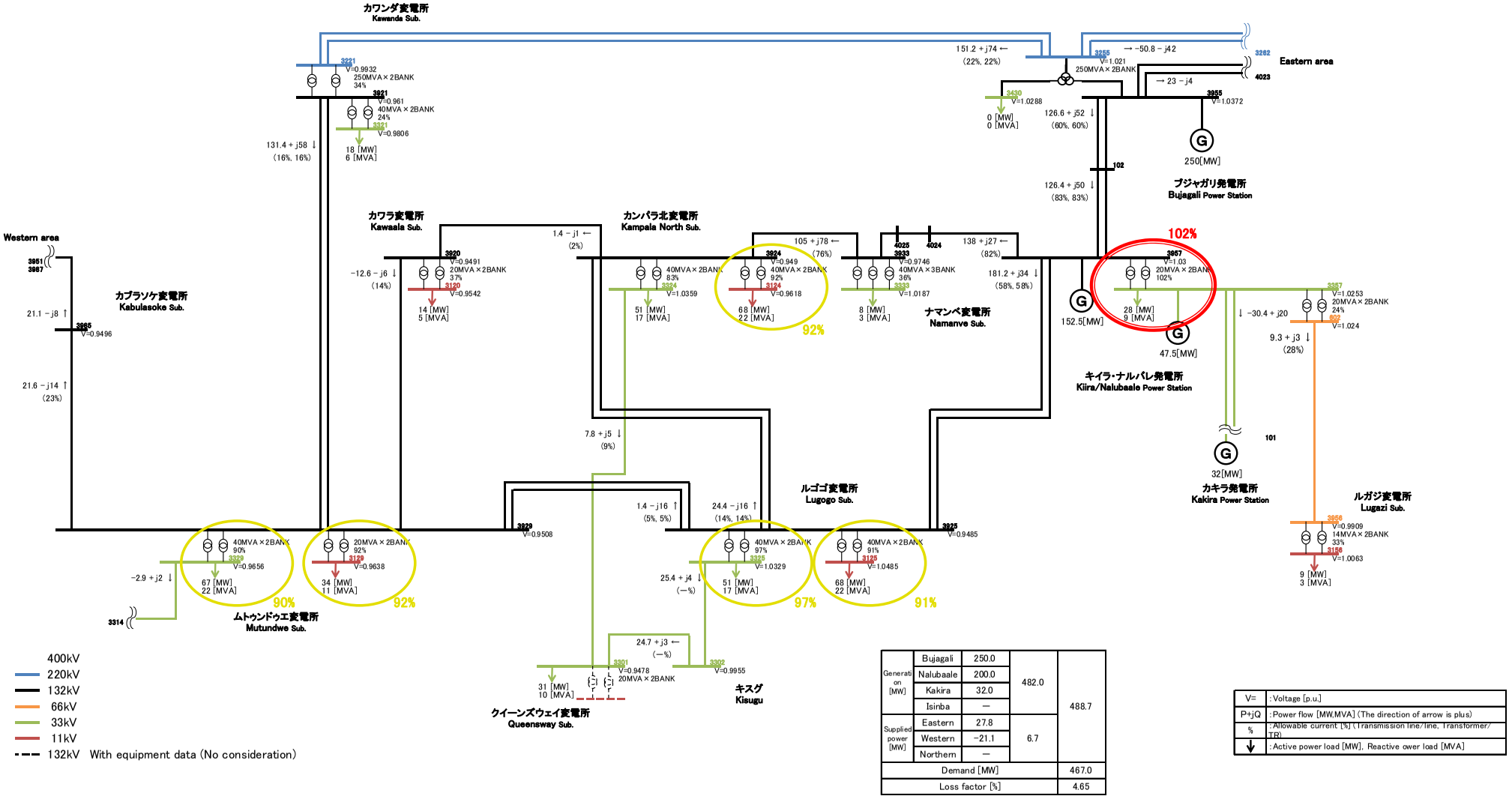
[1] 2016 cross-section

When one line between Kiira/Nalubaale and Lugogo is stopped, the part between Namanve and Kiira/Nalubaale is highly likely to be excessively loaded. When the part between Kampala North and Namanve where the route cannot be used, it is highly likely that voltage in the metropolitan area is not maintained.

[2] Immediately before operation of Queensway Substation in 2017

Power supply to the Kampala metropolitan area is not disturbed after the enhancement of transmission lines between Namanve and Kiira/Nalubaale and between Kampala North and Namanve. It is the same as 2016 before the enhancement.

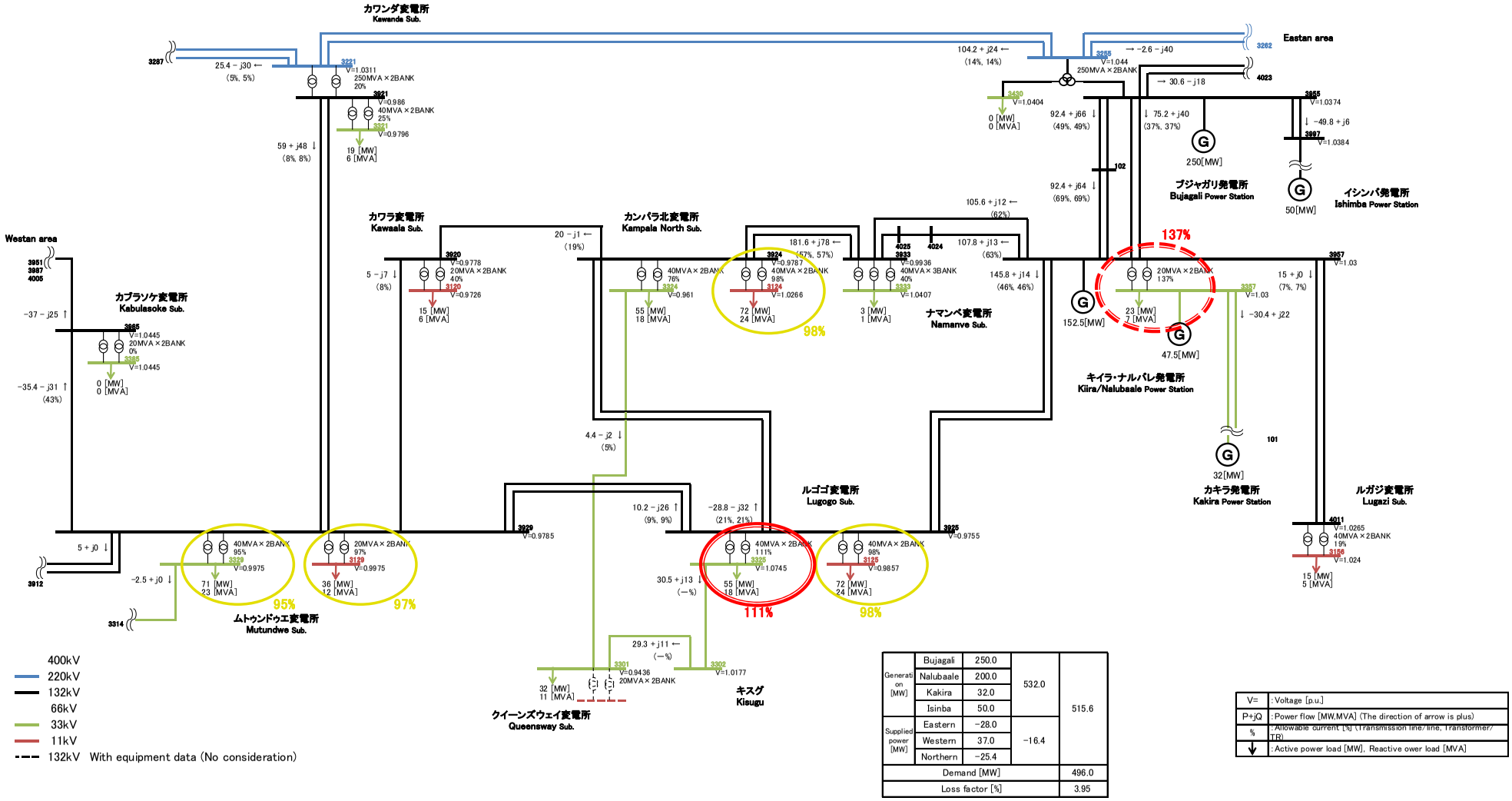
- It is likely that the transmission lines between Bujagali and Nalubaale and between Nalubaale and Namanve will need to be enhanced to meet the demand increase in the metropolitan area after 2023.



Generation [MW]	Bujagali	250.0	482.0	488.7
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	—		
Supplied power [MW]	Eastern	27.8	6.7	
	Western	-21.1		
	Northern	—		
Demand [MW]				467.0
Loss factor [%]				4.65

V=	: Voltage [p.u.]
P+jQ	: Power flow [MW,MVA] (The direction of arrow is plus)
%	: Allowable current [%] (Transmission line/line, Transformer/TR)
↓	: Active power load [MW], Reactive ower load [MVA]

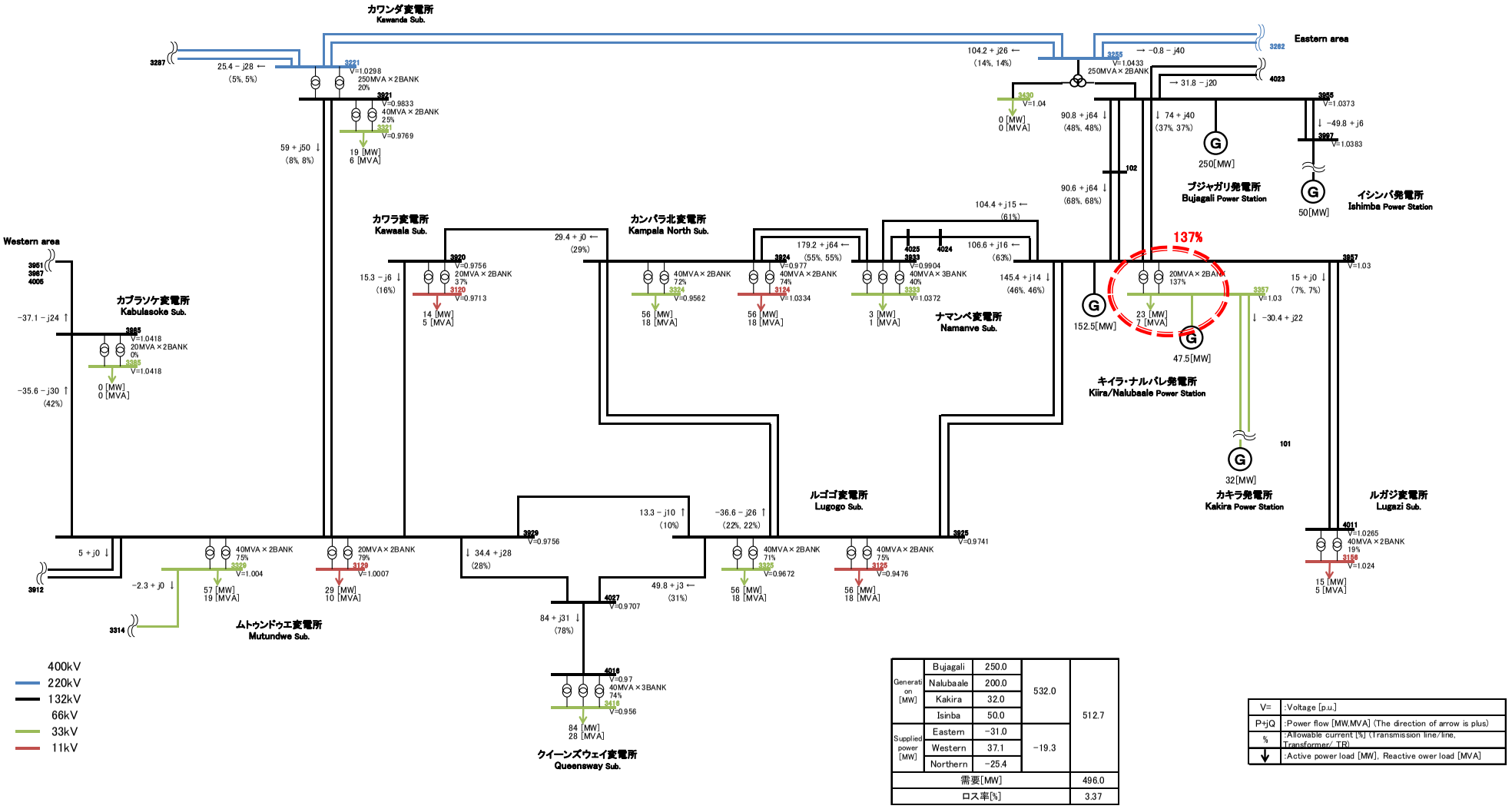
Figure 2-2-2-2.1 Power flow analysis (2016)



Generation [MW]	Bujagali	250.0	532.0	515.6
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	50.0		
Supplied power [MW]	Eastern	-28.0	-16.4	
	Western	37.0		
	Northern	-25.4		
Demand [MW]				496.0
Loss factor [%]				3.95

V=	: Voltage [p.u.]
P+jQ	: Power flow [MW,MVA] (The direction of arrow is plus)
%	: Allowable current [%] (Transmission line/line, Transformer/TR)
↓	: Active power load [MW], Reactive ower load [MVA]

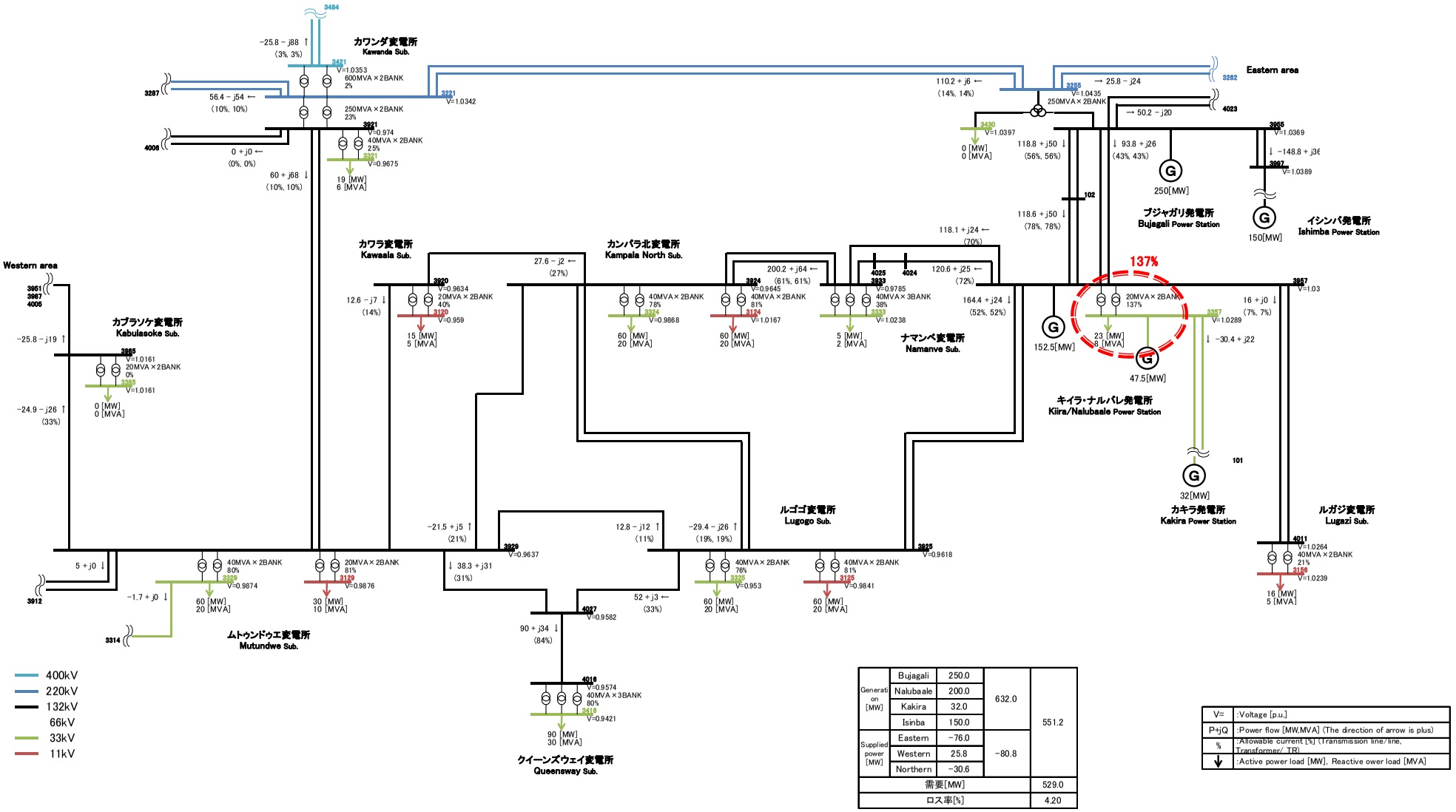
Figure 2-2-2-2.2 Power flow analysis (2017), before commission



Generation [MW]	Bujagali	250.0	532.0	512.7
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	50.0		
Supplied power [MW]	Eastern	−31.0	−19.3	
	Western	37.1		
	Northern	−25.4		
需要[MW]				496.0
ロス率[%]				3.37

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.3 Power flow analysis (2017), after commission



Generation [MW]	Bujagali	250.0	632.0	551.2
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	150.0		
Supplied power [MW]	Eastern	−76.0	−80.8	
	Western	25.8		
	Northern	−30.6		
需要[MW]				529.0
ロス率[%]				4.20

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.4 Power flow analysis (2018)

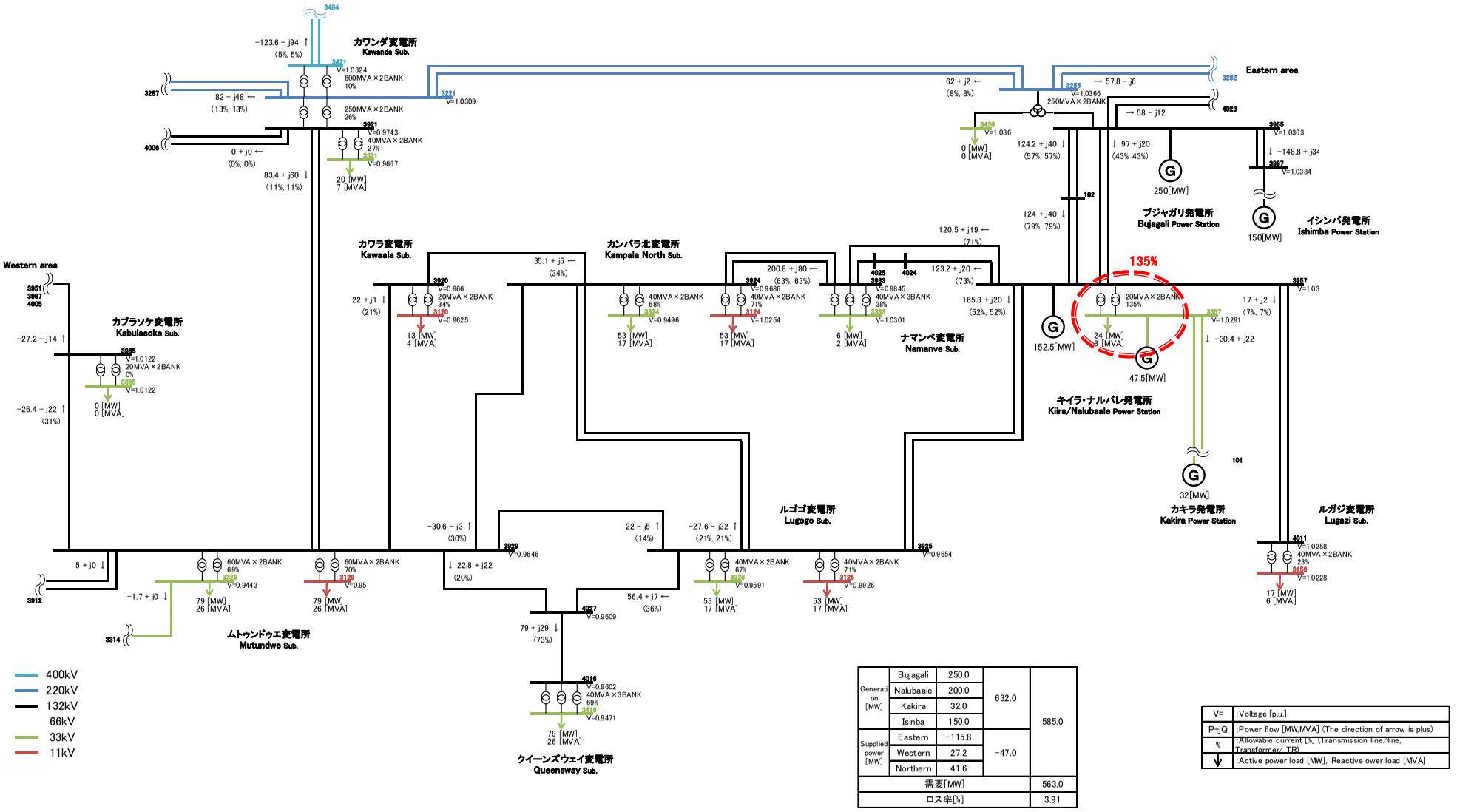


Figure 2-2-2-2.5 Power flow analysis (2019)

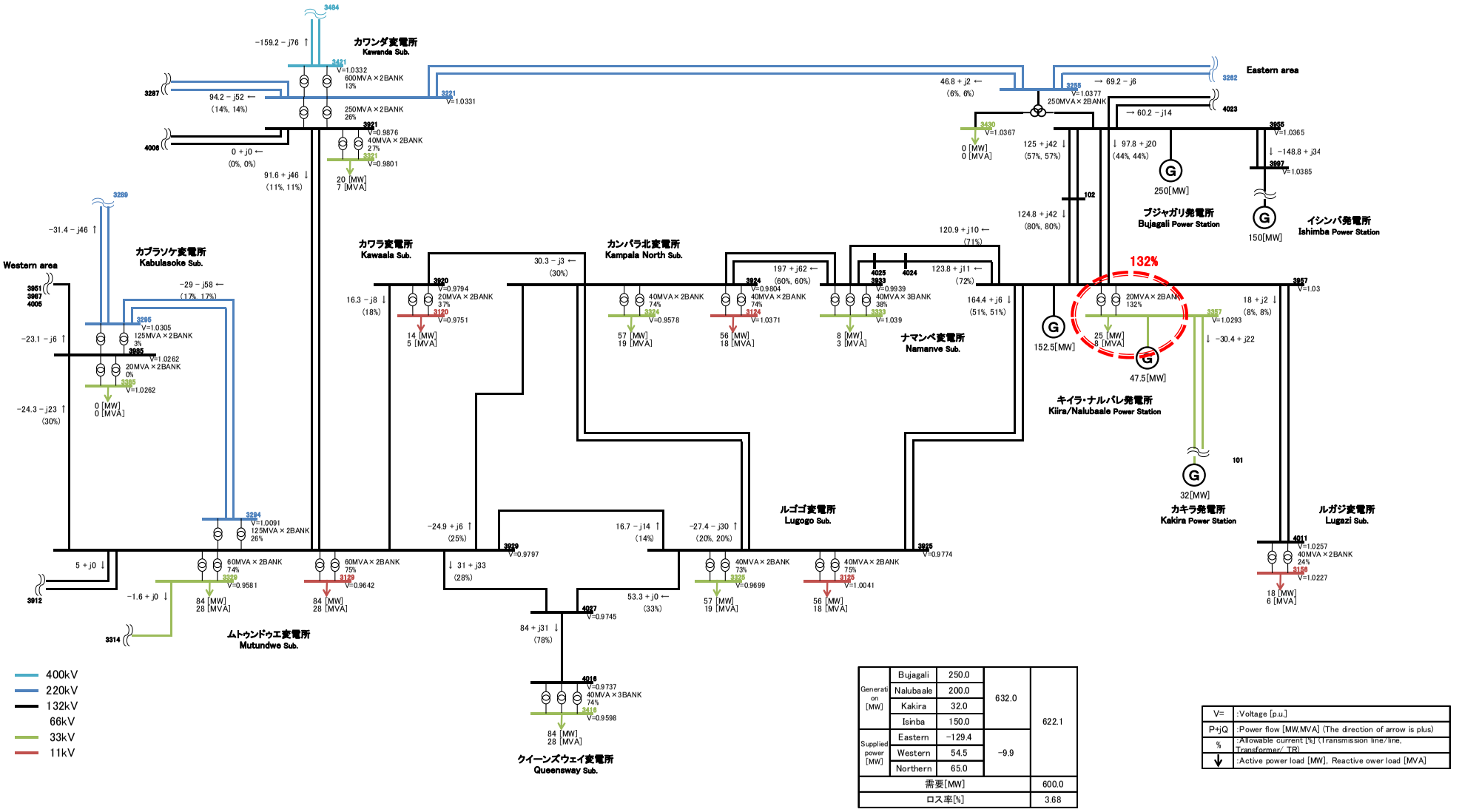
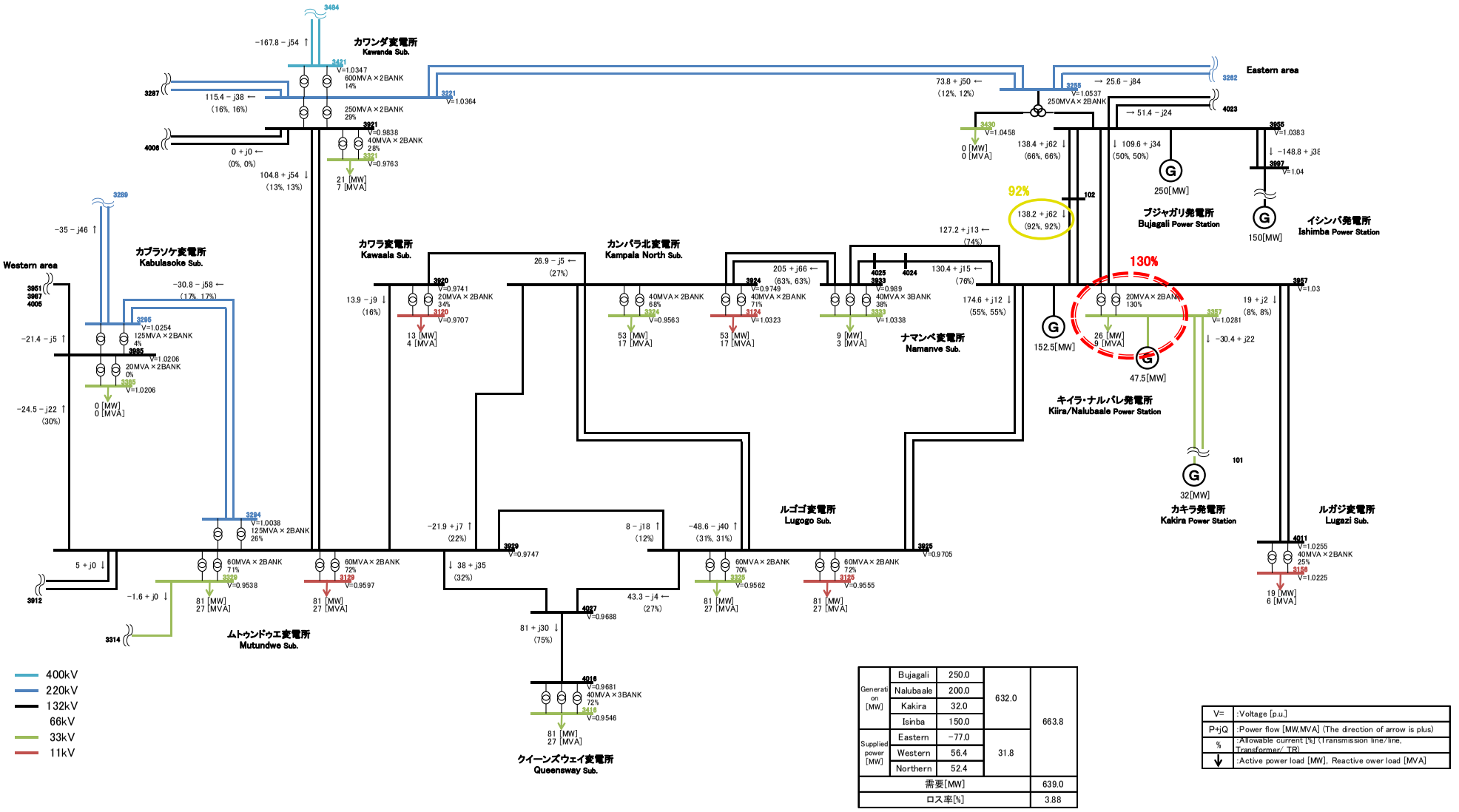


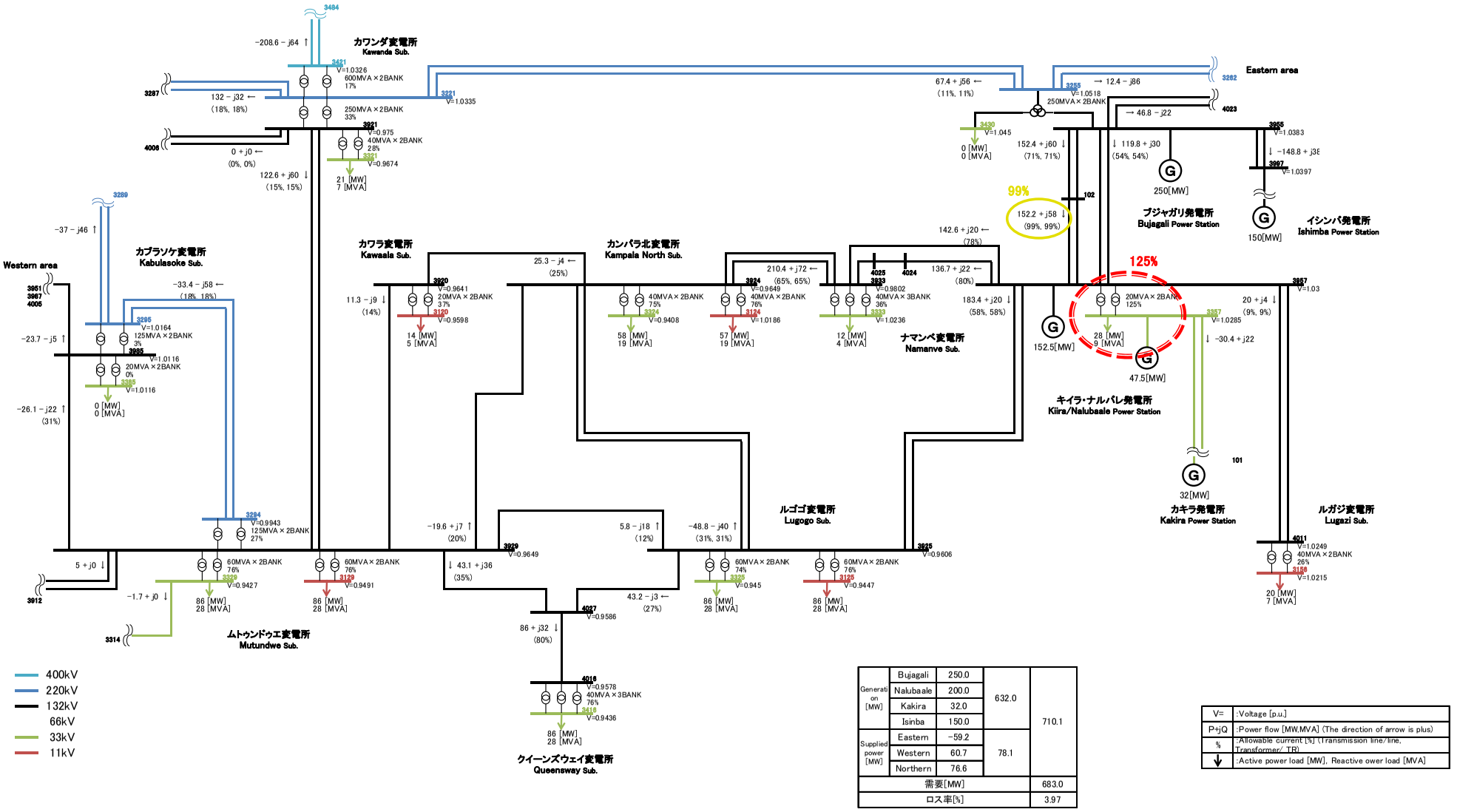
Figure 2-2-2-2.6 Power flow analysis (2020)



Generation [MW]	Bujagali	250.0	632.0	663.8
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	150.0		
Supplied power [MW]	Eastern	−77.0	31.8	
	Western	56.4		
	Northern	52.4		
需要[MW]				639.0
ロス率[%]				3.88

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

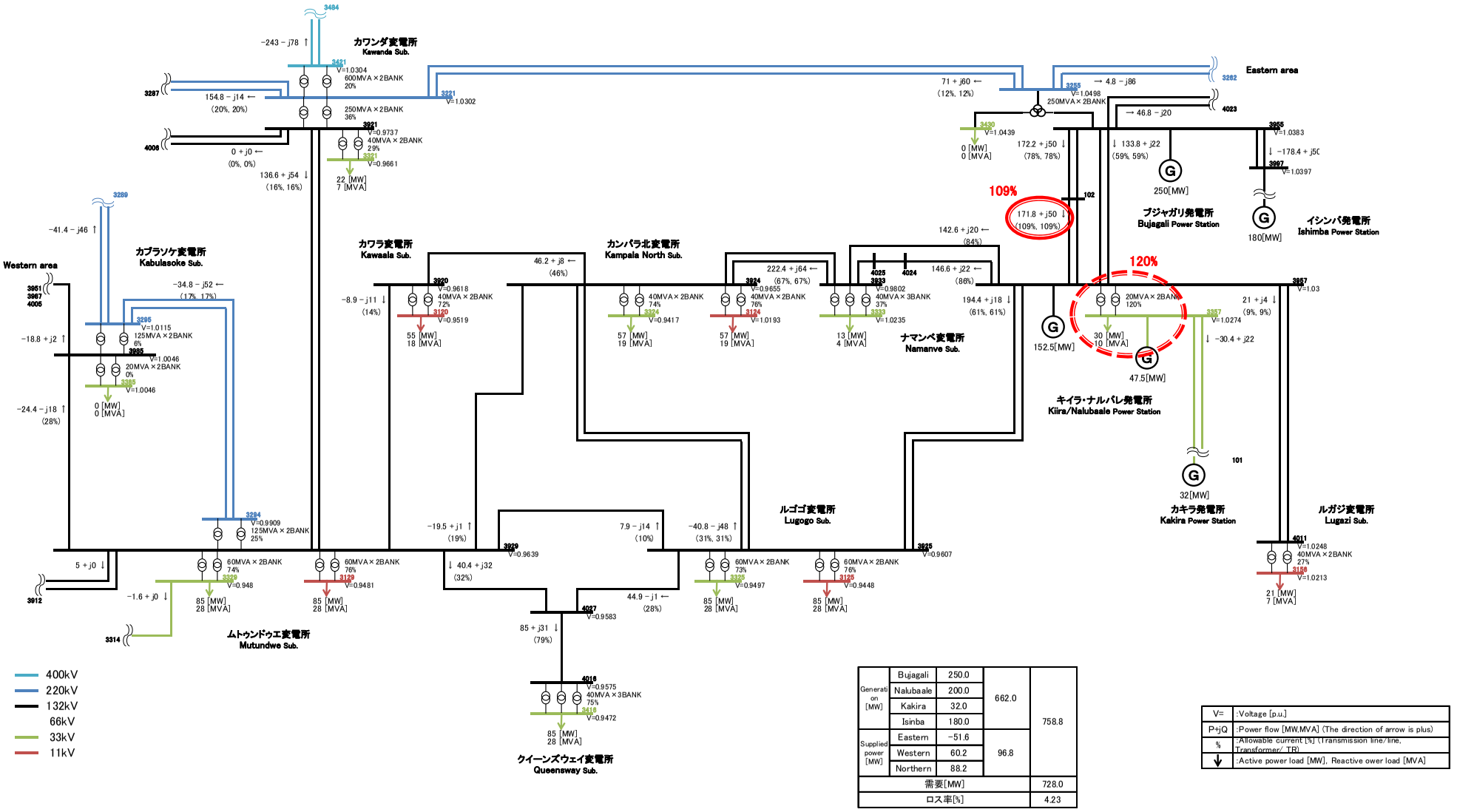
Figure 2-2-2-2.7 Power flow analysis (2021)



Generation [MW]	Bujagali	250.0	632.0	710.1
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	150.0		
Supplied power [MW]	Eastern	−59.2	78.1	
	Western	60.7		
	Northern	76.6		
需要[MW]				683.0
ロス率[%]				3.97

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

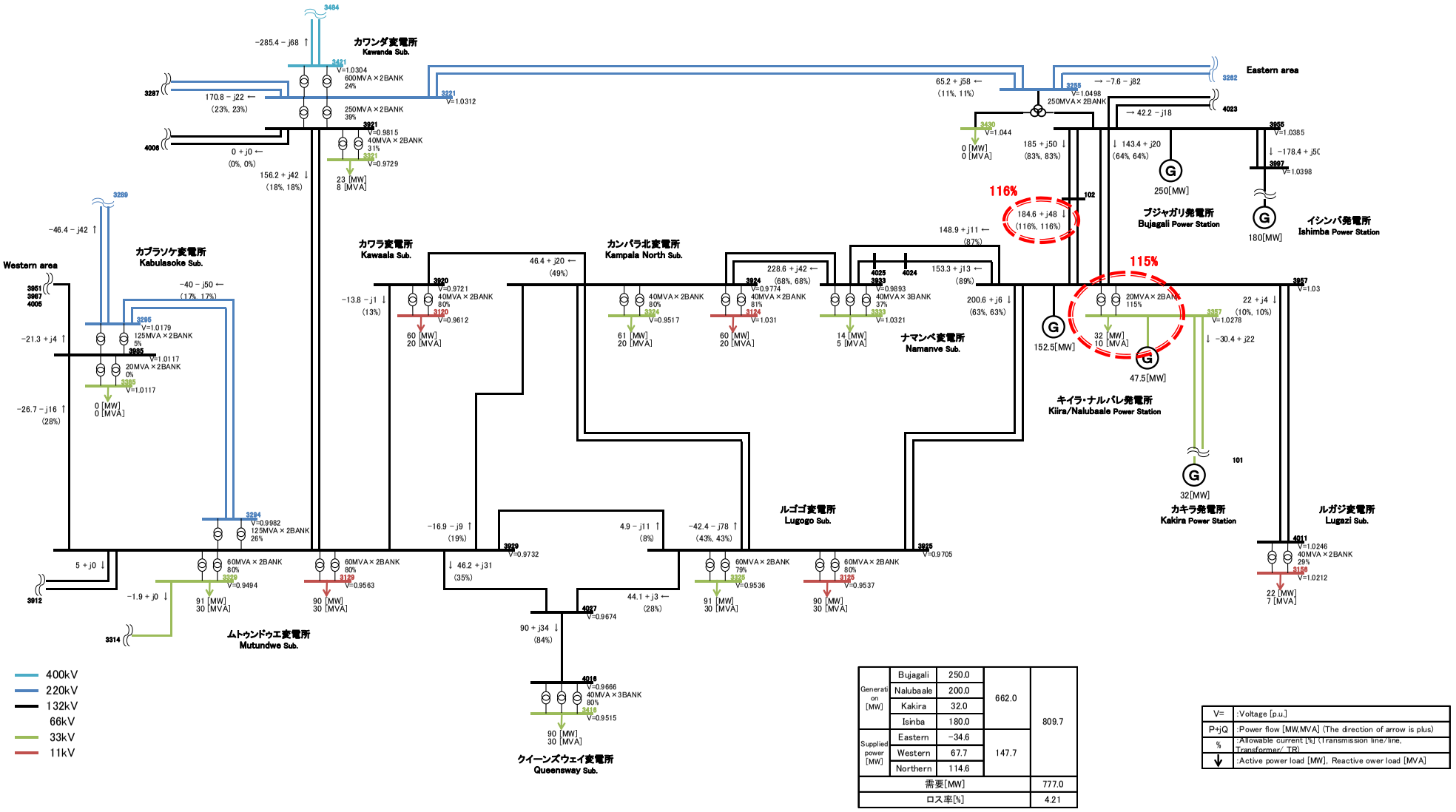
Figure 2-2-2-2.8 Power flow analysis (2022)



Generation [MW]	Bujagali	250.0	662.0	758.8
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	180.0		
Supplied power [MW]	Eastern	−51.6	96.8	
	Western	60.2		
	Northern	88.2		
需要[MW]				728.0
ロス率[%]				4.23

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.9 Power flow analysis (2023)



Generation [MW]	Bujagali	250.0	662.0	809.7
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	180.0		
Supplied power [MW]	Eastern	−34.6	147.7	
	Western	67.7		
	Northern	114.6		
需要[MW]				777.0
ロス率[%]				4.21

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.10 Power flow analysis (2024)

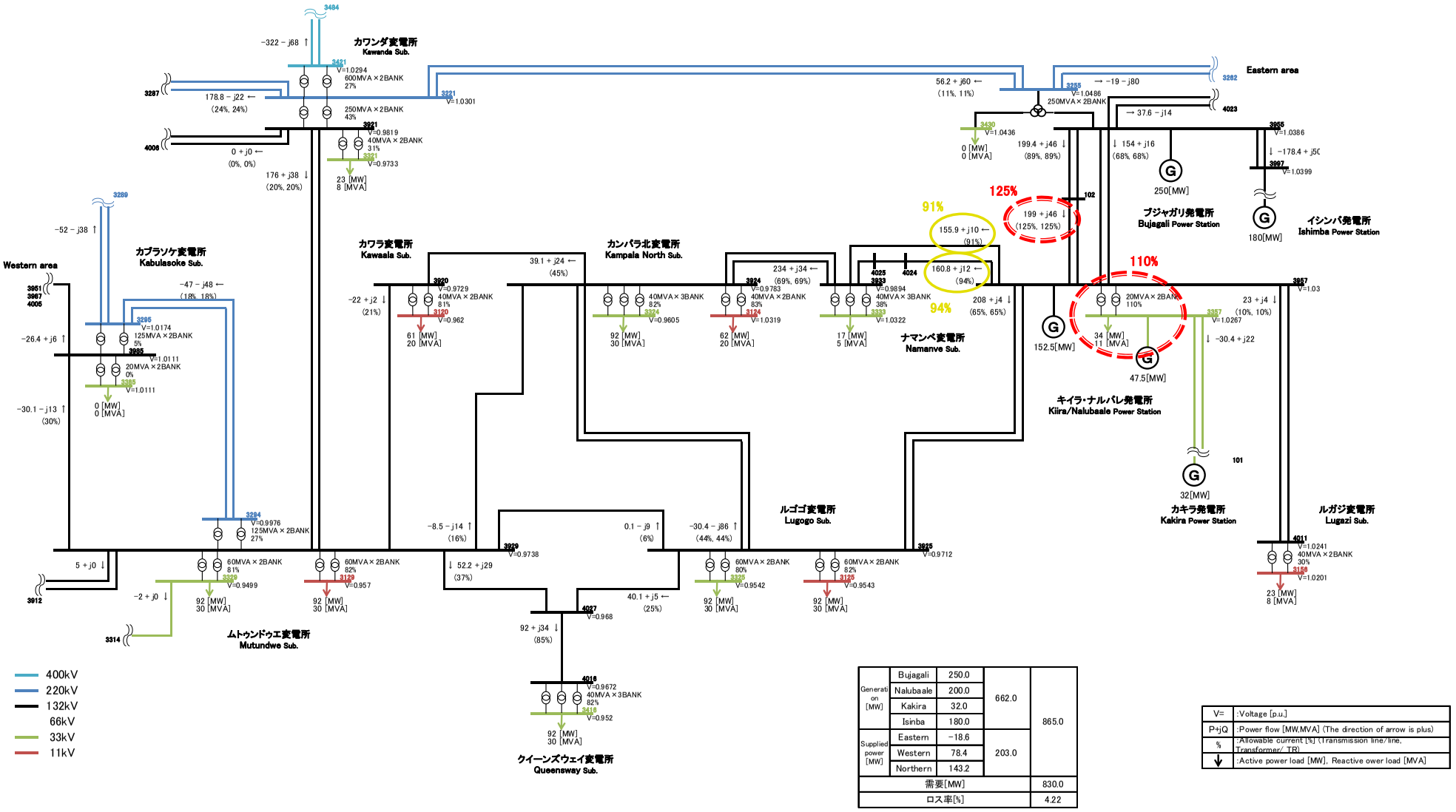
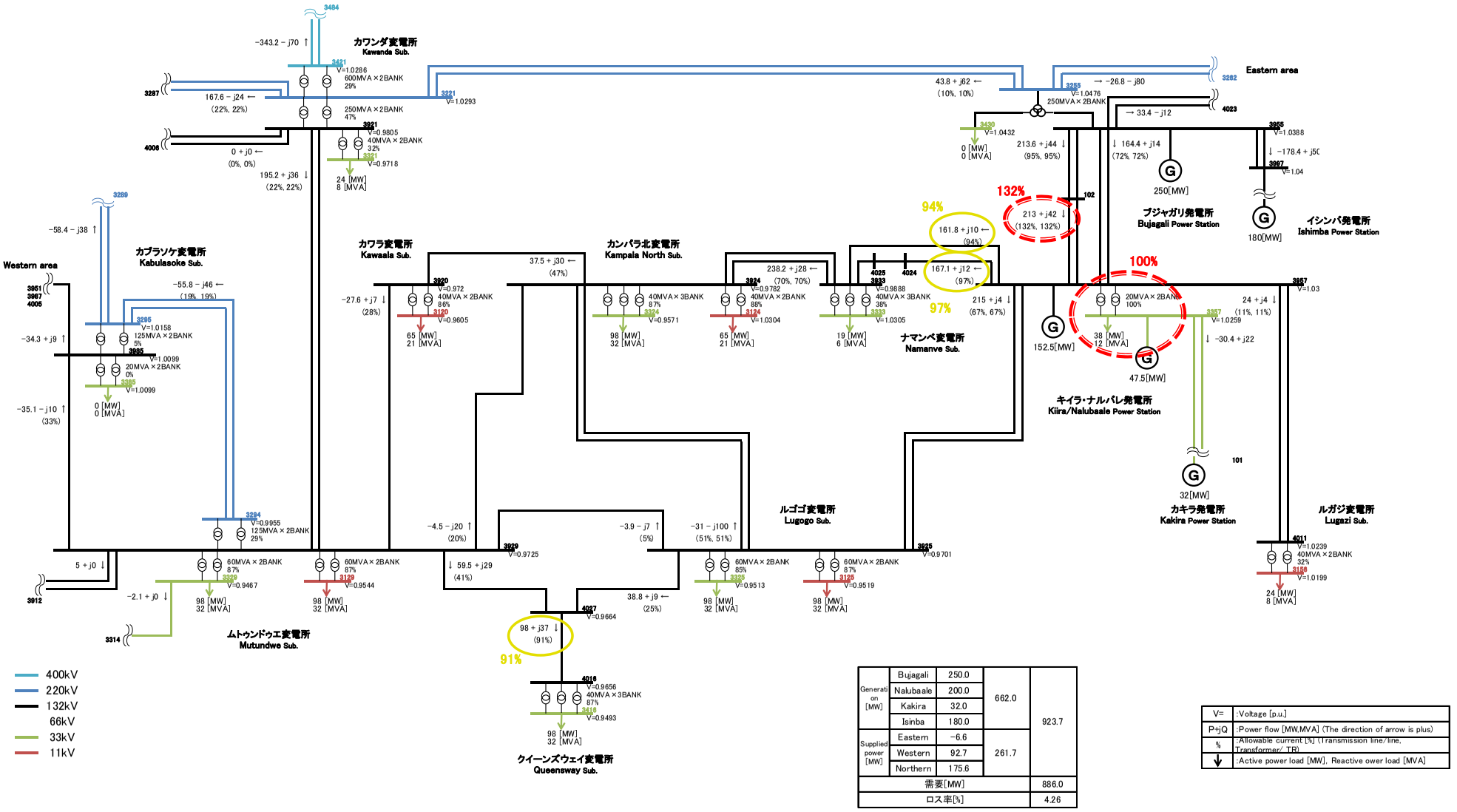


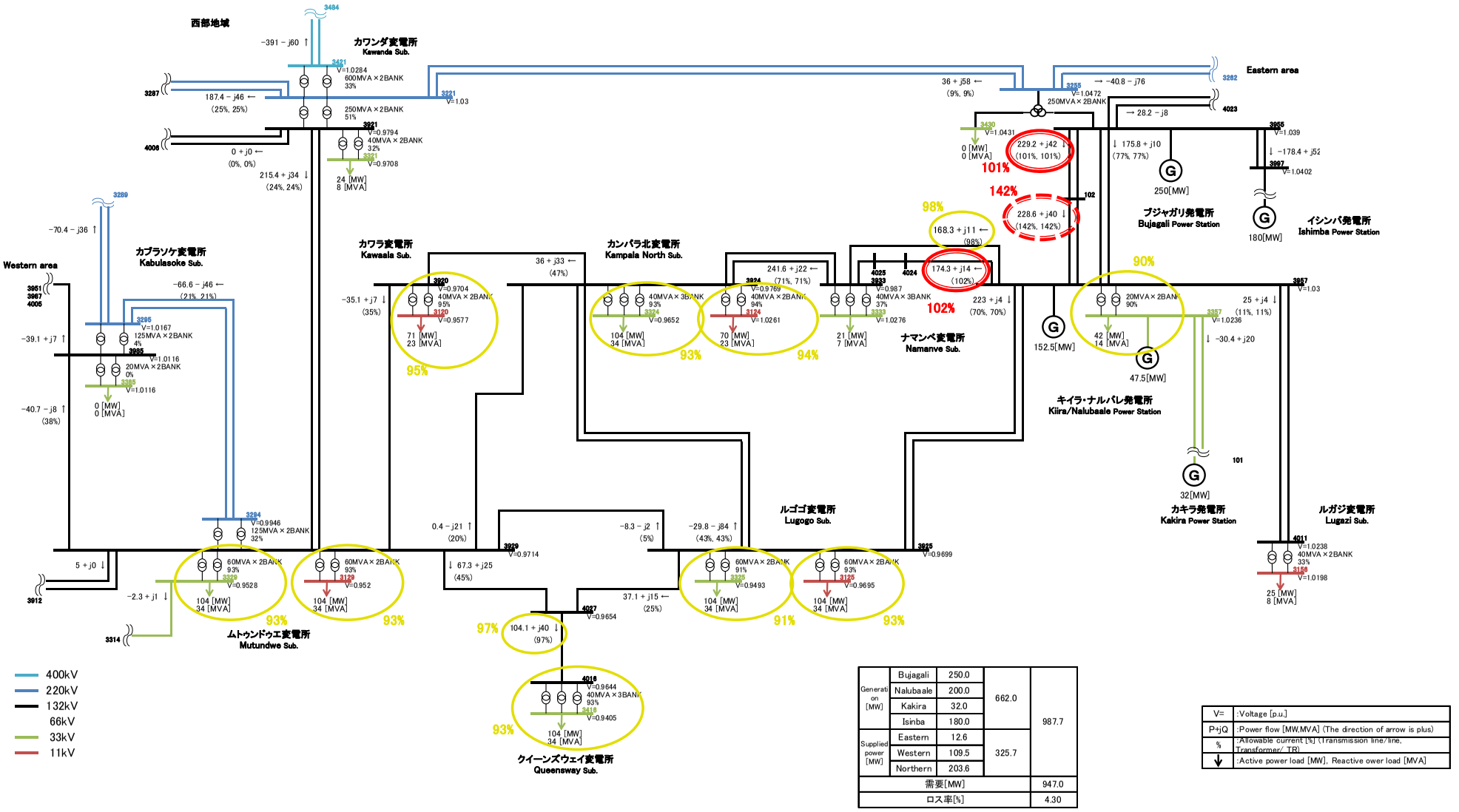
Figure 2-2-2-2.11 Power flow analysis (2025)



Generation [MW]	Bujagali	250.0	662.0	923.7
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	180.0		
Supplied power [MW]	Eastern	−6.6	261.7	
	Western	92.7		
	Northern	175.6		
需要[MW]				886.0
ロス率[%]				4.26

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.12 Power flow analysis (2026)



Generation [MW]	Bujagali	250.0	662.0	987.7
	Nalubaale	200.0		
	Kakira	32.0		
	Isinba	180.0		
Supplied power [MW]	Eastern	12.6	325.7	
	Western	109.5		
	Northern	203.6		
需要[MW]				947.0
ロス率[%]				4.30

V=	:Voltage [p.u.]
P+jQ	:Power flow [MW,MVA] (The direction of arrow is plus)
%	:Allowable current [%] (Transmission line/line, Transformer/ TR)
↓	:Active power load [MW], Reactive ower load [MVA]

Figure 2-2-2-2.13 Power flow analysis (2027)

2-2-2-3 Overall Plan

(1) Design Conditions

Project design conditions are as follows:

1) Weather conditions

Weather conditions applicable to designs for substation facilities, buildings, and foundations are as shown in Table 2-2-2-3.1.

Table 2-2-2-3.1 Weather conditions

Area		Kampala metropolitan area
Altitude		1,160 m
Ambient temperature	Maximum	35 ℃
	Minimum	10 ℃
	Average	25 ℃
Maximum wind speed		34 m/s
Rainfall		1,128 mm/year
Earthquake load		0.15 G (Horizontal direction)
Soil bearing capacity		10 ton/m^2(based on the investigation)

［Source］ Preparatory Study Team

2) Design Conditions

(a) System voltage

132 kV system: 132 kV ± 10.0%

33 kV system: 33 kV ± 10.0%

(b) System frequency

Permissible variation: 50 Hz ±0.5 Hz

(c) System earthing

132 kV system: Solidly earthing system

33 kV system: Solidly earthing system

(2) Applicable Standards and Units Used

132/33 kV substation facility shall be designed in accordance with IEC standards, JEC standards or equivalent standards in principle.

2-2-2-4 Basic Plan Overview

An overview of the basic plan of the Project based on the earlier described design policy (See Section 2-2-1.) is given in Table 2-2-2-4.1.

Table 2-2-2-4.1 Project Overview

	Plan Contents	Quantity
Procurement and installation	1. Substation facilities	
	- 132/33 kV Transformer	40 MVA x 3 units
	- 132 kV Gas Insulated Switchgears	8 units
	- 33 kV Gas Insulated Switchgears	14 units
	- 132 kV Control and Protection Panel	9 units
	- Other control panels	2 units
	- Low voltage facilities	3 units
	- 33 kV distribution lines	1 unit
	- Earthing system	1 unit
	2. Transmission facilities	
	- 132 kV overhead lines	450 m
	- 132 kV underground cables	2,310 m
	- Telecommunication lines	500 m
Procurement	3. Maintenance tools for procured items	1 lot
	4. Spare parts for procured items	1 lot
Construction	5. Civil and Construction	
	- Foundations for items (Gas Insulated Switchgears, transformers, towers)	1 lot
	- Control building (Total floor area: 680 m^2)	1 building

［Source］ Preparatory Study Team

(1) 132/33 kV Queensway Substation

1) Contents of the Project

The new 132/33kV Queensway Substation is to be constructed in accordance with the basic conditions below.

(a) Protection system

The protection system of Ugandan power system uses the differential current type for main protection and the ground direction relay type is used for backup protection. Teleprotection technologies are used for the protection to secure swiftness, sensitivity and selectivity. Consistency with the existing protection system needs to be ensured to connect the new substation with the system. When selecting equipment and device for the Project, communication protocol, etc., will be in accordance with the specifications of the existing communication.

(b) 132/33 kV transformer

Transformers will be oil-immersed self-cooled/oil-immersed air-cooled transformers that are generally used in Uganda.

(c) 132 kV Gas Insulated Switchgear

In selecting 132 kV switchgears, it is essential that they have the capacity to allow such accidents as fault current while being capable of minimizing impacts of failures promptly. Thus, bus rating and circuit breaker rating of the substation facility will have the specifications below based on the standard specifications in Uganda because of the need to secure consistency with existing facilities.

Table 2-2-2-4.2 Rating of 132 kV Gas-Insulated Switchgear

Equipment	Rated current [A]	Short circuit current [kA]
Busbar	3,150	31.5 (1 sec.)
Circuit breaker	3,150	31.5 (1 sec.)

(d) 132 kV facility control and protection panel

- The 132kV supervisory board will be a duplex type for effective use of the control room. Such device as simulant bus and measuring instruments will be installed in front of the 132 kV supervisory and protection panel and protection relays will be installed on the back side. The 132 kV control and protection panel will be installed in the control room on the second floor of the control building.
- The current differential relay used for main protection of the 132 kV transmission line will be a standard type in Uganda.
- The current differential relay and overcurrent relay used for backup protection of the 132/33 kV transformer will be independent relays in accordance with Ugandan standards.

(e) 33 kV Gas Insulated Switchgear

In selecting the 33kV switchgear, same as the case of 132 kV Gas Insulated Switchgear, it is essential that they have the capacity to allow such accidents as fault current while being capable of minimizing impacts of failures promptly. Thus, bus rating and circuit breaker rating of the substation facility will have the specifications below based on the standard specifications in Uganda because of the need to secure consistency with existing facilities.

Table 2-2-2-4.3 Rating of 33 kV Gas-Insulated Switchgear

Equipment	Rated current [A]	Short circuit current [kA]
Busbar	2,000	25 (1 sec.)
Circuit Breaker	2,000	25 (1 sec.)

(f) SCADA system

The interface of SCADA system of Japanese and Ugandan sides is shown in Figure 2-2-2-4.1.

- The Japanese side will procure and install SCADA terminal unit in the control room on the second floor of the control building to transfer signals to the Ugandan side.

- UETCL will procure such equipment as RTUs, multiplexer and ODF to be compatible with ABB's SCADA system and install them in the control room on the second floor of the control building
- UETCL will connect to the SCADA terminal unit.
- The Japanese side will procure and install optical cables from ODF to the splicing box (route along the buried route of 132kV cable).
- UETCL will connect the optical cable in the ODF and the splicing box

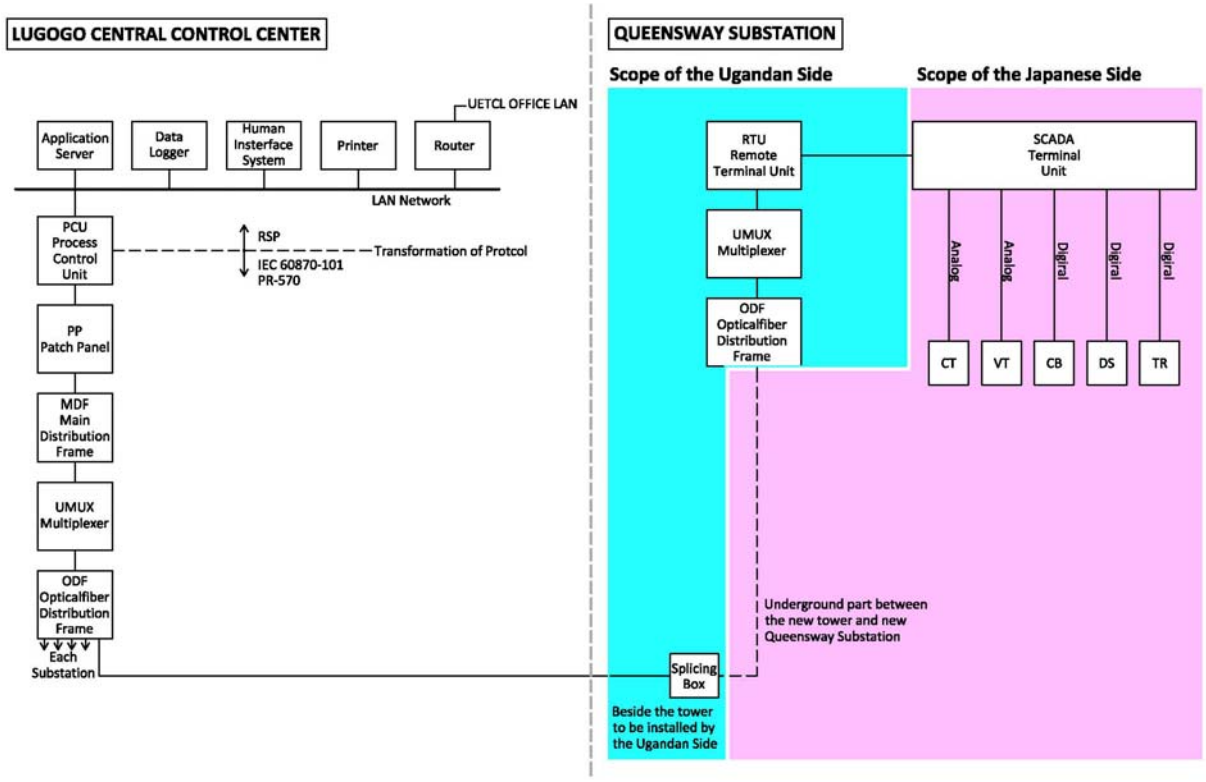


Figure 2-2-2-4.1 Interface of SCADA System

① Commercial electricity meters

- UETCL will procure four main commercial electricity meters and four electricity meters for checking accuracy and install them in the storage panel for commercial electricity meters to be procured by Japan in order to measure commercial electricity from the 33kV Gas Insulated Switchgear to two existing 33kV outdoor switchgear panels (previous Japan's grant aid project), two new 33kV indoor switchgear panels (under construction by UMEME) for UMEME. The storage panel for commercial electricity meters will be installed in the control room on the first floor of the control building.

② DC power supply system

- The 110V DC power supply system for control will consist of one set of lead battery, one permanent and one backup chargers and one DC distribution panel. The DC

power supply system will be installed in the control room on the first floor of the control building.

- The battery capacity will be to maintain two hours of power outage. It will be maintenance-free type and stored in the DC distribution panel.

③ AC power supply system

- The AC power supply system will consist of three station service transformers, one permanent distribution panel (415/240 V, 3 phases and 4 wires), and one emergency distribution panel (415/240 V, 3 phases and 4 wires). The circuit breaker will be automatically switchable with electrical interlocking. The AC power supply system will be installed in the control room on the first floor of the control building.

④ Diesel generator

- One diesel generator (415/240 V, 45kVA) will be installed in the diesel power generator room as a backup power source. The generator will be equipped with an automatic operation unit.
- The fuel tank will have a capacity for continuous 48-hour operation. It will be installed outdoors.

⑤ Substation earthing

- 132/33 kV substation earthing will be the mesh type of buried bare copper wire 75 centimeters deep from the ground. Bare copper wire and grounding rods, etc., necessary to make the earthing resistance below 1 ohm.
- The 132/33 kV substation earthing conductor and existing 33/11 kV substation earthing conductor will be connected at two points and the combined earthing resistance will be below one ohm.

⑥ 33 kV XLPE cable

- Procurement, installation and connection of the 33 kV XLPE cable will be conducted by the Japanese and Ugandan sides as shown below. See the next section for the cable specification selection policy.

No.	From	To	Cable Specification	Procure	Installation	Connection
1	132/33 kV Transformer	33 kV Gas Insulated Switchgear	Copper conductor, single core 300 mm^2 , XLPE 2 bundles/phase	Japan	Japan	Japan
2	33 kV Gas Insulated Switchgear	Station transformer No.1	Copper conductor, three core 60 mm^2 , XLPE	Japan	Japan	Japan
3	33 kV Gas Insulated Switchgear	Existing 33 kV Switchgear	Copper conductor, single core	Japan	Japan	Uganda

No.	From	To	Cable Specification	Procure	Installation	Connection
			300 mm^2 , XLPE 2 bundles/phase			
4	33 kV Gas Insulated Switchgear	New 33 kV Switchgear	Copper conductor, single core 300 mm^2 , XLPE 2 bundles/phase	Japan	Japan	Uganda

2) Design Conditions

(a) Weather conditions

The weather conditions are shown in the Table 2-2-2-3.1

(b) Electrical conditions

Area	Kampala metropolitan area
Minimum clearance of conductor	-
Phase to ground	1,200 mm
Phase to phase	1,500 mm
Minimum creepage distance	16 mm/kV
Equivalent salt deposit density	N/A

(c) Selection policy for transformers

⑦ 33 kV distribution line route

- General power supply cable

The transformer capacity per unit is 40MVA and the 33kV cables that distributes the power needs to permit the current that is generated in the operation of the transformer with the capacity of 40MVA.

N-1 condition is assumed for facility design and it will have the capacity to permit 20 percent excessive load for a short time period. This policy will be also adopted for the Project. Based on the local current standard specifications, the cable will be XLPE cable and the conductor will be made of copper.

The cable in a size that allows the above operation load with 80 percent of the facility capacity will be selected as a policy and it will be designed to prevent such accidents as burnouts in the operation near the upper limit of scope of control. Based on the conditions, the heat capacity required for a 33kV cable is 1050A as shown below and thus the smallest cable to allow this will be selected. However, the cable that allows the current as high as 1050A will be in an extremely big diameter and thus it will be two bundles of 300-square-millimeters cable in one phase to allow the required capacity.

a) Possible maximum current in operation

Substation capacity of the Project：40 MVA

Possible maximum current ：840 A ＝ 40 MVA×120%÷ （$\sqrt{3}$ × 33 kV）

b) Heat capacity required for cable : 1050 A ＝ 840 A÷80%

- Substation transformer supply cable

  The capacity of substation transformer per unit is 200 kVA and cables that allow current generated in the operation need to be selected. However, due to the small capacity of the substation transformers, the current generated in operation is less than 5A and thus the smallest size for the voltage class of 33kV available in the market can be chosen for the heat capacity. Thus, 60-square-millimeters cable that is the smallest available in the market for the voltage class will be used. It will be XLPE cable with the conductor made of copper will be used in consideration of local standard specifications. Because of the small cable size, three-core cables will be used in consideration of the handling in construction work.

3) Facility plan

The list of substation equipment to be delivered to the 132/33 kV Queensway Substation by the Japanese side and the single line diagrams of the substation are shown in Table 2-2-2-4.4 and E-01 and E-02, respectively.

Table 2-2-2-4.4 List of Equipment to be Delivered by Japan for 132 kV Queensway Substation

No.	Description	Specification	Quantity
QS1	**132/33 kVTransformer**		**3**
	➢ Standards	IEC, JEC or equivalent	
	➢ Capacity	32/40 MVA	
	➢ Voltage	Primary: 132 kV / Secondary: 33 kV	
	➢ Voltage regulating range	132 kV +5%/-15%	
	➢ Tap position	Primary side	
	➢ Tap number	17 taps (+12 taps/-4 taps)	
	➢ Cooling system	ONAN/ONAF	
	➢ Vector group	YNyn0+d1	
	➢ % impedance	Approx. 13.5%	
QS2	**132 kV Gas Insulated Switchgear**	**Double busbar system**	
QS2-1	**132 kV GIS Switchgear for line**		**2**
	➢ Standard	IEC, JEC, or equivalent	
	➢ Rated voltage	145 kV	
	➢ Rated current	1,250 A	
	➢ Rated interrupting current	31.5 kA	
	➢ Rated short-time withstand current	31.5 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-0.3 sec.-CO-3 min.-CO	
QS2-2	**132 kV GIS Switchgear for Transformer**		**3**
	➢ Standard	IEC, JEC, or equivalent	
	➢ Rated voltage	145 kV	
	➢ Rated current	1,250 A	
	➢ Rated interrupting current	31.5 kA	
	➢ Rated short-time withstand current	31.5 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-0.3 sec.-CO-3 min.-CO	

No.	Description	Specification	Quantity
QS2-3	**132 kV GIS Switchgear for bus coupler**		**1**
	➢ Standard	IEC, JEC, or equivalent	
	➢ Rated voltage	145 kV	
	➢ Rated current	1,250 A	
	➢ Rated interrupting current	31.5 kA	
	➢ Rated short-time withstand current	31.5 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-0.3 sec.-CO-3 min.-CO	
QS2-4	**132 kV GIS Voltage transformer**		**2**
	➢ Standard	IEC, JEC or equivalent	
	➢ Voltage transformer	$132/\sqrt{3}$ kV/$110/\sqrt{3}$ V	
	➢ Rated current	1,250 A	
QS3	**33 kV Gas Insulated Switchgear**		
QS3-1	**33kVGIS for Transformer**		**3**
	➢ Standard	IEC, JEC or equivalent	
	➢ Rated voltage	36 kV	
	➢ Rated current	1,250 A	
	➢ Rated interrupting current	25 kA	
	➢ Rated short-time withstand current	25 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-1 min.-CO-3 min.-CO	
QS3-2	**33kVGIS for feeders**		**6**
	➢ Standard	IEC, JEC or equivalent	
	➢ Rated voltage	36 kV	
	➢ Rated current	1,250 A	
	➢ Rated interrupting current	25 kA	
	➢ Rated short-time withstand current	25 kA (1 sec.)	
	➢ Others	Multimeter (Current, Voltage, Power, Reactive power, frequency, powerfactor) is included.	
QS3-3	**33kVGIS for bus section**		**2**
	➢ Standard	IEC, JEC or equivalent	
	➢ Rated voltage	36 kV	
	➢ Rated current	2,000 A	
	➢ Rated interrupting current	25 kA	
	➢ Rated short-time withstand current	25 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-1 min.-CO-3 min.-CO	
QS3-4	**33kVGIS for station transformer**		**3**
	➢ Standard	IEC, JEC or equivalent	
	➢ Rated voltage	36 kV	
	➢ Rated current	2,000 A	
	➢ Rated interrupting current	25 kA	
	➢ Rated short-time withstand current	25 kA (1 sec.)	
	➢ Circuit breaker		
	- Auto-reclosing	Three phase bundle	
	- Operating sequence	O-1 min.-CO-3 min.-CO	

No.	Description	Specification	Quantity
QS3-5	**33kVGIS Voltage transformer** ➢ Standard ➢ Voltage transformer	 IEC, JEC or equivalent $33/\sqrt{3}$ kV/$110/\sqrt{3}$ V	**3**
QS4	**132 kV Control and Protection Panel**		
QS4-1	**132/33 kV Transformer Control and Protection Panel** ➢ Standard ➢ Type ➢ Panel arrangement ➢ Protection function	 IEC, JEC or equivalent Duplex type panel - Front: Control Panel - Rear: Protection Panel 132 kV system and voltage regulation control of 40 MVA Transformer (including Mimic bus, control switch, meter, warming devices, other control function)	**3**
QS4-2	**132 kV Line Control and Protection Panel** ➢ Standard ➢ Type ➢ Panel arrangement	 IEC, JEC or equivalent Duplex type panel - Front: Control Panel - Rear: Protection Panel	**2**
QS4-3	**132/33 kVTransformer Switch Control and Protection Panel** ➢ Standard ➢ Type ➢ Panel arrangement	 IEC, JEC or equivalent Duplex type panel - Front: Control Panel - Rear: Protection Panel	**3**
QS4-4	**132 kV Bus Coupler Switch Control and Protection Panel** ➢ Standard ➢ Type ➢ Panel arrangement	 IEC, JEC or equivalent Duplex type panel - Front: Control Panel - Rear: Protection Panel	**1**
QS5	**Other Control Panel**		
QS5-1	**Energy meter panel** ➢ Standard ➢ Type	 IEC, JIS, JEC, JEM or equivalent Indoor, cubicle type	**1**
QS5-2	**Interface panel for SCADA system** ➢ Standard ➢ Type ➢ Transducer signal	 IEC, JIS, JEC, JEM or equivalent Indoor, cubicle type 4 – 20 mA	**1**
QS6	**Low voltage equipment**		
QS6-1	**DC Supply System (DC 110 V)** ➢ Standard ➢ Battery voltage ➢ Battery capacity ➢ Battery type	 IEC, JIS, JEC, JEM or equivalent DC 110 V 250 Ah/10hr (Power outage: 2 hours) Lead-acid type	**1**
QS6-2	**Station transformer and AC Distribution Panel** 1. Staton transformer ➢ Standard	 IEC, JIS, JEC, JEM or equivalent	**1**

No.	Description	Specification	Quantity
	➢ Type	Outdoor, Voltage tap changer is attached	
	➢ Primary voltage	33 kV	
	➢ Secondary voltage	415-240 V	
	➢ Rated capacity	600 kVA (200 kVA x 3)	
	➢ Cooling system	ONAN	
	➢ Phase number	3	
	➢ Frequency	50 Hz	
	➢ Tap voltage	33 kV ±2.5%, ±5%	
	➢ Tap number	5	
	2. AC Distribution Panel		
	➢ Station transformer	IEC, JIS, JEC, JEM or equivalent	
	➢ Type	Indoor, cubicle type	
	➢ Rated input	AC415 V ±5%, 3 phase 4 lines	
	➢ Rated output	3 phase AC 415 V, Single phase 240 V	
	➢ Rated short-time withstand current	25 kA (2 sec.)	
QS6-3	**Diesel engine generator (415/240 V, 45 kVA)**		**1**
	➢ Standard	IEC, JIS, JEC, JEM or equivalent	
	➢ Type	Indoor, cubicle type	
	➢ Rated output	AC415/250 V（3 phases 4 wires）	
	➢ Fuel tank	45 kVA	
	➢ Pole number	4	
QS7	**33 kV distribution line**		
QS7-1	**Cable between 33 kV GIS and 132/33 kV Transformer**		**738 m**
	➢ Type	XLPE Cable	
	➢ Size	300 mm^2	
	➢ Conductor	Copper	
	➢ Core	1	
	➢ Others	2 wires/phase	
QS7-2	**Cable between 33 kV GIS and Existing substation (1)**		**1,260 m**
	➢ Type	XLPE Cable	
	➢ Size	300 mm^2	
	➢ Conductor	Copper	
	➢ Core	1	
	➢ Others	2 wires/phase	
QS7-3	**Cable between 33 kV GIS and Existing substation (2)**		**522 m**
	➢ Type	XLPE Cable	
	➢ Size	300 mm^2	
	➢ Conductor	Copper	
	➢ Core	1	
	➢ Others	2 wires/phase	
QS7-4	**Cable between 33 kV GIS and Station Transformers**		**80 m**
	➢ Type	XLPE Cable	
	➢ Size	60 mm^2	
	➢ Conductor	Copper	
	➢ Core	3	

No.	Description	Specification	Quantity
QS8	**Substation facilities**		
QS8-1	Earthing system		1
	➢ Grounding resistance	Less than 1 ohm	
	➢ Material	Copper	
	➢ Termination box for earthing	Yes	
QS8-2	Distribution materials		1
	➢ Low voltage cables	- Power cable: XLPE cable - Control cable: PVC cable (Shield)	
	➢ Earthing materials	- Control cable: PVC cable - Connector	
	➢ Cable installation	- Cable pipu, connection box and fitting - Cable trays - Cable hanger - Terminals	

4) Substation building and ancillary facility construction plans

A new 132/33 kV substation is to be constructed on the premises adjacent to the existing Queensway Substation. The facilities to be built are as follows:

1) Foundation for three 40 MVA transformers (14.5 meters by 9.0 meters with 7.5-meter-high firewall, oil pit and wiring pit),
2) Foundation for seven 132kV gas-insulated switchgear bays (21.9 meters by 8.0 meters with 5.0-meter-high firewall and underground wiring pit),
3) Control building (1 basement floor and 2 floors above ground) to accommodate control device for main equipment,
4) Underground culverts connecting these facilities and existing buildings, and
5) Axillary facilities for these facilities

The site is a rectangular shape of approx. 2,300 square meters with a long side of 75 meters and a short side from 35 meters to 25 meters becoming narrower toward one end, smaller than other substation of the same scale. Thus, 132kV gas-insulated switchgear for small premises is selected and transformers and the switchgear will be connected with a duct for smaller area size. Also, the control building is a multi-story construction to reduce construction area and service transformers will be installed on the roof of the first floor. The wiring pits are housed within the gas-insulated switchgear foundations to reduce the construction area. The overview of the main facilities is shown below.

(a) Main facilities

Control building:

2-story with basement, reinforced concrete rigid-framed structure, construction area approx. 280 square meters, floor area approx. 680 square meters

Transformer base frame:

Basement, reinforced concrete wall construction, construction area approx. 132 square meters, floor area approx. 132 square meters

Foundations for 132 kV Gas Insulated Switchgear:

1 basement floor, reinforced concrete structure, construction area of approx. 180 square meters, and floor area of approx. 180 square meters

Wiring culverts (1), (2) and (3): basement, reinforced concrete box structure

The key features and construction plans of the facilities are as follows:

Table 2-2-2-4.5 Transformer base frame

Room	Area	Equipment/Specification
Transformer foundation		Mounting steel frame CT-300×150 Embedded
Fire protection wall		H=7.5 m、L=9.0 m
Oil Pit		D=1.5 m
Total	132 m^2	

Table 2-2-2-4.6 Foundation of 132 kV Gas-Insulated Switchgear

Room	Area	Equipment/Specification
Cable Pit		Light Fittings, Ventilation, Cable Rack
Total	180 m^2	

Table 2-2-2-4.7 Cable culverts (1)

Room	Area	Equipment/Specification
Cable Culvert (1)		Light Fittings, Ventilation, Cable Rack
Total	26 m^2	

Table 2-2-2-4.8 Cable culverts (2)

Room	Area	Equipment/Specification
Cable Culvert (2)		Light Fittings, Ventilation, Cable Rack
Total	26 m^2	

Table 2-2-2-4.9 Cable culverts (3)

Room	Area	Equipment/Specification
Cable Culvert (3)		Light Fittings, Ventilation, Cable Rack
Total	15 m^2	

Table 2-2-2-4.10 Control building

F	Room	Area	Equipment/Specification
B1	Cable Pit		Light Fittings, Ventilation, Cable Rack
	Water Tank		Light Fittings, Ventilation, Cable Rack
	Corridor		Light Fittings, Ventilation, Cable Rack
	Staircase		Light Fittings, Emergency Light
	(Sub Total)	200 m^2	
GF	Control Panel Room		Light Fittings, Ventilation, Air-condition, Cable Pit
	Control Room (1)		Light Fittings, Ventilation, Air-condition, Cable Pit
	Entrance, Staircase		Light Fittings, Emergency Light
	Corridor		Light Fittings, Emergency Light
	Battery Room		Light Fittings, Ventilation, Air-condition

F	Room	Area	Equipment/Specification
	Storage		Light Fittings, Ventilation
	Toilet		Light Fittings, Faucet, Wash basin, Sink
	Shower Room		Light Fittings, Shower set
	Kitchenette		Light Fittings, Sink, Electric heater
	(Sub Total)	280 m^2	
1F	Control Panel Room		Light Fittings, Ventilation, Air-condition, Free access floor H=300mm
	Staircase		Light Fittings, Emergency Light
	Corridor		Light Fittings, Emergency Light
	Roof Balcony		Station transformers will be installed
	Evacuation Balcony		Outdoor unit of ventilation will be installed. Evacuation route
	(Sub Total)	200 m^2	
	Total	680 m^2	

Main exterior finishing details for the facilities are as follows:

Table 2-2-2-4.11 Exterior Finishing Schedule

Facility	Item	Specification
Transformer Platform Foundation	Floor	Waterproofing Concrete Steel Trowel (Slope 1/100), Waterproofing Mortar Steel Trowel Finish
	Oil Pan	Waterproofing Concrete Steel Trowel (Slope 1/100), Waterproofing Mortar Steel Trowel Finish
	Wall	Exposed Waterproofing Concrete, Exterior Paint Finish
Mounting Steel Frame for 132 kV GIS	Floor	Waterproofing Concrete Steel Trowel (Slope 1/100), Waterproofing Mortar Steel Trowel Finish
	Steps	Waterproofing Mortar Steel Trowel Finish with SUS Non-slip
	Wall	Exposed Waterproofing Concrete (Additional concrete cover 15mm), Exterior Paint Finish
Cable Culvert	Floor	Waterproofing Concrete Steel Trowel
Control Building	Roof (1)	Asphalt Membrane Waterproofing (3 Layer), Styrofoam t=50, Concrete t=80 mm with expansion plastic joint @2000
	Roof (2)	Concrete Steel Trowel (Slope 1/50) Urethane Waterproofing
	Wall	Waterproofing Mortar Steel Trowel, Exterior Paint Finish
	Floor of Roof Balcony	Asphalt Membrane Waterproofing (3 Layer), Styrofoam t=50, Concrete t=80 mm with expansion plastic joint @2000, Non-slip tile (150)
	Balcony Floor	Waterproofing Mortar Steel Trowel, Urethane Waterproofing
	Windows	Readymade Aluminum Window
	Entrance Doors	Steel Door
	Delivery Doors	Steel Door
	Down spout	VP 100φ
	Roof Drain	Cast Iron

Main interior finishing details for the facilities are as follows:

Table 2-2-2-4.12 Interior Finishing Schedule

Facility	Room	Item	Specification
Transformer Platform Foundation	Cable Pit	Under floor	Waterproofing Concrete Steel Trowel (Slope 1/100)
		Floor	Exposed Waterproofing Concrete
		Ceiling	Exposed Waterproofing Concrete
	Oil Pit	Under floor	Waterproofing Concrete Steel Trowel
		Floor	Exposed Waterproofing Concrete
		Ceiling	Exposed
Mounting steel frame for 132 kV GIS	Cable Pit	Under floor	Waterproofing Concrete Steel Trowel (Slope 1/100)
		Floor	Exposed Waterproofing Concrete
		Ceiling	Exposed Waterproofing Concrete
Cable Culvert (1),	Oil pipe pit	Under floor	Waterproofing Concrete Steel Trowel (Slope 1/100), Waterproofing Mortar Steel Trowel Finish

Facility	Room	Item	Specification
(2), (3)		Floor	Exposed Waterproofing Concrete
		Ceiling	Exposed Waterproofing Concrete

Table 2-2-2-4.13 Control Building Interior Finishing Schedule

F	Room	Floor	Wall	Ceiling
B1	Cable Pit	Waterproofing Concrete Steel Trowel	Exposed Waterproofing Concrete	Exposed Waterproofing Concrete
	Water Tank	Waterproofing Concrete Steel Trowel	Exposed Waterproofing Concrete	Exposed Waterproofing Concrete
	Corridor	Waterproofing Concrete Steel Trowel	Exposed Waterproofing Concrete	Exposed Waterproofing Concrete
	Staircase	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Mortar Steel Trowel EP
GF	Control Panel Room	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Office	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Battery Room	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Storage	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Diesel Engine Generator Room	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Perforated Gypsum Board t=12mm, Light Steel gauge Suspended Ceiling System with Glass wool Mat t=100
	Entrance	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Corridor	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Staircase	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Mortar Steel Trowel EP Light Gauge Steel Frame PB12mmEP
	Toilet	Ceramic Tile 300mm*300mm	Ceramic Tile 200mm*200mm	Light Gauge Steel Frame Flexible B 6mmEP
	Shower Room	Ceramic Tile 300mm*300mm	Ceramic Tile 200mm*200mm	Light Gauge Steel Frame Flexible B 6mmEP
	Kitchenette	Ceramic Tile 300mm*300mm	Ceramic Tile 200mm*200mm	Light Gauge Steel Frame Flexible B 6mmEP
1F	Control Room	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP
	Staircase	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Mortar Steel Trowel EP Light Gauge Steel Frame PB12mmEP
	Corridor	Ceramic Tile 300mm*300mm	Mortar Steel Trowel EP	Light Gauge Steel Frame PB12mmEP

(2) Basic Plan for 132 kV Transmission Line

1) Planning

132 kV transmission line route diagram is shown in T-01 in Section 2-2-3. A new steel tower (QW1) will be built for 132 kV transmission lines for branching between towers 19 and 20 of 132 kV transmission lines of Lugogo Substation—Mutundwe Substation. A new cable dead-end tower (QW2) only approx. 20 meters away will be built and connected to 132kV cable and it will be connected to the 132 Gas Insulated Switchgear in 132/33kV Queensway Substation approx. 350 meters away.

The basic 132 kV transmission line plan is summarized below.

- Branching tower (QW1) and dead-end tower (QW2) will be constructed.
- Tower (QW1) for branching and cable dead-end tower (QW2) are connected via two circuits of overhead lines (ACSR 420 mm^2).
- Tower (QW1) for branching and cable dead-end tower (QW2) are connected via two circuits of overhead ground lines (50 mm^2).
- The cable dead-end tower (QW2) and 132/33 kV Queensway Substation are connected with two circuits of 132 kV ground cable. The 132 kV ground cable is a direct buried cable at approx. 1.5 meters below the ground level. The cable will be covered with concrete sheets to protect it from shocks. A tape to indicate the buried location of the cable will be buried underground. The cable crossing the road will be stored in strong and highly reliable PFP pipes used by Japanese power companies.
- The optical cable from the existing tower (20) to 132/33 kV Queensway Substation will be procured and installed on the 132kV ground cable route by the Japanese side.
- The Japanese side will procure the splicing box. UETCL will install the box at the existing tower (20) and connect the optical cable.

2) Design conditions

(a) Weather conditions

The weather conditions are shown in the Table 2-2-2-3.1

(b) Electrical conditions

Item	Requirement
1. Minimum clearance of conductor	-
- Phase to ground	1,200 mm
- Phase to phase	1,500 mm
2. Minimum creepage distance	16 mm/kV
3. Equivalent salt deposit density	N/A

(c) Selection policy for circuit capacity

① 132 kV overhead transmission circuit

One of two circuits of the 132 kV overhead transmission line that connects Lugogo Substation and Mutundwe Substation will be branched and drawn to the new Queensway Substation. The specifications of overhead cables for branching to be procured in the Project need to be compatible with existing overhead cables. Thus, the cables in type ACSR and 420 square millimeters that are the same specifications as the existing facilities will be used.

② 132 kV ground transmission circuit

Because the 132 kV overhead cables mentioned above cross the road on the way to the substation to be constructed in the Project, it will be switched with 132 kV ground buried cables around the branch point from the existing transmission line. Thus, the 132 kV

ground buried cable needs to permit the current generated in operation of the substation with facility capacity of 120 MVA.

The system operation in Uganda is in accordance with N-1 standards (idea of setting the reliability based on the impact on the power system in case one component of system facility stops for sudden incidents). Thus, N-1 condition is assumed for facility design and it will have the capacity to permit 20 percent excessive load for a short time period. This policy will be also adopted for the Project. Based on the local standard specifications, the wire will be XLPE cable and the conductor will be made of copper.

The cable in a size that allows the above operation load with 80 percent of the facility capacity will be selected as a policy and it will be designed to prevent such accidents as burnouts in the operation near the upper limit of scope of control. Based on the conditions, the heat capacity required for the 132kV cable is 790 A and thus the smallest cable to allow this, which is 800 square millimeters, will be selected.

a) Estimated maximum current in operation
   Substation facility capacity: 120 MVA
   Estimated maximum current: 630 A $=120\ \text{MVA} \times 120\% \div (\sqrt{3} \times 132\ \text{kV})$

b) Heat capacity required for cable: $790\ \text{A} = 630\ \text{A} \div 80\%$

③ Communication line

As for the communication line, the optical fiber cable that connects Lugogo Substation and Mutundwe Substation will be branched and drawn to the new Queensway Substation. The specifications of the optical fiber cable need to be procured to be compatible with the existing one. Thus, the cable with the application standards ITU-T and line type G652 in the same specifications as the existing facilities will be used.

A splicing box needs to be procured for branching in order to connect the communication line of the Project facility with the existing communication network. It will be procured by the Japanese side as it is equipment necessary for the Project implementation and that the Ugandan side will install it as it is appropriate to do it promptly at a time when there will be least impact on the electricity system of the country.

Because the optical fiber cable crosses a road, it is reasonable for Japanese side to install it when it conducts open cut work when it installs the 132 kV transmission line. Thus, the Japanese side will procure the splicing box to be installed at the branch point and the Ugandan side will install it and the optical fiber cable that is branched there and functions as the communication line to the project substation will be procured and installed by Japan.

Applied standards of main electric facilities

a) International Electrotechnical Commission (IEC) standard: to be applied to electrical equipment in general.

b) Japanese Electrotechnical Committee (JEC) standard: to be applied to electrical equipment in general.

3) Facility plan

Plans of 132 kV transmission lines are shown in the table below.

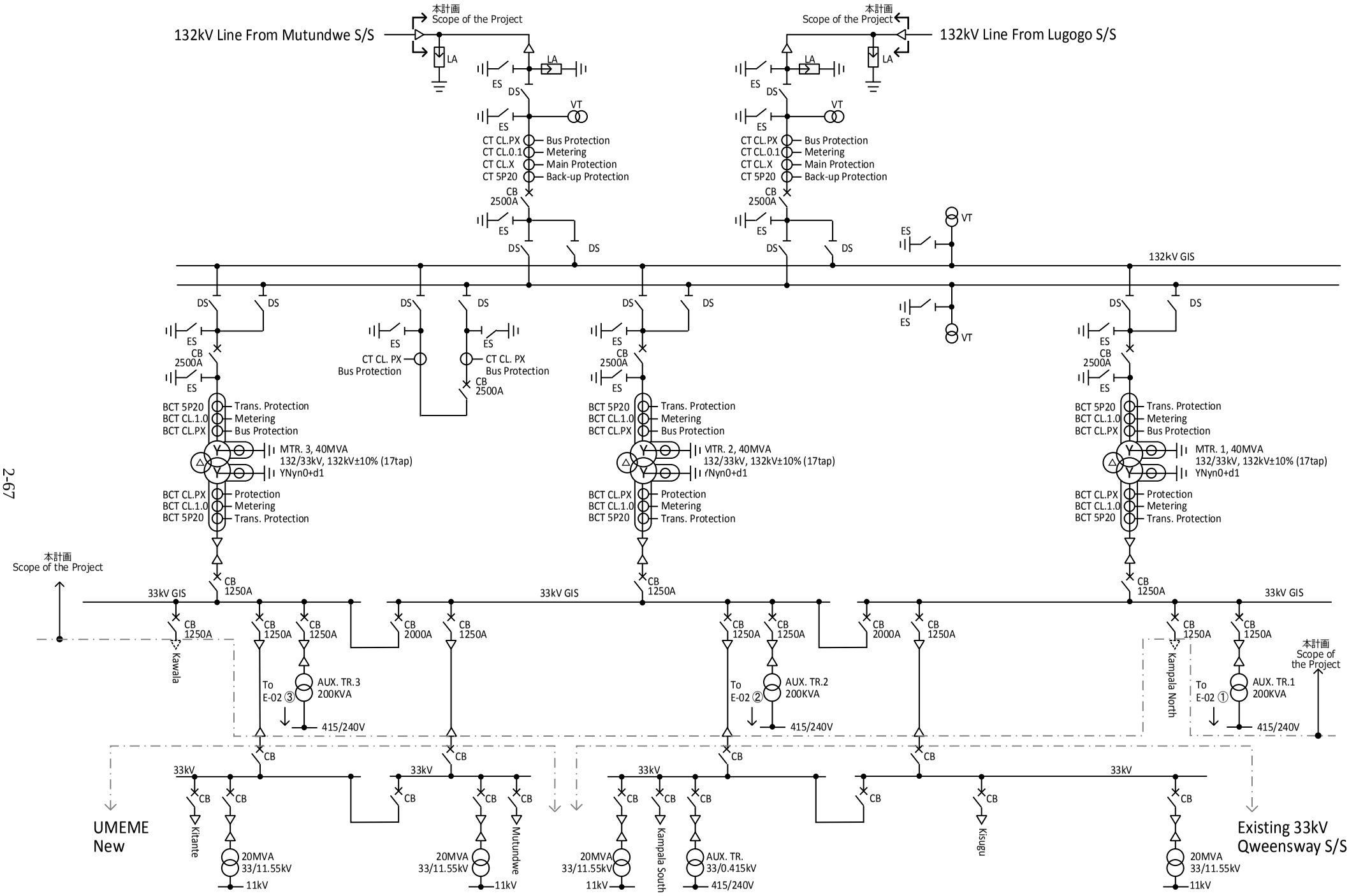
No.	Description	Specification	Quantity
QT1	**132 kV Overhead route**		
QT1-1	**Support**		**1**
	1. Tower (Tension type)		
	(1) Tower (Tension type)		**1**
	1) Type	Lattice type	
	2) Standard	JIS, JEC or equivalent	
	3) Material	SS 400 or equivalent	
	4) Surface finish	Galvanized coating (JIS HDZ45 or equivalent)	
	5) Structure	Wide base square type	
	6) Safety factor	1.2	
	(2) Insulator		
	1) Standard	IEC60383-1 or equivalent	**132**
	2) Size	254 mm tension type	**(11 pieces×**
	3) Creepage distance	320 mm	**12 sets)**
	4) Material	Porcelain	
	5) Color	Brown	
	6) Electro-magnetic failing load	120 kN	
	7) Others	11 pieces/phase	
	(3) Accessories (Tension type)	Lattice type (arcing horn, clamp etc.)	**12**
	(4) Buried grounding wire		
	1) Type	Galvanized hard steel strand wires	**200 m**
	2) Size	38 mm^2	
	3) Accessories	Earth angle	
	2. Dead-end tower		
	(1) Tower (Dead-end type)		**1**
	1) Type	Lattice type	
	2) Standard	JEC127, 128 or equivalent	
	3) Material	SS 400 or equivalent	
	4) Surface finish	Galvanized coating (JIS H 8641, JIS H 0401) HDZ 45 or equivalent	
	5) Structure	Wide base square type	
	6) Safety factor	1.2	
	(2) Insulator		
	1) Standard	IEC60383-1or equivalent	**198**
	2) Size	254 mm Tension type	**(11 pieces×**
	3) Creepage distance	320 mm	**18 sets)**
	4) Material	Porcelain	
	5) Color	Brown	
	6) Electro-magnetic failing load	120 kN	
	7) Others	11 pieces/phase	
	(3) Accessories (Tension type)	Lattice type (arcing horn, clamp etc.)	**18sets**

No.	Description	Specification	Quantity
	(4) Earthing wire		**200 m**
	1) Type	Galvanized hard steel strand wires	
	2) Size	100 mm^2	
	3) Others	Earth angle	
	(5) Arrestor		**6sets**
	1) Standard	IEC60099-4	
	2) IEC discharging class	2	
	3) Maximum system voltage	120 kV	
	4) Discharging current	10 kA	
	5) Accessory	Current indicator with discharging counter	
	(6) Outdoor terminal insulator type		**6sets**
	1) Type	Outdoor terminal	
	2) Underground cable size	800 mm^2	
	3) System voltage	132 kV	
QT1-2	**Overhead line**		**400 m**
	(1) Overhead power line		
	1) Type	ACSR	
	2) Size	420 mm^2 (Aluminum: 385 mm^2)	
	3) Sagging stress at 20 ℃	50 N/mm	
	(2) Damper		
	1) Type	Double torsional type	
	2) Quantity	6 sets	
QT1-3	**Overhead ground wire**		**50 m**
	1) Type	Galvanized hard steel strand wires	
	2) Size	50 mm^2	
	3) Shielding angle	15° or less	
	4) Sagging stress at 20 ℃	120 N/mm	
	5) Others	Mounting hardware is included.	
QT2	**132 kV Underground route**		**2,310 m**
	1) Type	XLPE	
	2) Size	800 mm^2	
	3) Conductor	Copper	
	4) Core	Single	
	5) Seethe type	Ant-proof PVC	
	6) Seethe Color	Black	
	7) Armor	Aluminum for direct burial or lead seethe	
QT3	**Telecommunication**		
QT3-1	**Optical fiber cable**		**500 m**
	1) Standard	ITU-T	
	2) Core	24	
	3) Cable type	G 652	
	4) Mode	Single	
	5) Frequency	1,550 nm	
	6) Others	- It includes FRP Pipe for optic fiber cable.	
QT3-2	**Splicing box**	**For optical fiber cable connection**	**1**
	1) Type	Outdoor use	
	2) Cores	24	
	3) Others	One set of mounting hardware are included	

2-2-3 Outline Design Drawing

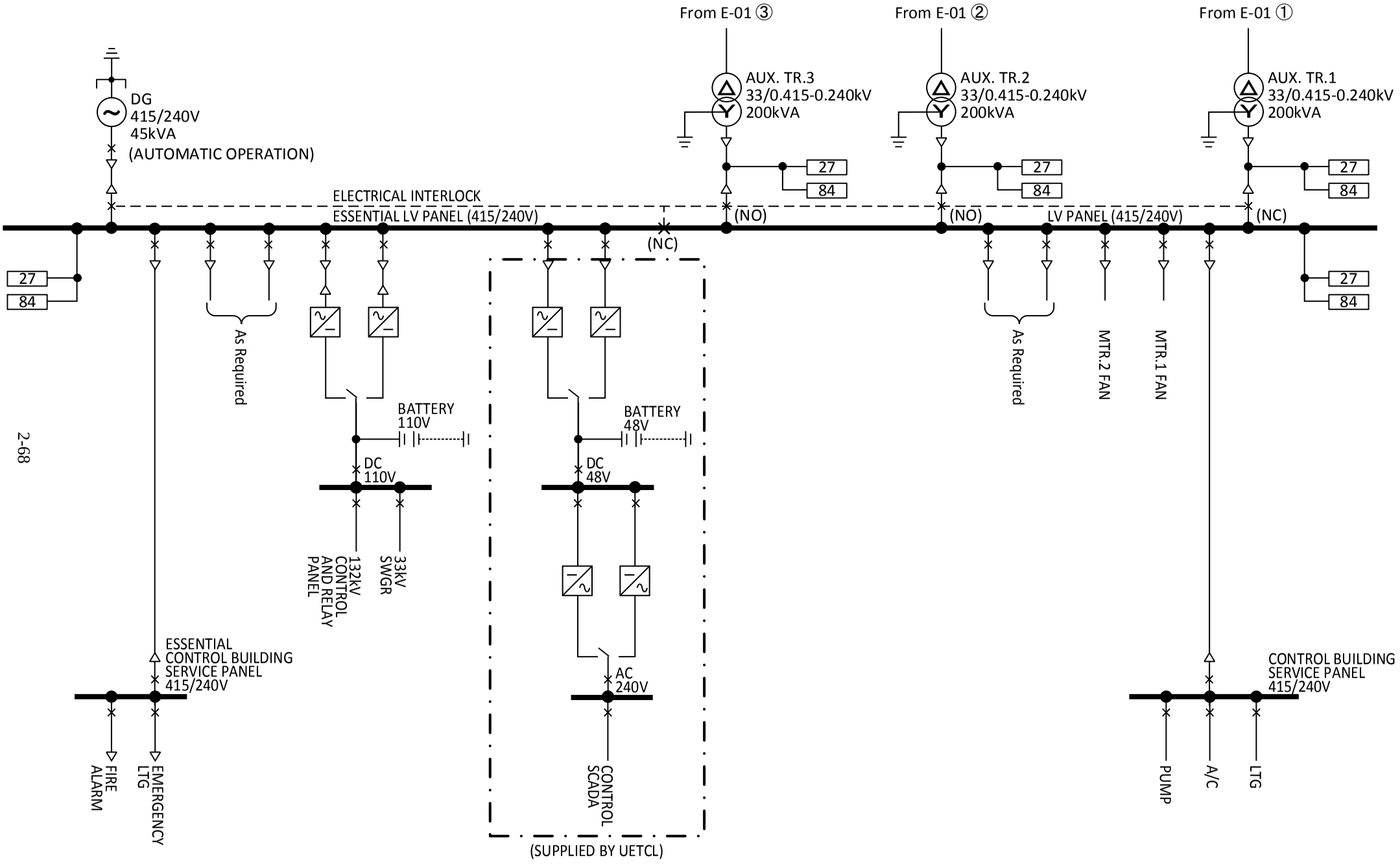
The outline design drawings of the Project are described below:

No.	Title
E-01	Single Line Diagram for 132/33 kV Queensway Substation
E-02	Single Line Diagram for 132/33 kV Queensway Substation (LV AC and DC Circuit)
T-01	132 kV Transmission Line and Underground Cable Route Map to Queensway Substation
T-02	Layout of Steel Towers
T-03	Type of Steel Tower [T]
T-04	Dead End Type Steel Tower Cable Termination
T-05	132 kV Underground Cable Section (General)
T-06	132 kV Underground Cable Section (For Road)
A-01	Site Layout of Queensway Substation
A-02	Section of Queensway Substation
A-03	Layout of Electrical Equipment



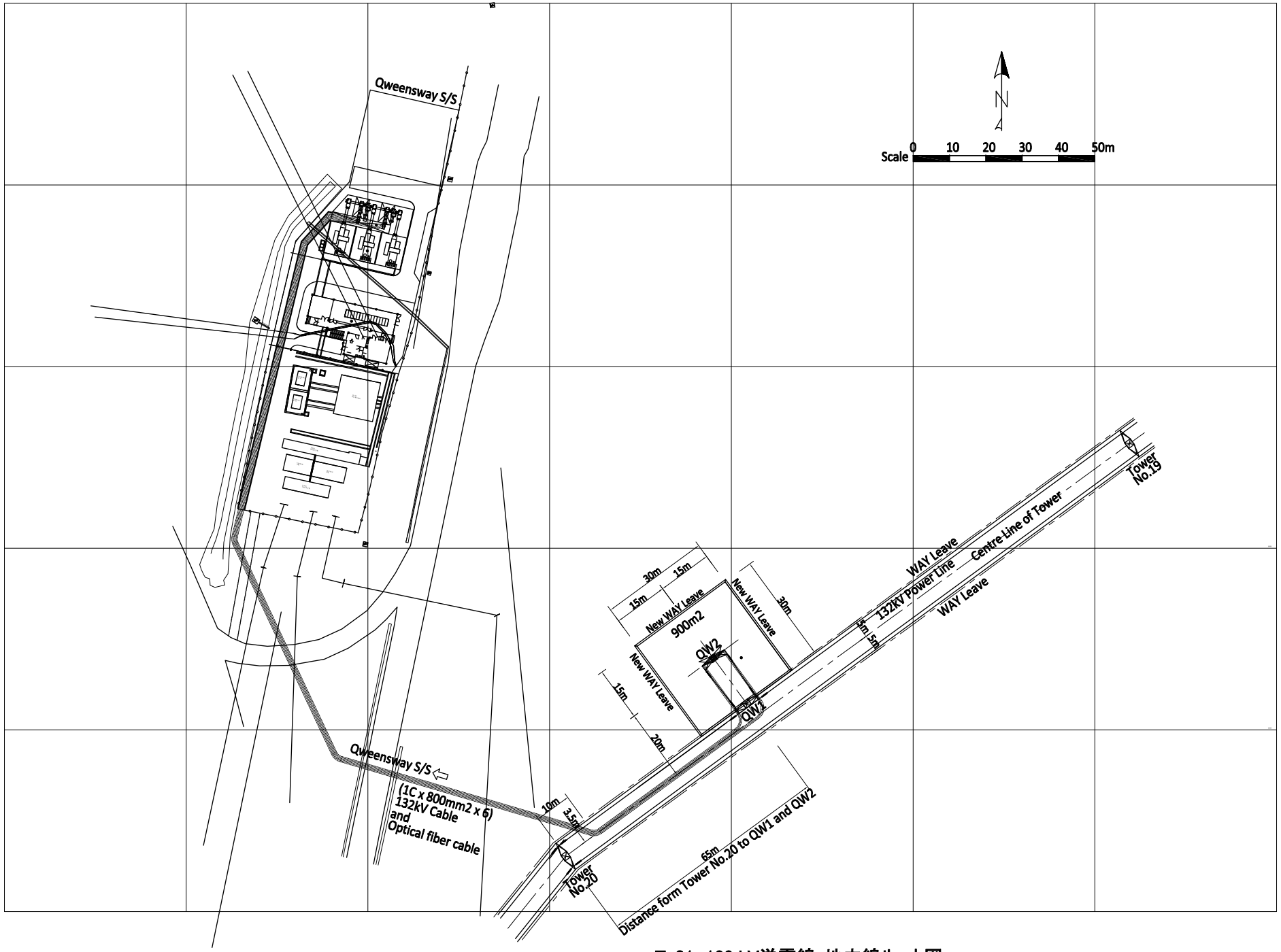
E-01 132/33 kVクイーンズウェイ変電所単線結線図

Single Line Diagram for 132/33kV Queensway Substation



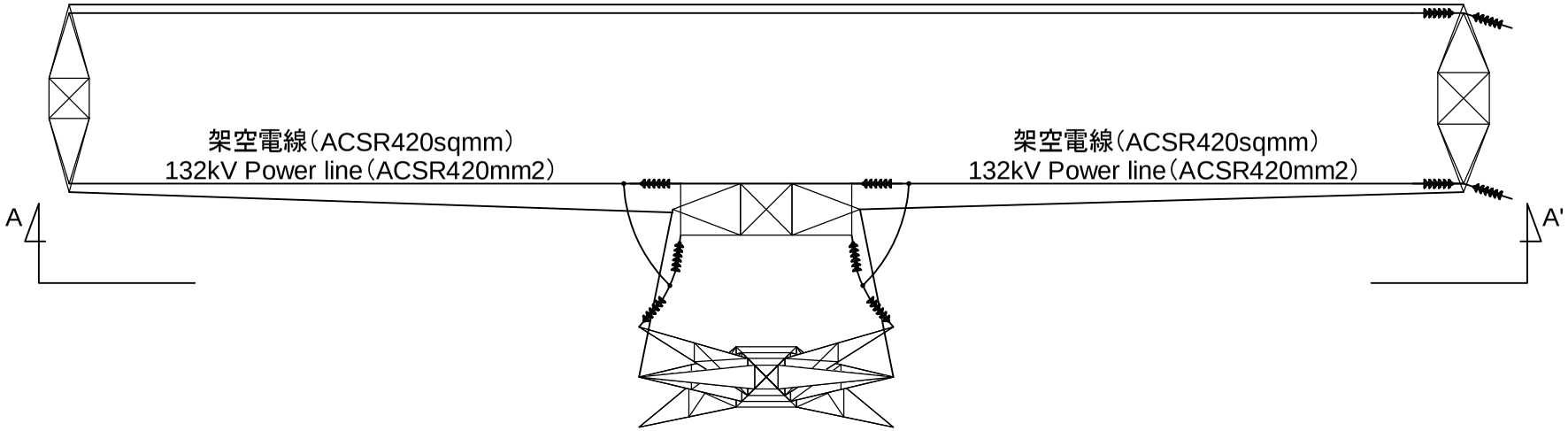
E-02 132/33 kVクイーンズウェイ変電所低圧及び直流単線結線図

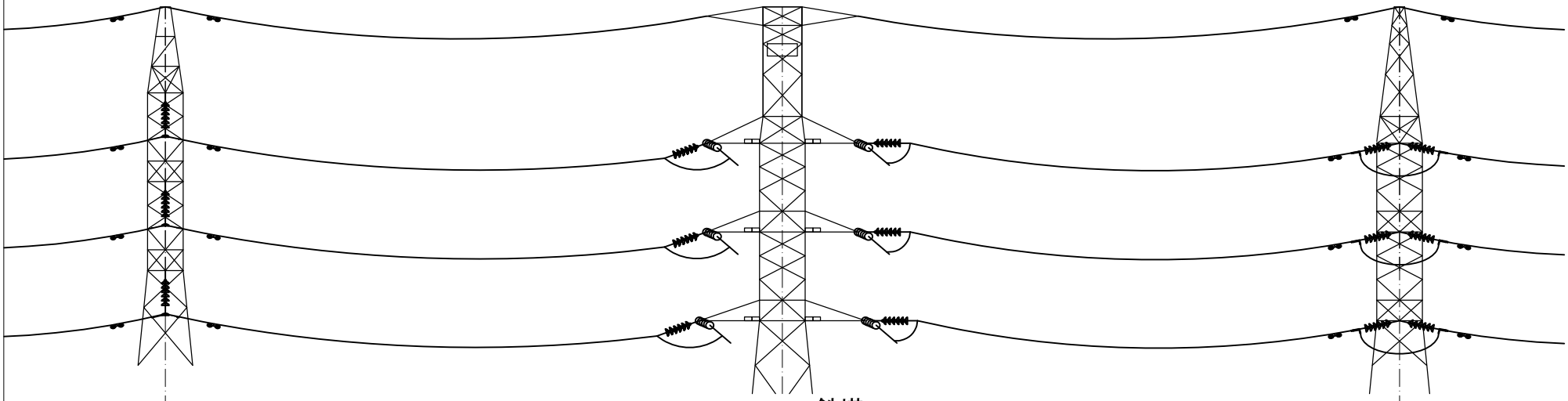
Single Line Diagram for 132/33 kv Queensway Substation (LV AC and DC Circuit)



T-01 132 kV送電線・地中線ルート図

132 kV Transmission Line and Underground Cable Route Map to Queensway Substation



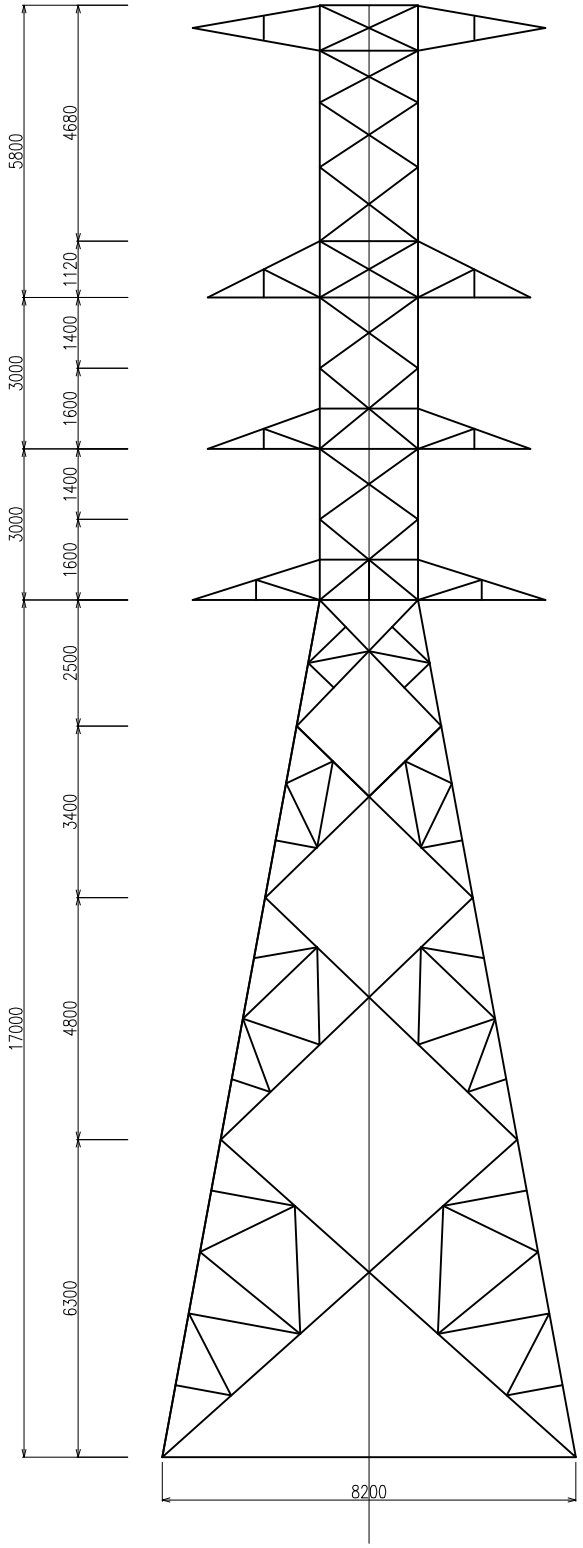


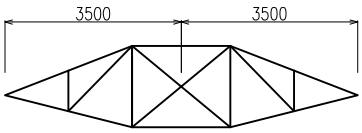
No.19 鉄塔
No.19 Tower

No.QW1 鉄塔
(引き込み用増設)
A-A' 断面
No.QW1 Tower
(For Expansion)
Section A-A'

No.20 鉄塔
No.20 Tower

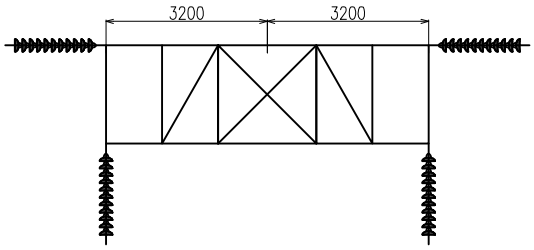
SCALE	NONE
TITLE	耐張鉄塔（分岐用）位置図 Improvement of Queensway Substation
DRG.NO.	T-02





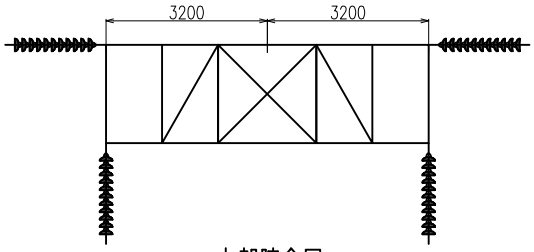
地線用腕金図

PLAN OF GROUNDINGWIRE X-ARM



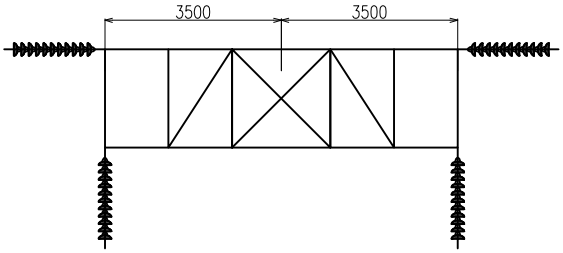
上部腕金図

PLAN OF TOP X-ARM



中部腕金図

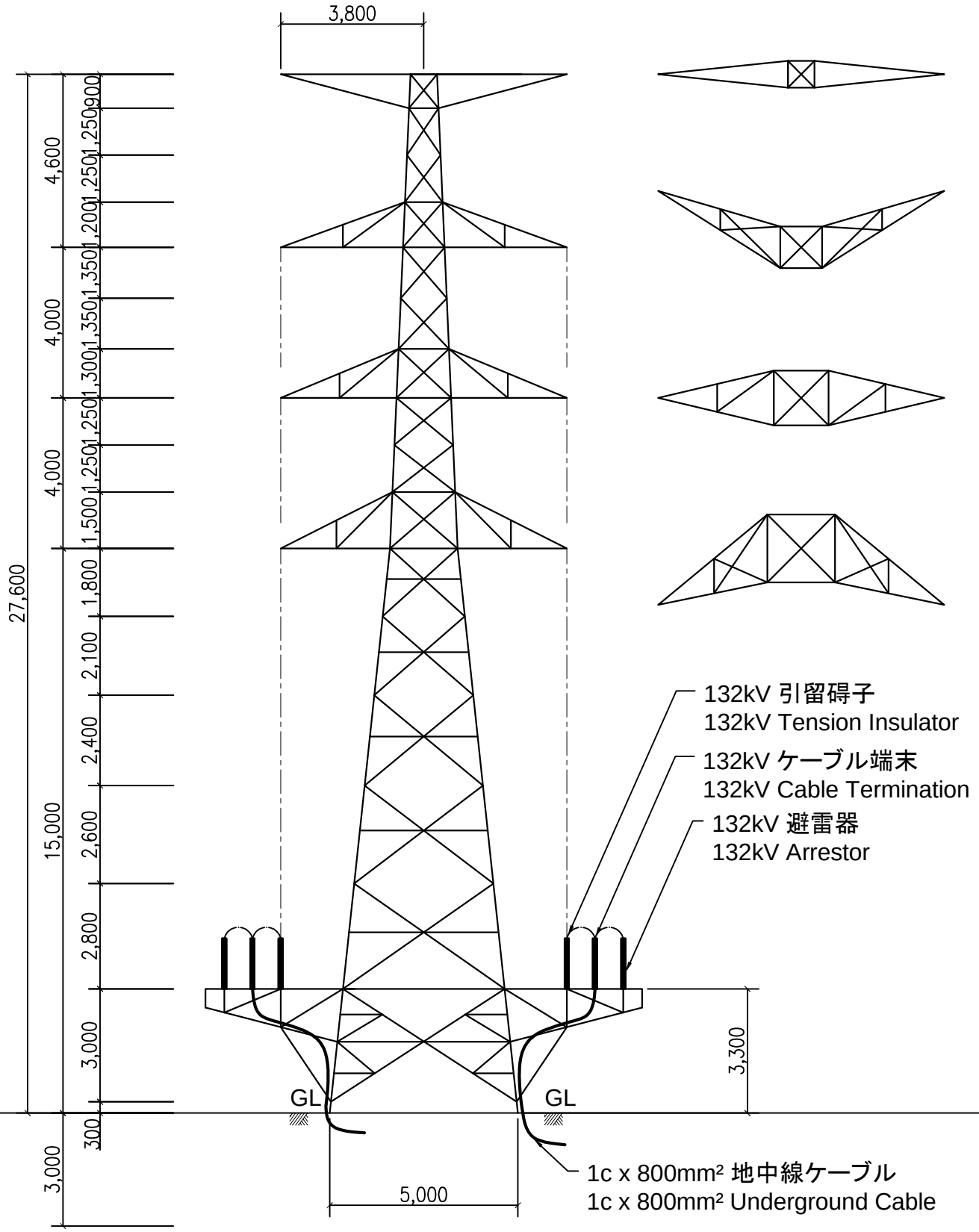
PLAN OF MIDDLE X-ARM



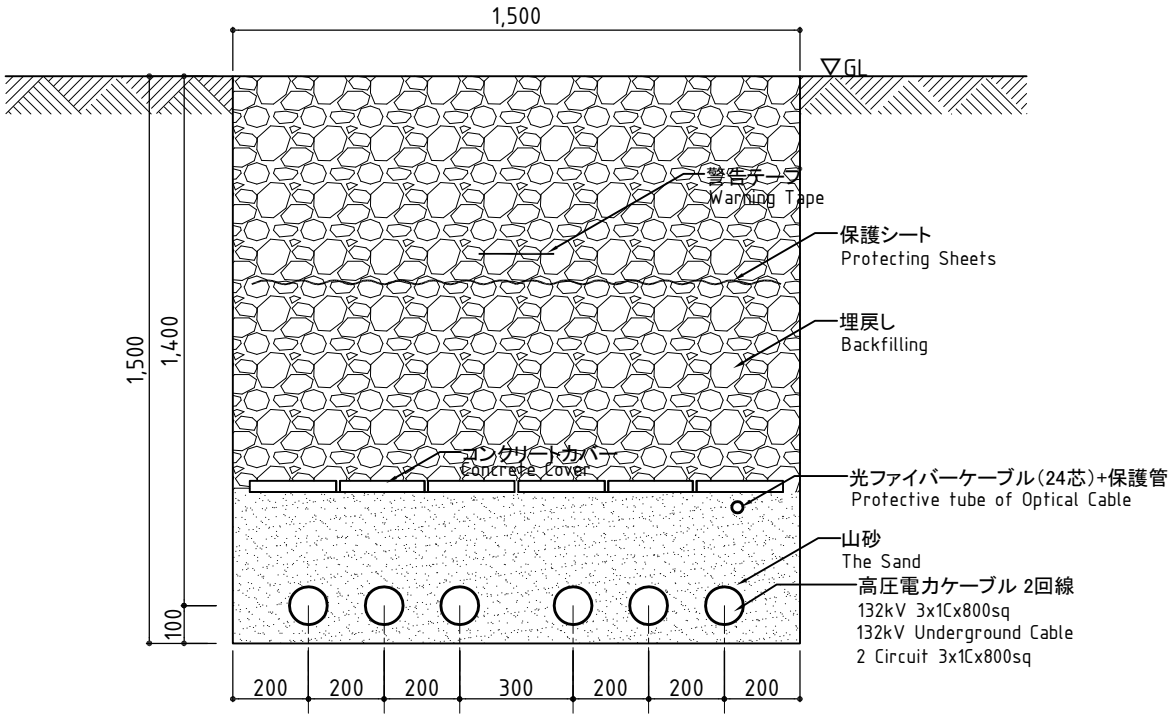
下部腕金図

PLAN OF BOTTOM X-ARM

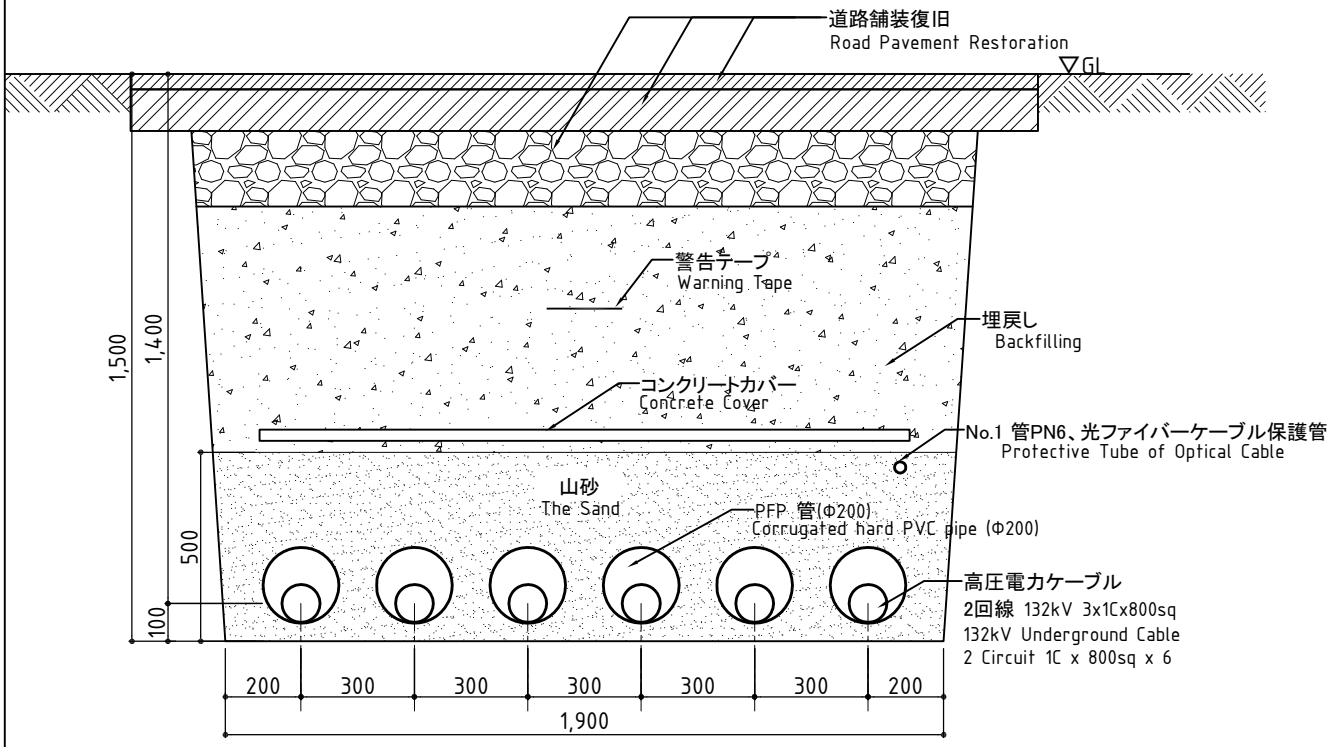
SCALE	1:150	
TITLE	耐張鉄塔図 Type of Steel Tower [T]	DRG.NO. T-03



SCALE	1:150
TITLE	引留鉄塔図 Dead End Type Tower Cable Termination
DRG.NO.	T-04



SCALE	1:20
TITLE	132 kV地中ケーブル位置図(一般) 132kV Underground Cable Section(General)
DRG.NO.	T−05



SCALE	1:20	
TITLE	132 kV地中ケーブル位置図（道路下） 132kV Underground Cable Section(For Road)	DRG.NO. T−06

S=1:500

Existing Site　Project Site

≒2,340m²

Land Filling Work 1.5m up from the existing Ground Level to protect against flood

Road Drainage Bypass Pipe Line 400φ*2 (Uganada Side Work)
See details A-02

Road Drainage Main Pipe Line 600φ (Uganda Side Work)
See details A-02

Control Building 1F

Control Room
AUXTR1
AUXTR2
AUXTR3

OF Cable (24)

Boundary Wall (Uganda Side Work)

Oil Water Separator

Existing Channel

Connecting Cable Culvert (Uganda Side Work)

Boundary line

Cable Culvert (3)

Security Distance W=2m

GATE 1

Existing

132kV Cable (6)

U-turn road to be demolished

4,004.981m²

Existing 33 kV SWGR

Existing 11 kV SWGR

TR 20MVA

Cable Culvert

277.200m²

Office

Existing SWGR Building

DEG

Tank

Switchgeer Room

Cable Culvert (2)

Cable Culvert (1)

No.3TR 40MVA

No.2TR 40MVA

No.1TR 40MVA

GIS

Cable Pit

Parking

Existing Channel

Septic tank

Control Building

Boundary line

GATE 2

GATE 3

Boundary Wall (Uganda Side Work)

Planning Pedestrian Walk Way

Rain Drainage Ditch (Uganda Side Work)

Pedestrian
Road
Road
Flyover
Flyover
Road
Road
BRT
BRT
Pedestrian

W=39,000

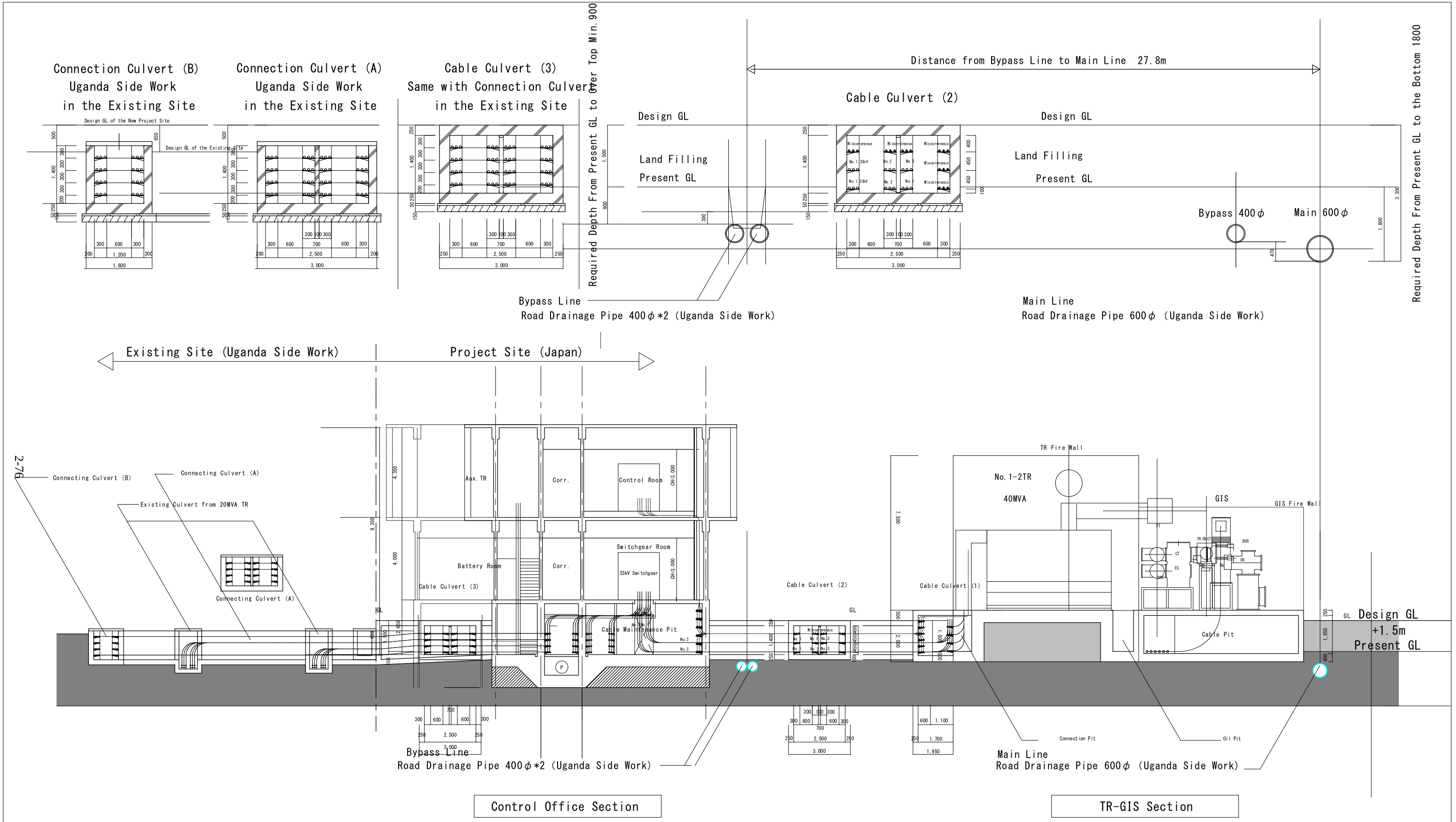
FLY OVER

CITY PLANNING ROAD W=39.0m

A1 FLYOVER PIER
P1 FLYOVER PIER
P2 FLYOVER PIER
P3 FLYOVER PIER
P4 FLYOVER PIER
P5 FLYOVER PIER

Planning Flyover Pier Layout

A-01 132/33kV クイーンズウェイ変電所サイト図
Site Layout of 132/33kV Queensway Substation



2-76

A-02 132/33kV クイーンズウェイ変電所地中断面図

Site Section of 132/33kV Queensway Substation

Boundary line

132kV Cable (6)

Security Distance W=2m

Boundary line

Security Distance W=2m

195.300m²

196.200m²

Manhole Hatch

Ventilation Tower (1)

Ventilation Tower (2)

Cable Culvert (1)

Cable Culvert (2)

Cable Culvert (4)

Control Building 1F Plan S=1:200

Control Building GF Plan S=1:200

TR GF Plan S=1:200

GIS GF Plan S=1:200

Boundary Wall (Uganda Side Work)

Boundary line

GATE 2

GATE 3

Road Drainage Ditch

Septic Tank

Total 759.6m2

A-03　電気機器配置図

Layout of Electrical Equipment

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

As the Project will be implemented based on the Japanese Grant Aid framework, it will be approved by the Japanese Government and commence after an Exchange of Notes (E/N) between the two countries and a Grant Agreement (G/A) between JICA and Uganda are exchanged. Basic policy and special considerations needed if the Project is implemented are given below.

(1) Project Implementing Body

The supervisory responsible agency for implementing the Project on the Ugandan side is the Ministry of Energy and Mineral Development (MoFPED). The Project implementing body responsible for O&M after the facilities go into service is UETCL. MoFPED and UETCL must appoint project representatives to stay in close contact and negotiate with the Japanese consultant and contractor so that the Project will progress smoothly.

The appointed UETCL project representative must explain project details sufficiently to MoFPED and UETCL project staff and project area residents so that they will cooperate with Project implementation.

(2) Consultant

Japanese consultants will enter a design and supervision agreement with UETCL to procure and install equipment for the Project, and produce detailed design and supervise construction work related to the Project. Along with drafting tender documents, consultants will handle bidding on behalf of UETCL, the Project implementing body.

(3) Contractor

In accordance with Japanese Grant Aid framework, independent Japanese contractors selected by Uganda through open bidding will build, procure and install equipment for the Project.

Contractors will need to continue supplying spare parts, support for failures, and other services after the Project is completed, and as such must give due consideration to a post-delivery communication and coordination for equipment and facilities.

(4) Need for Dispatching Engineers

Because the Project is a combination substation construction work composed of civil engineering, construction and installation of substation facilities on the new premises adjacent to the existing substation and construction work of approximately 0.35 kilometer of 132 kV transmission lines and they need to be carried out in a coordinated manner. With the majority of the work being done concurrently, it is essential that foremen familiar with the Japan’s Grant Aid Scheme be dispatched from Japan to keep management and site guidance for the whole works consistent in terms of scheduling, quality, finished forms and safety management.

2-2-4-2 Implementation Conditions

(1) Uganda Construction Conditions and Technology Transfers

As explained in Section 2-2-1-4, there are multiple general construction and electrical contractors in the Kampala metropolitan area which can accept orders for laborers, transportation vehicles and construction equipment within Uganda, as well as civil engineering work for facility and transmission line construction for the Project. However, dispatching Japanese engineers is essential in terms of schedule management, quality control and safety management. This will help in keeping the Project strictly on schedule, as well as because this will be the second use of 132 kV gas-insulated switchgears in Uganda and involve construction work of coordination building with the grade separation work slated to be conducted in 2017 as a Japanese Grant Aid Project.

(2) Using Local Equipment and Materials

While aggregate, cement, rebar and other materials for use in foundation work must be managed for quality and timely delivery, there is much precedent showing that these materials can be procured locally, as well as examples of locally procured material. Thus, in the interest of developing local industries, equipment than can be procured locally is to be used to the extent possible when formulating the construction plan. However, as Uganda relies on imports for the substation facilities and power transmission equipment needed for the Project, such equipment will be procured in Japan or another country.

(3) Safety Measures

With Uganda having relatively few safety problems and the Project being in an urban area, the area has good access and will be easy to monitor. Still, work after sunset is to be avoided, and sufficient care must be taken to prevent equipment theft and ensure the safety of construction staff.

(4) Tax Exemption

Customs duties to be imposed on the equipment and materials which are to be procured in Japan for the Project are not refunded in accordance with certain procedures. They are exempted under the total tax exemption system. Thus, they are not included in the budget for the Project.

The tax exemption procedures for the equipment and materials to be procured for the Project are as follows: 1) Bill of Lading, invoices, and other necessary documents are submitted to the implementing agency of UETCL by the purchasers, 2) the Ministry of Energy and Mineral Development (MEMD) checks them, and 3) the Ministry of Finance, Planning and Economic Development (MoFPED) approves them.

2-2-4-3 Scope of Works

The Japanese side will be responsible for procurement, installation, testing, adjustment and civil

engineering work for the 132/33 kV substation and 132 kV distribution lines for the Project within the existing Queensway substation. The Ugandan side will be responsible for leveling of the new Queensway Substation site and removal of existing structures there. Detailed scopes for the Japanese and Ugandan sides are as shown in Table 2-2-4-3.1.

Table 2-2-4-3.1 Work Demarcation for the Project (draft)

No.	Item	Work Demarcation		Notes
		Japan	Uganda	
1	(1) Acquisition of the Project sites (New substation and 132 kV transmission line route)		○	
	(2) Project site clearance		○	It includes the removal of obstacles on 132 kV transmission line route.
2	To construct the following facilities			
	(1) Control building, TR foundations, GIS foundations, cable pit	○		Reinforced concrete structure
	(2) Leveling of the Project site 1.5 m)		○	The installation of retaining wall is borne by Japan side.
	(3) The gates and fences		○	TR and the GIS fire protection wall is worked by Japanese side
	(4) The parking lot	○		
	(5) The road within the site	○		
	(6) The road outside the site		○	
	(7) Relocation of Country Trees on the site		○	
	(8) Replacement of drainage in the Project site		○	The work will be bedirected by Japanese side.
3	Incidental Work for New Substation			
	(1) Electricity			
	a) The distributing power line to the site	○		From TR (roof) to AC panels (1st floor)
	b) Main power equipment	○		From AC panels (1st floor) to each distribution panels (each panel)
	c) Lightning equipment	○		
	d) Fire alarm system	○		
	(2) Water Supply			
	a) The city water distribution main to the site		○	
	b) The supply system within the site (Water pump)	○		
	(3) Air conditioner			
	a) Room air conditioner work	○		
	b) Indoor ventilation work	○		
	(4) 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	○		Including for installation the water-purifying tank (for 10 persons)
	c) The drainage system for rain drainage within the site	○		Use of the existing rain drainage system
	(5) Gas Supply			
	(a) The city gas main to the site			Not necessary
	(b) The gas supply system within the site			Not necessary
	(6) Telephone System		N/A	
	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			

No.	Item	Work Demarcation		Notes
		Japan	Uganda	
	(7) 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 Uganda	○		
	(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	○		Tentative storeyard will be prepared nearby the 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	Securing and execution of budget for environmental and social considerations necessary for the project implementation		○	
11	Measures necessary to obtain the following permits: - Permits for installation work - Permits to access to restricted areas		○	Acquired prior to the implementation of the project, if necessary.
12	Securing of site for temporary storeyard of materials and equipment, and the gates and fences		○	Tentative storeyard will be prepared next to the site.
13	Construction of gates and fences for temporary storeyard	○		
14	Securing of parking during the work		○	
15	Office for construction work	○		It shall be used for Japanese contractor and consultant
16	Appropriate storage and safety control for materials and equipment at temporary storage	○		
17	Securing access roads, way leaves and usage permissions for construction of 132 kV transmission lines		○	

No.	Item	Work Demarcation		Notes
		Japan	Uganda	
18	Transfer of existing underground cables and pipes, and acquisition of related permits (electricity, telephone, water, sewerage, etc.)		○	If necessary
19	Acquisition of permits for trans-road work		○	
20	Provision of places to dispose of surplus soil and waste water		○	
21	Manufacturing and procurement of materials and equipment	○		
22	Installation, adjustment and tests of materials and equipment	○		The Ugandan side lends maintenance tools included in the set of equipment procured to the Japanese contractor.
23	Temporary dead-line work during the work		○	
24	Connection work of 132 kV transmission line (overhead line, grounding wire, optical fiber cable)		○	It includes the preparation of materials required for the work and repair of broken porcelain insulators of the existing towers relating to the Project.
25	Securing of cable trench and space from the 33 kV GIS to the existing panels		○	It includes the preparation of cable tray in the cable trench.
26	Final connection work of 33 kV power cables to the existing panel.		○	
27	Procurement of transaction meters.		○	4 units will be used as main meters and the other 4 units will be used as back-up meters.
28	Procurement and installation of equipment for SCADA system and the battery system.			Battery room will be located on the ground floor in the Control Building.
29	Initial operation guidance and operational guidance for maintenance and management of equipment procured	○		
30	Securing of the safety of persons concerned with the project at the project sites		○	
31	Response to and compensation for users of electricity in relation to outages inevitable for the work		○	
32	Announcement of outage plans to users of electricity during the work		○	

(Note): Items with sigh ○ indicate the responsible country. Asterisk marks on figures are items stated in M/D of the primary survey.

2-2-4-4 Consultant Supervision

According to the Japan's Grant Aid Scheme, consultants are to form a project team consistent with the final design and construction supervision based on the idea of the basic design and smoothly completes the work. This Project requires complex work on the substation facilities and transmission lines, with many connections to the existing substation facilities and monitoring based on on-site coordination with UETCL and UMEME. As such, the consultant is to station at least one engineer on site to handle overall schedule management, quality control, progress control and safety control during the construction supervision stage. Other engineers will also be dispatched to manage contractor progress with equipment installation, commissioning and adjustments, delivery testing and other work. As necessary, a domestic expert is to witness factory inspections and pre-shipment inspections for equipment manufactured domestically, and also supervise to prevent problems after unloading equipment at the site.

(1) Basic Policy for Construction Supervision

As basic policy, consultants are to supervise progress such that the work is completed within the given construction period. Along with ensuring equipment is delivered on time up to the quality and finished forms given in the agreement, they are to supervise and advise contractors so that they can perform the work safely at the site. The following are the main points to be kept in mind for construction supervision.

(2) Schedule Management

Consultant management staff will compare actual progress against the work schedule planned at time of contract monthly and weekly so that contractors will keep the delivery schedule given in the contract. If they interpret work to be behind schedule, they will warn contractors and request them to submit and implement plans to get back on schedule, and guide contractors so they can complete the work and deliver equipment within the contract construction period. The following items will be compared between work schedule and project progress:

- Work progress - progress of equipment and material manufacturing and site civil engineering and construction
- Equipment and material transport to site – equipment and materials for substation, power transmission equipment, civil engineering and construction
- Temporary works and readiness of construction machinery
- Productivity and actual numbers of engineers, skilled workers, laborers and other workers

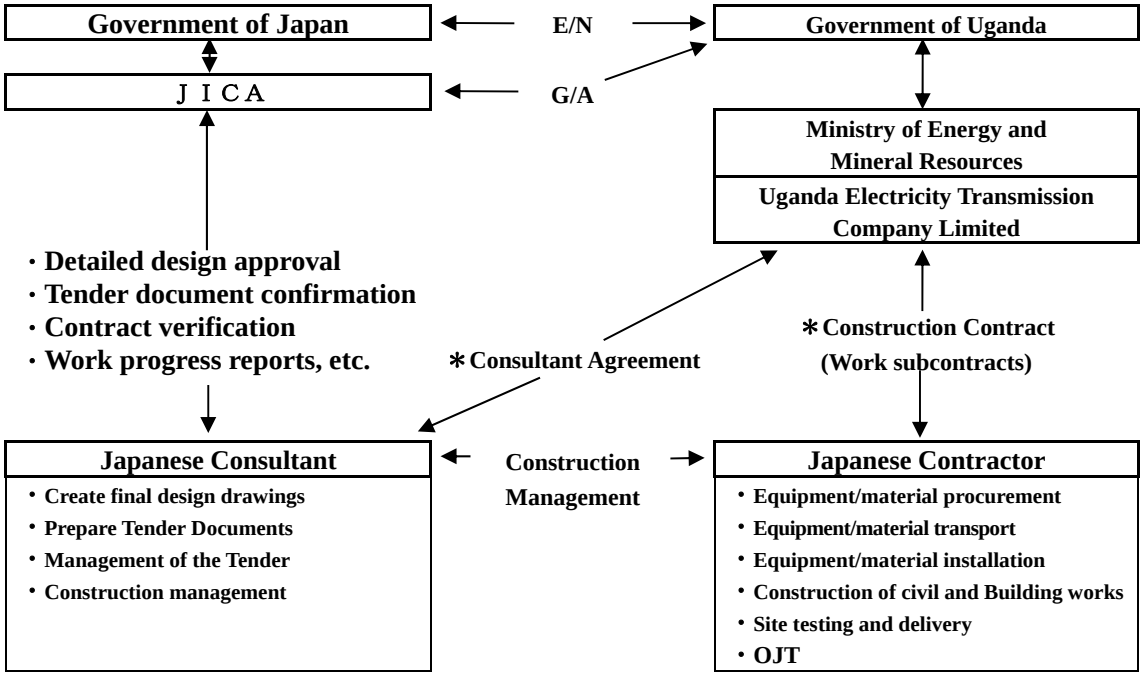
(3) Safety Control

Consultant supervisory staff will consult and work together with the contractor's representative, and manage work safely to prevent any occupational accidents on the site during the construction period or accidents involving third parties. The following actions are to be taken in terms of site safety management:

- Establish safety management regulations and select a safety manager
- Prevent disasters through regular inspection of construction machinery
- Decide a service route for transport machinery and other work vehicles, and ensure safe driving
- Strictly insist workers take advantage of worker benefits and take leave

(4) Overall Relationships concerning Project Implementation

Role correlations for the Project, including those during construction supervision, are as shown in Figure 2-2-4-4.1.



*JICA shall verify Consultant Agreement and Construction Contract

Figure 2-2-4-4.1 Project Relation Diagram

(5) Construction Managers

The contractor will procure and deliver equipment and materials for new substation construction work on the existing substation grounds and 132 kV transmission line work, as well as the related civil engineering work. Further, they will subcontract local Ugandan contractors to perform the work. Accordingly, the contractor is required to ensure subcontractors fully comply with the work schedule, quality, finished form and safety measures given in the work contract. To accomplish this, contractors will deploy engineers with experience in similar overseas work to guide and advise local contractors.

Given the scale and details of the substation facility and transmission line work for this Project, contractors will preferably station at least the number of engineers given in Table 2-2-4-4.1.

Table 2-2-4-4.1 Engineers to be dispatched by the Contractor

Title of engineers	Number of engineers	Responsibilities	Dispatch period
Inspector (Substation facilities)	1	Confirmation and verification of shop drawings for equipment, pre-shipping inspection	Drawing approval period and inspection period
Inspector (Transmission facilities)	1	Confirmation and verification of shop drawings for equipment, pre-shipping inspection	Drawing approval period and inspection period
Local procurement supervisor (Equipment)	1	Supervision of all installation works (Queensway Substation), coordination with related agency, acquisition of approval, implementation of OJT, equipment and materials procurement management, customs clearance procedures, labor management, accounting	Throughout the installation period
Local procurement	1	Supervision of overall construction works (Queensway	Construction work

Title of engineers	Number of engineers	Responsibilities	Dispatch period
supervisor (Work)		Substation and foundation), coordination with related agency	period
Local procurement supervisor (Construction)	1	Supervision of construction facility works, on-site inspection	Construction work period

2-2-4-5 Quality Control Plan

Consultant construction supervisory staff are to supervise and verify that the contractors are maintaining quality, construction and installed forms for equipment procured for the Project up to the quality and finished forms given in the contract documents, including technical specifications and detailed design drawings. Staff will request contractors to correct, change or revise the work if quality or finished form is in danger of being compromised.

(a) Verify fabrication drawings and specifications for equipment

(b) Witness factory inspections for equipment or verify inspections

(c) Verify packaging, transportation and temporary placements on site

(d) Verify working drawings and installation manual procedures for equipment

(e) Verify equipment commissioning, adjustment, testing and inspection reports

(f) Supervise site installation of equipment and witness commissioning, adjustments, tests and inspections

(g) Verify equipment working drawings, fabrication drawings, and finished forms

(h) Verify construction drawings, fabrication drawings, and on-site progress

2-2-4-6 Procurement Plan

The equipment and materials for the substation facilities to be procured and installed in this Project are not manufactured in Uganda. Thus, transformers, panels and other equipment for the substation facilities for the Project will be procured from such developed countries as the UK, France, Italy, Denmark Germany and other European countries and Japan. While Indian and Chinese products have recently started being introduced into UETCL's substation facilities, Japanese and European equipment are more reliable. Although some European substation facility manufactures have representative offices in Uganda, few of them provide such necessary follow-up services as handling of accidents and repair work and procurement of spare parts for high-voltage substation equipment. Thus, the providers of the substation facility equipment for the Project need to be decided in consideration of the local conditions and easiness of O&M of the facility to be performed by local engineers, availability of such follow-up services as spare part procurement and handling of accidents. Japanese transformers and power distribution equipment procured in past Japanese grant aid projects are still operating soundly at the existing Queensway Substation. Partly because of this, UETCL that will perform O&M of the facility and equipment after the project completion highly regards good

performance of main substation equipment and follow-up services of Japanese manufactures and thus desires Japanese products to be used for the substation facility equipment for the Project. Such construction machinery for equipment installation and transportation as 30-ton cranes and trailers can be leased locally and thus it does not interrupt the implementation of the Project.

In light of the above situation, equipment and materials to be used for the Project shall be procured as follows:

(1) Locally Procured Equipment and Materials

Construction equipment and materials (cement, sand, concrete aggregate, concrete roadblocks, brick, rebar, wood, gasoline, diesel, construction vehicles, cranes, trailers and other temporary work equipment/materials) will be procured locally.

(2) Equipment and Materials Procured in Japan

1) Substation Facility Equipment and Materials

132/33 kV transformer, 132 kV Gas Insulated Switchgear, 132kV facility control and protection panel, 33kV Gas Insulated Switchgear, low-voltage facility, etc.

2) Transmission and Distribution Line Equipment and Materials

132 kV transmission line equipment and materials (steel, insulator, etc.), 132kV cable, etc.

2-2-4-7 Operational Guidance Plan

As basic policy, a trainer from the manufacturer will give guidance on initial operation and O&M methods for the equipment procured in the Project before the work is complete as OJT and in accordance with the O&M manuals. To keep this guidance plan progressing smoothly, UETCL must appoint a full-time engineer to attend the OJT and keep close contact with Japanese consultants and contractors. The appointed UETCL engineer must build up the skill level of staff unable to attend and work to improve UETCL maintenance abilities. Also, special manufacturer engineers are needed for the installation, adjustment and testing of substation facilities and transmission line equipment which local contractors cannot handle. Thus, engineers must be sent from Japan to fulfill these roles and handle quality control, technical guidance and schedule management.

2-2-4-8 Implementation Schedule

Based on the Japan’s Grant Aid Scheme, the Project implementation schedule is given in Figure 2-2-4-8.1.

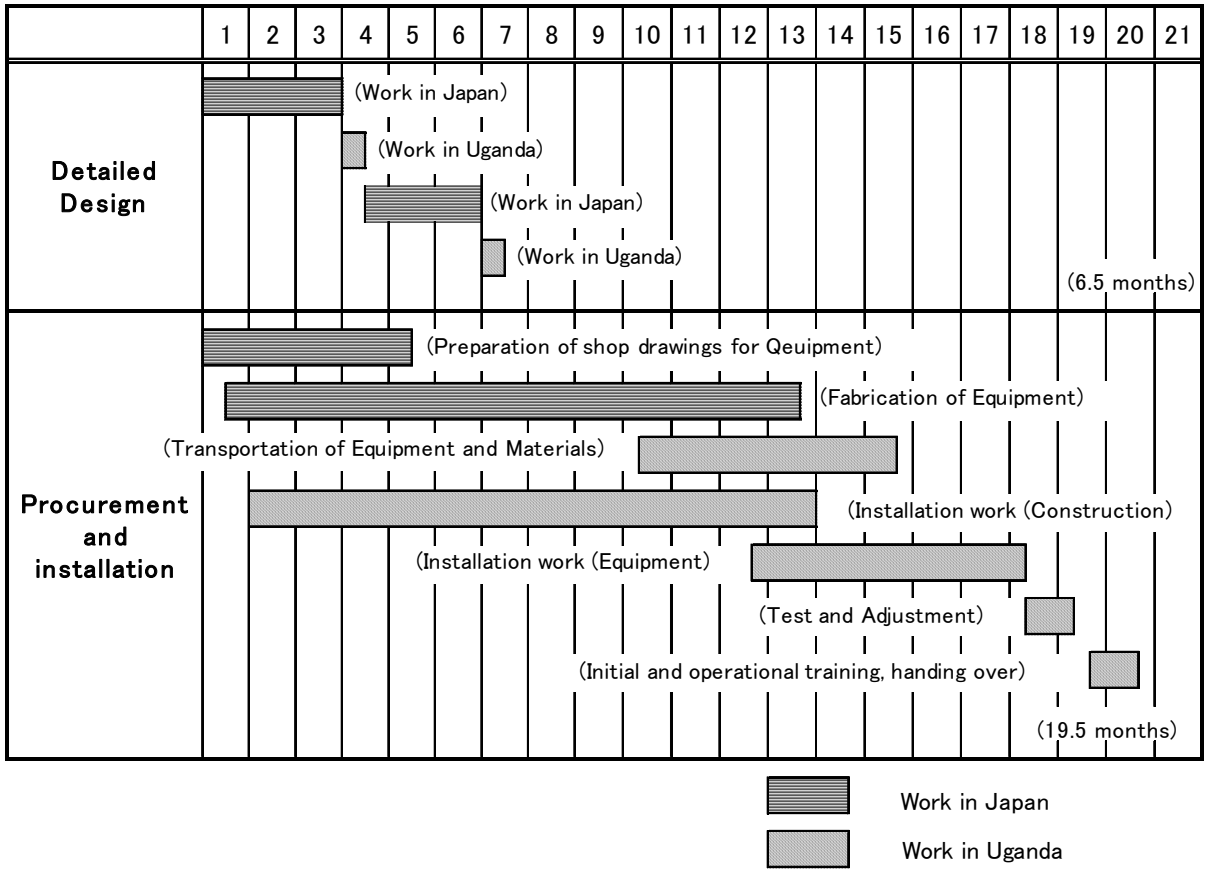


Figure 2-2-4-8.1 Project Implementation Schedule

2-3 Project Operation Plan

2-3-1 Basic Plan

Proper O&M for the transmission and substation facilities, as well as preservation of their surrounding environments, are essential to improving consumer trust in power supply in the Project area and steady power supply management. As such, appropriate preventative maintenance is recommended to reduce the rate of facility accidents and improve reliability, safety and efficiency levels. The basic concepts for transmission and substation facility maintenance are shown in Figure 2-3-1.1. Prevention must be the focus for maintenance of equipment and facilities procured, installed and built for the Project.

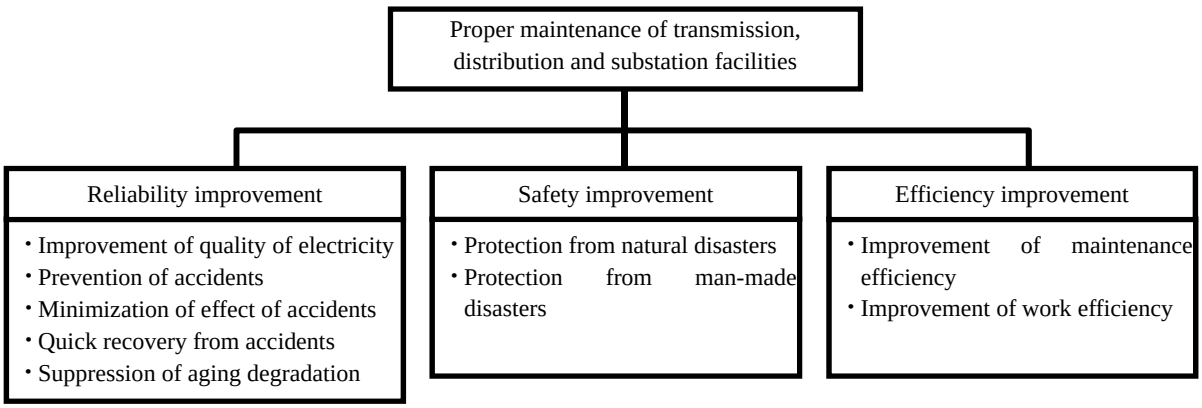


Figure 2-3-1.1 Basic Concepts for Transmission, Distribution and Substation Facility Maintenance

In the Project, engineers dispatched by the Japanese contractor are planned to train local engineers in O&M for the substation and transmission facilities during installation and the testing and adjustment periods. The fruits of this OJT can be fully reaped by also having the Japanese side furnish the necessary spare parts, tools for testing and maintenance, and O&M manuals, and establishing an O&M system for after services have started.

2-3-2 Operation and Maintenance Structure

2-3-2-1 Routine Inspection for Substation Facilities and Periodic Inspection Items

The standard regular inspection items for the substation facilities to be procured and installed in the Project are given in Table 2-3-2-1.1. As given in the table, inspections for the above facilities are classed as follows: 1) Daily inspections, which involve a sensory check to detect abnormal heat, sounds and smells from equipment, 2) Normal inspections, which check equipment for loose bolts, surface dirt or damage on insulation and other charging section items not checked on daily inspections, and 3) Detailed inspections, which include functional checks of interlock mechanisms between devices and precision maintenance of instrumentation. Normal inspections will be conducted once every one to two years, and detailed inspections will be conducted once every four years. Panel internal fuses, metering, relays and other components with deteriorating performance, reduced insulation, contact wear or change in qualities should be replaced as appropriate on normal and detailed inspections upon confirming component qualities and frequency of use.

Table 2-3-2-1.1 Inspection Items for Standard Facility Equipment

Inspection Items	Details of Inspection (Method)	Daily	Regular	Detailed
Visual appearance	State of switch indicators and display lights	○	○	
	Abnormal noise and/or smells	○	○	
	Overheat and discoloration of terminal	○	○	
	Cracking, damage or staining of bushings and porcelain tubes	○	○	
	Rust on mounting cases, frame, etc.	○	○	
	Abnormal heat (temperature gauge)	○	○	
	Clamping of bushing terminal (mechanically checked)	○	○	
	Gas pressure of Gas Insulated Switchgear	○	○	
Operating Devices and Control Panel	Display conditions on measuring instruments	○	○	○
	Indication on operation counters		○	○
	Dampness, rust or staining on operation box or panel		○	○
	Refilling oil, cleaning		○	○
	Clamping of distributing terminals	○	○	○
	Confirmation of switching display status		○	○
	Air or oil leaks		○	○
	Confirmation of pressures (air, etc.) before/after operation		○	○
	Confirmation of operation meter		○	○
	Rust, deformation and/or damage on springs (maintenance)	○	○	○
	Abnormalities of tightening pins		○	○
	Inspection of auxiliary switches and relays (maintenance)		○	○
	Inspection of DC control power source	○		
Measure and Test	Measurement of insulating resistance		○	○
	Measurement of contact resistance			○
	Breakage of heater wires		○	○
	Operation test of relay		○	○

2-3-2-2 Routine Inspection for Transmission Lines and Periodic Inspection Items

In maintaining 132 kV transmission lines, the most important services provided for consumers are routine inspection patrols of facilities for accidents, damage and breakage, and immediate repair of detected problem areas. There are various possible causes of overhead transmission line accidents, which include strong wind and other natural impacts and failure due to ageing, and an accident may lead to extensive power outage.

Below are main inspection items in routine patrols:

(a) Structural defects (insulator, electric wire, tower)

(b) Incoming extraneous matters

(c) Bird nests

(d) Trees close to conductive part (examine preventive measures including cutting trees)

Information on construction plans and road work plans to be carried out near the transmission lines will be gathered in the patrol and their impact on the transmission facilities will be examined. The routine patrol will be performed once or twice a month. However, special patrols will be also performed in such abnormal weather conditions as strong wind and torrential rains or disaster occurrences. Soundness (looseness) of the towers will be also checked once a year.

2-3-3 Spare Parts Purchasing Plan

2-3-3-1 Spare Parts

Parts which wear and deteriorate with daily operations must be replaced regularly. The following spare parts will be procured for the Project, fulfilling quantities needed for one year.

(a) 132 kV and 33 kV Gas Insulated Switchgears

(b) 132/33 kV transformers

(c) Control and protection panel

(d) DC supply system

(e) AC distribution panel

2-3-3-2 Spare Parts Procurement Plan

As a rule of Grant Aid Projects, the recipient country is required to be capable of O&M of the provided facility and preparatory study results conclude that the implementing agency, UETCL, has the capacity. The replacement parts to be provided within the scope of the Project will be those necessary in one year from the beginning of service. It is agreed that replacement parts thereafter will be provided by Uganda as the scope of O&M for which it is responsible.

Because the Project is substation facility and transmission line construction and there are not many mechanical sliding parts as is in the case of power generation facilities, the amount of spare parts for replacement to be procured is a justifiable minimum required quantity.

Spare parts for equipment not listed below will not be procured because no replacement is likely to be required in the first one year from the beginning of service.

(1) Procurement Plan for Replacement Parts for 132/33 kV transformer (Equipment No. QS1)

Three sets of 132/33 kV transformer are procured for the Project. The quantity estimated to be necessary for the first one year for one set listed below will be multiplied by three for three sets of 132/33 kV transformer for the procurement.

Table 2-3-3-2.1 132/33 kV Transformer (Equipment No. QS1)

No.	Description	Unit	Quantity
(1)	33 kV bushing	set	1
(2)	Buchholtz relay	set	1
(3)	Oil temperature gauge	set	1
(4)	Oil level gauge	set	1
(5)	MCCB (each one)	set	1
(6)	Auxiliary relay (each one)	set	1
(7)	Packing	set	100%
(8)	Fuse (each one)	set	100%
(9)	Lamp (each one)	set	100%
(10)	LED Lamp (each one)	set	1

(2) Procurement Plan for Replacement Parts for 132 kV Gas Insulated Switchgear (Equipment No. QS2)

A total of nine sets of equipment of the same structure are to be procured for 132 kV Gas Insulated Switchgear (Equipment Component No. QS2-1 to QS2-3). The quantity estimated to be necessary for the first one year for one set listed below will be multiplied by nine for nine sets 132 kV gas-insulated switchgear for the procurement.

Because 132 kV voltage transformer (Equipment Component No. QS2-4) does not have any movable section, it will not require any replacement part for the first one year and thus no replacement parts are procured.

Table 2-3-3-2.2 Replacement Parts for 132 kV Gas Insulated Switchgear (Equipment No. QS2)

No.	Description	Unit	Quantity
(1)	Closing coil for CB	set	1
(2)	Trip coil for CB	set	1
(3)	Closing contactor for DS & ES	set	1
(4)	Opening contactor for DS & ES	set	1
(5)	Interlock coil for DS & ES	set	1
(6)	Space heater element	set	5
(7)	SF6 gas cylinder	set	3

(3) Procurement Plan for Replacement Parts for 33 kV Gas Insulated Switchgear (Equipment No. QS3)

A total of 14 sets of equipment of the same structure are to be procured for 33 kV Gas Insulated Switchgear (Equipment Component No. QS3-1 to QS3-4). The quantity estimated to be necessary for the first one year for one set listed below will be multiplied by 14 for 14 sets of the switchgear for the procurement.

Table 2-3-3-2.3 Replacement Parts for 132 kV Gas-Insulated Switch Gear (Equipment No. QS3)

No.	Description	Unit	Quantity
(1)	Lamp (each one)	set	100%
(2)	LED Lamp (each type with socket)	set	10%
(3)	MCCB (each one)	set	1
(4)	Protection relay (each one)	set	1
(5)	Auxiliary relay (each one)	set	3

No.	Description	Unit	Quantity
(6)	Auxiliary timer	set	1
(7)	Electromechanical contactor (each one)	set	1
(8)	Trip coil (each one)	set	1
(9)	Closing coil (each one)	set	1
(10)	Space heater element	set	1
(11)	Meter (each one)	set	1
(12)	Switch (each one)	set	1

(4) Procurement Plan for Replacement Parts for 132 kV Control and Protection Panel (Equipment No. QS4)

The 132 kV facility control and protection panel consists of the following equipment of the equipment component number:

Equipment No. QS4-1	132/33 kV Transformer Control and Protection Panel	3 sets
Equipment No. QS4-2	132 kV Line Control and Protection Panel	2 sets
Equipment No. QS4-3	132/33 kV Transformer Switch Control and Protection Panel	3 sets
Equipment No. QS4-4	132 kV Bus Coupler Switch Control and Protection Panel	1 set

The auxiliary relay structures and sequence programs to be built in the facility differ and some failure may have great impacts on the system operation in the metropolitan area. Thus, one set of replacement part will be procured in the quantity below based on the characteristics of equipment of equipment component numbers QS4-1 to QS4-4 in order to secure supply reliability

Regarding 132 kV Line Control and Protection Panel and 132/33 kV Transformer Switch Control and Protection Panel, since these two equipment has similar structure, one set of the spare parts listed on Table 2-3-3-2.5 will be procured for these two equipment.

Table 2-3-3-2.4 Replacement Parts for 132/33 kV Transformer Control and Protection Panel (Equipment No. QS4-1)

No.	Description	Unit	Quantity
(1)	Meter (each one)	set	1
(2)	Switch (each one)	set	1
(3)	Lamp (each one)	set	100%
(4)	LED Lamp (each one with socket)	set	10%
(5)	MCCB (each one)	set	1
(6)	Auxiliary relay (each one)	set	3
(7)	Electromechanical contactor (each one)	set	1
(8)	Automatic voltage regulator	set	1

Table 2-3-3-2.5 Replacement Parts for 132 kV Line Control and Protection Panel (Equipment QS4-2) and 132/33 kV Transformer Switch Control and Protection Panel (Equipment No. QS4-3)

No.	Description	Unit	Quantity
(1)	Meter (each one)	set	1
(2)	Switch (each one)	set	1
(3)	Lamp (each one)	set	100%
(4)	LED Lamp (each one with socket)	set	10%
(5)	MCCB (each one)	set	1
(6)	Auxiliary relay (each one)	set	3

No.	Description	Unit	Quantity
(7)	Electromechanical contactor (each one)	set	1
(8)	Protection relay	set	1

Table 2-3-3-2.6 Replacement Parts for 132 kV Bus Coupler Switch Control and Protection Panel (Equipment No. QS4-4)

No.	Description	Unit	Quantity
(1)	Meter (each one)	set	1
(2)	Switch (each one)	set	1
(3)	Lamp (each one)	set	100%
(4)	LED Lamp (each one with socket)	set	10%
(5)	MCCB (each one)	set	1
(6)	Auxiliary relay (each one)	set	3
(7)	Electromechanical contactor (each one)	set	1
(8)	Protection relay	set	1

(5) Procurement Plan for Replacement Parts for Low voltage equipment (Equipment No. QS6)

The low voltage equipment consists of the equipment listed below. Because the structure of the equipment itself differs, replacement parts estimated to become necessary for the first year from the beginning of service will be procured separately in accordance with their characteristics.

Equipment No. QS6-1	DC Supply System (DC110V)	1 set
Equipment No. QS6-2	AC Distribution Panel	1 set
Equipment No. QS6-3	Diesel engine generator (415/240 V, 45kVA)	1 set

No replacement part will be procured for the Equipment No. QS6-3, diesel engine generator, as it will be a small maintenance-free generator.

Replacement parts for the equipment above are listed in Table 2-3-3-2.7 and Table 2-3-3-2.8 below.

Table 2-3-3-2.7 Replacement Parts for DC Supply System (DC110V) (Equipment No. QS6-1)

No.	Description	Unit	Quantity
(1)	MCCB (each one)	set	1
(2)	Meter (each one)	set	1
(3)	Lamp (each one)	set	100%
(4)	LED Lamp (each one with socket)	set	10%
(5)	Fuse (each one)	set	1
(6)	Auxiliary timer	set	1

Table 2-3-3-2.8 Replacement Parts for AC Switchboard (equipment No. QS6-2)

No.	Description	Unit	Quantity
(1)	MCCB (each one)	set	1
(2)	Meter (each one)	set	1
(3)	Lamp (each one)	set	100%
(4)	LED Lamp (each one with socket)	set	10%
(5)	Fuse (each one)	set	1
(6)	Auxiliary timer	set	1

2-4 Project Cost Estimation

2-4-1 Initial Cost Estimation

In the case of the actual implementation of the Project under the grant aid scheme of the Government of Japan, the Ugandan side is expected to pay the costs of its undertakings as listed below. The permanent secretary of MoFPED confirmed that the MoFPED will disburse the budget in the Minutes of Discussion.

The Ugandan side will bear the cost of items in the amount below.

Cost Items	US$	(≒JP¥)
1. Obtaining the Environment Permit	US$ 270,000 -	JP¥ 27,800,000 -
2. Compensation for project sites (Substation and towers)	US$ 1,500,000 -	JP¥ 154,900,000 -
3. Clearance of site	US$ 900,000 -	JP¥ 92,900,000 -
4. Procurement of equipment for SCADA system and the battery system	US$ 762,800 -	JP¥ 78,800,000 -
5. Procurement of transaction meters (8 units)	US$ 32,000 -	JP¥ 3,300,000 -
6. Construction of fence of substation area	US$ 300,000 -	JP¥ 30,900,000 -
7. Site filling and levelling	US$ 250,000 -	JP¥ 25,800,000 -
8. Installation of concrete culverts for water drainage	US$ 100,000 -	JP¥ 10,300,000 -
9. Construction of cable culverts with cable trays	US$ 300,000 -	JP¥ 30,900,000 -
10. Traffic control	US$ 10,000 -	JP¥ 1,000,000 -
11. Land rent for temporary storage yard	US$ 200,000 -	JP¥ 20,600,000 -
12. UETCL staff participation and transportation cost	US$ 250,000 -	JP¥ 25,800,000 -
13. Installation of IT System (Access control system and video surveillance system)	US$ 55,000-	JP¥ 5,600,000 -
14. Contingency (10% of the above)	US$ 492,980-	JP¥ 50,900,000 -
Approximate Total cost	US$ 5,422,780 -	JP¥ 595,500,000 -

2-4-2 Operation and Maintenance Cost

UETCL and UMEME maintain existing substations, transmission and distribution lines in the Project area and they will be responsible for O&M of the substation to be constructed in the Project after the service begins. Because the Queensway Substation to be upgraded in the Project already has operation workers, there is no need for additional employment. UETCL will be responsible for the transmission lines to be built newly with their current workforce.

Spare parts given in Table 2-3-3-2.1 to Table 2-3-3-2.8 need to be stocked all the time for sound operation of the substation to be upgraded in the Project and thus UETCL needs to allocate the budget necessary for it. The expense needed for procurement of these spare parts will be approx. 0.3 million USD/year. Since this amount is approx. 2.3% of the UETCL's transmission cost in 2012, 13.03 million USD (Equivalent to 31,987,329 thousand Uganda Shilling with the exchange rate: 1 USD = 2,454.45 UGX), this amount is considered to be affordable to UETCL. Moreover, since Queensway 132/33 kV Substation will supply the power to the central area, the priority of operation of

maintenance of this substation is relatively higher than other substations. Moreover, the specifications of the equipment were selected based on UETCL’s experiences, the operation and maintenance with UETCL’s technical skill is considered t be practicable.

CHAPTER 3 PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

Preconditions for the project will include acquiring the Project site and obtaining the EP for implementation of the project. As the Ugandan side is progressing with the necessary procedures and has experience with past similar Japanese grant aid work for distribution facilities, there are no special issues. An overview of the preconditions follows below.

1) The 132/33 kV transformers are scheduled to be constructed on the land owned by Pan-African Movement. In case of the implementation of the Project, it was agreed on the minutes between UETCL and Pan-African Movement on April 14 that the land will be transferred from Pan-African Movement to UETCL on condition that UETCL will compensate the land based on the Chief Government Valuer's opinion.

2) The Ugandan side needs to proceed securing the budget, concluding the agreement on the land, and compensating as scheduled.

3) The Ugandan side must obtain permits from the urban planning offices and land owners relevant to the 132 kV transmission line route, including the crossing of Queensway Road.

4) The Ugandan side needs to submit the Project proposal to NEMA based on the guidelines on the Environmental and Social Considerations of Uganda to obtain the Environmental Permit prior to the implementation of the Project.

3-2 Necessary Inputs by Recipient Country

(1) Prior to the Commencement of the Construction Work

- UETCL will relocate the Country Trees within the above mentioned area for the Project to outside of the area with coordination with Pan African Movement before commencement of the installation work of the Project by the Japanese side.
- UETCL will relocate the existing ditch within the above mentioned area for the Project to the northern side of existing Queensway Substation along the existing fence with coordination with Pan African Movement before commencement of the installation work of the Project by the Japanese side.
- UETCL and UEDCL will expand and add, within existing Queensway Substation, trenches for cables from the 33 kV switchgears of the Project to 33/11 kV substations by themselves for proper installation and connection of 33 kV lines of the Project.
- The Ugandan side will prepare access holding dimensions and number enough for the 33 kV cables of the Project to the existing 33 kV switchgears installed by the previous Japan's Grant Aid project.

(2) During the Construction Work

- UETCL and UEDCL will schedule power outages required for installation work of the Project and carry out them in timely manner. UETCL and UEDCL shall also manage any issue concerning the power outages, including related procedures, and compensation to and grievances from customers.

  Especially, to install the towers for branching 132 kV transmission line to the 132/33 kV Queensway Substation of the Project, UETCL agreed for both two circuits of the existing 132 kV transmission lines between Lugogo and Mutundwe to be kept in condition of power-cut during the installation work of these towers.

- UETCL will control traffic properly and timely to carry out location of 132 kV incoming lines to 132/33 kV Queensway Substation of the Project during the work. UETCL also agreed to manage any issue concerning the traffic control, including related procedures, and compensation to and grievances from the public.

- The Ugandan side will manage to secure the small branch road between Katwe road and Queensway road as the access to the existing main entrance of Queensway Substation with coordination with the related authorities.

- UETCL will secure a temporary storage yard (Approx. 5,000 m^2) for the Project near the Project site.

- UETCL will procure and supply to the Japanese side total 8 units (4 units for the main and 4 units for confirmation of accuracy of the main) of energy meters used for official transaction in Uganda.

- UETCL and UEDCL will decommission and relocate the existing equipment, facilities, materials and so on (terminal poles, underground cable, pipes and so on) within the above mentioned area for the Project to outside of the area before commencement of the installation work by the Japanese side.

- UETCL will procure and install the cable trench with cable tray which connets 132/33 kV Queensway Substation to the existing 33/11 kV Queensway Substation.

- UETCL will procure and install, by themselves, equipment such as remote terminal unit (RTU), multiplexer, optical fiber distribution frame (ODF), battery system and so on in conformity with the requirements of the existing ABB SCADA system.

  The equipment shall be connected by UETCL to the SCADA interface marshalling cubicle of the Project which collect information analog or digital signals of the equipment of the Project after procurement and installation of such equipment as RTU, ODF, and so on by UETCL.

(3) After the Commencement of Operation

- With applying the materials for the final connection work procured by the Japanese side, UETCL and UEDCL will carry out the final connection work between 33 kV lines of the Project to the existing 33/11 kV substations at Queensway Substation.
- UETCL will provide the setting list of the protection relays to the Japanese side.

3-3 Important Assumptions

The external conditions assumed for the Project to achieve and sustain its results are as follows:

(1) For overall goal

- The electric power development policy shall not be revised.
- The government and economy remain stable.

(2) For project objectives

- O&M is performed on a continuous basis.
- Fees are continuously collected, and government support continues.
- Facility security is maintained.

(3) For expected outcomes

- Power generation facilities in the upper stream and power distribution facilities in the lower stream are operated fully.
- The facility O&M plan is implemented.

3-4 Project Evaluation

3-4-1 Relevance

As shown below, relevance for this Project is considered to be high as it helps to achieve Ugandan national energy and power policies and benefits the public facilities and residents in a target area.

(1) Urgency and Relevance of Facility Capacity

Power will be developed mainly as follows:

1) Capacity to supply power demand maintained
2) Supply reliability (reducing power downtime, etc.) improved by ensuring reserve supply capacity
3) Power quality improved by improving power system structure, etc.

Of the above points, 1) is the most urgent as it is an underlying factor in stable power supply.

As described in Section 2-2-2-1 Prerequisites for the Project, the distribution capacity of the substations in the Kampala metropolitan area, particularly in the city center, is in short and, as a result, power is not supplied from substations in the city center, which has put them in a severe situation in which power is supplied from Kampala North Substation in the northern Kampala

metropolitan area to city center via 33kV distribution lines around the city center (approx. 15 kilometers from the target site of Queensway district) with a huge power distribution loss. Against the backdrop, power supply capacity is below the demand before securing supply capacity for future demand increase and thus there is urgent need for 1) listed above.

If the Exchange of Notes on the new Queensway Substation of the Project is concluded in 2014, its operation will begin in 2017 as it requires 26.0 months for tender and construction. As shown in Figure 2-2-2-1.5, without the beginning of operation in 2017 as planned, the current capacity of the existing facility (400MW) will not be sufficient to meet the estimated power demand (407MW) in 2017. Thus, there is extremely urgent need for the Project.

UETCL operates substations within the loading scope of 75 percent to 80 percent even at high loading time in order to avoid power outage resulting from excessive loads for instantaneous high loading. This means that, as shown in Figure 2-2-2-1.5, the company's operation standard cannot be met at the beginning of the operation of the project substation without the facility development with a total capacity of 120 MVA (＝facility capacity 40 MVA×3 banks) demanded in the Request Document. Thus, the requested facility capacity is considered to be relevant.

As shown in Figure 2-2-2-1.5, with a total capacity of 120 MVA (＝facility capacity 40 MVA×3 banks) in the Request Document and facility upgrading in the Kampala metropolitan area revised in the preparatory study (See Table 2-2-2-1.12), power demand in the area can be satisfied in the target year (2027) for the facility plan of the Project.

In other words, the Project scale and implementation timing are relevant not only from a short-term perspective but also mid- to long-term perspectives securing consistency with the target year (2028) of the upper-level plans of the project, Grid Development Plan 2012-2028 and the target year (2027) set to secure consistency with other similar Japanese grant aid projects.

(2) Benefit

Electric power is absolutely essential as energy for the self-reliant, sustainable socioeconomic growth of a nation. Particularly in capital areas, which hold government agencies and head offices of the companies which support the national economy, power development projects are one of the most important of economic infrastructure development in helping to establish a secure, efficient power distribution network.

The Project is to improve electric power distribution in the Kampala metropolitan area in Uganda as it faces a serious power system problem caused by supply capacity shortage due to recent rapid economic growth. The enhancement of supply capacity of power distribution facilities, which is currently insufficient, is a fundamental solution to the loss of opportunity gain due to disrupted supply and thus it is highly beneficial.

As shown in Figure 2-2-2-1.5, the new Queensway Substation urgently is needed and is essential for securing capacity to supply electricity in the Kampala metropolitan area. If the power distribution facility plan in the area is implemented based on the facility plan in the figure, power demand in the area will be 492 MW as shown in Figure 2-2-2-1.5 in the target year for project evaluation in 2020 and it can be managed by 505MW that is the total capacity of existing and project facilities.

Since generation reserve margin is not secured, existing substations will contribute to power supply in a highly loaded situation in the Kampala metropolitan area without securing standby facility. The facility capacity of the Project accounts for 17 percent of total facility capacity in the target year for project evaluation in 2020, as shown in the below formula.

(Project facility 120 MVA)÷(Project facility 120 MVA＋existing facility 580 MVA)＝approx. 17%

The power distribution facility to be developed in the Project is expected to supply 17 percent of the power to assist socioeconomic activities in the Kampala metropolitan area in the target year for project evaluation in 2020. An overview of socioeconomic conditions in the metropolitan area in 2020 is shown in Table 3-4-1.1. The Project will benefit approx. 17 percent of economic activities in the area, which is very high in terms of cost-benefit ratio for the amount of aid

Table 3-4-1.1　Socioeconomic Status in the Kampala Metropolitan Area

	Items	Quantity
Population	Total population	Approx. 2,365,000
	Population in poverty	Approx. 52,800
Household	General	303,000
	Commercial	17,000
	Industry	1,050
Medical facilities	Primary	28
	Secondary	130
	Third	60
Educational facilities	Primary	246
	Secondary	95
	University	45

［Source］Compiled by Study Team based on data from Uganda Bureau of Statistics and UMEME

(3) Operation and Maintenance Capabilities

Despite its struggles with large-scale capital investments such as the current cooperation project, UETCL does have a certain level of technical capacity in system operations and has steadily handled O&M for the national power transmission network.

This Project includes such relatively new technologies as Gas Insulated Switchgears and other equipment. As Uganda has already introduced them and the skills required for operation methods, system protection functionality and other O&M issues do not greatly exceed the technical levels for equipment used that has been used in the country, although internal structure of the switchgear and other equipment to be introduced may differ from that of traditional ones.

As such, manufacturer technicians will be used for O&M technology transfers, offering guidance on initial and standard operation based on the characteristics, features and specifications of the equipment. Assuming that the technology transfer of differing operation methods for each delivering manufacturer goes smoothly, there should be no issues in terms of O&M capabilities on the Ugandan side for the delivered equipment.

In addition, against the backdrop of significant power demand increase in tandem with Ugandan rapid economic growth and spatial limitations, Gas Insulated Switchgears are expected to be introduced to save space not just in the Kampala metropolitan area but also in regional cities. The introduction of Gas Insulated Switchgears and associated technology transfer in the Project will serve to make effective use of Japanese technical strength and to help improve the technical strength of Uganda for the future.

(4) Project to Contribute to Upper-Level Plans

UETCL formulated the Grid Development Plan 2012-2028 in October 2012 with 2028 as the target year and revises it in vision of the next 15 years in every October. As explained in Section 2-2-2-1 Prerequisites of the Project, the master plan is made targeting Uganda on the national level. Development projects such as this one for development in the Kampala metropolitan area and other regions must reconfirm the facility structure, facility capacity, demand distribution and other regional details and break down the upper level plans while adapting them to local features.

In light of this, Figure 2-2-2-1.5 gives the power plan of distribution facilities in the Kampala metropolitan area as formulated in the preparatory study. As given in Table 3-4-1.1, the new Queensway Substation in the Project, with the capacity of 120 MVA, is deemed to be essential for achieving the upper-level plan. It is estimated to contribute approximately 17% of the overall distribution facility capacity in the Kampala metropolitan area (=120MV (project facility capacity) ÷ 700MVA (total facility capacity in the area) in the target year for project evaluation in 2020.

(5) Consistency with Japan's Grant Aid Policy

The Country Assistance Policy for Uganda says that Japan will assist its extensive-area infrastructure development (road and electricity) taking advantage of Japanese technologies and knowledge and promote the development to help realize its economic growth.

The key component in this Project is to build a high-voltage substation on small premises. With the spatial restrictions, outdoor Gas Insulated Switchgears are essential. Given that the facilities will be required to supply stable power, European and Japanese manufacturers are deemed appropriate for key equipment including the Gas-Insulated Switchgears and transformers.

For the Gas Insulated Switchgear, most European manufacturers use indoor models as their standard, whereas Japanese manufacturers normally release both indoor and outdoor models and have a longer delivery record for outdoor models with established, verified technology. Construction work management skills of Japanese companies are extremely effective as they have many experiences of substation construction on small premises in the capital and regional cities for being an island nation.

As shown above, the Project is deemed to be highly relevant as a Japanese Grant Aid Project. It will contribute to the stable supply of electricity to the Kampala area, which supports the socioeconomic activities of Uganda, and it also utilizes the superior technical strengths of Japan.

3-4-2 Effectiveness

The impacts expected from the implementation of the Project are as follows:

(1) Quantitative Impacts

Outcome indicator	Base value (2014) (Current value)	Target value (2020) (3 years after the completion of the Project)	Reference Value (2020) Without the Project
1. Facility capacity of 132 kV Transformers at Kampala metropolitan area (MVA)	460	700	580
2. Voltage drop ratio of the power receiving end at Queensway Substation (%)	4.43	4.02	6.25
3. Transmission and distribution loss at Kampala metropolitan area (MW)	17.3	22.1	24.8

(2) Qualitative Impacts (Whole Project)

Present Status and Problems	Project Countermeasures (Grant Aid Project)	Extent of Project Effects and Improvement
1. In Uganda, the power demand has been rapidly increasing, but the present capacity of power transformer is not sufficient and aging. It is a major cause of the unstable power supply and transmission and distribution network loss.	Procurement and installation of the following equipment: **1. 132/33 kV Substation equipment** • 120 MVA＝40 MVA×3 banks **2. 132 kV Transmission equipment** • Two 132 kV Steel towers • 132 kV underground cable (0.35 km)	By the construction of new 132/33 kV substation, the loads on neighboring 132 kV substations, Lugogo Substation and Mutundwe Substation will be reduced. Through this, the risk of unstable power supply and transmission and distribution network will be decreased.
2. In Uganda, unstable power supply and power shortage is remarkable especially in Kampala and it causes the bottlenecks of economic, public administrative, social and welfare activities. However, it is difficult to construct new substations due to the limitation of available land for the construction of new substations.	This Project will utilize the Gas Insulated Switchgears, as 132 kV power facilities, which can reduce the offset distance compared to conventional facilities. Through this, the new substation will be constructed in a narrow area.	Gas Insulated Switchgear enables to reduce the required space to construct compact-type substation.
3. Existing 33/11 kV Queensway Substation mainly supplies power to the central area of Kampala City. However, power supply system has become unstable as planned power outages have been frequently carried out due to the increase of power demand	Installation of 132/33 kV substation facilities to Queensway Substation.	The power supply will become stable through the direct power supply from the 132 kV transmission network to the center of Kampala City by this Project. Thus, it is anticipated that the duration of planned power outage (1776.7 hours in 2013) will be improved and contribute to the people's daily lives. (It is expected that the planned power outage will be reduced to approx. 950 hours based on the demand and substation capacity of 2013. However, since it is difficult to forecast the future demand, it is quite difficult to identify the reduction of planned power outage in 2020.)

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

1． **Member List of the Study Team**

(1) First Field Survey

Name	Assignment	Organization
Hiroshi SATO	Team Leader	Director, Energy and Mining Division 2, Energy and Mining Group, Industrial Development and Public Policy Department Japan International Corporation Agency
Katsuya KUGE	Deputy Team Leader	Deputy Director, Energy and Mining Division 2, Energy and Mining Group, Industrial Development and Public Policy Department Japan International Corporation Agency
Hiroshi SASAKI	Planning Management	Energy and Mining Division 2, Energy and Mining Group, Industrial Development and Public Policy Department Japan International Corporation Agency
Kazunari NOGAMI	Chief Consultant/ Power Supply Planning	Yachiyo Engineering Co., Ltd.
Masatsugu KOMIYA	Deputy Chief Consultant/ Power Supply Planning	Yachiyo Engineering Co., Ltd.
Masayuki TAMAI	Substation Planning	Yachiyo Engineering Co., Ltd.
Katsuhiro MORIYAMA	Transmission Planning	Yachiyo Engineering Co., Ltd.
Yasuo HORIGOME	Facility Planning	Yachiyo Engineering Co., Ltd.
Kazuaki KONDO	Procurement Planning/ Cost Estimation	Yachiyo Engineering Co., Ltd.

(2) Second Field Survey

Name	Assignment	Organization
Hirofumi HOSHI/ Yasumichi ARAKI	Team Leader	Chief Representative, JICA Uganda Office/ Acting Chief Representative, JICA Uganda Office
Masatsugu KOMIYA	Chief Consultant/ Power Supply Planning	Yachiyo Engineering Co., Ltd.
Katsuhiro MORIYAMA	Substation Planning	Yachiyo Engineering Co., Ltd.
Kazuaki KONDO	Procurement Planning/ Cost Estimation	Yachiyo Engineering Co., Ltd.

[Note] Mr. Araki took over the role of Team Leader in 1 September.

APPENDIX 2

STUDY SCHEDULE

2. Survey Schedule

(1) First Field Survey

No.	Date	Day	Contents of Survey					Accommodation
			Official Members	Consultant Members				
				Chief consultant Group	Substation Group	Transmission Group	Facility Group	
			Mr. Sato, Mr. Kuge, Mr. Sasaki	Nogami, Komiya	Tamai, Kondo	Moriyama	Horigome	
1	10 Apr.	Thu.	• Trip {Narita 22:30 → Doha 04:20 by QR-807}	• Trip {Narita 22:00 → Dubai 04:15 by JL-5095}				On board
2	11 Apr.	Fri.	• Trip {Doha 07:40 → Entebbe 13:05 by QR-1387} • 16:00 Meeting at JICA Uganda Office	• Trip {Dubai 08:50 →Entebbe 13:00 by EK-729} • Team discussions				Kampala
3	12 Apr.	Sat.	• Team discussions					Kampala
4	13 Apr.	Sun.	• Data Review	• Team discussions				Kampala
5	14 Apr.	Mon.	• 09:00 Courtesy call and kick-off meeting to UETCL (Lugogo Substation) • 11:00 Courtesy Call to MEMD • 12:00 Courtesy Call to UEDCL (Sato, Kuge, Sasaki, Nogami, Komiya, and Kondo) • 14:00 Project site visit (Sato, Kuge, Sasaki, and Nogami) • 15:00 Technical discussion at UETCL (Project component) • 18:00 Market Survey (Nogami, Horigome, Kondo)					Kampala
6	15 Apr.	Tue.	• 09:00 Meeting with UETCL (Discussion on M/M) • Site visit to Namanve Substation • 15:00 Courtesy call to MOFPED	• 09:00 Technical discussion at UEDCL (EIA procedure and project site) • 13:00 Market Survey (Horigome, Kondo) • 15:00 Courtesy call to MOFPED (Komiya, Nogami, and Kondo)				Kampala
7	16 Apr.	Wed.	• 09:00 Signing on M/M at MEMD • 11:00 Report to JICA • 12:00 Report to EOJ • Trip {Entebbe 17:50 → Doha 23:15 by QR-1388}	• 09:00 Signing on M/M at MEMD • 10:00 Site survey (Mutundwe Substation) (Moriyama, Kondo) • 10:00 Internal meeting (Tamai, Horigome) • 14:00 Technical discussion at UETCL				JICA: Doha Consultant: Kampala
8	17 Apr.	Thu.	• Trip { Doha 01:35 → Narita 17:35 by QR-806}	• 09:00 Site survey at Queensway Substation (Underground cable route) • 14:00Technical discussion at UETCL (Single line diagram of the new substation)				Kampala
9	18 Apr.	Fri.		• 09:00 Site survey (Queensway Substation, Kawanda Substation and Mutundwe Substation) • Trip { Entebbe 15:35 → Dubai 21:55 by EK-730} [Komiya]				Komiya: Dubai Team: Kampala
10	19 Apr.	Sat.		• Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km) • Team discussion, arrangement of collected data • Trip {Dubai 02:50 → Narita 17:35 by JL-5096} [Komiya]				Kampala
11	20 Apr.	Sun.		• Team discussions				Kampala
12	21 Apr.	Mon.		• Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km)				Kampala
13	22 Apr.	Tue.		• Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km) • Trip { Entebbe 15:35 → Dubai 21:55 by EK-730} [Moriyama]				Moriyama: Dubai Team: Kampala
14	23 Apr.	Wed.		• Meeting with Umeme Limited etc. • Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km) • Trip {Dubai 02:50 → Narita 17:35 by JL-5096} [Moriyama]				Kampala

No.	Date	Day	Contents of Survey					Accommodation
			Official Members	Consultant Members				
				Chief consultant Group	Substation Group	Transmission Group	Facility Group	
			Mr. Sato, Mr. Kuge, Mr. Sasaki	Nogami, Komiya	Tamai, Kondo	Moriyama	Horigome	
15	24 Apr.	Thu.		• Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km) • Meeting with Umeme Limited etc.				Kampala
16	25 Apr.	Fri.		• Meeting with UETCL • Site survey (Queensway Substation) • Site survey (132 kV Transmission Line route, approx. 0.5 km)				Kampala
17	26 Apr.	Sat.		• Site survey (Lugogo Substation, Mutundwe Substation)				Kampala
18	27 Apr.	Sun.		• Team discussions				Kampala
19	28 Apr.	Mon.		• Meeting with Kampala Capital City Authority (KCCA) • Site survey (Kawaala Substation, Kampala North Substation, Namanve Substation) • Obtaining the survey report on topographic & geological investigation				Kampala
20	29 Apr.	Tue.		• Survey of power structural reform, energy sector policy and implementation status (MEMD) • Survey of power supply and demand (MEMD) • Survey of Socioeconomic conditions • Survey of balance of payments and tariff				Kampala
21	30 Apr.	Wed.		• Site survey (Kawanda Substation, 220 kV Transmission line between Bujagali Generating Station and Kawanda Substation) • Market survey of equipment and material • Survey of customs clearance Survey of port and transportation route				Kampala
22	1 May.	Thu.		• Site survey (Supplementary survey) • Market survey of equipment and material • Market survey (Local contractor, etc.)				Kampala
23	2 May.	Fri.		• Preparation of Field Report • Collection of supplementary documents and data • Survey Team discussions, arrangement of collected data				Kampala
24	3 May.	Sat.		• Preparation of Field Report • Collection of supplementary documents and data				Kampala
25	4 May.	Sun.		• Preparation of Field Report • Collection of supplementary documents and data				Kampala
26	5 May.	Mon.		• Preparation of Field Report • Collection of supplementary documents and data				Kampala
27	6 May.	Tue.		• Preparation of Field Report • Collection of supplementary documents and data				Kampala
28	7 May.	Wed.		• Submission, explanation and discussion of Field Report to MEMD, UETCL, and UEDCL				Kampala
29	8 May.	Thu.		• Corrections to Field Report • Survey Team discussions, arrangement of collected data				Kampala
30	9 May.	Fri.		• Corrections to Field Report • Acquisition of approval for the Field Report by MEMD, UETCL and UEDCL				Kampala
31	10 May.	Sat.		• Preparation of Field Report				Kampala
32	11 May.	Sun.		• Preparation of Field Report				Kampala
33	12 May.	Mon.		• Preparation of Field Report				Kampala
34	13 May.	Tue.		• Trip { Entebbe 15:35 → Dubai 21:55 by EK-730}				Dubai
35	14 May.	Wed.		• Trip {Dubai 02:50 → Narita 17:35 by JL-5096}				

(2) Second Field Survey

No.	Date	Day	Contents of survey				Place to stay
			Official member	Consultant member			
			Mr. Hoshi (Mr. Araki)	Mr. Komiya	Mr. Moriyama	Mr. Kondo	
1	20 Aug.	Wed.	• TV Conference on the Minutes with UETCL and MoFPED				
2	21 Aug.	Thu.					
3	22 Aug.	Fri.	• Signing on the Minutes				
4	23 Aug.	Sat.					
5	24 Aug.	Sun.			• Trip {Narita 22:30 → Doha 03:20 (QR-807)}		On board
6	25 Aug.	Mon.			• Trip {Doha07:40 → Entebbe 13:05 (QR-1387)} • 14:00Technical discussion (UETCL) • 16:00Technical discussion (JICA Uganda Office)		Kampala
7	26 Aug.	Tue.			• 09:00Site Survey (132/33 kV Queensway Substation and 33/11 kV Queensway Substation) • Internal meeting and data analysis		Kampala
8	27 Aug.	Wed.			• 09:00Site Survey (Lugogo Substation) • 11:30Technical discussion with UETCL (Protection system) • Internal meeting and data analysis		Kampala
9	28 Aug.	Thu.			• Site Survey to Kawaala Substation (Protection system) • Internal meeting and data analysis		Kampala
10	29 Aug.	Fri.			• Technical discussion with Umeme (Load shedding) • Site Survey at National Control Center (SCADA system) • Internal meeting and data analysis		Kampala
11	30 Aug.	Sat.			• Internal discussion and data analysis		Kampala
12	31 Aug.	Sun.			• Internal discussion and data analysis		Kampala
13	1 Sep.	Mon.		Preparation for the Field Survey	• Site Survey (132/33 kV Queensway Substation) • Technical discussion (Procedure of land filling)		Kampala
14	2 Sep.	Tue.		• Trip {Haneda 00:30 → Dubai 06:15 (JL-5093)} • Trip {Dubai 06:15 → Entebbe 13:30 (EK-729)} • Site survey (132/33 kV Queensway Substation)	• Site survey (132/33 kV Queensway Substation) • Discussion (Progress of the approval of Supplementary allocation budget)		Komiya: On board, Moriyama, Kondo: Kampala
				• Internal meeting			
15	3 Sep.	Wed.		• Courtesy call and technical discussion (JICA Uganda Office) • Courtesy call to UETCL • Courtesy call to UEGCL • Internal meeting			Kampala
16	4 Sep.	Thu.		• Courtesy call and explanation of the Project outline (MEMD) • Technical discussion (UETCL: Contents of works borne by the Ugandan side)			Komiya, Moriyama: Kampala Kondo: On board
				• Site survey (Mutundwe Substation)		• Trip {Entebbe 17:30 → Doha 23:15 (QR-1388)}	

No.	Date	Day	Contents of survey				Place to stay
			Official member	Consultant member			
			Mr. Hoshi (Mr. Araki)	Mr. Komiya	Mr. Moriyama	Mr. Kondo	
17	5 Sep.	Fri.		• Site survey (Lugogo Substation, Kampala North Substation) • Technical discussion with UETCL (Contents of works borne by the Ugandan side)		• Trip {Doha 01:45 → Narita 17:55 (QR-806)}	Kampala
18	6 Sep.	Sat.		• Internal meeting and data analysis			Kampala
19	7 Sep.	Sun.		• Internal meeting • Site survey (132/33 kV Queensway Substation)			Kampala
20	8 Sep.	Mon.		• Technical discussion with UETCL (Implementation Schedule) • Courtesy call (Uganda JICA Office) • Courtesy call (MEMD: Explanation of the outline)			Komiya: Kampala Moriyama: On board
				• Courtesy call (Embassy of Japan)	• Trip {Entebbe 17:30 → Doha 23:15 (QR-1388)}		
21	9 Sep.	Tue.		• Technical discussion with UETCL (Contents of works borne by the Ugandan side and quantitative project analysis)	• Trip {Doha 01:45 → Narita 17:55 (QR-806)}		Kampala
22	10 Sep.	Wed.		• Trip {Entebbe 16:10 → Dubai 22:30 (EK-730)}			Kampala
23	11 Sep.	Thu.		• Trip {Dubai 02:50 → Narita 17:35 (JL-5096)}			Kampala

【Remarks】(Alphabetical order)

JICA : Japan International Cooperation Agency
UEDCL : Uganda Electricity Distribution Company Limited
UETCL : Uganda Electricity Transmission Company Limited
MEMD : Ministry of Energy and Mineral Development
MoFPED : Ministry of Finance, Planning and Economic Development

APPENDIX 3

LIST OF PARTIES CONCERNED

IN THE RECIPIENT COUNTRY

3. List of Parties Concerned in the Recipient Country

Organization	Title
Ministry of Finance, Planning and Economic Development (MoFPED)	
Mr. Fredrick Matyama	Assistant Commissioner, Finance & Planning
Mr. Mugagga Denis	Economist, Aid Liaison Department
Mr. Tomohito Kanaizuka	ODA Loan Advisor
Ministry of Energy and Mineral Development (MEMD)	
Hon. Eng. Simon D'Ujanga	Minister of State for Energy
Mr. James Baanabe Isingoma	Acting Commissioner, Energy Resources Department
Engineer Paul Mubiru	Director Energy and Mineral Development
Uganda Electricity Transmission Company Limited (UETCL)	
Mr. Eriasi Kiyemba	Managing Director / CEO
Mr. Buhanga B	Manager, Planning and Investments
Mr. Gerald Muganga	Manager, Planning and Investments
Mr. Martin Erone	Manager, Corporate Services
Mr. Mukasa Fred	Principal Development Engineer
Mr. Francis Nteza	Principal Budget and Financial Officer
Mr. Matovu Patrick Jovam	Senior Business Analyst
Ms. Rachel A. Baalessanvu	Senior Planning Engineer
Mr. Asen Habumugisha	Senior Engineer
Mr. Mark Namungo	Senior Power Analyst
Mr. Joseph Jones Ogwal	Senior Environment Officer
Mr. Kironde Jimmy	Senior Control Engineer
Mr. Andrew Geno Omalla	Technical Officer Projects
Mr. Masereka Enos Bright	Planning Engineer
Mr. Mutabingwea Patrick	Protection Engineer
Mr. Katamba Raymond	Protection Engineer
Mr. Muwambi Erisa	Surveyor
Mr. Ocom Justin	Draughtsman
Ms. Mercy Mugenga B	Draughtsman
Mr. Kahororo Job	Draughtsman

Uganda Electricity Distribution Company Limited (UEDCL)

Mr. Joseph Katera	CEO
Ms. Esther Mulyagonja	Company Secretary
Mr. Franklin Kizito Oidu	Manager Technical Services
Mr Mwesigwa Paul	Finance Manager

UMEME Corporation

Mr. Wilberforce Asingwire	Planning Engineer
Mr. Sylver Hategekimans	Operation Engineer
Mr. John Muhwezi	Survey Manager
Mr. Fred Wandira	Power Transformer Engineer
Mr. Nelson Kiboigo	Operations and Maintenance Engineer

Pan-African Movement

Mr. Titus Kisambira	Director

Embassy of Japan in Uganda

Mr. Junzo Fujita	Ambassador Extraordinary and Plenipotentiary
Mr. Yutaka Nakamura	Counselor
Mr. Tatsuya Nakai	Second Secretary
Ms. Kazumi Kawamoto	Coordinator for Economic Cooperation

JICA Uganda Office

Dr. Hirofumi Hoshi	Chief Representative
Mr. Yasumichi Araki	Senior Representative
Mr. Ryoichi Kawage	Representative
Mr. Yoshio Nakagawa	Project Formulation Advisor
Mr. Daniel Rutabingwa	Consultant for Infrastructure Sector

APPENDIX 4

MINUTES OF DISCUSSIONS

1. First field survey

Minutes of Discussions
on the Preparatory Survey
on the Project for Improvement of Queensway Substation
in the Republic of Uganda
(First Field Survey)

In response to the request from the Government of the Republic of Uganda (hereinafter referred to as "Uganda") for financing, design and construction of new 132/33kV Queensway Substation and associated transmission line, 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 Queensway Substation (hereinafter referred to as "the Project")

JICA sent to Uganda the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Dr. Hiroshi Sato, Director, Energy and Mining Division 2, Industrial Development and Public Policy Department, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 11th April to 14th May, 2014.

The Team held discussions with the concerned officials of Uganda (MEMD, UETCL, UEDCL and MoFPED) and conducted a field survey in Uganda.

In the course of the discussions, all parties have confirmed the main items described in the attached sheets hereto. The Team will proceed with further study and prepare the preparatory survey report.

Kampala, Uganda
16th April, 2014

Dr. Hiroshi Sato
Leader, Preparatory Survey Team
Japan International Cooperation Agency
(JICA)

Mr. Fred KabagambeKaliisa
Permanent Secretary
Ministry of Energy and Mineral Development
(MEMD)

Mr. Eriasi Kiyemba
Managing Director/ CEO
Uganda Electricity Transmission Co. Ltd.
(UETCL)

Mr. Joseph Kateera
Managing Director
Uganda Electricity Distribution Co. Ltd.
(UEDCL)

Witness

Ms. Maris Wanyera
For: Permanent Secretary/ Secretary to the Treasury
Ministry of Finance, Planning and Economic Development
(MoFPED)

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve and reinforce the power supply to the central area of Kampala in Uganda by constructing new 132/33kV Queensway Substation with associated transmission lines and equipment.

2. Project Site

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

3. Responsible and Implementing Organizations

(1) The responsible sector ministry is the Ministry of Energy and Mineral Development (MEMD).
(2) The implementing agency is Uganda Electricity Transmission Co. Ltd. (UETCL)
(3) The cooperation agency is Uganda Electricity Distribution Co. Ltd (UEDCL)
(4) The organization structures of MEMD and UETCL are shown in Annex-3 and 4.

4. Items Targeted in the Project

(1) The Ugandan side and the Team discussed the final requested components of the Project and their priority in consideration of change of the conditions after submission of the application of the Japan's Grant Aid for the Project. The Team suggested three alternatives of the Project and priority of the components in each alternative in conformity with the current conditions surrounding the Project. The Ugandan side and the Team agreed the following alternative as the final requested components of the Project and their priority. The rating of the priority shown in the following table is higher in the following manner; A^+, A^-, and B.

Table Final requested components of the Project and their priority

Components	Capacity	Priority
Procurement and Installation Work		
1. No.1 and No.2 transformation banks		A^+
(1) 132/33 kV Transformer	40 MVA×2 units	
(2) 132 kV Outdoor GIS (Double Bus Type)	5 units	
(3) 33 kV Indoor GIS	1 lot	
(4) 132 kV Transmission Line for incomings (two circuits)	0.5 km distance	
(5) SCADA Terminal Unit	1 unit	
2. Connection bay for No.3 transformation bank		A^-
(1) 132 kV Outdoor GIS (Double Bus Type)	1 unit	
3. No.3 transformation bank		B
(1) 132/33 kV Transformer	40 MVA×1 unit	
(2) 33 kV Indoor GIS	1 lot	
Procurement Work		
4. Maintenance Tools for the Equipment of the Project	1 lot	A^+
5. Spare Parts for the Equipment of the Project	1 lot	
Construction Work		
6. Foundation for the Equipment of the Project (GISs, transformers, and towers for 132 kV transmission line)	1 lot	A^+
7. Control Building of Queensway Substation	1 building	

[Notes] GIS: Gas Insulated Switchgear

(2) The Team will study further the appropriateness of each component and technical specifications from the viewpoint of necessity and relevance as Japan's Grant Aid scheme, and will compile the findings into the preparatory survey report for the project appraisal process of the Government of Japan.

5. Japan's Grant Aid Scheme

(1) The Ugandan side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-5 and Annex-6.

(2) The Ugandan side will take the necessary measures, as described in Annex-7, for smooth implementation of the Project.

6. Environmental and Social Considerations

(1) The Team explained JICA's Guidelines for Environmental and Social Considerations to the Ugandan side and the Ugandan side agreed to comply with the guidelines. The Ugandan side will take necessary measures of the environmental and social consideration for the Project in accordance with both the JICA's guidelines and related environmental regulations of Uganda.

(2) The Ugandan side shall prepare and submit an Environmental and Social Impact Statement for approval by the National Environment Management Authority (NEMA) and obtain Environmental Permit for the Project until August, 2014.

7. Schedule of the Study

(1) The Team will continue the first field survey in Uganda until 14th May, 2014.

(2) The Team will prepare the draft report of the Preparatory Survey and dispatch a team to Uganda in order to explain its contents to the Ugandan side in August 2014 if the land for the Project is secured on schedule as mentioned in 8. (1).

8. Other Relevant Issues

(1) Landownership

- Improvement of Queensway substation;
  1) The Ugandan side agreed to make the final agreement in writing with Pan African Movement by 30th of April, 2014 for the land acquisition showed in Annex-1 and 2 for implementation of the Project.
- Right of way for 132kV transmission line:
  2) The Ugandan side agreed to make the final agreement in writing with the related authorities such as Kampala Capital City Authority (KCCA) by 13th of May, 2014 regarding securement of the right of way for 132 kV transmission line of the Project.

(2) Collaboration with relevant agencies/organizations

UETCL shall coordinate closely with the relevant agencies/organizations for smooth implementation of the Project. Especially, UETCL shall coordinate with UEDCL and UMEME to ensure the appropriate connection between the Project components and the existing distribution system. UEDCL and UMEME shall also cooperate with UETCL and provide UETCL with the necessary information on the distribution components targeted in the Project in timely manner.

(3) The Ugandan side agreed to provide city development plan around the Project site, such as the flyover plan, which may influenced the Project by 30th of April, 2014.

(4) The Ugandan side shall schedule power outages required for installation work of the Project and carry out them in timely manner. The Ugandan side shall also manage any issue concerning the power outages, including related procedures, compensation and grievances from customers.

(5) The Ugandan side agreed to inform to the Team on the location, total number and capacity of the 33/11 kV substations to be connected to the substation of the Project.

(6) Both the Ugandan side and the Team agreed to maintain the existing 33/11 kV transformation

equipment in Queensway Substation installed by the previous Japan's Grant Aid and currently under installation by UMEME, even after commissioning of the Project. The Ugandan side also agreed that those equipment will be replaced with own budget of the Ugandan side in accordance with necessity.

(7) UETCL agreed to relocate the existing drainage ditch in the Project site, currently owned by Pan African Movement, to outside of the Project site before the commencement of implementation of the Project not to disturb installation of the equipment and construction of the facilities of the Project. UETCL also agreed to relocate the Country Tree within the project site to outside of the project site with coordination with Pan African Movement.

(8) The Ugandan side shall confirm the status and conditions of the existing transmission lines and towers including the fitting materials around the connection point of 132 kV transmission line to be connected to the Project before the commencement of implementation of the Project. If necessary, the repair work of these equipment and materials shall be carried out by the Ugandan side to improve them in proper conditions.

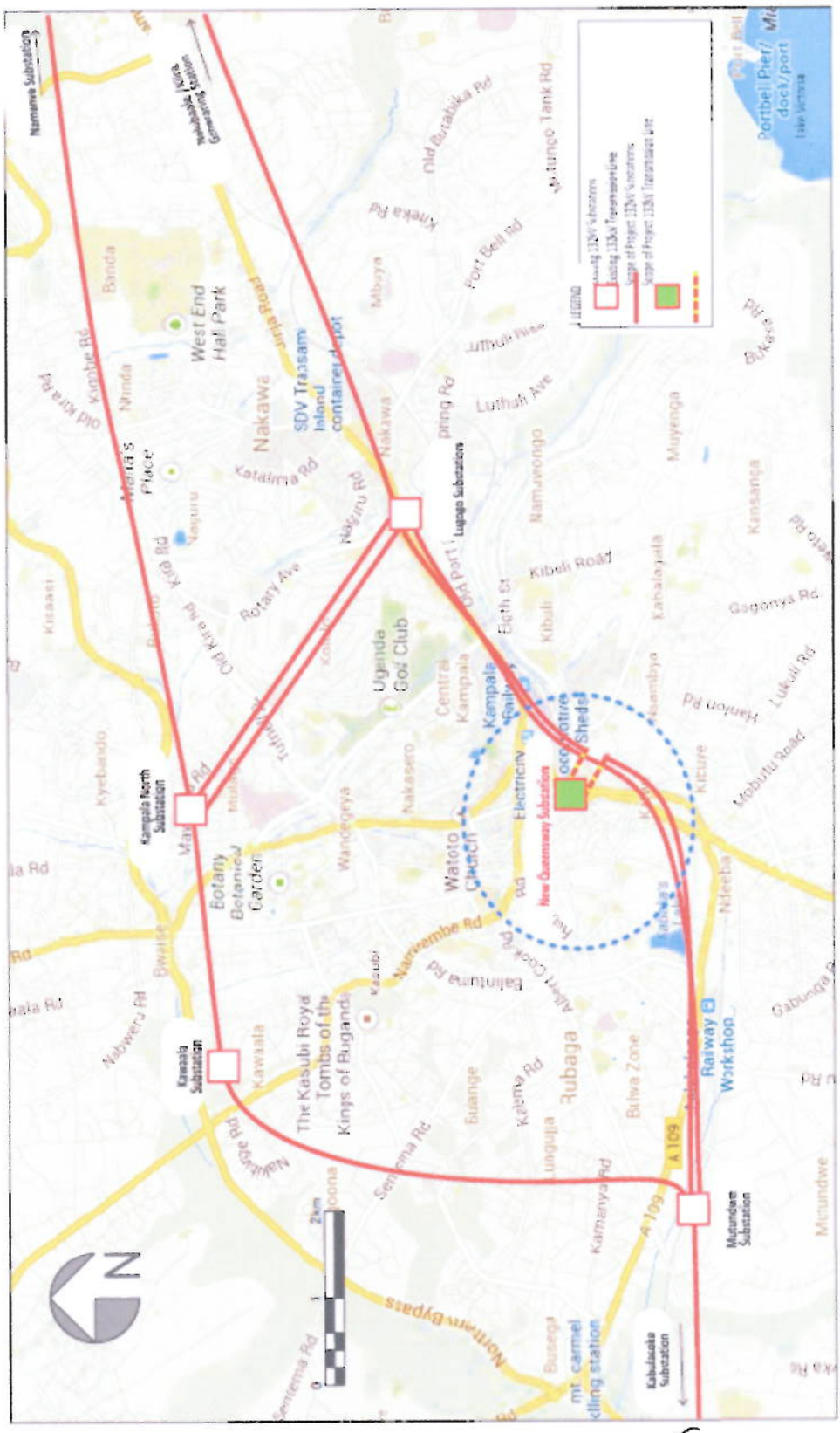
(End)

<List of Annex>

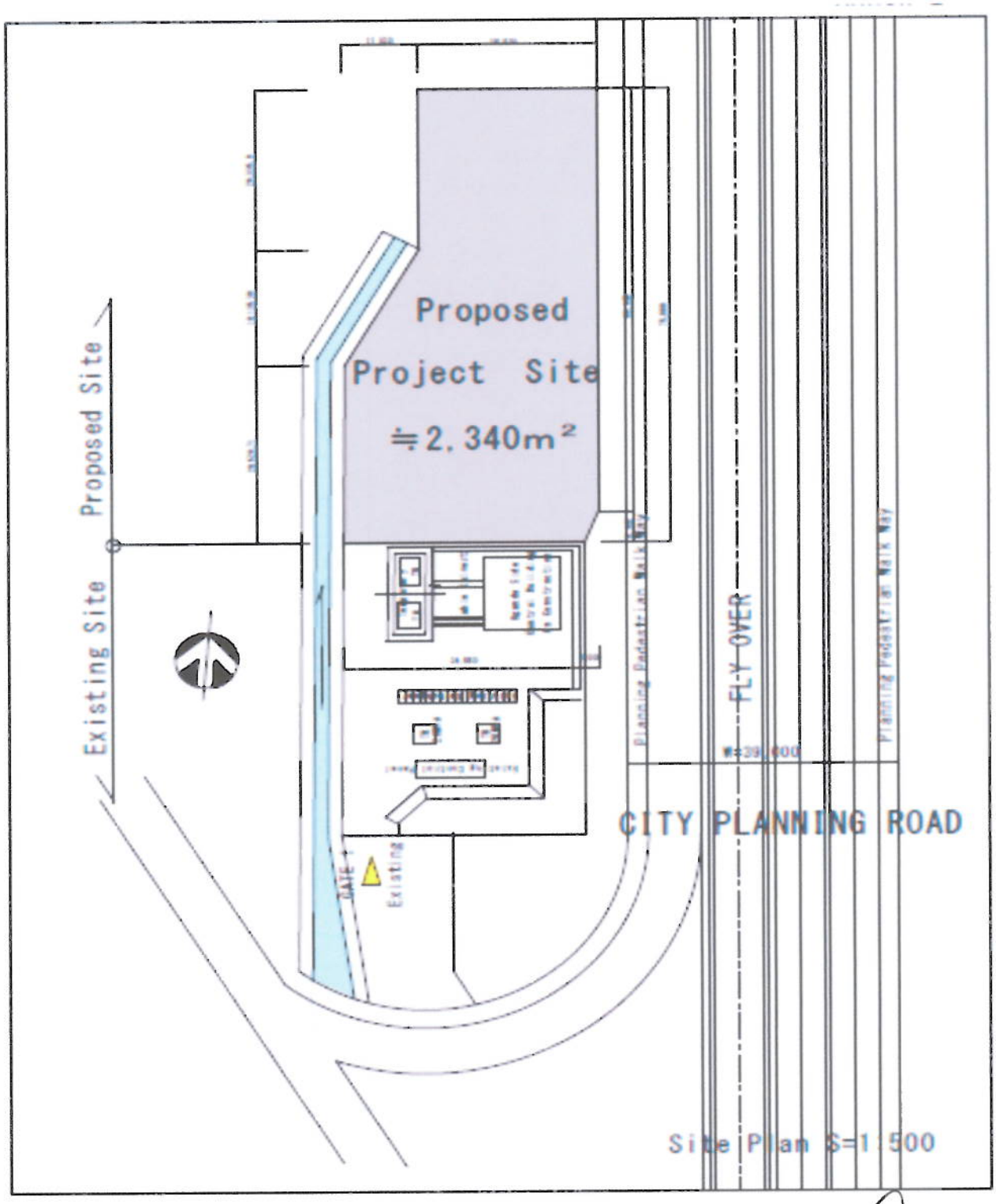
Annex-1	Location of the Project Sites
Annex-2	Layout of the Project Sites
Annex-3	Organization Structure of the Ministry of Energy and Mineral Development
Annex-4	Organization Structure of Uganda Electricity Transmission Co. Ltd
Annex-5	Japan's Grant Aid
Annex-6	Flow Chart of Japan's Grant Aid Procedures
Annex-7	Major Undertakings to be taken by Each Government

Annex - 1

LOCATION OF THE PROJECT SITES



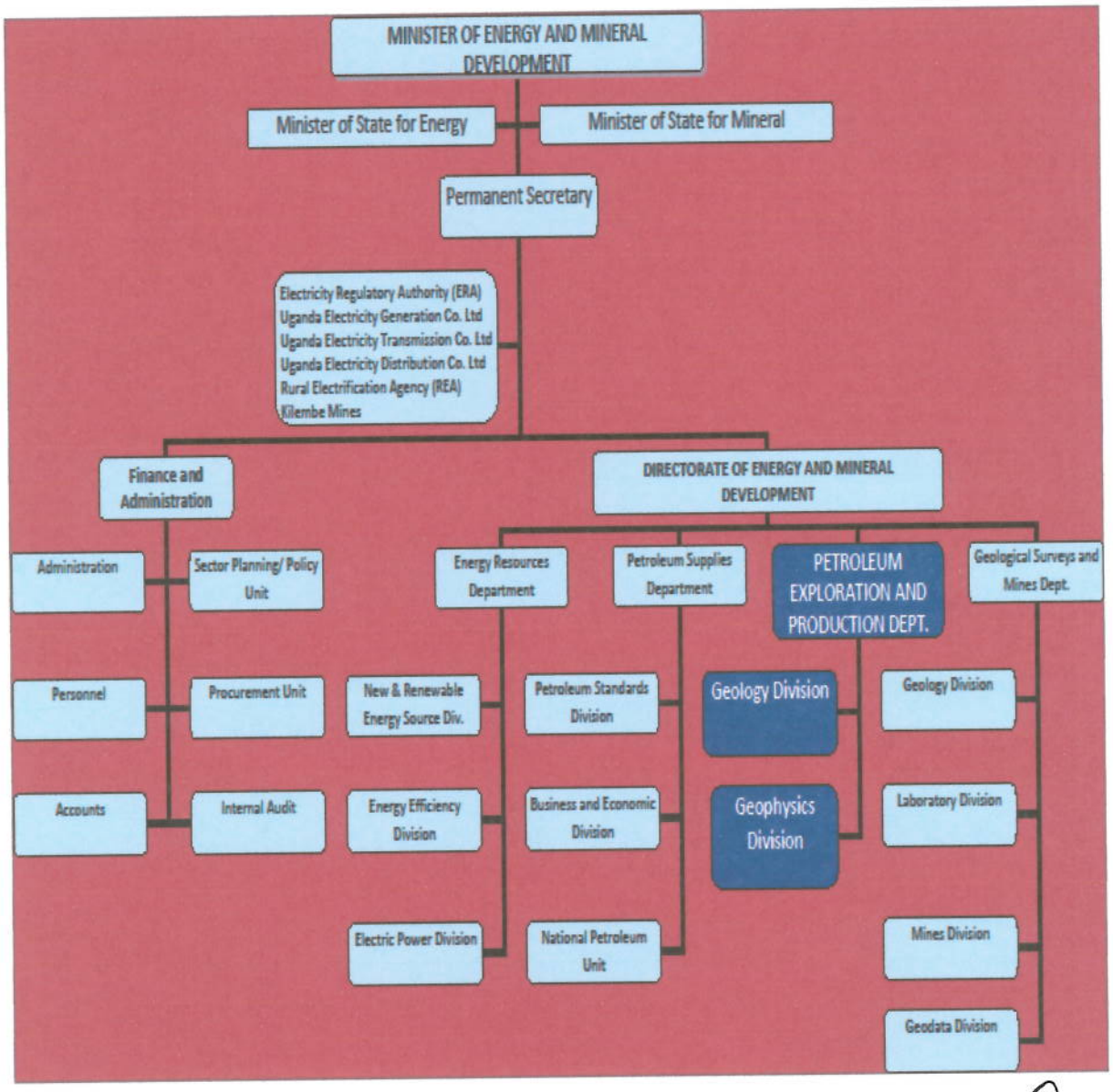
LAYOUT OF THE PROJECT SITES



Annex-3

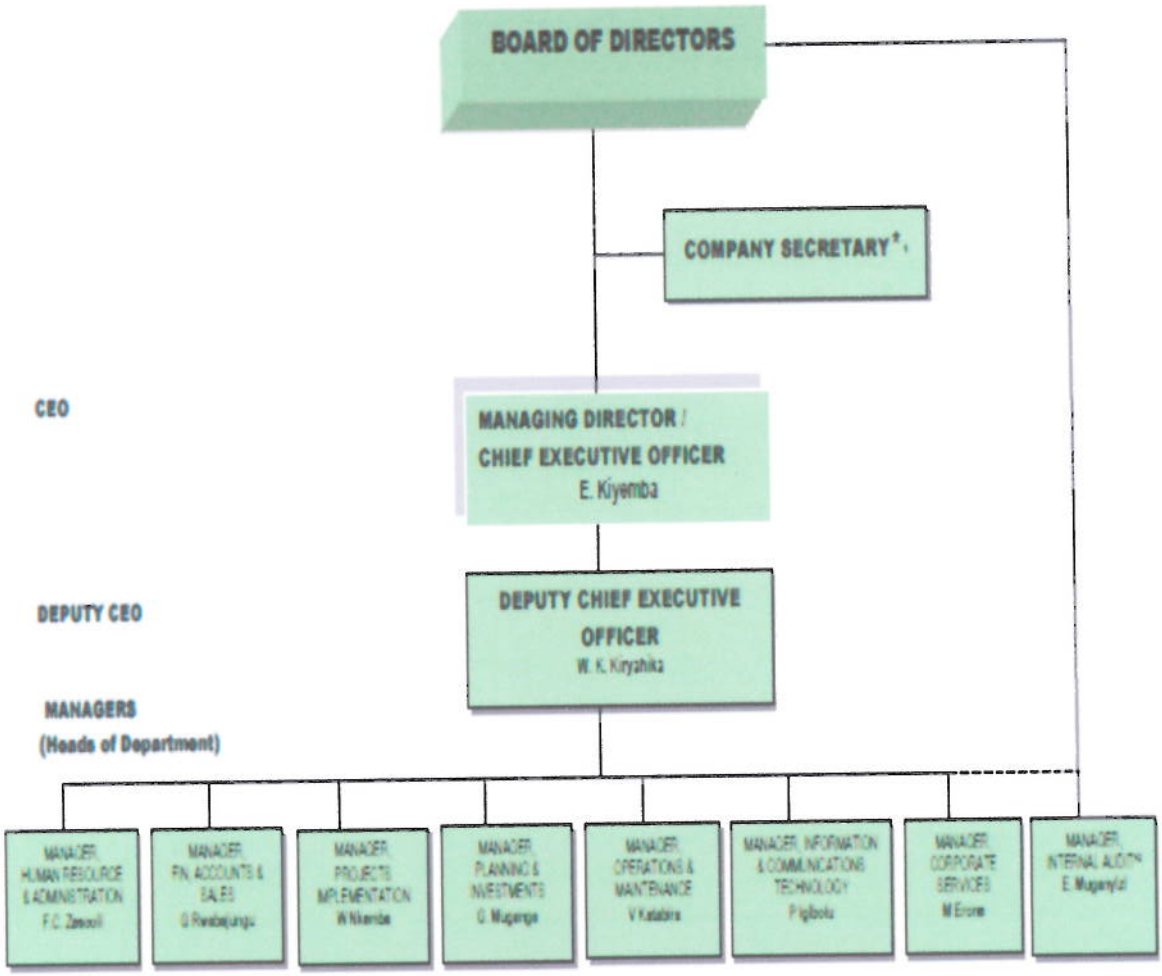
ORGANIZATION STRUCTURE OF THE MNINISTRY OF ENERGY AND MINERAL DEVELOPMENT

MINISTRY OF ENERGY AND MINERAL DEVELOPMENT – ORGANISATION STRUCTURE



ORGANIZATION STRUCTURE OF UGANDA ELECTRICITY TRANSMISSION Co. Ltd

TOP MANAGEMENT



NOTE:

*1 - Services of Company Secretary hired from Law Firm

FIN - Finance

*1 - Manager, Internal Audit reports to the Audit Committee of the Board

Updated:
31/03/2014
GDA/gla/68
HR & A DEPT

JAPAN'S GRANT AID

Based on the new JICA law entered into effect on October 1, 2008, JICA is designated as 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-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)

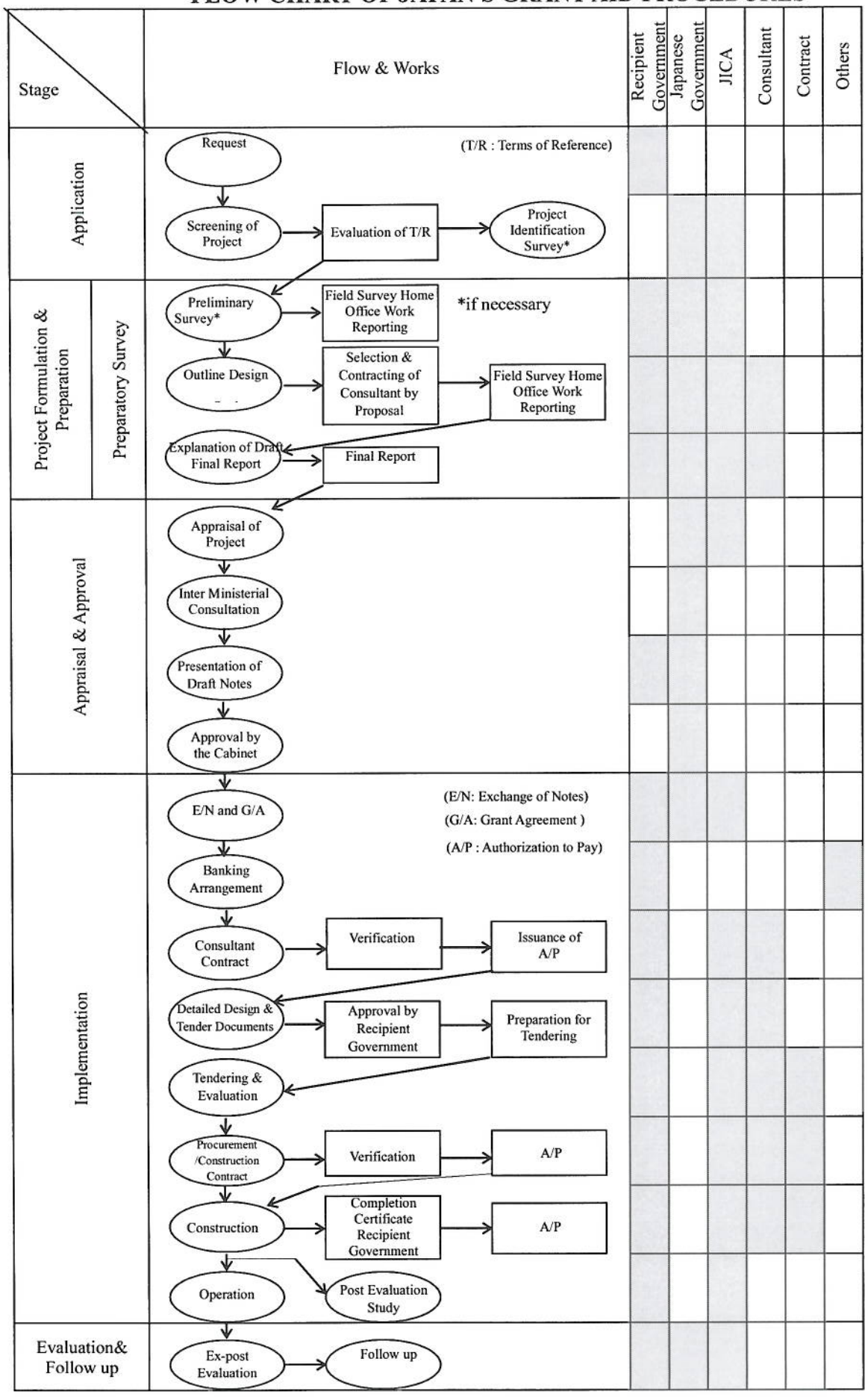
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(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)

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



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 Queensway Substation
in the Republic of Uganda

In response to the request from the Government of the Republic of Uganda (hereinafter referred to as "Uganda"), 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 Queensway Substation (hereinafter referred to as "the Project")

JICA sent to Uganda the Preparatory Survey Team (hereinafter referred to as "the Team") headed by Mr. Hirofumi Hoshi, Chief Representative, JICA Uganda Office. The Team is scheduled to stay in the country from 20th August to 10th September, 2014.

The Team held discussions with the concerned officials of Uganda (hereinafter referred to as "the Ugandan side"). In the course of the discussions, the Ugandan 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.

Kampala, Uganda
22nd August, 2014

Mr. Hirofumi Hoshi
Leader Preparatory Survey Team
Japan International Cooperation Agency
(JICA)

Mr. Fred Kabagambe Kaliisa
Permanent Secretary
Ministry of Energy and Mineral Development
(MEMD)

Mr. Eriasi Kiyemba
Managing Director/ CEO
Uganda Electricity Transmission Co. Ltd.
(UETCL)

Mr. Joseph Kateera
Managing Director
Uganda Electricity Distribution Co. Ltd.
(UEDCL)
Witness

Mr. Keith Muhakanizi
Permanent Secretary/Secretary to the Treasury
Ministry of Finance, Planning and Economic Development

ATTACHMENT

1. Contents of the Draft Final Report

The Ugandan 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 Uganda. The Ugandan side understood it.

2. Objective of the Project

The objective of the Project is to improve and reinforce the power supply to the central area of Kampala in Uganda by constructing new 132/33kV Queensway Substation with associated transmission lines and equipment.

3. Project Site

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

4. Responsible and Implementing Organizations

(1) The responsible sector ministry is the Ministry of Energy and Mineral Development (MEMD).
(2) The implementing agency is Uganda Electricity Transmission Co. Ltd. (UETCL)
(3) The cooperation agency is Uganda Electricity Distribution Co. Ltd (UEDCL)
(4) The organization structures of MEMD and UETCL are shown in Annex-3 and 4.

5. Components of the Project

The components of the project are shown in Table below.

Components	Capacity
Procurement and Installation Work	
1. Substation facilities	
- 132/33 kV Transformer	40 MVA×3 units
- 132 kV Gas Insulated Switchgears	8 units
- 33 kV Gas Insulated Switchgears	14 units
- 132 kV Control and Protection Panel	9 units
- Other control panels	2 units
- Low voltage facilities	3 units
- 33 kV distribution lines	1 unit
- Earthing system	1 unit
2. Transmission facilities	
- 132 kV overhead lines	450 m
- 132 kV underground cables	2,310 m
- Telecommunication lines	500 m
3. Civil and Construction	
- Foundations for items (Gas Insulated Switchgears, transformers, towers)	1 unit
- Control building	1 building
Procurement Work	
4. Maintenance tools for procured items	1 lot
5. Spare parts for procured items	1 lot

[Notes] GIS: Gas Insulated Switchgear

6. Japan's Grant Aid Scheme

(1) The Ugandan side has understood Japan's Grant Aid Scheme explained by the Team as

described in Annex-5 and Annex-6.

(2) The Ugandan side will take the necessary measures, as described in Annex-7, for smooth implementation of the Project.

7. Project Cost

The Ugandan side agreed that the cost for the Project should not exceed the amount agreed on Exchange of Notes (E/N). The Ugandan 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 Ugandan 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 8. 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 Ugandan side) before tender for the Project. Ugandan side also understood that the estimated cost for the Project attached as Annex 8 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

Ugandan 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 Ugandan.

10. Other Relevant Issues

(1) Landownership

- Improvement of Queensway substation;
  1) The Ugandan side agreed to make the final agreement in writing with Pan African Movement and Kampala Capital City Authority (KCCA) for the commencement of embankment at the Project site shown in Annex-2 by the conclusion of the Grant Agreement scheduled in November, 2014.
  2) The Ugandan side agreed to commence the embankment by the conclusion of the Grant Agreement and complete it by March, 2015.
- Transmission towers:
  3) The Ugandan side agreed to identify the landowners and make the basic agreement in writing with the landowners and related authorities for the land acquisition for showed in Annex-2 by the conclusion of the Grant Agreement.
  4) The Ugandan side agreed to complete the land acquisition by the delivery of tender documents scheduled in April, 2015.

(2) Environmental and Social Considerations

The Ugandan side agreed that the environmental application for the Project shall be accepted by the National Environment Management Authority (NEMA) by the delivery of tender documents.

(3) Budget Allocation

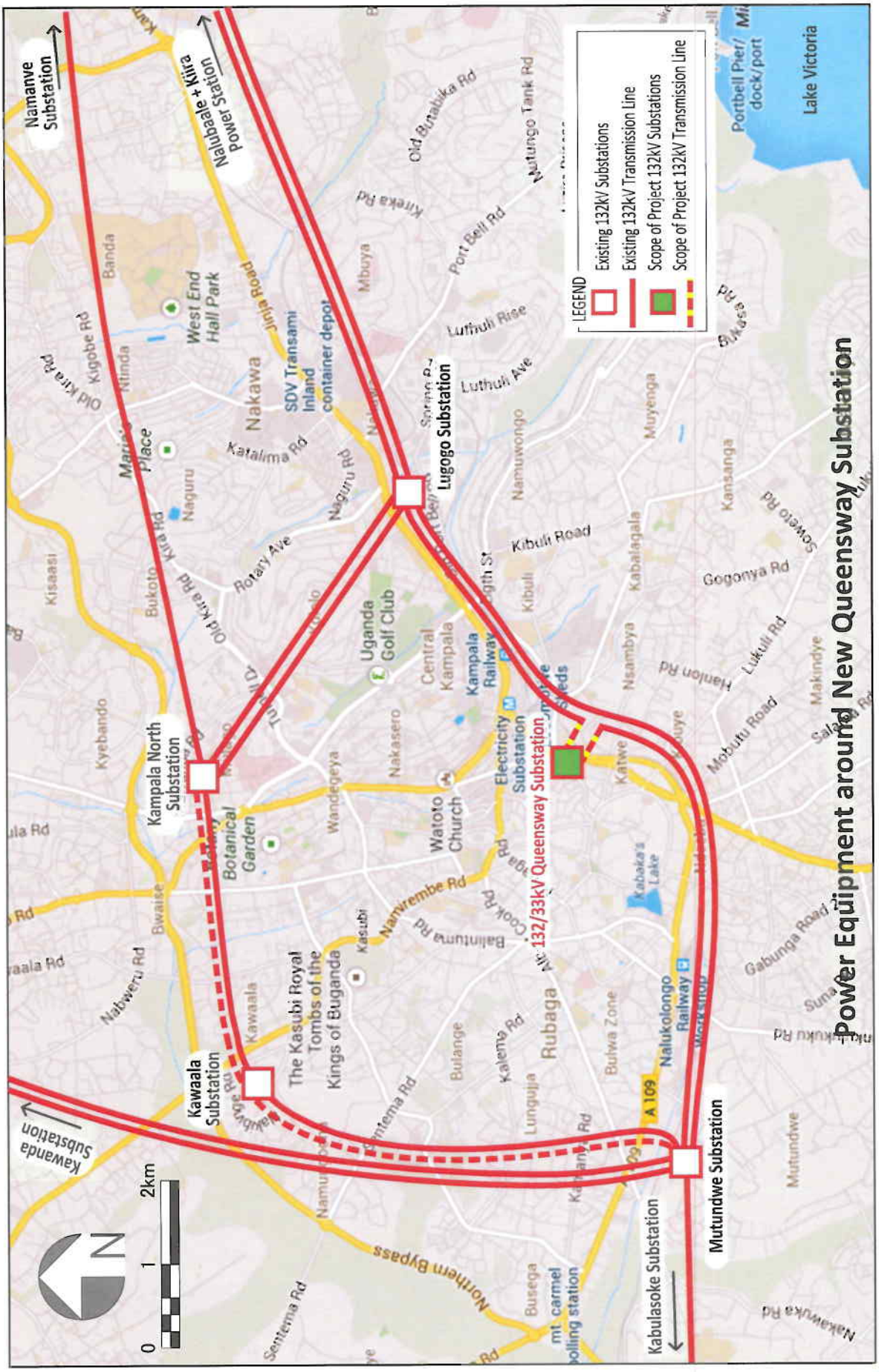
The Ugandan side agreed to secure the Supplementary Allocation Budget for the land acquisition and the Environmental Permit, mentioned in (1) and (2), from Ministry of Finance, Planning and Economic Development by the conclusion of the Grant Agreement.

(End)

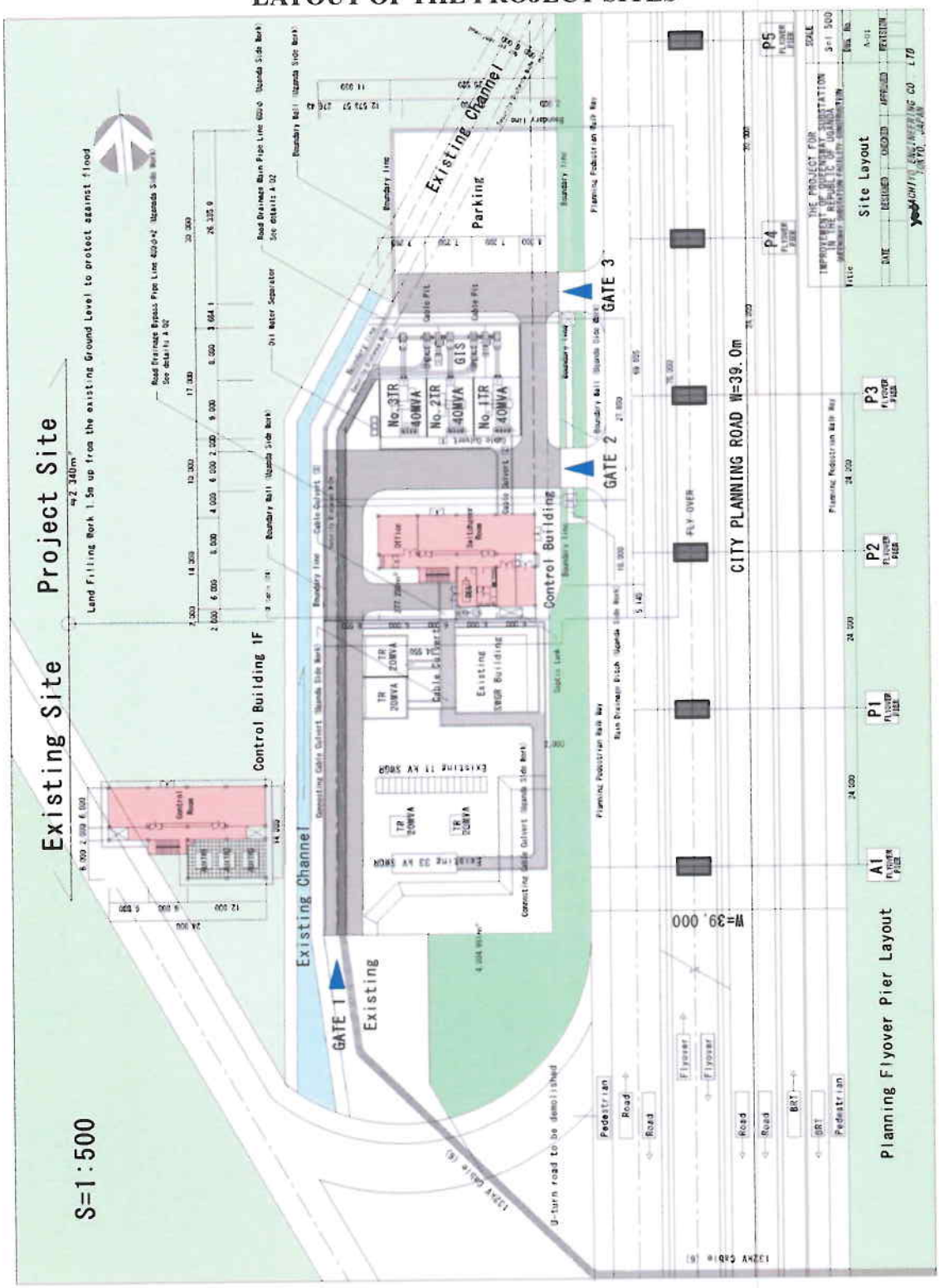
<List of Annex>

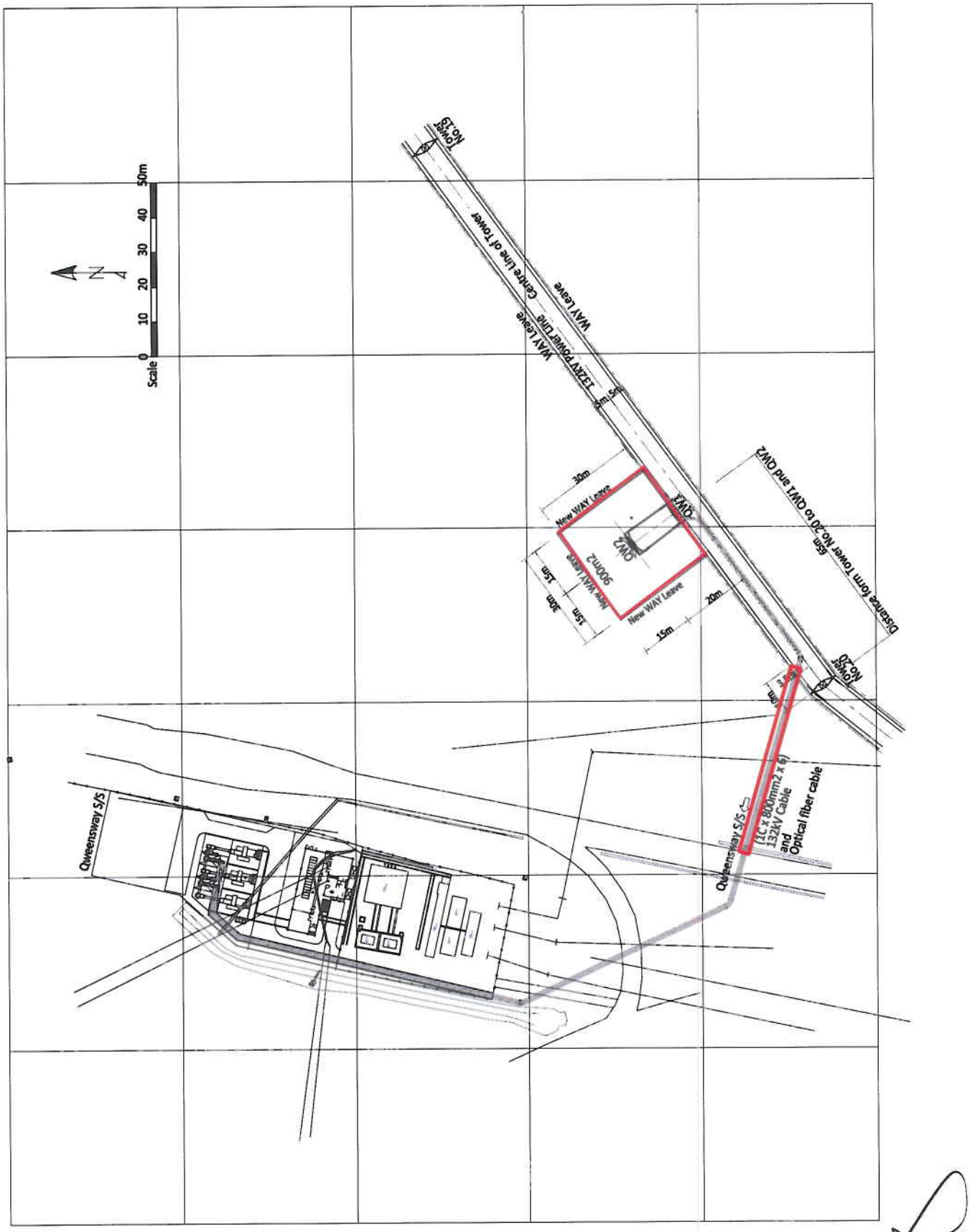
Annex-1	Location of the Project Sites
Annex-2	Layout of the Project Sites
Annex-3	Organization Structure of the Ministry of Energy and Mineral Development
Annex-4	Organization Structure of Uganda Electricity Transmission Co. Ltd
Annex-5	Japan's Grant Aid
Annex-6	Flow Chart of Japan's Grant Aid Procedures
Annex-7	Major Undertakings to be taken by Each Government
Annex-8	Estimated Project Cost

LOCATION OF THE PROJECT SITES



LAYOUT OF THE PROJECT SITES

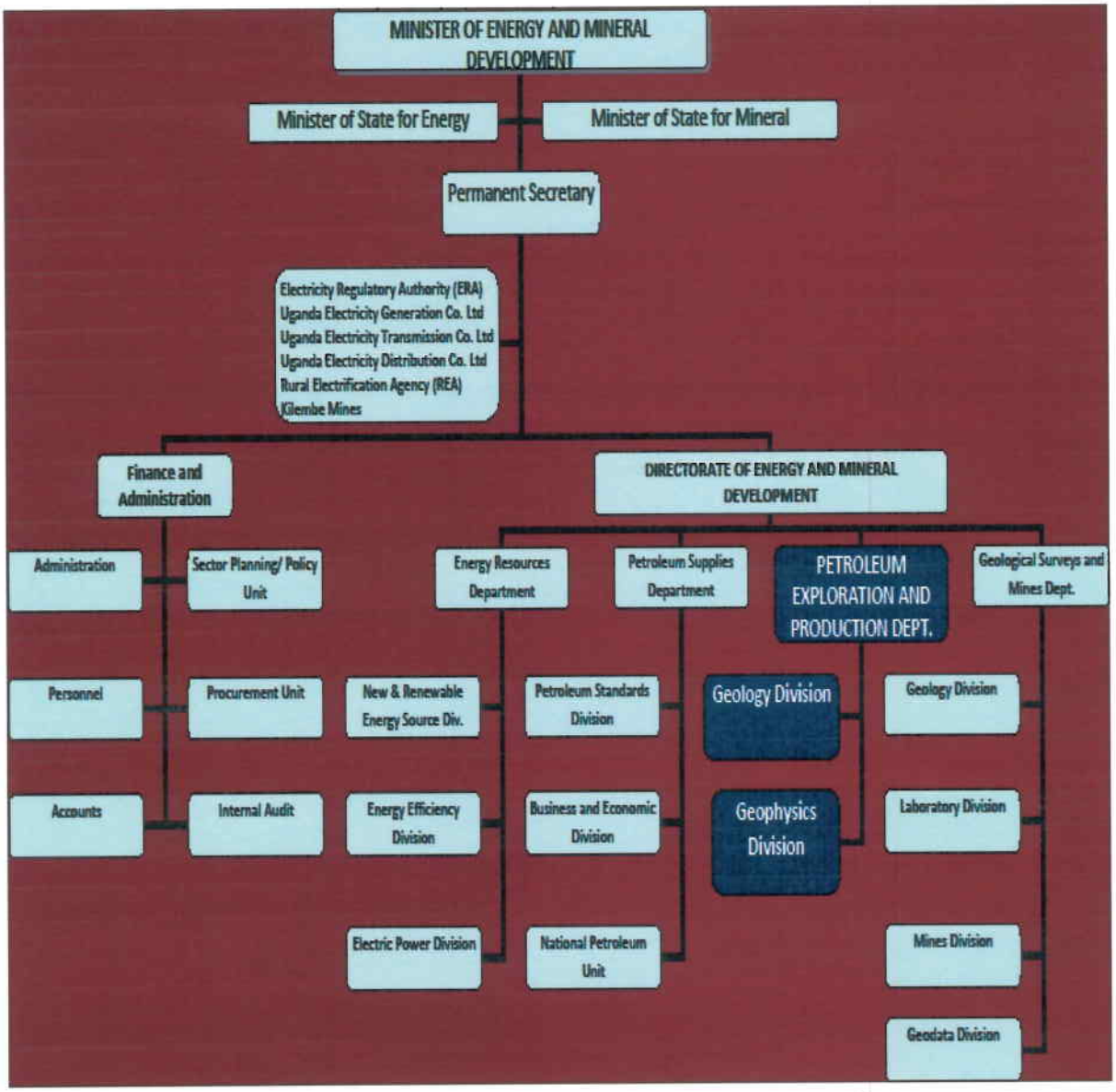



Tower No.19
WAY Leave
Centre Line of Tower
132kV Power Line
WAY Leave
5m
30m
New WAY Leave
QW1
QW2
900m2
New WAY Leave
30m
15m
New WAY Leave
15m
20m
15m
65m
Distance from Tower No.20 to QW1 and QW2
Tower No.20
Queensway S/S
Queensway S/S
LLC 800mm2 x 6)
132kV Cable
and
Optical fiber cable
N
Scale
0
10
20
30
40
50m

Annex-3

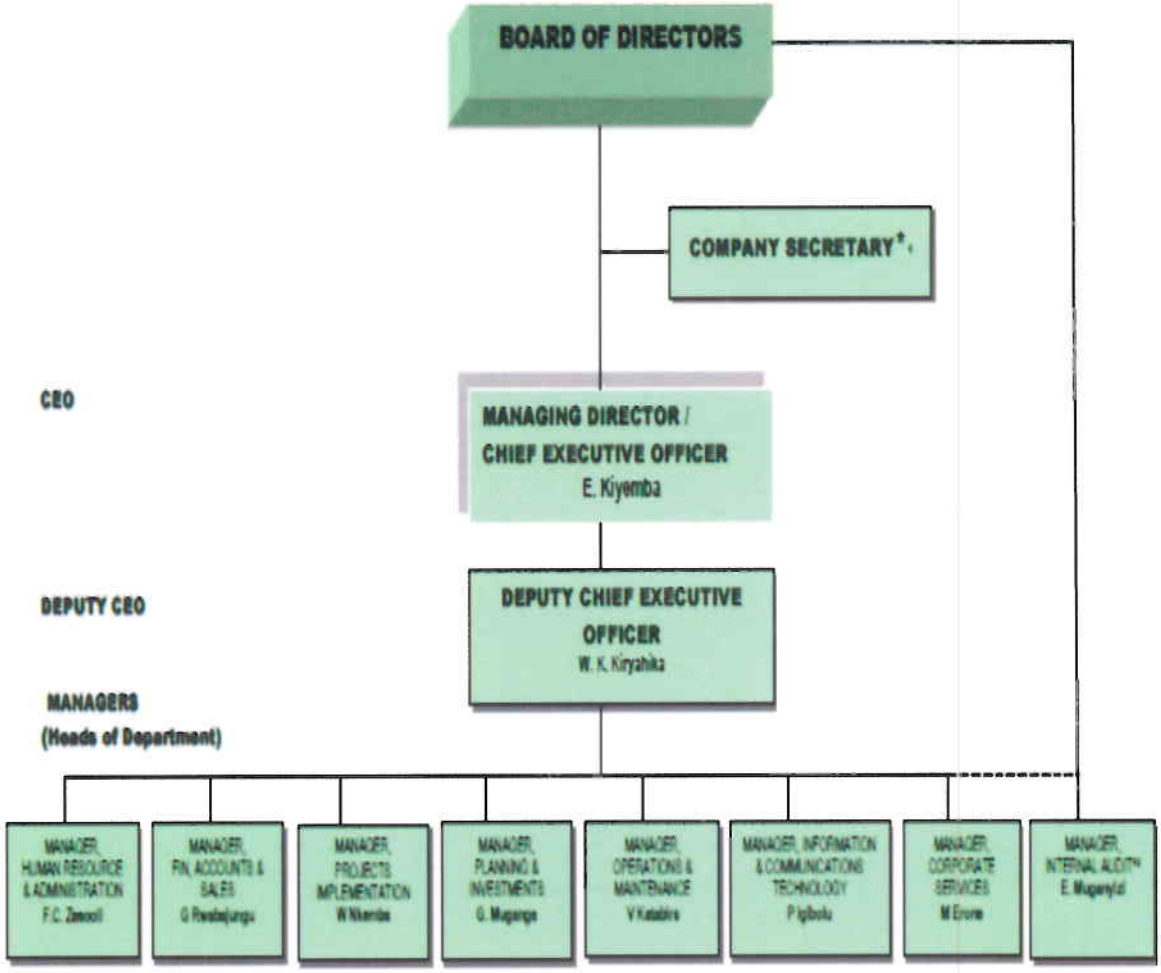
ORGANIZATION STRUCTURE OF THE MNINISTRY OF ENERGY AND MINERAL DEVELOPMENT

MINISTRY OF ENERGY AND MINERAL DEVELOPMENT – ORGANISATION STRUCTURE



ORGANIZATION STRUCTURE OF
UGANDA ELECTRICITY TRANSMISSION Co. Ltd

TOP MANAGEMENT



NOTE:

*1 - Services of Company Secretary hired from Law Firm

FIN - Finance

*2 - Manager, Internal Audit reports to the Audit Committee of the Board

Updated:
31/03/2014
GDA/gda/68
HR & A DEPT

JAPAN'S GRANT AID

Based on the new JICA law entered into effect on October 1, 2008, JICA is designated as 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-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)

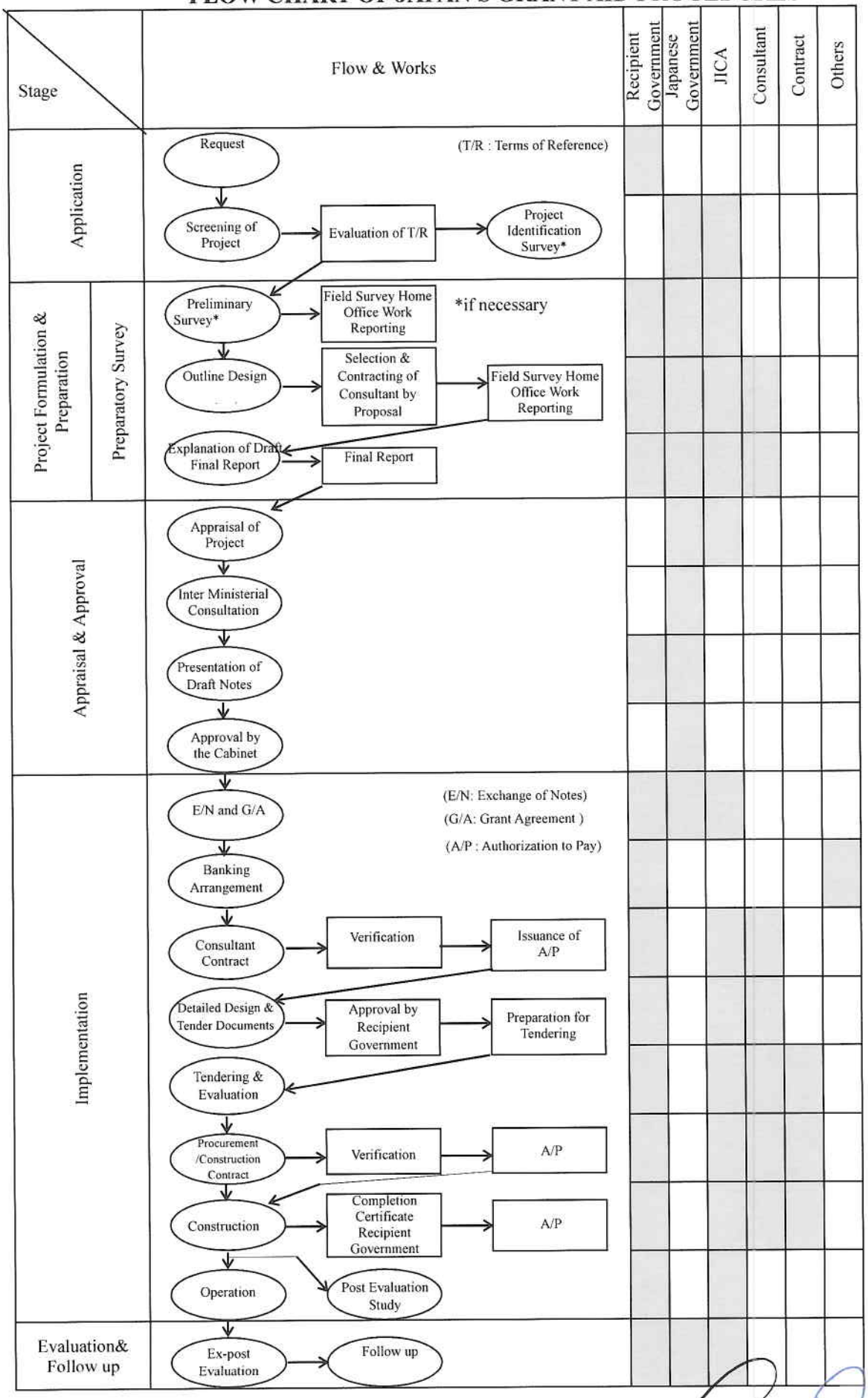
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(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)

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



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)

(Confidential)

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This Page is closed due to the confidentiality.

APPENDIX 5

FIELD REPORT

PREPARATORY SURVEY
ON
THE PROJECT FOR
IMPROVEMENT OF QUEENSWAY SUBSTATION
IN
THE REPUBLIC OF UGANDA

FIELD REPORT

30th APRIL 2014

Prepared and Submitted by:

Mr. Kazunari Nogami
Chief Consultant
Preparatory Survey Team, JICA

Confirmed and Agreed by:

Mr. Eriasi Kiyemba
Managing Director
Uganda Electricity Transmission Co. Ltd.

Confirmed and Agreed by:

Mr. Joseph Katera
Managing Director
Uganda Electricity Distribution Co. Ltd.

JICA PREPARATORY SURVEY TEAM
Yachiyo Engineering Co.,Ltd.

A-5-1

Contents

1. Outline of the Project

1.1 Background of the Project

In response to the request from the Government of the Republic of Uganda (Uganda), the Japan International Cooperation Agency (JICA), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (the Survey) on the Project for Improvement of Queensway Substation (the Project).

JICA sent to Uganda the Preparatory Survey Team (the Team) headed by Dr. Hiroshi Sato, Director, Energy and Mining Division 2, Industrial Development and Public Policy Department, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 11th April to 14th May, 2014.

The Team continued discussions with the concerned officials of Uganda and the field survey in Uganda in consideration of mutual understandings made on the minuets of discussions signed between the Ministry of Energy and Mineral Development (MEMD), Ministry of Finance, Planning and Economic Development, (MoFPED), Uganda Electricity Transmission Company Limited (UETCL) and Uganda Electricity Distribution Company Limited (UEDCL) on 16th April, 2014.

UETCL, UEDCL and the Team had series of technical discussions to form mutual understandings about the contents, scope, preconditions for the Outline Design, basic specifications, general layouts, and so on of the Project in the first field survey. UETCL, UEDCL and the Team agreed to record the following issues described on this Field Report as a conclusion of the discussions.

Components of the Project and their priority will be further examined and may be modified through the consultation with the Japanese Ministry of Foreign Affairs and JICA headquarters. It is important for the Ugandan side to understand that the Preparatory Survey is not a commitment for the future implementation of the Project.

Particularly, in consideration of the schedule and procedures of Japan's Grant Aid projects, the Team explained that the outline design, planning of the implementation schedule, the cost estimation and so on of the Project will be carried out in accordance with the mutual understandings made on this Field Report immediately after the first field survey. UETCL and UEDCL expressed understanding about the schedule and procedures of Japan's Grant Aid projects. UETCL and UEDCL agreed for the Team to progress the further study, the outline design, planning of the implementation schedule, the cost estimation and so on of the Project in accordance with the mutual understandings made on this Field Report immediately after the first field survey.

1.2 Framework for the Project

The framework for the Project is shown as follows.

A-5-2

(1) The responsible ministry is the Ministry of Energy and Mineral Development (MEMD).
(2) The implementing agency is Uganda Electricity Transmission Company Limited (UETCL).
(3) The cooperating agency is Uganda Electricity Distribution Company Limited (UEDCL).

1.3 The Scope of the Japanese side on Minutes of Discussions on 16th April, 2014

The Scope of the Japanese side on Minutes of Discussions (M/D) on 16th April, 2014 is shown in Table 1.3-1 and Figure 1.3-1.

The Ugandan side and the Team discussed the final requested components of the Project and their priority in consideration of change of the conditions after submission of the application of the Japan's Grant Aid for the Project. The Team suggested three alternatives of the Project and priority of the components in each alternative in conformity with the current conditions surrounding the Project. The Ugandan side and the Team agreed the following alternative as the final requested components of the Project and their priority. The rating of the priority shown in the following table is higher in the following manner; A+, A-, and B.

Based on the discussion after M/D signed on 16th April, 2014, the number of 33 kV Indoor GIS to be procured and installed is agreed between the Ugandan and Japanese side as below.

Table 1.3-1 Final requested components of the Project and their priority

Components	Capacity	Priority
Procurement and Installation Work		
1. No.1 and No.2 transformation banks		
(1) 132/33 kV Transformer	40 MVA×2 units	A+
(2) 132 kV Outdoor GIS (Double Bus Type)	5 units	
(3) 33 kV Indoor GIS	9 units	
(4) 132 kV Transmission Line for incomings	0.5 km distance	
(5) SCADA Interface Marshalling Cubicle	1 unit	
2. Connection bay for No.3 transformation bank		
(1) 132 kV Outdoor GIS (Double Bus Type)	1 unit	A-
3. No.3 transformation bank		
(2) 132/33 kV Transformer	40 MVA×1 unit	B
(3) 33 kV Indoor GIS	5 units	
Procurement Work		
4. Maintenance Tools for the Equipment of the Project	1 lot	A+
5. Spare Parts for the Equipment of the Project	1 lot	
Construction Work		
6. Foundation for the Equipment of the Project (GISs, transformers and towers for 132 kV transmission line)	1 lot	A+
7. Building of Queensway Substation	1 building	

[Notes] GIS: Gas Insulated Switchgear
[Remark] Quantities shall be examined in the outline design.

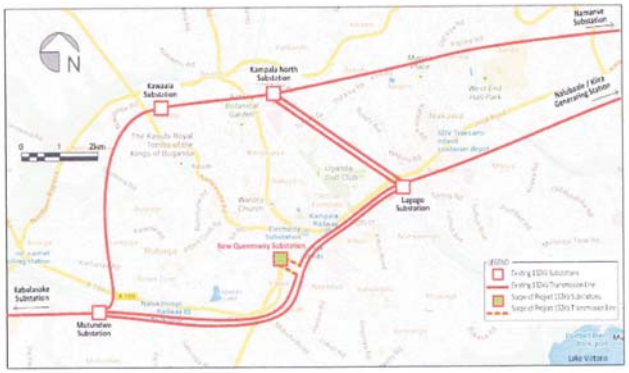


Figure 1.3-1 Location of the Requested Components

1.4 Obligations/Undertakings of the Ugandan side for the Project

(1) Preconditions

- UETCL shall obtain an Environmental Permit (EP) from National Environment Management Authority (NEMA) until August, 2014 after submitting the Project Brief in timely manner.
- UETCL agreed to secure the land as shown in Attachment-2 for 132/33 kV Queensway Substation of the Project in accordance with agreement on M/D signed on 16th April, 2014 and submit to the Team a copy of the official document showing the land belonging to UETCL.
- UETCL agreed to secure the land for the entire 132 kV transmission line route of the Project and submit to the Team a copy of the official document showing the land belonging to UETCL.
- UETCL and UEDCL agreed for the cables of the incoming 132 kV transmission lines to the 132/33 kV Queensway Substation of the Project to be installed under the existing main road in the existing Queensway Substation with coordination with UMEME.
- UETCL agreed to obtain permission from related authorities for 132 kV transmission lines to go across Queensway Road and the small branch road before commencement of the installation work by the Japanese side (see DWG. No. T-01).
- UETCL agreed to provide a list showing signals to be transferred from 132/33 kV Queensway Substation of the Project to Lugogo Central Control Center before the Team complete the first field survey.

A-5-3

(2) Necessary Inputs by the Ugandan side

1) Prior to the Commencement of the Construction Work

- UETCL agreed to relocate the Country Trees within the above mentioned area for the Project as shown in Attachment-2 to outside of the area with coordination with Pan African Movement before commencement of the installation work of the Project by the Japanese side.
- UETCL agreed to relocate the existing ditch within the above mentioned area for the Project to the northern side of existing Queensway Substation along the existing fence with coordination with Pan African Movement before commencement of the installation work of the Project by the Japanese side (see DWG. No. A-02).
- UETCL and UEDCL agreed to expand and add, within existing Queensway Substation, trenches for cables from the 33 kV switchgears of the Project to 33/11 kV substations by themselves for proper installation and connection of 33 kV lines of the Project (see DWG. No. A-01).
- The Ugandan side agreed to prepare access holding dimensions and number enough for the 33 kV cables of the Project to the existing 33 kV switchgears installed by the previous Japan's Grant Aid project.

2) During the Construction Work

- UETCL and UEDCL agreed to schedule power outages required for installation work of the Project and carry out them in timely manner. UETCL and UEDCL shall also manage any issue concerning the power outages, including related procedures, and compensation to and grievances from customers.

  Especially, to install the towers for branching 132 kV transmission line to the 132/33 kV Queensway Substation of the Project, UETCL agreed for both two circuits of the existing 132 kV transmission lines between Lugogo and Mutundwe to be kept in condition of power-cut during the installation work of these towers.
- UETCL agreed to control traffic properly and timely to carry out location of 132 kV incoming lines to 132/33 kV Queensway Substation of the Project during the work. UETCL also agreed to manage any issue concerning the traffic control, including related procedures, and compensation to and grievances from the public.
- The Ugandan side agreed to manage to secure the small branch road between Katwe road and Queensway road as the access to the existing main entrance of Queensway Substation with coordination with the related authorities.
- UETCL agreed to secure a temporary storage yard (Approx. 5,000 m^2) for the Project near the Project site.

- UETCL agreed to procure and supply to the Japanese side total 8 units (4 units for the main and 4 units for confirmation of accuracy of the main) of energy meters used for official transaction in Uganda.

- UETCL and UEDCL agreed to decommission and relocate the existing equipment, facilities, materials and so on (terminal poles, underground cable, pipes and so on) within the above mentioned area for the Project, as shown in Attachment-3, to outside of the area before commencement of the installation work by the Japanese side.

3) After the Commencement of Operation

- With applying the materials for the final connection work procured by the Japanese side, UETCL and UEDCL agreed to carry out the final connection work between 33 kV lines of the Project to the existing 33/11 kV substations at Queensway Substation.

- UETCL agreed to procure and install, by themselves, equipment such as remote terminal unit (RTU), multiplexer, optical fiber distribution frame (ODF) and so on in conformity with the requirements of the existing ABB SCADA system.

  The equipment shall be connected by UETCL to the SCADA interface marshalling cubicle of the Project which collect information analog or digital signals of the equipment of the Project after procurement and installation of such equipment as RTU, ODF, and so on by UETCL.

  The materials for this connection work shall be procured and installed by UETCL in accordance with their location at the first floor of the control building of the Project.

- UETCL shall provide the setting list of the protection relays to the Japanese side.

2. Technical requirements confirmed in the first field survey

2.1 Technical requirements for the substation of the Project

2.1.1 Technical requirements for the equipment of the substation of the Project

(1) Applicable Codes and Standards

The equipment of 132/33 kV Queensway Substation of the Project shall be designed in accordance with IEC, JEC standards and/or equivalent.

(2) Requirements for the equipment of the substations

The specifications of the equipment procured by the Japanese side are shown in Table 2.1.1-1. Single Line Diagram for the equipment is shown in DWG No. E-01 and E-02.

Table 2.1.1-1 Specification of Equipment to be supplied for 132/33 kV Queensway Substation by the Japanese side

No.	Description	Specifications	Q'ty
QS1	**132/33 kV Transformer**		**2 sets**
	➢ Standards	IEC, JEC or equivalent	
	➢ Capacity	40 MVA	
	➢ Primary voltage	132 kV	
	➢ Voltage regulating range	132 kV +/- 10%	
	➢ Steps (taps)	+/- 8 steps (17 taps)	
	➢ Secondary voltage	33 kV	
	➢ Cooling	ONAN/ONAF	
	➢ Vector group	YNyn0+d1	
	➢ % impedance	Approx. 13%	
	➢ Rated basic impulse withstand voltage	132 kV: 650 kV 33 kV: 170 kV	
	➢ Rated power frequency withstand voltage (1 min.)	132 kV: 275 kV 33 kV: 70 kV	
	➢ Bushing CT	132 kV line: 3 CTs 132 kV neutral: 1CT 33 kV line: 3 CTs 33 kV neutral: 1CT	
	➢ Neutral earthing	132 kV : Solidly earthing system 33 kV: Solidly earthing system	
	➢ Connection	132 kV side: Direct connection to GIS 33kV side: Cable connection (2 x 400 mm^2/phase)	
	➢ Others	- Fire walls between transformers are necessary. - Future space for No.3 Transformer is considered.	
QS2	**132 kV Outdoor GIS**		**1 lot**
	➢ Standards	IEC, JEC or equivalent	
	➢ Busbar configuration	Double Busbar system	
	➢ Quantity	Feeder bays : 2 bays Transformer bays : 2 bays Bus Coupler bay : 1 bay VT/ES bay : 2 sets	
	➢ Rated voltage	132 kV	
	➢ Rated current	Busbar: more than 2,000 A Bus coupler: more than 2,000 A Feeder: more than 2,000 A Transformer: more than 1,250 A	
	➢ Rated interrupting current	31.5 kA	
	➢ Rated short-time withstand current (short time)	31.5 kA (1 sec.)	
	➢ Rated basic impulse withstand voltage	650 kV	
	➢ Rated power frequency withstand voltage (1 min.)	275 kV	
	➢ Circuit Breaker		
	- Auto-reclosing	Not Available	
	- Operating sequence	O-0.3 sec.-CO-3 min.-CO (Three phase)	
	➢ Current Transformer		
	- Feeder bays	3 CTs	
	- Transformer bays	None	
	- Coupler bay	2 CTs	
	- Secondary current	1 A	
	➢ Voltage Transformer	132/√3 kV/110/√3 V	
	➢ Others		
	-Future bays for 132 kV feeders	- Future space for 1 x spare transformer feeder bay is considered.	

No.	Description	Specifications	Q'ty
QS3	**132 kV Control and Relay Panels**		**1 lot**
	➢ Type of Control and Protection panel	Duplex type panel	
	➢ Panel arrangement	Front of panel: 132 kV Switchgear Control and 40 MVA Transformer voltage regulating control with mimic bus, control switches, meters, alarms and other control devices Rear of panel: 132 kV Protection relays	
	➢ Standard Protection system (recommended)		
	- 132 kV Transmission line protection	Main: Current Differential Relay (standard type in Uganda) Back-up: Directional Ground Fault Relay, 1st Stage: Teleprotection 2nd Stage: Inverse Definite Minimum Time Over Current Relay	
	- 132/33 kV Transformer protection	Transformer Differential Relay Overcurrent Relay * Each relay shall have dedicated Device	
	- 132 kV Busbar protection	Current Differential Relay * Breaker Failure Protection shall be applied.	
QS4	**33 kV Indoor GIS**		**9 panels**
	➢ Standards	IEC, JEC or equivalent	
	➢ Busbar configuration	Single Busbar system	
	➢ Quantity	Following bays are provided. Control, metering and protection relays are mounted on the respective Switchgear. - 2 x 40 MVA Transformer bays - 4 x 33 kV Feeder bays - 1 x Bus Section bays - 2 x Station Transformer bays	
	➢ Rated voltage	36 kV	
	➢ Rated current	Busbar: 2,000 A Bus Section: 2,000 A Feeder: 1,250 A 132/33 kV Transformer: 2,000 A	
	➢ Rated interrupting current	20 kA	
	➢ Rated short-time withstand current (short time)	20 kA (1 sec.)	
	➢ Rated basic impulse withstand voltage	170 kV	
	➢ Rated power frequency withstand voltage (1 min.)	70 kV	
	➢ Circuit Breaker		
	- Auto-reclosing	Not Available	
	- Operating sequence	O-0.3 sec.-CO-3 min.-CO (Three phase)	
	➢ Current Transformer		
	- Secondary current	1 A	
	➢ Voltage Transformer	33/√3 kV/110/√3 V	
	➢ Protection relays	Numerical relays should be applied.	
	➢ Standard Protection system		
	- 33 kV Incomer (132/33 kV Transformer) protection	50/51/51N	
	- 33 kV Feeder Protection	50/51/51N/87 * A dedicated CT and devise is required for 87	
	- 33 kV Bus Coupler Protection	50/51/51N	
	- 33/0.415 kV Aux. Transformer Protection	50/51/51N	
QS5	**Others**		
-1	SCADA Interface Marshalling Cubicle	Interface terminals for Digital I/O, Analogue I/O and Pulse signals are provided by Japanese side. RTU,	1 panel

No.	Description	Specifications	Q'ty
		Multiplexer and ODF shall be provided by the Ugandan side.	
-2	Energy Meter Panel	The Panel shall be provided by the Japanese side. However, total 8 units (4 units for the main and 4 units for confirmation of accuracy of the main) of energy meters shall be provided by the Ugandan side.	1 panel
-3	DC Power Supply System ➢ DC Voltage ➢ Battery Capacity ➢ Battery type	 110 V DC 250 Ah/10hr (Black out time: 2 hours) Lead acid type (Maintenance free type) * Batteries will be installed inside the DC panel of the Project.	1 lot
-4	AC Power Supply System ➢ AC Voltage ➢ Station Service Transformer	 415/240 V AC (Three phases and four wires) Capacity: 200 kVA (Tentative) (2 sets) Final capacity will be informed later. AC distribution panel (1 panel) is included.	1 lot
-5	Diesel Engine Generator	45 kVA, 415/240 V AC (Three phases and four wires) Fuel tank capacity: 48 hours continuous operation	1 unit
-6	Substation Earthing ➢ Earthing Resistance ➢ Materials	 Less than 1 ohm Earthing conductors (copper wire) and terminals	1 lot

(3) Interface of SCADA system

UETCL shall procure and install, by themselves, equipment such as RTU, multiplexer, ODF and so on in conformity with the requirements of the existing ABB SCADA system.

The equipment shall be connected by UETCL to the SCADA interface marshalling cubicle of the Project which collect information analog or digital signals of the equipment of the Project after procurement and installation of such equipment as RTU, ODF, and so on by UETCL, as shown in Fig. 2.1.1-3.

The equipment after the SCADA interface marshalling cubicle up to the splicing box as shown in Fig. 2.1.1-3 shall be provided by UETCL. However, an optical fiber cable with 24 cores shall be procured and installed beside the 132 kV incoming underground cables of the Project by the Japanese side. The connection work of the optical fiber cable to the splicing box and ODF shall be carried out by UETCL.

UETCL explained to the Team that the existing splicing box is located on No. 20 Tower and the optical fiber cable will be connected to the system at the splicing box by UETCL.

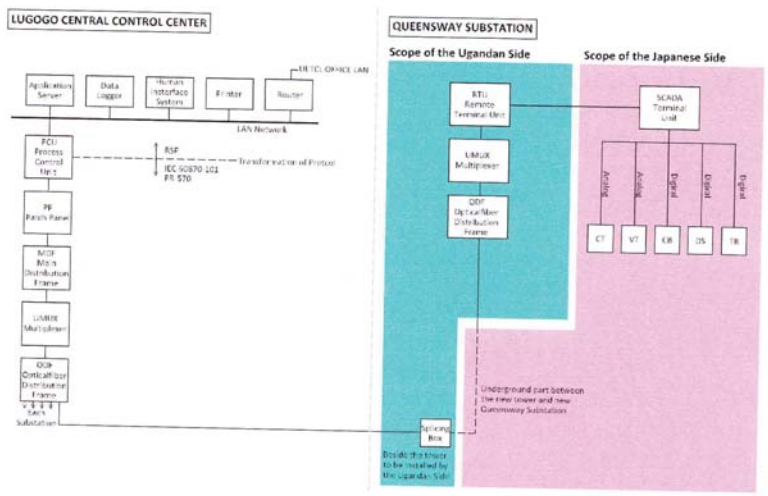


Fig. 2.1.1-3 Work demarcation between the Ugandan side and Japanese side regarding SCADA

2.1.2 Technical requirements for the facilities of the substation of the Project

(1) Design Conditions for the Substation Facilities

The design conditions for the substation facilities are shown in the following Table 2.1.2-1.

Table 2.1.2-1 Basic Conditions for the Facility Design of the Project

Items		Values
Altitude		1190 m
Ambient Temperature	Maximum	35 Degrees Centigrade
	Minimum	10 Degrees Centigrade
	Mean	25 Degrees Centigrade
Maximum Wind Velocity		34 m/s
Annual Rain Fall		1,128 mm/year
Seismic Force		Horizontal 0.15 G
Soil Bearing Capacity		10 t/m^2 (now on survey)

(2) Requirements for the Substation Facilities

Design ground level should be raised up by 1.5 m from existing ground level 65cm higher to the existing Queensway Substation to avoid flood. So retaining wall around the project site would be constructed.

1) Outline of Control Building

The Outline of Control Building is shown in Table 2.1.2-2 (See DWG. No. A-02 and A-03).

Ground floor level should be +1.0 m from the design ground level to secure the height of

Cable Culvert and Cable Pit.

Table 2.1.2-2 Outline of the Control Building

Items	Contents	Details
Structure	Reinforced Concrete Rahmen Structure	
Height of story	3 stories BFL-GFL=2.65 m GFL-1FL=4.0 m 1FL-RFL=4.0 m	BF: Cable Maintenance Pit, Water Tank 4ton, Pump unit, Submersible pump GF: Office, Switchgear Room, Entrance, Generator Room, Battery Room, Toilet, Shower, Pantry, Corridor, Stair Case 1F: Control Room, Corridor, Stair Case, Roof Balcony: 2 units of 200 kVA transformer, Emergency Balcony: Evacuation and Air-conditioning Units
Total Floor Area	Approx. 680 m^2	-
Building Area	Approx. 280 m^2	-
Exterior	Wall Finishing	Concrete with Urethane Exterior Paint Concrete Louver with Urethane Exterior Paint
	Roof Finishing	Concrete Plate t=80 wire-mesh @200 Urethane joint @2000 each Insulation t=50 Asphalt Membrane 3 Layer Water Proofing
Interior	Wall Finishing	Paint on Mortar iron trowel
	Floor Finishing	Free Access Floor h=300 mm Ceramic Tile 300 x 300
	Ceiling	System Ceiling with Gypsum Board t=12 mm Paint Finishing

2) Foundation of 132/33 kV 40MVA Transformers

The Outline of the Foundation of 132/33 kV transformers is shown in Table 2.1.2-3 (See DWG. No. A-02 and A-03).

Ground floor level should be +0.5 m from the design ground level.

Table 2.1.2-3 Outline of the Foundations of 132/33 kV transformers

Items	Contents	Details
Structure	Reinforced Concrete Mat Foundation	-
Height of story	1 story	GF: 2 units of 40 MVA transformer and future space [Note] For the equipment to avoid submerging to water on heavy rainy days, the floor level of the foundations shall be 0.5 m raised from the design ground level. Fire Wall: Concrete wall H=7.5 m, L=9.0 m, t=250 Total number 3 Oil pit: Around Transformer Foundation D=1.5 m filled with gravel, overflow piping connected to the oil-water separator set west-beside the foundation Cable Culvert (4) 500mm x 900mm
Total Floor Area	Approx. 132 m^2	-
Building Area	Approx. 132 m^2	-

3) Foundations of GISs

The Outline of the foundations of GISs is shown in Table 2.1.2-4 (See DWG. No. A-02

and A-03).

Ground floor level should be +0.5 m from the design ground level.

Table 2.1.2-4 Outline of the Foundations of GISs

Items	Contents	Details
Structure	Reinforced Concrete Wall Structure and Mat Foundation	-
Height of story	1 story	BF: Cable Pit for 132 kV cable (6) GF: GIS and Future Space Fire wall: H=5.0m L=8.0m t=200 [Note] For the equipment to avoid submerging to water on heavy rainy days, the floor level of the foundations shall be 0.5 m raised from the design ground level.
Total Floor Area	Approx. 180m^2	-
Building Area	Approx. 180m^2	-

4) Cable Culvert

The Outline of the Cable Culvert is shown in Table 2.1.2-5 (See DWG. No. A-02 and A-03).

Table 2.1.2-5 Outline of the foundations of GISs

Items	Contents
Cable Culvert (1) from 40 MVA transformers to Cable Culvert (2)	Reinforced Concrete Box Culvert Approx. 26 m^2 (W=1.7 m, H=2.0m with Cable Rack)
Cable Culvert (2) from Cable Culvert (1) to Control Building	Reinforced Concrete Box Culvert Approx. 26 m^2 (W=2.5 m, H=1.4m with Cable Rack)
Cable Culvert (3): from Control Building to Existing Facilities	Reinforced Concrete Box Culvert Approx. 15 m^2 (W=2.5 m, H=1.4 m with Cable Rack)

The function of each cable culvert is as follows. Cable Culvert (1) is for smooth cable installation from each transformer. Cable Culvert (2) is for connection to Control Building. Culvert (3) is for smooth cabling from new building to existing facilities.

5) Foundations for Towers of 132 kV transmission lines

The Outline of the foundations for Towers 132 kV transmission lines is shown in Table 2.1.2-3.

Table 2.1.2-3 Outline of the Foundations of 132/33 kV transformers

Items	Contents	Details
Structure	Reinforced Concrete Foundation	Tower H=Approx. 30 m, 2 Units

2.2 Technical requirements for Transmission Line

132 kV transmission line to new 132/33 kV Queensway Substation shall be installed as shown in DWG. No. T-01, the branch point is the existing transmission lines (between the existing No.19 and No.20 Towers).

The requirements for the transmission lines shall be as follows:

1) 132 kV overhead power lines between the new towers of Tower No. QW1 and QW2 (Double circuits).

2) 132 kV underground power lines between Tower No. QW2 tower and new 132/33 kV Queensway Substation (Double circuits). The underground cables are direct-buried type, however they shall be protected by warning tape and concrete cover. The laying depth shall be 1.4 m from the ground level.

3) The overhead grounding wires between the new towers of Tower No. QW1 and Tower No. QW2 (Double circuits).

4) The optical fiber cable from the tower of Tower No.20 to 132/33 kV Queensway Substation of the Project shall be procured and installed by the Japanese side. The optical fiber cable shall be connected to the existing splicing box at the tower of Tower No. 20 by UETCL.

(1) Design Conditions for 132 kV Transmission Line

The electrical conditions are shown in Table 2.2-1.

Table 2.2-1 Electrical Conditions

Items	Design Values
Minimum clearance of conductor	-
Phase to ground	1,200 mm
Phase to phase	1,500 mm
Minimum creepage distance of insulator	16 mm/kV
Equivalent salt deposit density	N/A

(2) Requirements for 132 kV Transmission Line

The specifications for 132 kV Transmission Line are shown in Table 2.2-2.

Table 2.2-2 Specifications for 132 kV Transmission Line

No.	Items	Specifications	Q'ty
TL1	➢ Tower	Style of tower: Steel lattice type Configuration of tower: Wide base square type Type of tower: Tension type (Angle: 0-20 degree), 1 tower Dead end type mounted cable termination and arrestor (Angle: 0-20 degree) 1 tower Safety factor: 1.2 for tension towers Earthing resistance: less than 10 ohms. [Note] Broken wire condition shall be two ACSR conductors or one conductor and one overhead grounding wire.	
TL2	➢ Overhead Line (Conductor)	Type: ACSR Size 420 (Aluminum: 385 mm^2, total: 420 mm^2) BS Sagging stress at 20 °C: 50 N /mm	400 m
TL3	➢ Insulator	Standards: IEC60383-1 or equivalent Size: 254 mm suspension insulators	1 lot

No.	Items	Specifications	Q'ty
		Creepage distance: 320 mm Material: Porcelain Color: Brown Electro-mechanical falling load: 120 kN Number of insulators shall be 11 units/phase	
TL4	➢ 132 kV Underground Cable	Type: XLPE Size: 800mm^2 Conductor: Copper Number of core: Single Core Type of sheath: PVC with anti-termite protection Color of sheath: Black Armor: Aluminum armor or lead metallic sheath for direct buried in the ground	2.31 km (0.35 km x 3 phases x 1 / phase x 2 circuits × 110%)
TL5	➢ 132 kV Underground cable termination	For Outdoor: Single core porcelain type For GIS: Single core	6 pcs 6 pcs
TL6	➢ Overhead Grounding Wire	Type: 50 mm^2 Steel wire strand The shielding angle: less than 15 degree. Sagging stress at 20°C: 120 N /mm	50 m
	➢ Fiber Optical Cable	Number of Core: 24 cores Type of optical fiber cable: Type ITU-T G655 or equivalent Mode: Single Wave length: 1550 nm Others: *Optical fiber cables shall be provided by the Japanese side. However the existing fiber optical line splice and termination of materials for the work shall be done by the Ugandan side. *The laying of the optical cable with the laying of 132 kV underground cable to the new 132/33 kV Queensway substation shall be carried out by the Japanese side.	500 m
TL7	➢ 132kV Outdoor Lightning Arrestor	Standards: IEC 60099-4 IEC line discharge class: class 2 Type: Porcelain Outdoor Zinc Oxide type Maximum System Voltage (kVrms): 145 kV Normal Discharge Current (kA crest): 10 kA Accessories: Surge counter with leakage current mA meter	6 pcs

2.3 Procurement Plan of Spare Parts and Maintenance Tools

Capability of sustainable operation and maintenance for the equipment of the Project by the Recipient is one of conditions for the Japan's Grant Aid. The Ugandan side shall keep operation and maintenance for the equipment of the Project properly by himself, including procurement of spare parts. On the other hand, the warranty period for the Project is 1 year after issuance of the completion certificate in case of the Japan's Grant Aid. To secure operation and maintenance for the equipment of the Project for the warranty period, the spare parts required for the period shall be provided as the scope of the Japanese side.

Possession of maintenance tools for proper operation and maintenance for the equipment of the Project by the Recipient is one of conditions for the Japan's Grant Aid. However, the special tools required for operation and maintenance of the equipment of the Project shall be provided as the scope of the Japanese side.

Outline of the spare parts and maintenance tools of the Project is shown in Attachment-4. More detailed parts, tools, test equipment and the quantity will be explained with the Draft Final Report.

2.4 On-the-Job Training (OJT)

An On-the-job training (OJT) will be carried out during the construction period. Through the OJT, maintenance and operation for the equipment of the Project will be carried out by Japanese skilled engineer of the manufacturers of the equipment of the Project at the project site.

3. Tentative Implementation Schedule of the Project

The tentative implementation schedule is shown as Attachment-5. In case that the Project is adapted by the Japanese Government, the Project will proceed as follows in the earliest scenario. The installation work of the Project will start in June, 2015. It is important for both sides to understand that the Preparatory Survey is not a commitment for the future implementation of the Project.

- ➢ The Exchange of Notes between the Ugandan and Japanese Government will be signed in November, 2014.
- ➢ The Tender Opening will be held in May, 2015.
- ➢ Installation work of the Project will start in June, 2015.
- ➢ Commissioning of the Project will be in March, 2017.

4. Drawings

Part 1 Substation

E-01: Single Line Diagram for Queensway Substation
E-02: Single Line Diagram for Queensway Substation (LV AC AND DC CIRCUIT)

Part 2 Transmission Lines

T-01: 132 kV Transmission Line and Underground Cable Route Map to Queensway Substation
T-02: Improvement of Queensway Substation
T-03: Type of Steel Tower [T]
T-04: Dead End Type Steel Tower Cable Termination
T-05: 132 kV Underground Cable Section (General)

T-06: 132 kV Underground Cable Section (For Road)

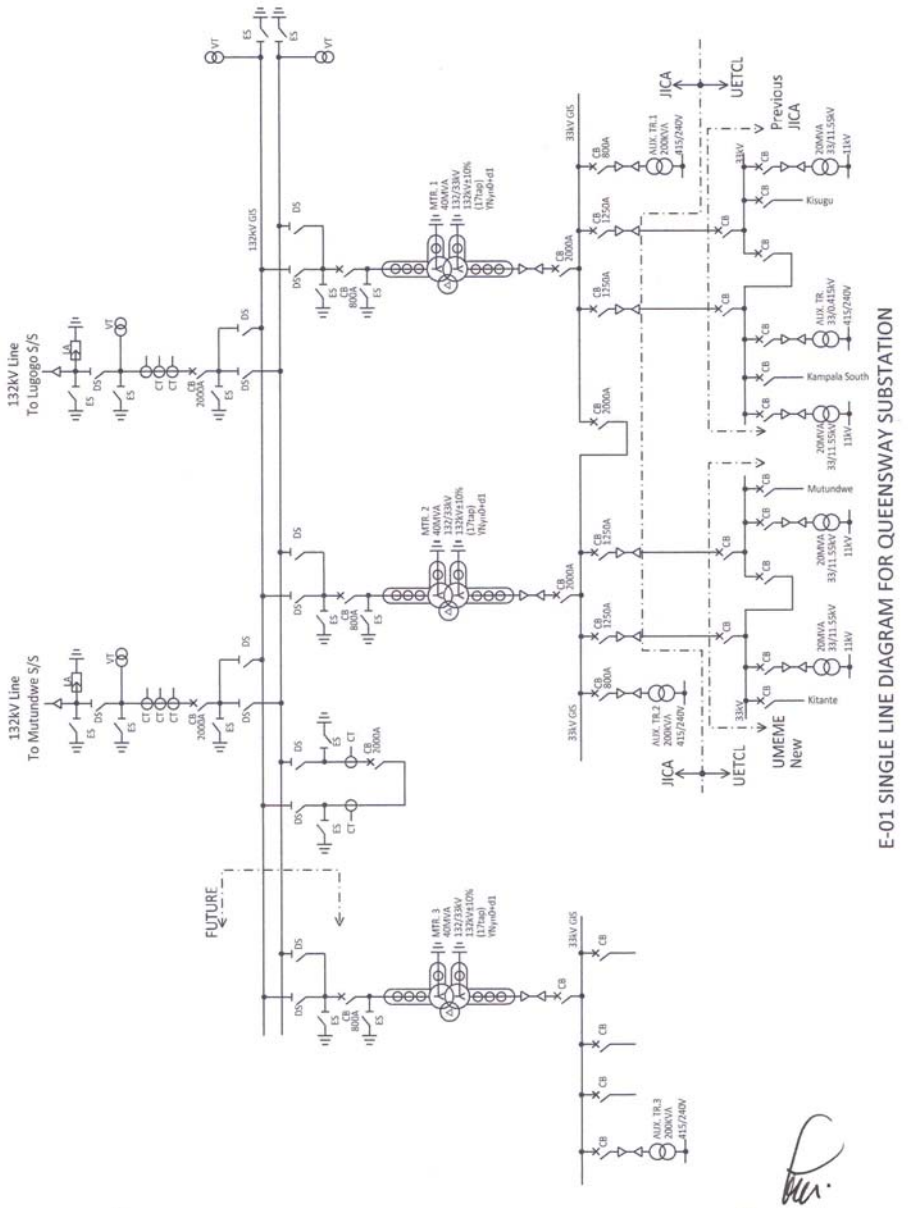
Part 3 Architectural

A-01: Site Layout of Queensway Substation

A-02: Section of Queensway Substation

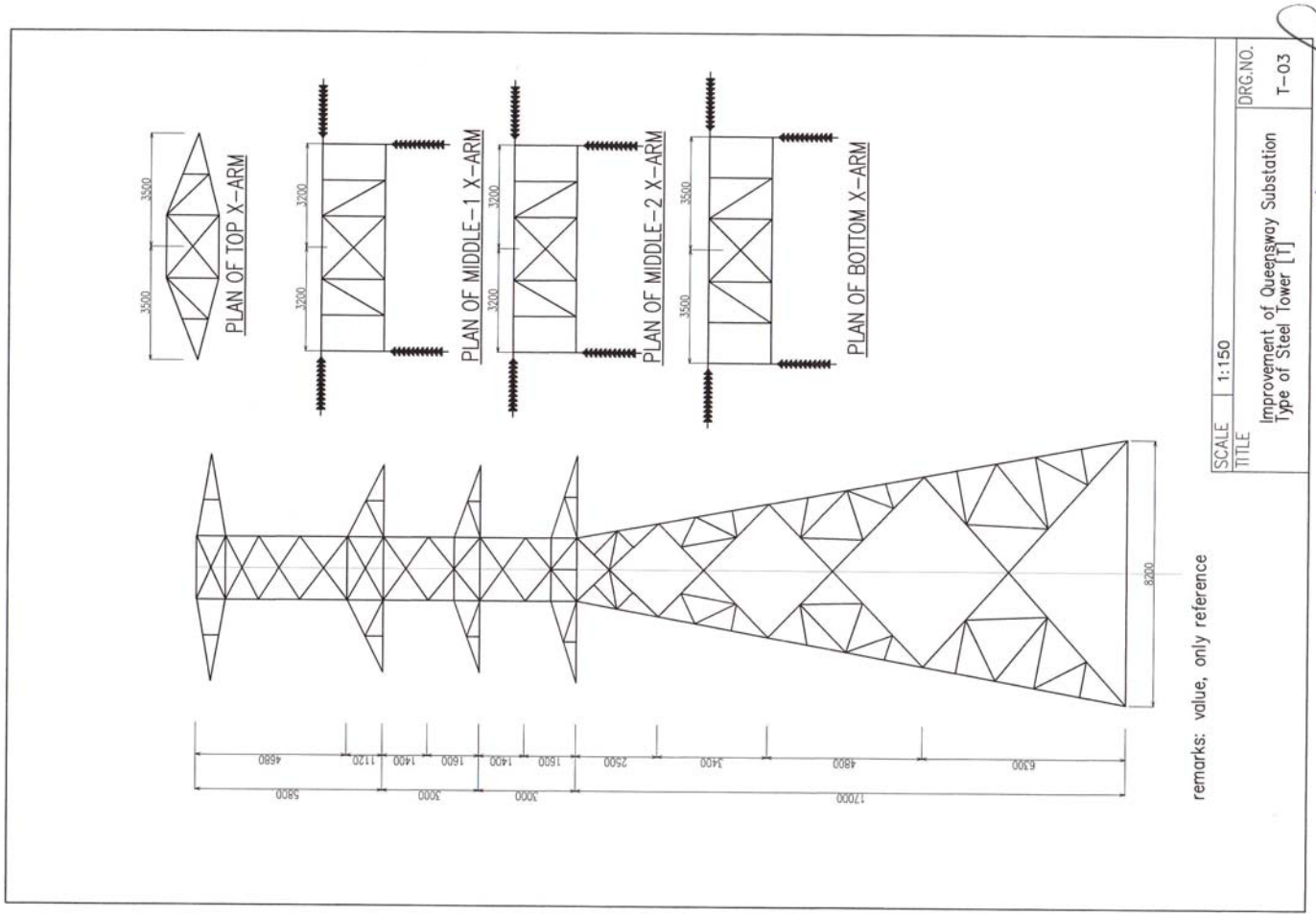
A-03: Layout of Electrical Equipment

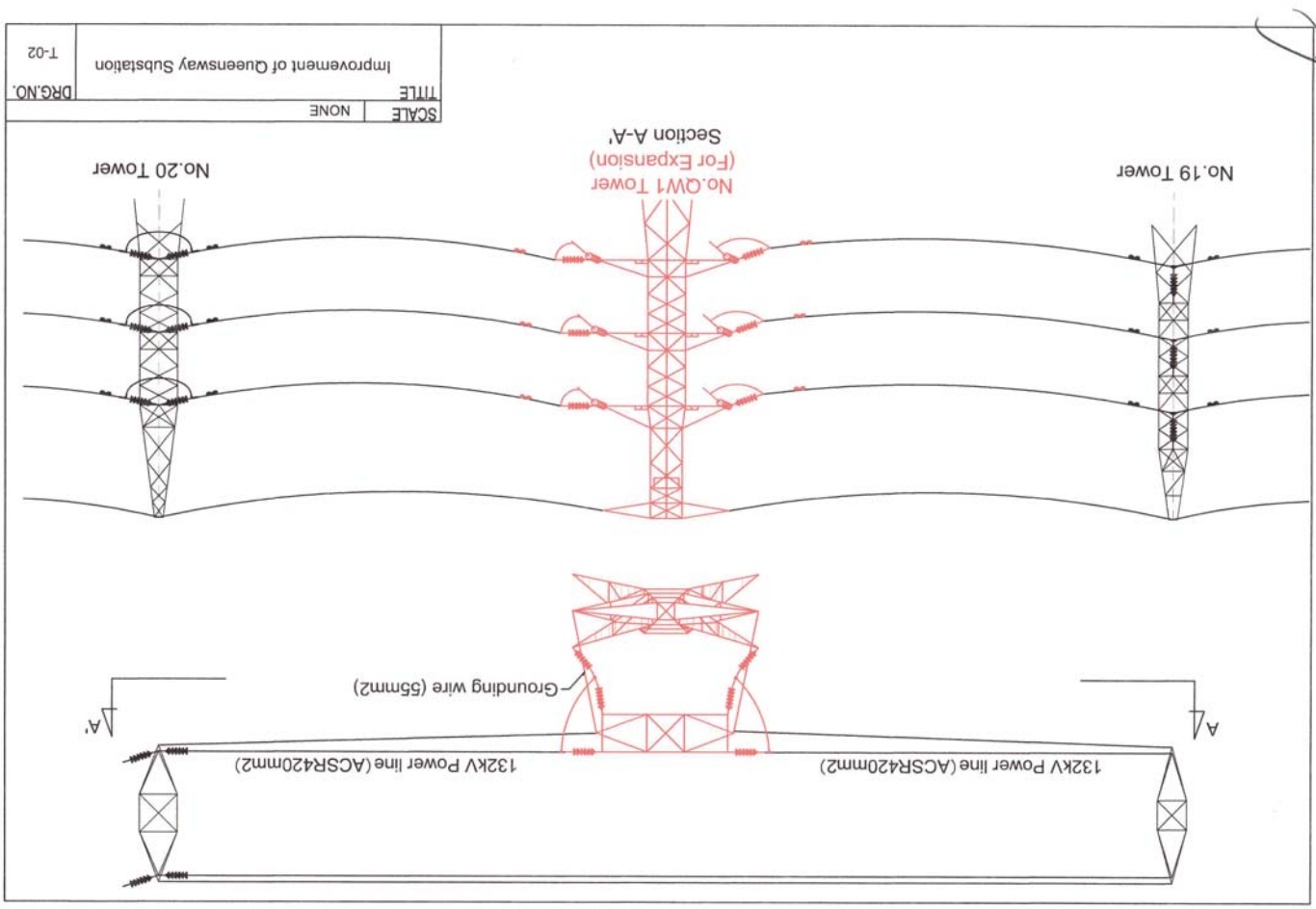
A-5-9

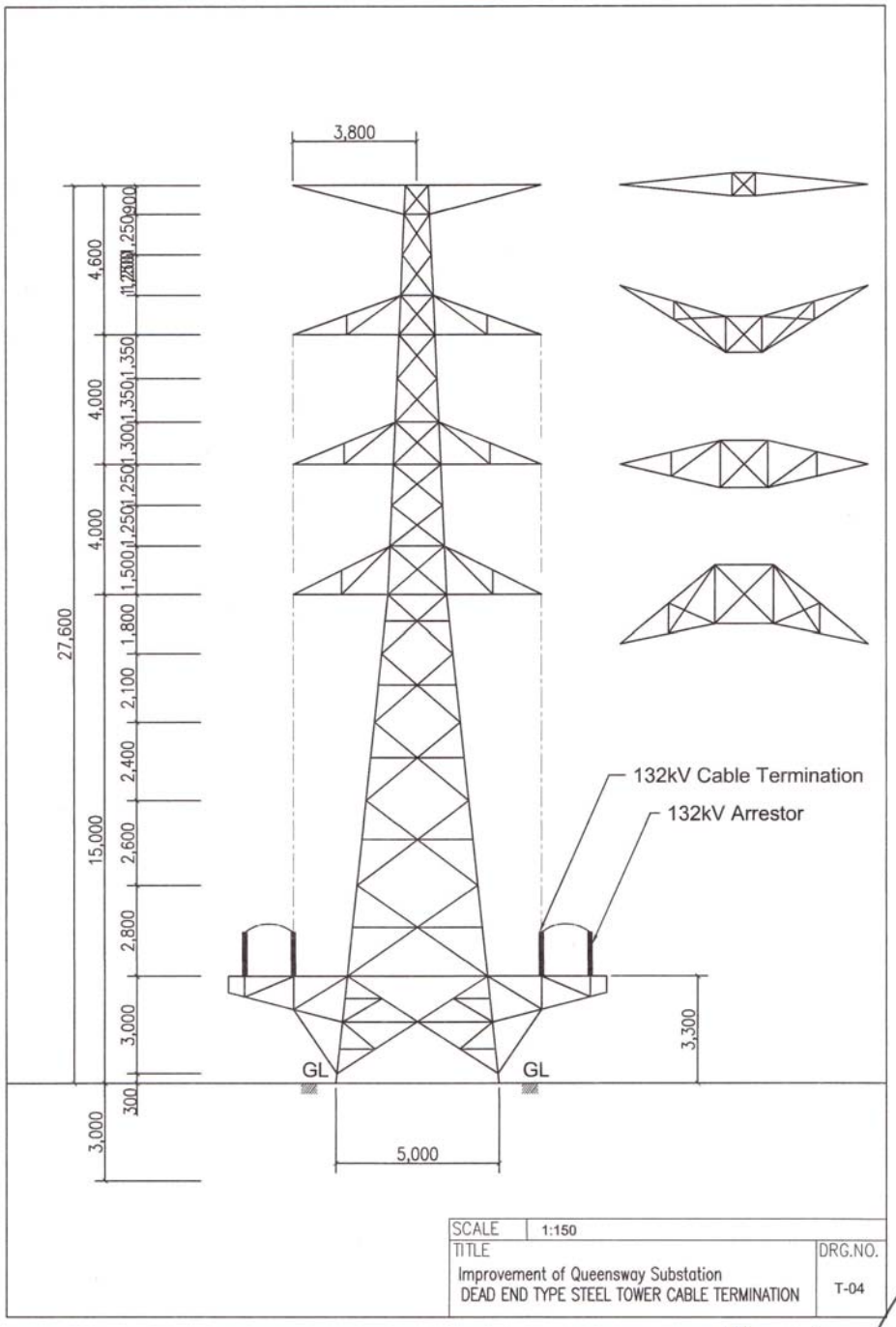


SCALE
NONE
TITLE
132kV TRANSMISSION LINE AND UNDERGROUND CABLE
ROUTE MAP TO QUEENSWAY SUBSTATION
DRG.NO.
T-01
132 kV Underground Cable
(Scope of the Project)
132kV Power line
Queensway
Substation

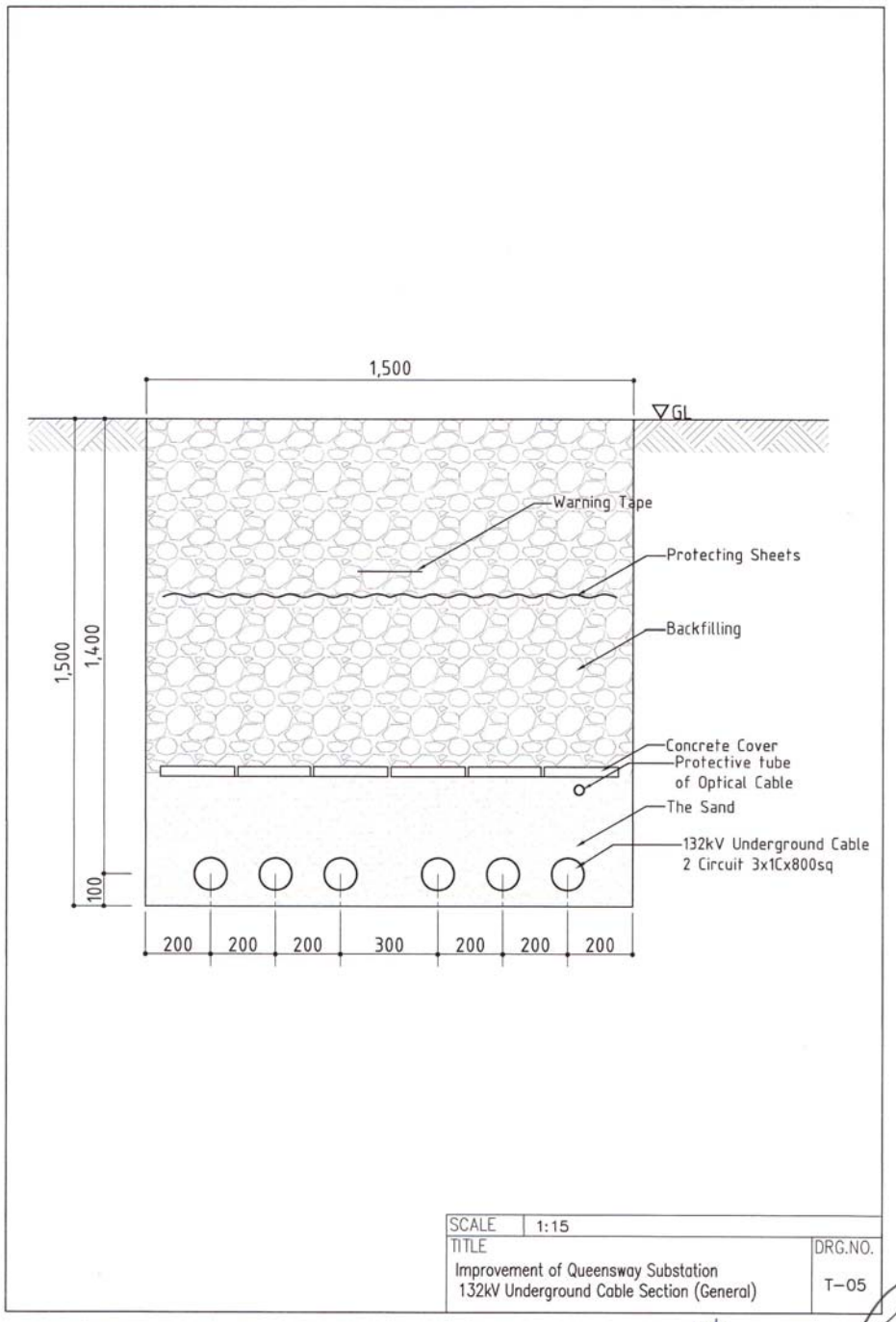
E-02 SINGLE LINE DIAGRAM FOR QUEENSWAY SUBSTATION (LV AC AND DC CIRCUIT)
(SUPPLIED BY UETCL)
CONTROL SCADA
AC 240V
DC 48V
BATTERY 48V
33kV SWGR
132kV CONTROL AND RELAY PANEL
DC 110V
BATTERY 110V
EMERGENCY LTG
FIRE ALARM
ESSENTIAL CONTROL BUILDING SERVICE PANEL 415/240V
LTG
A/C
PUMP
CONTROL BUILDING SERVICE PANEL 415/240V
MTR.1 FAN
MTR.2 FAN
As Required
As Required
84
27
(NC)
LV PANEL (415/240V)
ESSENTIAL LV PANEL (415/240V)
ELECTRICAL INTERLOCK
(NC)
84
27
(NO)
84
27
(NC)
AUX. TR.1
33/0.415-0.240KV
200KVA
AUX. TR.2
33/0.415-0.240KV
200KVA
DG
415/240V
45KVA
(AUTOMATIC OPERATION)


PLAN OF TOP X-ARM
PLAN OF MIDDLE-1 X-ARM
PLAN OF MIDDLE-2 X-ARM
PLAN OF BOTTOM X-ARM
3500
3200
8200
4680
1120
1400
1600
1400
1500
2500
3400
4800
6500
5800
5000
3000
17000
remarks: value, only reference
SCALE 1:150
TITLE Improvement of Queensway Substation Type of Steel Tower [T]
DRG.NO. T-03


SCALE NONE
TITLE Improvement of Queensway Substation
DRG.NO. T-02
No.20 Tower
No.QW1 Tower
(For Expansion)
No.19 Tower
Section A-A'
Grounding wire (55mm2)
132kV Power line (ACSR420mm2)
132kV Power line (ACSR420mm2)
A
A'



SCALE	1:150
TITLE	Improvement of Queensway Substation DEAD END TYPE STEEL TOWER CABLE TERMINATION
DRG.NO.	T-04



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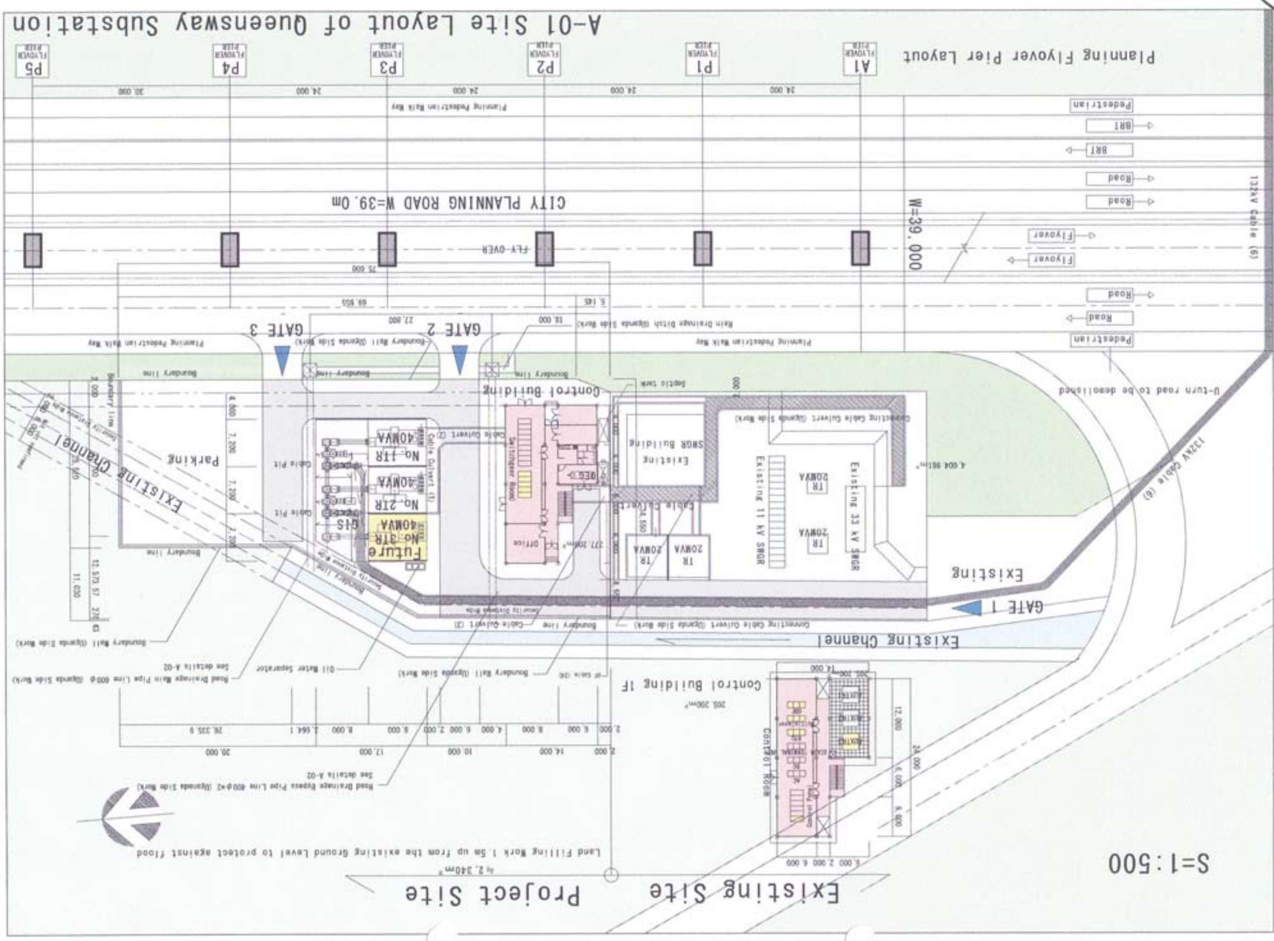
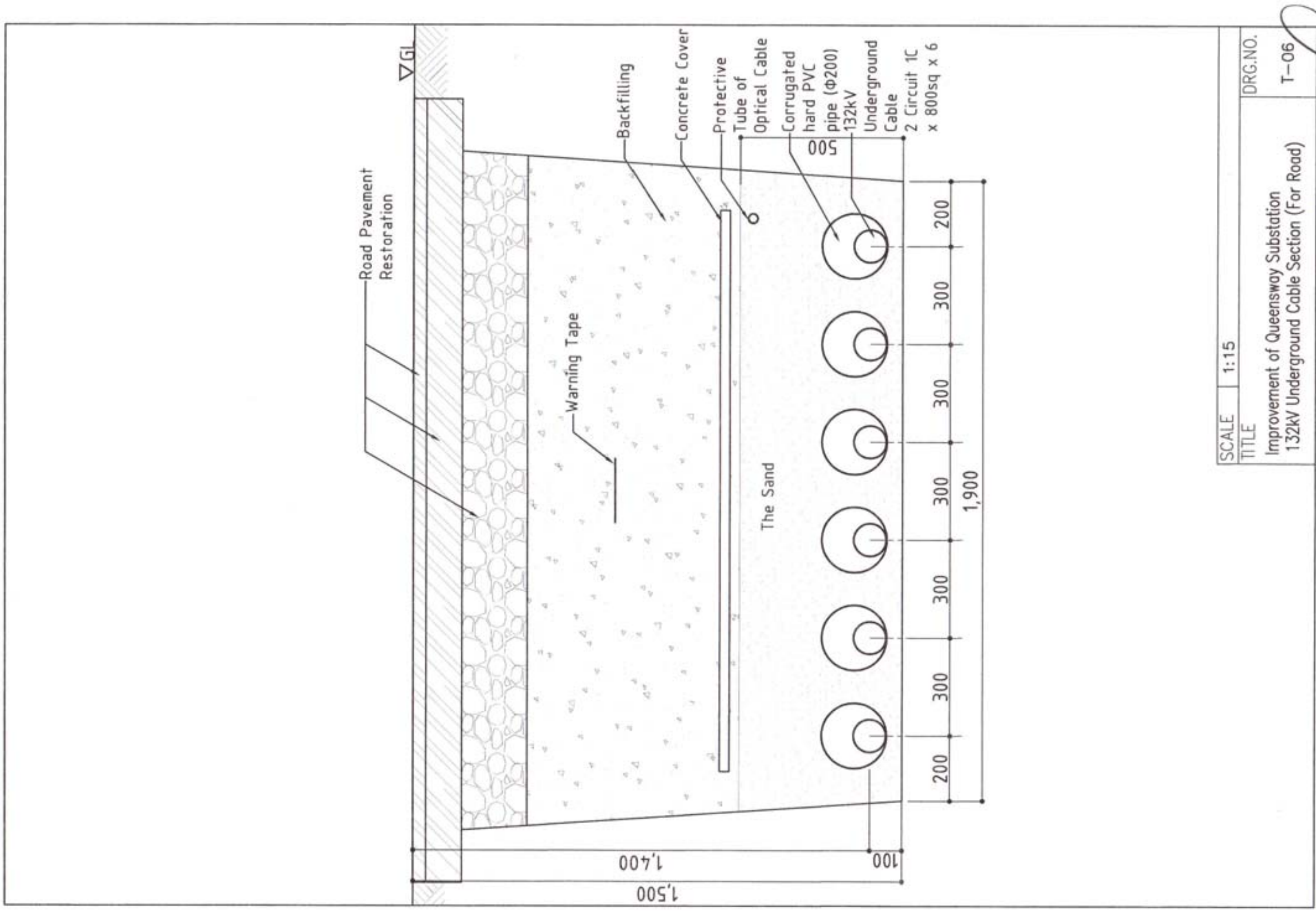
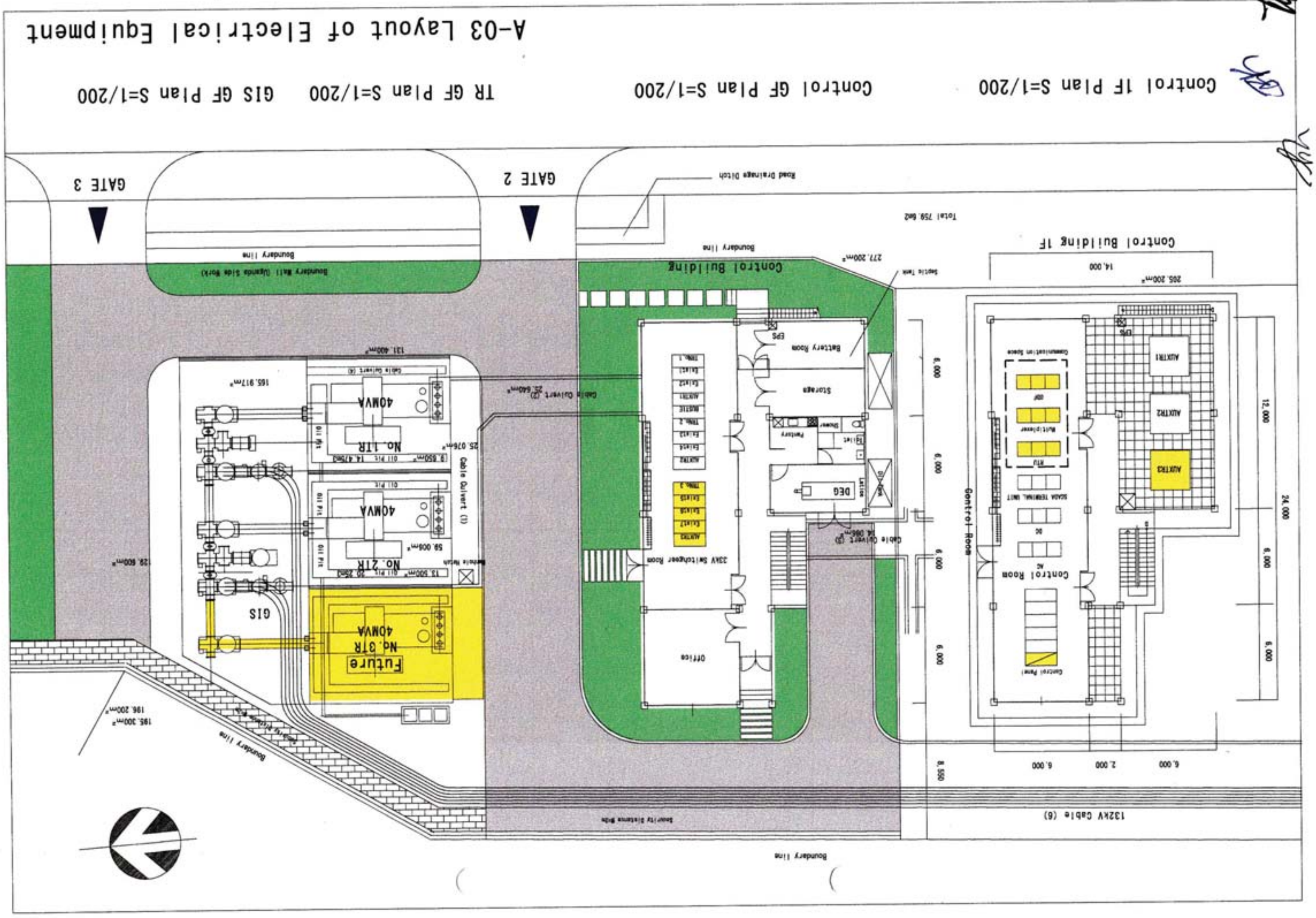
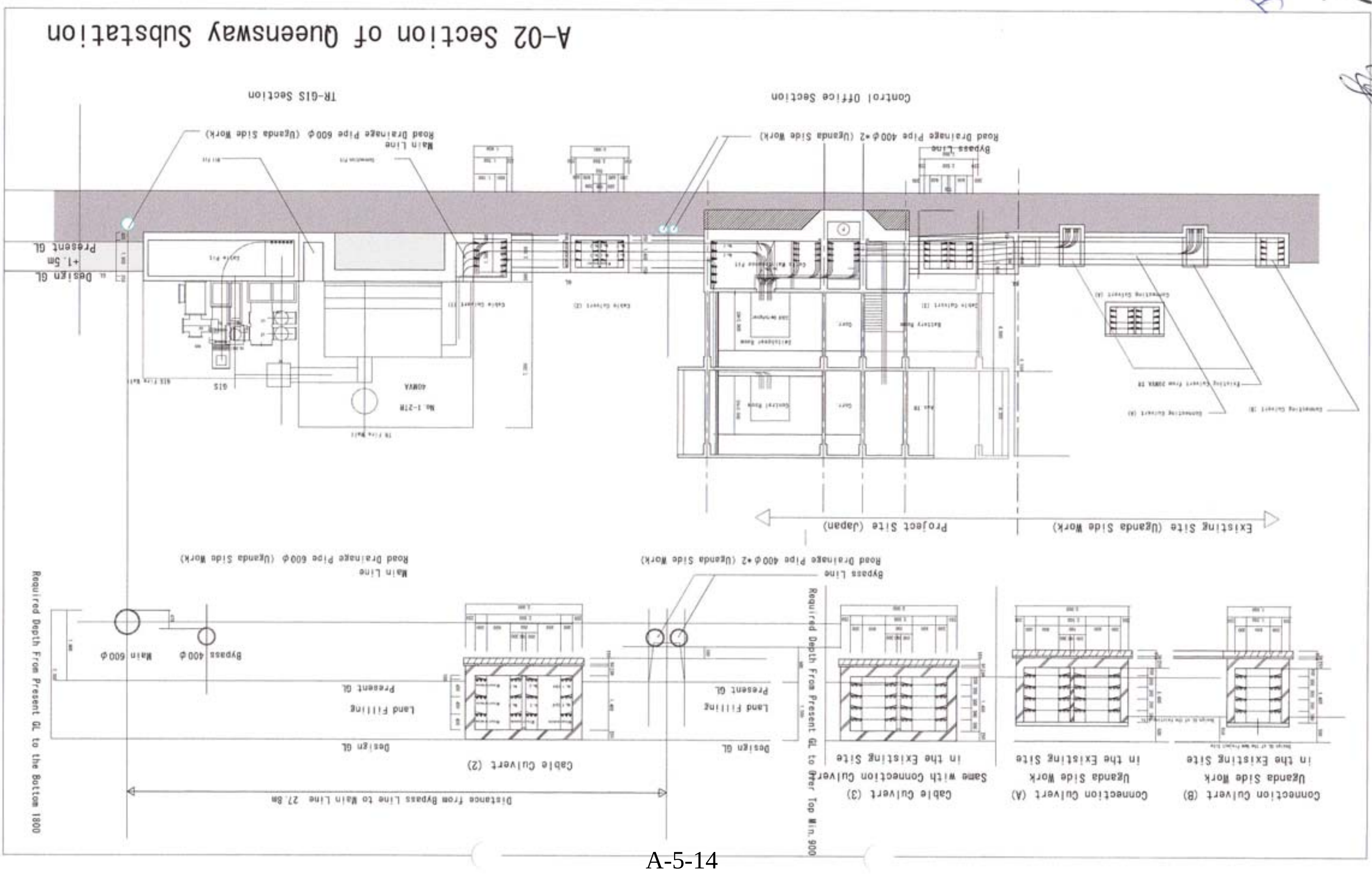
TITLE	Improvement of Queensway Substation 132kV Underground Cable Section (General)
DRG.NO.	T-05


A-01 Site Layout of Queensway Substation
Planning Flyover Pier Layout
P1
P2
P3
P4
P5
A1
CITY PLANNING ROAD W=39.0m
W=39.000
FLY-OVER
Pedestrian
BRT
Road
Flyover
GATE 1
GATE 2
GATE 3
Existing Channel
Existing
Control Building
Control Building 1F
Parking
No.1TR 40MVA
No.2TR 40MVA
Future No.3TR 40MVA
GIS
Existing SMGR Building
Existing 11 kV SMGR
Existing 33 kV SMGR
TR 20MVA
U-turn road to be demolished
Project Site
Existing Site
S=1:500


GL
Road Pavement Restoration
Warning Tape
Backfilling
Concrete Cover
Protective Tube of Optical Cable
Corrugated hard PVC pipe (Φ200)
132kV Underground Cable 2 Circuit 1C x 800sq x 6
The Sand
500
200
300
300
300
300
300
200
1,900
1,400
1,500
100
SCALE 1:15
TITLE
Improvement of Queensway Substation
132kV Underground Cable Section (For Road)
DRG.NO.
T-06


A-03 Layout of Electrical Equipment
Control 1F Plan S=1/200
Control GF Plan S=1/200
TR GF Plan S=1/200
GIS GF Plan S=1/200
GATE 2
GATE 3
Control Building
Control Building 1F
Control Room
Office
33kV Switchgear Room
Battery Room
Storage
GIS
No.1TR 40MVA
No.2TR 40MVA
Future No.3TR 40MVA
132kV Cable (6)
Boundary line


A-02 Section of Queensway Substation
Control Office Section
TR-GIS Section
Project Site (Japan)
Existing Site (Uganda Side Work)
Road Drainage Pipe 600φ (Uganda Side Work)
Main Line
Road Drainage Pipe 400φ×2 (Uganda Side Work)
Bypass Line
Main 600φ
Bypass 400φ
Present GL
Design GL
Land Filling
Cable Culvert (2)
Cable Culvert (3)
Same with Connection Culvert in the Existing Site
Connection Culvert (A)
Uganda Side Work in the Existing Site
Connection Culvert (B)
Uganda Side Work in the Existing Site
Distance from Bypass Line to Main Line 27.8m
Required Depth From Present GL to the Bottom 1800

APPENDIX 6

TECHNICAL MEMORANDUM

9th May, 2014

Technical Memorandum
on the Preparatory Survey on the Project for Improvement of Queensway Substation

UETCL, UEDCL, MEMD, MoFPED and the Preparatory Survey Team ("the Team") of JICA agreed and signed on the Minuets of Discussions for the results of the first field survey for the captioned Project ("the Project"). In addition, UETCL, UEDCL and the Team also agreed and signed on the Field Report for the Outline Design of the Project. This Technical Memorandum is prepared to agree some additional technical issues for the Outline Design of the Project.

1. **UETCL agreed to secure the area for the towers of the Project and complete the required procedures in timely manner before commencement of installation work by the Japanese side, as shown in Annex-1 and Annex-2 of this Technical Memorandum.**

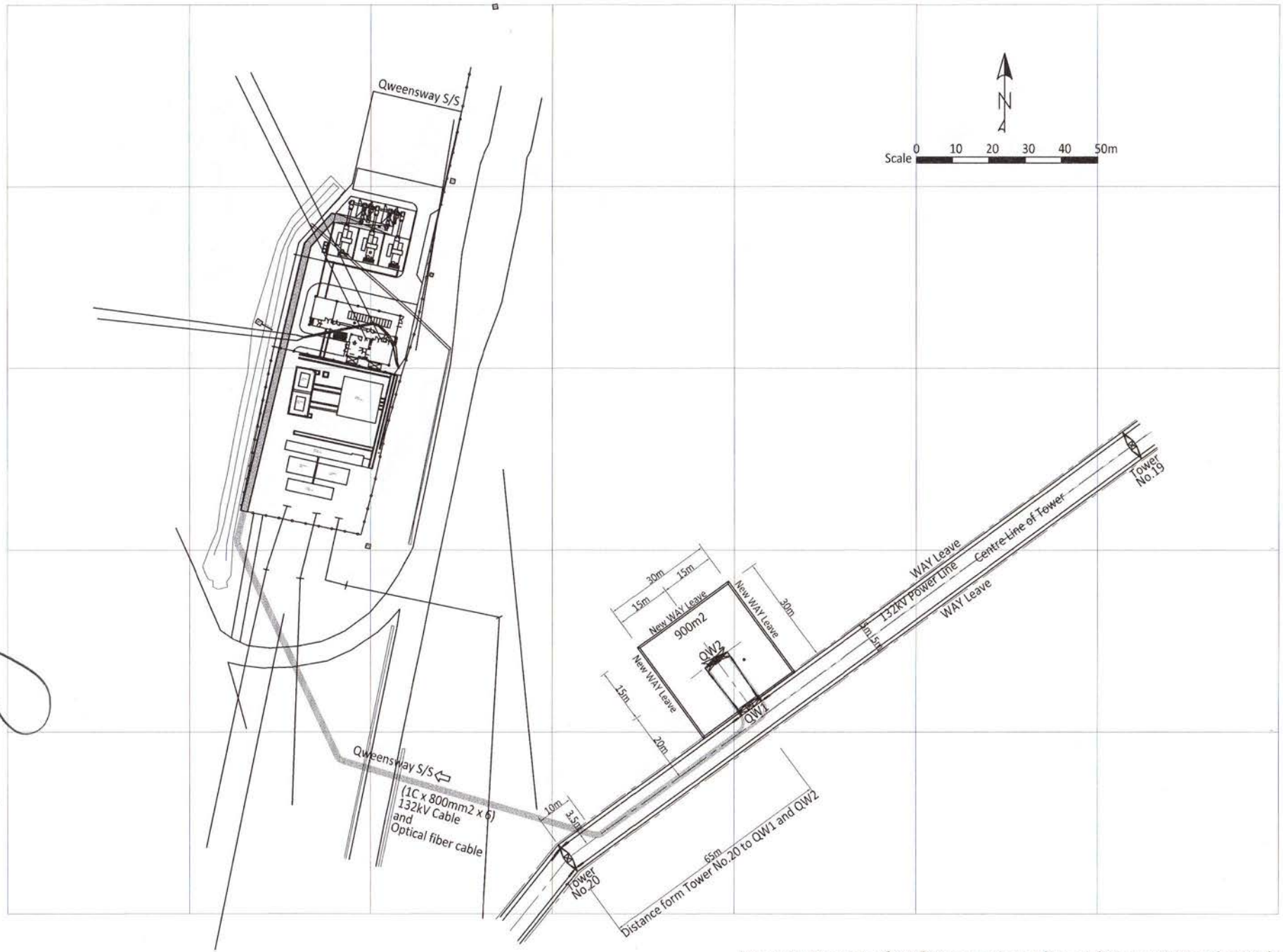
2. **The existing empty conduits for the cables of the Project to connect between the 33 kV switchgears of the Project and the existing 33 kV switchgears procured and installed in the previous JICA project have not been secured. UEDCL agreed to prepare a new cable trench by breaking the foundations of the existing switchgears in coordination with UMEME before commencement of installation work by the Japanese side in consideration of the number and size of the cables of the Project, as shown in Annex-3 of this Technical Memorandum.**

3. **UETCL and the Team confirmed that the existing splicing box for the optical fiber cables of the Project to be connected is not located at the Tower No.20 as described in the Field Report, but located at the Tower No.16. UETCL requested to the Team to procure the new splicing box. The Team agreed to do so. UETCL agreed to install the new splicing box at the location of the Tower No.20 and connect the optical fiber cables to the splicing box by himself, including procurement and installation of materials required for the connection work.**

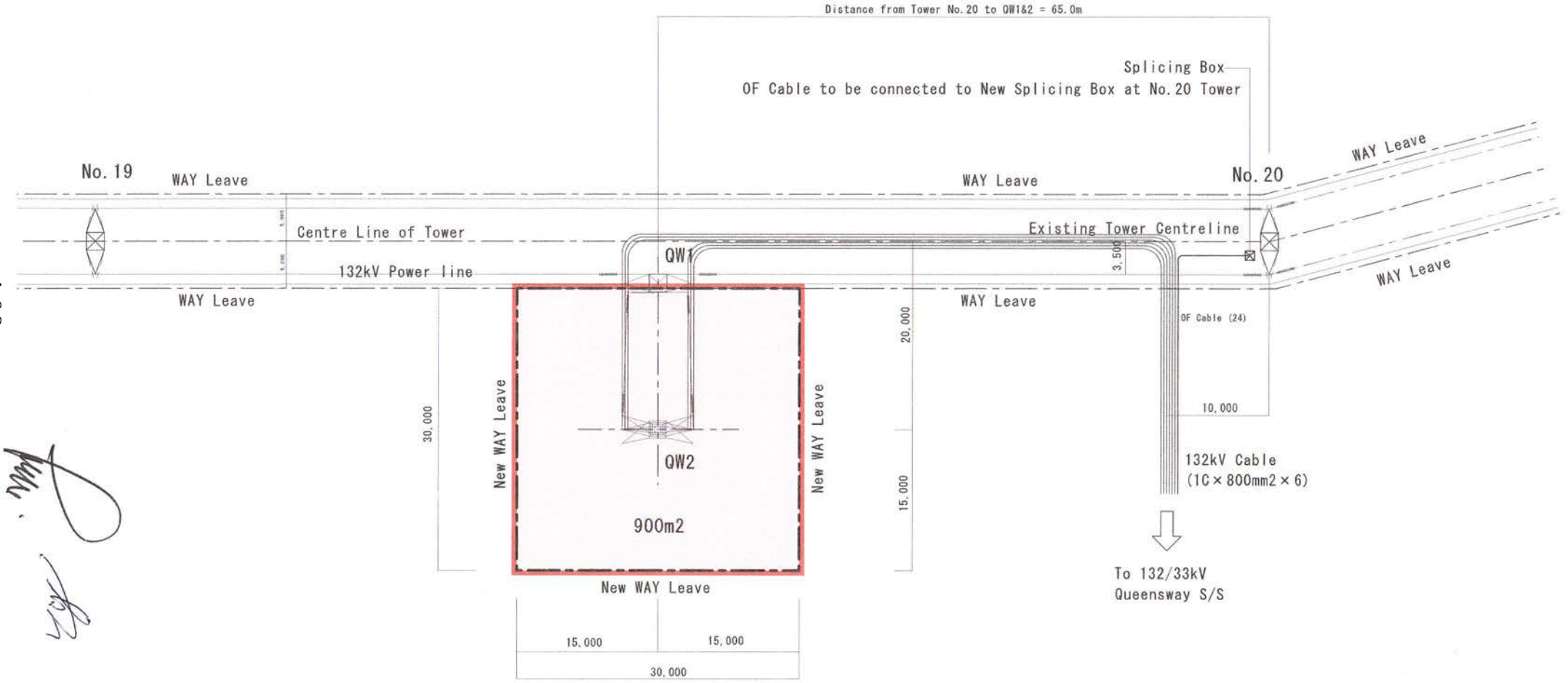
Annex

Annex-1: **Site map of 132 kV Transmission line and Tower QW1 and QW2 (Tentative)**
Annex-2: **Area to be obtained by UETCL for Installation of the Towers of the Project**
Annex-3: **New cable trench for 33 kV switchgear**

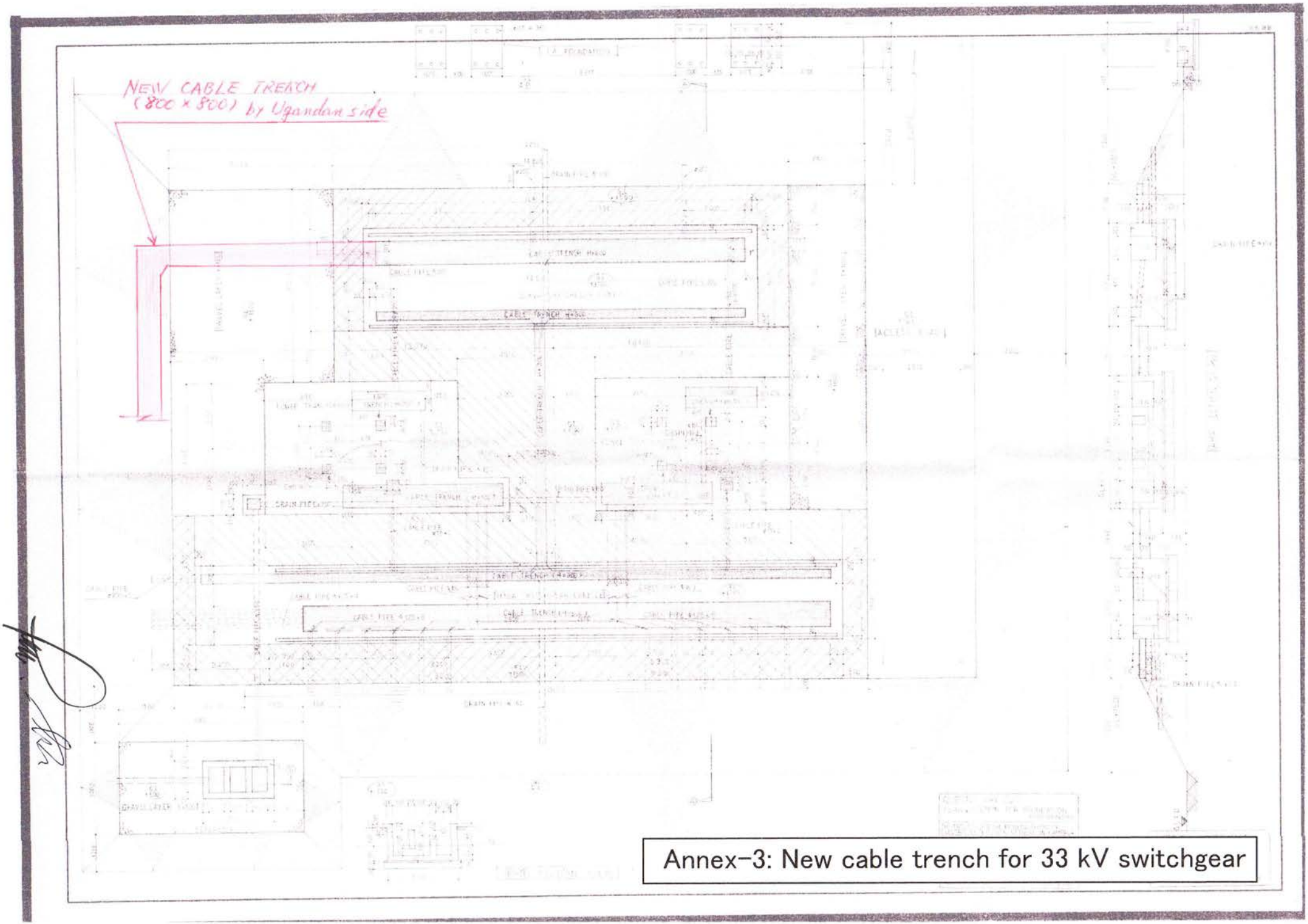
Mr. Kazunari Nogami Chief Consultant Preparatory Survey Team, JICA	Mr. Eriasi Kiyemba Managing Director Uganda Electricity Transmission Company Limited	Mr. Joseph Katera Managing Director Uganda Electricity Distribution Company Limited



Annex-1: Site map of 132kV Transmission line and Tower QWI and QW2 (Tentative)



ANNEX-2 Area to be obtained by UETCL for Instalation of the Towers of the Project



Annex-3: New cable trench for 33 kV switchgear