PREPARATORY SURVEY
ON
IMPROVEMENT OF SUBSTATIONS AND
DISTRIBUTION NETWORK PHASE 2
IN
THE REPUBLIC OF RWANDA

FIELD REPORT

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR THE CONSTRUCTION OF TWO RING MAIN UNITS, A SUBSTATION AND IMPROVEMENT OF TRANSMISSION AND DISTRIBUTION NETWORK IN KIGALI- RWANDA

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EXECUTIVE SUMMARY

Background

The Government of Rwanda, in its effort to sustain economic growth, has increased and stabilized the power production and distribution, hence reducing power shortages. The Government of Rwanda (GoR) also exercises a strong leadership role in donor coordination and has begun to work with donors on a clearer division of labour by identifying areas of individual donor comparative advantage. In connection with the mentioned strategy, the Government of Rwanda through Energy Development Corporation Limited (EDCL) has embarked on a country-wide electricity distribution to realize the primary EDPRS target.

A number of development partners so far committed to support the program including; World Bank IDA, World Bank, African Development Bank, BADEA, OFID, Saudi Funds, Netherlands, Japan, and others. It is in this regard that Rwandan government needs to submit the EIA report of the project, as one of the requirements for a grant by the Japanese Government in order to undertake the construction and improvement of Ring Main Units (RMU), substations, transmission and distribution network in Kigali, phase 2 with cooperation with Japan International Cooperation Agency (JICA).

Objectives of the study

The objective of the assignment is to assist EDCL to develop an Environmental Impact Assessment (EIA) and an Environmental Management Plan (EMP) to ensure that the construction of substations and the improvement of the transmission and distribution network in Kigali project is implemented in an environmentally and socially sustainable manner and in full compliance with Rwanda's and JICA's environmental and social policies and regulations. For this study to proceed, it had to be guided by environmental authorities. i.e. laws and safeguards.

Environmental compliance

An Environment Impact Assessment (EIA) is required by article 67 of the Organic law 04/2005 determining the modalities of protection, conservation and promotion of the environment in Rwanda, World Bank and JICA safeguard policies. The study was done in compliance to the laws and safeguards.

Approach and methodology of the study

The methodology of the study involved a preliminary assessment of the project, known as the scoping study; where project literature, preliminary technical studies were reviewed and field visits were done to understand the project, identify its boundaries and relevant stakeholders.

Literature review of Institutional, legislative and policy framework was done with a number of laws, policies, protocols and conventions such as; Organic law determining the modalities of environmental management in Rwanda, Organic law on land management, Resettlement Policy Framework (RPF), Environmental and Social management Framework (ESMF) and natural resources and JICA environmental and social guidelines.

Public consultation- From the scoping exercise, stakeholders were identified in three categories. (1) First category of Government officials, (2) Second category of local government officials and (3) Third category of locals and PAPs likely to benefit or be affected the project. Public consultation was carried with people from these stakeholder categories.

During the Public consultation, the study applied different participatory methods, namely; interviews, one-to-one discussions, focused group discussions (FGD) and official meetings with stakeholders. Discussions were guided key questionnaires, census survey form and stakeholders were asked to raise their concerns on the proposed project. Issue raised by one individual or a group of people was cross-checked by discussing it over with other individuals or groups. It is from these concerns that the likely impacts were determined and summarized in chapter 10.

Baseline data collection- Information was collected on the existing physical, biological, socio-economic environment of Ndera, Bumbogo and Rusororo sectors project area.

Hydrological analysis- involved determining the areas climate, the *Ecological analysis* involved an Assessment was done of flora and fauna for selected project sites to determine likely eco-sensitive areas and predict flora and fauna that could emerge with the introduction of this project., *Social environment analysis*- It involved collecting socio-economic primary data from field and matching it with secondary data obtained from desk reviews. Methods of obtaining field data were mainly through public consultation and expert observation.

Impact assessment applied number of tools and techniques to determine the nature (positive or negative), extent (spatial), occurrence (one-off, intermitted or constant), magnitude, whether reversible or irreversible, direct or indirect, probability of occurrence and significance with and without mitigation. For each adverse impact identified, its level of significance was indicated, mitigation measures for the predicted impacts were proposed and an Environmental Management Plan (EMP) developed.

A comprehensive report including all collected data, analysis of the data, anticipated impacts, proposed mitigation measures, an Environmental management plan and monitoring plan has been prepared. This has been shared with REG for inputs and constructive remarks, before RDB and finally JICA.

Project Description

The project components consist of:

Components	Capacity
Procurement and Installation Work	
1. **Ndera substation**	
(a) 20 MVA 110/15 kV transformers	2 units
(b) 110 kV switchgear	1 set
(c) 15kV switchgear	1 set
(d) Control and supervisory facilities	1 set
2. **Transmission Line**	
(a) Two circuits of 110 kV transmission lines from the existing line between Birembo and Gasogi substations to Ndera Substation	Approx. 2.2 km
3. **Distribution Line**	
(a) Two circuits of 15 kV distribution lines from Ndera Substation to existing line between Birembo and Free Zone Phase 1 substations	Approx. 650 m
(b) One circuit of 15 kV distribution line at Ndera (relocation) (about 200m)	Approx. 200m
(c) One circuit of 15 kV distribution line from existing Gasogi Substation to Kabuga Ring Main Unit (RMU) Switching Station	Approx. 6.5 km
4. **Modification of existing Gasogi Substation**	
(a) 15 kV switchgear panel for outgoing feeder to Kabuga RMU Switching Station	1 set
5. **RMU Switching Stations**	
(a) RMU Switching Stations at Kabuga and Murindi.	2 sets
Procurement Work	
6. **Maintenance Tools for the Equipment of the Project**	1 lot
7. **Spare Parts for the Equipment of the Project**	1 lot

Construction Work 8. **Foundation for the Equipment of the Project (Transformers, Towers for 110 kV Transmission Line, etc.)** 9. **Building of the Project (Ndera substation, Kabuga and Murindi RMU Switching Stations)**	1 lot 3 building

Consideration of Alternatives

The selected line routes, location of substation and RMUs were the most feasible in light of the existing electricity network in the area, most direct line of route, least expropriation effects and the positive project benefits. The alternative of "no-build" is not appealing since electricity is included as a measure of development in these urban and peri-urban areas and therefore is always given high priority in the list of developmental activities for Rwanda. While there will be no high environmental cost from these alternatives, with increasing population the demand for electricity connection increases and hence less power if these new networks are not constructed.

Environmental and social impact assessment

Chapter 10, in form of a table, gives a summary of issues raised during the public consultation likely to be caused by the electrification project development that were anticipated by the locals during stakeholders' and public consultation. Positive and negative impacts are discussed thoroughly in *chapter 6 and 7*; with positive impacts reflected and mitigation measures proposed for every anticipated negative impact.

The report highlights positive and negative impacts on the Physical environment, Biological environment Social environment and Human environment.

Mitigation measures were proposed for each of the adverse impacts anticipated, to an extent that they can be reduced, limited or eliminated hence manageable.

Environmental Management Plan (EMP) and monitoring plan

In *chapter 8 and 9*, presented in tabular form, an environmental and social management plan (EMP) and an Environmental Monitoring Plan indicating the mitigation measures, procedure to be followed, monitoring indicators, the responsible institutions to implement these measures and likely cost of implementing each of these mitigation measures have all been included in this comprehensive Environmental Impact Assessment (EIA) report.

The report ends with *Chapter 11*, making conclusions from the study findings and submission of summarised recommendations.

Recommendations proposed include:

1. Full replacement compensation of expropriated property based on Asset inventory and valuation in the ARAP.
2. Clear work schedule of project construction phasing and speeding of construction works to reduce on the time soil is left exposed.
3. Design shall considered re-routing of this existing line through route 3 of the project components.
4. For the safety of workers, safety gear and a health safety plan shall be required on site.
5. Hoarding of sites with wire mesh fencing, lighting and security guards to avoid insecurity in the form of theft.
6. To reduce on vegetation loss, restrictions to clear only trees in the accepted ROW width of 15m for the 110kV transmission line and 10m for distribution lines.
7. Offsetting the protected tree species "Umuco"- *Erythrina abyssinica,* lost during construction by financially contributing to tree nurseries growing this species.
8. Delivery trucks will be restricted to late morning and afternoon hours to reduce on the noise pollution and traffic congestion in the area. Furthermore, for noise pollution, noise emitting activities shall be subjected to the working hours (7-17h) when residents are away at work to avoid noise nuisance.
9. For solid waste management, regular waste disposal to Nduba damp site or hiring out a waste disposal company with a RURA registered garbage collecting company shall be entered into by the contractor.
10. To avoid human electrocution at towers, panels informing people of the dangers of climbing towers shall be placed at time of construction. Sharp spokes at the lower horizontal members of the towers to prevent people from climbing towers shall also be included in the construction of towers.
11. To avoid fires from lightning, a ground wire on the tower is necessary to avoid lightning from striking the tower and causing electric circuits that could be a hazard to the neighbourhood.

12. A fire management plan is proposed that includes installation of fire extinguishers.
13. It is recommended that a regular monitoring field visit and reporting is carried out by EDCL environmental and social safeguards specialists quarterly.
14. To ensure compliance with national laws and REMA guidelines an environmental audit should be carried out at the end of construction phase and during the operation phase.

In conclusion, given the nature and location of the project, the potential impacts associated with the proposed electrification project development are of a nature and extent that can be reduced, limited and eliminated by the application of appropriate mitigation measures. As a matter of fact, compliance with the proposed mitigation measures and regular monitoring done as per the Environmental management and monitoring plans issued in the report, the construction of substation, RMUs and improvement of transmission and distribution network in Kigali is bound to be executed in a sustainably efficient manner.

ACRONYMS

ADB	African Development Bank
ARAP	Abbreviated Resettlement Action Plan
BADEA	Banque Arabe de Développement Economique en Afrique
BP	Bank Policies
CAS	Country Assistance Strategy
CFL	Compact Fluorescent Lamp
CEPGL	Economic Community of the Great Lakes Countries
COMESA	Common Market for Eastern and Southern Africa
CSP	Country Strategy Paper
DDP	District Development Plan
EA	Environmental Assessment
EAC	East African Community
EARP	Electricity Access Roll out Programme
EDCL	Energy Development Corporation Limited
EDPRS	Economic Development and Poverty Reduction Strategy
EIA	Environmental Impact Assessment
EUCL	Energy Utility Corporation Limited
ESA	Environmental Security Assessment
ESMF	Environmental and Social Management Framework
FDG	Focus Discussion Group
GEF	Global Environment Facility
GDP	Growth Domestic Product
GoR	Government of Rwanda

HH	Household
IBA	Important Bird Area
IDA	International Development Agency
IMCE	Integrated Management of Critical Ecosystem
IWRM	Integrated Water Resources Management
JICA	Japanese International Corporation Agency
MDG	Millennium Development Goal
MINAGRI	Ministry of Agriculture
MINALOC	Ministry of Local Government
MINEAC	Ministry for East African Community
MINECOFIN	Ministry of Finance and Economic Planning
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
N/A	Not Applicable
NAFA	National Agro Forestry Authority
NEPAD	New Partnership for Africa's Development
OFID	OPEC Funds for International Development
OP	Operational Facility
PAP	Project Affected People/ person
PPE	Personal Protective Equipment
PPP	Policy, Plan, or Program
PRSP	Poverty Reduction Strategy Plan
RAP	Resettlement Action Plan

REMA	Rwanda Environment Management Authority
RPF	Resettlement Plan Framework
UNCBD	UN Convention on Biological Diversity
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	UN Framework Convention on Climate Change
WHO	World Health Organization

GLOSSARY OF TERMS

Environment: The physical factors of the surroundings of the human being including land, water, atmosphere, climate, and the biological factors of fauna and flora as well as the cultural, social, and economic aspects of human activity.
(Adapted from REMA 2006)

Environmental impact: Effects on the environment and natural resources that may be positive and/or negative and produce benefits and/or costs.
(Adapted from REMA 2006)

Environmental Impact Assessment (EIA): The systematic evaluation of a project to determine its impact on the environment and natural resources.
(Adapted from REMA 2006)

Environmental security: A condition in which a nation or region, through sound governance, capable management, and sustainable utilization of its natural resources and environment, takes effective steps toward creating social, economic, and political stability and ensuring the welfare of its population.

Environmental sustainability: Management of natural resources and the environment that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.

Policy: Strategy with defined objectives, set priorities, rules, and mechanisms to implement objectives.

Plan: Priority, option, or measure for resource allocation according to resource suitability and availability, following the orientation of and implementing relevant sectoral and global policies.

Program: Organized agenda with defined objectives to be achieved during program implementation, with specification of activities and program investments, in the framework of relevant policies and plans.

Project: A detailed proposal, scheme, or design of any development design or development activity, which represents an investment, involves construction works, and implements policy/planning objectives.

Scoping: A process of establishing the principal issues to be addressed in the EIA, the decision criteria, and indicators of desirable outcomes.

Screening: A process of determining whether EIA is required for a specific project

Social sustainability: Social sustainability refers to the continuous betterment of human well-being and welfare through access to health, nutrition, education, shelter, and gainful employment, as well as through maintenance of effective participation in decision-making within and across generations.

Stakeholders: Individuals, communities, government agencies, private organizations, non-governmental organizations, or others having an interest or stake in the EIA process and outcomes of the policies, plans, and/or programs. (Adapted from REMA 2006).

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Chapter 1. INTRODUCTION

Reducing the burden of environmental impacts is necessary if development is to become sustainable. As resources become limited, environmental impacts are becoming more complex, and as a result, Environmental and Social Impact Assessment (ESIA) has become of ever increasing importance as a tool for development decision-making. This role is formally recognized in Principle 17 of the Rio Declaration on Environment and Development *(UNCED 1992)* of which Rwanda is a signatory, which states:

''Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority''.

In practice, EIA is applied primarily to prevent or minimize the adverse effects of major development proposals, such as power stations, dams and reservoirs, industrial complexes, housing estates, hotels, roads, etc. It is also used as a planning tool to promote sustainable development by integrating environmental considerations into a wide range of proposed actions. Most notably, the use of policies and plans to focus on the highest levels of decision making and take care of the environment in considering development alternatives and options.

More limited forms of EIA can be used to ensure that smaller scale projects, conform to appropriate environmental standards or site and design criteria. Such projects include dredging activities, road realignment and upgrading, and housing subdivisions.

The aims and objectives of EIA can be divided into two categories.

- The immediate aim of EIA is to inform the process of decision-making by identifying the potentially significant environmental effects and risks of development proposals.
- The ultimate (long term) aim of EIA is to promote sustainable development by ensuring that development proposals do not undermine critical resource and ecological functions or the well-being, lifestyle and livelihood of the communities and peoples who depend on them.

Immediate objectives of EIA are to:

- improve the environmental design of the proposal;
- ensure that resources are used appropriately and efficiently;
- identify appropriate measures for mitigating the potential impacts of the proposal; and
- Facilitate informed decision making, including setting the environmental terms and conditions for implementing the proposal.

Long term objectives of EIA are to:

- protect human health and safety;
- avoid irreversible changes and serious damage to the environment;
- safeguard valued resources, natural areas and ecosystem components; and
- Enhance the social aspects of the proposal.

In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. *(UNCED, 1992)*

Rwanda like any other global player and a signatory to the Rio declaration and a number of other International Environmental treaties and protocols has embarked on actions to protect, preserve and improve the quality of the environment and ensure sustainable resources utilization. The protection and safeguarding of environment has become an important concern in Rwanda. Key environmental challenges concern deforestation, soil erosion, over grazing, misuse of wetlands and poor waste management associated with negative impacts on human health and biodiversity thus a hindrance to sustainable development of the country.

This trend of events has led to the reform of environmental policies, legal and institutional framework aimed at safeguarding the environment, an indication of Government concern to awaken the minds of the public to the dangers of environmental degradation. This will promote and enhance the well-being of the present and future generations.

Rwanda just like any developing country still faces the problem of poverty, which in turn pollutes the environment, and thus creating environmental stress. Those who are poor and hungry will often destroy their immediate environment in order to survive. They will cut down forests, their livestock will overgraze grasslands, they will crowd in congested cities and they will over use marginal land.

Realizing the magnitude of the problem, the Government of Rwanda has got on reforming strong environmental policies, legal and institutional instruments to safeguard the present and future generation to ensure sustainable development basing on Vision 2020.

1.1. Author presentation

This Environmental assessment was done by Eco-excellence consultancy Ltd. Eco-excellence consultancy is a national environmental consultancy. The firm's principal activities are to provide Environmental Consultancy services.
It operates under three segments: Environmental Assessment and Planning, Wastewater treatment and Renewable energy. The firm has currently devoted most of its efforts to the environmental assessment and planning sector as it grows into an eventual renowned environmental service provider.

Environmental Assessment, Planning and monitoring Segment

This segment draws from a unique team of experienced experts with different backgrounds to provide Environmental Impact Assessments and Strategic Environmental Assessment (EIA and SEA) services related to building and road construction, dam construction, agriculture and tourism. It also offers advice on issues pertaining environment and sustainable development on developmental plans, programs and policies.

Vision
Eco-excellence consultancy bares a vision to lead the way in providing quality environmental services in Africa.

Mission

Its mission is to offer quality environmental Services harmonize and facilitate government agencies and private enterprises to achieve their goal in environmental management, planning and sustainable development through expert analysis and advice.

Team

Eco-excellence consultancy houses a team of four qualified experts with periodic support from vastly experienced associates. Each of the qualified experts is privileged to have a minimum of masters in environmental sciences, wide experience in fields such as; environmental assessments, limnology, renewable energy, waste water treatment and construction works.

It is also a privilege to inform the public that Eco-excellence consultancy has been recognized by the Ministry of Natural Resources as among the few authorized environmental impact assessment experts.

1.2. Specific objectives of this ESIA

Because of the type and location of the project in an urban and peri-urban area, there are likely to be impacts resulting from the implementation the project. The assessment is meant to address:

- Potential environmental impacts at various phases of the project, including; project planning, construction and operational phases.
- Harmony of the proposed project with its surroundings (roads, residences, market, schools, etc.), including the physical environment (land, water and air) and social environment (human health, land amenities, noise, traffic, diseases, etc);
- Conformity of the proposed development with existing government policies, World Bank policies and JICA requirements;
- Land tenure and compensation issues.

The Environmental and Social Impact Assessment (ESIA) was conducted in order to examine, analyze and assess the proposed development so that when the project is implemented it will be environmentally sound and sustainable. The main objectives were to:

- Establish baseline conditions in the project area and surrounding environments and assess how these conditions would be altered by the proposed development;
- Seek and integrate the views of the various stakeholders in the decision making process and implementation of the project;
- Promote consultations among stakeholders;
- Identify appropriate measures to mitigate the identified negative impacts and enhance the positive impacts of the proposed project;
- Compile an Environmental Impact Statement or report, which will assist in decision making with regard to environmental aspects of the proposed development as well as the viability of the proposed project.

1.3. Approach and methodology

In general, the EIA study team started with the reviewing of all existing information on the proposed project, including project documents available from PITRAD (the sub-contracted survey and design team) and YEC (the JICA study team). Information available on other similar or related projects undertaken within the project area was also looked at, review of the relevant Policies, Kigali master plan and Gasabo district detailed plans, policies and regulations of the Government of Rwanda, World Bank and JICA. All this would act as secondary data to enhance a picture of how the scoping and baseline data could be handled.

1.3.1 Scoping

Upon reviewing the existing information on this project, scoping was done to identify the project boundaries, key stakeholders that might be affected or have interest in the development of this project. Scoping also directed the study to the area of interest, likely impact areas and entailed a broad assessment of the baseline data of the project.

The ESIA team carried out a detailed analysis of the proposed project through: field visits, interviews with focal groups, local authorities and Project Affected People (PAPs).

1.3.2 Field visits

Visits were made to the project site to assess the surrounding environment (physical and human) of the proposed project. In addition, the field visits were used to identify the stakeholders especially those who could be using the land (former stall owners) or have a claim on it, those who would benefit or be affected by the project. The neighboring residences were also visited as a key stakeholder in the locality.

1.3.3 Interviews

Interviews were conducted mainly with the proponent (developer) of the project, local residents, PAPs, Sector and Cell officials among others as the list in appendix 1 shall indicate.

1.3.4 Identification of significant impacts

After collecting the baseline data from the site visits and interviews with stake holders, Scoping matrices were prepared that assessed impacts of activities under planning, construction, operation. These impacts were then weighed on their significance based on whether the impact is expected or not, to some extent or unknown. It is those impact activities that were considered in proposing mitigation measures and eventually the environmental management plan.

Chapter 2. PROJECT DESCRIPTION

2.1. BACKGROUND

The Government of Rwanda, in its effort to sustain economic growth, has increased and stabilized the power production and distribution hence reducing power shortages. However, infrastructure bottlenecks in the urban areas and limited access in the rural areas have emerged as a significant constraint. One of three major strategic objectives of the Economic Development and Poverty Reduction Strategy (EDPRS 2013-2017) is to expand access while also improving the quality and lowering the cost of economic infrastructure especially transport, power, and communications. The Government of Rwanda (GoR) also exercises a strong leadership role in donor coordination and has begun to work with donors on a clearer division of labour by identifying areas of individual donor comparative advantage.

In connection with the mentioned strategy, the Government of Rwanda through Energy Development Corporation Limited (EDCL) is embarked on a country-wide electricity distribution to realize the primary EDPRS target.

A number of development partners so far committed to support the program including; World Bank IDA, World Bank, African Development Bank, BADEA, OFID, Saudi Funds, Netherlands, Japan, and others.

It is in this regard that Rwandan government is requesting the Japanese Government for a grant to undertake the construction and improvement of substations, transmission and distribution network in Kigali, phase 2.

2.2. PROJECT OBJECTIVES

The main objective of the project being the increased access to electricity in Rwanda and in particular Kigali City below is the specific objectives:

- To construct the new Ndera Substation.
- To construct a new double circuit 110kV transmission lines. i.e. Connecting from the existing line Birembo and Gasogi substation, to a new Ndera Substation.
- To construct new distribution lines. i.e. (i) Two circuits of 15kV distribution lines from Ndera Substation to existing line between Birembo and Free zone phase I substations, (ii)

once circuit of15kV distribution line from existing Gasogi substation to Kabuga Ring Main Unit (RMU) switching station.

- Modification of existing Gasogi substation by including 15kV switchgear panel for outgoing feeder to Kabuga RMU switching station.
- Construction of two Ring Main Units (RMUs) at Kabuga and Murindi.

2.3. JUSTIFICATION

Justification for the proposal of this project can be discussed on the following terms:

i. The 110kV transmission line and construction Ndera Substation (SS) were proposed to increase on the amount of power supplied to the Phase II of the Kigali Special Economic Zone.
ii. Ndera SS would also turn down power and distribute the Kimironko line for more power in Kimironko.
iii. 15kV Distribution line Gasogi SS- Kabuga RMU was proposed to reduce on the strain on the existing line from Kabuga supplying Nyagahinga Cell, which currently has low quantities of power. This new line will supply Nyagahinga Cell with increased amount of electricity.

In general the purpose of the project is to increase amounts of power supplied to urban and peri-urban areas of the Sectors of Bumbogo, Ndera and Rusororo in Gasabo District, Kigali.

2.4. PROJECT LOCATION

The Project area is located in Gasabo District and is one of three districts of Kigali City. The project components cover the following areas:

Table 1 Project Administrative location

Sectors	**Cells**
Bumbogo	Kinyaga
	Musave
Ndera	Kirenga
	Cyaruzinge
	Bwiza

	Rudashya
Rusororo	Nygahinga

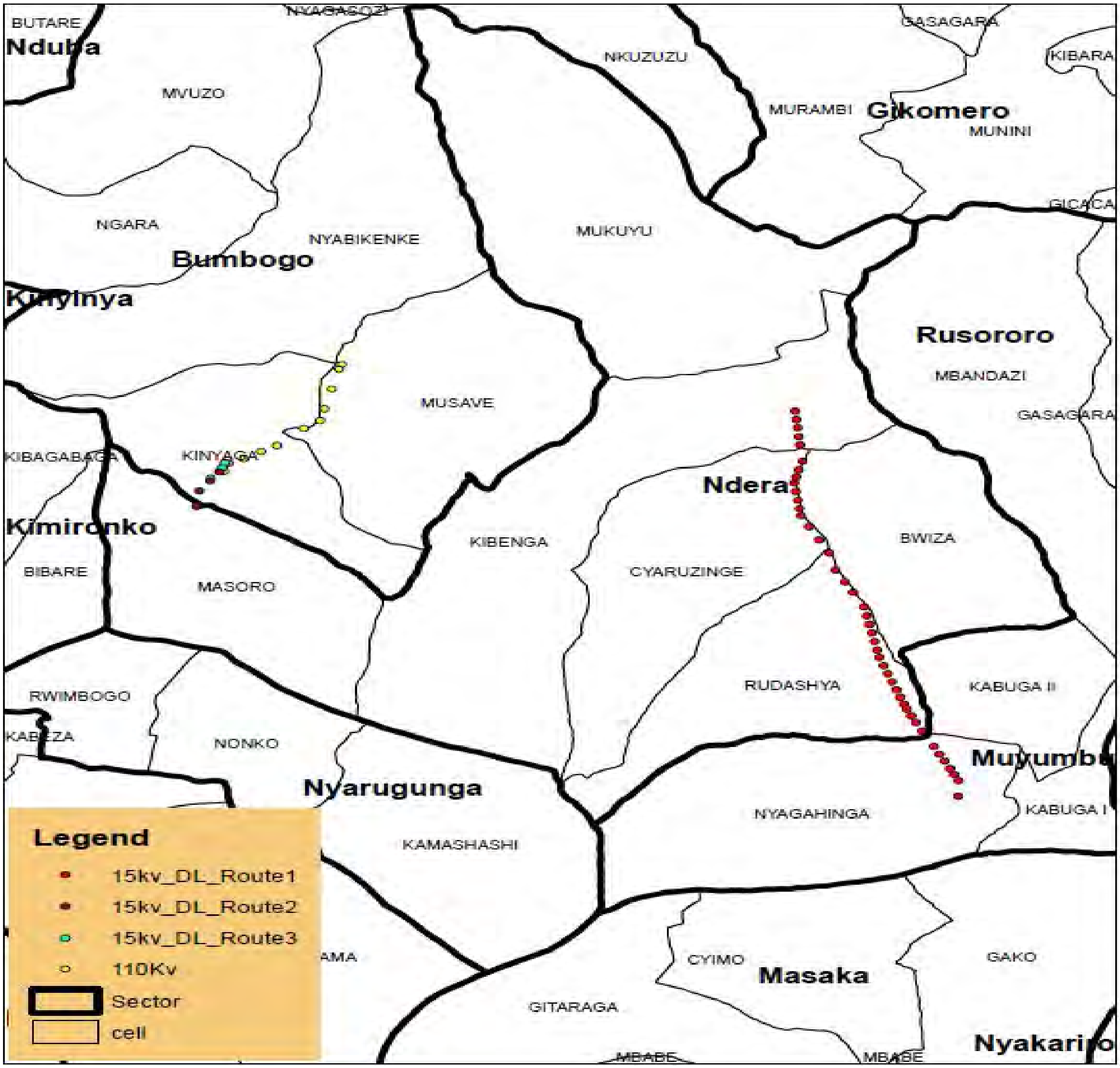


Figure 1:Sector and Cell location of project intervention areas.

2.5. PROJECT COMPONENTS

The table below summaries the major components of the project of substation, RMUs construction and improvement of transmission and distribution network in Kigali:

Table 2: Project components

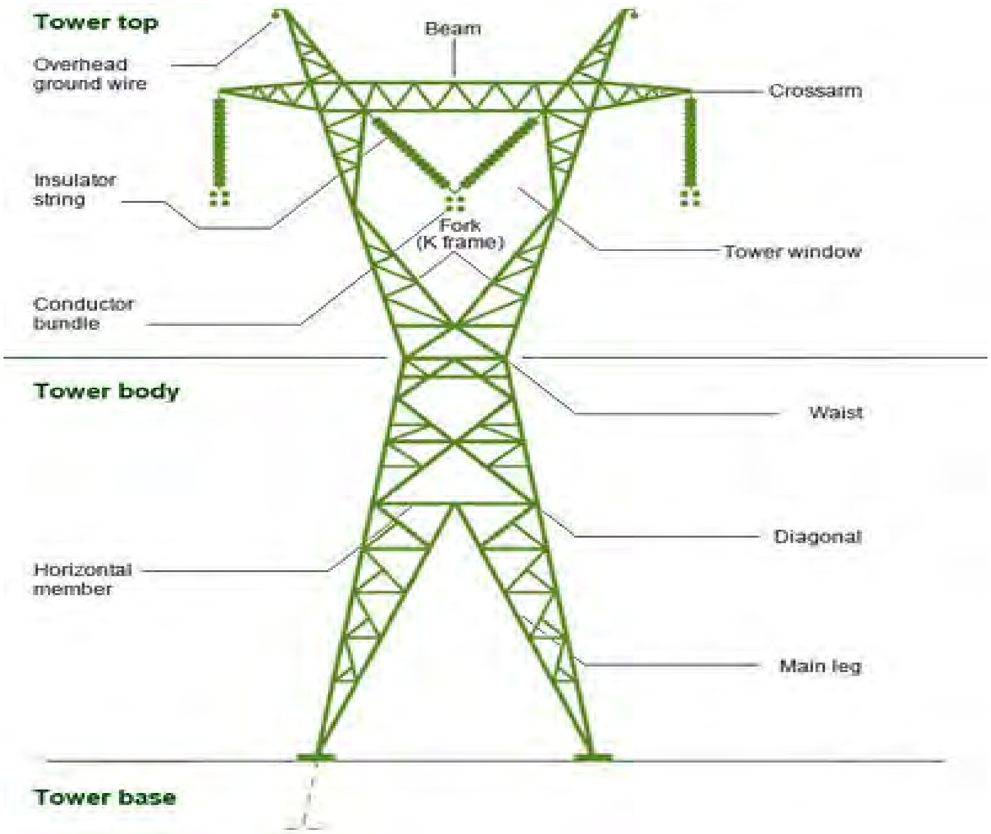
Components	Capacity
Procurement and Installation Work	
1. Ndera substation	
(a) 20 MVA 110/15 kV transformers	2 units
(b) 110 kV switchgear	1 set
(c) 15kV switchgear	1 set
(d) Control and supervisory facilities	1 set
2. Transmission Line	
(a) Two circuits of 110 kV transmission lines from the existing line between Birembo and Gasogi substations to Ndera Substation	Approx. 2.2 km
3. Distribution Line	
(a) Two circuits of 15 kV distribution lines from Ndera Substation to existing line between Birembo and Free Zone Phase 1 substations	Approx. 650 m
(b) One circuit of 15 kV distribution line at Ndera (relocation) (about 200m)	Approx. 200m
(c) One circuit of 15 kV distribution line from existing Gasogi Substation to Kabuga Ring Main Unit (RMU) Switching Station	Approx. 6.5 km
4. Modification of existing Gasogi Substation	
(a) 15 kV switchgear panel for outgoing feeder to Kabuga RMU Switching Station.	1 set
5. **RMU Switching Stations**	
(a) RMU Switching Stations at Kabuga and Murindi.	2 sets
Procurement Work	
1. **Maintenance Tools for the Equipment of the Project**	1 lot
2. **Spare Parts for the Equipment of the Project**	1 lot
Construction Work	
1. **Foundation for the Equipment of the Project (Transformers, Towers for 110 kV Transmission Line, etc.)**	1 lot
2. **Building of the Project (Ndera substation, Kabuga and Murindi RMU Switching Stations)**	3 building

A schematic layout of the project components is shown in the figure below.

DWG No. GA-01: Project Site Map -Key Map

Figure 2: Schematic layout of the project components

The project shall involve construction of towers and electric poles. An example of what the components of a tower would look like is shown in the figure below.



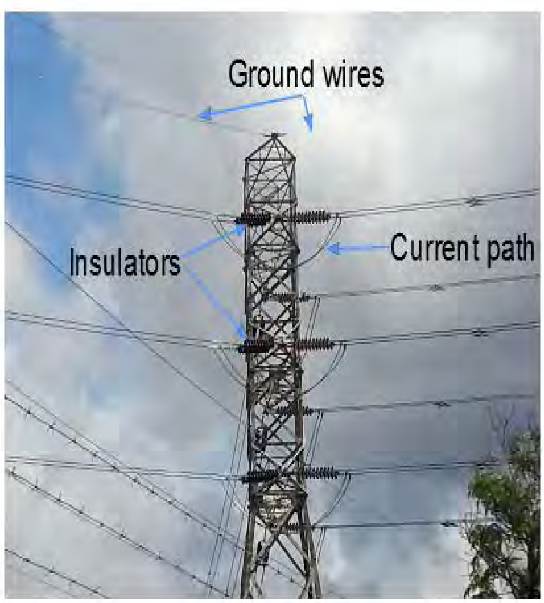


Figure 3: An example of components of a tower

Chapter 3. BASELINE DATA AND INFORMATION

This chapter gives background information of the project area as a whole in terms of its location, human, social and environment attributes which will play a crucial role in the identification of potential impact of the project.

3.1 Physical and Biological Environment

Physical environmental survey involves understanding the actual status of the area including the subject site and surrounds, in regard to; Climate, temperature, rainfall, relief, hydrology, vegetation, soil, water and air quality. Physical parameters of the site are discussed hereafter.

3.1.1 Temperature

The average annual temperature for the intervention area (Kigali city/ Gasabo district) will rise slightly above 18°C but not exceeding 25°C, during the dry season, while it might drop to 15°C in the wet season as the figure below indicates.

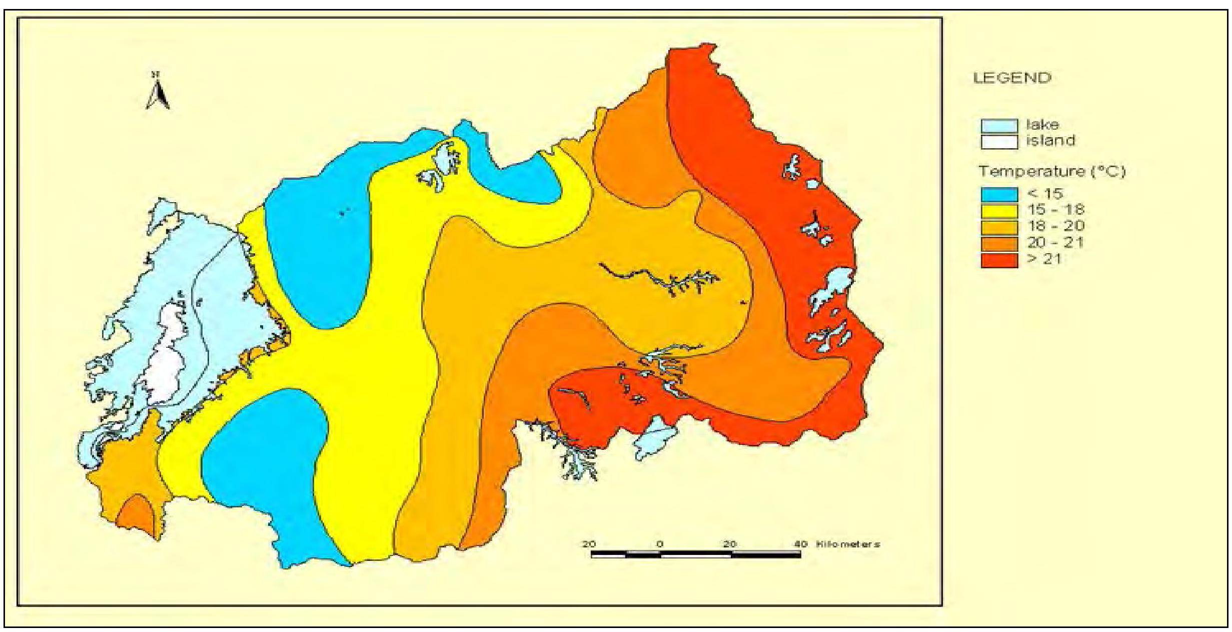


Figure 4: Average temperature map

3.1.2 Rainfall

The rainfall characteristics for Rwanda are known to exhibit large temporal and spatial variation due to varied topography and existence of large water bodies near the country. However, two rainy seasons are generally distinguishable; one centred on March – May and the other on October – December. For the area of concern, rainfall averages in the range of 1000-1200mm/yr, as may be observed from the figure below, in the central region of the country

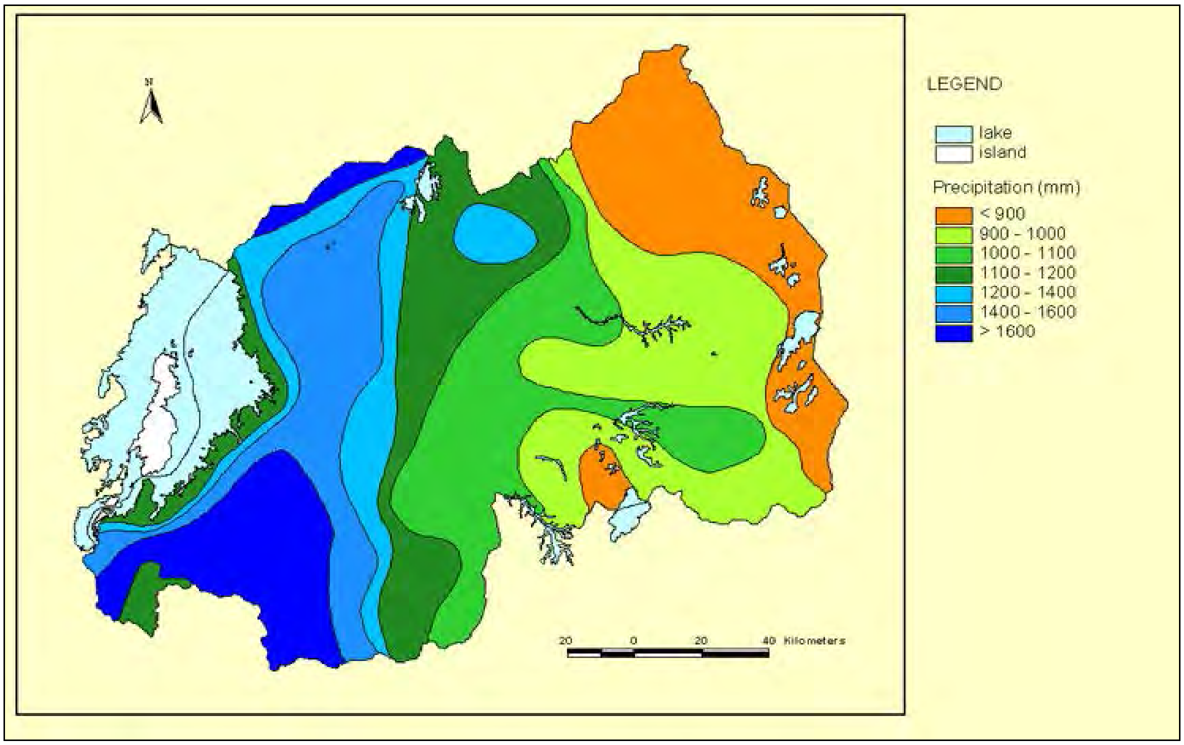


Figure 5: Average rainfall map

3.1.3 Relief

The project area covering three sectors (Bumbogo, Ndera and Rusororo) of Gasabo district located in Kigali, recognized as a hilly plateau. It is situated on a slope in range of 1472.5-1492.5m above sea level at the crest of the hill, fairly flat with a slope percentage of 6-16%. The site slopes gently over a 20m fall from the northern boundary down to the south eastern corner.

3.1.4 Vegetation

The site is mostly a populated land. The surrounding “natural vegetation” is now comprised of secondary disturbed vegetation, primarily shrubs, herbaceous plants and several species of grasses, including razor grass. There was no evidence of wildlife within and around the project site during the field visits. Dense population is a strong contributor to this state. From the assessment of the project area and interviews with the locals, there is no protected plant species mentioned in the Ministerial order No. 007/2008, article 4 II identified at project site.

3.1.5 Soils

The general soil structure observed in the project area is the result of the high rainfall and weathering of base rock material resulting in a uniform friable loam topsoil "A " horizon of around 100 – 200 mm in undisturbed areas overlaid over a finer more compacted clayey "B " horizon of 1000 to 3000 mm depth. This surface topsoil is generally very compacted especially in areas of buildings where the platforms created for the buildings have exposed the heavier subsoil's and this results in an impervious surface with high runoff.

3.1.6 Cultural heritage

During the site investigation, the consultant was particularly interested in the possibility of finding existing tangible or intangible cultural heritage, such as; archaeological, religious, cultural sites, spiritual sacred features, battle grounds, cemeteries, among others. *(World Bank OP 4.11 physical cultural resources).*

The study was not able to identify any significant cultural heritage in this area, as matter of fact consultations with the locals and university scholars from National University of Rwanda and records of the National Museum of Rwanda informed us that this site had not been used for any cultural heritage. *(National Museum of Rwanda, list of historical, cultural and archaeological sites in Rwanda, 2008)*

3.2. Socio Economic Environment

This section attempts to understand the current social status versus the likely effects of the proposed project. It involves collecting primary data from field investigations, group meetings, public consultations and expert field observations. It therefore describes the baseline of the socio-economic parameters of the area before project implementation. Some of the parameters that were discussed are; population and demography, land use, infrastructure (roads, water, electricity), health and sanitation, education, etc.

3.2.1 Population and demography

According to the preliminary results of the fourth population and Housing census (2012) indicated that Gasabo district has a population of 530,907 representing 46.8% of the total population for Kigali City (1,135,428 population) and 5% of the total national population (10,537,222). At the districts level comparisons, Gasabo and Nyagatare are the districts with the highest population constituting 50% and 42% of the total population. In addition, the EICV3 revealed that a significant proportion of households are headed by women and widows at 26.1 % and 17.8 % respectively.

3.2.2 Infrastructure

The infrastructure within the general project location is relatively established. There is a network of accessible roads providing access to most areas.

Component 15kV Distribution line from Gasogi SS- Kabuga RMU- The road to Gasogi SS is a well compacted laterite earth road, which connects to a reinforced concrete road at point proposed for Kabuga RMU.

110kV Transmission line from Birembo existing line to proposed Ndera SS- The road from is an earth road but as well compacted as the Gasogi one.

Around the project site there is electricity provided through the national grid. Water is available through the main water supply from nearby WASAC sources. Telephony services are available through provision of towers and a variety of wireless telephone networks from telephone companies are available.

3.2.3 Energy

The main sources of energy used for cooking are: firewood and charcoal. Charcoal is the energy source most used in cooking in urban areas. This use is among the direct causes of environmental degradation in the country resulting in disorderly exploitation of forests. For lighting, energy sources used are REG electricity, lamp oil, lanterns, candles and wood.

3.2.4 Housing and Settlement

The housing in the District of Gasabo is characterized by four different types: the well-developed urban area, urban areas in settlements, villages (imidugudu) in rural areas and houses scattered in rural areas.

For the project area in the peri-urban areas, most of the houses are built in earth brick and timber and roofed in iron sheet.

3.2.5 Agriculture

Agricultural activity is developed in the 8 rural areas of Gasabo. However with the expansion of the City there will be more and more loss in agricultural space. The project area is relatively fertile and crops such as; maize, cassava, banana, beans, and vegetables are mostly grown in this area.

Chapter 4. POLICY, LEGAL, AND ADMNISTRATIVE FRAMEWORK

4.1 Legislative and policy framework for environmental and social assessment in Rwanda

4.1.1 Constitution of the Republic of Rwanda

In consideration of the Constitution of the Republic of Rwanda of June 4, 2003 as amended to date, article 49 states that every citizen is entitled to a healthy and satisfying environment. Every person has the duty to protect, safeguard and promote the environment. The state shall protect the environment. The law determines the modalities for protecting, safeguarding and promoting the environment.

4.1.2 Rwanda Vision 2020

The vision 2020 of Rwanda gives strategic actions and inter alia institutes the principle of precaution to mitigate the negative effects caused to the environment by the socio-economic activities, to institute the "polluter pays" principle as well as preventive and penal measures to ensure the safeguard of the environment and to require the environmental impact study of any development project.

4.1.3 National Environmental Policy

The overall objective of the Environmental Policy is the improvement of man's wellbeing, the judicious utilization of natural resources and the protection and rational management of ecosystems for a sustainable and fair development.

The Policy seeks to achieve this through the following objectives:

i. To improve the health and the quality of life for every citizen and promote sustainable socio-economic development through a rational management and utilization of resources and environment;
ii. To integrate environmental aspects into all the development policies, planning and in all activities carried out at the national, provincial and local level, with the full participation of the population;

iii. To conserve, preserve and restore ecosystems and maintain ecological and systems functioning, which are life supports, particularly the conservation of national biological diversity;
iv. Optimum utilization of resources and attain a sustainable level of consumption of resources;
v. To create awareness among the public to understand and appreciate the relationship between environment and development;
vi. To ensure the participation of individuals and the community in the activities for the improvement of environment with special attention to women and the youth and
vii. To ensure the meeting of the basic needs of today's population and those of future generations.

4.1.4 National Environmental Law

The Organic Law n° 04/2005 of 08/04/2005 determining modalities of protection, conservation and promotion of environment in Rwanda regulates the Environmental impact Assessments. In its article 67: Every project shall be subjected to environmental impact assessment, before obtaining authorization for its implementation. This applies to programmes and policies that may affect the environment. Article 68 specifies the main points that an Environmental Impact Assessment must include. Article 69 stipulates that the environmental impact assessment shall be examined and approved by the Rwanda Environmental Management Authority or any other person given a written authorization by the Authority.

The environment impact assessment shall be carried out at the expense of the promoter. Article 70 states that an order of the Minister having environment in his attributions establishes the list of projects for which the public administration shall not warrant any authorization without an Environmental Impact Assessment describing direct and indirect consequences of the project to the environment.

4.1.5 Law N° 18/2007 of 19/04/2007 relating to expropriation in the public interest

The law defines the activities or projects that can be classified as public interest and process and requirements for expropriation activities as well as the cost for goods and other infrastructure to be expropriated. The law provides a window for appeal for somebody who is not satisfied by the cost of compensation.

4.1.6 Environmental Impact Assessment Regulations, 2006

REMA has now developed the EIA regulations which provide a guide and requirements for EIA in Rwanda. According to these new regulations, Article 1 makes it mandatory for all the projects listed under schedule I to be subjected to a full scale EIA.

The Article further states that no environmental authorization shall be granted by the Authority for any project in Schedule I to these Regulations if no environmental impact assessment has been submitted to the Authority in accordance with the provisions of these Regulations. The Article states that any project listed under Impact Level III of Schedule I to these Regulations shall require a full environmental impact assessment by preparation of an environmental impact report, unless the Authority refuses permission.

4.1.7 Ministerial order N° 003/2008 of 15/08/2008 relating to the requirements and procedure for Environmental Impact Assessment

Article 1 stipulates that Environmental Impact study is a systematic way of identifying environmental, social and economic impacts of a project before a decision of its acceptance is made. In article 3, the developer submits an official application which includes a project brief of the proposed project to the authority. Article 4 specifies that within thirty (30) calendar days after receipt of the project brief and after its analysis, the Authority shall submit the Terms of reference to the developer for the Environmental impact study.

4.2. Relevant policies

4.2.1 National Policy on EIA

The Constitution of the Republic of Rwanda, adopted in June 2003, ensures the protection and sustainable management of environment and encourages rational use of natural resources. Organic Law (No. 04/2005 of 08/04/2005) and various socioeconomic development policies and strategies such as “Rwanda Investment and Exports Strategic Action Plan, 2005-2007” and

“Vision 2020” call for a well regulated environment management system that takes into account principles of sustainable development while at the same time contributing to poverty reduction.

The Organic Law (Article 67) requires that projects, programmes and policies that may affect the environment shall be subjected to environmental impact assessment before obtaining authorisation for implementation. Article 69 gives REMA legal authority to oversee the conduct of EIA.

EIA is an invaluable tool for environmental management in a trans-boundary context, playing role in information dissemination between Rwanda and neighbouring countries and widening the scope of understanding of impacts beyond its borders. EIA process in Rwanda provides a pretext and basis for future international cooperation and conflict resolution concerning environmental impacts at a regional level.

4.2.2 Energy Policy

The national policy goal is to meet the energy challenges and needs of the Rwandan population for economic and social development in an environmentally sound and sustainable manner.

Since 1994, the energy sector as well as the overall economy has gone through structural modifications, where the role of the Government has changed, markets have been liberalised and private sector initiatives encouraged. Hence, the energy policy document has to take into account structural changes in the economy and political transformations at national and international levels.

The national policy objective for the development of the energy sector is to provide an input in the development process by establishing an efficient energy production, procurement, transportation, distribution, and end-user systems in an environmentally sound manner.

The Energy Policy, therefore, focuses on market mechanisms and means to reach the objective, and achieve an efficient energy sector with a balance between national and commercial interests.

An interactive and participatory process between Government, other stakeholders and relevant groups has been necessary as part of the formulation process in order to incorporate views of market actors and energy consumers to address the complex nature of the sector. Specifically, the energy policy takes into consideration the need to:

i. Have affordable and reliable energy supplies country wide;
ii. Reform the market for energy services and establishes an adequate institutional framework, which facilitates investment, expansion of services, efficient pricing mechanisms and other financial incentives;
iii. Enhance the development and utilisation of indigenous and renewable energy sources and technologies,
iv. Adequately take into account environmental considerations for all energy activities,
v. Increase energy efficiency and conservation in all sectors; and
vi. Increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring.

Domestic energy demand has grown rapidly due to population growth and the increase in economic activities especially during the last ten years. The vision of the energy sector is to effectively contribute to the growth of the national economy and thereby improve the standard of living for the entire nation in a sustainable and environmentally sound manner. The mission of the energy sector is to create conditions for the provision of safe, reliable, efficient, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis. By fulfilling its vision and mission, the energy sector will contribute to social economic development, and in the long-term framework, poverty reduction.

The national energy policy objectives are to ensure availability of reliable and affordable energy supplies and their use in a rational and sustainable manner in order to support national development goals. The national energy policy, therefore, aims to establish an efficient energy production, procurement, transportation, distribution and end-use systems in an environmentally sound and sustainable manner.

4.2.3 Land Policy

Apart from a few scattered land regulations, most of which date back to the colonial period, Rwanda has never had a proper land policy nor has it ever had a land law, a situation that enhances the existing duality between the very restrictive written law and the widely practised customary law, giving rise to insecurity, instability and precariousness of land tenure.

The Rwandan Government, therefore, found it compelling and necessary to establish a national land policy that would guarantee a safe and stable form of land tenure, and bring about a rational and planned use of land while ensuring sound land management and an efficient land administration.

Currently, the land tenure system in Rwanda operates in a dual legal system: On one hand, there is: the customary law, which governs almost all the rural land and promotes the excessive parcelling out of plots through the successive father-to-son inheritance system. And on the other, there is the written law, which mostly governs land in urban districts and some rural lands managed by churches and other natural and legal persons. This law confers several land tenure rights to individuals such as land tenancy, long term lease and title deeds (particularly in towns).

4.2.4 National Land Law

Land ownership in Rwanda is determined by the Organic law N°08/2005 of 14/07/2005 determining the use and management of Land in Rwanda. It also institutes the principles that are respected on land legal rights accepted on any land in the country as well as all other appendages whether natural or artificial. The Law provides the definitions of some key words:

- Construction area is an area purposely for human settlement, trade and industries, an area reserved for recreation and other basic activities of public utility.
- Area not for construction is an area reserved for agriculture, afforestation, grazing, reserved tourist places and recreational gardens.
- The ownership of Land is determined by article 4, which announces that, any person or association with legal personality has the right over the land and to freely exploit it as provided for by this organic law in article 5 and 6.

4.2.5 Rwanda building control regulations

The Rwanda Building Control Regulations serves as a standard reference for the regulation of planning and design of all buildings in Rwanda. The regulations will facilitate professional practice in the construction sector and reduce the emergence of informal developments so as to ensure well planned and safe building and housing facilities which are environmental friendly in the country. The document also provides regulations in the different areas including electrical installations; Safety: equipment, escape routes and fire alarm; Site activities: construction and site operations etc.

4.3 International legislative framework

4.3.1 Environmental International Conventions

Rwanda has signed and ratified the following environmental international conventions which are to some extent in line with this project and the national policies and laws:

- The international Convention on Biological diversity and its habitat signed in Rio de Janeiro in Brazil on 5 June 1992, as approved by Presidential Order No 017/01 of 18 March 1995;
- The CARTAGENA protocol on biodiversity to the Convention on Biological biodiversity signed in NAIROBI from May 15, to 26, 2000 and in NEW YORK from June 5, 2000 to June 4, 2001 as authorized to be ratified by Law No 38/2003 of 29 December 2003;
- The United Nations framework Convention on Climate Change, signed in Rio de Janeiro in Brazil on 5 June 1992, as approved by Presidential Order No 021/01 of 30 May 1995;
- The Kyoto Protocol to the framework on climate change adopted at Kyoto on March 6, 1998 as authorized to be ratified by Law No 36/2003 of December 2003;
- The RAMSAR International Convention of February 2, 1971 on Wetlands of International importance, especially as water flows habitats as authorized to be ratified by Law No 37/2003 of 29 December 2003;
- The STOCKHOLM Convention on persistent organic pollutants, signed in STOCKHOLM on 22 May 2001, as approved by Presidential Order No 78/01 of 8 July 2002;
- The ROTTERDAM International Convention on the establishment of the international procedures agreed by states on commercial transactions of agricultural pesticides and other poisonous products, signed in ROTTERDAM on 11 September 1998 and in New York from 12 November 1998 to 10 September 1999 as approved by Presidential Order No 28/01 of August 2003 approving the membership of Rwanda;
- The Basel Convention on the Control of Tran boundary Movements of Hazardous wastes and their disposal as adopted at Basel on 22 March 1989, and approved by Presidential Order No 29/01 of 24 August 2003 approving the membership of Rwanda;

- The Montreal International Conventional on Substances that deplete the Ozone layer, signed in London (1990), Copenhagen (1992), Montreal (1997), BEIJING (1999), especially in its article 2 of London amendments and Article 3 of Copenhagen, Montreal and Beijing amendments as approved by Presidential Order no 30/01 of 24 August 2003 related to the membership of Rwanda;
- The Bonn Convention opened for signature on June 23, 1979 on conservation of migratory species of wild animals as authorized to be ratified by Law No 35/2003 of 29 December 2003;
- The Washington agreement of March 3, 1973 on International trade in endangered species of Wild Flora and Fauna as authorized to be ratified by presidential Order No 211 of 25 June 1980.

4.3.2 International agreements

The following table indicates different agreements, date of signature and date of ratification where Rwanda is a signatory:

Table 3: Environmental assessment related agreements

No	Agreement	Date of signature	Date of ratification
1	Agreement on the biological diversity	10/06/1992	18/03/1995
2	Agreement - Context of the United NATIONS on the climate changes	10/06/1992	18/08/1998
3	Agreement related to the fight against desertification	10/06/1992	22/10/1998
4	The agreement Vienna on the protection of the ozone layer		6/12/2002
5	Agreement of Ramsar related to humid zones of international importance particularly the wild housing	1971	6/6/2003
6	International Agreement for the trade of the species in the process of disappearance (IATSPD)	20/10/1980	18/01/1981

7	Conservation Agreement of the animals of the migrating wild species (CMS)	23/06/1979	06/06/2003
8	African Agreement on the nature conservation and natural resources	15/09/1968	20/05/1975

These treaties and international agreements are relevant for the protection and the conservation of the environment and in particular the biodiversity in Rwanda together with the mobilization of funds as well at the bilateral and multilateral level.

4.4 World Bank Environmental and Social Safeguards Policies

World Bank Operational Policies (OP) and Bank Procedures (BP) Environmental Assessment - BP4.01 and OP 4.01 (January 1999 all of which require environmental assessment of projects proposed for World Bank financing to help ensure that they are environmentally sound and sustainable. The World Bank provides guidance on EA requirements through the Environmental Assessment Sourcebook (World Bank 1994) which includes sectoral guidelines. The World Bank EA process is implemented through a set of Operational Policies/Directives whose primary objective is to ensure that Bank operations do not cause adverse impacts and those they "do no harm". These safeguard policies are grouped into Environment, Rural Development, Social Development and International Law.
The following safeguard policies have been considered in this EIA.

OP/BP 4.01 Environmental Assessment (January 1999)
Environmental Assessment is one of the 10 safeguard policies of the World Bank. The World Bank Environment and Social Safeguard Policy aims at improving decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted.
The World Bank's environmental assessment policy and recommended processing are described in Operational Policy (OP)/Bank Procedure (BP) 4.01. The World Bank system assigns a project to one of three project categories, as defined below:

Category A: Environmental Assessments are normally required because the project may have diverse significant impacts (projects in this category are forestry, large industrial plants, irrigation and drainage, mineral development (including oil and gas), pipelines (oil, gas, and water), resettlement, rural roads, tourism, urban development, large transmission lines, etc.).

Category B: A limited environmental analysis is appropriate, as the project may have specific environmental impacts. Projects in this category include agro-industries (small scale), aquaculture & marine culture, small industries, mini-hydropower station, public facilities (hospitals, schools, housing complexes, rural electrification, telecommunications, small-scale tourism, rural water supply, etc.

Category C: Environmental analysis is normally unnecessary, as the project is unlikely to have significant environmental impacts. Projects in this category include education, family planning, nutrition, institutional development, technical assistance, etc.

OP/BP 4.04 Natural Habitats (Jun 2001)

The Bank supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable development. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

OP/BP 4.11 Physical Cultural Resource (July 2006)

Cultural property is defined to include both remains left by previous human inhabitants (e.g. middens, shrines) and unique natural environmental features such as canyons and waterfalls. The Bank does not support projects that will significantly damage non-replicable cultural property and assists only those projects that are sited or designed so as to prevent such damage.

OP/BP 4.12 Involuntary Resettlement (December 2001)

Details involuntary resettlement, emphasizing the severe economic, social and environmental risks, if unmitigated. It ensures that the population displaced by a project receives benefits from it and also covers those with usufruct or customary rights to land or other resources taken for the project. The Operational Policy is specifically inclusive, ensuring that all those affected both directly and indirectly by project developments are compensated as part of the project. Affected population, include those with income derived from informal sector and non-farm activities, and from common property resources. The absence of legal title does not limit rights to compensation. The World Bank's Policy objectives urge that involuntary resettlement be avoided whenever possible. If unavoidable, displaced persons need to:

- Share in project benefits,
- Participate in planning and implementation of resettlement programs, and
- Be assisted in their efforts to improve their livelihoods or standard of livings or at least to restore them, in real terms, to pre-displacement levels or levels prevailing prior to the beginning of project implementation, whichever is higher.

OP 7.60: Disputed Areas

Operational Policy (OP)/Bank Procedure (BP) 7.60: Projects in Disputed Areas may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area. Therefore, the Bank will only finance projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when the special circumstances of the case support Bank financing, notwithstanding the objection. The policy details those special circumstances. In such cases, the project documents should include a statement emphasizing that by supporting the project, the Bank does not intend to make any judgment on the legal or other status of the territories concerned or to prejudice the final determination of the parties' claims.

The project of interest is categorised under Category B.

4.5 JICA Guidelines for Environmental considerations

In its policy, Japan's ODA Charter states that in formulating and implementing assistance policies, Japan will take steps to assure fairness. Furthermore it states that when implementing ODA, great attention will be paid to factors such as environmental and social impacts on developing countries.

JICA, which is responsible for ODA, plays a key role in contributing to sustainable development in developing countries. The inclusion of environmental and social costs in development costs and the social and institutional framework that makes such inclusion possible are crucial for

sustainable development. Internalization and an institutional framework are requirements for measures regarding environmental and social considerations, and JICA is required to have suitable consideration for environmental and social impacts.
The main Objectives of JICA guidelines are to encourage Project proponents to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for examination of environmental and social considerations are conducted accordingly.

JICA classifies projects into four categories according to the extent of environmental and social impacts, taking into account an outline of project, scale, site condition, etc.

- Category A: Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas.
- Category B: Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.
- Category C: Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.
- Category FI: Proposed projects are classified as Category FI if they satisfy all of the following requirements: JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and those sub-projects are expected to have a potential impact on the environment.

In addition, when necessary JICA can change a category even after screening. This might occur such as when a new significant impact has come to light as a result of the cooperation project process, or in other specific situations.

4.6 Institutional framework for environmental management in Rwanda

The institutional framework for environmental management is currently enshrined in the Organic Law determining the modalities of protection, conservation and promotion of the environment in Rwanda, published in the Official Gazette RWA Nº 9 of the 1st May 2005, particularly in its chapter III relating to the establishment of the institutions.

In Rwanda, the implementation of natural resources management and environment policies and sectoral strategies involves several stakeholders, including government state institutions, NGOs, civil society, the private sector, decentralised entities and donors.

Likewise, at regional levels, many actors in the five member countries are involved in carrying out environmental management interventions at different levels, using different modalities and applying different standards. In order to co-ordinate and harmonise different management approaches besides policies, laws, regulations, agreements and standards.

Ministry of Natural Resources (MINIRENA)

MINIRENA is a multi-sectoral ministry covering five sectors: Lands, Water Resources, Forest, Mining and Environment. Environment is a cross cutting sector because it covers the four other sectors. MINIRENA is responsible for the development of policies, laws and regulations as well as coordination of all activities in the management of land, water resources, forest, mining activities and environment, as well as their follow up and evaluation.

Other key Ministries and institutions

- **MININFRA**: is responsible for setting policies related to energy including electricity; urbanization and settlements; road and communication infrastructure; Meteorology, Urban Water supply. MININFRA oversees the resettlement and housing of people. The Ministry is also charged with constructing infrastructures that protect the environment where different assessments are prioritized. Besides organizing human settlement MININFRA has the mandate for town planning, public infrastructure and transport; the management of water supply as well as actions to encourage water harvesting in the settlement and housing sector.

- **MINALOC:** Under the framework of decentralization, MINALOC oversees the implementation of the decentralization process as well as relevant community and social protection programmes. This Ministry is also responsible for environment governance and therefore for mobilizing the public to participate in the management and protection of natural resources.

Districts are responsible for production and protection of water, tourism, and the environment. Similarly, cities, towns, and municipalities are responsible for land and environmental management, urban planning, road maintenance, maintenance of protected and recreational areas, and providing drinking water, sanitation, and waste treatment and disposal. MINALOC is over-seeing various community environment management related programmes in the districts. These include: Vision 2020 Umurenge, HIMO, Ubudehe and CDF which involve poor communities to participate in various initiatives aimed at enhancing their income.

- **MINECOFIN**: is responsible for Macroeconomic policy instruments, resource mobilization, and coordination of development partners and allocation of budgets to different Ministries and sectors. MINECOFIN is also charged with overseeing and advising on the formation of various Funds (including the Environment and Forestry Funds). It is also concerned with mainstreaming natural resources and environment concerns in the budgetary, PRSP and DDP processes.

- **MIGEPROFE**: sets policies and guidelines for mainstreaming gender in formulation and implementation of central and local governments′ programmes. The Ministry is mandated to guide MININERA and local governments to mainstream gender related issues in natural resource and environment management and mobilize communities (women, men and youth) in the activities of natural resource and environment protection and management.

- **MINEDUC**: is responsible for training human resources in the management and protection of natural resources; It oversees the implementation of environmental education programmes in schools (by supporting Environmental Clubs), as well as initiating the process of mainstreaming environmental assessment into schools.

- **Rwanda Environment Management Authority (REMA): i**n 2002, Rwanda Environment Management Authority (REMA) was established to act as the implementation organ of environment-related policies and laws. REMA is also tasked to coordinate different environmental protection activities undertaken by environmental promotion agencies; to promote the integration of environmental issues in development policies, projects, plans and programmes(due the implication of EIA and SEA); to coordinate implementation of Government policies and decisions taken by the Board of Directors and ensure the integration of environmental issues in national planning among concerned departments and institutions within the Government; to advise the Government with regard to the legislation and other measures relating to environmental management or implementation of conventions, treaties and international agreements relevant to the field of environment as and when necessary; to make proposals to the Government in the field of environmental policies and strategies.

- **Rwanda natural resources Authority (RNRA):** RNRA is an authority under the Ministry of Natural Resources that heads the management of promotion of natural resources which is composed of land, water, forests, mines and geology. It is entrusted with supervision, monitoring and to ensure the implementation of all issues relating to promotion and protection of natural resources, Implementing national policies, laws, strategies, regulations and government resolutions in matters relating to the promotion and protection of natural resources; Making follow up and to implement international conventions Rwanda ratified on matters relating to natural resources management, Advising the Government on appropriate mechanisms for conservation of natural resources and investments opportunities; establishing cooperation and collaboration with other regional and international institutions with an aim of harmonizing the performance and relations on matters relating to management of natural resources. RNRA is coordinate and supervise activities of its 3 child agencies, which are: National Land Centre (NLC), OGM, Integrated Water Resources Management (IWRM) and National Forestry Authority (NAFA).

- **Rwanda Energy Group (REG): REG** has as mission to create conditions for the provision of sufficient, safe, reliable, efficient, cost-effective and environmentally appropriate energy services to households and to all economic sectors on a sustainable basis. REG has a vision of contributing effectively to the growth of the national economy and thereby improve the standard of living for the entire nation in a sustainable and environmentally sound manner.

- **RDB (**Rwanda Development Board): The Rwanda Development Board is evidence that Rwanda is open for business. It is truly a "one stop shop (Centre) for all investors". Rwanda Development Board was set up by bringing together all the government agencies responsible for the entire investor experience under one roof. **RDB is responsible for approval of EIA reports by issuing an EIA certificate.**

- **Rwanda Utilities Regulatory Agency (RURA)**

  The RURA energy sector's mission is to control and regulate an efficient, sustainable and reliable energy sector in a transparent and fair manner for the benefit of all stakeholders.

- **Provincial, District and Lower level Environmental Committees**

  The Rwandan National Environment Policy of 2003 also proposed the establishment of provincial, district and lower level environmental committees beside the establishment of REMA responsible for environmental protection.

Chapter 5. ALTERNATIVES AND OPTIONS OF THE PROJECT

The purpose of this chapter is to examine the possible alternatives for delivering the goals and objectives of the project. For this particular programme, some options have been considered. In seeking the best alternative, the "status quo" or "do nothing" option and the actual on grid electrification were considered and the alternatives analysis show the best alternative for implementation of the project.

5.1 Alternative line routes

An analysis of alternative line routes was undertaken by the surveying and design team through mapping and involvement of all the stakeholders in this selection process. At the end of this process, the line of routes chosen for this project based on the following:

i. The lines of route were the most direct compared to going along the road. E.g. From Route 1 D/L Gasogi SS- Kabuga RMU, this was the most direct compared to the going by the road.
ii. Also the line of routes chosen required less expropriation and hence less costly than other alternative routes.
iii. For the 110kV Transmission Line (T/L) route, tapping power from the Birembo SS-Gasogi SS was cheaper and most optimal compared to creating a new line from Birembo SS.

5.2 Ndera Substation and Ring Main Unit (RMU) location

Possible alternatives for the location of the sites for the construction of the Ndera substation and RMUs were considered. After analysis, the selected sites were retained due to the following reasons:

i. For Ndera substation- The selected plot is under the possession of REG/ EDCL (the proponent). EDCL possesses the land documents.
ii. Mulindi RMU site was chosen on grounds that it was closest position to the existing power line in Nyarugunga sector.
iii. Kabuga RMU site was located at end of the shortest line of Route 1 Distribution line from Gasogi substation.

5.3 No Project Alternative

A No Project (Do nothing option) alternative would primarily mean that the status quo will be maintained and in a sense the environmental impacts (adverse) will not occur. However the positive benefits will be forgone in terms of providing more access to electricity to the Rwandan population which would have in turn spurred and contributed to economic growth.

If the "do nothing option" was considered, some benefits would be missed out such as:

- Increased electricity supply to Kigali Special Economic Zone, Ndera, Bumbogo and Rusororo Sector areas.
- The Kabuga line supplying Nyagahinga Cell in Rusororo would continue to be strained and provide low amount of electricity to an area that is rapidly growing into a mixed use area (i.e.residential and institutions).

During the construction phase there would be no temporary employment opportunities for local contractors,

- There would be no employment or supply services and provisions for workers and to contractors,
- Within the respective project areas there would be no opportunities for petty trading and small business service provision along the power line routes,
- Potential beneficiary enterprises such as small industries and other agricultural processing businesses lacking electricity would still be affected,
- Data management with computers and communication facilities like access to internet, charging of mobile phones; electric lighting at night, extended opportunities for work and study would be evidently missed out,
- Socio-economic development would not be achieved if the projecte is not implemented,
- Generally, employment opportunities that would be created by the programme would be miss out,

5.4 Comparison of Alternatives

The selected line routes, location of substations and RMU were the most feasible in light of the availability of electricity network in the area, the positive environmental benefits, and most importantly because this is what the local communities prefer. The alternative of "no-build" is not feasible because electricity is included as a measure of development in a village and therefore is always given high priority in the list of developmental activities for any country. While there will be no high environmental cost from these alternatives, with increasing population it is expected that the demand for fuel wood will increase each year, putting very heavy pressure on the already dwindling forest resource.

Chapter 6. NATURE AND EXTENT OF KEY ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT

The project of construction of substations and improvement the transmission and distribution network in Kigali is likely to have potential impacts (both positive and negative) on the surrounding and connected communities, both directly and indirectly as there will be direct and indirect interactions between project activities and the environment. This chapter identifies analyses and classifies these impacts that could arise from the activities of the project, either during the construction phase or the operational phase.

The impacts also apply on socioeconomic environment (health, security, economic activities, employment, finances, population; present land use; planned development activities; community structure; distribution of income, goods and services; recreation; public health; cultural properties, etc) and to the biophysical environment (fauna, flora, water, air, soil, landscape).

These impacts were evaluated by assuming when there is no avoidance or mitigation measures are taken. The evaluation based on JICA environmental and social check lists and are shown in the scoping matrices below:

Table 4 Scoping matrix

	No.	Item	Evaluation during Scoping		Study Methods	Evaluation Basis
			Planning /Construction	**Operation**		
Social	1	Involuntary Resettlement	B-	D	ARAP	3 principle houses and one annex will be resettled. An estimate of 13,649m^2 of land shall be expropriated.
	2	Poverty	D	D	Socio Economic Study	No presence of households under the poverty line.
	3	Indigenous/Minorities	D	D	Census survey	No presence of indigenous people of the PAPs
	4	Economic activities, living and livelihood	B+/-	A+	Expert observation, Literature review	No impact is expected during planning phase. During construction phase, some adverse impacts are expected due to limited access to use of agricultural lands within project area. Positive impact by an affirmative program of employment of PAPs and other locals. During operational phase, positive impacts are expected towards local economies, growing businesses, due to stable and increased power supply to Ndera, Bumbogo and Rusororo sectors and employment. Increased power to Special economic zone shall speed up growth of industries in its phase 2.
	5	Land use & Utilization of local resources	B-	D	observed from Project design components	During planning period, due to the alignment of power lines or locations of the RMUs, there may be some changes in land use. During construction period, land in the ROW might not be used by locals. Also the use of water resource in the locality is necessary for construction works. No impact is expected during operation phase.

	6	Water Use/Water Right	D	D	Field visit observation and literature review	No impact at all phases. No water bodies with in the area. Most of the project area is a peri-urban area with no direct water supply other than water collection points. The water needed for construction shall be fetched by the contractor.
	7	Existing social infrastructure and services	B-	A+	Observed from project line of route.	During planning and construction, the Ndera 110kV transmission lines shall cross an existing power lines close to Azam factory, at the upper edge of the Special economic zone.
	8	Cultural Heritage	D	D	Public consultation and literature review	During the site visit and public consultation, there was no existence cultural properties and heritage mentioned nor observed. Hence no impact is expected during the 3 phases of the project.
	9	Land scape	D	D	Expert observation.	The towers shall take a small area(i.e. the largest covering $64m^2$ and the smallest pole $9m^2$), hence no significant change in land scape.
	10	Gender	D	D	Literature review on Rwanda gender law	In Rwanda, there is no gender inequality.
	11	Children's right	D	D	Literature review on Rwanda labour law	In Rwanda, child labour is prohibited.
	12	Infectious Disease (HIV/AIDS)	C-	D	Expert observation	No impact during planning and operation. During construction there is a likelihood that migrant workers, improved income could to an extent contribute to the spread of such sexually infectious diseases.
	13	Occupation health hazards	B-	D	Past observation of construction	Accidents during construction. No impact in during planning and operation phase.

					site routine	
	14	Human electrocution	D	B-	Past observation of power lines	No impact during planning and construction phase. Children climbing the towers are examples of possible cases of electrocution.
	15	Exposure to electro-magnetic fields	D	C-	Reference from Project design, IEC standards and REG/EUCL assurance letter	No impact during the planning and construction. Exposure to electro-magnetic fields of people living under these power lines could be cancerous in the future.
	16	Access roads to sites	D	D	Field visit observation.	No impact at all phases, this being an urban or peri-urban area with easily accessible earth roads plus the sites are close to the road.
	17	Security in the project area	B-	B+	Past observation of similar projects.	No impact in planning phase. During construction, depending on how material is stored, it could encourage theft in the area. During operation, increased power supplied, means adequate lighting hence improved security.
	18	Fire risk	D	B-	Past observation of similar projects.	During operation, electrical circuits could be caused broken conductors, lightning, resulting in fires.
Natural Environment	19	Protected Area	D	D	Field observation and literature review	No protected areas in the project area.

	20	Protected flora species	B-	D	Field observation and literature review	No impact during planning and operation phase. During construction phase, 2 trees shall be cut down locally called "Umuco" or scientifically called *Erythrina abyssinica* protected under the Rwanda Ministerial order No. 007/2008. Though these trees are abundant in the country, the reason for their protection is not that they are rare and endangered but rather for local cultural memory.
	21	Protected Fauna	D	D	Field observation and literature review	Project area is in an urban and peri-urban area, with community settlements and agricultural activity. Project activities will have no significant effects on it.
	22	Bird electrocution	D	C-	Field observation.	No impact during planning and construction phases. During operation, Migratory birds could get entangled with these conductors and get electrocuted.
	23	Ecosystem	D	D	Field observation and literature review	Project area is in an urban and peri-urban area, with community settlements and agricultural activity. This has already affected the indigenous ecosystem, whereby project activities will have no significant effects on it.
	24	Hydrology	D	D	Field observation and literature review	No water bodies with in the project area.
	25	Geology	B-	D	Field observation	Land levelling at Ndera SS
Pollution	26	Air pollution	B-	D	Past experience of construction sites	Dust from excavation works and emissions from heavy machines, automobiles during construction
	27	Water pollution	D	D	Field observation	No water bodies with in the project area.

					and literature review	
	28	Soil degradation/pollution	B-	B-	Past observation of similar projects.	Soil erosion from exposing soils during excavation and levelling during construction. Oil spillage from refuelling of equipment or automobiles during construction. Oil spillage at Ndera SS during refuelling of generators during operation
	29	Solid Waste	B-	D	Past observation of similar projects.	Organic waste from food leftovers, metal craps, cardboards, paper littered on site during construction, deconstruction of existing towers.
	30	Noise/Vibration	B-	C-	Past observation of similar projects.	Excavation works, compaction, vibration activities during construction are sources of noise during construction. Noise to an extent from Ndera SS, Kabuga and Mulindi RMU during operation.
	31	Odour	B-	D	Past observation of similar projects.	Unattended solid waste during construction could cause obnoxious odour from rotting waste.
	32	Poor sanitation	B-	D	Past observation of similar projects.	No impact during planning or operation. During construction, lack of toilets on site, existence of unhygienic toilets could be a source of diseases to humans around the sites.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

Chapter 7. IMPACTS EVALUATION

Based on the results of impacts assessment, the impacts created by the project were evaluated using an impact evaluation. The evaluation basis of most of the impacts anticipated in the scoping matrix remain the same in the impact matrix except for; Infectious diseases, exposure to electromagnetic fields, bird electrocution, noise and vibration, as shown in the tale below.

Table 5: Impact evaluation

	No.		**Evaluation during Scoping**		**Evaluation based on Study Result**		**Evaluation Basis**
		Item	**Planning /Construction**	**Operation**	**Planning /Construction**	**Operation**	
Social	1	Involuntary Resettlement	B-	D	B-	D	3 principle houses and one annex will be resettled. An estimate of 13,649m^2 of land shall be expropriated.
	2	Poverty	D	D	D	D	No presence of households under the poverty line.
	3	Indigenous/Minorities	D	D	D	D	No presence of indigenous people of the PAPs
	4	Economic activities, living and livelihood	B+/-	A+	B+/-	A+	No impact is expected during planning phase. During construction phase, some adverse impacts are expected due to limited access to use of agricultural lands within project area. Positive impact by an affirmative program of employment of PAPs and other locals. During operational phase, positive impacts are expected towards local economies, growing businesses, due to stable and increased power supply to Ndera, Bumbogo and Rusororo sectors and employment. Increased power to Special economic zone shall speed up growth of industries in its

							phase 2.
	5	Land use & Utilization of local resources	B-	D	B-	D	During construction period, land in the ROW might not be used by locals. Also the use of water resource in the locality is necessary for construction works. Ndera SS, Mulindi and Kabuga RMUs will no longer the land use purpose they previously had. No impact is expected during operation phase.
	6	Water Use/Water Right	D	D	D	D	No impact at all phases. No water bodies with in the area. Most of the project area is a peri-urban area with no direct water supply other than water collection points. The water needed for construction shall be fetched by the contractor.
	7	Existing social infrastructure and services	B-	A+	B-	A+	During planning and construction, the Ndera 110kV transmission lines shall cross an existing power lines close to Azam factory, at the upper edge of the Special economic zone.
	8	Cultural Heritage	D	D	D	D	During the site visit and public consultation, there was no existence cultural properties and heritage mentioned nor observed. Hence no impact is expected during the 3 phases of the project.
	9	Land scape	D	D	D	D	The towers shall take a small area (i.e. the largest covering $64m^2$ and the smallest pole $9m^2$), hence no significant change in land scape.
	10	Gender	D	D	D	D	In Rwanda, there is no gender inequality.
	11	Children’s right	D	D	D	D	In Rwanda, child labour is prohibited.

	12	Infectious Disease (HIV/AIDS)	C-	D	D	D	Construction of towers and laying of power lines is not a complex job to require foreign workers. The sites are with in Kigali city and hence the project shall employ people from within the area, no lodging involved hence no significant impact regarding spread of such diseases.
	13	Occupation health hazards	B-	D	B-	D	Accidents during construction. No impact in during planning and operation phase.
	14	Human electrocution	D	B-	D	B-	No impact during planning and construction phase. Children climbing the towers are examples of possible cases of electrocution.
	15	Exposure to electro-magnetic fields	D	C-	D	D	Project design has allowed for minimum vertical clearance from the lowest conductor to top of the structure of 5m to prevent any human activity on top of the roof of building from coming into contact with the conductor. Furthermore, WHO has confirmed after research that there is no evidence that exposure to low levels of EMFs is harmful to human health. Hence no adverse health impact to people along transmission line ROW.
	16	Access roads to sites	D	D	D	D	No impact at all phases, this being an urban or peri-urban area with easily accessible earth roads plus the sites are close to the road.
	17	Security in the project area	B-	B+	B-	B+	No impact in planning phase. During construction, depending on how material is stored, it could encourage theft in the area. During operation, increased power

							supplied, means adequate lighting hence improved security.
	18	Fire risk	D	B-	D	B-	During operation, electrical circuits could be caused broken conductors, lightning, resulting in fires.
Natural Environment	19	Protected Area	D	D	D	D	No protected areas in the project area.
	20	Protected flora species	B-	D	B-	D	During construction phase, 2 trees shall be cut down locally called "Umuco" or scientifically called *Erythrina abyssinica* protected under the Rwanda Ministerial order No. 007/2008. Though these trees are abundant in the country, the reason for their protection is not that they are rare and endangered but rather for local cultural memory.
	21	Protected Fauna	D	D	D	D	Project area is in an urban and peri-urban area, with community settlements and agricultural activity. Project activities will have no significant effects on it.
	22	Bird electrocution	D	C-	D	D	No bird migratory path in the project area. Also in the area already exists power lines hence addition of new lines will not cause significant impact.
	23	Ecosystem	D	D	D	D	Project area is in an urban and peri-urban area, with community settlements and agricultural activity. This has already affected the indigenous ecosystem, whereby project activities will have no significant effects on it.
	24	Hydrology	D	D	D	D	No water bodies with in the project area.
	25	Geology	B-	D	D	D	Geology of the area has already been disturbed at the time of preparation of the Kigali Special economic zone.

Pollution	26	Air pollution	B-	D	B-	D	Dust from excavation works and emissions from heavy machines, automobiles during construction
	27	Water pollution	D	D	D	D	No water bodies with in the project area.
	28	Soil degradation/pollution	B-	B-	B-	B-	Soil erosion from exposing soils during excavation and levelling during construction. Oil spillage from refuelling of equipment or automobiles during construction. Oil spillage at Ndera SS during refuelling of generators during operation
	29	Solid Waste	B-	D	B-	D	Organic waste from food leftovers, metal craps, cardboards, paper littered on site during construction, deconstruction of existing towers.
	30	Noise/Vibration	B-	C	B-	D	Ndera SS, Kabuga and Mulindi RMU will be closed door installations with minimal noise.
	31	Odour	B-	D	B-	D	Unattended solid waste during construction could cause obnoxious odour from rotting waste.
	32	Poor sanitation	B-	D	B-	D	During construction, lack of toilets on site, existence of unhygienic toilets could be a source of diseases to humans around the sites.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

Chapter8. ENVIRONMENTAL MANAGEMENT PLAN

Specific mitigating or abatement measures are suggested that should be adopted by the proponent of the project to minimize the potential significant impacts. The mitigation measures have put special focus on avoiding or reduction of vegetation clearing, pollution of soils, water, and air by effluents or emissions from construction activities. It has also addressed mitigation measures against impacts that would adversely affect human health and their socio-economic stature of stake holders. In order to have a more explicit understanding of the correlation between likely adverse impacts and mitigation measures, this information has been presented in the proceeding tables, where each activity has been matched with its likely negative impacts and proposed mitigation measures, the responsible during implementation and the cost involved.

Table 6: Environmental Management Plan

No.	Item	Mitigation Measures	Responsibility	Cost (USD)
	Planning phase			
1	Involuntary Resettlement	Compensation based on Asset inventory and valuation in the ARAP.	Sector authorities, REG/ EDCL	213,185
	Construction phase			
1	Land use & Utilization of local resources	Clear work schedule of project construction phasing and speeding of construction works	Contractor	N/A
2	Existing social infrastructure and services	Design has considered re-routing of this existing line through route 3 of the project components	REG/EDCL, PITRAD and Contractor	N/A
3	Occupation health hazards	Prepare and implement a site Health and safety plan that includes measures to: 1-Exclude the public from all constructions sites; 2-Ensure that workers use personal protection equipment; 3-Provide Health & Safety training for all personnel; 4-Follow documented procedures for all site activities; 5-Keep accident reports and records; 6-Inform local communities about the work and dangers	Contractor, EDCL engineers	N/A
4	Security in the project area	Hoarding of construction sites with wire mesh fencing, lighting of construction site at night and hiring of security guards	Contractor	Cost inclusive in construction contract

5	Protected flora species	1. Only clear the accepted ROW width of 15m for the 110kV transmission line and 10m for distribution lines 2. Explore possibility of offsetting the loss of the “Umuco” protected species by financially supporting plant nurseries with this species to increase on the planting of this species.	EDCL	3USD/ seedling
6	Air pollution	1-Minimize number of deliveries through timely scheduling. 2-Only contract automobiles with vehicle inspection certification, which are expected to have less exhaust emissions.	Contractor	N/A
7	Soil degradation/pollution	1- Soil compaction of completed portions. 2- Proper storm water drainage channels to avoid run-off from carrying away soils. 3-plant grass at completed areas. 4- As for oil spillage prevention, re-fueling shall be done on cemented grounds with sand to absorb the spilled oil.	Contractor	Cost inclusive in construction contract
8	Solid Waste	1- Regular disposal of solid waste to Nduba damp site or have a contract with a RURA registered waste disposal company to dispose it off.	Contractor	Cost inclusive in construction contract
9	Noise/Vibration	1- Noisey activities during working hours 7-17h. 2-Contractor shall use automobiles with Inspection certificates since they are in good condition emitting less noise.	Contractor	14USD/ Vehicle for Inspection
10	Odour	1- Regular disposal of solid waste to Nduba damp site or have a contract with a RURA registered waste disposal company to dispose it off.	Contractor	Cost inclusive in construction contract
11	Poor sanitation	1- Mobile toilets installed on site with a person in-charge of ensuring proper hygiene of these toilets.	Contractor	Cost inclusive in construction contract
	Operation phase			

1	Human electrocution	1-To avoid towers from being conductors capable of electrocuting people that touch them, horizontal insulators are used to connect the two conductors attached to the tower. (Refer to figure 3 above) 2-Also panels shall be placed on the towers with instructions in Kinyarwanda, English or French informing people of the dangers of getting close, touch or climbing the tower. 3-Sharp spokes shall be placed at the lower horizontal members to prevent children or other people from climbing the tower. 4-Towers are also designed to have a ground wire that provides a more direct current path to the earth for lightning to flow through than the transmission lines, hence avoiding lightning from striking the transmission lines and causing fires or electrocution. 5-Train and supervise EUCL operatives to ensure that they check house wiring carefully and reject if deficient. 6-Public education to raise villagers' awareness of dangers of electricity and how to utilize the system safely	Contractor, EDCL engineers	Cost part of the construction contract
2	Soil degradation/pollution	For oil spillage prevention, re-fueling shall be done on cemented grounds with sand to absorb the spilled oil.	EUCL	N/A
3	Fire risk	Towers shall be designed to have a ground wire that provides a more direct current path to the earth for lightning to flow through than the transmission lines, hence avoiding lightning from striking the transmission lines and causing fires or electrocution.	Contractor	Cost inclusive in construction contract

Chapter 9. MONITORING PLAN

A detailed environmental monitoring plan has been developed to verify that predictions of environmental impacts are accurate and that unforeseen impacts are detected at an early stage and allow corrective measures to be implemented, if needed.

During the construction phase, the plan provides for soil erosion, vegetation clearing, dust, noise, visual impacts, service disruption and safety monitoring.

During the operation period, monitoring is planned in terms of routine inspection of the health and safety of the workers, disruption impacts during maintenance of ROW, fire hazards, and electrocution. The Monitoring Plan is developed is presented at the end of this report as part of the EIA.

Environmental monitoring is an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. Monitoring includes:

- Visual observations;
- Selection of environmental parameters at specific locations;
- Sampling and regular testing of these parameters.

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the contractor at work sites during construction, under the direction and guidance of the supervising engineer who is responsible for reporting the monitoring to the implementing agencies, EDCL and donor counterpart JICA.

EDCL should in turn undertake independent monitoring of selected parameters to verify the results of the contractor and to audit direct implementation of environmental mitigation measures contained in the EMP and construction contract clauses for the Project. EDCL also will have the direct responsibility to implement and monitor land acquisition and compensation issues as outlined in the ARAP. Their Project teams should include an environmental monitoring and management specialist as well as a sociologist experienced in land acquisition and compensation issues.

RDB has the overall responsibility for issuing approval for the Project and ensuring that their environmental guidelines are followed during Project planning and implementation. Their role therefore is to review environmental monitoring and environmental compliance documentation submitted by the implementing authorities and they would not normally be directly involved in monitoring the Project unless some specific major environmental issue arose.

Environmental monitoring of the following parameters is recommended as a minimum for EDCL project of construction of substations, RMUs and improvement of transmission and distribution network in Kigali:

Noise Levels Monitoring

Although noise during construction is not expected to be a problem with the Project, periodic sampling of Contractor equipment and at work sites should be undertaken to confirm that it is not an issue. Noise level monitoring could be supplemented by consulting with Project Affected People in the first instance to identify the level of monitoring required.

Soil Erosion Monitoring

The excavation of earth for the establishment of towers, temporary and permanent access roads, , storage facilities and substations will exacerbate soil erosion. It will, therefore, be the responsibility of the Contractor's environmental inspectors to ensure the implementation and effectiveness of erosion control measures. Focus should be given to work sites where soil is disturbed and its immediate environ as well as along the ROW during and after vegetation clearing.

Monitoring of Vegetation Clearing

Unique stands of indigenous trees should not be removed for the establishment of towers. The Contractor's environmental inspectors should make sure that the unique tree stands should not be removed.

Monitoring Rehabilitation of Work Sites

The Contractor's environmental inspectors should ensure that areas used as temporary campsites for workers are progressively rehabilitated as they are no longer required. Once a site is rehabilitated it should be "signed off" by EDCL environmental staff.

Monitoring of Accidents/Health

The Contractor's environmental inspectors must make sure that appropriate signs are posted at appropriate locations/positions to minimise/eliminate risk of electrocutions. In addition the environmental inspectors should make sure that:

- EDCL will have overall responsibility to oversee that all environmental measures are put in place and that regulations are enforced. The construction supervision consultant should assist EDCL in this process in order to make sure that contractors fulfil the environmental requirements.

The following parameters could be used as indicators:

- Presence of posted visible signs on towers to prevent electrocution;
- Level of awareness of communities pertaining to dangers/risks associated with power lines;
- Presence/absence of unique stands of indigenous trees along the power line establishment route; and
- Accident reports. Records on actual accidents associated with the establishment of the transmission line could be compiled with the help of local peasant association officials, teachers/students of local schools.

Responsibilities and Costs for Environmental Mitigation Measures

The table below outlines the overall package of environmental monitoring measures that will be implemented in relation to the facility as outlined in detail in the EMP document. The table also assigns general responsibilities for implementing each group of mitigation measures.

These costs are therefore described as ‘Within contract budget’ in table below. Similarly, mitigation or monitoring measures that will be carried out by EDCL staff, with no additional expenditure required, are described as ‘Within operational budget’ in the table below.

Table 7: Environmental Monitoring Plan

No	Item	Mitigation Measures	Parameters to be monitored	Method	Frequency	Responsibility	Cost (USD)
	Planning phase						
1	Involuntary Resettlement	Compensation based on Asset inventory and valuation in the ARAP.	Cash transfer via bank accounts	EDCL Order of Payment to each PAP	In accordance with the monitoring plan in ARAP but preferably monthly.	EDCL	No cost applicable for monitoring since its within the EDCL operation budget.
	Construction phase						
1	Land use & Utilization of local resources	Clear work schedule of project construction phasing and speeding of construction works	Construction Duration	Work schedule	Before construction commencement and quarterly during construction phase	Contractor/ EDCL	No cost applicable for monitoring since its within the EDCL operation budget.
2	Existing social infrastructure and services	Design has considered re-routing of this existing line through route 3 of the project components	Existing line re-routed	Inclusive in Project design	During construction of Route 3	Contractor/ EDCL	

3	Occupation health hazards	Prepare and implement a site Health and safety plan that includes measures to: 1-Exclude the public from all constructions sites; 2-Ensure that workers use personal protection equipment; 3-Provide Health & Safety training for all personnel; 4-Follow documented procedures for all site activities; 5-Keep accident reports and records; 6-Inform local communities about the work and dangers	Workers with protective gear, records of accidents	Site inspection	Monthly	Contractor/ EDCL	No cost applicable for monitoring since its within the EDCL operation budget.
4	Security in the project area	Hoarding of construction sites with wire mesh fencing, lighting of construction site at night and hiring of security guards	Hoarding fence, light and security guards	Site inspection	Throughout the construction phase	Contractor	N/A
5	Protected flora species	1.Only clear the accepted ROW width of 15m for the 110kV transmission line and 10m for distribution lines 2. Explore possibility of offsetting the loss of the "Umuco" protected species by financially supporting plant nurseries with this species to increase on the planting of this species.	ROW width dimensions. Number of Umuco trees offset in tree nursery	Site inspection for ROW dimensions. Umuco Tree counting	Throughout the construction phase	Contractor/ EDCL	No cost applicable for monitoring since its within the EDCL operation budget.

6	Air pollution	1-Minimize number of deliveries through timely scheduling. 2-Only contract automobiles with vehicle inspection certification, which are expected to have less exhaust emissions.	Automobiles with inspection certificates	Site inspection	Through out the construction phase	Contractor/ Sector infrastructure department	No cost applicable for monitoring since its within the Sectors' operation budget.
7	Soil degradation/pollution	1- Soil compaction of completed portions. 2- Proper storm water drainage channels to avoid run-off from carrying away soils. 3-plant grass at completed areas. 4- As for oil spillage prevention, re-fuelling shall be done on cemented grounds with sand to absorb the spilled oil.	Soil parameters; PAHs, BTEX,	Soil sample analysis by Gas chromatograph- Mass spectrometry	Before construction, mid-term of construction and end of construction	Contractor	249USD/ soil sample analysis
8	Solid Waste	1- Regular disposal of solid waste to Nduba damp site or have a contract with a RURA registered waste disposal company to dispose it off.	Solid waste on site	Site inspection	Throughout the construction phase	EDCL/ Sector infrastructure department	No cost applicable for monitoring since its within the EDCL and Sectors' operation budget.
9	Noise/Vibration	1- Noisy activities during working hours 7-17h. 2- Contractor shall use automobiles with Inspection certificates since they are in good condition emitting less noise.	Automobiles with inspection certificates	Site inspection	Throughout the construction phase	Contractor/ Sector infrastructure department	No cost applicable for monitoring since its within the Sectors' operation budget.

10	Odour	1- Regular disposal of solid waste to Nduba damp site or have a contract with a RURA registered waste disposal company to dispose it off.	Solid waste on site	Site inspection	Throughout the construction phase	Contractor/ Sector infrastructure department	No cost applicable for monitoring since its within the Sectors' operation budget.
11	Poor sanitation	1- Mobile toilets installed on site with a person in-charge of ensuring proper hygiene of these toilets.	Clean mobile toilets on site	Site inspection	Throughout the construction phase	EDCL/ Sector infrastructure department	No cost applicable for monitoring since its within the Sectors' operation budget.
	Operation phase						
1	Human electrocution	1-To avoid towers from being conductors capable of electrocuting people that touch them, horizontal insulators are used to connect the two conductors attached to the tower. (Refer to figure 3 above) 2-Also panels shall be placed on the towers with instructions in Kinyarwanda, English or French informing people of the dangers of getting close, touch or climbing the tower. 3-Sharp spokes shall be placed at the lower horizontal members to prevent children or other people from climbing the tower. 4-Towers are also designed to	Towers with proposed mitigation precautionar y measures installed	Site inspection	At commissioning of the construction completion	EUCL/ Sector infrastructure department	No cost applicable for monitoring since its within the EUCL/ Sectors' operation budget.

		have a ground wire that provides a more direct current path to the earth for lightning to flow through than the transmission lines, hence avoiding lightning from striking the transmission lines and causing fires or electrocution. 5-Train and supervise EUCL operatives to ensure that they check house wiring carefully and reject if deficient. 6-Public education to raise villagers' awareness of dangers of electricity and how to utilize the system safely					
2	Soil degradation/pollution	For oil spillage prevention, re-fuelling shall be done on cemented grounds with sand to absorb the spilled oil.	Soil parameters; PAHs, BTEX,	Soil sample analysis by Gas chromatograph- Mass spectrometry	Annually	EUCL	249USD/ soil sample analysis
3	Fire risk	Towers shall be designed to have a ground wire that provides a more direct current path to the earth for lightning to flow through than the transmission lines, hence avoiding lightning from striking the transmission lines and causing fires or electrocution.	Towers with proposed mitigation precautionary measures installed	Site inspection	At construction completion. Also inspection throughout operation as part of Operation and Maintenance.	EUCL/ Sector infrastructure department	No cost applicable for monitoring since its within the EUCL/ Sectors' operation budget.

Chapter 10. STAKEHOLDERS CONSULTATION AND PUBLIC PARTICIPATION

During the Public consultation, the study applied different participatory methods, namely; interviews, one-to-one discussions, focused group discussions (FGD) and official meetings with stakeholders. Stakeholders consulted were informed on the proposed project and by using guiding questionnaire, the study was able to guide discussions and obtain relevant information on the likely impacts of the project activities. Stakeholders were asked to raise their concerns on the proposed project. An issue raised by one individual or a group of people was cross-checked by discussing it over with other individuals or groups.

With reference to this methodology, the study was able to conduct public consultation of the two (2) categories of stakeholders.

- Internal consultative meetings to understand the project- *First category* of Design team and Government officials were met, which included; PITRAD (design team) and REG (EDCL and EUCL).
- The *first category* met was of Local government officials, which included; Executive secretaries and infrastructure officers for the Gasabo District sectors of project intervention: Ndera, Bumbogo and Rusororo. Our discussions with them were again guided by the guiding questionnaires, from which information on project objectives, components, benefits, constraints in implementing the project and impacts likely to be caused by the project were reflected.
- The *second category* was of locals of the project area (i.e. residents, farmers, business people, etc.) who are either benefiting from the project or affected by it. These too were guided by the guiding questionnaires, from which information on project benefits and adverse impacts were aired out. A census survey form was applied in public consultation of the Project Affected People (PAPs) to determine their accurate socio-economic data. i.e. number of Female- male Headed Households (HH), how many they were in HH, what of their property would be expropriated, whether any of heads of HH were classified under vulnerable groups.

Meetings and group gatherings with stakeholders were scheduled as summarized in the table below. It shall be noted that consultation on issues regarding the social and environmental impacts of the project were far wider and are indicated in the issues table:

Table 8: Summary of Stakeholder meetings schedule

<table>
<tr><th>Date and Time</th><th>Place</th><th>Methods</th><th>Type of participant</th><th>Number of participants</th><th>Purpose of meeting.</th></tr>
<tr><td>4th May 2015</td><td>Bumbogo Sector office</td><td>Group meeting</td><td>Sector leader, Sector staff and Cell leaders</td><td>10</td><td>Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of organising public meetings with locals in the project area.</td></tr>
<tr><td>7th May 2015</td><td>Kinyaga Cell and Musave Cell offices</td><td>Individual meeting</td><td>Kinyaga Cell leader, Kinyaga Socio-economic development officer (SEDO), Musave SEDO</td><td>3</td><td>To show them line of route and pegs placed for the Tower Angle points. To know how and when public consultation meetings will be organized for project introduction and actual local consultation of impacts likely to arise from the project activities.</td></tr>
<tr><td>11th May 2015</td><td>Musave Cell office</td><td>Focus Group Discussion meeting</td><td>Locals of Musave Cell and the Musave Cell SEDO and EDCL official</td><td>14</td><td rowspan="2">Explain to the Locals the following about the new project:
• The Project objectives
• Components of the project and The Project affected area
• Over all schedule of project development
• The likely impacts by the Project. i.e. the benefits and likely negative impacts
• The Criteria of Right of Way (ROW)</td></tr>
<tr><td>12th May 2015</td><td>Kinyaga Cell office</td><td>Focus Group Discussion meeting</td><td>Locals of Kinyaga Cell</td><td>6</td></tr>
</table>

					• Process of land acquisition • Eligibility and entitlement to compensation • Grievance and redress mechanism for those that are not satisfied with the entire process. • Take comments and questions from the attendees and respond to each of them.
13th May 2015	Rusororo Sector Office	Individual meeting	Rusororo Sector Leader and Infrastructure official	2	Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of local public consultation.
18th May 2015	Nyagahinga Cell office	Individual meeting	Nyagahinga Cell leader	1	To show him line of route and pegs placed for the Tower Angle points. To know how and when public consultation meetings will be organized for project introduction and actual local consultation of impacts likely to arise from the project activities..
22nd May 2015	Ndera Sector office	Group meeting	Sector leader, Cell leaders and EDCL official	8	Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of census survey and asset inventory of PAPs.
22nd May 2015	Nyagahinga cell	Focus Group Discussion meeting	Nyagahinga Cell PAPs, EDCL official	6	Explain to the PAPs the following about the new project: • The Project objectives • Components of the project and The Project affected
26th May 2015	Kibenga Cell	Focus Group Discussion	PAPs from Kabenga, Cyaruzinge and Rudashya	20	

		meeting	Cells		area • Over all schedule of project development • The likely impacts by the Project. i.e. the benefits and likely negative impacts • The Criteria of Right of Way (ROW) • Process of land acquisition • Eligibility and entitlement to compensation • Grievance and redress mechanism for those that are not satisfied with the entire process. • Take comments and questions from the attendees and respond to each of them.

Meeting process:

All meetings begun with the consultant introducing his team to the attendees, where they are coming from and purpose of their visit.

Similar procedure was followed during the public consultation meetings and individual consultations of the local authorities and local residents.

For meetings held with the Sector authorities, the consultant requested for a rendezvous directly with the Executive Secretary (Sector leader) either by phone call or by written request. Meetings were then scheduled and organized by the Sector leader at his availability.

The Sector leader would then facilitate the consultant by informing the Cell leaders to avail themselves for a meeting with the consultant and in turn Cell leaders would facilitate in organizing meeting at village level. Once the Cell leaders were on board, they facilitated the consultant in meeting the locals.

In all the meetings held with Sector leaders, cell leaders and locals, the following was the structure of our discussion.

The stakeholders were informed on the following items of the project.

- The purpose of the Project
- Components of the project and The Project affected area
- Over all schedule of project development
- The likely impacts by the Project. i.e. the benefits and likely negative impacts
- The Criteria of Right of Way (ROW)
- Process of land acquisition
- Asking for collaboration during census and asset inventory.
- Eligibility and entitlement to compensation
- Grievance and redress mechanism for those that are not satisfied with the entire process

Once these items were explained to the attendees of the meeting then the floor was opened for comments or questions.

Issues raised and responses addressing them during the stake holder engagement process were compiled and summarised in the *table* below and have been considered in chapters for impact assessment and incorporated in the Environmental impact and management plan.

Table 9: Summary of common issues raised during Public consultation

Issues at hand	Stake holders	Response to issues at hand
Acceptable Compensation for lost property	Locals	Accurate valuation of land, crops and homes for compensation will be guided by an Abbreviated Resettlement Action Plan (ARAP) and full replacement compensation.
Job opportunities for locals during construction phase	Locals of the project area	An affirmative program that gives locals in the area, employment priority during construction.
Questioning whether the power lines would serve their communities	Local authorities and locals	The purpose of the power lines was to increase the amount of power in the Sectors of Bumbogo, Ndera and Rusororo.
Worry of exposure to electro-magnetic for those under the power line	Locals	A clearance of more than 5m above the lowest conductor was maintained for all structures within which no electrocution can occur. It was also explained that these fields only revolve around the conductor and not beyond
Worry of human electrocution	Locals and their authorities	A clearance of more than 5m above the lowest conductor was maintained for all structures within which no electrocution can occur. For children and adults that might attempt to climb; Panels with instructions of the dangers shall be placed on the towers. Sharp spokes shall be placed at lower members of the tower to prevent them from climbing.

Fire risks from lighting or short circuits of conductors	Locals and their authorities	A ground wire for each tower shall be designed to direct lighting current to the earth and avoid lightning from striking.
Poor solid waste management of sites resulting in poor odour for areas surrounding the sites	Locals	Regular disposal of all solid waste from sites shall be ensured by a RURA registered waste disposal company, in contract with the contractor.
Insecurity around site area resulting from construction material unattended	Locals and authorities	Contractor shall hoard all sites with construction going on, place adequate lighting and security personnel
Occupational health hazards on site. e.g. injuries.	Local authorities	Safety gear for workers involved in construction. First aid kit on site. Prohibit unauthorised public from site. Contractor's Insurance for calamities or death on site shall be part of the contract.

Chapter 11. CONCLUSION AND RECOMMENDATIONS

11.1 Conclusion

The Scoping Exercise has identified a number of issues pertaining to the proposed construction of stations and improvement of transmission and distribution network in Ndera, Bumbogo and Rusororo sectors in Gasobo district of Kigali City. The issues/impacts have been assessed and described in some detail to gain an adequate understanding of possible environmental effects of the proposed project – from design to operation, in order to formulate mitigation measures in response to negative aspects which have emerged. The Environmental Management Plan (EMP) provides a way forward for implementation of the identified mitigation measures. The EMP should be implemented as a prerequisite for a positive Record of Decision (RoD) by the appropriate authorities.

The estimated costs of implementing the mitigation measures are just indicative. Appropriate bills of quantities by the contractors should clearly give the actual figures. In any case the consultant has used informed judgement to come up with these figures.

The Environmental Monitoring Plan provides parameters to be monitored and responsibility. While the consultant is aware that each monitoring aspect need to have a separate budget line, for small projects which are remotely located this does not make economic sense. The consultant is recommending that the Project Proponent (EDCL) assigns the Environmental and social safeguard specialists to undertake the monitoring of the mitigation measures for the project through its existence. This way the proponent will achieve sustainable project implementation at reduced cost for undertaking the monitoring. The figures given are considered to be absolute maximum such monitoring could cost. However, regular internal monitoring shall be carried out by the project proponent.

Given the nature and location of the development, the conclusion is that the potential impacts associated with the proposed project of substation construction and improvement of transmission and distribution network in Kigali are of a nature and extent that can be reduced, limited and eliminated by the application of appropriate mitigation measures.

11.2 Recommendations

Based on the findings of this EIA study and as included in the EMP, the study recommendations are:

1) Full replacement compensation of expropriated property based on Asset inventory and valuation in the ARAP.
2) Clear work schedule of project construction phasing and speeding of construction works to reduce on the time soil is left exposed.
3) Design shall considered re-routing of this existing line through route 3 of the project components.
4) For the safety of workers, safety gear and a health safety plan shall be required on site.
5) Hoarding of sites with wire mesh fencing, lighting and security guards to avoid insecurity in the form of theft.
6) To reduce on vegetation loss, restrictions to clear only trees in the accepted ROW width of 15m for the 110kV transmission line and 10m for distribution lines.
7) Offsetting the protected tree species "Umuco"- *Erythrina abyssinica,* lost during construction by financially contributing to tree nurseries growing this species.
8) Delivery trucks will be restricted to late morning and afternoon hours to reduce on the noise pollution and traffic congestion in the area. Furthermore, for noise pollution, noise emitting activities shall be subjected to the working hours (7-17h) when residents are away at work to avoid noise nuisance.
9) For solid waste management, regular waste disposal to Nduba damp site or hiring out a waste disposal company with a RURA registered garbage collecting company shall be entered into by the contractor.
10) To avoid human electrocution at towers, panels informing people of the dangers of climbing towers shall be placed at time of construction. Sharp spokes at the lower horizontal members of the towers to prevent people from climbing towers shall also be included in the construction of towers.

11) To avoid fires from lightning, a ground wire on the tower is necessary to avoid lightning from striking the tower and causing electric circuits that could be a hazard to the neighbourhood.
12) A fire management plan is proposed that includes installation of fire extinguishers.
13) It is recommended that a regular monitoring field visit and reporting is carried out by EDCL environmental and social safeguards specialists quarterly.
14) To ensure compliance with national laws and REMA guidelines an environmental audit should be carried out at the end of construction phase and during the operation phase.

12. REFERENCES

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19. World Bank OP/BP 4. 04 Natural Habitat

20. World Bank OP/BP 4. 11 Physical Cultural Resources

13.1 List of consulted People

Attendance list of the PAPs during the Public Consultation in Bumbogo Sector in Gasabo District with the Consultant & EDCL

Date: 11-05-2015

NAMES	Contacts/Adress	Tel.	Signature
SANWARD Richard	EARP / EDCL	0788361654	
Bayingana desire	pitrad / ibamba	0788284321	
Mukamanzi Emerthe	Bumbogo (GASABO)	0784722962	
Mukakarega Yuriana	Bumbogo (GASABO)	—	
Mukapfizi Sinivia	Bumbogo (GASABO	0783136712	
HITAMUNGU Ignace	Bumbogo, gasabo	0788817918	
Ngendahayo Eduard	Bumbogo gasabo	0788652888	
TWIZERIMANA Cyprien	Bumbogo (GASABO)	0788594470	
Hashitoimana	BUMBOGO	0788473979	
NZIRAGIZA Samuel	BUMBOGO/GASABO	0788281674	
Gosigwa Emmanuel	bumbogo gasabo	0784057135	
Rwabigwi Théoneste	Social Economic Development/Musave Officer	0788445314	
Iyakaremye Edouard	Bumbogo	0788635660	
Songa Silver	Eco Excellence Consultancy Ltd	0788356191	

Le 11/05/2015

Rwabigwi Théoneste

Sedo / MUSAVE

Date: 12/05/2015

Name	Contacts / Address	Telephone	Signature
1. Songa Silvan	Eco-Excellence Consultancy Ltd	0788356191	
1. Mukantwali Jeanine	Kinyaga	0788399393 0788410471	
2. HORAHIMPUNDU MONIQUE	KINYAGA	0783072816	
3. Kayihura Emile	Kinyaga	0788770345 0788567498	
4) KARANGWA Casimir	KINYAGA	0782022744	
5 Hodari j. claude	Kinyaga	0788465486	
6. HABIYAMBERE Sylvestre	Kinyaga	0788409306 0788307042	[illegible]

ATTENDANCE LIST OF PAPS IN NDERA SECTOR DURING THE PUBLIC CONSULTATIONS

NAMES	ADRESS	TEL.NUMBER	SIGNATURE
Richard Sangabo	REG/EARP	0788861654	
Kozijuka Claude	NDERA		
Rahemora Callixte	Ndera		
Muzima Richard	Masaka	0788475101	
Ndayisenga Jean Damascène	Cyaruzinge Gasagara	0783334951	
Gashugula Jean Pierre	Cyaruzinge-Gasagara	0782781549	
Bizumuremyi Jean	Kibenga - Bwerenga	—	
Mukamurenzi Francine	Rudashya - Rubonga		
Ngiruwonsanga Casimir	CYARUZINGE Gahure	0783380204	
Uzamukunda Beatrice	Gitaraga - Kibenga	......	
Ayirwanda Margarithe	Gitaraga - Kibenga		
Uzarerwa Mathieu	Gitaraga - Kibenga		
Mukarame Daniel	Kitaraga Kibenga	0788777956	
UWIMANA J. Baptiste	BURUNGA - KIBENGA	0788726358	
IYAMUREMYE Celestin	Burunga - Kibenga	0788033120	
KABANDANA ATHANASE	BURUNGA	0788828122	
Imaculée	BURUNGA	0788355083	
AYIRWANDA MARIGARITA			
HABINEZA	0782498965		
Bisengimana Marco	0788676620	990781080778	

13.2 Terms of references for EIA provided by RDB

RDB | RWANDA DEVELOPMENT BOARD

Application reference: **11.07.023/1270/DIR-MD/EK/th**
Certificate N° **RDB/3/EC/JDK/ 192 / 08 /15**

ENVIRONMENT IMPACT ASSESSMENT (EIA) CERTIFICATE OF APPROVAL

This is to certify that the Environmental Impact Statement (EIS) received from **Energy Development Corporation Limited (EDCL),** of P.O.Box 537 Kigali, Rwanda, regarding the **Construction of Ndera substation and improvement of power transmission and network in Kigali (Gasogi, Kabuga and Ndera)**; with the objective of **increasing access to electricity in Rwanda, in particular Kigali City;**

The EIS, was submitted in accordance with the Regulations relating to the requirements & procedures for Environmental Impact Assessment and;

Has been reviewed and found to have enough and relevant mitigation measures to the identified likely impacts of the project on the environment. It was therefore approved subject to the fulfillment of the attached conditions.

Signed by:

for

Ag. KANYEMERA

Sandra RWAMUSHAIJA
Ag Chief Operating Officer
Rwanda Development Board (RDB)

Dated this ..25th........day of August 2015

* To be issued in Duplicate: original to Developer: copies to REMA, RNRA, REG Ltd, Gasabo District

CONDITIONS OF APPROVAL

- **The developer shall, in addition to Power transmission lines and Substation construction standards required to conform with minimum basic safety, health, operational and environmental protection, present written commitments to RDB undertaking to comply with the following conditions:**

General condition

- This certificate of approval is valid for a period of 3 years before the commencement of the project. Application for its renewal shall be examined by RDB. Otherwise, it is valid during the whole lifecycle of this specific project unless henceforth revoked or suspended;
- Observe all relevant national and international policies, regulation, standards and legislation that guide this specific project throughout its life cycle;
- Ensure that this certificate together with the EIS are present at the project site during project development/construction and are available at all times for monitoring purposes;
- Obtain all other necessary approvals/permits from other relevant institutions as required before construction and operation. This certificate does not replace other required approvals/permits;
- Fulfill other environmental conditions and requirements as may be prescribed from time to time by the Environmental Authority or any other lead agency;
- Ensure that the Environmental Management Plan is implemented as prescribed in the EIS and ensure that records are kept for future monitoring or environmental audits;
- Carry out regular environmental audits and submit Audit Reports to the Authority;
- Ensure that any other undesirable environmental impacts that may arise due to the implementation of this project but were not contemplated at the time of undertaking this Environmental Impact Assessment are mitigated;
- Construction and rehabilitation works will start after the expropriation and compensation exercises are dully completed in accordance with prevailing regulations and laws.

Construction and operation phases (as applicable)

- Construction works likely to produce excessive vibrations and noise shall be carried out during day hours in order to avoid disturbance to the local people;
- Provide to the workers personal protective equipment: boots, overall, grooves, goggles, helmets, earmuffs, nose and mouth masks, tower mounting equipment etc. and enforce their use at work;
- Access to working area shall be restricted to the workers and permitted and guided visitors;
- Avoid emissions of dust emanating from earth works on site and increased traffic movement of vehicles;
- Potable water, temporal ecosan toilets should be available on the construction site;
- Prepare an Emergency and Contingency plan and put in place safety and risk avoidance measures;
- Sanitation facilities should be provided for substation staff and they should be kept clean;

- Constantly liaise with relevant authorities and consult stakeholders including local communities in case of any new development or changes as regards to implementation of your project plan activities;
- Abide to all national social and environmental safeguard policies and standards and strive to maintain and constantly improve standards;
- Design and implement an internal Environmental, Health and Safety Policy and Awareness Programme;
- Have a clear tree planting program to replace those that will be cut on the right of way (ROW) and during the construction of access roads;
- The substation sites should be fenced and their access restricted to REG/EDCL workers on service and guided visitors;
- Ensure safe disposal of all types of wastes (solid or liquid) in specified sites;
- Ensure any pits resulting from excavation activities are backfilled;
- The alignment of the ROW should be done in such a way that reduces the number of electrical pylons in wetland areas and in any other fragile/protected ecosystem;
- All machinery, trucks and equipment at the construction site should be in good condition so as to reduce the level of noise and exhaust emissions;
- Avoid oil spillage or disposal of any other hazardous material in the soil or in the water courses/bodies in the project area;
- A first aid kit should be availed on the construction site and some workers trained in the techniques of handling injured people. Transport means should be always present and ready for transport of injured to the nearest clinic;
- Organize regular sensitization sessions on the prevention measures for accidents and contamination of HIV / AIDS;
- The work contract should include environmental clauses so as to allow compliance with environmental obligations and to account for damages caused during construction;
- The construction and rehabilitation works should preserve protected animal and plant species if found in the project area, and should not in any case negatively impact on historical and memorial sites as well as any cultural heritage;

  - The EIS is thus approved subject to the fulfillment of the conditions described above together with all mitigation measures proposed in the EMP.

N.B. Note that in case of non-compliance of the conditions described above, RDB reserves the right to withdraw the certificate.

Signed by

Fred KARANGERA

Sandra RWAMUSHAIJA
Ag Chief Operating Officer
RDB

Mr Emmanuel KAMANZI
Managing Director
EDCL

PRIME ECONOMIC ZONES LTD.
Gateway to East & Central Africa

NO. 113.PEZ/2014

EWSA
N°...7221
17 SEP 2014
AFFECTATION.........................

The Chief Executive Officer
REG LTD
KIGALI

To CEO
CC : MD - EUCL
MD - EDCL

September 16, 2014

Dear Sir,

RE: YOUR REQUEST FOR FACILITATION TO START CIVIL WORKS IN KSEZ

Reference is made to your letter dated 15 September 2014 requesting for the above mentioned facilitation to acquire A2,A3,A4a and install the power plant immediately has been approved.

Therefore, you can go ahead and commence the civil works and installation of the thermal power plant but please speed up the 30% down payment and sign the contract as soon as possible

Thank you for doing business with us.

Please accept the assurance of our highest consideration.

Regards,

— MD - EDCL
— Alendowée
— Donath

FYI
TAC MD-EDCL
23/09/2014

PRIME ECONOMIC ZONES LTD
Gateway to East & Central Africa
B.P.1321 Kigali, Rwanda

Jeanne Isabelle Gasana
Managing Director

CC:

- Managing Director / EDCL LTD
- Managing Director/EUCL LTD
- Head of Procurement Unit/REC Ltd
- Chief Finance Officer/REG Ltd

KIGALI

PRIME ECONOMIC ZONES LTD.
Gateway to East & Central Africa

INVOICE

To : REG

Information:

593,443,860FRW / Payment of 30% of the total cost of 1,978,420,200FRW.

Plot number: A2,A3,A4A
Surface area : **46,003.4 m2**

Bank reference:
Account Number: 2000061610294 RWF

Beneficiary: PRIME ECONOMIC ZONES Ltd

Bank: B.R.D

Done at Kigali, on August 18, 2014

PRIME ECONOMIC ZONES LTD
Gateway to East & Central Africa
B.P 1321 Kigali, Rwanda

Jeanne Isabelle GASANA
Managing Director

ABBREVIATED RESSETLEMENT ACTION PLAN (ARAP)

IMPROVEMENT OF SUBSTATIONS, TRANSMISSION AND DISTRIBUTION NETWORK IN KIGALI PHASE 2

PREPARED BY: ECO-EXCELLENCE CONSULTANCY LTD

VOLUME (VOL.) 1

August 2015

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ACRONYMS

ARAPs	Abbreviated Resettlement Action Plans
EDCL	Energy Development Corporation Limited
EDPRS:	Economic Development and Poverty Reduction Strategy
EUCL	Energy Utility Corporation Limited
ESS:	Environment and Social Safeguards
HIV:	Human Immune Deficiency Virus
JICA:	Japan International Cooperation Agency
PAPs:	Project Affected Persons
RAP:	Resettlement Action Plan
REMA:	Rwanda Environment Management Authority
RMU:	Ring Main Unit
RoW:	Right of Way
RPF:	Resettlement Policy Framework
rwf:	Rwandan Franc

EXECUTIVE SUMMARY

In response to the request from the Government of the Republic of Rwanda (Rwanda), 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 Substations and Distribution Network Phase 2 in Kigali. If the requirements are met and once an agreement is signed, JICA's Grant Aid will support a series of components planned in the framework of Rwanda Energy Group Co. Ltd (REG) with its subsidiary companies the Energy Development Corporation Limited (EDCL and the Energy Utility Corporation Limited (EUCL).

The projects components shall include;

- Construction of the new Ndera Substation in Free Trade Zone Phase II
- Construction of new Ring Main Units (Switching station) at Kabuga and Murindi
- Construction of new 110kV transmission lines. i.e. From the existing line between Birembo and Gasogi substation to the Ndera Substation
- Construction of new distribution lines. i.e. (i) Two circuits of 15kV distribution lines from Ndera Substation to existing line between Birembo and Free Trade Zone Phase II substations, (ii) on circuit of15kV distribution line from existing Gasogi substation to Kabuga Ring Main Unit (RMU) switching station.
- Modification of existing Gasogi substation by including 15kV switchgear panel for outgoing feeder to the new Kabuga RMU switching station

Out of these initiatives, it is anticipated that the components will generate economic and physical resettlement in the areas of implementation and its surroundings.

The planning and implementation of the components shall lead to the loss of land, houses, crops and trees and thus affect the livelihood of the Project affected people (PAPs).

The precedent actions, although it will not cause a large scale involuntary resettlement, therefore principally triggered the Energy Development Corporation Limited (EDCL) to prepare an abbreviated resettlement action plan (ARAP) in accordance with the JICA Guidelines for Environmental and Social Considerations (hereinafter "JICA Guidelines") , as well as need to comply with involuntary resettlement procedures and laws in Rwanda on expropriation and land ownership.

It is important to note that JICA Guidelines clearly states that the recipient country has the primary responsibility for planning, implementing and monitoring resettlement issues.

It is in this perspective that the following document covers an Abbreviated Resettlement Action Plan (ARAP) for construction and improvement of substation, transmission and distribution network in Kigali, phase 2.

The main objective of this Abbreviated Resettlement Action Plan (ARAP) is to ensure just compensation of the PAPs for the loss of crops, trees, land and houses in the project component site that will be lost during construction activities. The ARAP principally describes the activities of the components that are proposed and the associated impact causing land acquisition and resettlement arising there from.

The main elements of the ARAP are: public consultation, predicting potential impacts, census survey, documentation and valuation of assets, disclosure of entitlement, compensation and resettlement, addressing grievances and monitoring.

The census was done by a team composed of consultant team, village and Cell officials to identify the crops, trees, land and houses likely to be lost and their owners.

The PAPs were meaningfully consulted and participated in planning and implementing the compensation process. Before and during the creation of this ARAP, meetings were held on site to inform the PAPs that their properties might at some point be lost to make way for the rehabilitation of the project components. In the meetings, PAPs got to know how the compensations will be done and their major role in the Project activities.

The section on valuation on properties/assets likely to be lost, highlights the land, houses, crops and trees in the proposed component area, brief biography of the Project Affected Persons (PAPs) and the magnitude of the loss. The report also describes the process used in the valuation of existing land, houses, crops and trees in the line of route of the transmission and distribution of the component areal coverage.

The total number of households (HH) affected are 59, comprising of a total number of PAPs equaling to One hundred and Ninety One (191), out of which 3 households with 13 PAPs need to relocate their houses within their original property. The total number of expropriated area is coming to 14,539.2m^2, with the amount of money to be compensated reaching One hundred and eighty two million, three hundred and fifty thousand, three hundred four (**182,350,304Rwf**) Rwandan Francs.

The PAPs, the consultant, Cells and the Sectors authorities participated in the surveys, reviews and the signing of all documentation related to the compensation process. The Government of Rwanda through EDCL shall ensure compensation for crops, trees, land and houses through the Sectors and ensure all PAPs receive their cash through their Personal Bank accounts without delay. EDCL and Sectors will ensure that the eligible PAPs are compensated prior to physical relocation or commencement of any physical works at the Project site.

EDCL together with the concerned sectors will be responsible for monitoring and reporting the implementation of the ARAP.

Any aggrieved party may ask for justification of the decisions from the Resettlement and Compensation Committee, but should the answer still be unsatisfactory, they may appeal to the local leadership starting with the Cell, Sector authorities and then to the District land commission. If the grievances are not resolved, it will proceed to the Courts of Law. EDCL will ensure that all PAPs understand the complaints procedure and will ensure each party involved fulfils its duties to the PAPs ensuring just compensation.

CHAPTER 1: INTRODUCTION

1.1. PROJECT BACKGROUND

The Government of Rwanda, in its effort to sustain economic growth, has increased and stabilized the power production and distribution reduces power shortages. However, infrastructure bottlenecks in the urban areas and limited access in the rural areas have emerged as a significant constraint. One of three major strategic objectives of the Economic Development and Poverty Reduction Strategy (EDPRS 2013-2017) is to expand access while also improving the quality and lowering the cost of economic infrastructure especially transport, power, and communications. The Government of Rwanda (GoR) also exercises a strong leadership role in donor coordination and has begun to work with donors on a clearer division of labour by identifying areas of individual donor comparative advantage.

In connection with the mentioned strategy, the Government of Rwanda through Rwanda Energy Group (REG) under Energy Development Corporation Limited (EDCL) is embarked on a country-wide electricity distribution to realize the primary EDPRS target.

A number of development partners so far committed to support the program including; World Bank IDA, World Bank GEF/ESMAP CEIF, African Development Bank, BADEA, OFID, Saudi Funds, Netherlands, Japan, and others.

It is in this regard that Rwandan government requested Japan International Cooperation Agency (JICA) for a grant aid to undertake the construction and improvement of substations, transmission and distribution network in Kigali, phase 2.

1.2. OBJECTIVES OF THE PROJECT

The main objective of the project is to increase access to electricity in Kigali City, with the following specific objectives:

- To construct a new Ndera Substation.
- To construct a new 110kV transmission line from the existing line of Birembo and Gasogi substation to Ndera Substation
- To construct new distribution lines. i.e.
    - Two circuits of 15kV distribution lines from the Ndera Substation to existing line between Birembo and Free zone phase I substations,

    - One circuit of15kV distribution line from existing Gasogi substation to Kabuga Ring Main Unit (RMU) switching station.
- Modification of existing Gasogi substation by including 15kV switchgear panel for outgoing feeder to Kabuga RMU switching station.
- Construction of two Ring Main Unit at Kabuga and Murindi

CHAPTER 2: PROJECT DESCRIPTION AND POTENTIAL IMPACTS

2.1. PROJECT COMPONENTS

The project consists of the improvement and construction of substations, transmission and distribution network in Kigali. The following are the project components:

Table 1: Project components

Components	Capacity
Procurement and Installation Work	
1. **Ndera substation**	
(a) 20 MVA 110/15 kV transformers	2 units
(b) 110 kV switchgear	1 set
(c) 15kV switchgear	1 set
(d) Control and supervisory facilities	1 set
2. **Transmission Line**	
(a) Two circuits of 110 kV transmission lines from the existing line between Birembo and Gasogi substations to Ndera Substation	Approx. 2.2 km
3. **Distribution Line**	
(a) Two circuits of 15 kV distribution lines from Ndera Substation to existing line between Birembo and Free Zone Phase 1 substations	Approx. 650 m
(b) One circuit of 15 kV distribution line at Ndera (relocation) (about 200m)	Approx. 200m
(c) One circuit of 15 kV distribution line from existing Gasogi Substation to Kabuga Ring Main Unit (RMU) Switching Station	Approx. 6.5 km
4. **Modification of existing Gasogi Substation**	
(a) 15 kV switchgear panel for outgoing feeder to Kabuga RMU Switching Station	1 set
5. **RMU Switching Stations**	
(a) RMU Switching Stations at Kabuga and Murindi.	2 sets
Procurement Work	
6. **Maintenance Tools for the Equipment of the Project**	1 lot
7. **Spare Parts for the Equipment of the Project**	1 lot
Construction Work	
8. **Foundation for the Equipment of the Project (Transformers, Towers for 110 kV Transmission Line, etc.)**	1 lot
9. **Building of the Project (Ndera substation, Kabuga and Murindi RMU Switching Stations)**	3 building

DWG No. GA-01: Project Site Map -Key Map

Figure 1: Schematic layout of the project components

2.2. PROJECT LOCATION

The Project area is located in Gasabo District and is one of three districts of Kigali City. The project components cover the following Sectors and Cells:

Table 2: Project administrative location

Sectors	Cells
Bumbogo	Kinyaga
	Musave
Ndera	Kirenga
	Cyaruzinge
	Bwiza
	Rudashya
Rusororo	Nygahinga
NYARUGUNGA	Kamashashi

A pictorial representation of coverage of the line of route of the distribution and transmission lines is shown below:

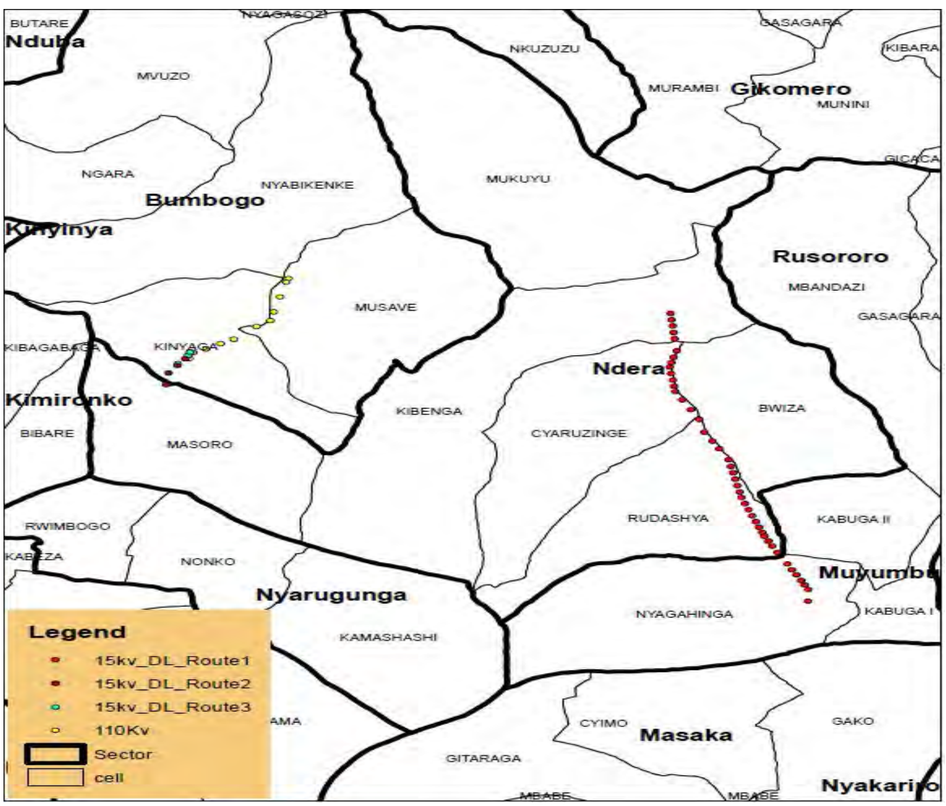

Figure 2: Sectoral and Cell location of project intervention areas

2.3. POTENTIAL IMPACTS

Right of Way (ROW) was defined as the width of working space along the line of route of transmission and distribution lines. The criteria for resettlement and land acquisition for this Project defined by REG/EUCL were defined as elaborated in the table below.

Table 3: Criteria for Resettlement and Land Acquisition

N0	Items	
1	ROW	110kV T/L: 15m width (7.5m +7.5m) 15kV D/L for double circuits: 10m width (5m +5m) 15kV D/L for Single circuit: 10m width (5m +5m)
2	Land Acquisition	Lands are acquired only where towers are erected.
3	Resettlement of structures lived or used by people such as houses, shops, etc.	A minimum vertical clearance from the lowest conductor to the top of structures is 5m. This is applied to the transmission line (110kV) and all distribution lines (15kV) of the project. Structures within ROW do not meet the above minimum clearance, meaning the distance between the lowest conductor and the top of structures is less than 5m, are subject of resettlement.
4	Resettlement of trees	All trees within ROW must be removed.
5	Resettlement of other objects	Other objects within ROW not meeting the minimum clearance will be evaluated based on social impacts and safety.

Based on the ROW along the line of route, potential impacts were discussed against the lists of components, basically indicating which components are likely to give rise to resettlement and the extent of impact of each of these components .Land area required for a tower base varies, ranging from 256m^2 to 9m^2.

Table 4: Potential impacts

	Potential Impacts	
Components	**Tower Type (Base Area) and Number**	**Land required**
Transmission line- 2 circuits of 110kV Lines	Type A (256 m^2) x 2 Type B (169 m^2) x 4 Type C (144 m^2) x 3	1,620m^2 (transmission line) 1,216m^2 (Gantry)
Distribution line (Route 1)- one circuit of 15kV distribution line from Gasogi substation to Kabuga RMU	Tower D (64 m^2) x 15 Tower E (9 m^2) x 28	1,212 m^2
Distribution line (Route 2) of 2 circuits of 15kV from Ndera substation to existing Birembo and free zone phase 1	Tower D (64 m^2) x 4	256 m^2
15kV Distribution line- Route 3: Re-routing for 110kV Tower	Tower D (64 m^2) x 2	128 m^2
Kabuga RMU Switching stations	NA	300m^2
Mulindi RMU Switching stations	NA	300m^2
	TOTAL	5,032m^2

For a new Ndera Substaion, a land (approximately 15,000m^2) is already secured by REG in Free Trade Zone Phase II.

Access road (approximately 400m^2) is included in the land secured for the Ndera Substation. Also since the project components are situated along or near the existing roads, there is no need to open access roads.

In terms of storage area (approximately total of 5, 000m^2), a main storage will be available in Free Zone for temporal use, preferably near the thermal power plant.Along the transmission/distribution lines, communities agreed to provide a space for temporal use with a rental fee as temporal acquisition.

2.3.1.Loss of land, crops and houses

The civil works, surveying, line route determination, pole/tower erection and fixing shall be entailed with clearing the vegetation inherent in the project site which includes; crops, fruit trees, other trees, and elephant grass.

Land at sites for poles/towers and RMUs will be acquired by REG from land owner.

Since the sites are located along roads, there will be no need for clearing or acquiring land for access roads.

2.4. ANALYSIS OF ALTERNATIVE

In this project, a number of alternatives were considered. In seeking the best alternative to achieve the project objectives with minimized impact of land acquisition and resettlement, the "status quo" or "do nothing" option and the actual proposed project on grid electrification were considered, the alternatives analysis show the best alternative for implementation of the project.

2.4.1. Alternative of line routes

An analysis of alternative line routes was undertaken by the surveying and design team through mapping and involvement of all the stakeholders in this selection process. At the end of this process, the lines of route chosen for this project were based on the following:

i. The lines of route were the most direct compared to going along the road, which would have been longer and more costly to the project. E.g. For Route 1-Distribution line (D/L) Gasogi SS- Kabuga RMU, the proposed Route 1 was the most direct route compared to a line going by the entire road.
ii. Also the line of routes were chosen based on less expropriation and resettlement avoiding built up area, hence less social impacts on affected communities and less costly than other alternative routes.
iii. For the 110kV Transmission Line (T/L) route, tapping power from the Birembo SS-Gasogi SS was cheaper and most optimal compared to an alternative, such as creating a new line from Birembo SS.
iv. Tower type with a smaller base is chosen whenever possible, considering technical feasibility and safety.

2.4.2. *Alternative of Ndera Substation and Ring Main Unit (RMU) location*

Possible alternatives for the location of the sites for the construction of the Ndera substation and RMUs were considered. After analysis, the selected sites were retained due to the following reasons:

i. For Ndera substation- The selected plot is under the possession of REG/ EUCL (the proponent). EUCL possesses the land documents. The location is within Free Trade Zone Phase II where the power demand is expected to increase. Other alternative will require an acquisition of 15, 000m^2 near Free Trade Zone Phase II, which may cause a significant social impact, such as a large scale involuntary resettlement.
ii. Mulindi RMU site was chosen on grounds that it was closest position to the existing power line in Nyarugunga Sector and there is no building or structure. Finding another plot of land without structure along the existing line may be difficult as the neighboring area is residential and built up area.
iii. Kabuga RMU site was located at end of the shortest line of Route 1 Distribution line from Gasogi substation. There is no building or structure. Finding another plot of land without structure along the new distribution line (Route 1) may be difficult as the neighboring area is residential and built up area.

2.4.3. No Project Alternative

A No Project (Do nothing option) alternative if chosen, would primarily mean that the status quo will be maintained and in a sense any impacts (adverse) that come with the project will not occur. However the positive benefits will be forgone in terms of providing more access to electricity to the Kigali project intervention area population which would have in turn spurred and contributed to economic growth.

In particular if the "do nothing option" was considered, some benefits would be missed out such as:

- Increased electricity supply to Kigali Special Economic Zone, Ndera, Bumbogo and Rusororo Sector areas.
- The Kabuga line supplying Nyagahinga Cell in Rusororo would continue to be strained and provide low amount of electricity to an area that is rapidly growing into a mixed use area (i.e. residential and institutions).
- Businesses would not grow for lack of sufficient electricity, employment from these businesses and other related electricity dependent activities would not be realized.
- During the construction phase there would be no temporary employment opportunities for local contractors.

The "no project" alternative was there not considered as a viable option.

CHAPTER 3: LEGAL FRAMEWORK

3.1. Relevant legislation in Rwanda

3.1.1. The Constitution of Rwanda

The Rwandan Constitution, promulgated in 2003 recognizes ownership of property also found in various legal texts of Rwanda including the Rwandan Constitution which recognizes every person's right to private property (Article 29). Consequently, private property, whether individually or collectively owned is inviolable. Exceptionally, the right to property may be overruled in the case of public interest. In these cases, circumstances and procedures are determined by the law and subject to fair and prior compensation (Article 29).

In addition, the present Organic Land Law sets a legal framework for property law under articles 5 and 6 which provides for full ownership of land and permits any person that owns land (either through custom or otherwise), to be in conformity with the provisions of this law. It is important to observe however that full ownership of land is only granted upon acquisition of a land title issued by the general land registrar authority. Once the efforts to provide proper land tenure documentation are completed, ownership of land without proper documents such as land title will not be deemed lawful land ownership and thus in event of circumstances like expropriation, one will not be able to benefit from a fair and just compensation package.

3.1.2. Land Regime in Rwanda

The Organic Land Law also provides two types of formal land tenure: full ownership/ freehold and long term leasehold. Following the recent privatization of State owned lands, very few land users currently hold either type of land tenure. Therefore, the Organic Land Law recognizes existing rights, whether written or unwritten, under both civil law and customary practices through new national land tenure arrangements. Efforts are being made under the Law (Article 7) to formalize land ownership, especially those acquired through customary means. For instance, rural populations with customary/indigenous land rights are being encouraged to register their land through decentralized land institutions like; the District Land Bureau, Sector Land Committees and Cell Land Committees (Ministerial Order N° 001/2006 of 26/09/2006 determining the structure of Land Registers, the responsibilities and the functioning of the District Land Bureau).

All types of land tenure must be in compliance with the designated land use and environmental protection measures as outlined in the Land Use Master Plan (Organic Land law N0 08/2005 of 14/07/2005, article 6).

The law also recognizes the private ownership of the land except the marshlands which are owned by the Government. In order to confirm this private ownership, the Government has completed registration of all lands and provide title to the owners. It is from the land titles that the study is able to understand category of land use for each PAP and also determine who the rightful land owner is, in the process of the asset inventory.

3.1.2.1. Eligibility

Eligibility for compensation is enshrined under the Rwandan constitution (Article 29) and the Expropriation Law. The two laws regulate and give entitlement to those affected, whether or not they have written customary or formal tenure rights. The person to be expropriated is defined under article 2(7) of the Expropriation Law to mean any person or legal entity who is to have his or her private property transferred due to public interest, in which case they shall be legally entitled to payment of compensation.

3.1.2.2. Compensation entitlement

In case an individual suffers any loss, Article 3 of the Expropriation Law stipulates that he or she should receive just compensation for it, although it is not clear what comprises fair and just compensation, this being left to the judgment of independent valuers. Article 4 of this law also stipulates that any project which results in the need for expropriation for public interest shall provide for all just compensation in its budget. Through mutual arrangement, both parties can determine the mode of payment. Article 22 (2) of the of the Expropriation Law provides that through an agreement between the person to expropriate and the one to be expropriated, just compensation may either be monetary, alternative land or a building equivalent as long as either option equates to fair and just monetary compensation. In case the determination of 'just' compensation exceeds in value the alternative land given to the expropriated person, the difference will be paid to the expropriated person.

3.1.2.3. Land Assets Classification and valuation

A land holder whose holding has been expropriated shall be entitled to payment of compensation for land and other assets, plus compensation relating to all activities resulting in any improvement to the land.

Land and other assets are classified into two categories: movable and immovable assets, both of which are eligible for compensation. For movable assets, compensation relates to inconveniences and other transition costs caused in the process of relocation. Immovable assets include: crops, forests, any building or other activity aimed at efficient use of the land, the value of land, and the activities thereon that belong to the person expropriated.

The valuation is made considering the size, nature and location of land as well as the prevailing market price. The amount of compensation for property is determined on the basis of the replacement cost of the property. Currently markets for land are very immature due to the recent revision of Land Law which privatized State-owned land. Prior to the 2005 Organic Land Law, as all land was State owned, buying and selling of land was not permitted. Following the recent restructuring of Land legislation, people now have the right to claim ownership and trade in newly-privatized lands. However, the decrees supporting this aspect of the 2005 Organic Land Law are not yet fully implemented, and awareness is currently perceived to be low among the population such that appropriate market prices for land have yet to be established.

MINIRENA shall provide relevant land assessments and information on price differentials according to the location of land to be expropriated, which will form the basis upon which fair and just compensation is to be calculated. The law provides that the valuation for expropriated lands be based on its type, use, location and availability, building on this guidance provided by MINIRENA. For the time being, until proper market prices are established, prices are negotiated openly and freely by the buyer and the seller.

3.1.2.4. Procedures for Expropriation

The law provides for public sensitization on the importance of the project to be established and the need for expropriation. In addition to sensitization, the Expropriation Law requires prior consultative meetings and examination of the project proposal involving expropriation, with a view to avoid eventual prejudice on the person or entity subject to expropriation. Normally, a consultative meeting is held within 30 days after receipt of the application for expropriation. Based on these consultations, the relevant Land Commission or Committee (from the Cell level to the National level) takes a decision to approve the project within a period of 15 days.

The application for expropriation should contain relevant information about the project, including description, the justification that the project is aimed at the public interest, the Land Use Master Plan for the land area on which the project shall be implemented, documentation indicating that the project does not have negative impacts on environment (or that the impact is mitigated by the project) as well as proof confirming the availability of funds to fully cover compensation costs. The Land Use Master Plan should be referred and a survey conducted in order to get a comprehensive description of the actions/ items on that land as well as the list of beneficiaries of activities on that land.

After the survey process is completed and approved, parties must sign a contract detailing the objective of expropriation, the value of compensation and the payment method and schedule. The contract serves as a documentary evidence of the full consent of all parties to the rights and obligations as well as procedures enshrined therein. They bind the parties to it and the contractual provisions become the law between the parties.

The relevant Land Commission (in this case the Sector and Cell authorities suffice and no land commission is required) normally communicates the final decision publicly to the population. The decision is also normally posted in the public offices where the land at issue is located as well as on radio Rwanda and in State newspapers. As such, this is intended to inform the concerned parties and it is normally done within 30 days after the decision has been made (article 13 of the Expropriation Law).

The just compensation approved by the Land Commission (in this case the Sector and Cell authorities signature of approval suffice and no land commission is required) shall be paid within a period not exceeding one hundred and twenty (120) days from the day of approval of the just compensation.

In case it exceeds that period, the expropriation shall be invalid except in case the person to expropriate and the one to be expropriated come to terms.

Subsequent to receiving just compensation, the expropriated person has a period that does not exceed ninety (90) days, in order to relocate.

At any time the person to be expropriated is still waiting for payment, he or she has right to cultivate crops within a period not exceeding ninety days (90) and harvest the crops still on his or her land. (Article 24 of the Expropriation law).

3.2. JICA Policies on Resettlement

The key principle of JICA policies on involuntary resettlement is summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.

II. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.

III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.

IV. Compensation must be based on the full "replacement cost" as much as possible.

V. Compensation and other kinds of assistance must be provided prior to displacement.

VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.

IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.

XI. Eligibility of Benefits include; the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.

XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

XIII. Provide support for the transition period (between displacement and livelihood restoration).

XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.

XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed financial Plan, etc.

3.3. GAP ANALYSIS BETWEEN JICA/WORLD BANK AND THE LAWS OF RWANDA

The section compares differences between the laws of Rwanda related to expropriation and the JICA Guidelines and World Bank's safeguards on Involuntary Resettlement, which JICA refers as a benchmark. The promulgation of the new expropriation law introduces a legal framework within which expropriation activities must be conducted, and above all, attempts to bring Rwandan Legislation more in line with international best practice requirements.

Despite this, there are still some gaps between the National Rwandan legislation and the World Bank policy OP4.12 and the JICA guidelines. These relate to the general principles for resettlement, eligibility criteria, notification period for expropriation and resettlement and the procedures required throughout the resettlement process.

Table 5: Illustrating the differences between JICA/W.B and Laws of Rwanda

No.	JICA Guidelines	Laws of the Country	Gap between JICA Guidelines& Laws of the Country	Policies applied to the Project
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	No similar provisions in the Rwandan National Law.	Expropriation of land for public interest is regarded as inevitable and the affected persons shall be given fair and just compensation Article 3 of the expropriation law	Alternative analysis, including no project option, is conducted to minimize impacts of involuntary resettlement and loss of means of livelihood.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	In the Rwandan National Law on expropriation, compensation of destroyed properties is considered	No measures to minimize impact of the displaced people	Alternative analysis, including no project option, is conducted to minimize impacts of involuntary resettlement and loss of means of livelihood. Compensation will be made for any loss caused by the project as described in this ARAP based on legislations of the country and JICA guidelines.
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	There are no explicit provisions on livelihood restoration	The Rwandan legislation is silent on this matter.	Compensation will be based on full replacement cots and provided before resettlement. Assistance and supports are provided to PAPs to restore their livelihood at least at its original level, if not better.
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Compensation is calculated considering the size, nature and location and considering the prevailing market prices. (Article 22) The Expropriation Law	No gap. Although the word “market price” used in the Expropriation Law actually includes any fees, costs, taxes, etc. hence it is actually the same as “full replacement cost.”	Compensation will be based on the full replacement cost, including any fees and costs involved.

5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	The Expropriation Law, Article 23 stated the just compensation shall be awarded to the expropriated person before he or she relocates.	No gap. Compensation will be provided prior to relocation.	Compensation and other kinds of assistance will be provided prior to displacement.
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	It is not indicated in the Rwandan National Law, however it is requested by the Rwandan Development Board to be mentioned in the EIA report	No gap.	Since this project will not trigger a large scale resettlement, an ARAP will be prepared in accordance with JICA GL.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	The expropriation law governs the specifics of land acquisition. The law provides for public dissemination on the importance of the project to be established and the need for expropriation. (Article 11, 12, 13)	No major gap.	Consultations with PAPs and their communities was held on the 4th , 7th , 11^{th,} 12th, 13th, 18th, 22nd, 26th May 2015 in community groups. Individual PAP consultations and local authorities were done through to mid-June. Information on the project and ARAP was provided in advance.
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	The medium of exchange in Rwanda is Kinyarwanda and all Rwandans can hear and speak Kinyarwanda language.	No gap	Kinyarwanda will be used in consultation and Compensation payment agreements with PAPs are prepared in Kinyarwanda.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	General Guidelines and Procedure for EIA states public participation in planning and decision making for the project.	There are no specific guidelines for participation of affected people in planning, implementation, and monitoring of RAP.	Consultations during EIA and ARAP preparation will be used as opportunities for public participation in ARAP planning, implementation and monitoring.

10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	The expropriation law article 26 provides complaints procedures for individuals dissatisfied with the value of their compensation. The law stipulates that the dissatisfied person has a period of 30 days after the project approval decision has been taken to appeal(Article 19)	No gap.	An appropriate and accessible grievance mechanism will be established. (Refer to chapter 6 of this ARAP)
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12	According to the Rwandan expropriation law, the census of the affected people is conducted as well as inventory of their properties at the beginning of the land survey, which is considered the cut-off date. (Article 17)	No gap in terms of conducting inventory and establishment of cut –off date. However, no socio-economic survey is conducted by government funded projects.	An initial baseline survey (including socio-economic survey) will be conducted based on WB OP 4.12. A cut-off date for this project is the 13th May 2015.
11.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	The Rwandan legislation (organic land law 5, 6, 7) defines the eligibility as both formal (legal) and informal (customary) owners of expropriated land. Article 18 of the Expropriation law considered in addition to legal documents, a document or testimony of the neighbors confirming ownership for the land as an evidence.	There is a gap. The Rwandan legislation does not specifically recognize all users of land to be expropriated while OP 4.12 chapter 14(a),(b),(c) entitles those with formal legal rights to land, those with no formal legal rights to land and those who have no recognizable right or claim to the land they are occupying	Follow the OP4.12 guidelines and principles. Eligibility to benefits includes both formal and informal owners of land and owners of other assets affected by the Project.

12.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are Land-based. (WB OP4.12 Para.11)	Article 23 of the expropriation law provides for fair and just compensation and it stipulates that this could be monetary or an alternative land or a building equivalent to the determination of just monetary compensation.	No major gap.	Due to the fact that land owners as well as displaced persons opted for full payment compensation as opposed to land to land, monetary based compensation will be generally applied.
13.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	There are no explicit support for transition period and livelihood restoration	The Rwandan legislation is silent on this matter.	Since full compensation is by cash transfer payment as opted by all PAPs, there will be no need for support during transition period. It shall be observed that property can only be acquired after PAP has been paid.
14.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	No clear provision on the vulnerable groups among those displaced	The Rwandan legislation is silent on this matter.	No vulnerable groups were found in this project area hence would not apply.
15.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	No indication in the Rwandan National law	The Rwandan legislation is silent on this matter	PAPs were fewer than 200 people hence ARAP will be prepared for this project.

3.4. POLICIES APPLIED TO THE PROJECT

I. The Government of Rwanda will use the Project Resettlement Policy (the Project Policy) for the "IMPROVEMENT OF SUBSTATIONS, TRANSMISSION AND DISTRIBUTION NETWORK IN KIGALI PHASE 2" specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between Rwanda's legal framework for resettlement and JICA's Policy on Involuntary

Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

II. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

III. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

IV. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:

- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

V. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

VI. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

VII. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.

VIII. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.

IX. The resettlement plans will be designed in accordance with Rwanda's expropriation law No. 18/2007 and JICA's Policy on Involuntary Resettlement.

X. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.

XI. Payment for land and/or non-land assets will be based on the replacement cost.

XII. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

XIII. Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential. As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.

XIV. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

XV. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, and women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

XVI. PAPs will be involved in the process of developing and implementing resettlement plans.

XVII. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

XVIII. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.

XIX. Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.)

XX. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

XXI. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities.

Cut-off-date of Eligibility

The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, Cut-off dates for titleholders will be the date of notification under the Expropriation law No.18/2007 and for non-titled holders will be the beginning date of the census survey; **13th /May/2015**. This date was disclosed to the PAPs during preliminary meetings with PAPs and local authorities, informed individually and through meetings that any development after the valuation exercise shall not be compensated. The establishment of the eligibility cut-off date is intended to prevent the influx of ineligible non-residents who might take advantage of Project entitlements

Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of full replacement cost. Full replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction as follows:

- Productive Land (agricultural, aquaculture, garden and forest) based on actual current market prices that reflect recent land sales in the area, and in the absence of such recent sales, based on recent sales in comparable locations with comparable attributes, fees and taxes or in the absence of such sales, based on productive value;
- Residential land based on actual current market prices that reflect recent land sales, and in the absence of such recent land sales, based on prices of recent sales in comparable locations with comparable attributes; fees and taxes.
- Houses and other related structures based on actual current market prices of affected materials;
- Annual crops equivalent to current market value of crops at the time of compensation;
- For perennial crops, cash compensation at replacement cost is equivalent to current market value given the type and age at the time of compensation.

- For timber trees, cash compensation at replacement cost will be equivalent to current market value for each type, age of each tree.

Reference documents for price replacement cost were;

- Ministerial order No. 002/16.01 of 23/11/2009- Determining the reference land prices in the city of Kigali.
- Recent Land transfer agreements of 2015 from Sector offices, for the respective Cells of project influence, were referred in coming up with the market prices (i.e. full replacement cost).
- Prices for structures were calculated based on current cost of construction material and labour. The calculations were done against each component of the structure. e.g. roof material, wall elevation material, windows and doors, foundation material, fencing material and labour involved in erecting the building.

Unit price references for land, building structures, crops and trees are explained in *sub-chapter 5.1* in detail.

CHAPTER 4: SCOPE OF RESETTLEMENT IMPACT

To assess impacts of the project on the Project Affected Persons (PAPs), a social economic survey was conducted by the consultant. This section of the project presents the findings on the socio-economic conditions of the people that will be directly affected by the project and the general socio-economic conditions of the area.

4.1. CENSUS SURVEY

4.1.1.Methods

Census survey started on 13th May 2015, with locals of the Bumbogo Sector in particular Musave and Kinyaga Cells. This was followed by Nyagahinga Cell in Rusororo Sector and finally Bwiza, Cyaruzinge, Kibenga and Rudashya Cells in Ndera Sector. The survey went on through the month of May and mid-June and was focused mainly on the Project Affected Person (PAP).

A census form, in *appendix 4*, was used to guide questions in this survey. Among the items covered in this form were; identification of those PAPs interviewed, who the Head of Household (HH) were, whether female or male, number of adults, children in a HH, who are disabled in these HH, what the HH source of income is, what was going to be affected by project activity.

To understand the general socio-economic conditions of the project intervention area, the following methods were used in the survey:

- Direct interviews with local authorities on the socio-economic status of the specific areas.
- Focus Group Discussions with PAPs as means of public consultation on their status, impression on project effects.
- Literature review on general socio-economic status of these areas.

4.1.2. Cut-off-date

Cut-off date for titleholders was set on the date of 13th May 2015. This date was disclosed to PAPs in earlier meetings, for example those held on the 11th May 2015, who were informed individually and through meetings that any development after the valuation exercise shall not be compensated.

The method applied to prevent further population influx after the cut-off date was the signed agreements of valued property for full replacement compensation by property owners, countersigned and stamped by local authorities at Sector level as means of legalizing the full replacement compensation agreement.

Furthermore, notice has been sent from REG/ EDCL to Gasabo District and Sectors under which project components traverse, informing them of the project boundaries and alerting authorities not allow any further developments in the line of route.

Since Sector level authorities are responsible for authorizing any property development in these areas. e.g. transfer of land, construction of buildings, transformation of buildings, they will be responsible for avoiding any population influx and mushrooming developments after the cut-off dates.

4.2. Project Affected Units and Affected Persons

From the census survey, ten (10) of the 59 HH shall lose their entire plots of land to specific project activity. It was noted during this survey that most of those losing their entire land either had more land adjacent to the plot or lived elsewhere and had this as secondary land. This meant that entire loss of land under this project never meant that the affected people had to physically move far off.

Details of the Project affected Units (PAUs) and Persons (PAPs) are indicated in the tables below.

Table 6: *Ndera Substation, 110kV double circuit Transmission lines, Rerouting 15kV Distribution line- D/L (Route 3) and 15Kv Distribution line (Route 2).*

Type of loss	No of PAUs			No of APs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement						
1. HH (Structure on Private land)	2	0	2	10	0	10
Not required for displacement						
2. Land owners	15	0	15	77	0	77
3. Crop/tree owners without land	3	0	3	9	0	9
Grand Total(1-3)			20			96

Table 7: *15kv D/L between the existing Gasogi Substation and new Kabuga RMU (Route 1)*

Type of loss	No of PAUs			No of APs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement						
1. HH (Structure on Private land)	1	0	1	3	0	3
Not required for displacement						
2. Land owners	30	0	30	69	0	69
3. Crop/tree owners without land resettlement	7	0	7	21	0	21
Grand Total(1-3)			38			93

Table 8: *Ring Main Unit at Murindi*

Type of loss	No of PAUs			No of APs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement						
1. HH (Structure on Private land)	0	0	0	0	0	0
Not required for displacement						
2. Land owners	1	0	1	2	0	2
3. Crop/tree owners without land resettlement	0	0	0	0	0	0
Grand Total(1-3)			1			2

Table 9: *Total Numbers of Project Affected Units (PAUs) and Affected Persons (APs)*

Type of loss	No of PAUs			No of APs		
	Legal	Illegal	Total	Legal	Illegal	Total

Required for displacement						
1. HH (Structure on Private land)	3	-	3	13	-	13
Not required for displacement						
2. Land owners	46	-	46	149	-	148
3. Crop/tree owners without land resettlement	10	-	10	30	-	30
Grand Total(1-3)			59			191

If the project is not implemented within two years of this census survey, the result will be updated and revised.

Of these 59 HH affected by the project, two (2) PAPs from Bumbogo Sector did not agree with the valuation of their property on grounds that wanted all the land under the ROW to also be included in the property for full replacement compensation.

During the survey from Rusororo Sector, it was not possible to access two (2) PAPs, while two (2) PAPs were contacted on phone but did not show interest in meeting the study team regarding the asset inventory or census survey. From Ndera Sector, it was not possible to get any contacts of one (1) PAP, while three (3) PAPs were informed of the ARAP exercise but did not show interest.

Procedure regarding full replacement compensation of these absente PAPs is explained chapter 4.3.1 with reference to the expropriation law and common practice in similar cases of donor funded projects.

4.3. ASSET INVENTORY

In order to prepare for compensation and other resettlement benefits, it was imperative that a comprehensive asset and affected persons inventory in the designated areas for the different project components were done. The inventory specified the different assets and properties affected in each plot of land as well as their owners. The activity was conducted by the registered property valuer with support from the consultancy team. The inventory was reflected under loss of; land, buildings or structures, trees and crops.

4.3.1. Land

Most of the land in the project area is still registered under the farm/agricultural land. From this inventory, the actual area of land affected is 14,539.2m^2.

This includes 1,090m^2 in Bumbogo Sector, 155m^2 in Rusororo Sector and 164m^2 in Ndera Sector, a total of 1,409m^2 land that either had PAPs absent or those that did not agree with the valuation of their land.

With reference to the Rwanda expropriation law, for those who do not agree with the value, they will appeal to the grievance organigram elaborated in sub-chapter 6.1, figure 6.

As for the absentee PAPs, common practice is that these valued full replacement compensation cost shall be transferred to Sector accounts “Escrow account” from which, once found, they can collect their compensation. This is a practice that has been used for example in an AFDB project “Interconnection Uganda- Rwanda- DRC” transmission lines with a similar case as this one.

Table 10: Land type and size

No.	Components	Sector (Gasabo District)	Land Type	Total Affected land (m²)
I	110kV T/L, re-routing 15kV D/L(Route 3) and 15Kv D/L (Route 2)	BUMBOGO	Agricultural Land	11,462.48
II	15kV D/L Route 1	RUSORORO	Agricultural Land	689
III	15kV D/L Route 1	NDERA	Agricultural Land	1,416.72
IV	Murindi RMU	NYARUGUNGA	Residential land	971
		TOTAL		**14,539.2**

4.3.2.Buildings/ Structures

The number of buildings that will be lost to project activities are three (3) principal houses with and one (1) annex house. All these buildings are made of earth bricks and roofed with iron sheets.

Table 11: Buildings to be affected

No	Sector (Gasabo District)	Building Type	Number Affected	Price(RWF)
1	BUMBOGO	Single story, mud brick	1 (Principal residential house)	3,980,088.69
		Single story, mud brick	1 (Principal residential house)	3,676,962.24
		Single story, mud brick	1 (Annex house to the Principal house	1,016,959.6
2	NDERA	Single story, mud brick	1 (Principal house)	711,367.62
	TOTAL		4	9,385,378.15

Pictures of the buildings that will be lost as a result of the project activities are shown hereafter

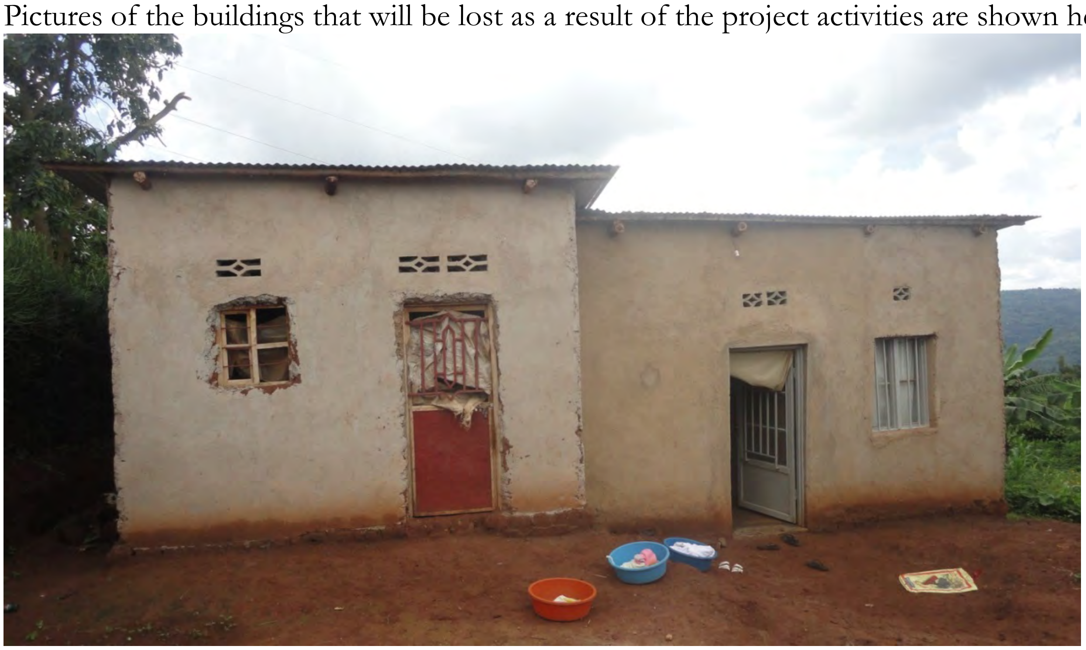

Figure 3: One of the buildings in Bumbogo Sector that will be affected by Project

Figure 4: Second building in Bumbogo Sector affected.

Figure 5: Building in Ndera Sector affected by the project

4.3.3.Trees and crops

Trees within the ROW width, trees and crops within the area covered by the towers and poles were included with in property lost to project activities. For the crops inventory was done based on area of coverage while for trees it was based on the number of trees. It should be noted that the total area is included in the land type table 10 above.

Table 12: Crops and trees to be affected

Crop Type	Area affected (m^2)
Napier grass “Ubwatsi bw'inka”	3119
Peas “Amashaza”	881
Cassava leaves “Isombe”	26
Sweet potatoes “Ibijumba”	951
Maize “Ibigori”	1971
Beans “Ibishyimbo”	2243.8
Sorghum “Amasaka”	390
Ground nuts “Ubunyobwa”	700
Imiravumba	86
Passparum	789
Flowers “Indabo”	168
Tomatoes “Inyanya”	284.7
Total surface area	***11,609.5***

Tree Type	No of trees affected
Mangoes	54
Avocado	151
Cassava “Imyumbati”	1020
Yams “Amateke”	992
Banana	782
“Imiyenzi”	2445
Tree tomato “Ibinyomoro”	4
Pine apple “Ananas”	26
Macadamia “Makadamiya”	167
Eucalyptus trees “Inturusu”	12317
Cedrela	19
Passion fruit “Amacunga”	5
Greveria “Gereveriya”	94
Guava “Amapera”	22
“Imihati”	299
“Imitagara”	12
“Kasiya”	102
“Filawo”	3
“Umunyinya”	2
Paw paw “Ipapayi”	6
“Umusave”	20
“Cypres”	2367
Bamboo “Umugano”	2
Jacaranda	12

"Ibibonobono"	8
Erythrina abyssinica "Umuco"	2
Total number of trees	**20,622**

4.4. *SOCIO ECONOMIC BASELINE OF PAPS*

a) ***Number of People Affected persons (PAPs)***

According to the results, the project area where the transmission line traverses, the total provisional population of the project affected people (PAP) is one hundred and eighty three (183). Of these, male headed household are (43) while female headed households is ten (16) and the physical disabled are six (6).

b) ***Occupation***

The socioeconomic household survey findings show that majority of the affected PAPs depend on farming and other off farm activities like office employees, business, drivers and Technical activities. Below is the table illustrating the socioeconomic status of the PAPs in the project area.

The survey results indicate livelihood of the Project Affected Households (PAHs) as summarized in the table below, based on raw collected data.

Table 13: Summary of Socio-economic survey results

Total PAP population	191
No. of Male Headed HH	43
No. of Female Headed HH	16
Average age of Male Head of HH	47
Average age of Female Head of HH	45
No. of children	130
No. of Disabled people	6
Occupation of Heads of HH: • Business owners • Civil servants • Employees of private entities • Farmers • students	 12 6 8 32 1
Average HH size	7
Common Structure of housing	Earth brick houses, plastered with cement mortar and iron sheet roofing.
Secondary source of income	Majority of PAPs depend on farming as income source with a few owning their SME businesses and employed as civil servants in public institutions.
Maximum land owned by individual PAP in project area	26,983m^2
Minimum land owned by	222m^2

individual PAP in project area				
Average land owned by individual PAP in project area	$13{,}602m^2$			
Bumbogo sector population	Male	female	total	Population density (km^2)
	17,926	17,965	35,891	592
Ndera Sector population	Male	female	total	Population density (km^2)
	20,954	20,831	41,785	830
Rusororo Sector population	Male	female	total	Population density (km^2)
	18,291	17,924	36,215	693
% above extreme poverty in Gasabo District	86.8			
% of HH owning various devices in Gasabo District	Mobile phone- 75.5 Radio- 57.5 TV set- 27.1			
% of HH with atleast one savings account in Gasabo District	61.2			
% Employment rate in Gasabo District	78			

4.5. VULNERABLE GROUPS

Reference made to the World Bank Involuntary resettlement Policy, vulnerable groups shall include; people below the poverty line, women, indigenous peoples, children, the elderly, disabled and other groups not protected by National land. e.g. those without legal title to assets.

Within the project area, there is no vulnerable group among PAPs or PAHs for the following reasons.

- Among 59 PAHs, 16 of them are headed by female. In Rwanda, female headed households do not face any disadvantages in terms of economic activities, land/asset tenures, decision making or participation in social activities, nor are considered socially marginalized. None of the female heads of PAHs are widows. Hence they are not considered socially vulnerable for this project.
- 6 disabled people among PAPs are dependent members within PAHs and the project will not affect their situation or living conditions, hence they do not special assistance.
- There is no household under poverty line among PAHs.

CHAPTER 5: COMPENSATION AND INCOME RESTORATION

5.1. COMPENSATION

Basis of calculation for price of land, building/structures, crops and trees were:

Land to land compensation could have been the best option, however, PAPs opted to have cash compensation for affected property instead of land to land.

For the land price, an average price of recently concluded land transfer agreements with in the Cell of the land valued for this project was applied. This information was obtained from the Sector offices but these referred agreements were never allowed to be copied. The unit prices which includes taxes and fees, was used for each of the cells is indicated in the table below.

Table 14: *Land prices used*

No	Sector	Cell	Price (Rwf)/m^2 of land
1	Bumbogo	Kinyaga	9,917.4
		Musave	5464.6
2	Ndera	Cyaruzinge, Rudashya, Bwiza	2,303.5
3	Rusororo	Nyagahinga	3053.4

<u>Valuation of Building/ Structures</u>

Pricing was based on costing of material and labour per m^2 for the foundation, wall elevations, roofing, finishes and number of pieces of items like doors, windows, electrical installations. Details of each house are inclusive in the full replacement cost/compensation agreement that has been agreed by the PAP by signature or thumb stamp and that now bares the Sector authorities' signature and stamp. Please refer to the Volume II of this report for the detail of the property valuation/ asset inventory which EDCL shall use to effect full replacement cost.

<u>Crops and tree rates</u>

During the asset inventory and valuation of trees and crops likely to be lost to project activities, unit prices for most of the crops and trees applied came from the following table. For trees age was important in determining the unit price, while for other crops it was the area that guided the unit price.

Table 15: Rate of valuation of crops and trees

Type of Crop	Unit	Age	Value (rwf)
Pineapple	Cluster		300
Tree Tomato	Plant	0 to 1 year	1300
		1 to 3 years	2550
		3 to 5 years	2000
Mango	Plant	0 to 1 year	3450
		1 to 3 years	7000
		3 to 5 years	9000
Guava	Plant	0 to 2 years	3450
		2 to 4 years	7000

		≥ 4 years	9000
Papaya	Plant	0 to 1 year	1200
		1 to 3 years	9000
		≥ 3 years	10,700
Avocado	Plant	0 to 1 year	4005
		1 to 3 years	13,020
		≥ 3 years	24,060
Moringa trees	Plant	0 to 1 year	1000
		1 to 3 years	4005
		3 to 5 years	5500
		≥ 5 years	7500
Other fruit trees (not listed in the crop valuation document)	Plant	0 to 2 years	2100
		2 to 4 years	4500
		4 to 5 years	5500
Medicinal crops	Plant		2800
Bananas	Mat	0 to 1 year	500
		≥ 1 year	2500
	Are	0 to 1 year	22, 00
	Are	≥ 1 year	110,000
Pilipili	Plant	0 to 6 months	150
	Plant	≥ 1 year	650
	Are	0 to 6 months	15,000
	Are	≥ 1 year	65,000
Elephant Grass	Are		10,000
Spurges	Cluster	Young Age	105
		Average	525
		Aged	920
Spurge enclosure	m	Young Age	270
		Average	420
		Aged	920
Dracaenas	Cluster	Young Aged	125
		Average Age	575
Enclos de Dracaenas	m	Young Age	285
		Average Age	860
Ficus	Plant	Young Age	270
		Average	860
		Aged	2860 to 4290
Imiko	Plant	Young Age	270
		Average Age	450
Other trees not specified	Plant	Young Age	105
		Average	270
		Aged	450
Castor Oil Plant	Plant	Young Age	105
		Average	575
		Aged	715
Sipure – Cypres Gereveliya – Greveleia Gasiya – Acacia Pinusi – Pinus Umusave – Markhamia	Plant, are	Young	286/plant, 7150/are
		3 to 5 years	572 to 858/plant, 13,585/are
		5 to 10 years	1287 to 2145/plant,

Sederela – Terminalia			22,880/are
		≥ 10 years	4290 to 5720/plant, 57,200/are
Pasparum	m^2		620
Beans	Are		2250
Sorghum	Are		3500
Colocases	Plant, are		80/plant, 20,000/are
Cassava	Plant, are		90/plant, 4050/are
Rice	Are		14,000

The compensation packages will be verified by the implementation team, EDCL. The team will make sure that all relevant documents have been signed by the relevant parties' i.e. PAPs, Sector leader. The team will also ensure that all relevant ownership documents are attached on individual payment forms. Once this had been verified by EDCL, it will be sent to Ministry of Finance and Economic Planning (MINECOFIN) for payment.

The full replacement compensation packages will be made directly by the Ministry of Finance and Economic Planning (MINECOFIN) to the PAPs bank accounts or Savings and Credit Cooperation (SACCOs) accounts. PAPs without bank accounts will be encouraged to open bank accounts before payments can be made.

5.2. INCOME RESTORATION MEASURES

World Bank OP 4.12 Para (6c) states that displaced persons should be offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living, and provided with development assistance in addition to compensation measures. Such as land preparation, credit facilities, training or job opportunities.

Similarly, JICA guidelines stipulate that the project implementation should ensure that displaced people receive resettlement assistance, preferably under the project, so that their standards of living, income earning capacity, and production levels are improved.

In addition to the full replacement compensation valued at an agreed property valuation for this project and given the nature of this project which is linear and the fact that households will be allowed to utilize the land within the corridor for agricultural purposes other than plant trees, the impact on livelihood is minimal.

Also, the following measures shall be considered by the project to support affected persons:

a) *Access to jobs during construction*
Able bodied members of the affected households will be given the first priority for recruitment during the construction phase. Given, the nature of the project, available jobs for local people will mainly be in form of casual labor. It expected that by employing them, they will be able to improve their income and this will facilitate their survival during the transition stage. Gender equality during recruitment of the PAPs should be emphasized. The

contractor shall work hand in hand with the local leaders to identify the affected households to be given priority for employment.

b) *Income from renting of storage space from PAPs*

Due to the close proximity to the sites, affected will be given priority in hiring rental space for storage of material, hence creating an addition source of income during the construction process.

5.3. Entitlement Matrix

Entitlement matrix proposes eligibility and payments for the losses triggered by the project (e.g. land, housing, trees, crops, land etc). Hence, based on analysis of the impact of the project and the criteria for eligibility, the following entitlement matrix is developed on categories of PAPs according to losses and their entitlement benefits. Table shows the entitlement benefits.

Table 16*: Entitlement Matrix*

Type of Loss	Entitled Person	Type of Impact	Compensation/Entitlement/ benefits	Responsible Organization
Land (Agricultural/residential)	Title holder	**No displacement** Less than 20% of land holding affected, the remaining land remains economically viable.	Cash compensation for affected land equivalent to full replacement cost	EDCL/ MINECOFIN
		Displacement More than 20% of land holding lost or less than 20% of land holding lost but remaining land not economically viable	Cash compensation for affected land equivalent to full replacement cost	
	Rental/lease holder	**No displacement**: Land used for residence partially affected, limited loss, and the remaining land remains viable for present use	Cash compensation equivalent to 10% of lease/ rental fee for the remaining period of rental/ lease agreement (written or verbal)	EDCL/MINECOFIN
Buildings and structures	Owner	**Displacement:** Entire structure affected or structure partially affected but the remaining structure is not suitable for continued use	Cash compensation of full replacement cost for entire structure and other fixed assets without depreciation, or alternative structure of equal or better size and quality in an available location which is acceptable to the PAP. Right to salvage materials without deduction from compensation.	EDCL/MINECOFIN
Standing crops	1. Land owners 2. Crop Owner	Crops affected by land acquisition or temporary acquisition or easement	Cash compensation equivalent to average of last 3 years market value/ full replacement cost for the mature and harvested crop.	EDCL/MINECOFIN

			For crop owners with lease title: Cash compensation for the harvest of the affected land equivalent to average market value (full replacement cost) of last 3 years, or market value (full replacement) of the crop for the remaining period of tenancy/ lease agreement, whichever is greater.	
Trees	1. Land owners 2. Tree Owner	Trees lost	Cash compensation based on type, age and productive value of affected trees plus 10% premium	EDCL/MINECOFIN
Temporary Acquisition	1. Owner 2. Tenant/occupant	Temporary acquisition	Cash compensation for any assets affected (e.g. boundary wall demolished, trees removed)	EDCL/MINECOFIN

NB:

- Special assistance was not considered since all PAPs were not under poverty line "locally called Ubudehe program".
- Female headed Households (HH) were not considered vulnerable, since females in Rwanda have equal rights as men to access of land, property and any other opportunities.
- Disabled people encountered in the Census survey were not Heads of HH, hence there is no entitlement specifically for them.
- Commercial land, squatters and street vendors were not observed in the project line of route and hence were not considered in this Entitlement matrix.

5.4. VERIFICATION AND DISCLOSURE OF ENTITLEMENTS

The local community and PAPs was involved in the process of documentation and valuation of their assets. Property valuation forms were presented to PAPs for verification, once they were comfortable with the proposed full replacement cost for their property, they signed or thumb pressed in ink against their names as a sign of agreement. These documents were then shared with the Cell and Sector authorities who countersigned as a sign of approval and authorization of legal process. These compensation agreement forms shall compose the Volume II of the ARAP report, with details of area, quantity and cost of the valued property that will be lost to project activity.

The ARAP will be disclosed after the approval by REG and the medium of communication will be in English and ***Kinyarwanda for the part of asset valuation***. The translated copy of ARAP in Kinyarwanda will be displayed at Cell, Sector and District offices and it will also be discussed during community works (Umuganda).

CHAPTER 6: GRIEVANCE AND REDRESS MECHANISM

Full replacement cost for compensation of property likely to be lost is supervised by the resettlement and compensation committee. This committee comprises of; members from EDCL and Sector authorities. Their duty is to verify whether all assets valued and all PAPs have been fully compensated at the full replacement cost agreed by both the PAP and EDCL.

In the event that the PAP rejects the value given by this compensation committee or in case a PAP is not paid at full replacement cost as in the compensation agreement form indicated in Volume II, then this the point at which the grievance and redress mechanism commences.

The grievance and redress mechanism follows the current dispute resolution hierarchy at local government level.

- *Stage 1*- PAP will raise the issue with Village leaders "locally called Umudugudu" for a solution to be reached. If the resolution at this stage does not satisfy the PAP, it is raised to the next stage.
- *Stage 2*- The issue is raised at the Cell level "locally called Akagali". At this stage are Cell mediators "locally called Abunzi" that sort out matter below a threshold of 5Million Rwanda Francs. Here the grievance is assessed by these mediators in the presence of the PAP and written resolution declared. Should it not be satisfying to the PAP, then the PAP will raise it with the next stage.
- *Stage 3*- at the Sector level; where a team from the Sector and District land commission seat to resolve the issues between the PAP and developer (EDCL). Incase grievance reached thisstage, it is at this level that from previous projects, effective resolutions are passed to the satisfaction of both parties. However, should this fail, the matter is raised by the grieving PAP to the Courts of law.

According to Article 26 of the Expropriation Law N0 18/2007 of 19/04/2007, filing a case in courts of law does not stop expropriation process to be effected. Article 26 provides complaints procedures for individuals dissatisfied with the value of their compensation according to the law. It stipulates that dissatisfied persons have a period of 30 days after project approval decision has been taken to appeal (Article 19).

It shall be noted that grievance redress is a process done at no cost and anyone can appeal, except at the stage of the courts of law, where a fee is incurred.

EDCL will follow up the aggrieved PAPs at each level to ensure that the grievances are resolved. Each sector should identify one PAP to work with EDCL and the local leaders to ensure that the grievances are attended to in time. This is in addition to the existing Compensation Committee.

To ensure that the affected parties are fully aware and to reduce possible backlog of complaints, it should be noted in advance that most members of these communities take time to decide to complain within 30 day period required to file their complaints. As per international standards, grievances logged outside this timeframe may still be valid and legitimate. Customarily, the government expropriation authorities ensure that all affected people are fully informed, and will issue warnings about the consequences of failure to lodge their complaints in time. Within this customary procedure, affected people were informed by the consultant during the public consultation and were found to be fully aware of the grievance and redress procedures before their assets are compensated.

6.1. Organizational responsibilities

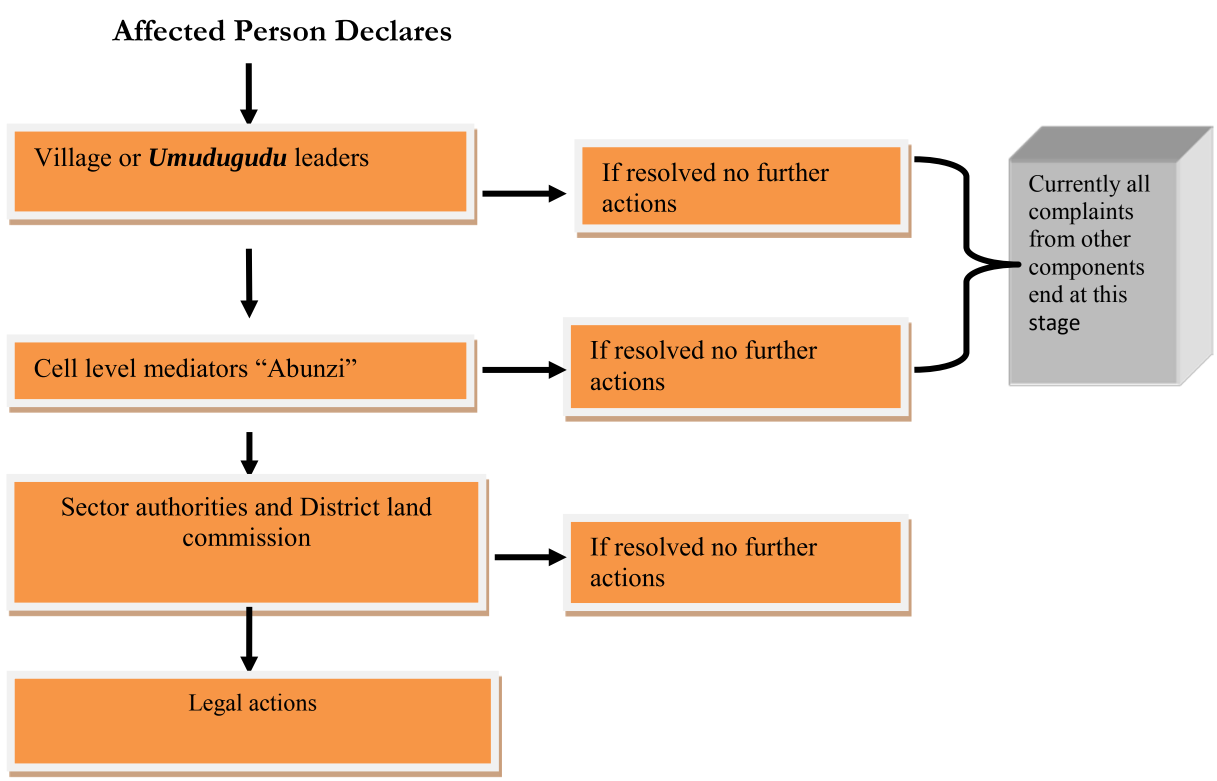

Figure 6: Organigram of grievance and redress mechanism

CHAPTER 7: IMPLEMENTING ORGANIZATION

Rwanda Energy Group (REG) - Is the institution in Rwanda responsible for development of energy and delivery to the public. In this particular project the type of energy is electricity. Under it, operate two autonomous companies, i.e. EDCL and EUCL. EDCL in charge of all infrastructure development of these energy sources, while EUCL plans, manages this utility and recovers funds from the services provided to the public. EDCL is responsible regarding approval and implementation of the ARAP

Energy Development Corporation Ltd (EDCL) - Is responsible for overseeing the designs of the project, reviewing the ARAP and valuation of property likely to be affected by the project before submitting the complete report of full replacement compensation to MINECOFIN. EDCL will also participate in the tendering process of a potential contractor and supervise the construction works of this project. It is responsible for grievance redress throughout the project from planning to the commissioning of construction works.
Once the works are complete, the power lines are then transferred to EUCL for operation and management.

Energy Development Corporation Ltd (EUCL)-Is responsible for operation and maintenance of the project after construction works have been commissioned, including informing communities not to build structures or plant trees that may come within the 5m clearance from the lowest power line.

Local government- Sector and Cell authorities shall be responsible on verifying the valued property of PAPs and this will be verified by signature and stamp from Executive Secretaries of Sector and Cells against each PAPs valued compensation agreement. They will also inform the PAPs by list on notice board of the completion of bank transaction of their full replacement compensation. The Village, Cell and Sector levels shall be the core of resolution of the grievance redress. Only when the grievance redress has reached the Sector level shall the District land commission be involved.

Ministry of Finance and Economic planning (MINECOFIN) - Shall be responsible for disbursing the full replacement compensation to verified PAPs as per list and bank accounts submitted by EDCL.

CHAPTER 8: IMPLEMENTATION SCHEDULE

This section outlines the different activities that will be undertaken to ensure successful implementation of the project and their expected timeframes.
The compensation payment should occur in the pre-construction phase to avoid both delays in the project construction and stress to the PAPs.

Table 17: Implementation schedule

No.	Resettlement Implementation plan																		
	Activities	**Responsible Agencies**				**Sep-15**				**Oct-15**				**Nov-15**				**Dec-15**
1	***Preparation for implementation***																		
	Explain features of Resettlement plan (RP) to key Project staff in EDCL	EDCL																	
	Activate implementation coordination mechanism amongst respective government agencies (i.e. EDCL, Sectors of Bumbogo, Ndera and Rusororo)	EDCL/ Sector leaders																	
	Continue consultation with PAPs through Sector and Cell authorities on progress of project and compensation	EDCL/ Sector leaders																	
	Processing of compensation funds	EDCL/ MINECOFIN																	
2	***Implementation***																		
	Payment of compensation (1- bank transfer, 2- Inform all HH members of compensation payment.	EDCL/MINECOFIN																	
	Monitoring and evaluation	EDCL																	
	Grievance Redress with procedure of recording and processing of grievances	EDCL/ Sector authorities																	
3	***Contingency***																		
	Contingency funds for increased costs	EDCL																	
	Resettlement coordination group or key adminstrators responsible for unanticipated problems	EDCL/ Sector authorities																	
	Early Review of Resettlement implementation	EDCL/ Sector authorities																	
4	**Documentation of Compensation process and Resettlement Planned changes**	EDCL																	

CHAPTER 9: COST AND BUDGET

9.1. *COMPENSATION COSTS*

The total compensation budget for the property likely to be affected, relating to the improvement and construction of substations, transmission and distribution lines in Kigali will be **182,350,304Rwf.** It includes cost of compensation for a sum of **165,834,553 Rwf** which includes; crops, trees, land and Residential houses and a compensation Implementation budget **16,515,751 Rwf**. EDCL will be responsible for the compensation costs displayed in this ARAP.

It shall be noted that as per article 24 of the expropriation law, just compensation approved by the Land commission (in this case the approved signature and stamps of the Sector and Cell leaders) shall be paid within a period not exceeding One hundred and twenty (120) days from the day of approval of the just compensation. The date of approval of just compensation in this case is 21st July 2015, which would mean payment at full replacement cost should be completed before 21st November 2015.

Table 18: Cost of Compensation

Items of Compensation activities	**Cost (Rwf)**
Land	111,344,377.4
Crops and trees	45,104,797.6
Buildings	9,385,378
Total compensation budget	**165,834,553**

9.2. *IMPLEMENTATION BUDGET*

A budget has been estimated for the resettlement implementation process based on the activities described in the implementation schedule in chapter 8.

Table 19: Implementation budget

	Activities	**Responsible Agencies**	**Unit**	**Quantity**	**Cost (Rwf)**
1	***Preparation for implementation***				
	EDCL internal Workshop on ARAP with key Project staff	EDCL	Lump sum	1	300,000
	Field trips to activate implementation coordination mechanism	EDCL/ Sector leaders	Trips	6	60,000
	Consultations with PAPs through Sector and Cell authorities on	EDCL/ Sector leaders	Trips	5	50,000

	progress of project and compensation				
2	***Implementation***				
	Inform all HH members of compensation payment.	EDCL/ Sector leaders	Trips	3	30,000
	Grievance Redress with procedure of recording and processing of grievances	EDCL/ Sector authorities	Lump sum	1	200,000
3	***Contingency***	EDCL/ Sector authorities			-
	Contingency funds for increased costs	EDCL	Lump sum	1	15,775,751
4	**Documentation of Compensation process and Resettlement Planned changes**	EDCL	Lump sum	1	100,000
	Total				**16,515,751**

9.3. TOTAL OF COST AND BUDGET

Table 20: Total cost and budget

No	Item	Cost (Rwf)
1	Compensation cost	**165,834,553**
2	Implementation cost	16,515,751
	Total	**182,350,304**

CHAPTER 10: MONITORING BY IMPLEMENTING AGENCY.

10.1. MONITORING FRAMEWORK

Monitoring of the ARAP will be carried out during the whole process of affected assets valuation and compensation to ensure that the objectives are met and successful implementation of the ARAP occurs.

The monitoring will be carried out by a committee composed of; Sector representatives, representatives at the Cell level and EDCL, to ensure that all of the responsible implementing agencies follow the schedule and comply with the principles of the ARAP.

Internal monitoring of ARAP implementation shall be done by EDCL and Sector authorities, no government has been established with the mandate of external monitoring of ARAPs.

A monitoring form for the implementation of the ARAP is proposed in the proceeding sub-chapter.

10.2. MONITORING FORM

Table 21: ARAP Implementation Monitoring form

Resettlement Activities	Planned Total	Unit	Monthly Progress			Progress in %		Expected Date of Completion	Responsible Organization
			Sept 2015	Oct .2015	Nov 2015	Till the last month	Up to the month		
Approval of ARAP								7th September 2015	EDCL
Processing Compensation Fund								31 October 2015	EDCL/ MINECOFIN
Progress of Compensation Payment	59	No. of HHs						30 November 2015	EDCL/MINECOFIN
Components near the Ndera Substation, Route 2 and 3	20	No. of HHs						30 November 2015	EDCL/MINECOFIN
15kV DL between Gasogi Substation and Kabuga RMU	38	No. of HHs						30 November 2015	EDCL/MINECOFIN
Murindi RMU	1	No. of HHs						30 November 2015	EDCL/MINECOFIN
Progress of Land Acquisition (All Lots)	14,539.2	m^2						30 November 2015	EDCL/Sector leaders
Components near the Ndera Substation	11,462.48	m^2						30 November 2015	EDCL/Sector leaders

15kV DL between Gasogi Substation and Kabuga RMU	2105.72	m^2						30 November 2015	EDCL/Sector leaders
Murindi RMU	971	m^2						30 November 2015	EDCL/Sector leaders

CHAPTER 11: PUBLIC PARTICIPATION AND CONSULTATION

11.1. METHODS

Information collected from the preliminary desk review, preliminary consultation with EUCL and EDCL staff and after having an initial field visit, the study was able to identify likely project stakeholders. Without chronological priority, these stakeholders were identified in two categories. (1) Local government officials at Sector, Cell and village level and (2) Second category of locals likely to benefit or be affected by the project.

During the Public consultation, the study applied different participatory methods, namely; interviews, one-to-one discussions, focused group discussions (FGD) and official meetings with stakeholders. Stakeholders consulted were informed on the proposed project and by using guiding questionnaire, the study was able to guide discussions and obtain relevant information on the likely impacts of the project activities. Stakeholders were asked to raise their concerns on the proposed project. An issue raised by one individual or a group of people was cross-checked by discussing it over with other individuals or groups. It is from these concerns that the common issues were determined and summarized in the proceeding sub-chapter.

11.2. DETAILS OF MEETINGS

Based on the World Bank and JICA resettlement policy guiding principles, project affected persons and project affected communities were meaningfully consulted early in the planning process and encouraged to participate in the planning and implementation of the resettlement program.

During the public consultation, the project affected persons were informed about their options and rights pertaining to resettlement. Consultation and meetings with PAPs were held to discuss issues related to compensation. EDCL and the Consultant held meetings with the local communities on the sites in order to inform them about the planned project components.

Some of the affected people do not live in the project areas; they shifted to other places however the head of households and their spouses were contacted for the meeting and the number of Household heads that attended was 39 people (PAPs) from all three (3) sectors (Bumbogo, Ndera and Rusororo), these included the head of households and their spouses.

The study was able to conduct public consultation of the two (2) categories of stakeholders.

- The *first category* met was of Local government officials, which included; Executive secretaries and infrastructure officers for the Gasabo District sectors of project intervention: Ndera, Bumbogo and Rusororo. Our discussions with them were again guided by the guiding questionnaires, from which information on project objectives, components, benefits, constraints in implementing the project and impacts likely to be caused by the project were reflected.
- The *second category* was of locals of the project area (i.e. residents, farmers, business people, etc.) who are either benefiting from the project or affected by it. These too were guided by the guiding questionnaires, from which information on project benefits and adverse impacts were aired out. A census survey form was applied in public consultation of the Project Affected People (PAPs) to determine their accurate socio-economic data. i.e. number of Female- male Headed Households (HH), how many they were in HH, what of their property would be expropriated, whether any of heads of HH were classified under vulnerable groups.

Details of the meetings progressed in the following manner:

1. Meeting proceedings:

All meetings begun with the consultant introducing his team to the attendees, where they are coming from and purpose of their visit.

Similar procedure was followed during the public consultation meetings and individual consultations of the local authorities and local residents. For meetings held with the Sector authorities, the consultant requested for a rendezvous directly with the Executive Secretary (Sector leader) either by phone call or by written request. Meetings were then scheduled and organized by the Sector leader at his availability.

The Sector leader would then facilitate the consultant by informing the Cell leaders to avail themselves for a meeting with the consultant and in turn Cell leaders would facilitate in organizing meeting at village level. Once the Cell leaders were on board, they facilitated the consultant in meeting the PAPs.

In all the meetings held with Sector leaders, cell leaders and PAPs, the following was the structure of our discussion.

The stakeholders were informed on the following items of the project.

- The purpose of the Project
- Components of the project and The Project affected area
- Over all schedule of project development
- The likely impacts by the Project. i.e. the benefits and likely negative impacts
- The Criteria of Right of Way (ROW)
- Process of land acquisition
- Asking for collaboration during census and asset inventory.
- Eligibility and entitlement to compensation
- Grievance and redress mechanism for those that are not satisfied with the entire process

Once these items were explained to the attendees of the meeting then the floor was opened for comments or questions.

2. **Issues raised by meeting attendees were common amongst the PAPs of the different Sectors and these revolved around:**
    - Whether the transmission and distribution lines would benefit the areas along the line of route.
    - What the basis of unit prices for land to be compensated?
    - What the process of land compensation would be?
    - Whether they would benefit from job opportunities during construction phase?
    - What would happen to those without final land ownership documents of affected area but that have contracts that show they have purchased this land?
    - Whether adequate compensation would be paid to PAPs in their areas and in time.
    - When works would commence for local authorities to indicate it their action plans and follow up.
3. **The Proponent, consultant and local authorities responded to the above questions chronologically in the following manner:**
    - The project was meant to increase the amount of power supply to those areas it traversed in the Sectors of Bumbogo, Ndera and Rusororo. Power from the Ndera Substation would increase power supply to the Free Trade Zone Phase II and also reinforce existing lines in the area.

- The unit prices for land would be based on current market prices this year of 2015. Land transfer contracts would be consulted from Sector offices and an average unit price for land in the particular Cell of the land to be compensated would be considered as the Unit price.
- Once the valuation of affected property, i.e. land, crops and trees, is completed by the property valuer in the presence of the affected person, then a compensation agreement form with all the valued property shall be prepared and signed as acceptable by the affected person. These forms collectively in specific Cells and Sectors, shall be signed and stamped as approved by Cell and Sector leaders. The forms will then be sent to EDCL for verification as part of an ARAP report, which will be counter verified. Once approved by EDCL, the payment order will be prepared and sent to MINECOFIN for final payment of full replacement cost to each ones bank or financial institution account. Those not comfortable with the payment shall raise their concerns through the explained grievance redress process.
- An affirmative process is place to grant the affected persons priority of employment when construction works start. As a matter of fact during the placing of reference concrete beacons for the towers and poles, it was the affected persons that were given these jobs.
- Regarding those without final land ownership documents but have purchase agreement, based on the article 18 of the expropriation law that legally recognizes those with written evidence indicating the he or she purchase the land, received it as a donation or as a legacy or a successor.
- Full replacement cost would be compensated for all property valued for each PAP based on the current market price.
- Construction contract is anticipated to be signed by August 2016 for works to commence as per the Tentative project implementation schedule.

Meetings and group gatherings with stakeholders were scheduled as summarized in the table below:

Table 22: Summary of Stakeholder meetings

Date and Time	Place	Methods	Type of participant	Number of participants	Purpose of meeting.
4th May 2015	Bumbogo Sector office	Group meeting	Sector leader, Sector staff and Cell leaders	10	Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of census survey and asset inventory of PAPs.
7th May 2015	Kinyaga Cell and Musave Cell offices	Individual meeting	Kinyaga Cell leader, Kinyaga Socio-economic development officer (SEDO), Musave SEDO	3	To show them line of route and pegs placed for the Tower Angle points. To agree on how they could organize the locals and PAPs to meet the study team as a project introduction before census survey and asset inventory begins.
11th May 2015	Musave Cell office	Focus Group Discussion meeting	PAPs of Musave Cell and the Musave Cell SEDO and EDCL official	14	Explain to the PAPs the following about the new project: • The Project objectives • Components of the project and The Project affected area • Over all schedule of project development • The likely impacts by the Project. i.e. the benefits and likely negative impacts • The Criteria of Right of Way (ROW) • Process of land acquisition • Request for collaboration during census and asset
12th May 2015	Kinyaga Cell office	Focus Group Discussion meeting	PAPs of Kinyaga Cell	6	

					inventory. • Eligibility and entitlement to compensation • Grievance and redress mechanism for those that are not satisfied with the entire process. • Take comments and questions from the attendees and respond to each of them.
13th May 2015	Rusororo Sector Office	Individual meeting	Rusororo Sector Leader and Infrastructure official	2	Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of census survey and asset inventory of PAPs.
18th May 2015	Nyagahinga Cell office	Individual meeting	Nyagahinga Cell leader	1	To show him line of route and pegs placed for the Tower Angle points. To agree on how they could organize the locals and PAPs to meet the study team as a project introduction before census survey and asset inventory begins.
22nd May 2015	Ndera Sector office	Group meeting	Sector leader, Cell leaders and EDCL official	8	Introduce the project to the Sector, its objectives, indicate line of route and project area and request for facilitation in the process of census survey and asset inventory of PAPs.
22nd May 2015	Nyagahinga cell	Focus Group Discussion meeting	Nyagahinga Cell PAPs, EDCL official	6	Explain to the PAPs the following about the new project: • The Project objectives

26th May 2015	Kibenga Cell	Focus Group Discussion meeting	PAPs from Kabenga, Cyaruzinge and Rudashya Cells	20	• Components of the project and The Project affected area • Over all schedule of project development • The likely impacts by the Project. i.e. the benefits and likely negative impacts • The Criteria of Right of Way (ROW) • Process of land acquisition • Request for collaboration during census and asset inventory. • Eligibility and entitlement to compensation • Grievance and redress mechanism for those that are not satisfied with the entire process. • Take comments and questions from the attendees and respond to each of them.

Figure 7: Public consultation with locals of the project areas

REFERENCES

1. *EDPRS II, 2013*. Economic Development and Poverty Reduction Strategy 2013-2018.
2. *Government of Rwanda, 2003*. Constitution of the Republic of Rwanda.
3. *Government of Rwanda, 2007*. Law No. 18/2007 of 19/04/2007 relating to expropriation in the Public interest.
4. *Government of Rwanda, 2009*. Ministerial order No. 001/16.00 of 23/11/2009 determining the reference land prices in the City of Kigali.
5. *JICA, 2010*. Japan International Cooperation Agency (JICA) Guidelines for environmental and social considerations.
6. *JICA, 2015*. Field report for Preparatory survey on Improvement of substations and distribution network phase 2 in the Republic of Rwanda.
7. *World Bank, 2004*. Involuntary Resettlement Source book.

APPENDIX

APPENDIX 1: SCHEMATIC OF THE PROJECT COMPONENTS

DWG No. GA-01: Project Site Map -Key Map

APPENDIX 2: REG LETTER ON ROW, RESETTLEMENT AND LAND ACQUISITION CRITERIA

Rwanda Energy Group | REG | Energy Utility Corporation Limited

Kigali, 16 April 2015

Ref: 11.07.023/......../15/MD/LVM/WB/kf

Attn: Ms.Asami KABASAWA
JICA Phase-II Study Team,
Yachiyo Engineering Co.,Ltd,
Tel :+(81)-3-5906-3749,
Fax: :+(81)-3-3221-5705.

Dear Ms.Kabasawa;

<u>Ref</u> : Preparatory Survey on The Project for Improvement of Substations and Distribution Network JICA-Phase 2.

<u>Sub</u>: ROW, Resettlement and Land Acquisition Criteria

Reference is made to the letter No.RW-01 dated on 15th April 2014, requesting for the information related to ROW, Land acquisition and Resettlement criteria for the preparation of Resettlement Action Plan on the captioned project above (Improvement of Substations and Distribution Network JICA-Phase2).

I would like to inform you that, the ROW of 15kV Single circuit indicated in the Table2.2.1-2 Electrical Conditions (pg17) of the Field Report signed by EUCL and EDCL representatives on 2nd April, 2015 is revised as 10m width (5m+5m) instead of 6m wide (3m+3m). All other information as requested are here with attached:

Yours Sincerely,

William BIHOYIKI
Ag. Head of Electricity Transmission Unit

RUTABEMARA Maurice

Received on 16th April 2015

<u>Cc:</u>

- DOP-EUCL
- Director of Planning-EDCL
- MD-EDCL;
- CEO-REG

KN 82 ST 3., Nyarugenge District, P.O. Box 537 Kigali,Rwanda
Tel : +(250) (0) 252 573 66, Fax (250) (0) 252 573 802

PREPARATORY SURVEY ON IMPROVEMENT OF SUBSTATIONS AND DISTRIBUTION NETWORK JICA-PHASE 2 IN THE REPUBLIC OF RWANDA

Table A: Criteria for Resettlement

No	Items	ROW, Land Acquisition and Criteria for Resettlement
1	ROW	110kV T/L: 15m width (7.5m +7.5m) 15kV D/L for double circuits: 10m width (5m +5m) 15kV D/L for Single circuit: 10m width (5m +5m)
2	Land Acquisition	Lands are acquired only where towers will be erected. The details of lands required for towers (GIS coordinates, surface area, height, etc....) will be provided after lines (Line route, Line profile and Tower spotting) design is completed.
3	Resettlement of structures lived or used by people such as houses, shops, etc.	A minimum vertical clearance from the lowest conductor to the top of structures is 5m. This is applied to the transmission line (110kV) and all distribution lines (15kV) of the captioned project. Structures within ROW that do not meet the above minimum clearance, meaning the distance between the lowest conductor and the top of structures is less than 5m, are subject of resettlement.
4	Resettlement of trees	All trees within ROW must be removed.
5	Resettlement of other objects	Other objects within ROW not meeting the minimum clearance will be evaluated based on social impacts and safety.

N.B:

The minimum clearance for this project is established with reference to the international standards such as IEC and other good practice. The clearance is set with an additional distance as a precautionary safety measure.

Bikorgiki William
Ag. Head of ETU,
16/04

Kazungu Fredrick
Project Manager (JICA-2 Projects)
16/04/2015

APPENDIX 3: LIST OF PUBLIC CONSULTED

Attendance list of the PAPs during the Public Consultation in Bumbogo Sector in Gasabo District with the Consultant & EDCL

Date: 11-05-2015

NAMES	Contacts/Adress	Tel.	Signature
SANTWARO Richard	EARP/EDCL	0788361654	
Bayingana desire	pitnad/ibamba	0788284527	
Mukamanzi Emerithe	Bumbogo(Gasabo)	0784722962	
Mukakarega Juliana	Bumbogo(Gasabo)	—	
mukapfizi Sirivia	Bumbogo/Gasabo	0783136712	
Hitimunoinzi Ignace	Bumbogo, Gasabo	0788517918	
Ngendahayo Edward	Bumbogo/Gasabo	0788652888	
TWIZERIMANA Cyprien	Bumbogo (GASABO)	0788594470	
Hashiko Aimable	BUMBOGO	0788479979	
NZIRAGIZA Samuel	BUMBOGO/GASABO	0788281674	
Gasigwa Emmanuel	bumbogo gasabo	0784057135	
Rwabigwi Théoneste	Social Economic Development Officer/Musave	078844531	
Iyakaremye Edward	Bumbogo	0788635660	
Songa Gilbert	Ew Excellence Consultancy Ltd	0788356191	

11/05/2015

Rwabigwi Théoneste

Sedo /Musave

Date: 12/05/...

Name	Contacts/Adresse	Telephone	Signature
1. Songa Silvan	Eco-Excellence Consultancy Ltd	0788356191	[signature]
1. Mukamtwali Jeanviere	Kinyaga	~~0788399393~~ 0788410471	—
2. HORANIMPUNDU MONIQUE	KINYAGA	0783072816	—
3. Kayihura Emile	Kinyaga	0787370345 / 0788567498	—
4) KARANGWA Casimir	KINYAGA	0782022744	—
5 Hodari J. claude	Kinyaga	0788465486	
6. HABIYAMBERE Sylvestre	Kinyaga	0788409306 / 0788307042	[illegible]

ATTENDANCE LIST OF PAPS IN NDERA SECTOR DURING THE PUBLIC CONSULTATIONS

NAMES	ADRESS	TEL.NUMBER	SIGNATURE
Richard Sangabo	REG/EARP	0788861654	
Kozifuku Claude	NDERA		
Kahemora Callixte	Ndera		
Muzima Richard	Masaka	0788475101	
Ndayisenga Jean Damascène	Cyaruzinge-Gasagara	0783334951	
Gashugura Jean Pierre	Cyaruzinge-Gasagara	0782781549	
Bizumuremyi Jean	Kibenga-Rurunga	-	
Mukamurenzi Francine	Rudashya-Rubingo	-	
Nkubito Eclomir	Cyaruzinge Kabuye	0783380204	
Uzamukunda Beatrice	Gitaraga - Kibenga	- - - - - -	
Akimana Marguerite	Gitaraga - Kibenga		
Uzarora Yohani	Gitaraga - Kibenga		
Muhirwa Daniel	Kibenga Rurunga	0788777956	
UWIMANA J. Baptiste	BURUNGA-KIBENGA	0788726358	
IYAMUREMYE Celestin	BURUNGA - KIBENGA	0788033180	
KABANDANA ATHANASE	BURUNGA	0788828122	
Ingabire	BURUNGA	0788355083	
AYIRWANDA MARGARITA			
HABINEZA	0788498965		
Bisengimana Marco	0788676620	0781080778	

Attendance list of PAPs during the Public consultations in Rusororo Sector

NAMES	ADDRESS	TEL.	SIGNATURE
SANGABO Richard	EARP/REG	0788361654	[signature]
Bayingana desire	pitand/ibamba	0788284322	[signature]
Ngabo William	Africa mission Alliance	0788302679 / 0788800996	[signature]
NBUyeimanaNoël	Githarala	0788502436	[signature]
Hakizimana Stanislas	gisharara	0788/38734	[signature]
Senga Silvan	Eco-Excellent Consult Ltd	0788356/61	[signature]

Byemejwe n'Umuyobozi w'Akagari ka Nyagahinga

E/S HABIYAREMYE Robert

APPENDIX 4: CENSUS SURVEY FORM

Annex 1

Socio-economic data on PAPs of ………………………………………………………………………….

Construction of poles at…………………………………….

Names of Evaluator……………………………………………………………………………………………………

No	Names of	ID No	Hh head status	Hh head age	Hh head ocupation	Total hh no	Adults	Children	Males	Females	Disabled or old	Belongs to any CBO	Other signatories	Asset los	Characteristic & building material	Area taken under construction of poles	Area taken under construction of control cabins amazi	Costs	crops in the area under construction of poles

Picture o No…………………….

Picture of land to be acquired/infrastructures to be destroyed

MININFRA- REG **Project: Improvement of Substation and Distribution Network Phase 2** **IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO**	**Fiche no:01**

Amazina ya nyiribintu: BIZUMUREMYI JEAN **Acc. number:………………………………. Izina rya Banki……………** **Tel: ya nyiribintu: 0782886053** **I.D.N° :** **Akarere : GASABO** **Umurenge : NDERA** **Akagali : KIBENGA** **Umudugudu : BURUNGA**	**Byemejwe n'Akarere ka GASABO** **Cachet et Signature** **Date:**	**Amazina n' umukono by' uwabaruye** **Date:**

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP1	15-TD1	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.5	147424.00
			Igiteranyo cy'ubutaka				**147424.00**
II			**Ibimera**				
2.1			Ibishyimbo	m^2	128.00	80.00	10240.00
2.2			Ibigori	m^2	128.00	72.00	9216.00
2.3			Insina	Pce	12.00	1488.0	17856.00
2.4			Avoka nkuru	Pce	2.00	16000.00	32000.00
			Igiteranyo cy'ibimera				**69312.00**
			Igiteranyo cya byose hamwe				**216,736**

MININFRA- REG **Project: Improvement of Substation and Distribution Network Phase 2** **IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO**	**Fiche no:02**

Amazina ya nyiribintu: MUKAGACINYA HERENE **Acc. number:………………………………. Izina rya Banki……………** **Tel: ya nyiribintu: 0788564982** **I.D.N° :** **Akarere : GASABO** **Umurenge : NDERA** **Akagali : KIBENGA** **Umudugudu : BURUNGA**	**Byemejwe n'Akarere ka GASABO** **Cachet et Signature** **Date:**	**Amazina n' umukono by' uwabaruye** **Date:**

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-2; AP1..AP2	15-PB1	**Ubutaka**				
1.1			Ubutaka	m^2	9.00	2303.5	20731.50
			Igiteranyo cy'ubutaka				**20731.50**
II			**Ibimera**				
2.1			Ibishyimbo	m^2	9.00	80.00	720.00
2.2			Insina	Pce	5.00	1488.00	7440.00
			Igiteranyo cy'ibimera				**8160.00**
			Igiteranyo cya byose hamwe				**28,892**

MININFRA- REG **Project: Improvement of Substation and Distribution Network Phase 2** **IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO**	**Fiche no:03**

Amazina ya nyiribintu: UWIMANA JEAN BAPTISTE **Acc. number:………………………………. Izina rya Banki……………** **Tel: ya nyiribintu: 0788726358** **I.D.N° : 1198180131028198** **Akarere : GASABO** **Umurenge : NDERA** **Akagali : KIBENGA** **Umudugudu : BURUNGA**					**Byemejwe n'Akarere ka GASABO** **Cachet et Signature** **Date:**		**Amazina n' umukono by' uwabaruye** **Date:**
N°	**N° de pylone/ N° of tower**	**Type de pylone/ Type of tower**	**Item damaged/Biens endommages/ibintu byononwe**	**Unit Ikintu/Ubuso**	**Quantity/ Quantite/ Umubare**	PRIX UNIT	PRIX TOTAL
I	**DL1-3; AP1..AP2**	**15-PB1**	**Ubutaka**				
1.1			Ubutaka	m^2	212.00	2303.5	488342.00
			Igiteranyo cy'ubutaka				**488342.00**
II			**Inkuta n'ibizikozeho**				
2.1			Inkuta zubakishije ibiti n'	m^3	14.21	13691.0	194521.73
2.2			Ibishahuro by'ibyondo	m^2	142.08	1908.0	271088.64
			Igiteranyo cy'ubutaka				**465610.37**
III			**Igisenge**				
3.1			Amabati asanzwe n'ibiti b	m^2	33.75	5695.0	192206.25
			Igiteranyo cy'igisenge				**192206.25**
IV			**Amadirishya n'inzugi**				
4.1			Urugi rwa planchette	Pce	1.00	34975.0	34975.00
4.2			Amadirishya y'imbaho	m^2	0.64	29025.0	18576.00
			Igiteranyo cy'amadirishya n'inzugi				**53551.00**
V			**Ibimera**				
5.1			Ibishyimbo	m^2	72.00	80.00	5760.00
5.2			Insina	Pce	5.00	1488.00	7440.00
5.3			Ibigori	m^2	72.00	72.00	5184.00
5.4			Imiyenzi	Pce	15.00	100.00	1500.00
5.5			Imihati	Pce	26.00	100.00	2600.00
5.6			Avoka nkuru	Pce	1.00	16000.00	16000.00
			Igiteranyo cy'ibimera				**38484.00**
			Igiteranyo cya byose hamwe				**1,238,194**

MININFRA- REG **Project: Improvement of Substation and Distribution Network Phase 2** **IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO**							**Fiche no:04**
Amazina ya nyiribintu: HABINEZA FAUSTIN **Acc. number:………………………………. Izina rya Banki……………** **Tel: ya nyiribintu: 0782498965** **I.D.N° :** **Akarere : GASABO** **Umurenge : NDERA** **Akagali : KIBENGA** **Umudugudu : BURUNGA**					**Byemejwe n'Akarere ka GASABO** **Cachet et Signature** **Date:**		**Amazina n' umukono by' uwabaruye** **Date:**
N°	**N° de pylone/ N° of tower**	**Type de pylone/ Type of tower**	**Item damaged/Biens endommages/ibintu byononwe**	**Unit Ikintu/Ubuso**	**Quantity/ Quantite/ Umubare**	PRIX UNIT	PRIX TOTAL
I	**DL1-4; AP1..AP2**	**15-PB1**	**Ubutaka**				
1.1			Ubutaka	m^2	220.72	2302.5	508207.80
			Igiteranyo cy'ubutaka				**508207.80**
II			**Ibimera**				
2.1			Inyanya	m^2	220.72	400.00	88288.00
			Igiteranyo cy'ibimera				**88288.00**

			Igiteranyo cya byose hamwe			596,496

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:05

Amazina ya nyiribintu: SUCCESSION SEMARORA,AYIRWANDA MARGUARETTE / UZAMUKUNDA

Acc. number: 5020 Izina rya Banki SACCO NDERA
Tel: ya nyiribintu: 0788777956
I.D.N^o : 1192570000139031 / 1196470003536085
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	N^o de pylone/ N^o of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-5; AP1..AP2	15-PB1	**Ubutaka**				
1.1			Ubutaka	m^2	9.00	2303.5	20731.50
			Igiteranyo cy'ubutaka				**20731.50**
II			**Ibimera**				
2.1			Ibigori	m^2	48.00	72.00	3456.00
2.2			Imyumbati	Pce	7.00	286.00	2002.00
2.3			Insina	Pce	7.00	1488.00	10416.00
2.4			Umwembe mukuru	Pce	3.00	5340.00	16020.00
2.5			Ipapaye	Pce	1.00	2000.00	2000.00
2.6			Umusave	Pce	3.00	4500.00	13500.00
			Igiteranyo cy'ibimera				**47394.00**
			Igiteranyo cya byose hamwe				**68,126**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:06

Amazina ya nyiribintu: MAHIRANYE DANIEL

Acc. number: 401-2868978-11. Izina rya Banki BPR
Tel: ya nyiribintu: 0788777956
I.D.N^o : 1198480015407076
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	N^o de pylone/ N^o of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	Between AP1..AP2	None	**Ibimera**				
1.1			Imiyenzi	Pce	3.00	150.00	450.00
1.2			Avoka nkuru	Pce	1.00	16000.00	16000.00
1.3			Isombe	Pce	3.00	1200.00	3600.00
1.4			Inturusu nkuru	Pce	1.00	2400.00	2400.00
1.5			Umusave	Pce	5.00	4500.00	22500.00
1.6			Insina	Pce	10.00	1488.00	14880.00
			Igiteranyo cy'ibimera				**59830.00**
			Igiteranyo cya byose hamwe				**59,830**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2

Fiche no:07

IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO		
Amazina ya nyiribintu: NYIRANDEGE MARTHE Acc. number: 8337 Izina rya Banki SACCO NDERA Tel: ya nyiribintu: 0783334951 I.D.N° : 1194570000792076 Akarere : GASABO Umurenge : NDERA Akagali : CYARUZINGE Umudugudu : GASHURE	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP-2	15-TD1	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Avoka nkuru	Pce	3.00	16000.00	48000.00
2.2			Kasiya	Pce	4.00	5300.00	21200.00
2.3			Passparme	Pce	64.00	180.00	11520.00
			Igiteranyo cy'ibimera				**80720.00**
			Igiteranyo cya byose hamwe				**228,144**

MININFRA- REG Project: Improvement of Substation and Distribution Network Phase 2 IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO		Fiche no:08
Amazina ya nyiribintu: NDUWAYO Frolbert Acc. number: 7010258 Izina rya Banki CSS Tel: ya nyiribintu: 0788450440 I.D.N° : 1198080020976011 Akarere : GASABO Umurenge : NDERA Akagali : CYARUSIGA Umudugudu : GASHURE	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-7; AP2....AP3	15-PB1	**Ubutaka**				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
1.2			**Igiteranyo cy'ubutaka**				**20731.50**
II			**Ibimera**				
2.1			Inyanya	Pce	36.00	400.00	14400.00
2.2			Imyumbati	Pce	14.00	286.00	4004.00
			Igiteranyo cy'ibimera				**18404.00**
			Igiteranyo cya byose hamwe				**39,136**

MININFRA- REG Project: Improvement of Substation and Distribution Network Phase 2 IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO		Fiche no:09
Amazina ya nyiribintu: NDUWAYO Frolbert Acc. number: 7010258 Izina rya Banki CSS Tel: ya nyiribintu: 0788450440 I.D.N° : 1198080020976011	Byemejwe n'Akarere ka GASABO Cachet et Signature	Amazina n' umukono by' uwabaruye

Akarere : GASABO Umurenge : NDERA Akagali : CYARUSIGA Umudugudu : GASHURE					Date:		Date:
N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-8; AP2...AP3	15-PB1	Ubutaka				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
1.2			Igiteranyo cy'ubutaka				20731.50
II			Ibimera				
2.1			Ibigori	m^2	96.00	72.00	6912.00
			Igiteranyo cy'ibimera				6912.00
			Igiteranyo cya byose hamwe				27,644

MININFRA- REG Project: Improvement of Substation and Distribution Network Phase 2 IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO		Fiche no:10
Amazina ya nyiribintu: NKORERIMANA Eimable Acc. number:………………………………………………………….. Tel: ya nyiribintu: 0784951106 I.D.N° : Akarere : GASABO Umurenge : NDERA Akagali : KIBEGA Umudugudu : GITARAGA	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP3	15-PA1	Ubutaka				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			Igiteranyo cy'ubutaka				147424.00
II			Ibimera				
2.1			Inyanya	m^2	64.00	72.00	4608.00
2.2			Insina	Pce	8.00	1488.00	11904.00
2.3			Isombe	Pce	1.00	1200.00	1200.00
2.4			Ikinyomoro	Pce	1.00	1000.00	1000.00
2.5			Ubwansi bw'inka	Pce	8.00	350.00	2800.00
			Igiteranyo cy'ibimera				21512.00
			Igiteranyo cya byose hamwe				168,936

MININFRA- REG Project: Improvement of Substation and Distribution Network Phase 2 IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO		Fiche no: 11
Amazina ya nyiribintu: NYIKO ANDREW Acc. number: …………………………………………………………. Tel: ya nyiribintu: I.D.N° : Akarere : GASABO Umurenge : NDERA Akagali : KIBEGA Umudugudu : GITARAGA	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

	N° de		Item damaged/Biens		Quantity/		

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-10; AP3..AP4	15-PB1	Ubutaka				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
			Igiteranyo cy'ubutaka				20731.50
			Igiteranyo cya byose hamwe				20,731.50

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO — **Fiche no:12**

Amazina ya nyiribintu: NYIKO ANDREW Acc. number: …………………………………………………….. Tel: ya nyiribintu: 0782781549 I.D.N° : Akarere : GASABO Umurenge : NDERA Akagali : KIBEGA Umudugudu : GITARAGA	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-11; AP3..AP4	15-PB1	Ubutaka				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
			Igiteranyo cy'ubutaka				20731.50
II			Ibimera				
2.1			Inturusu nkuru	Pce	25.00	4000.00	100000.00
2.2			Inturusu iriganiye	Pce	48.00	2400.00	115200.00
2.3			Inturusu ntoya	Pce	95.00	300.00	28500.00
			Igiteranyo cy'ibimera				243700.00
			Igiteranyo cya byose hamwe				264,432

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO — **Fiche no:13**

Amazina ya nyiribintu: NTAGUJYIRA EIMABLE Acc. number: ………………………………………. Izina rya Tel: ya nyiribintu: 0788305372 I.D.N° : Akarere : GASABO Umurenge : NDERA Akagali : KIBEGA Umudugudu : GITARAGA	Byemejwe n'Akarere ka GASABO Cachet et Signature Date:	Amazina n' umukono by' uwabaruye Date:

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL-12;	15-PB1	Ubutaka				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
			Igiteranyo cy'ubutaka				20731.50
II			Ibimera				
2.1			Inturusu nkuru	Pce	36.00	4700.00	169200.00
2.2			Inturusu iriganiye	Pce	62.00	2400.00	148800.00
2.3			Inturusu nyoya	Pce	85.00	300.00	25500.00
			Igiteranyo cy'ibimera				343500.00
			Igiteranyo cya byose hamwe				364,232

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:14

Amazina ya nyiribintu: MUZIMA RICHARD

Acc. number: 401-2008621-11 Izina rya Banki BPR
Tel: ya nyiribintu: 0788475101
I.D.N° : 1198280185802036
Akarere : GASABO
Umurenge : CYARUZINGE
Akagali : KIBEGA
Umudugudu : GATARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP4	15-TD1+2	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
			Igiteranyo cy'ubutaka				**147424.00**
II			**Ibimera**				
2.1			Inturusu nkuru	Pce	22.00	2400.00	52800.00
2.1			Urubingo	m^2	64.00	350.00	22400.00
			Igiteranyo cy'ibimera				**75200.00**
			Igiteranyo cya byose hamwe				**222,624**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no: 15

Amazina ya nyiribintu: KAYIGIRE EMELINE

Acc. number: ……………………………………………………………..
Tel: ya nyiribintu: 0782781549
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-14; AP4..AP5	15-TB1+2	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Imyumbati	Pce	22.00	286.00	6292.00
2.2			Kasiya	Pce	29.00	5300.00	153700.00
2.3			Inturusu nkuru	Pce	6.00	2400.00	14400.00
2.4			Imiyenzi	Pce	4.00	150.00	600.00
2.5			Umunyinya	Pce	1.00	1000.00	1000.00
			Igiteranyo cy'ibimera				**175992.00**
			Igiteranyo cya byose hamwe				**323,416**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no: 16

Amazina ya nyiribintu: MUSHIMIYIMANA PEACE na SEBAGABO MARCELLIN

Acc. number: ………………………………………………. Izina

Byemejwe n'Akarere ka GASABO

Amazina n' umukono by' uwabaruye

Tel: ya nyiribintu: 0788559543
I.D.N° : 1197670006618028 / 1196980003854023
Akarere : GASABO
Umurenge : NDERA
Akagali : CYARUZINGE
Umudugudu : GATARE

Cachet et Signature

Date:

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	**DL1-15; AP4..AP5**	**15-TB1**	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Ubwansi bw'inka	Pce	1280.00	350.00	448000.00
2.2			Insina	Pce	103.00	1488.00	153264.00
2.3			Inturusu nkuru	Pce	289.00	4000.00	1156000.00
2.4			Inturusu iriganiye	Pce	446.00	2400.00	1070400.00
2.5			Imiyenzi	Pce	12.00	500.00	6000.00
2.6			Gereveriya	Pce	3.00	5500.00	16500.00
2.7			Ipapayi	Pce	4.00	1000.00	4000.00
2.8			Cypre iriganiye	Pce	1.00	4500.00	4500.00
			Igiteranyo cy'ibimera				**2858664.00**
			Igiteranyo cya byose hamwe				**3,006,088**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:17

Amazina ya nyiribintu: KAREMERA CALISTE

Acc. number: …………………………………………………………….
Tel: ya nyiribintu:
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	**AP4..AP5**	None	**Ibimera**				
			Insina	Pce	53.00	1488.00	78864.00
			Igiteranyo cy'ibimera				**78864.00**
			Igiteranyo cya byose hamwe				**78,864**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:18

Amazina ya nyiribintu: SIBOMANA SELESTINE na MANIRAGABA VIVIANE

Acc. number: ……………………………………………………….
Tel: ya nyiribintu: 0788844409
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N° de	Item damaged/Biens	Quantity/

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP5	15-TD1+2	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Imigwegwe	Pce	104.00	350.00	36400.00
2.2			Cypre ziriganiye	Pce	8.00	4500.00	36000.00
2.3			Inturusu nkuru	Pce	46.00	5300.00	243800.00
2.4			Inturusu iriganiye	Pce	34.00	2400.00	81600.00
2.5			Inturusu ntoya	Pce	27.00	300.00	8100.00
2.6			Imiyenzi	Pce	28.00	150.00	4200.00
2.7			Imigano	Pce	2.00	300.00	600.00
			Igiteranyo cy'ibimera	Pce			**410700.00**
			Igiteranyo cya byose hamwe				**558,124**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no: 18

Amazina ya nyiribintu: FURAHA DATIVA

Acc. number: …………………………………………………….
Tel: ya nyiribintu:
I.D.N°   :
Akarere   : GASABO
Umurenge : NDERA
Akagali   : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP6	15-TD1+2	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Voka nkuru	Pce	2.00	16000.00	32000.00
2.2			Jakaranda	Pce	5.00	5500.00	27500.00
2.3			Inturusu nkuru	Pce	1.00	2400.00	2400.00
			Igiteranyo cy'ibimera	Pce			**61900.00**
			Igiteranyo cya byose hamwe				**209,324**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:19

Amazina ya nyiribintu: RUGOMBANA ZEFANIA

Acc. number: ………………………………………………………….
Tel: ya nyiribintu: 0785747485
I.D.N°   :
Akarere   : GASABO
Umurenge : NDERA
Akagali   : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-19; AP6	15-TB1	**Ubutaka**				

1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Ibigori	Pce	64.00	72.00	4608.00
2.2			Ibishyimbo	Pce	64.00	80.00	5120.00
2.3			Imyumbati	Pce	24.00	130.00	3120.00
2.4			Isombe	Pce	2.00	1200.00	2400.00
2.5			Umwembe mukuru	Pce	1.00	5340.00	5340.00
2.6			Avoka nkuru	Pce	3.00	16000.00	48000.00
2.7			Insina	Pce	11.00	1488.00	16368.00
2.8			Umusave muto	Pce	2.00	6500.00	13000.00
			Igiteranyo cy'ibimera				**97956.00**
			Igiteranyo cya byose hamwe				**245,380**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:20

Amazina ya nyiribintu: KAREGEYA EGIDE

Acc. number: ,,, Izina rya
Tel: ya nyiribintu:
I.D.N^o : 1196880008549058
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	**N^o de pylone/ N^o of tower**	**Type de pylone/ Type of tower**	**Item damaged/Biens endommages/ibintu byononwe**	**Unit Ikintu/Ubuso**	**Quantity/ Quantite/ Umubare**	PRIX UNIT	PRIX TOTAL
I	**AP6..AP7**	None	**Ibimera**				
1.1			Inturusu nkuru	Pce	66.00	2400.00	158400.00
1.2			Inturusu ntoya	Pce	68.00	300.00	20400.00
1.3			Gereveriya ziriganiye	Pce	16.00	4500.00	72000.00
1.4			Kasiya	Pce	19.00	4700.00	89300.00
1.5			Imigwegwe	Pce	13.00	350.00	4550.00
1.6			Jakaranda	Pce	1.00	5500.00	5500.00
			Igiteranyo cy'ibimera				**350150.00**
			Igiteranyo cya byose hamwe				**350,150**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:21

Amazina ya nyiribintu: AYIRWANDA Eugene

Acc. number: …………………………………………………………………….
Tel: ya nyiribintu: 0788394095
I.D.N^o : 1197580099722157
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBEGA
Umudugudu : GITARAGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^O	**N^o de pylone/ N^o of tower**	**Type de pylone/ Type of tower**	**Item damaged/Biens endommages/ibintu byononwe**	**Unit Ikintu/Ubuso**	**Quantity/ Quantite/ Umubare**	PRIX UNIT	PRIX TOTAL
I	**AP6..AP7**	None	**Ibimera**				
1.1			Imitagara	Pce	10.00	5200.00	52000.00
1.2			Firawo	Pce	4.00	6500.00	26000.00
1.3			Cypres	Pce	2.00	5500.00	11000.00
1.4			Kasiya	Pce	4.00	4700.00	18800.00
1.5			Umusave	Pce	1.00	4500.00	4500.00

1.6			Insina	Pce	4.00	1488.00	5952.00
1.7			Isombe	Pce	1.00	1200.00	1200.00
1.8			Avoka ntoya	Pce	1.00	5510.00	5510.00
1.9			Amapera mato	Pce	1.00	3550.00	3550.00
			Igiteranyo cy'ibimera				**128512.00**
			Igiteranyo cya byose hamwe				**128,512**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:22

Amazina ya nyiribintu: NZARIVUGANKITE JEAN BOSCO ,MUGIRANEZA BERNARD ,MUNYAKAYANZA SYLIVESTRE
Acc. number: …………………………………………………….
Tel: ya nyiribintu:
I.D.N° : 1198180013078058 / 119780011192090 /
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruve

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-22; AP6..AP7	15-PB1	**Ubutaka**				
1.1			Ubutaka	m^2	222.00	2303.50	511377.00
1.2			**Igiteranyo cy'ubutaka**				**511377.00**
II			**Ibimera**				
2.1			Imyumbati	Pce	55.00	286.00	15730.00
2.2			Kasiya	Pce	18.00	4700.00	84600.00
2.3			Insina	Pce	2.00	1488.00	2976.00
2.4			Umusave muto	Pce	1.00	6500.00	6500.00
			Ubwatsi bw'inka	m^2	36.00	350.00	12600.00
			Igiteranyo cy'ibimera				**122406.00**
			Igiteranyo cya byose hamwe				**633,783**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:23

Amazina ya nyiribintu: ABIYINGOMA ANISIA
Acc. number: ………………………………………………………...
Tel: ya nyiribintu: 0788747334
I.D.N° : 1196370003471018
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruve

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-23; AP6..AP7	15-PB1	**Ubutaka**				
1.1			**Ubutaka**	m^2	32.00	2303.5	73712.00
			Igiteranyo cy'ubutaka				**73712.00**
II			**Ibimera**				
2.1			Cypres ntoya	Pce	2.00	1200.00	2400.00
2.2			Cypres iriganiye	Pce	5.00	5500.00	27500.00
2.3			Inturusu ntoya	Pce	450.00	300.00	135000.00
2.4			Inturusu iriganiye	Pce	120.00	720.00	86400.00
2.5			Imigwegwe	Pce	5.00	350.00	1750.00

			Igiteranyo cy'ibimera				**253050.00**
			Igiteranyo cya byose hamwe				**326,762**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:24

Amazina ya nyiribintu: NYIRAHABIMANA Lourence

Acc. number: 426223136811 Izina rya Banki BPR NDERA
Tel: ya nyiribintu: 0788658390
I.D.N° : 1195870002423041
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	**AP7**	**15-TD1**	**Ubutaka**				
1.1			Ubutaka	m^2	64.00	2303.50	147424.00
1.2			**Igiteranyo cy'ubutaka**				**147424.00**
II			**Ibimera**				
2.1			Inturusu ntoya	Pce	935.00	300.00	280500.00
2.2			Inturusu iriganiye	Pce	950.00	720.00	684000.00
2.3			Inturusu nkuru	Pce	1400.00	2400.00	3360000.00
2.4			Cypres ntoya	Pce	345.00	1200.00	414000.00
2.5			Cypres iriganiye	Pce	785.00	4000.00	3140000.00
2.6			Cypres nkuru	Pce	1220.00	5500.00	6710000.00
2.7			Imigwegwe	Pce	15.00	350.00	5250.00
			Igiteranyo cy'ibimera				**14593750.00**
			Igiteranyo cya byose hamwe				**14,741,174**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:25

Amazina ya nyiribintu: MUSABIMANA Gaudance

Acc. number: ………………………………………………………………
Tel: ya nyiribintu: 0788772222/0788830644
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	**DL1-25; AP-7**	**15-PB1**	**Ubutaka**				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
1.2			**Igiteranyo cy'ubutaka**				**20731.50**
II			**Ibimera**				
2.1			Inturusu ntoya	Pce	18.00	300.00	5400.00
2.2			Inturusu iriganiye	Pce	19.00	720.00	13680.00
2.3			Inturusu nkuru	Pce	9.00	2400.00	21600.00
			Igiteranyo cy'ibimera				**40680.00**
			Igiteranyo cya byose hamwe				**61,412**

MININFRA- REG

Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO
Fiche no:26

Amazina ya nyiribintu: NYAMVURA OLIVER

Acc. number: …………………………………………………………………...
Tel: ya nyiribintu: 0727762606 / 0781103807
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruve

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-26; AP7	15-PA1	**Ubutaka**				
1.1			Ubutaka	m^2	9.00	2303.50	20731.50
1.2			**Igiteranyo cy'ubutaka**				**20731.50**
II			**Ibimera**				
2.1			Ibijumba	Pce	8.00	240.00	1920.00
2.2			Umuco	Pce	1.00	1000.00	1000.00
			Igiteranyo cy'ibimera				**2920.00**
			Igiteranyo cya byose hamwe				**23,652**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO
Fiche no:27

Amazina ya nyiribintu: HAKIZIMANA Ernest

Acc. number: ………………………………………………………………
Tel: ya nyiribintu: 0782661956
I.D.N° : 1199280120908047
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N°	N° de pylone/ N° of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
II	AP-7..AP-8	None	**Ibimera**				
2.1			Inturusu ntoya	Pce	65.00	300.00	19500.00
			Inturusu iriganiye	Pce	49.00	720.00	35280.00
2.2			Inturusu nkuru	Pce	30.00	2400.00	72000.00
			Igiteranyo cy'ibimera				**126780.00**
			Igiteranyo cya byose hamwe				**126,780**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO
Fiche no:28

Amazina ya nyiribintu: MUKAMPUGA FRANCINE

Acc. number: ………………………………………………………………
Tel: ya nyiribintu:0789211906
I.D.N° :
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruve

Date:

Umudugudu : RUHANGARE

N^{O}	N^{o} de pylone/ N^{o} of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	DL1-28; AP-7	15-PB1	**Ubutaka**				
1.1			Ubutaka	m^{2}	9.00	2303.50	20731.50
1.2			**Igiteranyo cy'ubutaka**				**20731.50**
II			**Ibimera**				
2.1			Cypres nkuru	Pce	2.00	6500.00	13000.00
2.2			Ibibonobono	Pce	5.00	400.00	2000.00
			Umusave	Pce	3.00	4500.00	13500.00
			Isombe	Pce	1.00	1200.00	1200.00
			Igiteranyo cy'ibimera				**28500.00**
			Igiteranyo cya byose hamwe				**49,232**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:29

Amazina ya nyiribintu: KAYIJUKA CLAUDE

Acc. number: …………………………………………………..
Tel: ya nyiribintu:
I.D.N^{o} : 1195280001867031
Akarere : GASABO
Umurenge : NDERA
Akagali : RUDASHYA
Umudugudu : RUHANGARE

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^{O}	N^{o} de pylone/ N^{o} of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP7	None	**Ibimera**				
1.1			Umusave	Pce	2.00	4500.00	9000.00
1.2			Isombe	Pce	6.00	1200.00	7200.00
1.3			Insina	Pce	11.00	1488.00	16368.00
1.4			Imiravumba	Pce	1.00	1200.00	1200.00
			Igiteranyo cy'ibimera				**33768.00**
			Igiteranyo cya byose hamwe				**33,768.00**

MININFRA- REG
Project: Improvement of Substation and Distribution Network Phase 2
IBARURA RY'IBINTU BYATEMWE/BYONONWE MU KARERE KA GASABO

Fiche no:30

Amazina ya nyiribintu: MUGIRANEZA XAVIER

Acc. number: ……………………………………………………………..
Tel: ya nyiribintu: 0789794924
I.D.N^{o} : 1196480003533018
Akarere : GASABO
Umurenge : NDERA
Akagali : KIBENGA
Umudugudu : BURUGA

Byemejwe n'Akarere ka GASABO

Cachet et Signature

Date:

Amazina n' umukono by' uwabaruye

Date:

N^{O}	N^{o} de pylone/ N^{o} of tower	Type de pylone/ Type of tower	Item damaged/Biens endommages/ibintu byononwe	Unit Ikintu/Ubuso	Quantity/ Quantite/ Umubare	PRIX UNIT	PRIX TOTAL
I	AP-1	None	**Ibimera**				
1.1			Umusave uriganiye	Pce	21.00	4500.00	94500.00
1.2			Imihati	Pce	7.00	500.00	3500.00
1.3			Umwembe mukuru	Pce	1.00	5340.00	5340.00

1.4			Avoka nkuru	Pce	3.00	16000.00	48000.00
1.5			Muringa	Pce	2.00	7500.00	15000.00
			Igiteranyo cy'ibimera				**166340.00**
			Igiteranyo cya byose hamwe				**166,340**

Annex 1

Socio-economic data ....

Construction of poles at.............................. BUMBOGO

Names of Evaluator.................................... JEROME CHARLES

No	Names of hh members	ID No	Hh head status	Hh head age	Hh head ocupation	Total hh no	Adults	Children	Males	Females	Disabled or old	Belongs to any CBO	Other signatories	Asset lost	Characteristic & building material	Area taken under construction of poles	Area taken under construction of control cabins amazi	Costs	crops in the area under construction of poles
1	Innocent nzamwera	no 1196680001797082	male	49	famer	4	2	2	1	3				house and crops	bricks	73*24			maize,beans,avocado, trees and bananas
2	gasigwa emmanuel	no 1197880005164069	male	37	famer	7	3	4	3	4				land and eucalptus		282			eucalptus
3	inyasi hitamungu	no 1195880002825091	male	57	businessman	14	4	10	6	8				land and crops		33*26			beans,bananas
4	mukarengwa juliena	no 1198080094050009	female	35	employer	4	2	2	3	1				land and crops		20*26			beans,bananas,maze and casava
5	edouard ngendahayo	no11980800940500039	male	35	business	13	10	3	7	6				land and crops		26*18			maze,pinaple,banana,casava, avocado trees
6	urayeneza protais	no 119880007457005	male	31	technician	3	2	1	1	2	no	no	no	land and crops		16*21			mango tree,avocado tree,pineaple,maze
7	iyakaremye edouard	no 11961800053191	male	54	driver	7	2	5	2	5	no	no	no	land and crops		16*21			beans,maze,banana,avocado
8	habiyaremye sylvestre	no 11959800024708018	male	56	judge	12	3	9	4	8	no	no	no	crops					maze,bananas,beans,goese
9	kayihura emile	no 1197080077587015	male	45										land		12*12			
10	mukantwari	no 1196070002534041	male	55	business	4	4	4			no	no	no	land and crops		21*36	no		casava,beans,avocado,bananas
11	gasana pasteur	no 119700009197094	male	45	business	10	4	6	8	2	no	no	no	land and eucarptus		49*47	no		ecarptus
12	musabiba valerie	no 1195670001688002	female	59	pasassion	9	2	5	3	6	NO	NO	NO	land and crops	land critiveted	239			bananas,pinaple,avocados,cassava
13	mukandutiye console	no 11584700075350550	female	34	business	5	3	2	3	2	no	no	no	land and crops	land critiveted	17*88			eucartus,beans,maize
14	karurangwa antoni		male	50	famer	6	2	4	4	2	no	no	no	house and crops	bricks	29*27			maize,bananas,avoceansados,b
15	mashiro aimable	no 1197180002071077	male	44	business	4	2	2	2	2				land and crops		20*20			bananas,grasse areas,pinaple,avocados

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[Attachment]

Attachment – 1 Member List of the Study Team

Attachment – 2 Work Demarcation for Transmission Line, Distribution Line and Ring Main Unit

Attachment – 3 Tentative implementation schedule

1. Outline of the Project

1.1 Background of the Project

In response to the request from the Government of the Republic of Rwanda (Rwanda), 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 Substations and Distribution Network Phase 2 (the Project).

JICA sent to Rwanda the Preparatory Survey Team (the Team) headed by Mr. Toshiyuki Hayashi, Senior Advisor, JICA, to conduct the first field survey and the Team is scheduled to stay in the country from 8^{th} March to 16^{th} April, 2015.

The Team continued discussions with the concerned officials of Rwanda and the field survey in Rwanda.

EDCL, EUCL 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. EDCL, EUCL and the Team agreed to record the following issues described on this Field Report as a conclusion of the discussions.

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

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. EDCL and EUCL expressed understanding about the schedule and procedures of Japan's Grant Aid projects. <u>EDCL and EUCL 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.</u>

1.2 Framework for the Project

The framework for the Project is shown as follows.

(1) The responsible ministry is Ministry of Infrastructure (MININFRA).
(2) The implementing agency is Energy Development Corporation Limited (EDCL).
(3) The relevant organization is Energy Utility Corporation Limited (EUCL).

1.3 The Scope of the Japanese side

The Scope of the Japanese side is shown in Table 1.3-1 and DWG. No. GA-01.

Two (2) sets of 110/15 kV transformers (20 MVA, Outdoor type) shall be installed as the scope of the Japanese side.

Table 1.3-1 Outline of the Final Components

Components	Capacity
Procurement and Installation Work	
1. **Ndera substation**	
(a) 20 MVA 110/15 kV transformers	2 units
(b) 110 kV switchgear	1 set
(c) 15kV switchgear	1 set
(d) Control and supervisory facilities	1 set
2. **Transmission Line**	
(a) Two circuits of 110 kV transmission lines from the existing line between Birembo and Gasogi substations to Ndera Substation	Approx. 2.2 km
3. **Distribution Line**	
(a) Two circuits of 15 kV distribution lines from Ndera Substation to existing line between Birembo and Free Zone Phase 1 substations	Approx. 650 m
(b) One circuit of 15 kV distribution line from existing Gasogi Substation to Kabuga Ring Main Unit (RMU) Switching Station	Approx. 6.5 km
4. **Modification of existing Gasogi Substation**	
(a) 15 kV switchgear panel for outgoing feeder to Kabuga RMU Switching Station	1 set
5. **RMU Switching Stations**	
(a) RMU Switching Stations at Kabuga and Murindi.	2 sets
Procurement Work	
6. **Maintenance Tools for the Equipment of the Project**	1 lot
7. **Spare Parts for the Equipment of the Project**	1 lot
Construction Work	
8. **Foundation for the Equipment of the Project (Transformers, Towers for 110 kV Transmission Line, etc.)**	1 lot
9. **Building of the Project (Ndera substation, Kabuga and Murindi RMU Switching Stations)**	3 building

[Remark] Quantities shall be examined in the outline design.

1.4 Obligations/Undertakings of the Rwanda side for the Project

Preconditions

① The Rwanda side has agreed to conduct the environmental and social considerations required by JICA Guidelines for Environmental and Social Considerations (2010). An Abbreviated Resettlement Action Plan (ARAP) must be prepared and the land acquisition should be completed by December 2015. An approval on environmental clearance, such as EIA Certificate of Authorization as well as other relevant permits/licenses required for the implementation of the Project must be obtained in a timely manner to meet the Project schedule. An Environmental Management Plan (EMP), monitoring plan and impact mitigation measures must be prepared during an environmental assessment.

Necessary Inputs by the Rwanda side

Prior to the Commencement of the Construction Work

② To do land preparation work and leveling work before commencement of installation work by the Japanese side (refer to 2.1.7 and 2.2.2). Necessary lands are as follows:

(1) Ndera Substation

(2) 110kV connection area near tower No. 212: approx. 32 m x 38 m minimum

(3) 110kV transmission line; approx. 2.2 km

(4) 15kV distribution line for Route-1: approx. 6.5 km, refer to DWG No. DL-11

(5) 15kV distribution line for Route-2: approx. 650 m, refer to DWG No. DL-21

(6) 15kV distribution line for Route-3 approx. 200 m, refer to DWG No. DL-31

(7) Kabuga RMU switching station: 20 m x 15 m

(8) Murindi RMU switching station: 20 m x 15 m

(9) Necessary access road for constructing all transmission and distribution lines

③ To obtain permission from related authorities for 110 kV transmission lines and 15 kV distribution lines to go across the roads before commencement of installation work by the Japanese side.

④ To resettle occupants in accordance with the resettlement plan prepared at the stage of the survey in smooth manner, if necessary.

During the Construction Work

⑤ To schedule both power and communication network shutdown required for construction works of the Project, and carry out in timely manner. The Rwanda side shall also manage any issue concerning the shutdown including related procedures, and compensation to and grievances from customers.

⑥ To modify the NECC SCADA system and the Optical Network Management System to accommodate the new three stations so called Ndera substation and Kabuga & Murindi switching stations. This modification includes the additional network connection measures of the Multiplexer/SDH panel in Gasogi substation for the connection of new optic fiber cable from Kabuga switching station.

⑦ To procure and construct the communication cable (optic fiber cable) from Multiplexer/SDH panel in Murindi switching station to the existing communication network of distribution lines.

⑧ To provide the setting list of protection relays related to the Project for coordination of setting values with new relays to be supplied under the Project. The setting value change at the substations where the transmission lines connected from Ndera substation shall be conducted by the Rwanda side including necessary tests and thier records shall be presented to Japan side.

⑨ To extend 15 kV switching room with cable trench to accommodate one additional 15 kV feeder panel supplied by the Japanese side.

⑩ To secure a temporary storage yard of approximately 5,000 m^2 near the Project site during the construction period of the Project.

⑪ To implement Environmental Management Plan and mitigation measures prepared through the environmental assessment and monitor environmental and social impacts caused by the Project with an adaptive management approach.

⑫ To construct fence and gate for 110 kV connection site, refer to DWG No. TL-05.

⑬ To construct fences and gates at the project sites in accordance with the layout and arrangement of the equipment and facilities of the Project.

⑭ To dismantle the existing towers in order to implement the Project.

After the Commencement of Operation

⑮ To monitor environmental and social impacts during the operation with an adaptive management approach.

2. Technical requirements confirmed in the first field survey

2.1 Technical requirements for the Substation of the Project

2.1.1 General requirement

(a) General Design Condition

Table 2.1.1-1 Basic Conditions for the Facility Design of the Project

Items		Values
Altitude		~~Over 1,000 m upto~~ 2,000 m
Ambient Temperature	Maximum	40 ~~30~~ Degrees Centigrade
	Minimum	5 ~~13~~ Degrees Centigrade
	Mean	20 ~~22~~ Degrees Centigrade
Maximum Wind Velocity		30 m/s
Annual Rain Fall		1,450 1,128 mm/year
Seismic Force		Horizontal 0.10 G
Soil Bearing Capacity		~~40~~ t/m^2 (now on survey) 25

(b) System voltage

- 110 kV : 110 kV ± 10% (99.0 - 110 - 121.0 kV)
- 15 kV : 15 kV ± 10% (13.5 - 15 – 16.5 kV)

(c) Frequency

50 Hz ± 0.5 Hz (49.5 - 50 – 50.5 Hz)

(d) Short circuit current

According to our approximate system analysis, the following short circuit current is considered.

- 110 kV : 31.5 kA or more
- 15 kV : 25 kA or more

(e) Grounding system

- 110 kV : Solid grounding
- 15 kV : Solid grounding

(f) Pollution level for Insulator

Light (IEC-60815)

(g) Applicable Codes and Standards

As a rule, the transmission and substation system equipment shall be designed in accordance with IEC and IEC compatible standards. (JEC and so on)

2.1.2 Technical requirements for Ndera Substation

The following basic concept is applied for Ndera Substation.

- 110 kV double circuit transmission lines are connected to the substation, one is from Birembo and the other is from Gasogi substations.
- Two sets of 20 MVA transformer (T1 & T2) will be installed and parallel operation of two transformers will be conducted.
- Indoor type 15 kV switchgear with double busbar system will be installed in the new control building.
- Entire earthing system in the substation will be considered.
- One set of control and supervisory equipment will be installed.

Please refer "Single Line Diagram for Ndera Substation (Preliminary)".

Table 2.1.2-1 Equipment to be provided for Ndera Substation

No.	Equipment	Q'ty	Unit	Major Specifications
1. Ndera Substation				
(1)	110 kV Switchgear	1	lot	- 2 sets of 110 kV Feeder bay 145 kV*, 31.5 kA or more 1 set (for three phases) comprising of:- • Disconnecting Switch (DS) • Circuit Breaker (CB) • Current Transformer (CT) • DS with Earthing Switch (ES) • Voltage Transformer (VT) • Lightning Arrester (LA) - 2 sets of 110/15 kV Transformer bay 145 kV*, 31.5 kA or more 1 set (for three phases) comprising of:- • Disconnecting Switch (DS) • Circuit Breaker (CB) • Current Transformer (CT) • Lightning Arrester (LA) - 3 phases of 110 kV VT for 110 kV Busbars Note*: Taking into consideration of altitude of the site (approximately 1,500 m), the rated voltage of 110 kV system shall be 145 kV.
(2)	20 MVA, 110/15 kV Transformer	2 27 27 steps	sets	- 2 x 20 MVA Transformers with OLTC - Primary: 110 kV+/- 16% -27T - Secondary: 15 kV - Parallel operation of the two transformers is considered.
(3)	250 kVA, 15/0.4 kV Auxiliary transformer 14	1	set	- 1 x 100 kVA Transformer with NLTC - Primary: 15 kV+/- 2.5%, +/- 5.0% - Secondary: 400-230 V, Three phase, four wires The capacity will be confirmed considering the auxiliary loads in the whole substation.
(4)	Indoor type 15 kV GIS Switchgear with double busbars	1	lot	- 2 sets of 110/15 kV transformer bays 36 kV*, 1,250 A, 25 kA or more - 1 set of 15 kV coupler bay 36 kV*, 2,500 A, 25 kA or more - 8 sets of feeder bays 36 kV*, 800 A, 25 kA Note*: The rated voltage of 15 kV system shall be 36 kV, since the distribution voltage of the whole country is 30 kV, while that in Kigali city is 15 kV.
(5)	110 kV busbar	1	lot	Aluminum tubes for three phase busbars Note; The conductor fittings on the busbars for future 50 MW power plant bay will be provided.
(6)	Gantry towers	1	lot	- Dead-end gantry towers for 2 circuits of 110 kV transmission lines
(7)	Insulators	1	lot	- Support insulators for 110 kV busbar and transmission line wires at gantry towers
(8)	110 kV conductors and fittings	1	lot	- 2 sets for 110 kV transmission line bays - 2 sets for 110/15 kV transformer bays

No.	Equipment	Q'ty	Unit	Major Specifications
				- 1 set for 110 kV busbars
(9)	Towers for Grounding wires	1	lot	- 2 sets of towers for grounding wires
(10)	110 kV Control and Protection Panel for Transmission Line	1	lot	The panel includes the following devices for two (2) circuits;- - Bay control units (ABB REF670 or equivalent) - Protection relays (Areva P545 or equivalent)
(11)	110/15 kV Transformer Control Panels	2	sets	The panel includes;- - On-load tap changer control - Bay control unit (ABB RET670 or equivalent)
(12)	110/15 kV Transformer Protection Panel	1	lot	The panel includes the following devices for two (2) transformers;- - Transformer differential protection relays - Protection relays for neutral circuits
(13)	15 kV Control Panel	1	lot	The panel(s) includes Bay control units for all 15 kV feeders, including Incoming and Bus coupler bays.
(14)	AC Distribution Panel	1	lot	- MCCBs for 400/230 V AC, three phase, four wires
(15)	DC Distribution Panels	1	lot	- MCCBs for 110 V DC - MCCBs for 48 V DC The MCCBs may be installed in Charger panels.
(16)	Battery and Charger Panel	1	lot	- 110 V DC Batteries and Charger - 48 V DC Batteries and Charger
(17)	Uninterruptible Power Supply	1	set	- Input voltage: 400/230 V AC, three or single phase - Output voltage: 230 V AC, single phase The back-up time is at least 1 hour.
(18)	Micro SCADA system	1	lot	- Server and Client (Work Station HMI) with Bay Control Unit (BCU) system for controlling and supervising of the substation - Remote Terminal Unit (RTU) for communication with the existing National Electricity Control Center (NECC) SCADA system (ABB RTU560 or equivalent)
(19)	Communication System	1	lot	The communication system includes;- - SDH multiplexer panel (including ECI BG-20 or equivalent) - IP PBX equipment with telephone sets - Cables including optical fiber cables for the substation inside
(20)	15 kV power cables	1	lot	15 kV power cables and necessary accessories for connection - 15 kV cables between 110/15 kV transformers and 15 kV switchgear (incoming circuits) - 15 kV cables between 15 kV switchgear panels and first 15 kV distribution tower(s) and/or pole(s)
(21)	Low voltage power and control cables	1	lot	- Necessary low voltage power and control cables and necessary accessories for connection
(22)	Earthing system in the substation	1	lot	- Earthing conductors and accessories - Overhead grounding wires for new 110 kV switchgear and transformer area

2.1.3 Technical requirements for 15 kV RMU Switching Stations

The 15 kV RMU Switching Stations will be installed at "Kabuga" and "Murindi" area.

The Switching Stations are received power from the major substations by 15 kV and distribute the power to the other Switching Stations, and transform the voltage to 400 V AC to the surroundings. Table 2.1.2-2 shows the equipment list for each 15 kV RMU Switching Station.

Table 2.1.3-1 Equipment List for each Switching Station at Kabuga and Murindi

No.	Equipment	Q'ty	Unit	Major Specification
(1)	Indoor type 15 kV GIS Switchgear	5	panel	- 36 kV, 1,250 A, 25 kA or more - 4 x Feeder panels - 1 x 15/0.4 kV Transformer feeder panel
(2)	630 kVA Transformer	1	set	- 630 kVA (ONAN) - 15,000±2.5%, ±5.0% / 400-230 V
(3)	AC Distribution panel	1	set	- MCCBs for 400/230 V AC, three phase, four wires
(4)	110 & 48V DC Battery and Charger	1	lot	- MCCBs for 110 V DC - MCCBs for 48 V DC The MCCBs will be installed in each Charger panel.
(5)	Remote Terminal Unit (RTU)	1	lot	- RTU for communication with the existing National Electricity Control Center (NECC) SCADA system (ABB RTU560 or equivalent)
(6)	Communication System	1	lot	The communication system includes;- - SDH multiplexer panel (including ECI BG-20 or equivalent) - IP PBX equipment with telephone set - Cables including optical fiber cables for the substation inside
(7)	15 kV power cables	1	lot	- Between 15 kV Switchgear and 630 kVA Transformer - 15 kV cables between 15 kV switchgear panels and first 15 kV distribution tower(s) and/or pole(s)
(8)	Low voltage power and control cables	1	lot	Cables and necessary accessories for connection
(9)	Earthing system	1	lot	Earthing conductors and accessories

2.1.4 Technical requirements for 15kV Switchgear Modification of Gasogi Substation

In order to connect an additional distribution line to Kabuga RMU switching station, one additional 15 kV feeder bay has to be extended. The existing 15 kV Switchgear room with cable trench will be extended by the Rwanda side to accommodate one extended switchgear panel supplied by Japanese side.

Table 2.1.3-1 Equipment List for Gasogi Substation

No.	Equipment	Q'ty	Unit	Major Specifications
(1)	Indoor type 15 kV GIS Switchgear feeder panel for extension	1	set	- 15 kV GIS Switchgear feeder panel Type ZX1.5 (ABB) - 40.5 kV, 1250 A, 25 kA

2.1.5 Technical requirements for the facilities of Ndera Substation

(1) Design Conditions for the Substation Facilities

The design conditions for the substation Facilities are shown in the above mentioned Table 2.1.1-1.

(2) Requirements for the Substation Facilities

Design Ground Level would be set on 1546.5m from sea level. Necessary land preparation including Access Road, Earth wall, Land Leveling, Boundary Fence would be constructed by the Rwanda side. But Pavement of the approach road, Ditch of site rain drainage, Control Building, Cable Pit, TR Foundations, Fire Wall, Gantry Foundations, Bus Structure Foundations and other Equipment Foundations would be constructed by Japanese side.

outdoor lighting
water supply from utility

1) Outline of Control Building

The Outline of Control Building is shown in Table 2.1.5-1 (See DWG A-05, 06, 07, 08).

Ground Floor Level should be +1.0m from Design Ground Level to secure the height of Cable Pit.

Table 2.1.5-1 Outline of the Control Building

Items	Contents	Details
Structure	Reinforced Concrete Rahmen Structure	
Height of story	2 stories BFL-GFL=2.65 m GFL-1FL=3.5 m, 5.1m	BF: Cable Pit with Water Tank (10ton)×2 GF: Control Room, Switchgear Room, Entrance, Office, Meeting Room, Battery Room, Charger Room, Telecom Room, On Duty Room, Toilet, Shower, Kitchen, Corridor, Stair Case
Total Floor Area	Approx. 540 m²	BF:180m2 GF:360m2
Building Area	Approx. 360 m²	-
Exterior	Wall Finishing	Concrete with Urethane Exterior Paint Concrete Louver with Urethane Exterior Paint
	Roof Finishing	Concrete Plate t=80 with 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	Ceramic Tile 300*300
	Ceiling	LGS Ceiling with Gypsum Board t=12 Paint Finish

roof = like Musha S/S

The outline of major architectural equipment is as following,

a) Electrical work: Lighting system, Socket system, Exterior Lighting system
b) Plumbing work: Water supply, Water tank (10ton 2 units), Septic tank and Soak Pit
c) Mechanical Work: Air-condition (Control Room, Charger Room, Telecom Room)

2) Foundation of 110/15 kV 20MVA Transformers

The Outline of the Foundation of 110/15 kV transformers is shown in Table 2.1.5-2 (See DWG A-05). Ground Floor Level should be +0.2 m from Design Ground Level.

Table 2.1.5-2 Outline of the Foundations of 110/15 kV transformers

Items	Contents	Details
Structure	Reinforced Concrete Mat Foundation	-
Height of story	1 story	GF: 2 units of 20 MVA transformer [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=5.1 m, L=6.0 m, t=250 Total number 1 Oil pit: Around Transformer Foundation D=1.5 m covered with Gravel, overflow piping connected to the oil-water separator set west-beside the foundation Cable Culvert 700mm*1000mm

3) Foundations of Electrical Equipment

The Outline of the foundations of Electrical Equipment, Gantry, CB, DS and others is shown in Table 2.1.5-3 (See DWG A-02 and A-03).

Table 2.1.5-3 Outline of the Foundations of Electrical Equipment

Items	Contents	Details
Structure	Reinforced Concrete Foundation	-
Height of story	0 story	[Note] to avoid submerging to water on heavy rainy days, the floor level of the foundations shall be 0.2 m- raised from the ground level.

4) Cable Pit

The Outline of the Cable Culvert is shown in Table 2.1.5-4 (See DWG A-05).

Table 2.1.5-4 Outline of the Cable Pit

Items	Details
Cable Pit from 20 MVA transformers to Control Building	Reinforced Concrete Box with Concrete Cover t=50mm, t=150mm Length around 30m (W=0.7 m, D=1.0m)

Cable Pit is for smooth installation and maintenance from each transformer to Control Building.

2.1.6 Technical requirements for the facilities of RMU Switching Stations

(1) Design Conditions for RMU Switching Stations Facilities

The design conditions for the Ring Main Unit Facilities are shown in the Table 2.1.2-1 same as Substation Facilities.

(2) Requirements for the RMU Switching Stations Facilities

Necessary land development including Access Road, Earth wall, Land Leveling, Boundary Fence would be constructed by Rwandan side. But Pavement of the approach road, Ditch of site rain drainage, Power Supply Building, equipment Foundations would be constructed by the Japanese side.

1) Outline of RMU Switching Stations Buildings

The Outline of RMU Switching Stations Buildings is shown in Table 2.1.6-1 (See DWG A-03 and A-04).

Table 2.1.6-1 Outline of RMU Switching Stations Station Building

Items	Contents	Details
Structure	Reinforced Concrete Wall Structure	
Height of story	1 stories GFL-1FL=4.0 m	GF: Switchgear Room, Battery Room, AUX Transformer Room
Total Floor Area	Approx. 80 m^2	-
Building Area	Approx. 80 m^2	-
Exterior	Wall Finishing	Concrete 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	Ceramic Tile 300*300
	Ceiling	Exposed Concrete Paint Finishing

2.1.7 Preparation Work to be done by the Rwanda Side

Before commencement of construction work to be done by the Japanese side, following works should be completed by the Rwanda Side.

(1) Land Preparation Work at the site of Ndera Substation

1) Requirements of Land Preparation Work at the site of Ndera Substation

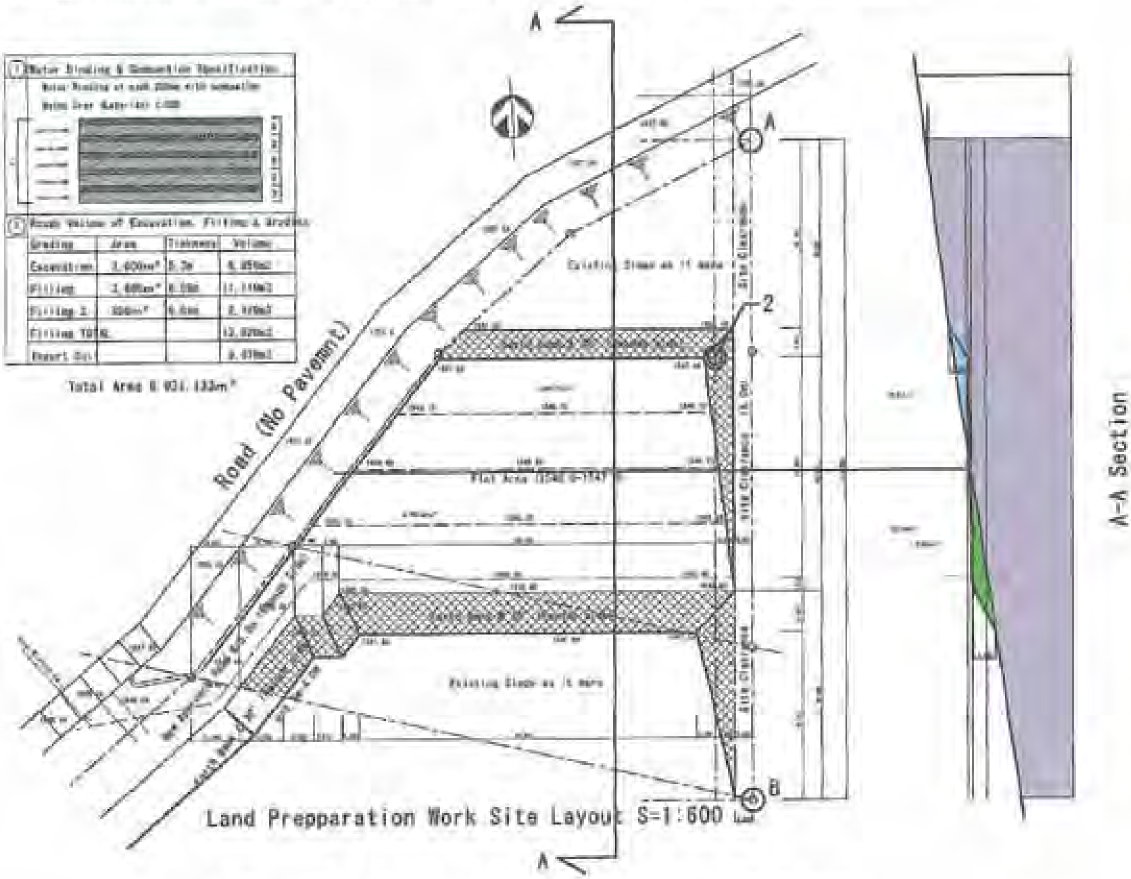


Figure 2.1.7-1 Land Preparation Work Site Layout

According to the Drawing as shown in Figure 2.1.7-1, land preparation work should be done.

Upper part of the site it should be excavated down to the level of 1,546.5 m from see level with bank (30 degree slope). Roughly estimated volume of the excavated soil would be 6,850 m^3.

Lower part of the site it should be land filling with excavated soil and import soil with bank (30 degree slope). Roughly estimated total volume of land filling soil would be 13,520 m^3.

And approach road (W=5.0 m) should be prepared.

At the area of land filling, water binding would be required at each 30 cm with compaction by tamper.

Estimated construction schedule would be from 6 months to 7 months.

Excavation soil Volume: 7,000 m^3

Filling Soil Volume: 13,600 m^3 (Import soil Volume: Cray 6,600 m^3)

Grading Area: 6,560 m^2

(2) Land Preparation Work at the sites of RMU Switching Station

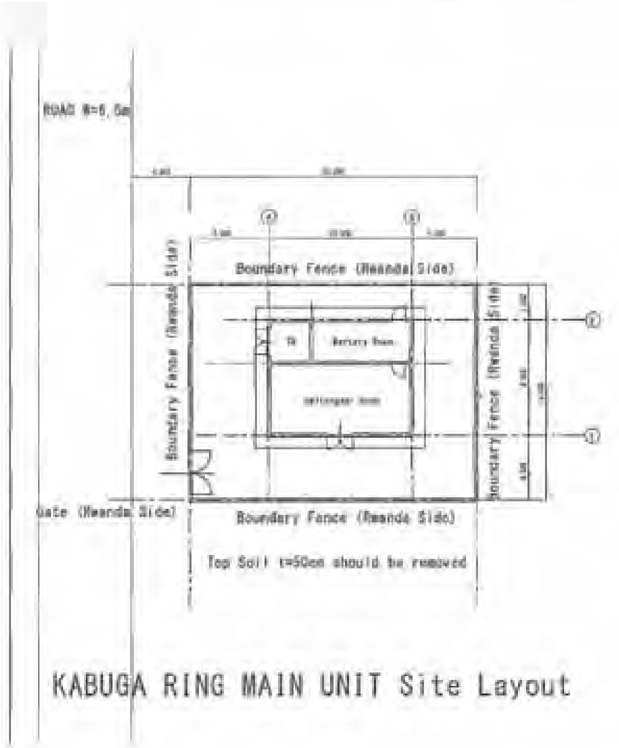


Figure 2.1.7-2 Land Preparation Work Site Layout at Kabuga RMU Switching Station

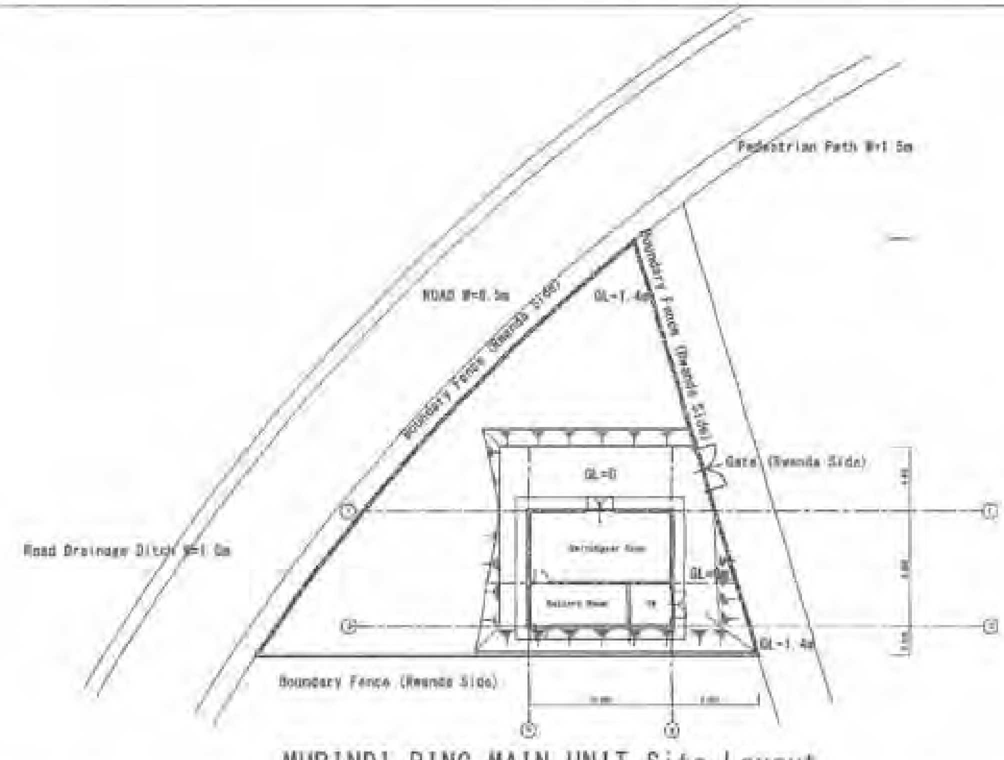


Figure 2.1.7-3 Land Preparation Work at Murindi RMU Switching Station

There are two sites of RMU Switching Stations. Topographie Survey has not yet completed.
Proposed site area in Kabuga RMU Switching Station will be 15m in width and 20 m in length as shown in Figure 2.1.7-2 Land Preparation Work at Kabuga RMU Switching Station. Total site area is 300 m^2.

The site is almost flat but top soil of this site is very week, so 30 cm of this top soil should be removed and new cray should be refilled of the same volume. Therefore total volume of land preparation work would be as follows,

Kabuga RMU Swiching Station Site

Excavation and dumping soil Volume: 300 $m^2 \times 0.3$ m = 90 m3

Filling Soil Volume: 90 m^3 (Import soil: Cray)

Grading Area: 300 m^2

Proposed site area in Murindi RMU Switching Station will be as shown in Figure 2.1.7-3 Land Preparation Work at Murindi RMU Switching Station. Total site area is around 530 m^2.
Terrain of this site is down slope from the road border line down to the bottom border line around 2.8 m. So in the middle part of down slope, flat area will be required. The size of the required flat area is 13 m in width and 15 m in length, total flat area is around 200 m^2. Half of this area will be excavated and using excavated soil another half of this area will be landfilling and make it flat area. Top soil of this site is very week, so 30 cm of this top soil should be removed and new cray should be refilled of the same volume. Therefore total volume of land preparation work would be as follows,

Murindi RMU Swiching Station Site

Excavation and dumping soil Volume: 200 $m^2 \times 0.3$ m = 60 m^3

Filling Soil Volume: 46 m^3 (Import soil: Cray)

Grading Area: 200 m^2

(3) Land Preparation Work at the site of 110 kV Transmission Line

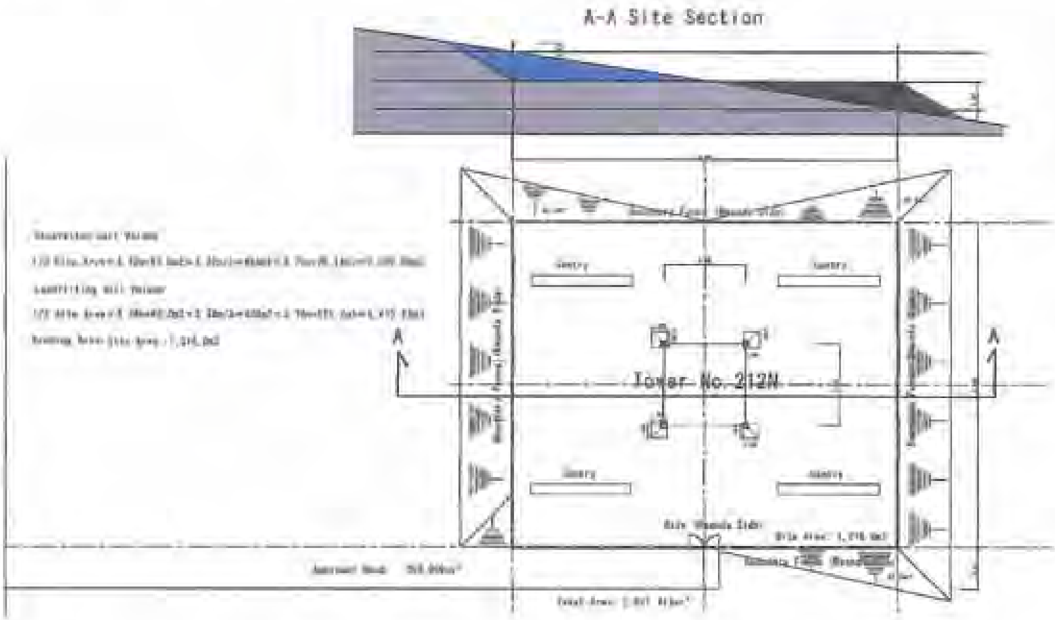


Figure 2.1.7-4 Land Preparation Work at Gantry Tower 110 kV

Proposed site area in 110 kV Gantry Tower No. 222N will be as shown in Figure 2.1.7-4 Land Preparation Work at Gantry Tower 110 kV. Total site area is around 2,030 m^2.

Terrain of this site is down slope from the road border line down to the bottom border line. So in the middle part of down slope, flat area will be required. The size of the required flat area is 38 m in width and 32 m in length, total flat area is around 1,216 m^2. Half of this area will be excavated and using excavated soil another half of this area will be landfilling and make it flat area. Therefore total volume of land preparation work would be as follows.

Murindi RMU Switching Station Site

Excavation soil Volume: 2,340 m^3

Filling Soil Volume: 3,440 m^3

Import soil: Cray: 100 m^3

Grading Area: 1,216 m^2

2.2 Technical requirement for Transmission and Distribution Lines

2.2.1 Technical requirement for Transmission and Distribution Lines

(1) Scope of Work

Project scope of work for transmission and distribution lines shows on DWG No. GA-01 attached hereafter is as follows;

① 110 kV Transmission Line:

New Ndera substation will be energized from existing 110 kV transmission line between Birembo and Musha substations. The tower of No. 212 on the transmission line shall be re-built with tension type tower form suspension type tower, and then the new tension type tower will be split two way, one is for Birembo substation and another one is for Musha substation via Gosogi substation, refer to attached drawing No. GA-03. The new tension tower named "Tower No. 212N" will be connected to new 110 kV transmission line with double circuits up to Ndera substation line length is approx. 2.2 km, the transmission line route shown on drawing No TL-01 attached.

② 15 kV Distribution Line: Route-1

15 kV distribution line: Route-1with single circuit from Gasogi substation to Kabuga RMU switching station shown on DWG No. DL-11 will be constructed, the line length is approx. 6.0 km. Support of the 15kV distribution line is tower and steel pole types, refer to DWG No. DL12. The 15 kV distribution line shall be considered to be used for 30 kV distribution line.

③ 15 kV Distribution Line: Route-2

15 kV distribution line: Route-2 with double circuits from Ndera substation to existing 15 kV distribution line between Birembo substation and free zone PH-1 RMU station shall be constructed. The line length is approx. 600 m. Conductor configuration is vertical layout with lattice type tower, refer to DWG No. DL-22 attached. This 15 kV Distribution line shall also be used for 30 kV distribution line.

④ 15 kV Distribution Line: Route-3

There was an existing steel tower for 15 kV distribution line from Berimbo substation to Gishaka area, the tower has been located on planned 110 kV transmission line at approaching to new Ndera substation. Therefore, concerned two (2) existing towers of the 15 kV distribution line shall be diverted as shown on DWG No. DL-31 attached. The line configuration is triangle layout shown on DWG No. DL22 attached. This 15 kV Distribution line shall also be used for with 30 kV distribution line.

⑤ Kabuga RMU Swiching Station:

Kabuga RMU switching station will connect 15 kV distribution line: Route-2 above item ③, from Gasogi substation. Outgoing feeders will be connected to existing distribution lines located near the station.

⑥ Murindi RMU Swiching Station

Incoming feeders are connected from existing 15 kV distribution line. The existing tower to be connected to the RMU Swiching Station is suspension type tower; therefore the tower should be needed to re-build to tension type tower. Outgoing feeder will be connected to existing distribution lines located near the station, refer to DWG No. RM-11 attached.

(2) Design Conditions for 110 kV Transmission (T/L) and 15 kV Distribution Lines (D/L)

Natural Conditions and Electrical Conditions are shown in Table 2.2.1-1 and Table 2.2.1-2, respectively.

Table 2.2.1-1 Natural Conditions

Items	Design Values
Altitude	Over 1000m upto 2000m
Conductor temperature	-
Minimum temperature	5 degree C
Everyday temperature	25 degree C
Maximum temperature	80 degree C
Sag calculation to determin steel tower height	50 degree C
Wind speed	30 m/s
Wind load on conductors	56.3 kg/ m^2
Wind load on steel tower	163.1 kg/ m^2
Soil bearing capacity	40 ton/m^2 (now on survey)

Table 2.2.1-2 Electrical Conditions

Items	Design Value
Standard Span Length	350m for 110kV T/L, 250m for 15kV D/L
Wind Span	350m for 110kV T/L, 250m for 15kV D/L
Weight Span	450m for 110kV T/L, 350m for 15kV D/L
Vertical Component	15% of Max Working Tension for 110kV T/L
Right of Way (ROW)	- 110kV T/L: 15m width (7.5m +7.5m) - 15kV D/L for double circuits: 10m width (5m +5m) - 15kV D/L for Single circuit: 6m width (3m +3m)
Height of conductor (See Note 1)	
General area (m)	7 m
Waterway (m)	10 m
Road crossing (m)	8 m
Shield angle for Lightning	30 degree
Minimum nominal specific creepage distance	16 mm/kV
Equivalent salt deposit density	0.063 mg/cm^2

Note:

a) As EUCL's concept, facility for15kV distribution line shall be designed usable for 30kV distribution line.

b) To decide standard tower height, conductor height of 8 meters shall be employed.

(3) Requirements for 110 kV Transmission and Distribution Lines

Specifications for 110 kV Transmission and Distribution Lines are shown as follows.

Table 2.2.1-3 Specifications for 110kV Transmission Line

No.	Items	Specifications	
1)	Line Structure	Type:	Steel lattice type tower
		Configuration of tower:	Dual circuits, vertical layout (See DWG. No. TL-03)
		Type of tower:	Suspension type (110A2: Angle: 3 degree), Tension type (110B2: Angle: 15 degree), Tension type (110C2: Angle 30 degree) Termination tower (Angle: 60 degree or dead-end)
		Safety factor:	1.0 for main body 1.2 for arms
2)	Overhead Line (Conductor)	Type: ACSR Size 240/40 DIN	
3)	Insulator	Standards:	IEC60383-1 or equivalent
		Size:	254 mm suspension insulators
		Creepage distance:	292 mm
		Material:	Porcelain
		Color:	Brown

No.	Items	Specifications
		Ball and socket coupling: 16mm Number of insulators: 9 pcs/phase
4)	Shield Wire and Optical Fiber Cable	Type: OPGW x 2 Number of Optic Fiber Core: 24 cores Shielding angle: less than 30 degree.

Table 2.2.1-4 Specifications for 15kV Distribution Line: Route-1

No.	Items	Specifications
1)	Line Structure	Type: Steel lattice type tower and Steel Pole Configuration of tower: Single circuit, triangle layout for tower and horizontal layout for steel pole, See DWG. No. T-03
2)	Overhead Line (Conductor)	Type: ACSR Size 120/20, DIN
3)	Insulator for Tower	Specification : Same as 110kV Transmission Line but electromechanical Failing Load is 70kN Number of insulators: three (3) units/string to be confirmed
	Insulator for Pole	Type: Pin type on cross arm
4)	Shield Wire	Type: OPGW Number of Optic Fiber Core: 24 cores Shielding angle: less than 30 degree.

Table 2.2.1-5 Specifications for 15kV Distribution Line: Route-2

No.	Items	Specifications
1)	Line Structure	Type: Steel lattice type tower Configuration of tower: Double circuit, vertical layout See DWG. No. T-03
2)	Overhead Line (Conductor)	Type: ACSR Size 120/20, DIN 48204 /4-1974
3)	Insulator for Tower	Specification: Same as 110kV Transmission Line but electromechanical Failing Load is 70kN Number of insulators shall be three (3) units/string to be confirmed
4)	Shield Wire	Type: G655 or equivalent The shielding angle: less than 30 degree.

Table 2.2.1-6 Specifications for 15kV Distribution Line: Route-3

No.	Items	Specifications
1)	Line Structure	Type: Steel lattice type tower Configuration of tower: Single circuit, See DWG. No. T-03
2)	Overhead Line (Conductor)	Type: ACSR Size 120/20, DIN 48204 /4-1974
3)	Insulator for Tower	Specification: Same as 110kV Transmission Line Number of insulators shall be three (3) units/string to be confirmed
4)	Shield Wire	Type: G655 or equivalent The shielding angle: less than 30 degree.

Table 2.2.1-7 Specifications for Power Cable of 15kV Distribution Lines

No.	Items	Specifications
1)	Type	15kV or 30kV, XLPE insulation, PVC sheath, tape armor, copper conductor
2)	Standard	IEC 60502
3)	Size	50mm2, 70mm2, 95mm2, 120mm2, up to 240mm2

(4) Work Demarcation for Transmission Line, Distribution Line and Ring Main Unit

Work Demarcation for Transmission Line, Distribution Line and Ring Main Unit is shown in Attachment-2.

2.2.2 Technical requirements for the Foundation of Transmission and Distribution Lines

(1) Design Conditions for the Facilities

The design conditions for Facilities of the RMU Switching Stations are shown in the Table 2.1.1-1 same as Substation Facilities.

(2) Requirements for the Facilities

Necessary land development including Access Road, Earth wall, Land Leveling, Boundary Fence would be constructed by the Rwanda side.

1) Foundations for Towers of 110 kV Transmission lines

The Outline of the foundations for Towers 110 kV Transmission Lines is shown in Table 2.2.2-1.

Table 2.2.2-1 Outline of the Foundations of 110 kV Transmission Line Tower

Items	Contents	Details
Structure	Reinforced Concrete Foundation (Pad & Chimney Type)	Tower H (Now on study)

2) Foundations for Towers of 15 kV Distribution lines

The Outline of the foundations for Towers 15 kV Distribution Lines is shown in Table 2.2.2-2.

Table 2.2.2-2 Outline of the Foundations of 15 kV Distribution Line Tower

Items	Contents	Details
Structure	Reinforced Concrete Foundation	Tower H (Now on study)

2.3 Environmental and Social Consideration

JICA Study Team will hire a local consultant to assist EDCL in preparation of an Abbreviated Resettlement Action Plan and obtaining the necessary clearance and relevant permits/licenses. EDCL should work in collaboration with the local consultant and facilitate him in accessing necessary data and information to carry out his tasks.

JICA Study Team and EDCL visited Rwandan Environment Management Authority (REMA) and Rwanda Development Board (RDB) to confirm a procedure to obtain an EIA Certificate. It is imperative that EDCL submit a Project Brief to RDB so that RDB can determine whether the Project requires a full EIA or not. Presently EDCL is aiming to submit a Project Brief to RDB by 2 April 2015 and Screening result from RDB is expected by 15 April 2015.

In accordance with the Screening result from RDB, a further environmental study or a full EIA study will be carried out.

EDCL has already started process of acquiring land and resettlement for some of the components. EDCL must apply the above ARAP retrospectively as much as possible to the land acquisition and resettlement that have been already in process.

For the smooth implementation of the project, it is targeted that EDCL completes land acquisition by December 2015. ARAP should be finalized and authorized (or at least acknowledged) by Ministry of Finance by June 2015.

The table below is a schedule for each action to be taken for obtaining an EIA Certificate and preparation of ARAP. In order to complete the land acquisition by December 2015, implementation of the ARAP should start from July 2015. Each action and its schedule for implementation of ARAP will be confirmed with the person in charge of land acquisition at EDCL in the first week of April 2015 and this schedule will be revised and shared among relevant members.

Table 2.3-1 Schedule of Environmental Assessment and Preparation of ARAP

	Action	Actor	Expected Time Period/Target Date	2015 Mar	Apr	May	Jun	Dec
Environmental Assessment	Submission of Project Brief to RDB for Screening	EDCL/JICA ST/Local Consultant(JICA)	02 April 2015		▲			
	Issue of Screening result	RDB	Within 15days after submission of Project Brief		▲			
	Further Environmental study (e.g. a full EIA study), (if required by Screening Result)	EDCL/Local Consultant(JICA)						
	Issue of EIA Certificate	RDB	Issue date is depending Screening Result		▲			
Preparation of ARAP	Mobilization of Local Consultant	JICA/Local Consultant(JICA)			▲			
	ARAP Study	EDCL/Local Consultant(JICA)						
	Submission of ARAP to Min of Finance	EDCL					▲	
	Approval (or acknowledgment) of ARAP	Min of Finance.						
	Submission of ARAP to JICA	EDCL/Local Consultant(JICA)					▲	
Implementation of ARAP	Completion of Land Acquisition	EDCL	December 2015					▲

2.4 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 Rwanda 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 insurance 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.

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.

Spare parts and maintenance tools listed in Table 2.4-1 and Table 2.4-2 are recommended to be procured. More detailed parts, tools, test equipment and the quantity will be explained with the Draft Final Report.

Table 2.4-1 Recommended Spare Part List

Legend: pc: piece, ea.: each,
N.A.: Not applicable

Name of Spare Parts	Quantity		
	Ndera	Kabuga	Murindi
1. 110 kV Switchgear equipment			
1.1 Circuit Breaker			
(1) Closing coil	1 pc	N.A.	N.A.
(2) Tripping coil	1 pc	N.A.	N.A.
1.2 Disconnecting Switch (DS)			
(1) Fixed and moving contact (3 phase set for DS)	1 set	N.A.	N.A.
(2) Fixed and moving contact (3 phase set for Earthing switch)	1 set	N.A.	N.A.
1.3 Transformer			
1.3.1 110/15 kV Transformer			
(1) Gasket (complete set)	1 set	N.A.	N.A.
(2) Buchholz relay set	1 set	N.A.	N.A.
(3) Oil temperature indicator (main tank and conservator)	1 pc ea.	N.A.	N.A.
(4) Oil level indicators (main tank and conservator)	1 pc ea.	N.A.	N.A.
(5) Silica gel for Breathers	200%	N.A.	N.A.
1.3.2 15/0.4 kV Transformer			
(1) Oil temperature indicator	1 pc	1 pc	1 pc
(2) Silica gel for Breathers	200%	200%	200%

Name of Spare Parts	Quantity		
	Ndera	Kabuga	Murindi
2. 15 kV Switchgear equipment			
(1) Closing coil	1 pc	1 pc	1 pc
(2) Tripping coil	1 pc	1 pc	1 pc
(3) Vacuum bulbs complete with necessary accessories for replacement (for three phase)	1 set ea.	1 set ea.	1 set ea.
(4) Isolating main terminals (completed one pole)	1 set ea.	1 set ea.	1 set ea.
(7) Fuse (each type)	100%	100%	100%
(8) Meter (each type)	1 pc ea.	1 pc ea.	1 pc ea.
(9) Auxiliary relay (each type)	1 pc ea.	1 pc ea.	1 pc ea.
(10) Necessary accessories for 15 kV cable	1 set	1 set	1 set
3. Control and Protection			
(1) Protection relay (each type)	1 pc ea.	N.A.	N.A.
(2) Bay control unit	1 pc ea.	1 pc ea.	1 pc ea.
(3) Fuse (each type)	100%	100%	100%
(4) Meter (each type)	1 pc ea.	1 pc ea.	1 pc ea.
(5) Auxiliary relay (each type)	1 pc ea.	1 pc ea.	1 pc ea.
(6) Control and selector switch, if any (each type)	1 pc ea.	1 pc ea.	1 pc ea.
4. Station LV Power Supply Equipment			
4.1 AC Distribution Board			
(1) MCCB (each type)	1 pc ea.	1 pc ea.	1 pc ea.
(2) Indicating lamp, if any (each type)	100%	100%	100%
(3) Fuse (each type)	100%	100%	100%
(4) Meter (each type)	1 pc ea.	1 pc ea.	1 pc ea.
4.2 DC Distribution Board			
(1) MCCB (each type)			
(2) Indicating lamp, if any (each type)	100%	100%	100%
(3) Fuse (each type)	100%	100%	100%
(4) Meter (each type)	1 pc ea.	1 pc ea.	1 pc ea.
4.3 Battery and Charger			
(1) Battery	2 cells ea.	2 cells ea.	2 cells ea.
(2) Electrolyte (20 letter/tank)	1 tank	1 tank	1 tank
(3) Control Card and diode module	1 pc ea.	1 pc ea.	1 pc ea.
(4) Indicating lamp, if any (each type)	100%	100%	100%
(5) Fuse (each type)	100%	100%	100%
(6) Meter (each type)	1 pc ea.	1 pc ea.	1 pc ea.
5. Communication			
(1) RTU card	1 pc ea.	1 pc ea.	1 pc ea.

2.5 On-the-Job Training (OJT)

On-the-job training (OJT) will be carried out during the construction period. Through the OJT, maintenance and operation staff of the Rwanda side will be able to experience practical and advanced skill from Manufacturer's engineers. Contents of OJT are suggested as follows.

- Operation and maintenance on 110 kV and 15 kV substation equipment
- Protection relay setting
- Fault analysis and operation record management
- Deterioration diagnosis of insulation oil
- Purification processing insulation oil

3. Tentative Implementation Schedule of the Project

The tentative implementation schedule is shown as Attachment-3. 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 October, 2016. 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 Rwanda and Japanese Government will be signed in March, 2016.
- The Tender Opening will be held in July 2016.
- Installation work of the Project will start in October, 2016.
- Commissioning of the Project will be in May, 2018.

4. Drawings

Part 1 Substation

Part 2 Transmission and Distribution Lines

Part 3 Architectural

Attachment

1. Member List of the Study Team

First Field Survey

Name	Assignment	Organization
Toshiyuki HAYASHI	Team Leader	Japan International Corporation Agency
Gaku SAITO	Vice Team Leader	Japan International Corporation Agency
Yoshiyuki KUDO	Chief Consultant/ Transmission and distribution Planning	Yachiyo Engineering Co., Ltd.
Kenji SAKEMURA	Substation Facilities	Yachiyo Engineering Co., Ltd.
Keiichiro OHASHI	Power Flow Analysis/ Protection Control	Yachiyo Engineering Co., Ltd.
Atsuhito URUNO	Transmission Facilities	Yachiyo Engineering Co., Ltd.
Yasuo HORIGOME	Facility Planning/ Cost Estimation	Yachiyo Engineering Co., Ltd
Kyohei KUROHANE	Construction Planning/ Cost Estimation	Yachiyo Engineering Co., Ltd.
Asami KABASAWA	Social and Environmental Considerations	Yachiyo Engineering Co., Ltd.
Tomoya NAKASHIMA	Substation Facilities Assistant	Yachiyo Engineering Co., Ltd.

Work Demarcation for the Project

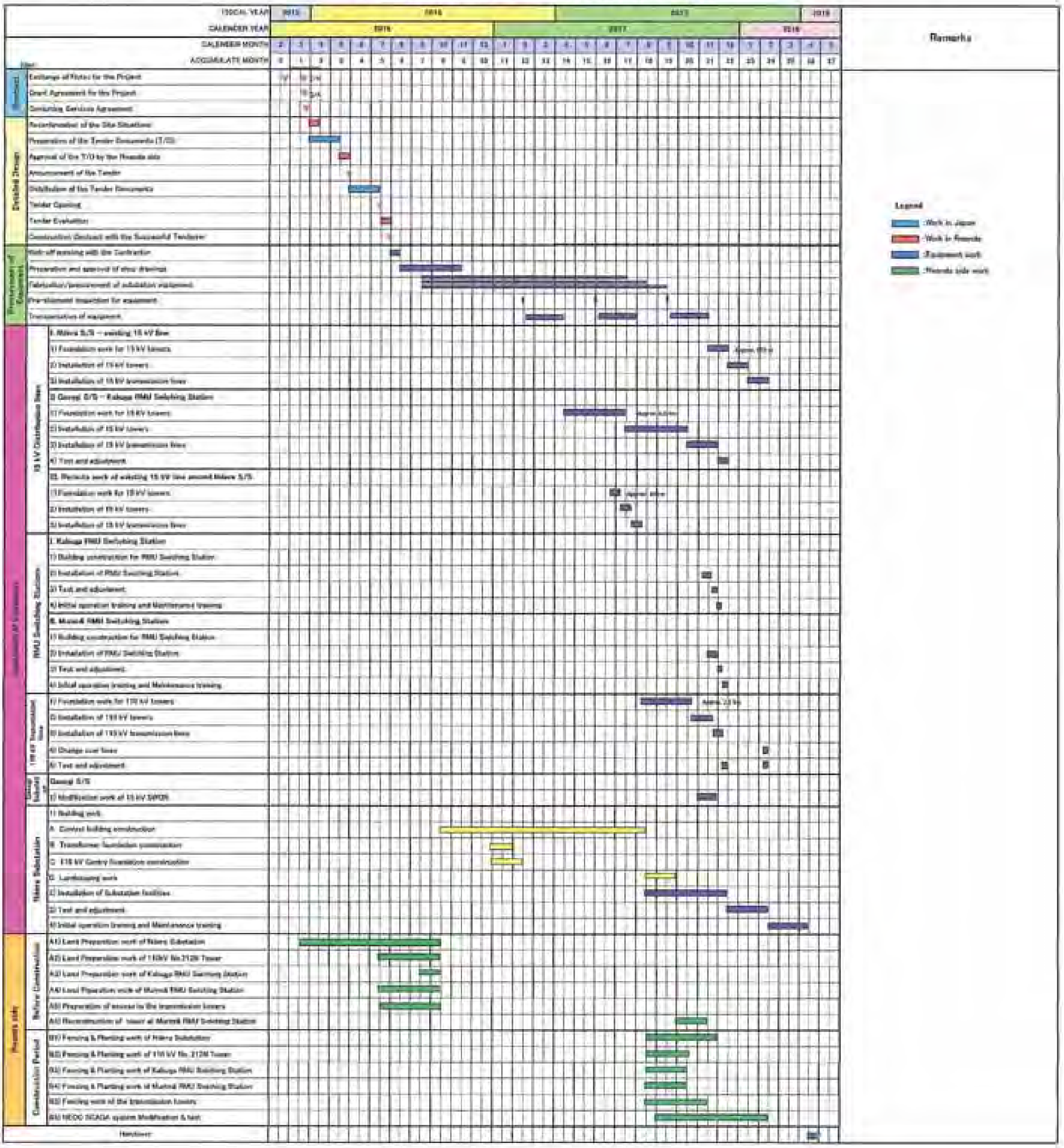
No.	Work Items	Japan Side		Rwanda Side		Remarks
		Proc.	Cons.	Proc.	Cons.	
1.	Ndera Substation					
(1)	Secure the Land			•		In REG Land
(2)	Site Leveling				•	
(3)	Gate and Fence			•	•	
(4)	Building work of the substation	•	•			
(5)	110 kV Switchgear	•	•			
(6)	20 MVA Transformers	•	•			
(7)	250 kVA Auxiliary Transformer	•	•			
(8)	15 kV Switchgear	•	•			
(9)	Substation Control and Protection equipment	•	•			
(10)	110 V DC Battery and Charger	•	•			
(11)	48 V DC Battery and Charger	•	•			
(12)	Communication equipment including RTU and SDH equipment	•	•			
(13)	15kV cables between Transformers and Switchgear	•	•			
(14)	Outgoing 15 kV Cables except item 3.2(2) in this table	•	•			
(15)	Protection Relay setting change of the substations where the transmission lines from Ndera substation to be interconnected				•	Birembo & Musha S/Ss
(16)	Spare parts for Substation	•	•			
(17)	Maintenance tools for Substation, etc	•	•			
(18)	Technical training for equipment		•			
2	110 kV Transmission Line (T/L)					
2.1	Secure of Land and Site leveling					
(1)	T/L Connection Area (32m x 38m)			•		
(2)	Site leveling work at the connecting area				•	
(3)	Right of Way for all T/L (2.2 km) (secure of land at T/L tower foundations, etc)			•	•	
(4)	Storage yard for construction materials			•		
2.2	110kV Transmission Line (Approx. 2.2 km) From connection point to Ndera S/S)					
(1)	Connecting Facility such as gantry, insulator, etc, at connecting point of 110 kV T/L	•	•			

No.	Work Items	Japan Side		Rwanda Side		Remarks
		Proc.	Cons.	Proc.	Cons.	
(2)	Dismantling of existing 110 kV Tower				•	
(3)	Replacement of line conductors and insulator string sets from nearest both towers	•	•			
3.	15 kV Distribution Line (D/L)					
3.1	Route-1: from Gasogi S/S to Kabuga RMU SS					
(1)	Secure the land with ROW			•		
(2)	Cable from 15 kV SWGR at Gasogi S/S to 15 kV D/L tower/pole	•	•			
(3)	Overhead 15 kV D/L from Gasogi S/S to Kabuga SS (Approx. 6.5 km)	•	•			
(4)	Cable from 15 kV D/L tower to 15 kV SWGR at Kabuga RMU SS	•	•			
(5)	Communication cable from Gosogi S/S to Kabuga RMU SS	•	•			
3.2	Route-2: from Ndera S/S to Existing 15 kV D/L					
(1)	Secure the land with ROW			•		
(2)	Cables from 15 kV SWGR at Ndera S/S to 15 kV D/L first tower, 2 circuits	•	•			For Free zone 1 & Birembo S/Ss
(3)	Overhead 15 kV D/L with dual circuits, between Ndera S/S to the Existing line (Approx. 650 m)	•	•			
(4)	Cables from the new tower to existing tower	•	•			
3.3	Route-3: Line Diversion for securing 110 kV T/L tower in front of Ndera S/S (due to 110 kV T/L impossible to pass over in AZAM factory)					
(1)	Secure the land with ROW			•		
(2)	Overhead line of 15 kV D/L between existing towers	•	•			With 2 towers
(3)	Cable(s) from tower to consumer(s)			•	•	
(4)	Dismantle of one (1) existing tower				•	Tower No.
(5)	Construction of new two (2) Tower	•	•			
(6)	15kV cable from 15kV outgoing feeders	•	•			
4.	RMU Switching Stations					
4.1	Construction of Kabuga RMU Station					
(1)	Secure the Land			•		
(2)	Site Leveling				•	

No.	Work Items	Japan Side		Rwanda Side		Remarks
		Proc.	Cons.	Proc.	Cons.	
(3)	Gate and Fence			•	•	
(4)	Building work of the station (8 m x 10 m)	•	•			
(5)	15 kV Switchgear with Bay Control Unit	•	•			
(6)	110 V DC Battery and Charger	•	•			
(7)	48 V DC Battery and Charger	•	•			
(8)	Communication equipment including RTU and SDH equipment	•	•			
(9)	Connection of communication cable at Kabuga RMU SS	•	•			
(10)	Connection of communication cable at Gasogi S/S	•	•			
(11)	630 kVA Auxiliary Transformer	•	•			
(12)	Auxiliary LV distribution Board for the station	•	•			
(13)	LV distribution board for surround consumers	•	•			
(14)	Outgoing LV cables for (13) above			•	•	
(15)	15kV outgoing cables except from Gasogi S/S	•	•			
(16)	Spare parts for Switching station	•	•			
(187	Technical training for equipment		•			
4.2	Construction of Murindi RMU Station					
(1)	Secure the Land of the Station and new Tower			•		
(2)	Site Leveling				•	
(3)	Gate and Fence			•	•	
(4)	Relocation of existing tower	•	•			
(5)	Building work of the station (8m x 10m)	•	•			
(6)	15kV Switchgear with Bay Control Unit	•	•			
(7)	DC 110V Battery and Charger	•	•			
(8)	DC 48V Battery and Charger	•	•			
(9)	Communication equipment including RTU and SDH equipment	•	•			
(10)	Connection of outgoing communication cable from Murindi RMU SS			•	•	
(11)	630kVA Auxiliary Transformer	•	•			
(12)	Auxiliary LV distribution Board for the station	•	•			
(13)	LV distribution board for surround consumers	•	•			
(14)	Outgoing LV cables for (13) above			•	•	
(15)	15kV outgoing cables	•	•			

No.	Work Items	Japan Side		Rwanda Side		Remarks
		Proc.	Cons.	Proc.	Cons.	
(16)	Spare parts for Switching station	•	•			
(17)	Technical training for equipment		•			
(18)	New tension tower near the station	•	•			
(19)	Relocation of 15kV overhead line for Market			•	•	With DS on tower
(20)	Communication network for the Station SCADA			•	•	
5.	Existing Gasogi Substation					
(1)	Expansion of 15kV SWGR for connection of new 15kV cable to Kabuga RMU SS	•	•			
(2)	Expansion of 15kV switchgear room with cable trench				•	
6.	NECC SCADA System					
(1)	Modification of SCADA System of NECC and Network Management system for accommodation of new Ndera S/S, Kabuga RMS SS and Murindi RMS SS			•	•	
(2)	Modification of Gasogi S/S communication equipment (SDH Panel) to connect additional communication cable from Kabuga RMU SS			•	•	

Tentative Implementation Schedule of the Project



Part 1 Substation

Drawing List

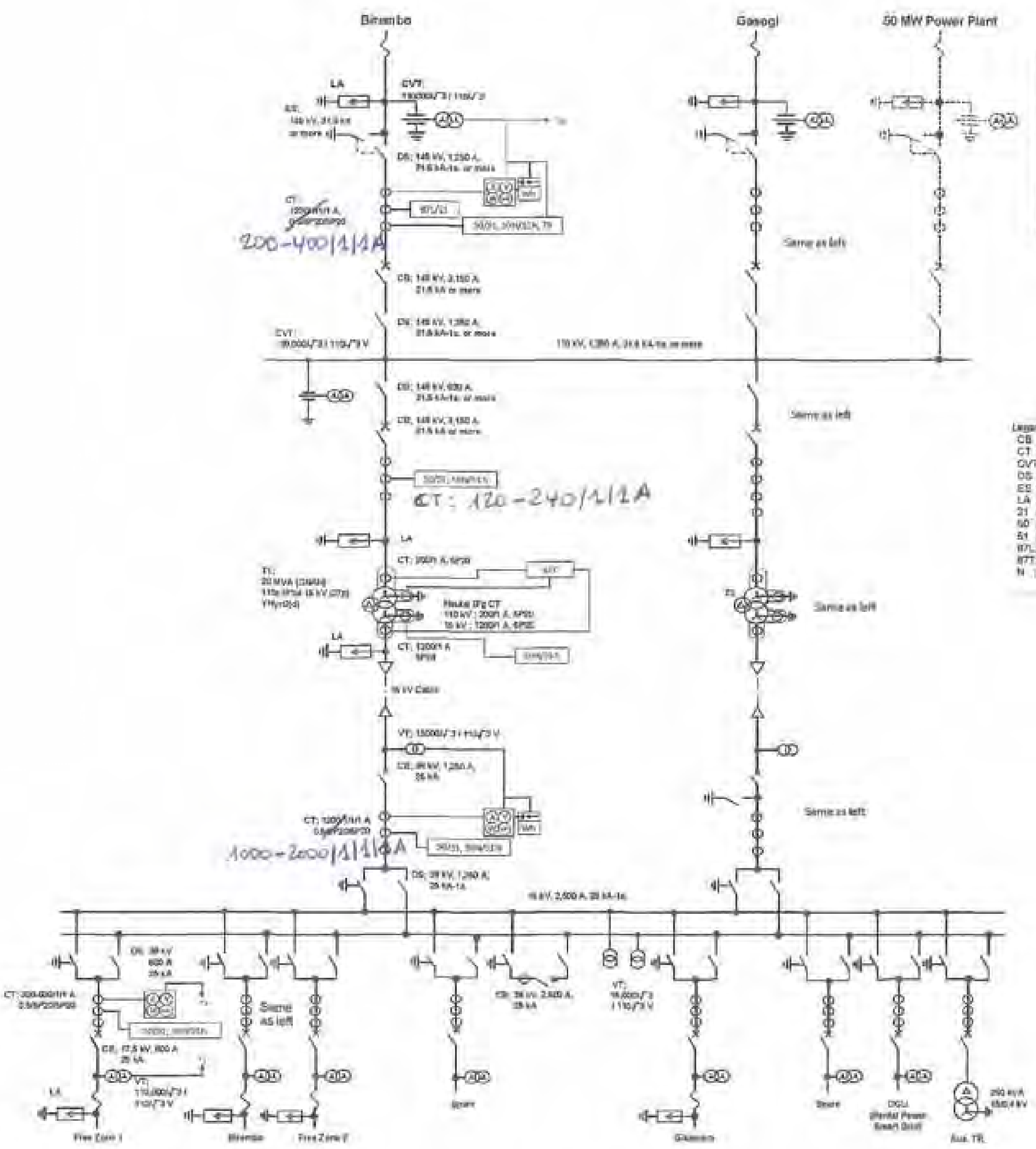
DWG No.	DWG Title

Part 1 Substation

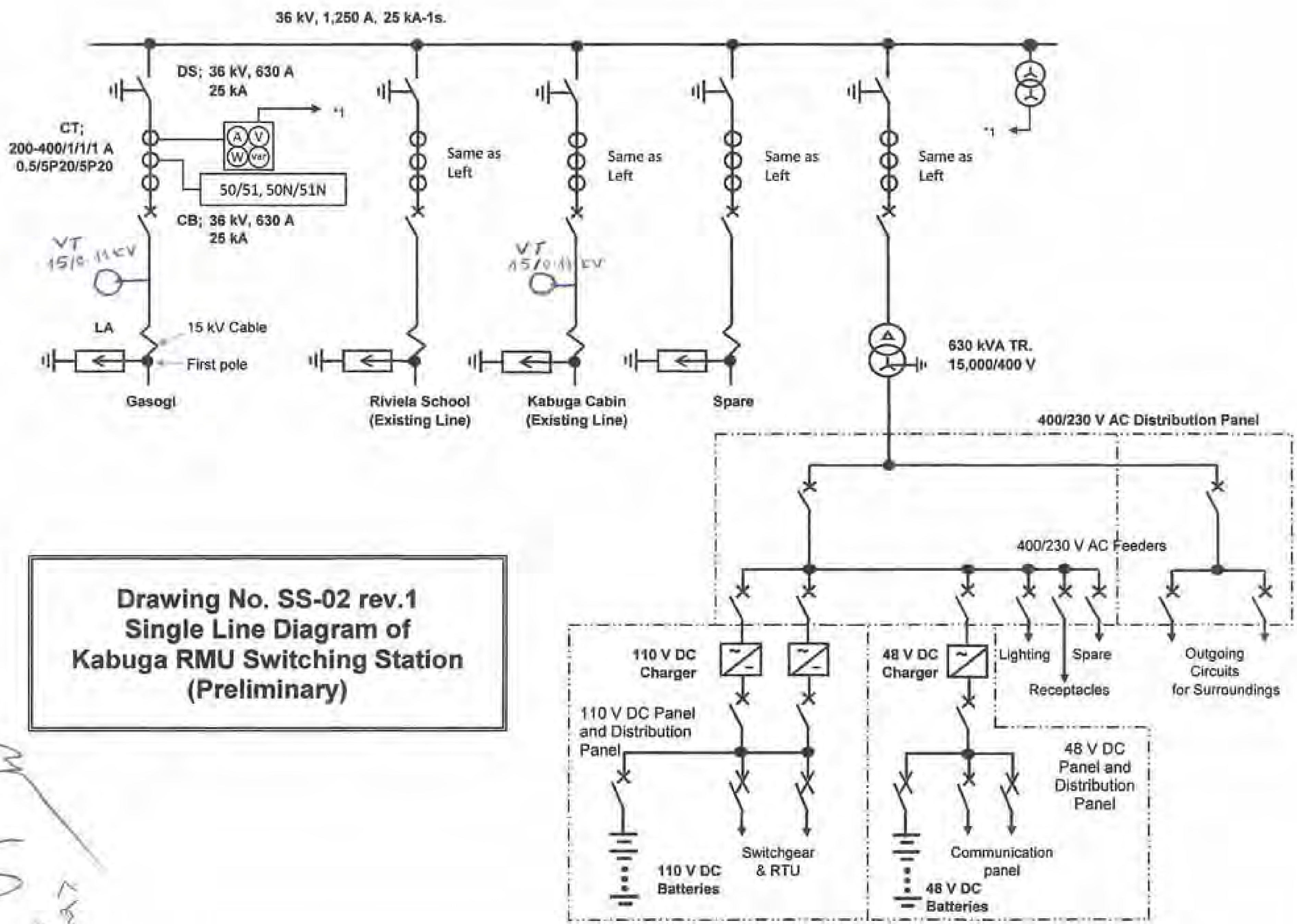
(1)	SS-01:	*Single Line Diagram of Ndera Substation (Preliminary)*
(2)	SS-02	Single Line Diagram of Kabuga RMU Switching Station (Preliminary)
(3)	SS-03	Single Line Diagram of Murindi RMU Switching Station (Preliminary)
(4)	SS-04	Control System Diagram of Ndera Substation and RMU Switching Stations
(5)	SS-05	Single Line Diagram of Gasogi Substation (Preliminary)

April 1, 2015
JICA Study Team

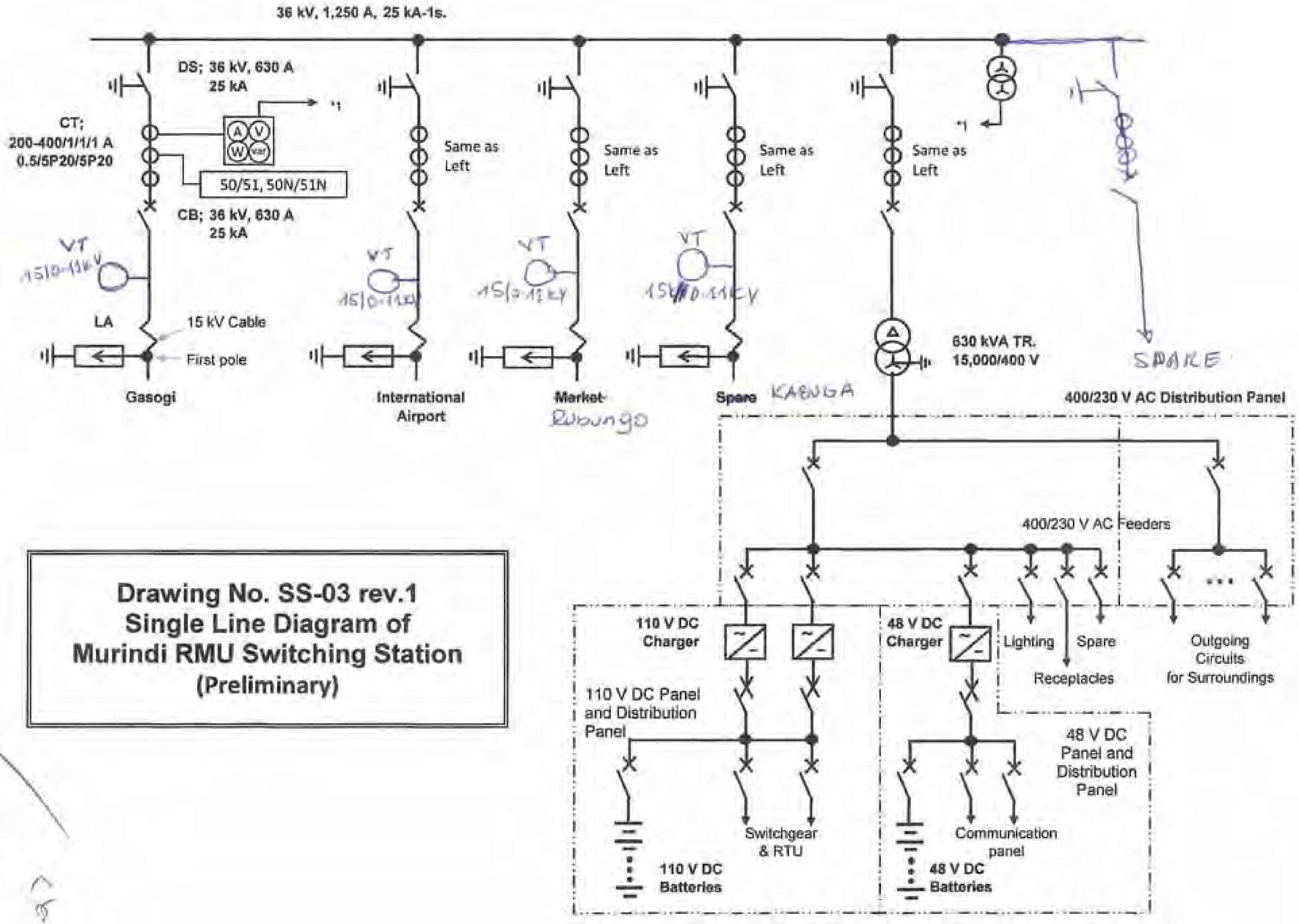
Drawing No. SS-01 rev.1 Single Line Diagram of Ndera Substation (Preliminary)



Legend
CB : Circuit Breaker
CT : Current Transformer
CVT : Capacitor Voltage Transformer
DS : Disconnecting Switch
ES : Earthing Switch
LA : Lightning Arrester
21 : Distance relay
50 : Overcurrent relay (instantaneous)
51 : Overcurrent relay (inverse time)
87L : Current differential relay
87T : Transformer differential relay
N : Neutral circuit



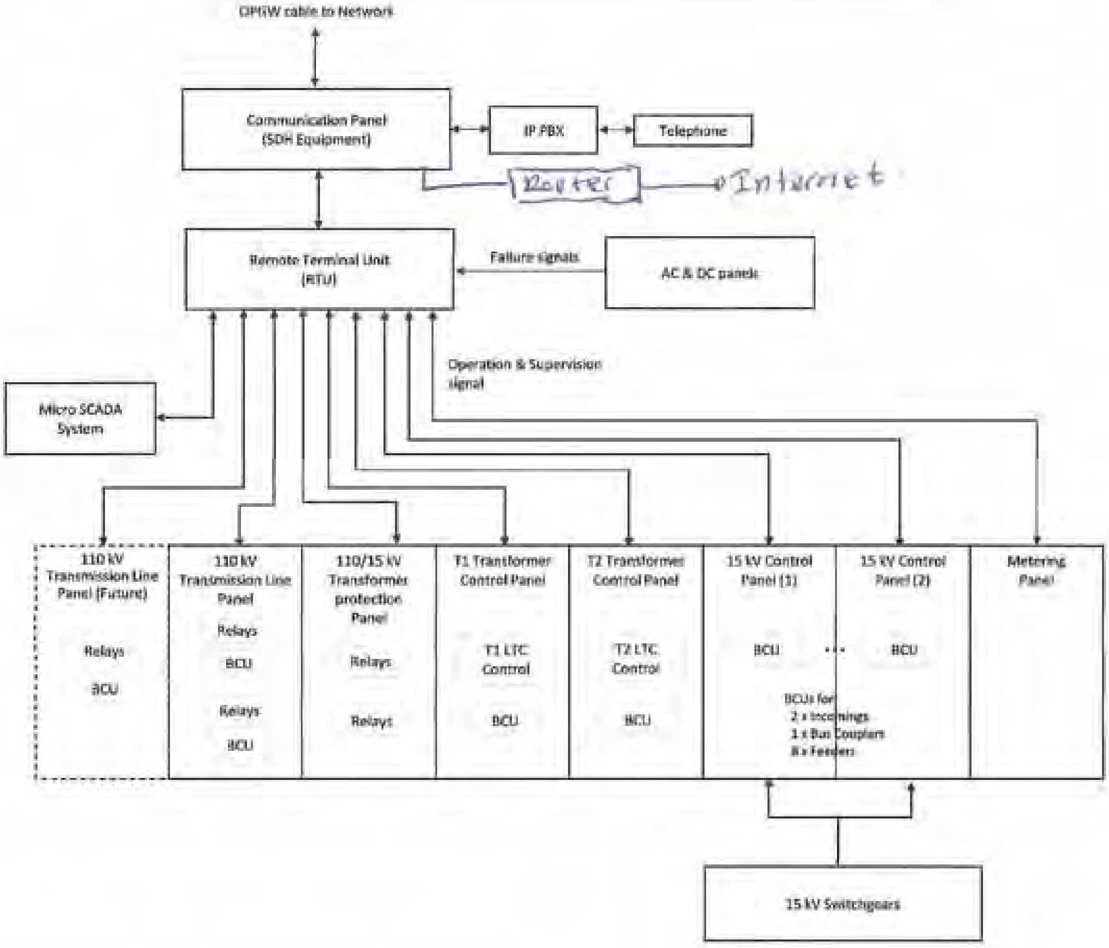
Drawing No. SS-02 rev.1
Single Line Diagram of
Kabuga RMU Switching Station
(Preliminary)



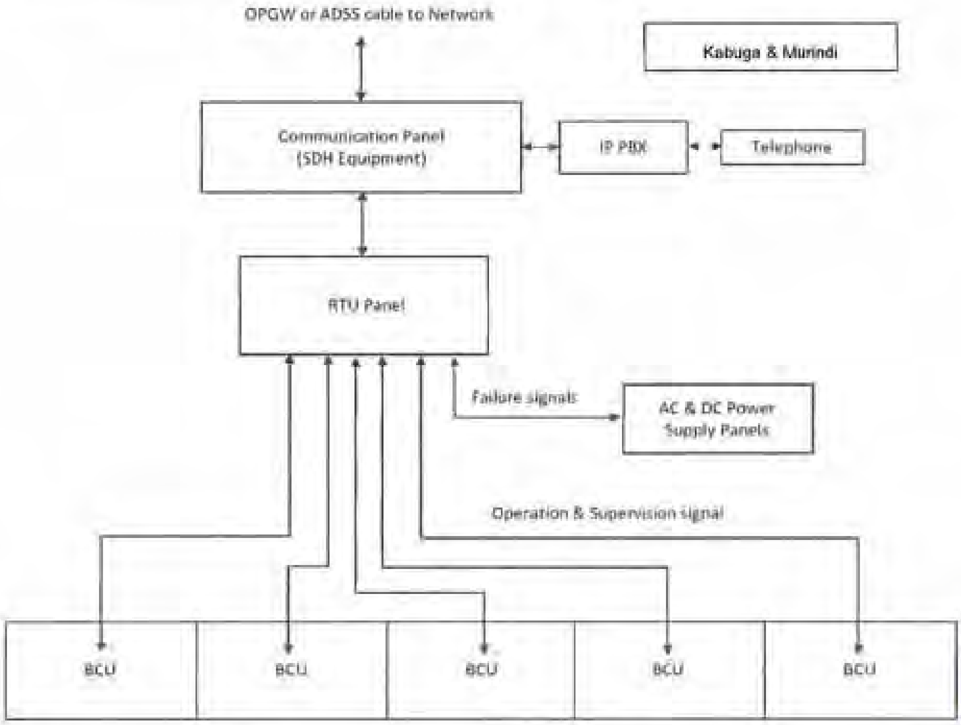
Drawing No. SS-03 rev.1
Single Line Diagram of
Murindi RMU Switching Station
(Preliminary)

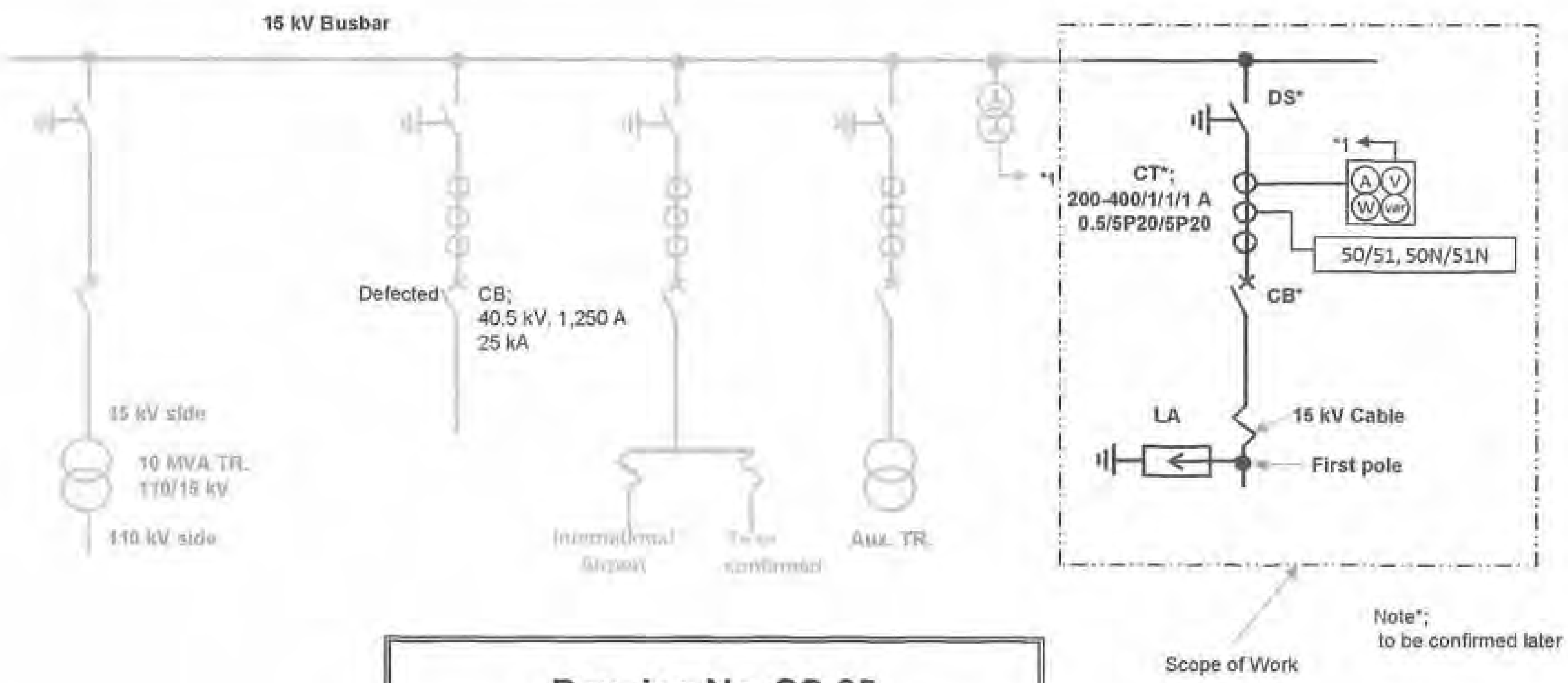
Drawing No. SS-04

Control System Diagram of Ndera Substation



Control System Diagram of RMU Switching station



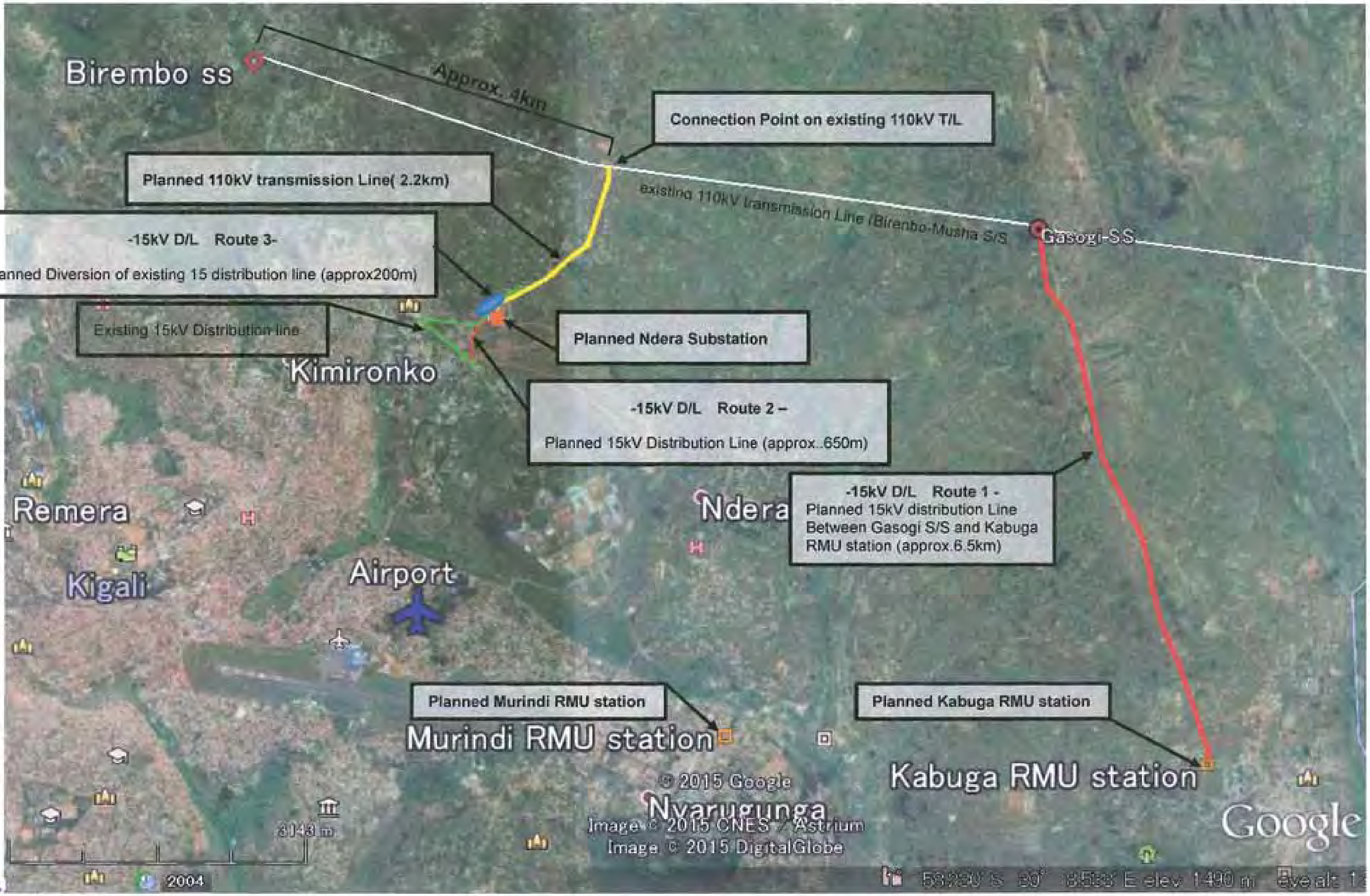


Drawing No. SS-05
Single Line Diagram of
Gasogi Substation
(Preliminary)

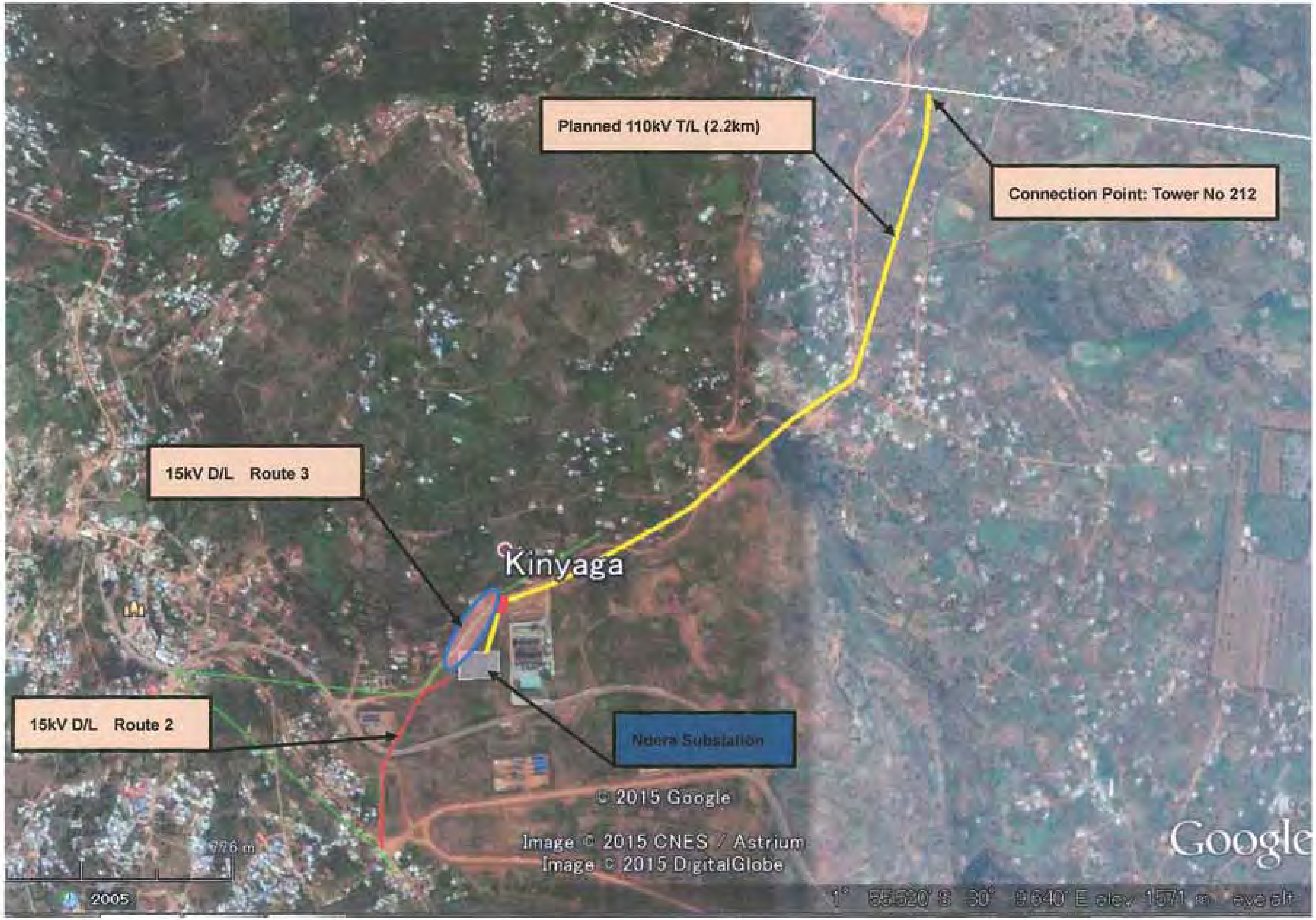
Part 2 Transmission and Distribution Lines

Drawing List

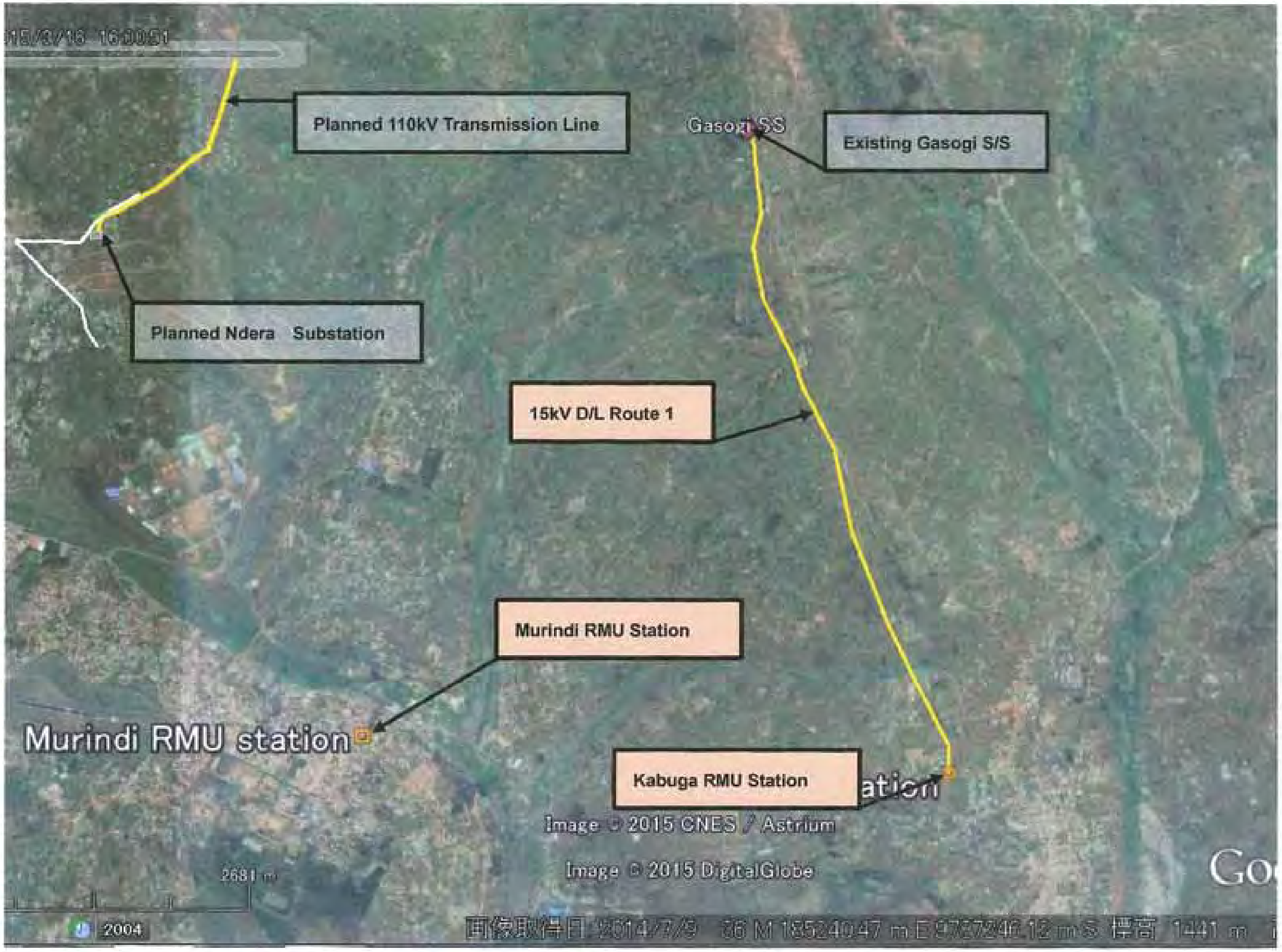
DWG No.	DWG Title
1. General	
(1) GA-01:	Project Site Map – Key Map –
(2) GA-02:	Project Site Map – 110kV T/L, Ndera S/S, 15kV D/L Route 2 &3 -
(3) GA-03:	Project Site Map – 15kV D/L of Route 1, Kabuga and Murindi RMU Switching Stations -
(4) GA-04:	Coordination Point of T/L & D/L
(5) GA-05:	Project Concerned 110/15kV Network Diagram
2. 110kV Transmission Line (TL)	
(1) TL-01:	Plan Drawings for 110kV Transmission Line
(2) TL-03:	110kV Typical Tower Types (110A2,110B2,110C2&110D2) & (110E1)
(3) TL-04:	Typical Foundation Plan for 110kV T/L
(4) TL-05	Plan Drawing at 110kV Connection Point
3. 15kV Distribution Lines (DL) and Ring Main Unit (RMU) Stations	
3.1 Route 1: between Gasogi S/S and Kabuga RMU station	
(1) DL11:	15kV Distribution Line Map: Route-1
(2) DL12;	Typical Tower/Pole Type of 15kV D/L: Route-1
3.2 Route 2: between Ndera S/S and Existing Connection Point	
(1) DL21:	15kV Distribution Line Map: Route 2
(2) DL22:	Typical Tower Type: Route-2
3.3 Route 3: between Existing Connection points	
(1) DL31:	Re-routing plan of existing 15kV D/L: Route 3
3.4 Site Layout of RMU Switching Station	
(1) RM01:	Site Layout of Kabuga RMU Station
(2) RM11:	Site Layout of Murindi RMU Station



DWG No. GA-01: Project Site Map -Key Map-



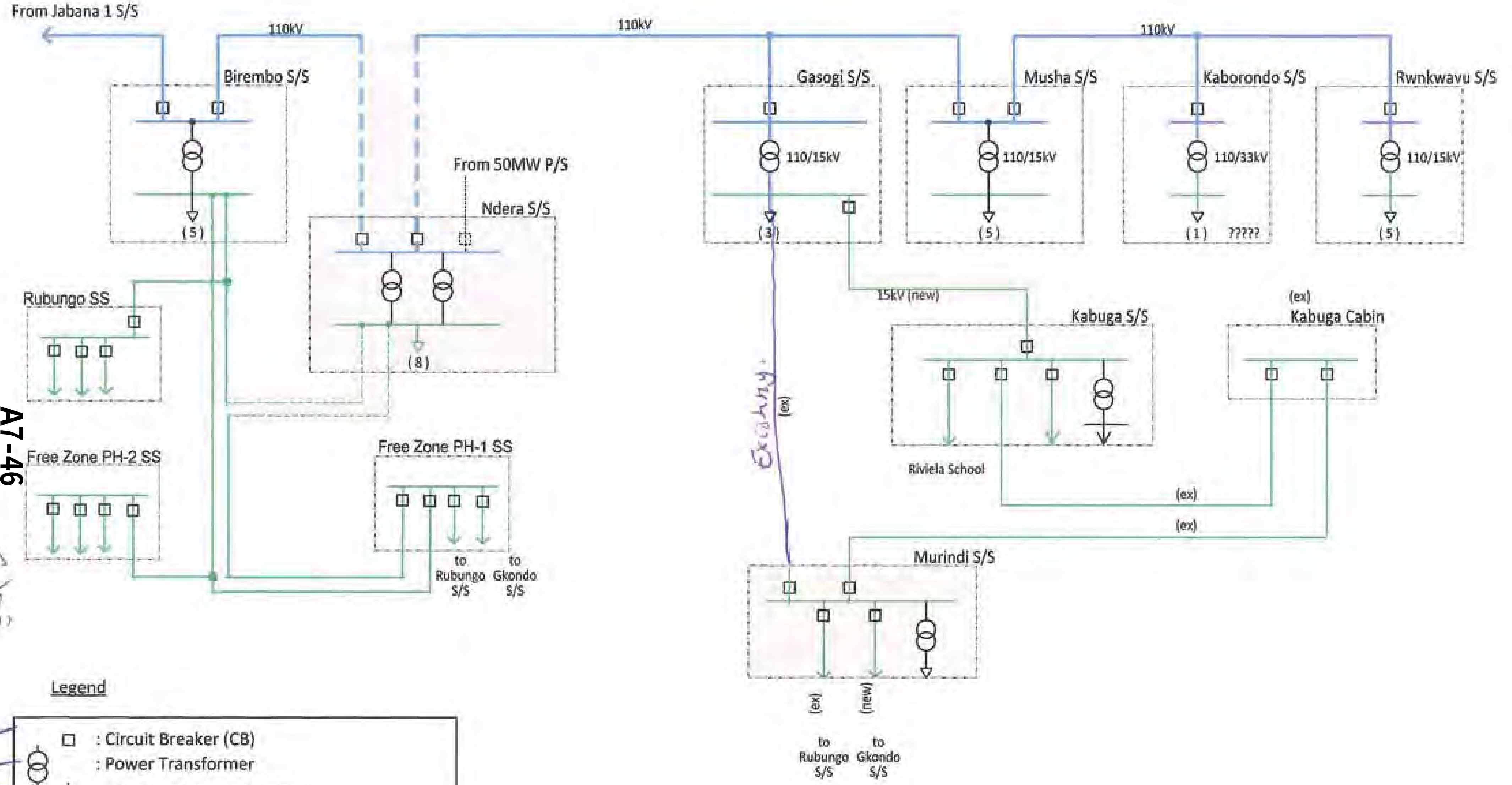
DWG No. GA-02: Project Site Map -110kV T/L, Ndera Substation, 15kV D/L Route 2 and 3-



DWG No. GA-03: Project Site Map -15kV D/L of Route 1, Kabuga and Murindi RMU stations-

DWG No. GA-04: Coordination Point of T/L and D/L (UTM: Zone 36M) by GPS

AP No.	Coordination Point		AP No.	Coordination Point		AP No.	Coordination Point	
	East	North		East	North		East	North
110kV T/L (approx. 2.2km)			15kV D/L: Route-1 (approx. 6km)			15kV D/L: Route-2 (approx. 490m)		
AP1	184120.00	9787770.00	AP1	188793.00	9787106.00	AP1	182851.00	9786243.00
AP2	184107.00	9787745.00	AP2	188870.00	9786382.00	AP2	182744.00	9786070.00
AP3	183887.00	9786949.00	AP3	188794.00	9786060.00	AP3	182637.00	9785922.00
AP4	183717.00	9786833.00	AP4	188887.00	9785586.00	AP4	183887.00	9785680.00
AP5	183437.00	9786586.00	AP5	189157.00	9785028.00			
AP6	183096.00	9786395.00	AP6	189222.00	9784795.00	15kV D/L: Route-3 (approx. 430m)		
AP7	182937.05	9786334.50	AP7	189507.00	9784262.00	AP1	182904.00	9786229.00
			AP8	189663.00	9783517.00	AP2	182900.00	9786339.00
			AP9	189973.00	9782743.00			
			AP10	190493.00	9781671.00	Kabuga RMU Station (≒ 300m2)		
			AP11	190485.00	9781439.00	at corner	190492.00	9781431.00
						Murindi RMU Station(≒80m2)		
						at corner	185371.00	9781726.00



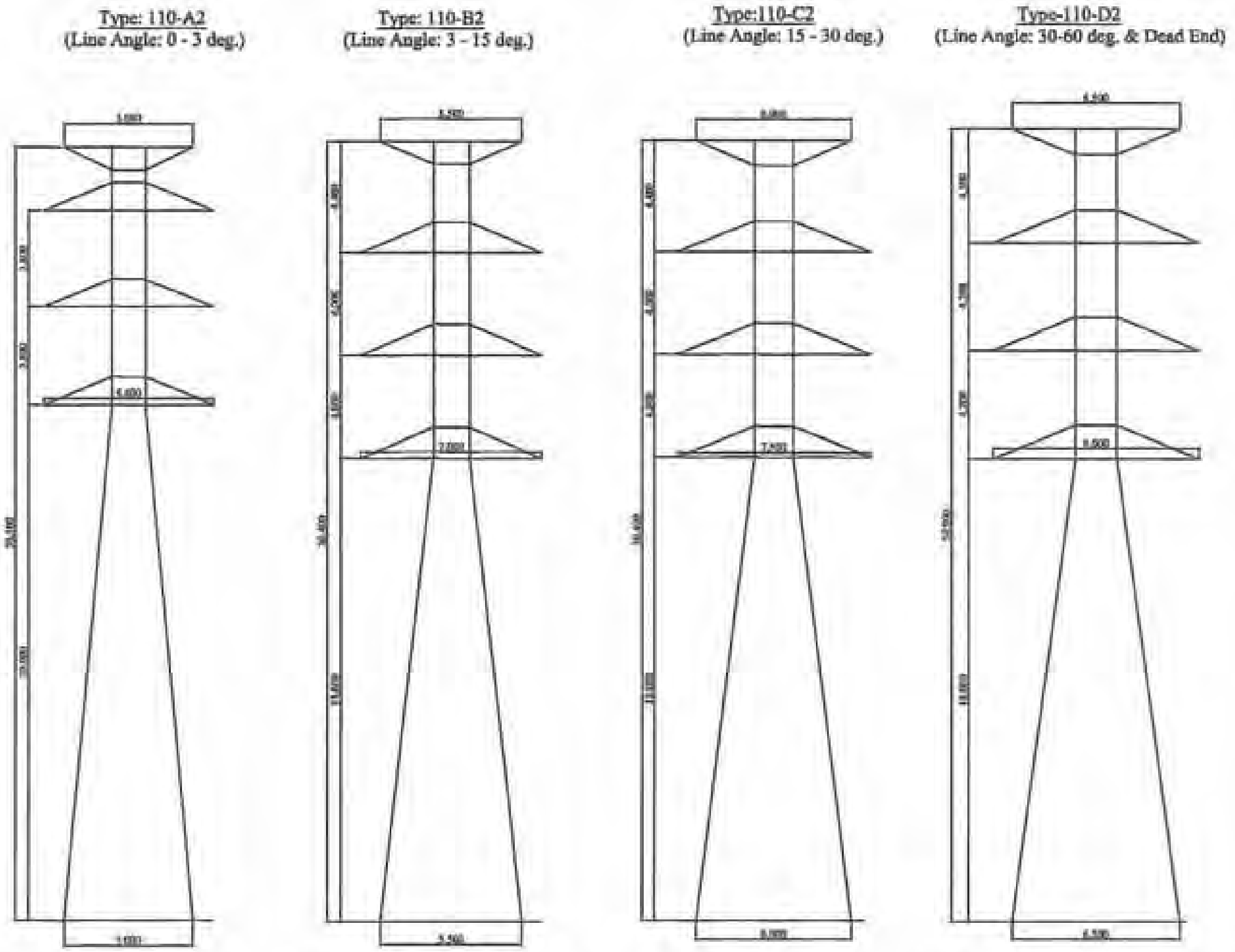
Legend

- □ : Circuit Breaker (CB)
- : Power Transformer
- : 15kV Distribution Feeders
- : Project Scope of Work
- Existing Facility (Solid Line)
- Existing Facility (Solid Line)

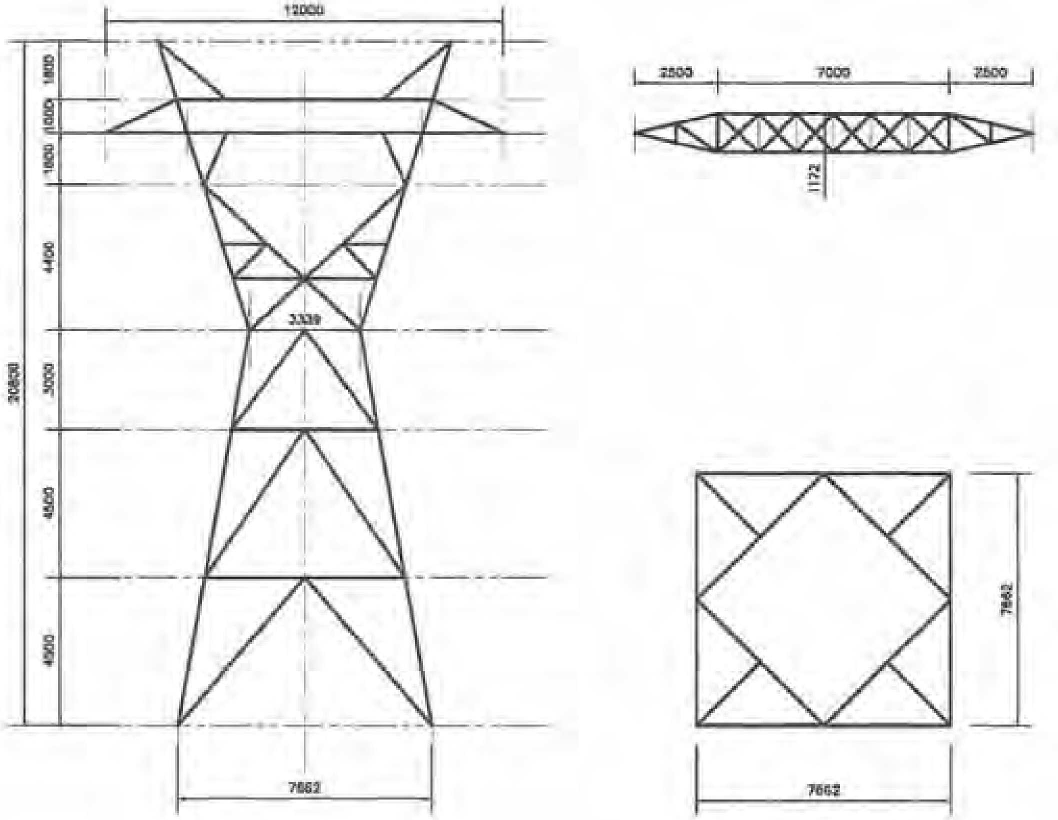
DWG No. GA-05: Project Concerned 110/15kV Network Diagram

19th March 2015

DWG No. TL01: Plan Drawing for 110kV Transmission Line

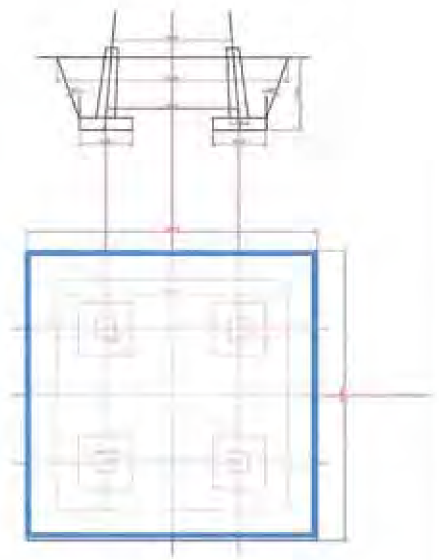


DWG No. TL-03 (1/2) : 110kV Typical Tower Type (110A2, 110B2, 110C2, 110D2 and 110E1)



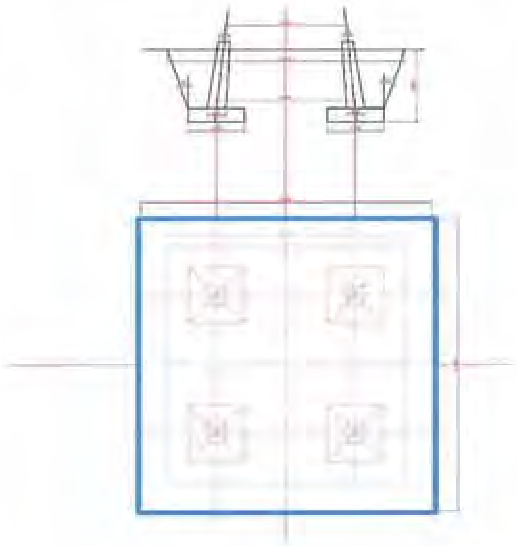
Tower Type 110E1 (110kV Tension type, Single circuit: 1cct)

DWG No. TL-03 (2/2): 110kV Typical Tower Type (110A2, 110B2, 110C2, 110D2 & 110E1)



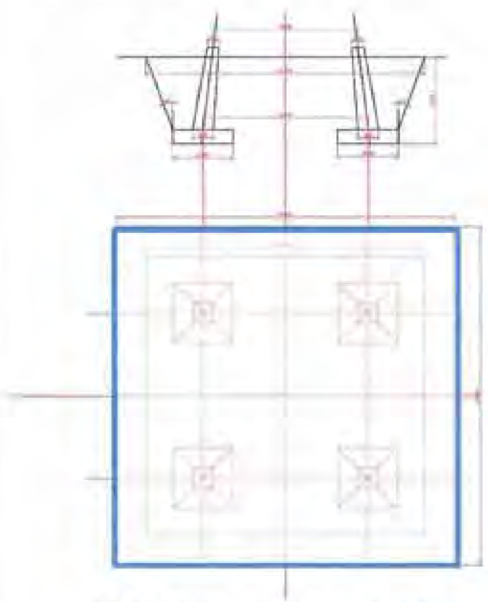
110kV Tower type – 110A2 –

Land Size to be Secured: 12mx12m



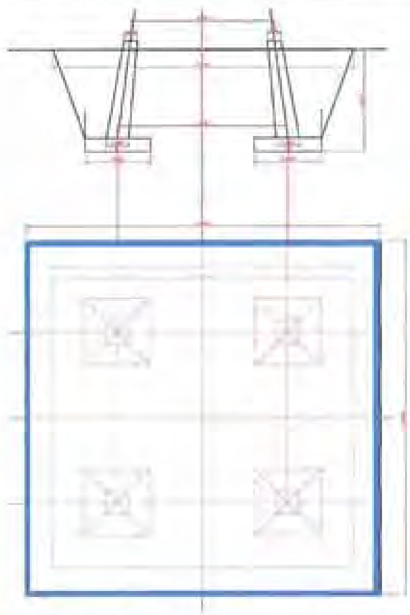
110kV Tower Type – 110B2 –

Land Size to be Secured: 13mx13m



110kV Tower Type – 110C2 –

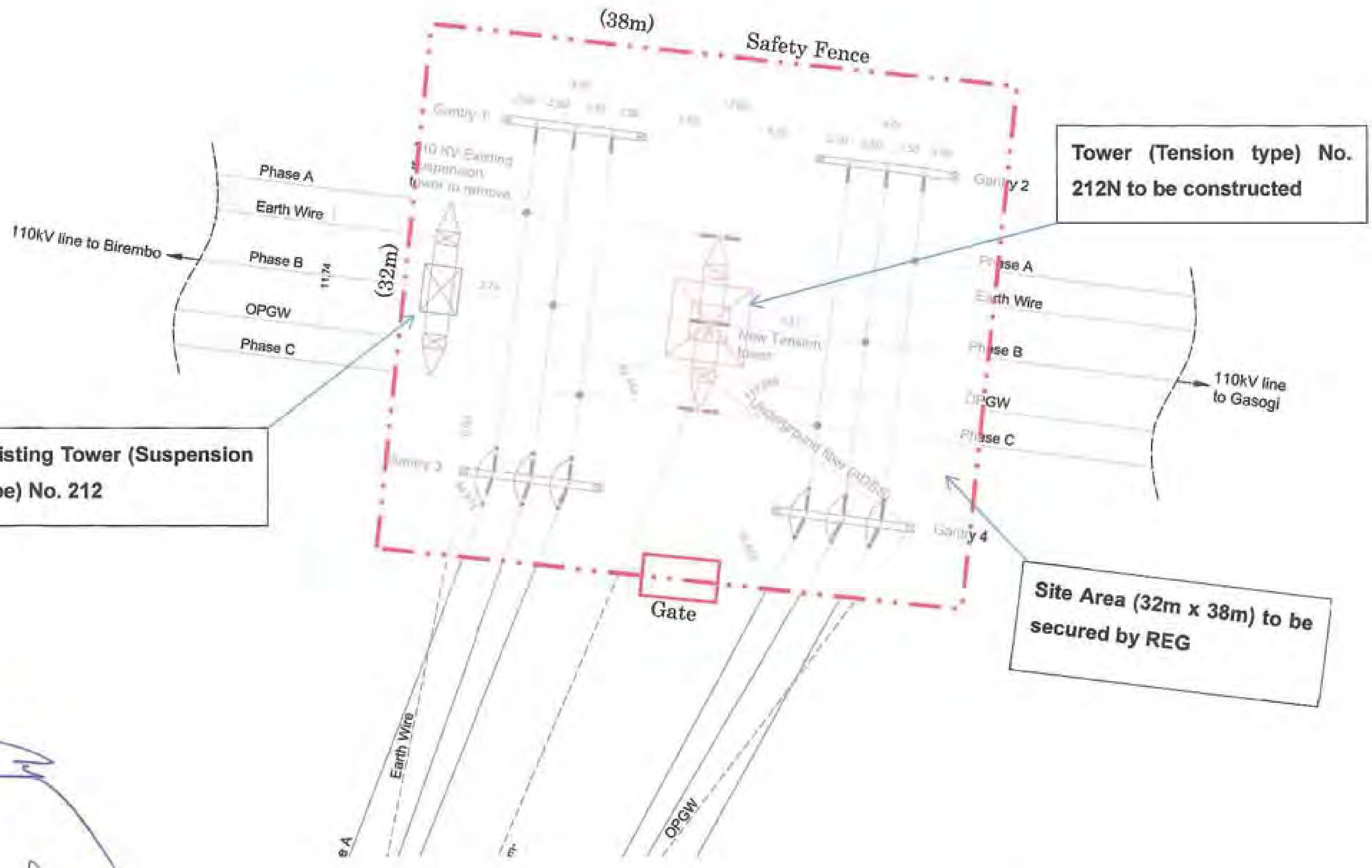
Land Size to be Secured: 14mx14m



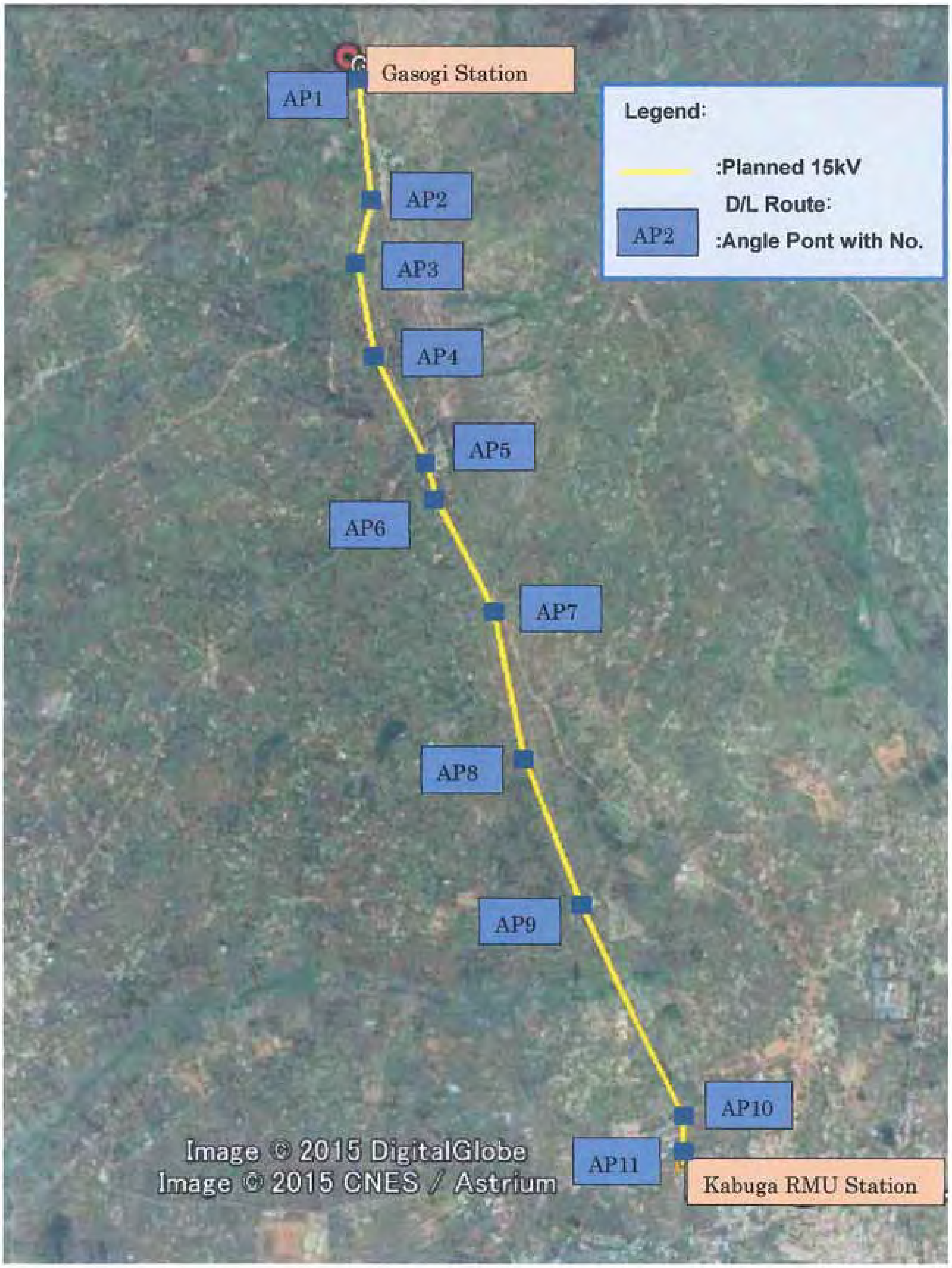
110kV Tower Type – 110D2 –

Land Size to be Secured: 16mx16m

DWG No. TL-04: Typical Foundation Plan for 110kV T/L

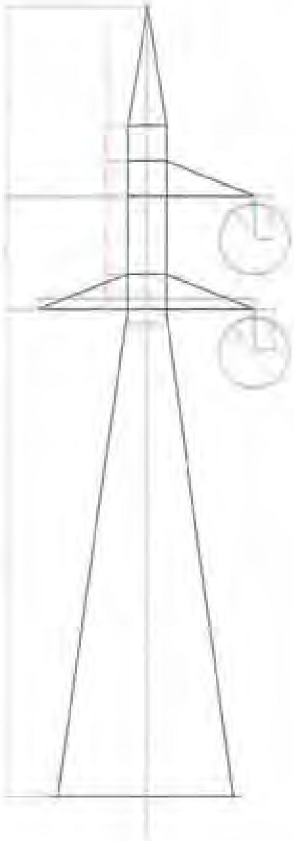


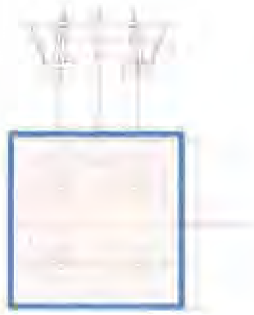
TL-05: Plan Drawing at 110kV Connection Point



DWG No. DL11: 15kV Distribution Line Map: Route 1

(From Gasogi S/S to Kabuga RMU Station)

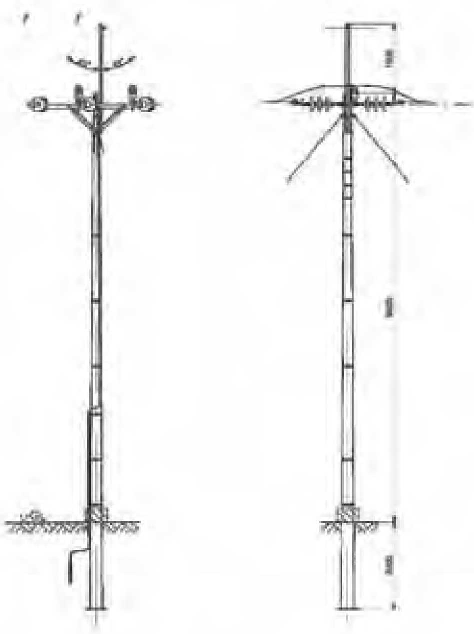




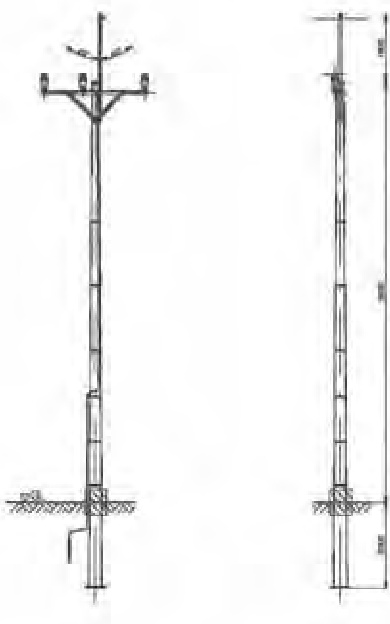
Typical Tower Foundation Plan
(Land Area: approx. 8m x 8m)

Type 15TB1
(Suspension Tower Type)

Type 15TD1
(Tension Tower Type)



Type 15PB1
(Suspension Pole Type)

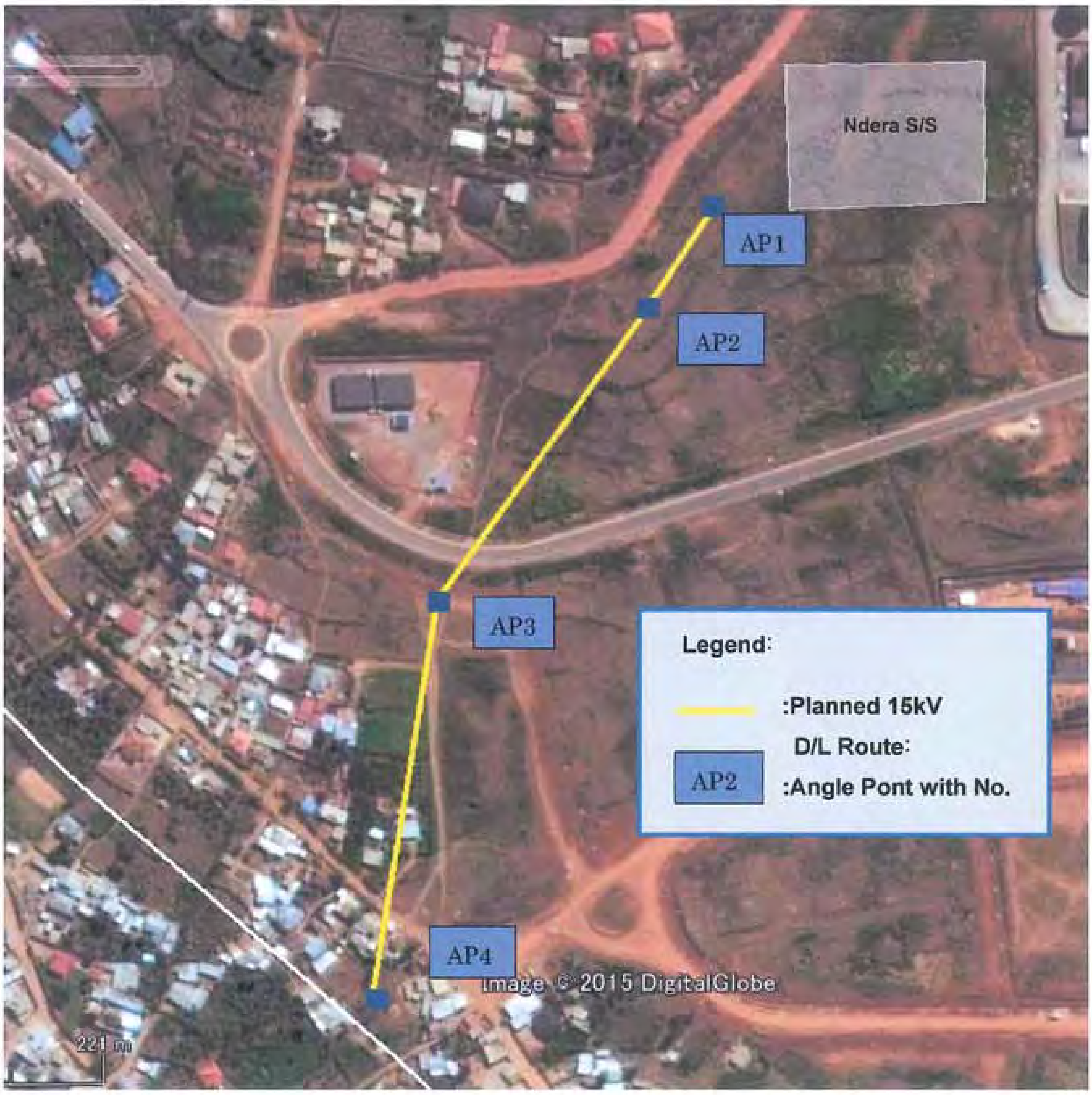


Type 15PA1
(Tension Pole Type)

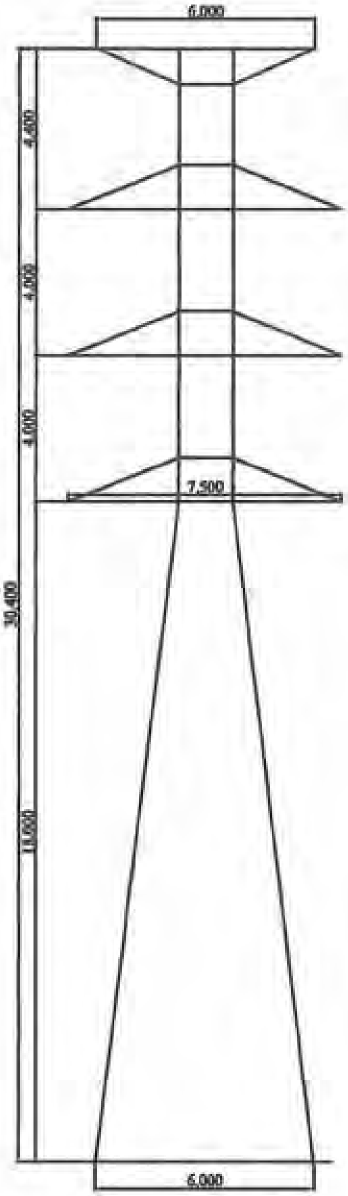
Note: Land area to be secured for 15kV pole foundation: approx. 2m x 2m each

DWG No. DL12: Typical Tower/Pole Type of 15kV D/L (Single Circuit)

(For 15kV D/L Route 1 and 3, Single Circuit)

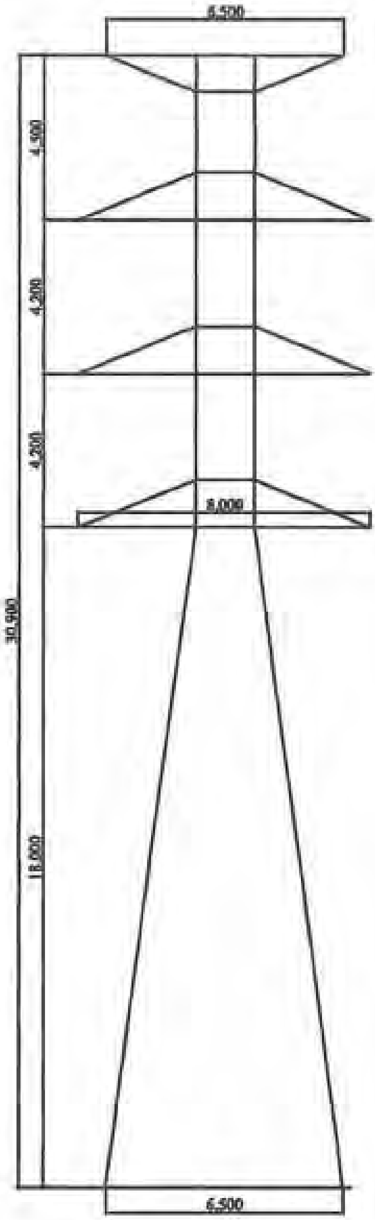


DWG No. DL21: 15kV Distribution Line Map: Route 2
(From Ndera S/S to Existing Tower)



Type 15TB2

(For Tension type, 2 cct)



Type 15TD2

(for Tension and Dead end, 2cct)

Land Area to be secured: 8m x 8m each

Tower Type Foundation Plan

DWG No. DL22: Typical Tower Type of 15kV D/L

(For 15kV D/L: Route 2)

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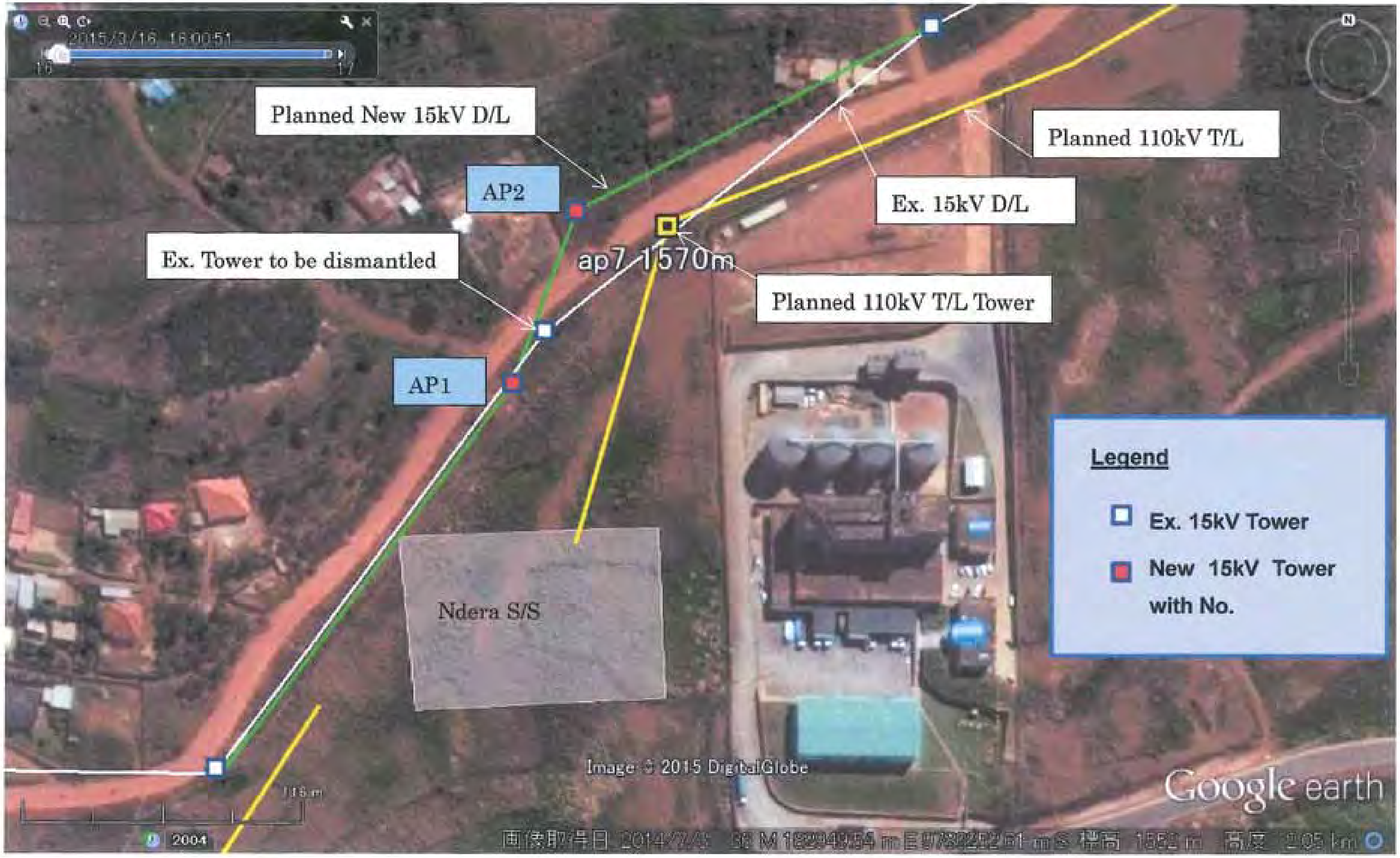
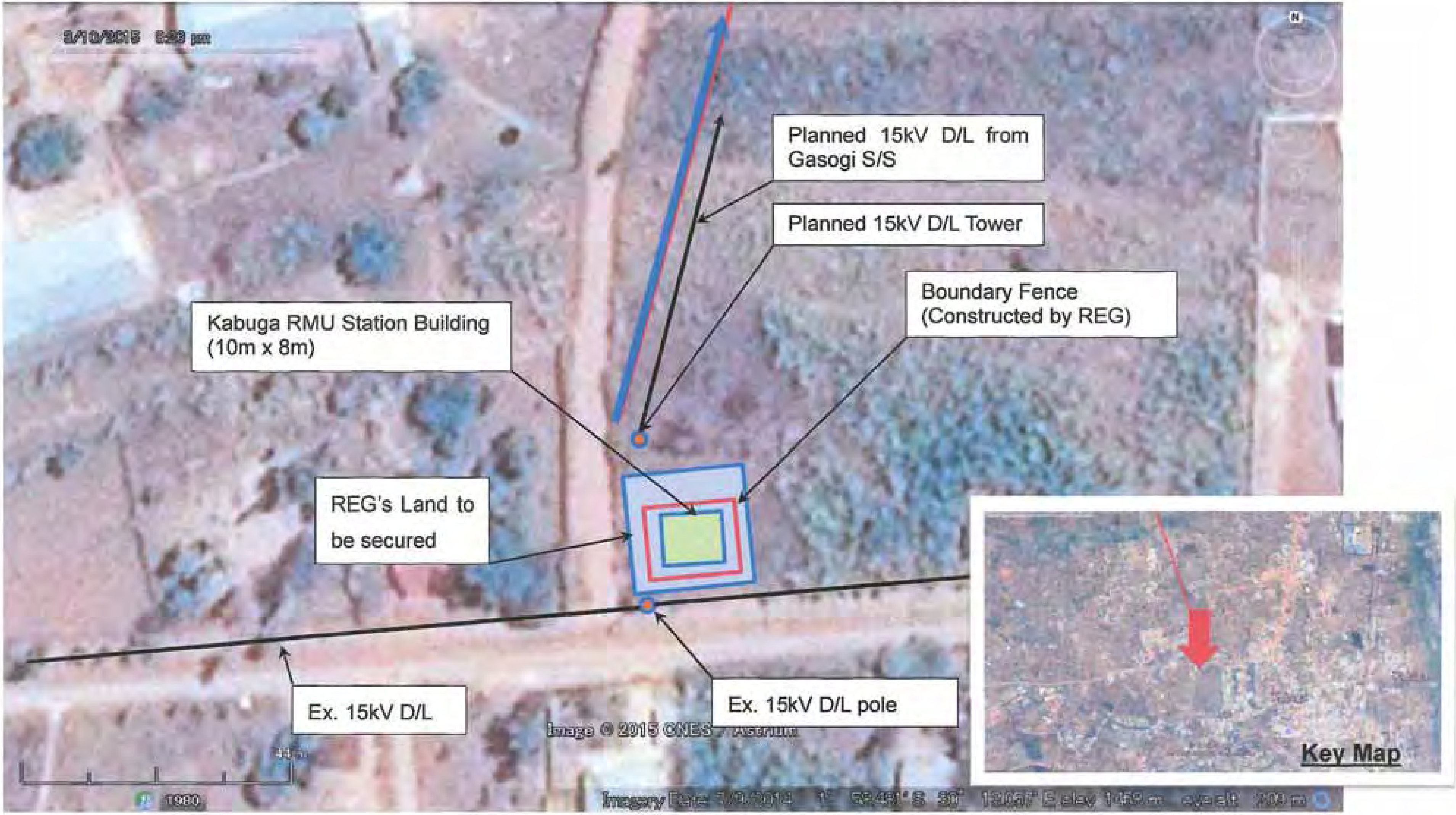
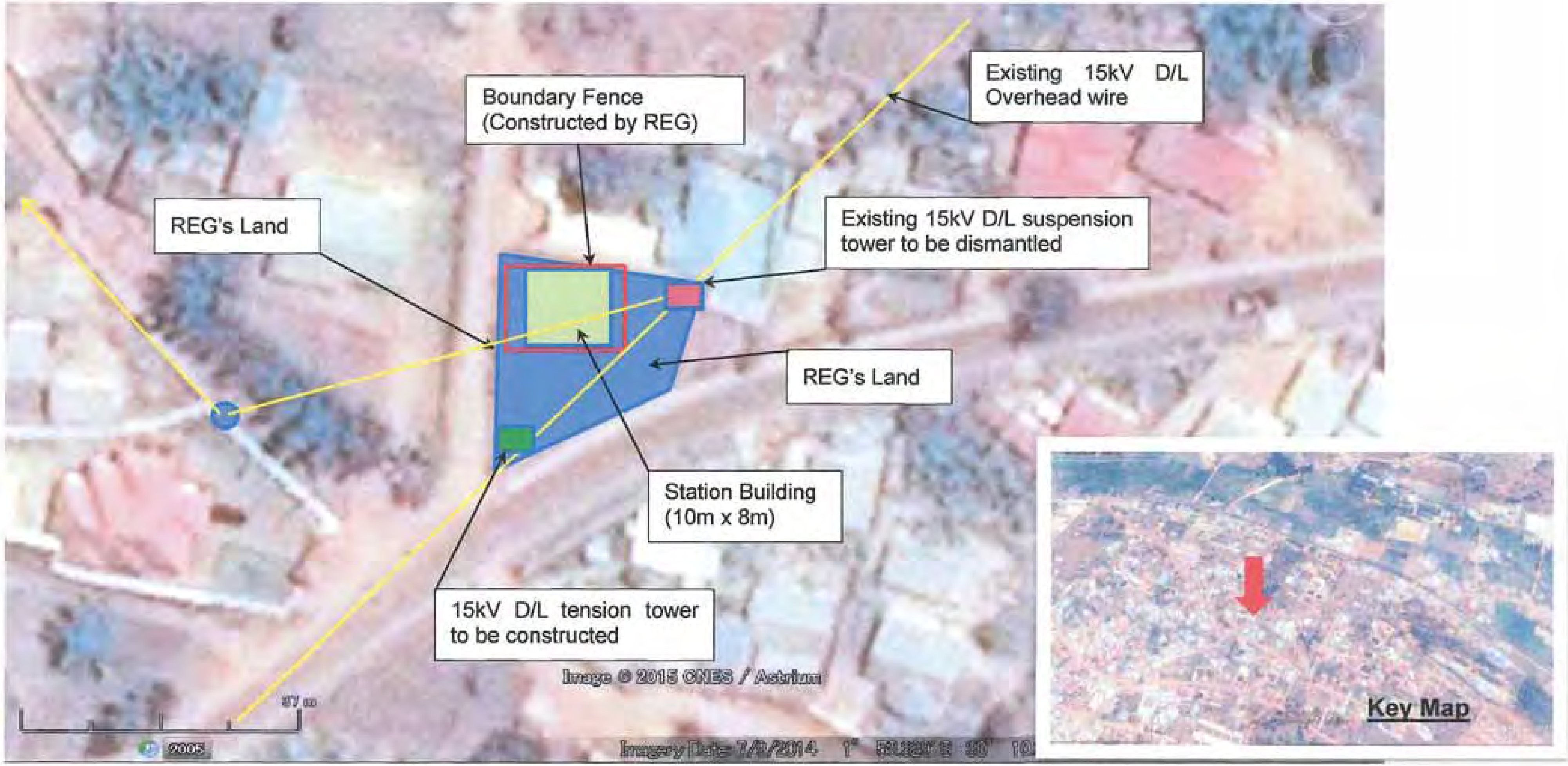


DWG No. DL-31: Reroute of existing 15kV D/L: Route-3



DWG No. RM-01: Site Layout of Kabuga RMU Station



DWG No. RM-11: Site Layout of Murindi RMU Station

Part 3 Architectural

Drawing List

DWG No.	DWG Title

Part 3 Architectural

(1) A-1 Land Preparation Work of Ndera Substation

(2) A-2 Land Preparation Work of Tower No.212N

(3) A-3 Land Preparation Work of Kabuga RMU Switching Station

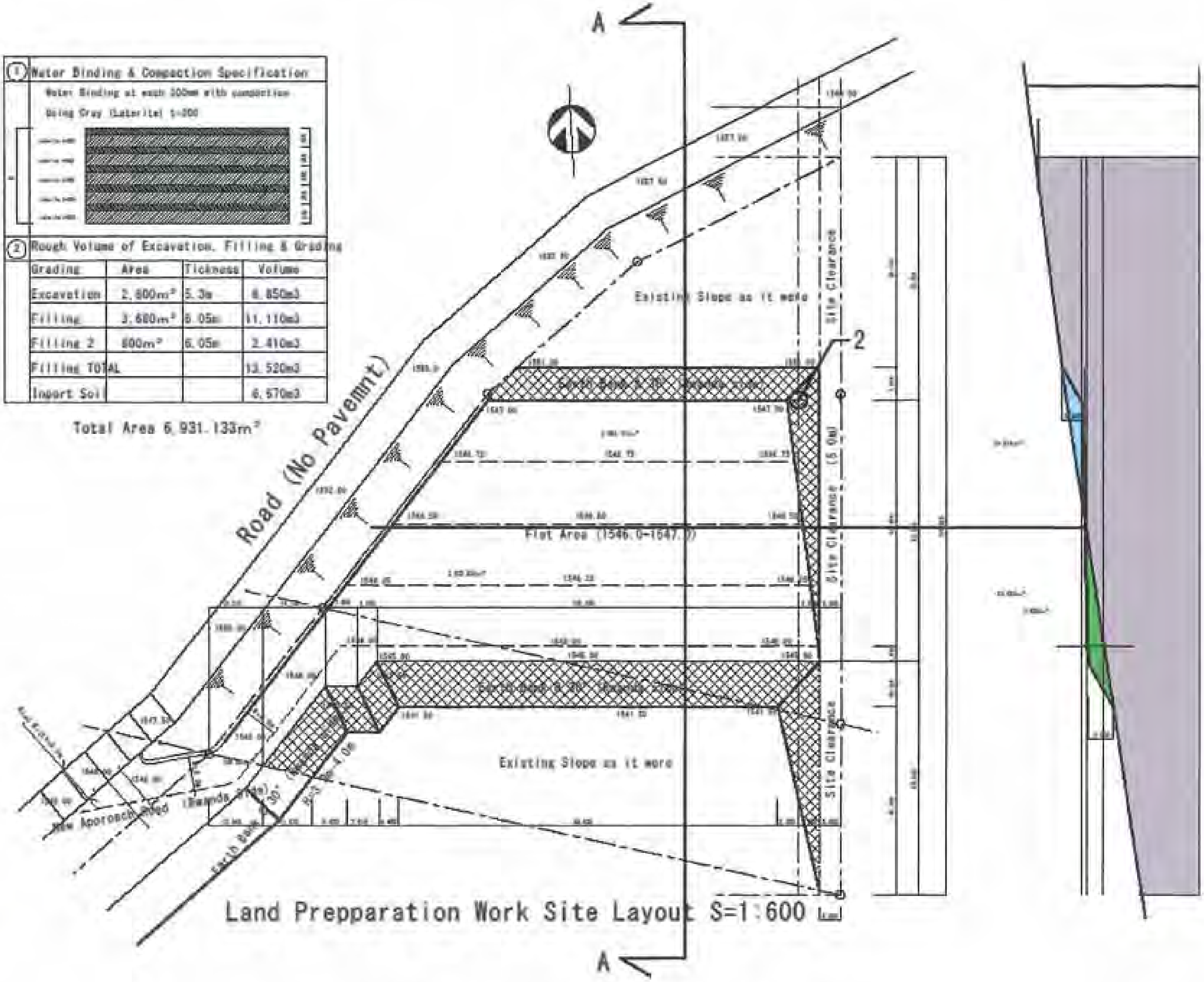
(4) A-4 Land Preparation Work of Murindi RMU Switching Station

(5) A-5 NDERA Substation Site Layout

(6) A-6 NDERA Substation Control Building Plan

(7) A-7 NDERA Substation Control Building Section & Elevation

(8) A-8 NDERA Substation Control Building Section Detail



① Water Binding & Compaction Specification

② Rough Volume of Excavation, Filling & Grading

Grading	Area	Tickness	Volume
Excavation	2,800m²	5.3m	6,850m3
Filling	3,680m²	6.05m	11,110m3
Filling 2	800m²	6.05m	2,410m3
Filling TOTAL			13,520m3
Inport Soil			6,570m3

Total Area 6,931.133m²

A-1 Land Preparation Work of Ndera Substation

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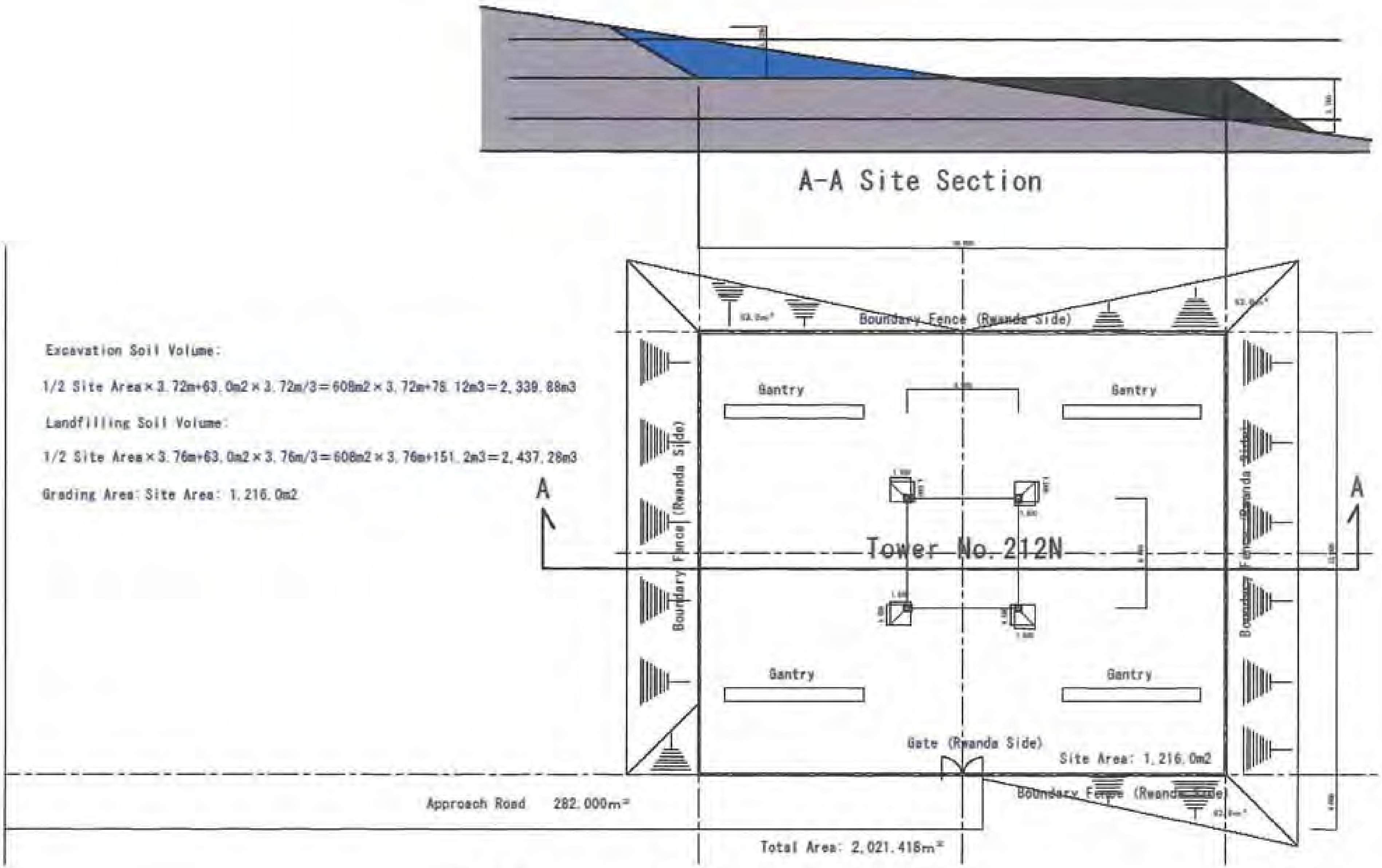
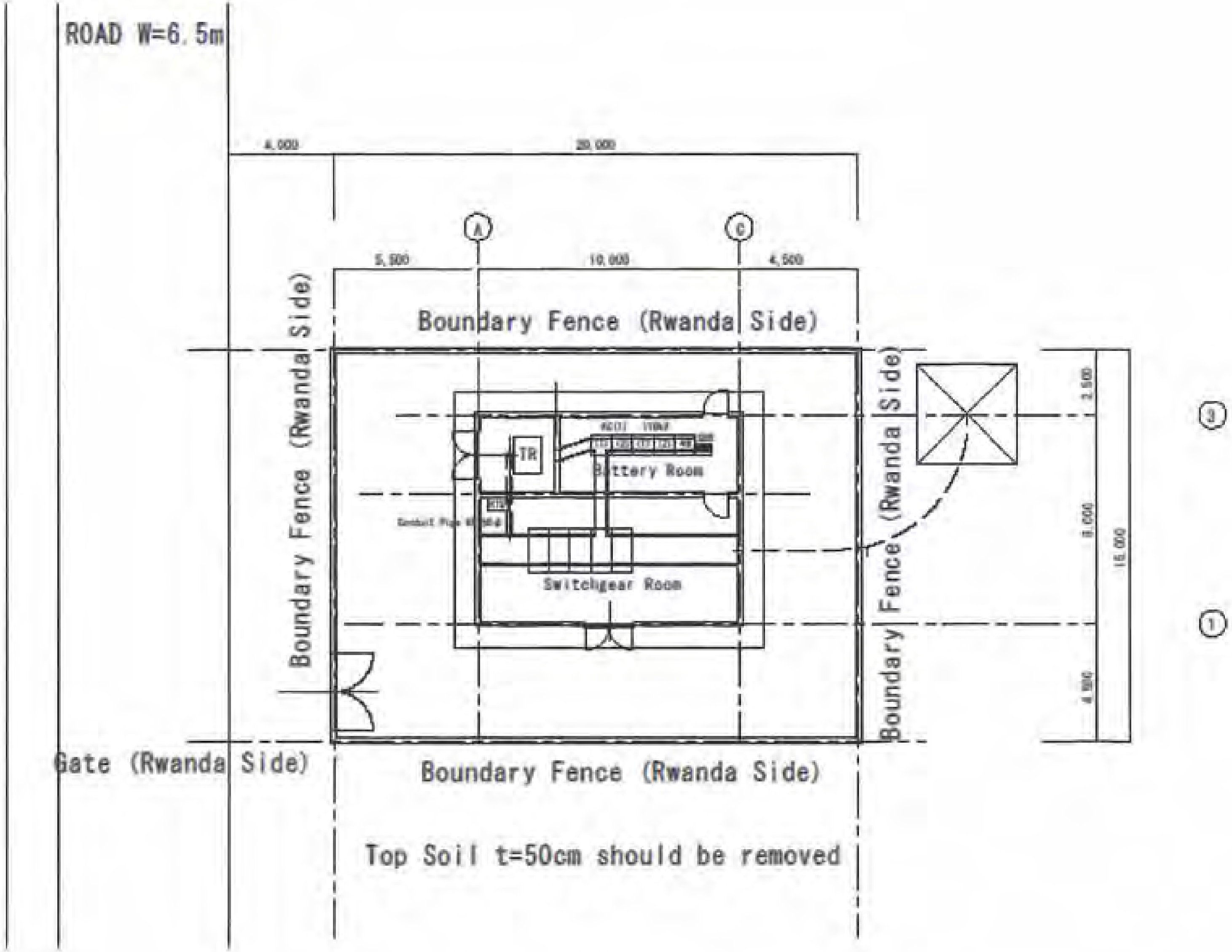
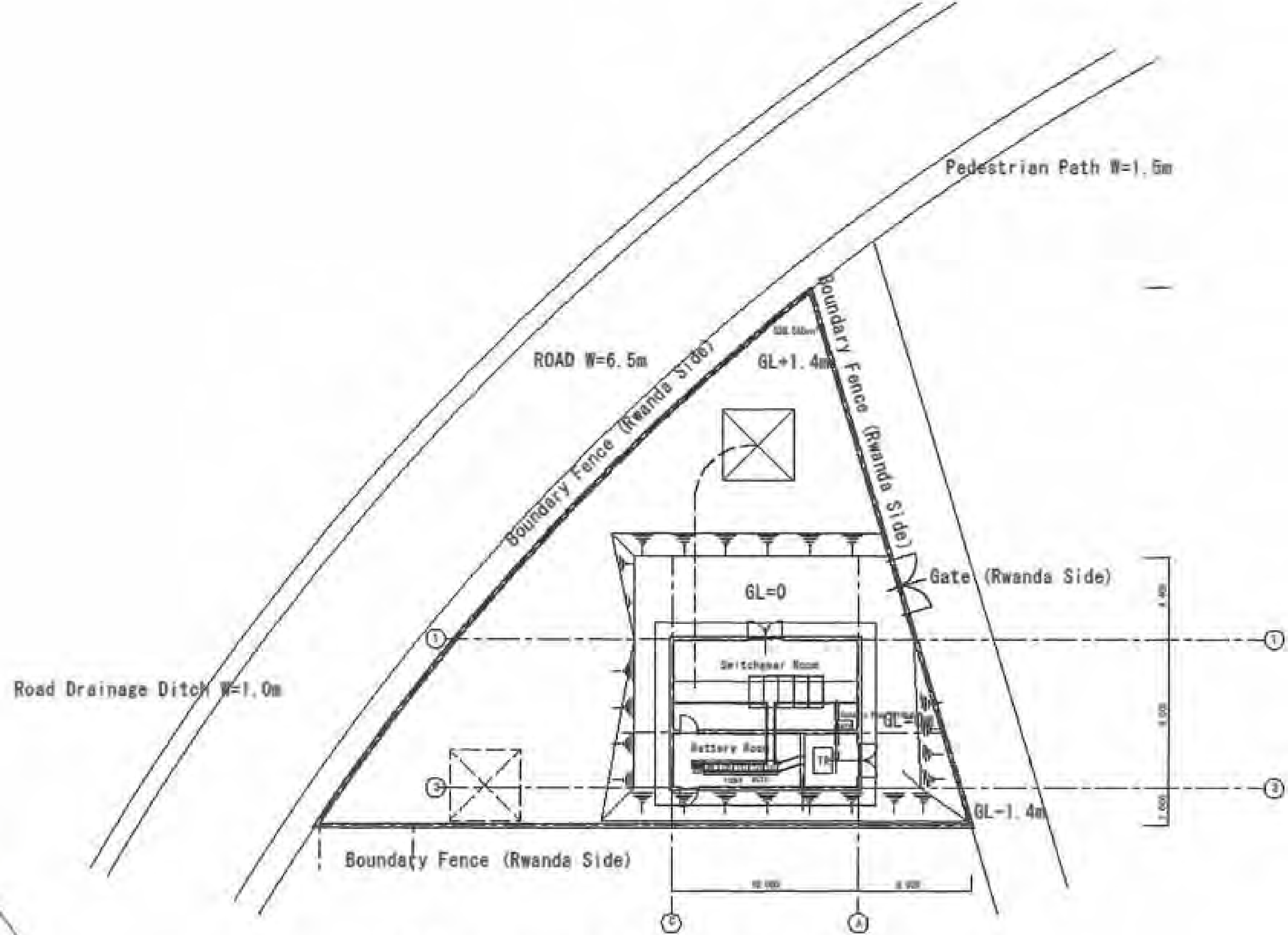


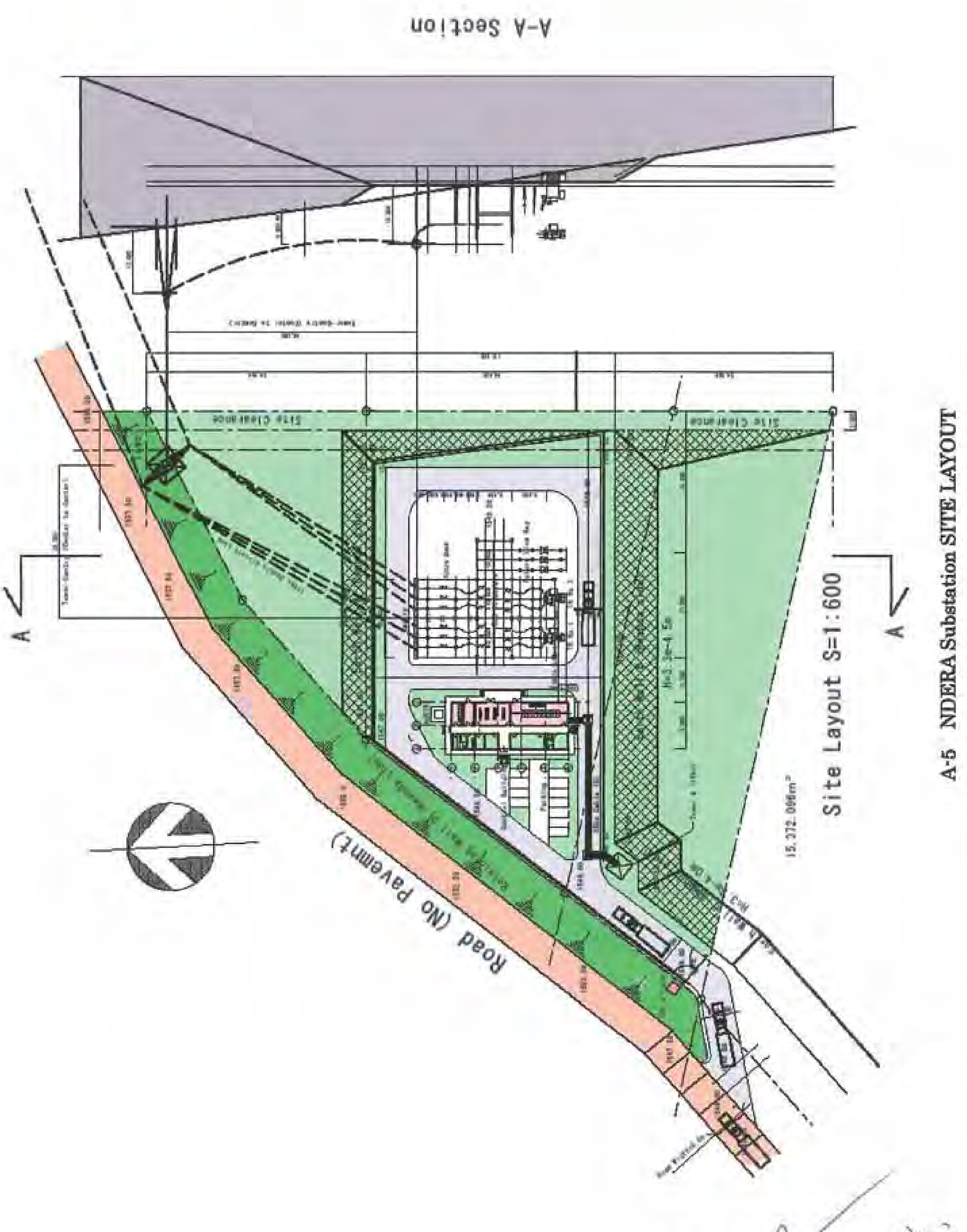
A-2 Land Preparation Work of Tower No.212N



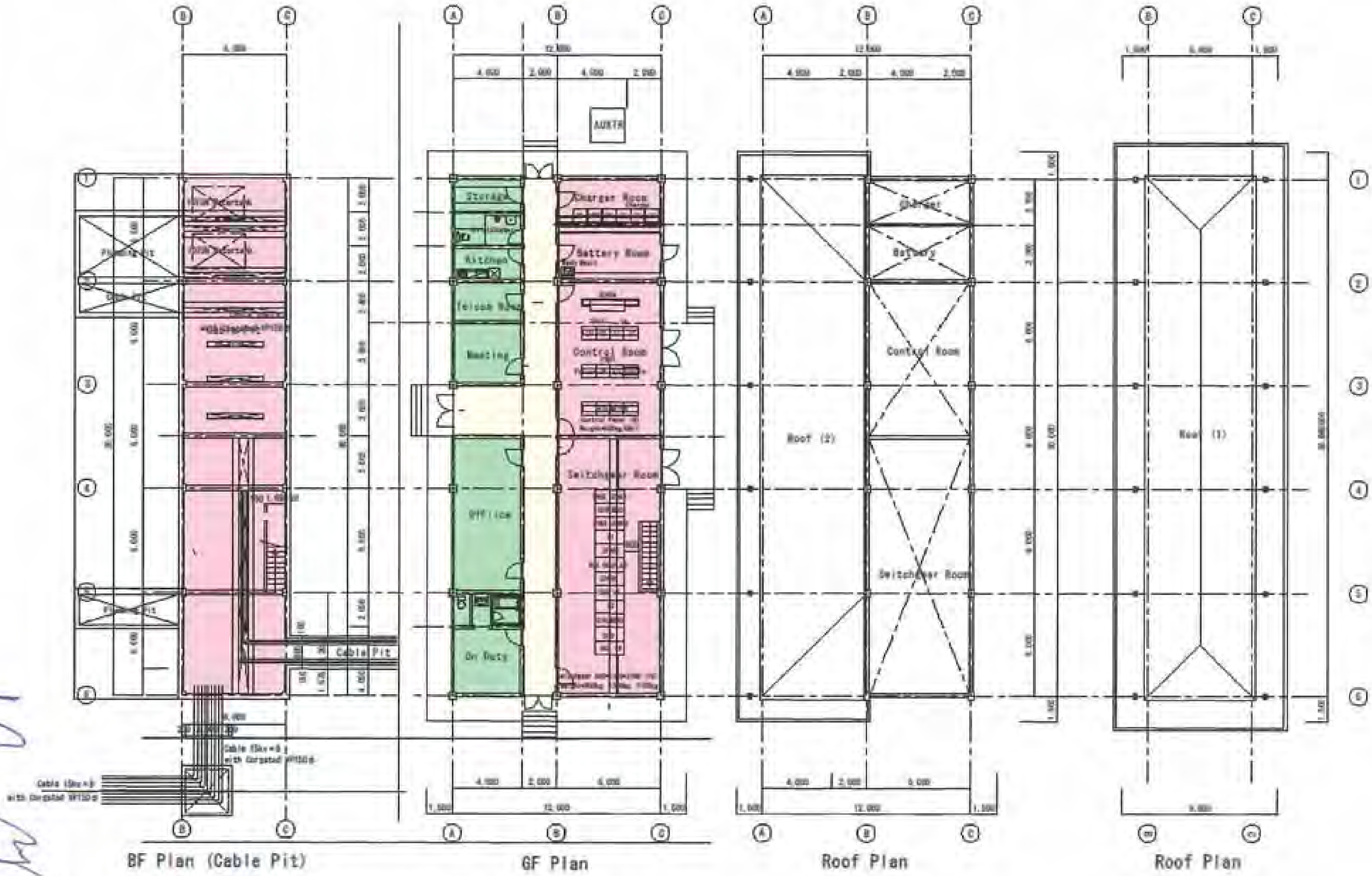
A-3 Land Preparation Work of KABUGA Ring Main Unit



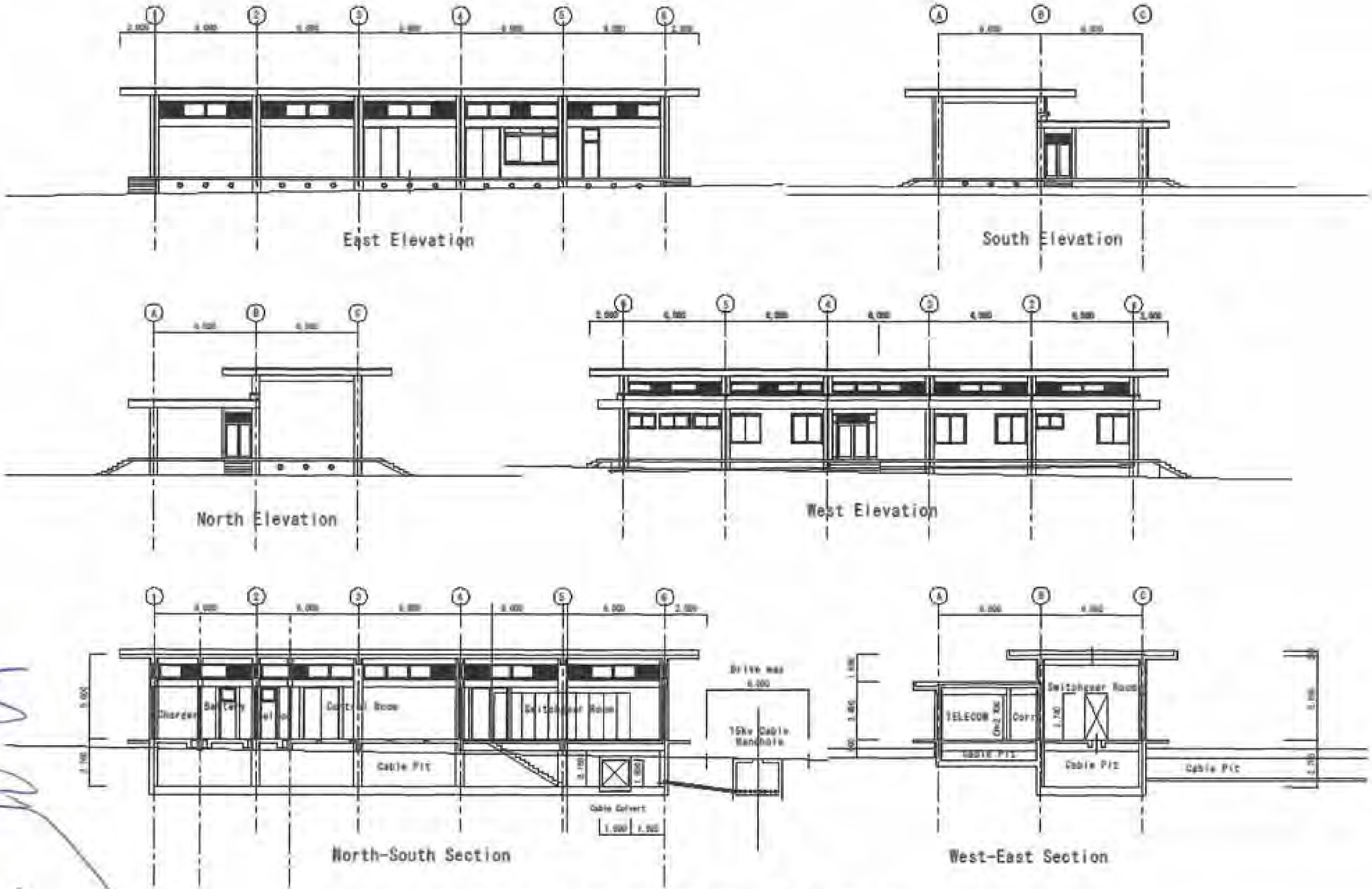
A-4 Land Preparation Work of MURINDI Ring Main Unit



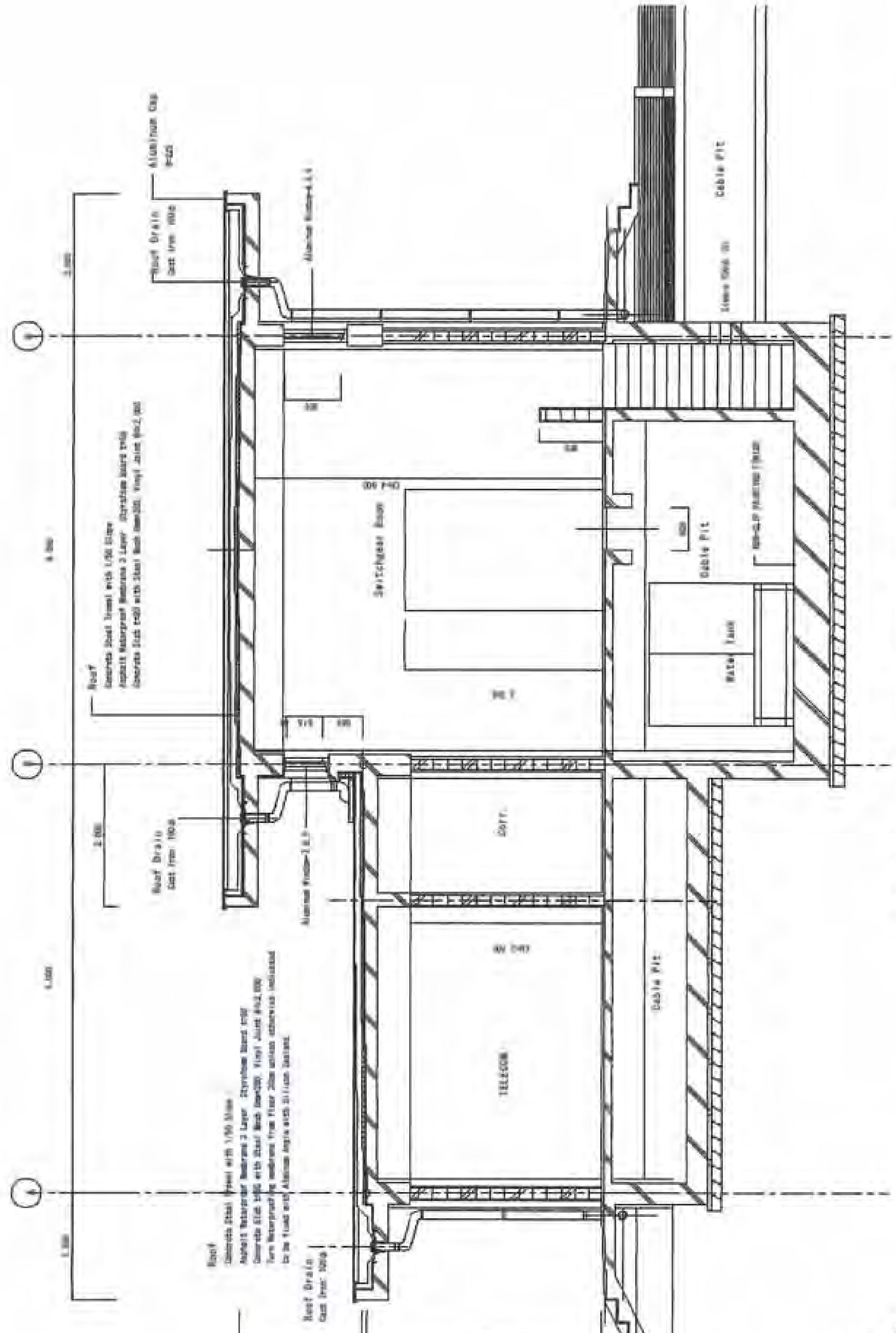
A-5 NDERA Substation SITE LAYOUT



A-6 NDERA Substation Plan



A-7 NDERA Substation Section & Elevation



A-8 NDERA Substation Section Detail

Minutes of Field Report Meeting

Name of the Project	The Project for Improvement of Substations and Distribution Network Phase 2
Date	31st March , 1st & 2nd April, 2015
Time	14:00 - 17:00 (GMT+2)
Venue	EUCL Gikondo Office at Gikondo Substation
Attendees	EUCL members & JICA study Team, Refer to Attendance List
Discussion Summary	All parties went over a draft of the Field Report prepared by the JICA study team; the following items are discussed in the meeting. **A: Regarding Obligations/Undertaking of the Rwanda side;** 1. The Rwanda side requested the JICA Study Team following items; (1) 15kV Power Cable: The JICA Study Tram agreed that all 15kV power cables from 15kV switchgears of the substations and switching stations shall be provided by the Japan side. Regarding the new 15kV outgoing cables for the Ndera substation, the JICA Study Team requested the Rwanda side to confirm and inform the JICA Study Team with all locations where the cables will be connecting with 15kV towers or poles, with their number and coordination points. (2) Power Stoppage Plan: The JICA Study Team will prepare a time chart of power stoppage plan for the existing lines during construction of the 110kV transmission and 15kV distribution lines. The time chart shall be ready after completing the design of the lines approximately by the end of July 2015. 2. Malfunction of the spare 15kV SWGR at the Gasogi substation; The Rwanda side informed that after repairing the malfunction of the spare, the EUCL would use it for a 15kV distribution line feeding to the international airport as double circuits therefore the spare feeder cannot be used for the Kabuga RMU switching station. The JICA Study Team and the Rwandan side agreed on the following demarcation of tasks. ① JICA Study Team shall provide one (1) set of new 15kV SWGR with necessary materials for Kabuga RMU switching station. The details including communication system and other items to be informed later. ② The Rwanda side will expand the 15kV SWGR room with cable trench before construction of the 15kV SWGR.

	[B Technical Issue] 1. Air Condition (A/C) in the Control Building at the Ndera substation The Rwanda side will internally discuss and inform the JICA Study Team whether the A/C for control building is necessary or not. 2. The width of an entrance road in Ndera substation: The Rwanda side and the JICA Study Team agreed that the width of entrance should be 5 meter, instead of 8m. 3. Confirmation of the planned110kV and 15kV line alignment to Concerned Authorities: JICA requested the Rwanda side to explain and confirm with concerned authorities regarding the planned alignment of the 110kV and 15kV lines shown in the Field Report. The Rwanda side will inform the JICA Study Team by the mid-April 2015, if the authorities have any concerns or comments. 4. Estimation Cost: The Rwanda side agreed that they estimate costs on each work item listed on the Demarcation Work Table of the Field Report and inform the JICA Study Team as soon as possible. 5. Substation The Rwanda side and the JICA Study Team agreed that the JICA Study Team confirm a license of BG-20. 6. The Connection Point of the 110kV Transmission Line with the Existing Transmission Line The Rwanda side suggested another connection method of 110kV T/L proposed by EUCL in order to minimize the site size, which is currently planned as 32m x 38m. The JICA study team has confirmed the suggested method during the site visit on 1st April and will investigate the method and inform EUCL with results as soon as possible.
Handouts	Draft of Field Report

Project for IMPROVEMENT OF SUBSTATIONS AND DISTRIBUTION NETWORK PHASE 2

Attendance List

Date: 31st March 2015 Location: Gikondo Substation

Purpose: Meeting on Field Report

No.	Name	Organization	Title	Telephone	Email
1	BUTERA LAURENT	EUCL/REG	Transmission ENG	0788775679	butelau@yahoo.co.uk
2	Simon J NDIRAMIYE	EUCL/REG	Transmission ENG.	0788483731	sjndiramiye@eucl.reg.rw
3	Kazungu Fredric	REG/EUCL	Transmission Engineer	0788563539	f.kazungu@eucl.reg.rw
4	Kudo Toshiyuki	JICA Study Team	Chief Consultant	0784379258	fuga1013@nifty.com
5	Atsuhito Unno	JICA Study Team	Transmission/Distribution Facility	0786370046	unno@intl.yachiyo-eng.co.jp
6	Yasuo Horigome	〃	Facility Planning	078 636 9068	yasuo_horigome@msn.com
7	Kenji SAKEMUR	〃	Substation	078 637 0037	k-sakemura@wjec.co.jp
8	Asami KABASAWA	〃	Env & Soc Considerations	078 2368 864	asamikabasawa@gmail.com
9	Kyohei KUROHANE	〃	Construction Planning	078 236 9446	ky-kurohane@intl.yachiyo-eng.co.jp
10	BIHOYIKI Hilliam	EUCL/REG	Head of transmission	0788568426	wbihoyiki@eucl.reg.rw
11					
12					
13					

添付資料- 9

系統解析に係るデータ

目　　次

1. 変電所への需要想定負荷の配分

2. 潮流計算報告書

1) 2018 年断面（詳細）

2) 2021 年断面（要約）

3) 2023 年断面（要約）

4) 2026 年断面（要約）

5) 2028 年断面（詳細）

3. 三相短絡電流計算報告書

1) 2018 年断面

2) 2021 年断面

3) 2028 年断面

1. 変電所への需要想定負荷の配分

変電所への需要想定負荷の配分

（単位: MW）

高ケース	2015 (1月実績)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
ギコンド変電所	25.06	37.0	41.4	25.0	27.2	29.6	32.3	35.3	38.5	42.1	46.0	50.2	54.8	59.8	65.2	71.2	77.6	84.7	92.3
ジャバナ変電所	14.45	21.4	23.6	24.4	26.5	28.9	31.5	34.4	37.6	41.1	44.8	49.0	53.5	58.3	63.7	69.5	75.8	82.6	90.1
ビレンボ変電所	6.18	9.9	11.2	11.7	12.7	13.9	15.1	16.5	18.0	19.7	21.5	23.5	25.6	28.0	30.5	33.3	36.3	39.6	43.2
ガソギ変電所	3.89	7.0	7.8	8.2	8.9	9.7	10.6	11.6	12.6	13.8	15.1	16.5	18.0	19.6	21.4	23.3	25.5	27.8	30.3
マウント･キガリ変電所(15kV)	*4.22*			*6.9*	*7.5*	*8.2*	*8.9*	*9.7*	*10.6*	*11.6*	*12.7*	*13.8*	*15.1*	*16.5*	*18.0*	*19.6*	*21.4*	*23.4*	*25.5*
マウント･キガリ変電所(30kV)	*3.06*			*8.9*	*9.7*	*10.5*	*11.5*	*12.6*	*13.7*	*15.0*	*16.4*	*17.9*	*19.5*	*21.3*	*23.2*	*25.3*	*27.6*	*30.1*	*32.9*
マウント･キガリ変電所(合計)	7.28	26.3	30.5	15.8	17.2	18.7	20.4	22.3	24.4	26.6	29.0	31.7	34.6	37.8	41.2	45.0	49.1	53.5	58.4
ンデラ変電所				9.5	10.3	11.3	12.3	13.4	14.6	16.0	17.5	19.1	20.8	22.7	24.8	27.0	29.5	32.2	35.1
ガハンガ変電所				3.8	4.1	4.5	4.9	5.4	5.9	6.4	7.0	7.6	8.3	9.1	9.9	10.8	11.8	12.9	14.0
ニャブゴゴ変電所				8.2	8.9	9.7	10.6	11.6	12.6	13.8	15.1	16.5	18.0	19.6	21.4	23.3	25.5	27.8	30.3
ルリマ変電所				15.8	17.2	18.7	20.4	22.3	24.4	26.6	29.0	31.7	34.6	37.8	41.2	45.0	49.1	53.5	58.4
中央地区負荷合計	57	102	115	122	133	145	158	173	189	206	225	246	268	293	319	348	380	415	452
ムシャ変電所	2.6	18.0	20.5	18.2	19.5	21.2	23.2	25.2	27.4	29.7	32.2	35.0	37.9	41.0	44.5	48.1	52.1	56.5	61.2
＋ガラマ変電所負荷				4.1	4.4	4.8	5.2	5.7	6.2	6.7	7.3	7.9	8.5	9.2	10.0	10.8	11.7	12.7	13.8
カバロンド変電所	4.924	7.8	9.1	9.5	10.2	11.1	12.1	13.2	14.3	15.5	16.8	18.2	19.8	21.4	23.2	25.1	27.2	29.5	31.9
ルウィンクワブ変電所	0.427	1.8	2.5	2.8	3.0	3.3	3.6	3.9	4.2	4.6	5.0	5.4	5.8	6.3	6.8	7.4	8.0	8.7	9.4
＋キレヘ変電所負荷				2.8	3.0	3.3	3.6	3.9	4.2	4.6	5.0	5.4	5.8	6.3	6.8	7.4	8.0	8.7	9.4
東地区負荷合計		28	32	37	40	44	48	52	56	61	66	72	78	84	91	99	107	116	126

（単位: MW）

中ケース	2015 (1月実績)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
ギコンド変電所	25.06	32.2	35.7	21.4	23.4	25.6	28.0	30.7	33.6	36.8	40.3	44.0	48.1	52.5	57.2	62.4	68.0	74.0	80.6
ジャバナ変電所	14.45	18.6	20.3	20.8	22.8	25.0	27.4	30.0	32.8	35.9	39.3	42.9	46.9	51.2	55.9	60.9	66.3	72.3	78.6
ビレンボ変電所	6.18	8.6	9.7	10.0	10.9	12.0	13.1	14.4	15.7	17.2	18.8	20.6	22.5	24.6	26.8	29.2	31.8	34.6	37.7
ガソギ変電所	3.89	6.1	6.7	7.0	7.7	8.4	9.2	10.1	11.0	12.1	13.2	14.4	15.8	17.2	18.8	20.5	22.3	24.3	26.4
マウント･キガリ変電所(15kV)	*4.22*			*5.9*	*6.5*	*7.1*	*7.7*	*8.5*	*9.3*	*10.2*	*11.1*	*12.1*	*13.3*	*14.5*	*15.8*	*17.2*	*18.8*	*20.4*	*22.2*
マウント･キガリ変電所(30kV)	*3.06*			*7.6*	*8.3*	*9.1*	*10.0*	*10.9*	*12.0*	*13.1*	*14.3*	*15.7*	*17.1*	*18.7*	*20.4*	*22.2*	*24.2*	*26.4*	*28.7*
マウント･キガリ変電所(合計)	7.28	22.9	26.3	13.5	14.8	16.2	17.7	19.4	21.2	23.3	25.4	27.8	30.4	33.2	36.2	39.4	43.0	46.8	50.9
ンデラ変電所				8.1	8.9	9.7	10.7	11.7	12.8	14.0	15.3	16.7	18.3	19.9	21.7	23.7	25.8	28.1	30.6
ガハンガ変電所				3.2	3.6	3.9	4.3	4.7	5.1	5.6	6.1	6.7	7.3	8.0	8.7	9.5	10.3	11.3	12.2
ニャブゴゴ変電所				7.0	7.7	8.4	9.2	10.1	11.0	12.1	13.2	14.4	15.8	17.2	18.8	20.5	22.3	24.3	26.4
ルリマ変電所				13.5	14.8	16.2	17.7	19.4	21.2	23.3	25.4	27.8	30.4	33.2	36.2	39.4	43.0	46.8	50.9
中央地区負荷合計	57	89	99	105	114	125	137	150	165	180	197	215	235	257	280	305	333	362	394
ムシャ変電所	2.6	15.7	17.7	15.6	16.8	18.4	20.1	21.9	23.9	26.0	28.2	30.6	33.2	36.0	39.0	42.2	45.7	49.4	53.4
＋ガラマ変電所負荷				3.5	3.8	4.1	4.5	4.9	5.4	5.9	6.4	6.9	7.5	8.1	8.8	9.5	10.3	11.1	12.0
カバロンド変電所	4.924	6.8	7.8	8.1	8.7	9.6	10.5	11.4	12.5	13.6	14.7	16.0	17.3	18.8	20.4	22.0	23.8	25.8	27.9
ルウィンクワブ変電所	0.427	1.6	2.2	2.4	2.6	2.8	3.1	3.4	3.7	4.0	4.3	4.7	5.1	5.5	6.0	6.5	7.0	7.6	8.2
＋キレヘ変電所負荷				2.4	2.6	2.8	3.1	3.4	3.7	4.0	4.3	4.7	5.1	5.5	6.0	6.5	7.0	7.6	8.2
東地区負荷合計		24	28	31	34	38	41	45	49	53	58	63	68	74	80	87	94	101	110

（単位: MW）

低ケース	2015 (1月実績)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
ギコンド変電所	25.06	25.6	27.8	16.5	18.4	20.4	22.6	25.0	27.6	30.5	33.6	36.9	40.5	44.5	48.7	53.2	58.1	63.4	69.1
ジャバナ変電所	14.45	14.8	15.9	16.1	17.9	19.9	22.0	24.4	26.9	29.7	32.8	36.0	39.6	43.4	47.5	51.9	56.7	61.9	67.5
ビレンボ変電所	6.18	6.8	7.5	7.7	8.6	9.5	10.6	11.7	12.9	14.3	15.7	17.3	19.0	20.8	22.8	24.9	27.2	29.7	32.4
ガソギ変電所	3.89	4.8	5.2	5.4	6.0	6.7	7.4	8.2	9.1	10.0	11.0	12.1	13.3	14.6	16.0	17.5	19.1	20.8	22.7
マウント･キガリ変電所(15kV)	*4.22*			*4.6*	*5.1*	*5.6*	*6.2*	*6.9*	*7.6*	*8.4*	*9.3*	*10.2*	*11.2*	*12.3*	*13.4*	*14.7*	*16.0*	*17.5*	*19.1*
マウント･キガリ変電所(30kV)	*3.06*			*5.9*	*6.5*	*7.3*	*8.0*	*8.9*	*9.8*	*10.8*	*12.0*	*13.1*	*14.4*	*15.8*	*17.3*	*18.9*	*20.7*	*22.6*	*24.6*
マウント･キガリ変電所(合計)	7.28	18.2	20.5	10.4	11.6	12.9	14.3	15.8	17.5	19.3	21.2	23.3	25.6	28.1	30.8	33.6	36.7	40.1	43.7
ンデラ変電所				6.3	7.0	7.7	8.6	9.5	10.5	11.6	12.8	14.0	15.4	16.9	18.5	20.2	22.1	24.1	26.3
ガハンガ変電所				2.5	2.8	3.1	3.4	3.8	4.2	4.6	5.1	5.6	6.2	6.8	7.4	8.1	8.8	9.6	10.5
ニャブゴゴ変電所				5.4	6.0	6.7	7.4	8.2	9.1	10.0	11.0	12.1	13.3	14.6	16.0	17.5	19.1	20.8	22.7
ルリマ変電所				10.4	11.6	12.9	14.3	15.8	17.5	19.3	21.2	23.3	25.6	28.1	30.8	33.6	36.7	40.1	43.7
中央地区負荷合計	57	70	77	81	90	100	111	122	135	149	164	181	199	218	238	261	285	311	338
ムシャ変電所	2.6	12.5	13.8	12.1	13.2	14.6	16.2	17.8	19.6	21.5	23.6	25.7	28.0	30.5	33.2	36.0	39.0	42.3	45.8
＋ガラマ変電所負荷				2.7	3.0	3.3	3.6	4.0	4.4	4.8	5.3	5.8	6.3	6.9	7.5	8.1	8.8	9.5	10.3
カバロンド変電所	4.924	5.4	6.1	6.3	6.9	7.6	8.4	9.3	10.2	11.2	12.3	13.4	14.6	15.9	17.3	18.8	20.4	22.1	23.9
ルウィンクワブ変電所	0.427	1.2	1.7	1.9	2.0	2.2	2.5	2.7	3.0	3.3	3.6	4.0	4.3	4.7	5.1	5.5	6.0	6.5	7.0
＋キレヘ変電所負荷				1.9	2.0	2.2	2.5	2.7	3.0	3.3	3.6	4.0	4.3	4.7	5.1	5.5	6.0	6.5	7.0
東地区負荷合計		19	22	24	27	30	33	37	40	44	48	53	58	63	68	74	80	87	94

2. 潮流計算報告書

1) 2018 年断面（詳細）

Electrical Transient Analyzer Program

Load Flow Analysis

Loading Category (1): Design

Generation Category (1): Grid Balance

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	1	11	68	80

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	30	0	0	17	0	42	89

Method of Solution:	Newton-Raphson Method
Maximum No. of Iteration:	9999
Precision of Solution:	0.0001000
System Frequency:	50.00 Hz
Unit System:	Metric
Project Filename:	Rwanda-Imp SSs Ph 2
Output Filename:	C:\Users\3010\Documents\ SugarSync Business\ 2 \Rwanda ETAP Project File\R-LF-2018 w HFO.lfr

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Bus Input Data

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
10-Kba/Msh/Rwi-B	110.000	1	100.0	0.0								
B-1-Jb1-Jb3-1	15.000	1	100.0	0.0								
B-1-Jb1-Jb3-2	15.000	1	100.0	0.0								
B-10-Bre-Gso-1	110.000	1	100.0	0.0								
B-10-Bre-Jb1-1	110.000	1	100.0	0.0								
B-10-Bre-Jb1-2	110.000	1	100.0	0.0								
B-10-Bre-Nde-2	110.000	1	100.0	0.0								
B-10-Bre-Sha-1D	110.000	1	100.0	0.0								
B-10-Bre-Sha-1DT-F	110.000	1	100.0	0.0								
B-10-Bre-Sha-2D	110.000	1	100.0	0.0								
B-10-Bre-Sha-2DT-F	110.000	1	100.0	0.0								
B-10-Gha-MKi-1	110.000	1	100.0	0.0								
B-10-Gha-MKi-2	110.000	1	100.0	0.0								
B-10-Gko-Jb1-1	110.000	1	100.0	0.0								
B-10-Gko-Jb1-2	110.000	1	100.0	0.0								
B-10-Gko-MKi-1	110.000	1	100.0	0.0								
B-10-Gko-MKi-2	110.000	1	100.0	0.0								
B-10-Gso-Msh-1	110.000	1	100.0	0.0								
B-10-Gso-Msh-2	110.000	1	100.0	0.0								
B-10-Gso-Nde-1	110.000	1	100.0	0.0								
B-10-Gso-Nde-2	110.000	1	100.0	0.0								
B-10-Jb-Grid-1	110.000	1	100.0	0.0								
B-10-Jb1-Jb2-1	110.000	1	100.0	0.0								
B-10-Jb1-Jb2-2	110.000	1	100.0	0.0								
B-10-Jb1-Nbg-1	110.000	1	100.0	0.0								
B-10-Jb1-Nbg-2	110.000	1	100.0	0.0								
B-10-Kba-Msh-2	110.000	1	100.0	0.0								
B-10-Kba-Rwi-2	110.000	1	100.0	0.0								
B-10-Mki-Grid-1	110.000	1	100.0	0.0								
B-10-MKi-Nbg-1	110.000	1	100.0	0.0								
B-10-MKi-Nbg-2	110.000	1	100.0	0.0								
B-20-Sha-Grid-1	220.000	1	100.0	0.0								
Bre-1-B-1	15.000	1	100.0	0.0	1.755	0.577	9.945	3.269				
Bre-10-B-1	110.000	1	100.0	0.0								
C-BN	110.000	1	100.0	0.0								
C-GN	110.000	1	100.0	0.0								

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
C-Kab-3-B	30.000	1	100.0	0.0								
C-Msh-1-B	15.000	1	100.0	0.0								
C-Rwi-B-1	15.000	1	100.0	0.0								
G-Jb2-10-B	110.000	1	100.0	0.0								
G-Jb3-1-B	15.000	1	100.0	0.0								
G-Kse-1-B2	110.000	1	100.0	0.0								
Gha-1-B-1	15.000	1	100.0	0.0	0.570	0.187	3.230	1.062				
Gha-10-B-1	110.000	1	100.0	0.0								
Gko-1-B-1	15.000	1	100.0	0.0	5.000	1.643	20.000	6.574				
Gko-10-B-1	110.000	1	100.0	0.0								
Gso-1-B-1	15.000	1	100.0	0.0	1.230	0.404	6.970	2.291				
Gso-10-B-1	110.000	1	100.0	0.0								
Jb1-1-B-1	15.000	1	100.0	0.0	3.660	1.203	20.740	6.817				
Jb1-10-B-1	110.000	1	100.0	0.0								
Jb2-.6-B-1	6.600	1	103.0	0.0								
Jb2-10-B-1	110.000	1	100.0	0.0								
Jb2-10-B-2	110.000	1	100.0	0.0								
Jb3-1-B-1	15.000	1	100.0	0.0								
Jb3-1-B-2	15.000	1	100.0	0.0								
Jb3-1-B-2d	15.000	1	100.0	0.0								
Kba-3-B-1	30.000	1	100.0	0.0	0.950	0.312	8.550	2.810				
Kba-10-B-1	110.000	1	100.0	0.0								
Kse-1-B-5	11.000	1	103.0	0.0								
Kse-1-B-6	11.000	1	103.0	0.0								
Kse-10-B3	110.000	1	100.0	0.0								
MKi-1-B-1	15.000	1	100.0	0.0	1.035	0.340	5.865	1.928				
MKi-3-B-1	30.000	1	100.0	0.0	1.335	0.439	7.565	2.486				
MKi-10-B-1	110.000	1	100.0	0.0								
Msh-1-B-1	15.000	1	100.0	0.0	2.730	0.897	15.470	5.085				
Msh-10-B-1	110.000	1	100.0	0.0	0.410	0.135	3.690	1.213				
N-Jb3-.04-1	0.400	1	103.0	0.0								
N-Jb3-.04-2	0.400	1	103.0	0.0								
N-Jb3-.04-3	0.400	1	103.0	0.0								
N-Jb3-.04-4	0.400	1	103.0	0.0								
N-Jb3-.04-5	0.400	1	103.0	0.0								
N-Jb3-.04-6	0.400	1	103.0	0.0								
Nbg-1-B-1	15.000	1	100.0	0.0	1.230	0.404	6.970	2.291				
Nbg-10-B-1	110.000	1	100.0	0.0								
Nde-1-B-1	15.000	1	100.0	0.0	1.425	0.468	8.075	2.654				

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
Nde-10-B-1	110.000	1	100.0	0.0								
Rwi-1-B-1	15.000	1	100.0	0.0	0.280	0.092	2.520	0.828				
Rwi-10-B-1	110.000	1	100.0	0.0	0.280	0.092	2.520	0.828				
Sha-10-B-1	110.000	1	100.0	0.0								
Sha-20-B-1	220.000	1	100.0	0.0								
Total Number of Buses: 80					21.890	7.195	122.110	40.136	0.000	0.000	0.000	0.000

Generation Bus				Voltage		Generation			Mvar Limits	
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Min
B-10-Jb-Grid-1	110.000	Voltage Control	1	100.0	0.0	10.000			7.000	0.000
B-10-Mki-Grid-1	110.000	Voltage Control	1	100.0	0.0	15.000			10.000	0.000
B-20-Sha-Grid-1	220.000	Swing	1	100.0	0.0					
Jb2-.6-B-1	6.600	Voltage Control	1	103.0	0.0	18.600			15.300	0.000
Kse-1-B-5	11.000	Voltage Control	1	103.0	0.0	40.000			30.000	0.000
Kse-1-B-6	11.000	Voltage Control	1	103.0	0.0	10.000			7.500	0.000
N-Jb3-.04-1	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-2	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-3	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-4	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-5	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-6	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
						100.800	0.000			

Line/Cable Input Data

Line/Cable			Length				Ohms or Siemens/1000 m per Conductor (Cable) or per Phase (Line)		
ID	Library	Size	Adj. (m)	% Tol.	#/Phase	T (°C)	R	X	Y
1-Jb1-Jb3	15NCUS3	240	50.0	0.0	1	75	0.094138	0.089300	
10-Bre-Jb1(S/C)		176.	7500.0	0.0	1	75	0.232520	0.477340	0.0000024
10-Bre-Nde-1(S/C)		176.	4000.0	0.0	1	75	0.232506	0.441167	0.0000026
10-Bre-Nde-2(S/C)		282.	2200.0	0.0	1	75	0.072450	0.188633	0.0000061
10-Bre-Sha-1		282.	8600.0	0.0	2	75	0.036268	0.124622	0.0000092
10-Bre-Sha-2		282.	8600.0	0.0	2	75	0.036268	0.124622	0.0000092
10-Gha-MKi(S/C)		282.	7900.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gko-Jb1(S/C)		282.	9100.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gko-MKi(S/C)		282.	5400.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gso-Msh(S/C)		176.	19000.0	0.0	1	75	0.232506	0.441167	0.0000026
10-Gso-Nde-1(S/C)		176.	5400.0	0.0	1	75	0.232506	0.441167	0.0000026
10-Gso-Nde-2(S/C)		282.	2200.0	0.0	1	75	0.072450	0.188633	0.0000061
10-Jb1-Jb2(S/C)		282.	1200.0	0.0	1	75	0.144906	0.426513	0.0000027
10-Jb1-Nbg(S/C)		282.	7800.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Kba-Msh(S/C)		176.	25200.0	0.0	1	75	0.232506	0.441167	0.0000026
10-Kba-Rwi(S/C)		176.	7700.0	0.0	1	75	0.232506	0.441167	0.0000026
10-MKi-Nbg(S/C)		282.	6400.0	0.0	1	75	0.144920	0.462685	0.0000025

Line / Cable resistances are listed at the specified temperatures.

2-Winding Transformer Input Data

Transformer		Rating					Z Variation			% Tap Setting		Adjusted	Phase Shift	
ID	Phase	MVA	Prim. kV	Sec. kV	% Z1	X1/R1	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
Bre-10/1-T-1	3-Phase	20.000	110.000	15.000	10.46	22.00	0	0	0	0	0	10.4600	YNyn	0.000
Gha-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Gko-10/1-T-1	3-Phase	15.000	110.000	15.000	9.00	20.00	0	0	5.0	0	0	9.4500	YNyn	0.000
Gko-10/1-T-2	3-Phase	15.000	110.000	15.000	8.93	20.00	0	0	5.0	0	0	9.3765	YNyn	0.000
Gko-10/1-T-3	3-Phase	15.000	110.000	15.000	9.20	20.00	0	0	5.0	0	0	9.6600	YNyn	0.000
Gso-10/1-T-1	3-Phase	10.000	110.000	15.000	9.32	13.00	0	0	5.0	0	0	9.7860	YNyn	0.000
Gso-10/1-T-2F	3-Phase	15.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Jb1-10/1-T-1	3-Phase	10.000	110.000	15.000	10.20	13.00	0	0	5.0	0	0	10.7100	YNyn	0.000
Jb1-10/1-T-2	3-Phase	10.000	110.000	15.000	10.20	13.00	0	0	5.0	0	0	10.7100	YNyn	0.000
Jb2-10/.6-TG-1	3-Phase	15.000	110.000	6.600	10.40	19.00	0	0	5.0	0	0	10.9200	YNd	0.000
Jb2-10/.6-TG-2	3-Phase	15.000	110.000	6.600	10.40	19.00	0	0	5.0	0	0	10.9200	YNd	0.000
Jb3-1/0-TG-1	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-2	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-3	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-4	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-5	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-6	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Kba-10/3-T-1	3-Phase	10.000	110.000	30.000	8.35	13.00	0	0	0	0	0	8.3500	YNyn	0.000
Kse-10/1-TG-1n2	3-Phase	62.500	110.000	11.000	12.50	45.00	0	0	5.0	0	0	13.1250	YNd	0.000
Kse-10/1-TG-2n2	3-Phase	15.000	110.000	11.000	10.00	20.00	0	0	0	0	0	10.0000	YNd	0.000
MKi-10/1-T-1	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
MKi-10/3-T-1	3-Phase	20.000	110.000	30.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Msh-10/1-T-1	3-Phase	10.000	110.000	15.000	10.20	20.00	0	0	5.0	0	0	10.7100	YNd	0.000
Msh-10/1-T-1F	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	0	0	0	10.0000	YNd	0.000
Nbg-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Nbg-10/1-T-2n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Nde-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Nde-10/1-T-2n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Rwi-10/1-T-1n	3-Phase	10.000	110.000	15.000	10.00	13.00	0	0	5.0	0	0	10.5000	YNd	0.000
Sha-20/10-T-1n	3-Phase	90.000	220.000	110.000	12.50	45.00	0	0	10.0	0	0	13.7500	YNd	0.000

2-Winding Transformer Load Tap Changer (LTC) Settings

Transformer	Connected Buses ("*" LTC Side)		Transformer Load Tap Changer Setting					
ID	Primary Bus ID	Secondary Bus ID	% Min. Tap	% Max. Tap	% Step	Regulated Bus ID	% V	kV
Bre-10/1-T-1	*Bre-10-B-1	Bre-1-B-1	-10.00	14.00	1.000	Bre-1-B-1	100.00	15.000
Gha-10/1-T-1n	*Gha-10-B-1	Gha-1-B-1	-16.00	16.00	1.300	Gha-1-B-1	100.00	15.000

2-Winding Transformer Load Tap Changer (LTC) Settings

Transformer	Connected Buses ("*" LTC Side)		Transformer Load Tap Changer Setting					
ID	Primary Bus ID	Secondary Bus ID	% Min. Tap	% Max. Tap	% Step	Regulated Bus ID	% V	kV
Gko-10/1-T-2	*Gko-10-B-1	Gko-1-B-1	-15.99	16.00	1.230	Gko-1-B-1	100.00	15.000
Gko-10/1-T-3	*Gko-10-B-1	Gko-1-B-1	-16.00	16.09	1.231	Gko-1-B-1	100.00	15.000
Gso-10/1-T-1	*Gso-10-B-1	Gso-1-B-1	-15.99	16.00	1.230	Gso-1-B-1	100.00	15.000
Gso-10/1-T-2F	*Gso-10-B-1	Gso-1-B-1	-16.00	16.00	1.230	Gso-1-B-1	100.00	15.000
Jb1-10/1-T-1	*Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Jb1-10/1-T-2	*Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Kba-10/3-T-1	*Kba-10-B-1	Kba-3-B-1	-8.00	8.00	1.000	Kba-3-B-1	100.00	30.000
MKi-10/1-T-1	*MKi-10-B-1	MKi-1-B-1	-16.00	16.00	1.300	MKi-1-B-1	100.00	15.000
MKi-10/3-T-1	*MKi-10-B-1	MKi-3-B-1	-16.00	16.00	1.300	MKi-3-B-1	100.00	30.000
Msh-10/1-T-1	*Msh-10-B-1	Msh-1-B-1	-10.00	10.00	1.250	Msh-1-B-1	100.00	15.000
Msh-10/1-T-1F	*Msh-10-B-1	Msh-1-B-1	-10.00	10.00	1.250	Msh-1-B-1	100.00	15.000
Nbg-10/1-T-1n	*Nbg-10-B-1	Nbg-1-B-1	-16.00	16.00	1.300	Nbg-1-B-1	100.00	15.000
Nbg-10/1-T-2n	*Nbg-10-B-1	Nbg-1-B-1	-16.00	16.00	1.300	Nbg-1-B-1	100.00	15.000
Nde-10/1-T-1n	*Nde-10-B-1	Nde-1-B-1	-16.00	16.00	1.230	Nde-1-B-1	100.00	15.000
Nde-10/1-T-2n	*Nde-10-B-1	Nde-1-B-1	-16.00	16.00	1.230	Nde-1-B-1	100.00	15.000
Rwi-10/1-T-1n	*Rwi-10-B-1	Rwi-1-B-1	-16.00	16.00	1.230	Rwi-1-B-1	100.00	15.000
Sha-20/10-T-1n	*Sha-20-B-1	Sha-10-B-1	-10.00	10.00	0.850	Sha-10-B-1	102.00	112.200

Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
Bre-10/1-T-1	2W XFMR	Bre-10-B-1	Bre-1-B-1	2.37	52.25	52.30	
Gha-10/1-T-1n	2W XFMR	Gha-10-B-1	Gha-1-B-1	2.62	52.43	52.50	
Gko-10/1-T-1	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.15	62.92	63.00	
Gko-10/1-T-2	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.12	62.43	62.51	
Gko-10/1-T-3	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.22	64.32	64.40	
Gso-10/1-T-1	2W XFMR	Gso-10-B-1	Gso-1-B-1	7.51	97.57	97.86	
Gso-10/1-T-2F	2W XFMR	Gso-10-B-1	Gso-1-B-1	3.50	69.91	70.00	
Jb1-10/1-T-1	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	8.21	106.78	107.10	
Jb1-10/1-T-2	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	8.21	106.78	107.10	
Jb2-10/.6-TG-1	2W XFMR	Jb2-10-B-2	Jb2-.6-B-1	3.83	72.70	72.80	
Jb2-10/.6-TG-2	2W XFMR	Jb2-10-B-2	Jb2-.6-B-1	3.83	72.70	72.80	
Jb3-1/0-TG-1	2W XFMR	Jb3-1-B-2	N-Jb3-.04-1	66.03	396.21	401.67	
Jb3-1/0-TG-2	2W XFMR	Jb3-1-B-2	N-Jb3-.04-2	66.03	396.21	401.67	
Jb3-1/0-TG-3	2W XFMR	Jb3-1-B-2	N-Jb3-.04-3	66.03	396.21	401.67	
Jb3-1/0-TG-4	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-4	66.03	396.21	401.67	
Jb3-1/0-TG-5	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-5	66.03	396.21	401.67	
Jb3-1/0-TG-6	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-6	66.03	396.21	401.67	
Kba-10/3-T-1	2W XFMR	Kba-10-B-1	Kba-3-B-1	6.40	83.25	83.50	
Kse-10/1-TG-1n2	2W XFMR	Kse-10-B3	Kse-1-B-5	0.47	20.99	21.00	
Kse-10/1-TG-2n2	2W XFMR	Kse-10-B3	Kse-1-B-6	3.33	66.58	66.67	
MKi-10/1-T-1	2W XFMR	MKi-10-B-1	MKi-1-B-1	2.62	52.43	52.50	
MKi-10/3-T-1	2W XFMR	MKi-10-B-1	MKi-3-B-1	2.62	52.43	52.50	
Msh-10/1-T-1	2W XFMR	Msh-10-B-1	Msh-1-B-1	5.35	106.97	107.10	
Msh-10/1-T-1F	2W XFMR	Msh-10-B-1	Msh-1-B-1	2.50	49.94	50.00	
Nbg-10/1-T-1n	2W XFMR	Nbg-10-B-1	Nbg-1-B-1	2.62	52.43	52.50	
Nbg-10/1-T-2n	2W XFMR	Nbg-10-B-1	Nbg-1-B-1	2.62	52.43	52.50	
Nde-10/1-T-1n	2W XFMR	Nde-10-B-1	Nde-1-B-1	2.62	52.43	52.50	
Nde-10/1-T-2n	2W XFMR	Nde-10-B-1	Nde-1-B-1	2.62	52.43	52.50	
Rwi-10/1-T-1n	2W XFMR	Rwi-10-B-1	Rwi-1-B-1	8.05	104.69	105.00	
Sha-20/10-T-1n	2W XFMR	Sha-20-B-1	Sha-10-B-1	0.34	15.27	15.28	
1-Jb1-Jb3	Cable	B-1-Jb1-Jb3-1	B-1-Jb1-Jb3-2	0.21	0.20	0.29	
10-Bre-Jb1(S/C)	Line	B-10-Bre-Jb1-2	B-10-Bre-Jb1-1	1.44	2.96	3.29	0.2193774
10-Bre-Nde-1(S/C)	Line	B-10-Bre-Gso-1	C-BN	0.77	1.46	1.65	0.1269621
10-Bre-Nde-2(S/C)	Line	C-BN	B-10-Bre-Nde-2	0.13	0.34	0.37	0.1626596
10-Bre-Sha-1	Line	B-10-Bre-Sha-2DT-F	B-10-Bre-Sha-1DT-F	0.26	0.89	0.92	0.9599407
10-Bre-Sha-2	Line	B-10-Bre-Sha-2D	B-10-Bre-Sha-1D	0.26	0.89	0.92	0.9599407
10-Gha-MKi(S/C)	Line	B-10-Gha-MKi-1	B-10-Gha-MKi-2	0.95	3.02	3.17	0.2387549
10-Gko-Jb1(S/C)	Line	B-10-Gko-Jb1-2	B-10-Gko-Jb1-1	1.09	3.48	3.65	0.2750214
10-Gko-MKi(S/C)	Line	B-10-Gko-MKi-1	B-10-Gko-MKi-2	0.65	2.06	2.16	0.1631995
10-Gso-Msh(S/C)	Line	B-10-Gso-Msh-1	B-10-Gso-Msh-2	3.65	6.93	7.83	0.6030700

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
10-Gso-Nde-1(S/C)	Line	C-GN	B-10-Gso-Nde-1	1.04	1.97	2.23	0.1713988
10-Gso-Nde-2(S/C)	Line	C-GN	B-10-Gso-Nde-2	0.13	0.34	0.37	0.1626596
10-Jb1-Jb2(S/C)	Line	B-10-Jb1-Jb2-2	B-10-Jb1-Jb2-1	0.14	0.42	0.45	0.0394709
10-Jb1-Nbg(S/C)	Line	B-10-Jb1-Nbg-1	B-10-Jb1-Nbg-2	0.93	2.98	3.13	0.2357326
10-Kba-Msh(S/C)	Line	B-10-Kba-Msh-2	10-Kba/Msh/Rwi-B	4.84	9.19	10.39	0.7998612
10-Kba-Rwi(S/C)	Line	B-10-Kba-Rwi-2	10-Kba/Msh/Rwi-B	1.48	2.81	3.17	0.2444020
10-MKi-Nbg(S/C)	Line	B-10-MKi-Nbg-1	B-10-MKi-Nbg-2	0.77	2.45	2.56	0.1934217
Bre-10-C-1	Tie Breakr	B-10-Bre-Jb1-1	Bre-10-B-1				
Bre-10-C-2	Tie Breakr	B-10-Bre-Sha-1DT-F	Bre-10-B-1				
Bre-10-C-3	Tie Breakr	B-10-Bre-Sha-1D	Bre-10-B-1				
Bre-10-C-4	Tie Breakr	B-10-Bre-Gso-1	Bre-10-B-1				
Gha-10-C-1	Tie Breakr	B-10-Gha-MKi-1	Gha-10-B-1				
Gko-10-C-1	Tie Breakr	B-10-Gko-Jb1-1	Gko-10-B-1				
Gko-10-C-2	Tie Breakr	B-10-Gko-MKi-1	Gko-10-B-1				
Gso-10-C-1	Tie Breakr	B-10-Gso-Nde-1	Gso-10-B-1				
Gso-10-C-2	Tie Breakr	B-10-Gso-Msh-1	Gso-10-B-1				
Jb1-1-C-1	Tie Breakr	Jb1-1-B-1	B-1-Jb1-Jb3-1				
Jb1-10-C-1	Tie Breakr	B-10-Jb1-Jb2-1	Jb1-10-B-1				
Jb1-10-C-2	Tie Breakr	B-10-Jb-Grid-1	Jb1-10-B-1				
Jb1-10-C-3	Tie Breakr	B-10-Bre-Jb1-2	Jb1-10-B-1				
Jb1-10-C-4	Tie Breakr	B-10-Gko-Jb1-2	Jb1-10-B-1				
Jb1-10-C-5	Tie Breakr	B-10-Jb1-Nbg-1	Jb1-10-B-1				
Jb2-10-C-1	Tie Breakr	B-10-Jb1-Jb2-2	Jb2-10-B-1				
Jb3-1-C-1	Tie Breakr	B-1-Jb1-Jb3-2	Jb3-1-B-1				
Kba-10-C-1	Tie Breakr	10-Kba/Msh/Rwi-B	Kba-10-B-1				
MKi-10-C-1	Tie Breakr	MKi-10-B-1	B-10-Mki-Grid-1				
MKi-10-C-2	Tie Breakr	B-10-Gko-MKi-2	MKi-10-B-1				
MKi-10-C-3	Tie Breakr	B-10-MKi-Nbg-2	MKi-10-B-1				
MKi-10-C-4	Tie Breakr	B-10-Gha-MKi-2	MKi-10-B-1				
Msh-10-C-1	Tie Breakr	B-10-Gso-Msh-2	Msh-10-B-1				
Msh-10-C-2	Tie Breakr	B-10-Kba-Msh-2	Msh-10-B-1				
Nbg-10-C-1	Tie Breakr	B-10-Jb1-Nbg-2	Nbg-10-B-1				
Nbg-10-C-2	Tie Breakr	B-10-MKi-Nbg-1	Nbg-10-B-1				
Nde-10-C-1	Tie Breakr	B-10-Bre-Nde-2	Nde-10-B-1				
Nde-10-C-2	Tie Breakr	B-10-Gso-Nde-2	Nde-10-B-1				
Nde-10-C-3	Tie Breakr	G-Kse-1-B2	Nde-10-B-1				
Rwi-10-C-1	Tie Breakr	B-10-Kba-Rwi-2	Rwi-10-B-1				
Sha-10-C-1	Tie Breakr	Sha-10-B-1	B-10-Bre-Sha-2DT-F				
Sha-10-C-2	Tie Breakr	Sha-10-B-1	B-10-Bre-Sha-2D				
Sha-20-C-Grid	Tie Breakr	B-20-Sha-Grid-1	Sha-20-B-1				
C-Rwinkwabu-SW	Tie Switch	Rwi-1-B-1	C-Rwi-B-1				
S-Jb2-10-B-1	Tie Switch	Jb2-10-B-1	G-Jb2-10-B				
S-Jb2-10-B-2	Tie Switch	G-Jb2-10-B	Jb2-10-B-2				

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
S-Jb3-1-B-1	Tie Switch	Jb3-1-B-1	G-Jb3-1-B				
S-Jb3-1-B-2	Tie Switch	G-Jb3-1-B	Jb3-1-B-2				
S-Jb3-1-B-2d	Tie Switch	Jb3-1-B-2	Jb3-1-B-2d				
S-Kba-Bus	Tie Switch	Kba-3-B-1	C-Kab-3-B				
S-Kse-1-B2	Tie Switch	G-Kse-1-B2	Kse-10-B3				
S-Musha-Bus	Tie Switch	Msh-1-B-1	C-Msh-1-B				

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
10-Kba/Msh/Rwi-B	110.000	96.152	-6.2	0	0	0	0	B-10-Kba-Msh-2	-14.766	-5.521	86.1	93.7	
								B-10-Kba-Rwi-2	5.403	1.647	30.8	95.7	
								Kba-10-B-1	9.363	3.874	55.3	92.4	
B-1-Jb1-Jb3-1	15.000	100.171	-9.3	0	0	0	0	B-1-Jb1-Jb3-2	-7.113	-5.188	338.3	80.8	
								Jb1-1-B-1	7.113	5.188	338.3	80.8	
B-1-Jb1-Jb3-2	15.000	100.196	-9.3	0	0	0	0	B-1-Jb1-Jb3-1	7.115	5.190	338.3	80.8	
								Jb3-1-B-1	-7.115	-5.190	338.3	80.8	
B-10-Bre-Gso-1	110.000	100.906	-3.8	0	0	0	0	C-BN	6.081	9.210	57.4	55.1	
								Bre-10-B-1	-6.081	-9.210	57.4	55.1	
B-10-Bre-Jb1-1	110.000	100.906	-3.8	0	0	0	0	B-10-Bre-Jb1-2	27.531	7.865	148.9	96.2	
								Bre-10-B-1	-27.531	-7.865	148.9	96.2	
B-10-Bre-Jb1-2	110.000	100.282	-4.2	0	0	0	0	B-10-Bre-Jb1-1	-27.414	-7.848	149.2	96.1	
								Jb1-10-B-1	27.414	7.848	149.2	96.1	
B-10-Bre-Nde-2	110.000	100.686	-3.8	0	0	0	0	C-BN	-6.070	-9.482	58.7	53.9	
								Nde-10-B-1	6.070	9.482	58.7	53.9	
B-10-Bre-Sha-1D	110.000	100.906	-3.8	0	0	0	0	B-10-Bre-Sha-2D	-22.723	-10.875	131.0	90.2	
								Bre-10-B-1	22.723	10.875	131.0	90.2	
B-10-Bre-Sha-1DT-F	110.000	100.906	-3.8	0	0	0	0	B-10-Bre-Sha-2DT-F	-22.723	-10.875	131.0	90.2	
								Bre-10-B-1	22.723	10.875	131.0	90.2	
B-10-Bre-Sha-2D	110.000	101.056	-3.7	0	0	0	0	B-10-Bre-Sha-1D	22.739	9.951	128.9	91.6	
								Sha-10-B-1	-22.739	-9.951	128.9	91.6	
B-10-Bre-Sha-2DT-F	110.000	101.056	-3.7	0	0	0	0	B-10-Bre-Sha-1DT-F	22.739	9.951	128.9	91.6	
								Sha-10-B-1	-22.739	-9.951	128.9	91.6	
B-10-Gha-MKi-1	110.000	99.868	-4.7	0	0	0	0	B-10-Gha-MKi-2	-3.831	-1.342	21.3	94.4	
								Gha-10-B-1	3.831	1.342	21.3	94.4	
B-10-Gha-MKi-2	110.000	99.942	-4.6	0	0	0	0	B-10-Gha-MKi-1	3.832	1.109	21.0	96.1	
								MKi-10-B-1	-3.832	-1.109	21.0	96.1	
B-10-Gko-Jb1-1	110.000	99.842	-4.6	0	0	0	0	B-10-Gko-Jb1-2	-21.865	-5.839	119.0	96.6	
								Gko-10-B-1	21.865	5.839	119.0	96.6	
B-10-Gko-Jb1-2	110.000	100.282	-4.2	0	0	0	0	B-10-Gko-Jb1-1	21.920	5.742	118.6	96.7	
								Jb1-10-B-1	-21.920	-5.742	118.6	96.7	
B-10-Gko-MKi-1	110.000	99.842	-4.6	0	0	0	0	B-10-Gko-MKi-2	-3.301	-3.872	26.7	64.9	
								Gko-10-B-1	3.301	3.872	26.7	64.9	
B-10-Gko-MKi-2	110.000	99.942	-4.6	0	0	0	0	B-10-Gko-MKi-1	3.303	3.714	26.1	66.5	
								MKi-10-B-1	-3.303	-3.714	26.1	66.5	
B-10-Gso-Msh-1	110.000	99.749	-4.3	0	0	0	0	B-10-Gso-Msh-2	37.661	14.076	211.6	93.7	
								Gso-10-B-1	-37.661	-14.076	211.6	93.7	
B-10-Gso-Msh-2	110.000	97.394	-5.6	0	0	0	0	B-10-Gso-Msh-1	-37.065	-13.531	212.6	93.9	
								Msh-10-B-1	37.065	13.531	212.6	93.9	
B-10-Gso-Nde-1	110.000	99.749	-4.3	0	0	0	0	C-GN	-46.006	-17.120	258.3	93.7	

Bus		**Voltage**		**Generation**		**Load**		**Load Flow**					**XFMR**
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								Gso-10-B-1	46.006	17.120	258.3	93.7	
B-10-Gso-Nde-2	110.000	100.686	-3.8	0	0	0	0	C-GN	46.289	17.342	257.7	93.6	
								Nde-10-B-1	-46.289	-17.342	257.7	93.6	
B-10-Jb-Grid-1	110.000	100.282	-4.2	10.000	0.000	0	0	Jb1-10-B-1	10.000	0.000	52.3	100.0	
B-10-Jb1-Jb2-1	110.000	100.282	-4.2	0	0	0	0	B-10-Jb1-Jb2-2	-18.523	-5.826	101.6	95.4	
								Jb1-10-B-1	18.523	5.826	101.6	95.4	
B-10-Jb1-Jb2-2	110.000	100.333	-4.2	0	0	0	0	B-10-Jb1-Jb2-1	18.528	5.802	101.6	95.4	
								Jb2-10-B-1	-18.528	-5.802	101.6	95.4	
B-10-Jb1-Nbg-1	110.000	100.282	-4.2	0	0	0	0	B-10-Jb1-Nbg-2	16.533	3.430	88.4	97.9	
								Jb1-10-B-1	-16.533	-3.430	88.4	97.9	
B-10-Jb1-Nbg-2	110.000	100.023	-4.5	0	0	0	0	B-10-Jb1-Nbg-1	-16.506	-3.582	88.6	97.7	
								Nbg-10-B-1	16.506	3.582	88.6	97.7	
B-10-Kba-Msh-2	110.000	97.394	-5.6	0	0	0	0	10-Kba/Msh/Rwi-B	14.895	5.015	84.7	94.8	
								Msh-10-B-1	-14.895	-5.015	84.7	94.8	
B-10-Kba-Rwi-2	110.000	96.017	-6.3	0	0	0	0	10-Kba/Msh/Rwi-B	-5.398	-1.863	31.2	94.5	
								Rwi-10-B-1	5.398	1.863	31.2	94.5	
B-10-Mki-Grid-1	110.000	99.942	-4.6	15.000	10.000	0	0	MKi-10-B-1	15.000	10.000	94.7	83.2	
B-10-MKi-Nbg-1	110.000	100.023	-4.5	0	0	0	0	B-10-MKi-Nbg-2	8.226	0.667	43.3	99.7	
								Nbg-10-B-1	-8.226	-0.667	43.3	99.7	
B-10-MKi-Nbg-2	110.000	99.942	-4.6	0	0	0	0	B-10-MKi-Nbg-1	-8.221	-0.844	43.4	99.5	
								MKi-10-B-1	8.221	0.844	43.4	99.5	
* B-20-Sha-Grid-1	220.000	100.000	0.0	45.560	23.587	0	0	Sha-20-B-1	45.560	23.587	134.6	88.8	
Bre-1-B-1	15.000	100.493	-7.2	0	0	11.799	3.878	Bre-10-B-1	-11.799	-3.878	475.7	95.0	
Bre-10-B-1	110.000	100.906	-3.8	0	0	0	0	Bre-1-B-1	11.835	4.676	66.2	93.0	-2.000
								B-10-Bre-Jb1-1	27.531	7.865	148.9	96.2	
								B-10-Bre-Sha-1DT-F	-22.723	-10.875	131.0	90.2	
								B-10-Bre-Sha-1D	-22.723	-10.875	131.0	90.2	
								B-10-Bre-Gso-1	6.081	9.210	57.4	55.1	
C-BN	110.000	100.726	-3.8	0	0	0	0	B-10-Bre-Gso-1	-6.072	-9.322	58.0	54.6	
								B-10-Bre-Nde-2	6.072	9.322	58.0	54.6	
C-GN	110.000	100.566	-3.9	0	0	0	0	B-10-Gso-Nde-1	46.257	17.424	258.0	93.6	
								B-10-Gso-Nde-2	-46.257	-17.424	258.0	93.6	
C-Kab-3-B	30.000	98.826	-10.5	0	0	0	0	Kba-3-B-1	0.000	0.000	0.0	0.0	
C-Msh-1-B	15.000	99.993	-9.0	0	0	0	0	Msh-1-B-1	0.000	0.000	0.0	0.0	
C-Rwi-B-1	15.000	99.759	-7.9	0	0	0	0	Rwi-1-B-1	0.000	0.000	0.0	0.0	
G-Jb2-10-B	110.000	100.333	-4.2	0	0	0	0	Jb2-10-B-1	18.528	5.802	101.6	95.4	
								Jb2-10-B-2	-18.528	-5.802	101.6	95.4	
G-Jb3-1-B	15.000	100.196	-9.3	0	0	0	0	Jb3-1-B-1	7.115	5.190	338.3	80.8	
								Jb3-1-B-2	-7.115	-5.190	338.3	80.8	
G-Kse-1-B2	110.000	100.686	-3.8	0	0	0	0	Nde-10-B-1	49.888	11.299	266.6	97.5	
								Kse-10-B3	-49.888	-11.299	266.6	97.5	
Gha-1-B-1	15.000	100.408	-5.8	0	0	3.826	1.258	Gha-10-B-1	-3.826	-1.258	154.4	95.0	
Gha-10-B-1	110.000	99.868	-4.7	0	0	0	0	Gha-1-B-1	3.831	1.342	21.3	94.4	-1.300

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								B-10-Gha-MKi-1	-3.831	-1.342	21.3	94.4	
Gko-1-B-1	15.000	100.232	-7.5	0	0	25.093	8.248	Gko-10-B-1	-8.403	-2.763	339.7	95.0	
								Gko-10-B-1	-8.469	-2.782	342.3	95.0	
								Gko-10-B-1	-8.221	-2.703	332.3	95.0	
Gko-10-B-1	110.000	99.842	-4.6	0	0	0	0	Gko-1-B-1	8.428	3.253	47.5	93.3	-2.462
								Gko-1-B-1	8.494	3.275	47.9	93.3	-2.460
								Gko-1-B-1	8.245	3.182	46.5	93.3	-2.462
								B-10-Gko-Jb1-1	-21.865	-5.839	119.0	96.6	
								B-10-Gko-MKi-1	-3.301	-3.872	26.7	64.9	
Gso-1-B-1	15.000	100.901	-6.2	0	0	8.326	2.737	Gso-10-B-1	-3.490	-1.087	139.4	95.5	
								Gso-10-B-1	-4.836	-1.650	194.9	94.6	
Gso-10-B-1	110.000	99.749	-4.3	0	0	0	0	Gso-1-B-1	3.500	1.215	19.5	94.5	-2.460
								Gso-1-B-1	4.845	1.829	27.3	93.6	-2.460
								B-10-Gso-Nde-1	-46.006	-17.120	258.3	93.7	
								B-10-Gso-Msh-1	37.661	14.076	211.6	93.7	
Jb1-1-B-1	15.000	100.171	-9.3	0	0	24.471	8.043	Jb1-10-B-1	-8.679	-1.427	338.0	98.7	
								Jb1-10-B-1	-8.679	-1.427	338.0	98.7	
								B-1-Jb1-Jb3-1	-7.113	-5.188	338.3	80.8	
Jb1-10-B-1	110.000	100.282	-4.2	0	0	0	0	Jb1-1-B-1	8.742	2.251	47.2	96.8	-2.460
								Jb1-1-B-1	8.742	2.251	47.2	96.8	-2.460
								B-10-Jb1-Jb2-1	-18.523	-5.826	101.6	95.4	
								B-10-Jb-Grid-1	-10.000	0.000	52.3	100.0	
								B-10-Bre-Jb1-2	-27.414	-7.848	149.2	96.1	
								B-10-Gko-Jb1-2	21.920	5.742	118.6	96.7	
								B-10-Jb1-Nbg-1	16.533	3.430	88.4	97.9	
*Jb2-.6-B-1	6.600	103.000	-0.5	18.600	7.163	0	0	Jb2-10-B-2	9.300	3.582	846.4	93.3	
								Jb2-10-B-2	9.300	3.582	846.4	93.3	
Jb2-10-B-1	110.000	100.333	-4.2	0	0	0	0	B-10-Jb1-Jb2-2	18.528	5.802	101.6	95.4	
								G-Jb2-10-B	-18.528	-5.802	101.6	95.4	
Jb2-10-B-2	110.000	100.333	-4.2	0	0	0	0	Jb2-.6-B-1	-9.264	-2.901	50.8	95.4	
								Jb2-.6-B-1	-9.264	-2.901	50.8	95.4	
								G-Jb2-10-B	18.528	5.802	101.6	95.4	
Jb3-1-B-1	15.000	100.196	-9.3	0	0	0	0	B-1-Jb1-Jb3-2	7.115	5.190	338.3	80.8	
								G-Jb3-1-B	-7.115	-5.190	338.3	80.8	
Jb3-1-B-2	15.000	100.196	-9.3	0	0	0	0	N-Jb3-.04-1	-1.186	-0.865	56.4	80.8	
								N-Jb3-.04-2	-1.186	-0.865	56.4	80.8	
								N-Jb3-.04-3	-1.186	-0.865	56.4	80.8	
								G-Jb3-1-B	7.115	5.190	338.3	80.8	
								Jb3-1-B-2d	-3.557	-2.595	169.2	80.8	
Jb3-1-B-2d	15.000	100.196	-9.3	0	0	0	0	N-Jb3-.04-4	-1.186	-0.865	56.4	80.8	
								N-Jb3-.04-5	-1.186	-0.865	56.4	80.8	
								N-Jb3-.04-6	-1.186	-0.865	56.4	80.8	
								Jb3-1-B-2	3.557	2.595	169.2	80.8	

Bus	Voltage			Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
Kba-3-B-1	30.000	98.826	-10.5	0	0	9.300	3.057	Kba-10-B-1	-9.300	-3.057	190.6	95.0	
								C-Kab-3-B	0.000	0.000	0.0	0.0	
Kba-10-B-1	110.000	96.152	-6.2	0	0	0	0	Kba-3-B-1	9.363	3.874	55.3	92.4	-6.000
								10-Kba/Msh/Rwi-B	-9.363	-3.874	55.3	92.4	
*Kse-1-B-5	11.000	103.000	0.8	40.000	12.063	0	0	Kse-10-B3	40.000	12.063	2129.0	95.7	
*Kse-1-B-6	11.000	103.000	-0.2	10.000	3.390	0	0	Kse-10-B3	10.000	3.390	538.1	94.7	
Kse-10-B3	110.000	100.686	-3.8	0	0	0	0	Kse-1-B-5	-39.923	-8.609	212.9	97.8	
								Kse-1-B-6	-9.965	-2.690	53.8	96.5	
								G-Kse-1-B2	49.888	11.299	266.6	97.5	
MKi-1-B-1	15.000	101.165	-6.6	0	0	7.038	2.313	MKi-10-B-1	-7.038	-2.313	281.8	95.0	
MKi-3-B-1	30.000	100.730	-7.2	0	0	9.011	2.962	MKi-10-B-1	-9.011	-2.962	181.2	95.0	
MKi-10-B-1	110.000	99.942	-4.6	0	0	0	0	MKi-1-B-1	7.052	2.594	39.5	93.9	-2.600
								MKi-3-B-1	9.034	3.427	50.7	93.5	-2.600
								B-10-Mki-Grid-1	-15.000	-10.000	94.7	83.2	
								B-10-Gko-MKi-2	3.303	3.714	26.1	66.5	
								B-10-MKi-Nbg-2	-8.221	-0.844	43.4	99.5	
								B-10-Gha-MKi-2	3.832	1.109	21.0	96.1	
Msh-1-B-1	15.000	99.993	-9.0	0	0	18.198	5.981	Msh-10-B-1	-5.792	-1.904	234.7	95.0	
								Msh-10-B-1	-12.406	-4.078	502.7	95.0	
								C-Msh-1-B	0.000	0.000	0.0	0.0	
Msh-10-B-1	110.000	97.394	-5.6	0	0	3.910	1.285	Msh-1-B-1	5.812	2.301	33.7	93.0	-5.000
								Msh-1-B-1	12.449	4.929	72.2	93.0	-5.000
								B-10-Gso-Msh-2	-37.065	-13.531	212.6	93.9	
								B-10-Kba-Msh-2	14.895	5.015	84.7	94.8	
N-Jb3-.04-1	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2200.4	78.4	
N-Jb3-.04-2	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2200.4	78.4	
N-Jb3-.04-3	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2200.4	78.4	
N-Jb3-.04-4	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2200.4	78.4	
N-Jb3-.04-5	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2200.4	78.4	
N-Jb3-.04-6	0.400	100.396	-7.1	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2200.4	78.4	
Nbg-1-B-1	15.000	100.501	-5.7	0	0	8.270	2.718	Nbg-10-B-1	-4.135	-1.359	166.7	95.0	
								Nbg-10-B-1	-4.135	-1.359	166.7	95.0	
Nbg-10-B-1	110.000	100.023	-4.5	0	0	0	0	Nbg-1-B-1	4.140	1.457	23.0	94.3	-1.300
								Nbg-1-B-1	4.140	1.457	23.0	94.3	-1.300
								B-10-Jb1-Nbg-2	-16.506	-3.582	88.6	97.7	
								B-10-MKi-Nbg-1	8.226	0.667	43.3	99.7	
Nde-1-B-1	15.000	100.961	-5.2	0	0	9.656	3.174	Nde-10-B-1	-4.828	-1.587	193.7	95.0	
								Nde-10-B-1	-4.828	-1.587	193.7	95.0	
Nde-10-B-1	110.000	100.686	-3.8	0	0	0	0	Nde-1-B-1	4.835	1.720	26.7	94.2	-1.230
								Nde-1-B-1	4.835	1.720	26.7	94.2	-1.230
								B-10-Bre-Nde-2	-6.070	-9.482	58.7	53.9	
								B-10-Gso-Nde-2	46.289	17.342	257.7	93.6	
								G-Kse-1-B2	-49.888	-11.299	266.6	97.5	

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
Rwi-1-B-1	15.000	99.759	-7.9	0	0	2.788	0.916	Rwi-10-B-1	-2.788	-0.916	113.2	95.0	
								C-Rwi-B-1	0.000	0.000	0.0	0.0	
Rwi-10-B-1	110.000	96.017	-6.3	0	0	2.603	0.856	Rwi-1-B-1	2.795	1.007	16.2	94.1	-4.920
								B-10-Kba-Rwi-2	-5.398	-1.863	31.2	94.5	
Sha-10-B-1	110.000	101.056	-3.7	0	0	0	0	Sha-20-B-1	-45.478	-19.902	257.8	91.6	
								B-10-Bre-Sha-2DT-F	22.739	9.951	128.9	91.6	
								B-10-Bre-Sha-2D	22.739	9.951	128.9	91.6	
Sha-20-B-1	220.000	100.000	0.0	0	0	0	0	Sha-10-B-1	45.560	23.587	134.6	88.8	-4.250
								B-20-Sha-Grid-1	-45.560	-23.587	134.6	88.8	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# Indicates a bus with a load mismatch of more than 0.1 MVA

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
10-Kba/Msh/Rwi-B	110.000	645.0	0	0	0	0	0	0	0	0	15.765	93.7	86.1	13.3
B-1-Jb1-Jb3-1	15.000	99999.0	0	0	0	0	0	0	0	0	8.804	80.8	338.3	0.3
B-1-Jb1-Jb3-2	15.000	99999.0	0	0	0	0	0	0	0	0	8.807	80.8	338.3	0.3
B-10-Bre-Gso-1	110.000	99999.0	0	0	0	0	0	0	0	0	11.037	55.1	57.4	0.1
B-10-Bre-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	28.632	96.2	148.9	0.1
B-10-Bre-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	28.515	96.1	149.2	0.1
B-10-Bre-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	11.259	53.9	58.7	0.1
B-10-Bre-Sha-1D	110.000	99999.0	0	0	0	0	0	0	0	0	25.192	90.2	131.0	0.1
B-10-Bre-Sha-1DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	25.192	90.2	131.0	0.1
B-10-Bre-Sha-2D	110.000	99999.0	0	0	0	0	0	0	0	0	24.821	91.6	128.9	0.1
B-10-Bre-Sha-2DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	24.821	91.6	128.9	0.1
B-10-Gha-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	4.059	94.4	21.3	0.0
B-10-Gha-MKi-2	110.000	99999.0	0	0	0	0	0	0	0	0	3.989	96.1	21.0	0.0
B-10-Gko-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	22.631	96.6	119.0	0.1
B-10-Gko-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	22.660	96.7	118.6	0.1
B-10-Gko-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	5.088	64.9	26.7	0.0
B-10-Gko-MKi-2	110.000	645.0	0	0	0	0	0	0	0	0	4.971	66.5	26.1	4.0
B-10-Gso-Msh-1	110.000		0	0	0	0	0	0	0	0	40.206	93.7	211.6	
B-10-Gso-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	39.458	93.9	212.6	0.2
B-10-Gso-Nde-1	110.000	99999.0	0	0	0	0	0	0	0	0	49.088	93.7	258.3	0.3
B-10-Gso-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	49.431	93.6	257.7	0.3
B-10-Jb-Grid-1	110.000		0	0	0	0	0	0	0	0	10.000	100.0	52.3	
B-10-Jb1-Jb2-1	110.000	99999.0	0	0	0	0	0	0	0	0	19.418	95.4	101.6	0.1
B-10-Jb1-Jb2-2	110.000	99999.0	0	0	0	0	0	0	0	0	19.416	95.4	101.6	0.1
B-10-Jb1-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	16.885	97.9	88.4	0.1
B-10-Jb1-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	16.890	97.7	88.6	0.1
B-10-Kba-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	15.716	94.8	84.7	0.1
B-10-Kba-Rwi-2	110.000	99999.0	0	0	0	0	0	0	0	0	5.710	94.5	31.2	0.0
B-10-Mki-Grid-1	110.000		0	0	0	0	0	0	0	0	18.028	83.2	94.7	
B-10-MKi-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	8.253	99.7	43.3	0.0
B-10-MKi-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	8.264	99.5	43.4	0.0
B-20-Sha-Grid-1	220.000		0	0	0	0	0	0	0	0	51.304	88.8	134.6	
Bre-1-B-1	15.000	2000.0	1.755	0.577	10.044	3.301	0	0	0	0	12.420	95.0	475.7	23.8
Bre-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	50.383	90.2	262.1	8.3
C-BN	110.000		0	0	0	0	0	0	0	0	11.125	54.6	58.0	
C-GN	110.000		0	0	0	0	0	0	0	0	49.430	93.6	258.0	
C-Kab-3-B	30.000		0	0	0	0	0	0	0	0	0	0.0	0.0	
C-Msh-1-B	15.000		0	0	0	0	0	0	0	0	0	0.0	0.0	
C-Rwi-B-1	15.000		0	0	0	0	0	0	0	0	0	0.0	0.0	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
G-Jb2-10-B	110.000	99999.0	0	0	0	0	0	0	0	0	19.416	95.4	101.6	0.1
G-Jb3-1-B	15.000	99999.0	0	0	0	0	0	0	0	0	8.807	80.8	338.3	0.3
G-Kse-1-B2	110.000	99999.0	0	0	0	0	0	0	0	0	51.152	97.5	266.6	0.3
Gha-1-B-1	15.000	800.0	0.570	0.187	3.256	1.070	0	0	0	0	4.028	95.0	154.4	19.3
Gha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	4.059	94.4	21.3	0.7
Gko-1-B-1	15.000	2500.0	5.000	1.643	20.093	6.604	0	0	0	0	26.414	95.0	1014.3	40.6
Gko-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	26.975	93.3	141.8	4.5
Gso-1-B-1	15.000	2000.0	1.230	0.404	7.096	2.332	0	0	0	0	8.764	95.0	334.3	16.7
Gso-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	49.088	93.7	258.3	8.2
Jb1-1-B-1	15.000	2500.0	3.660	1.203	20.811	6.840	0	0	0	0	25.759	95.0	989.8	39.6
Jb1-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	57.584	97.1	301.4	9.6
Jb2-.6-B-1	6.600	3150.0	0	0	0	0	0	0	0	0	19.932	93.3	1692.8	53.7
Jb2-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	19.416	95.4	101.6	3.2
Jb2-10-B-2	110.000	3150.0	0	0	0	0	0	0	0	0	19.416	95.4	101.6	3.2
Jb3-1-B-1	15.000	800.0	0	0	0	0	0	0	0	0	8.807	80.8	338.3	42.3
Jb3-1-B-2	15.000	800.0	0	0	0	0	0	0	0	0	8.807	80.8	338.3	42.3
Jb3-1-B-2d	15.000	410.0	0	0	0	0	0	0	0	0	4.403	80.8	169.2	41.3
Kba-3-B-1	30.000	800.0	0.950	0.312	8.350	2.745	0	0	0	0	9.790	95.0	190.6	23.8
Kba-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	10.133	92.4	55.3	1.8
Kse-1-B-5	11.000	3150.0	0	0	0	0	0	0	0	0	41.779	95.7	2129.0	67.6
Kse-1-B-6	11.000	3150.0	0	0	0	0	0	0	0	0	10.559	94.7	538.1	17.1
Kse-10-B3	110.000	3150.0	0	0	0	0	0	0	0	0	51.152	97.5	266.6	8.5
MKi-1-B-1	15.000	2000.0	1.035	0.340	6.003	1.973	0	0	0	0	7.408	95.0	281.8	14.1
MKi-3-B-1	30.000	2000.0	1.335	0.439	7.676	2.523	0	0	0	0	9.485	95.0	181.2	9.1
MKi-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	25.628	90.6	134.6	4.3
Msh-1-B-1	15.000	2000.0	2.730	0.897	15.468	5.084	0	0	0	0	19.156	95.0	737.4	36.9
Msh-10-B-1	110.000	3150.0	0.410	0.135	3.500	1.150	0	0	0	0	39.458	93.9	212.6	6.8
N-Jb3-.04-1	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
N-Jb3-.04-2	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
N-Jb3-.04-3	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
N-Jb3-.04-4	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
N-Jb3-.04-5	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
N-Jb3-.04-6	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2200.4	
Nbg-1-B-1	15.000	2500.0	1.230	0.404	7.040	2.314	0	0	0	0	8.705	95.0	333.4	13.3
Nbg-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	16.890	97.7	88.6	2.8
Nde-1-B-1	15.000	2500.0	1.425	0.468	8.231	2.705	0	0	0	0	10.164	95.0	387.5	15.5
Nde-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	59.693	93.7	311.2	9.9
Rwi-1-B-1	15.000	800.0	0.280	0.092	2.508	0.824	0	0	0	0	2.935	95.0	113.2	14.2
Rwi-10-B-1	110.000	3150.0	0.280	0.092	2.323	0.764	0	0	0	0	5.710	94.5	31.2	1.0
Sha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	49.642	91.6	257.8	8.2
Sha-20-B-1	220.000	3150.0	0	0	0	0	0	0	0	0	51.304	88.8	134.6	4.3

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
1-Jb1-Jb3	Cable	480.37	338.31	70.43					
10-Bre-Jb1(S/C)	Line	443.00	149.25	33.69					
10-Bre-Nde-1(S/C)	Line	443.00	57.97	13.09					
10-Bre-Nde-2(S/C)	Line	581.00	58.69	10.10					
10-Bre-Sha-1	Line	1162.00	131.03	11.28					
10-Bre-Sha-2	Line	1162.00	131.03	11.28					
10-Gha-MKi(S/C)	Line	581.00	21.33	3.67					
10-Gko-Jb1(S/C)	Line	581.00	118.97	20.48					
10-Gko-MKi(S/C)	Line	581.00	26.75	4.60					
10-Gso-Msh(S/C)	Line	443.00	212.64	48.00					
10-Gso-Nde-1(S/C)	Line	443.00	258.30	58.31					
10-Gso-Nde-2(S/C)	Line	581.00	257.98	44.40					
10-Jb1-Jb2(S/C)	Line	581.00	101.63	17.49					
10-Jb1-Nbg(S/C)	Line	581.00	88.63	15.25					
10-Kba-Msh(S/C)	Line	443.00	86.05	19.43					
10-Kba-Rwi(S/C)	Line	443.00	31.22	7.05					
10-MKi-Nbg(S/C)	Line	581.00	43.40	7.47					
Bre-10/1-T-1	Transformer				20.000	12.725	63.6	12.420	62.1
Gha-10/1-T-1n	Transformer				20.000	4.059	20.3	4.028	20.1
Gko-10/1-T-1	Transformer				15.000	9.034	60.2	8.846	59.0
Gko-10/1-T-2	Transformer				15.000	9.103	60.7	8.914	59.4
Gko-10/1-T-3	Transformer				15.000	8.838	58.9	8.654	57.7
Gso-10/1-T-1	Transformer				10.000	3.705	37.0	3.655	36.6
Gso-10/1-T-2F	Transformer				15.000	5.179	34.5	5.110	34.1
Jb1-10/1-T-1	Transformer				10.000	9.027	90.3	8.795	88.0
Jb1-10/1-T-2	Transformer				10.000	9.027	90.3	8.795	88.0
Jb2-10/.6-TG-1	Transformer				15.000	9.966	66.4	9.708	64.7
Jb2-10/.6-TG-2	Transformer				15.000	9.966	66.4	9.708	64.7
Jb3-1/0-TG-1	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-2	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-3	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-4	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-5	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-6	Transformer				1.625	1.531	94.2	1.468	90.3
* Kba-10/3-T-1	Transformer				10.000	10.133	101.3	9.790	97.9
Kse-10/1-TG-1n2	Transformer				62.500	41.779	66.8	40.841	65.3

CKT / Branch		Cable & Reactor			Transformer				
		Ampacity (Amp)	Loading Amp		Capability (MVA)	Loading (input)		Loading (output)	
ID	Type			%		MVA	%	MVA	%
Kse-10/1-TG-2n2	Transformer				15.000	10.559	70.4	10.322	68.8
MKi-10/1-T-1	Transformer				20.000	7.514	37.6	7.408	37.0
MKi-10/3-T-1	Transformer				20.000	9.662	48.3	9.485	47.4
Msh-10/1-T-1	Transformer				10.000	6.251	62.5	6.097	61.0
Msh-10/1-T-1F	Transformer				20.000	13.389	66.9	13.059	65.3
Nbg-10/1-T-1n	Transformer				20.000	4.389	21.9	4.353	21.8
Nbg-10/1-T-2n	Transformer				20.000	4.389	21.9	4.353	21.8
Nde-10/1-T-1n	Transformer				20.000	5.131	25.7	5.082	25.4
Nde-10/1-T-2n	Transformer				20.000	5.131	25.7	5.082	25.4
Rwi-10/1-T-1n	Transformer				10.000	2.971	29.7	2.935	29.3
Sha-20/10-T-1n	Transformer				90.000	51.304	57.0	49.642	55.2

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
10-Kba-Msh(S/C)	-14.766	-5.521	14.895	5.015	128.1	-506.0	96.2	97.4	1.24
10-Kba-Rwi(S/C)	5.403	1.647	-5.398	-1.863	5.2	-215.8	96.2	96.0	0.13
1-Jb1-Jb3	-7.113	-5.188	7.115	5.190	1.6	1.5	100.2	100.2	0.03
10-Bre-Nde-1(S/C)	6.081	9.210	-6.072	-9.322	9.3	-111.4	100.9	100.7	0.18
10-Bre-Jb1(S/C)	27.531	7.865	-27.414	-7.848	116.3	16.7	100.9	100.3	0.62
10-Bre-Nde-2(S/C)	-6.070	-9.482	6.072	9.322	1.6	-160.7	100.7	100.7	0.04
10-Bre-Sha-2	-22.723	-10.875	22.739	9.951	15.8	-924.6	100.9	101.1	0.15
10-Bre-Sha-1	-22.723	-10.875	22.739	9.951	15.8	-924.6	100.9	101.1	0.15
10-Gha-MKi(S/C)	-3.831	-1.342	3.832	1.109	1.5	-233.4	99.9	99.9	0.07
10-Gko-Jb1(S/C)	-21.865	-5.839	21.920	5.742	55.8	-97.1	99.8	100.3	0.44
10-Gko-MKi(S/C)	-3.301	-3.872	3.303	3.714	1.6	-157.6	99.8	99.9	0.10
10-Gso-Msh(S/C)	37.661	14.076	-37.065	-13.531	596.3	545.4	99.7	97.4	2.35
10-Gso-Nde-1(S/C)	-46.006	-17.120	46.257	17.424	251.0	304.3	99.7	100.6	0.82
10-Gso-Nde-2(S/C)	46.289	17.342	-46.257	-17.424	31.8	-81.9	100.7	100.6	0.12
10-Jb1-Jb2(S/C)	-18.523	-5.826	18.528	5.802	5.4	-23.9	100.3	100.3	0.05
10-Jb1-Nbg(S/C)	16.533	3.430	-16.506	-3.582	26.6	-151.7	100.3	100.0	0.26
10-MKi-Nbg(S/C)	8.226	0.667	-8.221	-0.844	5.2	-176.7	100.0	99.9	0.08
Bre-10/1-T-1	-11.799	-3.878	11.835	4.676	36.3	798.0	100.5	100.9	0.41
Gha-10/1-T-1n	-3.826	-1.258	3.831	1.342	4.2	84.4	100.4	99.9	0.54
Gko-10/1-T-1	-8.403	-2.763	8.428	3.253	24.5	490.1	100.2	99.8	0.39
Gko-10/1-T-2	-8.469	-2.782	8.494	3.275	24.7	493.8	100.2	99.8	0.39
Gko-10/1-T-3	-8.221	-2.703	8.245	3.182	24.0	479.4	100.2	99.8	0.39
Gso-10/1-T-1	-3.490	-1.087	3.500	1.215	9.8	128.0	100.9	99.7	1.15
Gso-10/1-T-2F	-4.836	-1.650	4.845	1.829	9.0	179.3	100.9	99.7	1.15
Jb1-10/1-T-1	-8.679	-1.427	8.742	2.251	63.3	823.3	100.2	100.3	0.11
Jb1-10/1-T-2	-8.679	-1.427	8.742	2.251	63.3	823.3	100.2	100.3	0.11
Jb2-10/.6-TG-1	9.300	3.582	-9.264	-2.901	35.8	680.6	103.0	100.3	2.67
Jb2-10/.6-TG-2	9.300	3.582	-9.264	-2.901	35.8	680.6	103.0	100.3	2.67
Jb3-1/0-TG-1	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-2	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-3	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-4	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-5	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-6	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Kba-10/3-T-1	-9.300	-3.057	9.363	3.874	62.8	817.0	98.8	96.2	2.67
Kse-10/1-TG-1n2	40.000	12.063	-39.923	-8.609	76.8	3454.3	103.0	100.7	2.31
Kse-10/1-TG-2n2	10.000	3.390	-9.965	-2.690	35.0	699.7	103.0	100.7	2.31
MKi-10/1-T-1	-7.038	-2.313	7.052	2.594	14.1	281.2	101.2	99.9	1.22

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
MKi-10/3-T-1	-9.011	-2.962	9.034	3.427	23.2	464.9	100.7	99.9	0.79
Msh-10/1-T-1	-5.792	-1.904	5.812	2.301	19.9	397.6	100.0	97.4	2.60
Msh-10/1-T-1F	-12.406	-4.078	12.449	4.929	42.6	851.7	100.0	97.4	2.60
Nbg-10/1-T-1n	-4.135	-1.359	4.140	1.457	4.9	98.4	100.5	100.0	0.48
Nbg-10/1-T-2n	-4.135	-1.359	4.140	1.457	4.9	98.4	100.5	100.0	0.48
Nde-10/1-T-1n	-4.828	-1.587	4.835	1.720	6.6	132.9	101.0	100.7	0.27
Nde-10/1-T-2n	-4.828	-1.587	4.835	1.720	6.6	132.9	101.0	100.7	0.27
Rwi-10/1-T-1n	-2.788	-0.916	2.795	1.007	7.0	90.6	99.8	96.0	3.74
Sha-20/10-T-1n	-45.478	-19.902	45.560	23.587	81.9	3685.8	101.1	100.0	1.06
					2071.1	14478.7			

Alert Summary Report

	% Alert Settings
	Critical
Loading	
Bus	100.0
Cable	100.0
Reactor	100.0
Line	100.0
Transformer	100.0
Panel	100.0
Protective Device	100.0
Generator	101.0
Inverter/Charger	100.0
Bus Voltage	
OverVoltage	105.0
UnderVoltage	95.0
Generator Excitation	
OverExcited (Q Max.)	101.0
UnderExcited (Q Min.)	100.0

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
10-Grid-North	Power Grid	Under Excited	0.00	Mvar	0.00	0.0	
Kba-10/3-T-1	Transformer	Overload	10.00	MVA	10.13	101.3	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	45.560	23.587	51.304	88.80 Lagging
Source (Non-Swing Buses):	100.800	38.317	107.837	93.47 Lagging
Total Demand:	146.360	61.904	158.913	92.10 Lagging
Total Motor Load:	21.890	7.195	23.042	95.00 Lagging
Total Static Load:	122.399	40.231	128.841	95.00 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	2.071	14.479		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

2. 潮流計算報告書

2) 2021 年断面（要約）

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
10-Kba/Msh/Rwi-B	110.000	645.0	0	0	0	0	0	0	0	0	19.348	98.1	106.4	16.5
B-1-Jb1-Jb3-1	15.000	99999.0	0	0	0	0	0	0	0	0	8.805	80.8	338.2	0.3
B-1-Jb1-Jb3-2	15.000	99999.0	0	0	0	0	0	0	0	0	8.807	80.8	338.2	0.3
B-10-Bre-Gso-1	110.000	99999.0	0	0	0	0	0	0	0	0	22.285	96.3	116.3	0.1
B-10-Bre-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	50.793	98.5	265.0	0.3
B-10-Bre-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	50.340	98.6	265.2	0.3
B-10-Bre-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	22.298	96.0	116.7	0.1
B-10-Bre-Sha-1D	110.000	99999.0	0	0	0	0	0	0	0	0	44.507	97.2	232.2	0.2
B-10-Bre-Sha-1DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	44.507	97.2	232.2	0.2
B-10-Bre-Sha-2D	110.000	99999.0	0	0	0	0	0	0	0	0	44.374	97.6	231.1	0.2
B-10-Bre-Sha-2DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	44.374	97.6	231.1	0.2
B-10-Gha-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	5.261	94.2	27.9	0.0
B-10-Gha-MKi-2	110.000	99999.0	0	0	0	0	0	0	0	0	5.192	95.5	27.5	0.0
B-10-Gko-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	31.569	95.4	167.4	0.2
B-10-Gko-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	31.699	95.3	167.0	0.2
B-10-Gko-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	4.223	54.2	22.4	0.0
B-10-Gko-MKi-2	110.000	645.0	0	0	0	0	0	0	0	0	4.093	56.0	21.7	3.4
B-10-Gso-Msh-1	110.000		0	0	0	0	0	0	0	0	49.003	97.6	259.1	
B-10-Gso-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	47.899	98.0	259.8	0.3
B-10-Gso-Nde-1	110.000	99999.0	0	0	0	0	0	0	0	0	60.364	96.9	319.2	0.3
B-10-Gso-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	60.913	96.7	318.8	0.3
B-10-Jb-Grid-1	110.000		0	0	0	0	0	0	0	0	12.207	81.9	64.3	
B-10-Jb1-Jb2-1	110.000	99999.0	0	0	0	0	0	0	0	0	20.006	92.6	105.4	0.1
B-10-Jb1-Jb2-2	110.000	99999.0	0	0	0	0	0	0	0	0	20.003	92.6	105.3	0.1
B-10-Jb1-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	24.233	96.4	127.7	0.1
B-10-Jb1-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	24.194	96.3	128.0	0.1
B-10-Kba-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	19.475	98.4	105.6	0.1
B-10-Kba-Rwi-2	110.000	99999.0	0	0	0	0	0	0	0	0	7.321	94.4	40.3	0.0
B-10-Mki-Grid-1	110.000		0	0	0	0	0	0	0	0	18.028	83.2	95.5	
B-10-MKi-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	12.825	97.8	67.9	0.1
B-10-MKi-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	12.844	97.6	68.1	0.1
B-20-Sha-Grid-1	220.000		0	0	0	0	0	0	0	0	90.356	96.0	237.1	
Bre-1-B-1	15.000	2000.0	2.265	0.744	12.684	4.169	0	0	0	0	15.736	95.0	609.3	30.5
Bre-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	89.015	97.2	464.5	14.7
C-BN	110.000		0	0	0	0	0	0	0	0	22.264	96.2	116.5	
C-GN	110.000		0	0	0	0	0	0	0	0	60.875	96.7	319.0	
C-Kab-3-B	30.000		0	0	0	-2.975	0	0	0	0	2.975	0.0	57.5	
C-Msh-1-B	15.000		0	0	0	-4.896	0	0	0	0	4.896	0.0	190.4	
C-Rwi-B-1	15.000		0	0	0	0	0	0	0	0	0	0.0	0.0	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
G-Jb2-10-B	110.000	99999.0	0	0	0	0	0	0	0	0	20.003	92.6	105.3	0.1
G-Jb3-1-B	15.000	99999.0	0	0	0	0	0	0	0	0	8.807	80.8	338.2	0.3
G-Kse-1-B2	110.000	99999.0	0	0	0	0	0	0	0	0	51.741	96.4	270.8	0.3
Gha-1-B-1	15.000	800.0	0.735	0.242	4.213	1.385	0	0	0	0	5.209	95.0	199.3	24.9
Gha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	5.261	94.2	27.9	0.9
Gko-1-B-1	15.000	2500.0	6.460	2.123	25.816	8.485	0	0	0	0	33.974	95.0	1308.3	52.3
Gko-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	34.924	92.8	185.2	5.9
Gso-1-B-1	15.000	2000.0	1.590	0.523	9.007	2.961	0	0	0	0	11.155	95.0	429.4	21.5
Gso-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	60.364	96.9	319.2	10.1
Jb1-1-B-1	15.000	2500.0	4.725	1.553	26.885	8.837	0	0	0	0	33.274	95.0	1278.1	51.1
Jb1-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	81.443	96.0	429.1	13.6
Jb2-.6-B-1	6.600	3150.0	0	0	0	0	0	0	0	0	20.669	90.0	1755.4	55.7
Jb2-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	20.003	92.6	105.3	3.3
Jb2-10-B-2	110.000	3150.0	0	0	0	0	0	0	0	0	20.003	92.6	105.3	3.3
Jb3-1-B-1	15.000	800.0	0	0	0	0	0	0	0	0	8.807	80.8	338.2	42.3
Jb3-1-B-2	15.000	800.0	0	0	0	0	0	0	0	0	8.807	80.8	338.2	42.3
Jb3-1-B-2d	15.000	410.0	0	0	0	0	0	0	0	0	4.403	80.8	169.1	41.2
Kba-3-B-1	30.000	800.0	1.210	0.398	10.798	3.549	0	0	0	0	12.640	95.0	244.3	30.5
Kba-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	12.158	99.2	66.8	2.1
Kse-1-B-5	11.000	3150.0	0	0	0	0	0	0	0	0	42.384	94.4	2159.8	68.6
Kse-1-B-6	11.000	3150.0	0	0	0	0	0	0	0	0	10.772	92.8	548.9	17.4
Kse-10-B3	110.000	3150.0	0	0	0	0	0	0	0	0	51.741	96.4	270.8	8.6
MKi-1-B-1	15.000	2000.0	1.335	0.439	7.537	2.477	0	0	0	0	9.339	95.0	360.1	18.0
MKi-3-B-1	30.000	2000.0	1.725	0.567	9.628	3.164	0	0	0	0	11.950	95.0	231.7	11.6
MKi-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	30.365	90.7	160.9	5.1
Msh-1-B-1	15.000	2000.0	3.480	1.144	19.310	6.347	0	0	0	0	23.990	95.0	933.1	46.7
Msh-10-B-1	110.000	3150.0	0.520	0.171	4.383	1.441	0	0	0	0	47.899	98.0	259.8	8.2
N-Jb3-.04-1	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
N-Jb3-.04-2	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
N-Jb3-.04-3	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
N-Jb3-.04-4	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
N-Jb3-.04-5	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
N-Jb3-.04-6	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2199.7	
Nbg-1-B-1	15.000	2500.0	1.590	0.523	9.147	3.007	0	0	0	0	11.302	95.0	431.8	17.3
Nbg-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	24.194	96.3	128.0	4.1
Nde-1-B-1	15.000	2500.0	1.845	0.606	10.510	3.455	0	0	0	0	13.006	95.0	499.3	20.0
Nde-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	74.038	96.3	387.5	12.3
Rwi-1-B-1	15.000	800.0	0.360	0.118	3.236	1.064	0	0	0	0	3.785	95.0	145.8	18.2
Rwi-10-B-1	110.000	3150.0	0.360	0.118	2.942	0.967	0	0	0	0	7.321	94.4	40.3	1.3
Sha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	88.748	97.6	462.2	14.7
Sha-20-B-1	220.000	3150.0	0	0	0	0	0	0	0	0	90.356	96.0	237.1	7.5

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
1-Jb1-Jb3	Cable	480.37	338.20	70.40					
10-Bre-Jb1(S/C)	Line	443.00	265.23	59.87					
10-Bre-Nde-1(S/C)	Line	443.00	116.46	26.29					
10-Bre-Nde-2(S/C)	Line	581.00	116.70	20.09					
10-Bre-Sha-1	Line	1162.00	232.23	19.99					
10-Bre-Sha-2	Line	1162.00	232.23	19.99					
10-Gha-MKi(S/C)	Line	581.00	27.91	4.80					
10-Gko-Jb1(S/C)	Line	581.00	167.44	28.82					
10-Gko-MKi(S/C)	Line	581.00	22.40	3.86					
10-Gso-Msh(S/C)	Line	443.00	259.79	58.64					
10-Gso-Nde-1(S/C)	Line	443.00	319.23	72.06					
10-Gso-Nde-2(S/C)	Line	581.00	319.01	54.91					
10-Jb1-Jb2(S/C)	Line	581.00	105.40	18.14					
10-Jb1-Nbg(S/C)	Line	581.00	128.00	22.03					
10-Kba-Msh(S/C)	Line	443.00	106.37	24.01					
10-Kba-Rwi(S/C)	Line	443.00	40.32	9.10					
10-MKi-Nbg(S/C)	Line	581.00	68.07	11.72					
Bre-10/1-T-1	Transformer				20.000	16.248	81.2	15.736	78.7
Gha-10/1-T-1n	Transformer				20.000	5.261	26.3	5.209	26.0
Gko-10/1-T-1	Transformer				15.000	11.696	78.0	11.378	75.9
Gko-10/1-T-2	Transformer				15.000	11.786	78.6	11.465	76.4
Gko-10/1-T-3	Transformer				15.000	11.442	76.3	11.131	74.2
Gso-10/1-T-1F	Transformer				15.000	11.497	76.6	11.155	74.4
Jb1-10/1-T-1	Transformer				10.000	6.163	61.6	6.047	60.5
Jb1-10/1-T-2	Transformer				10.000	6.163	61.6	6.047	60.5
Jb1-10/1-T-F1	Transformer				20.000	13.201	66.0	12.952	64.8
Jb2-10/.6-TG-1	Transformer				15.000	10.335	68.9	10.001	66.7
Jb2-10/.6-TG-2	Transformer				15.000	10.335	68.9	10.001	66.7
Jb3-1/0-TG-1	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-2	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-3	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-4	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-5	Transformer				1.625	1.531	94.2	1.468	90.3
Jb3-1/0-TG-6	Transformer				1.625	1.531	94.2	1.468	90.3
Kba-10/3-T-1	Transformer				10.000	6.079	60.8	6.023	60.2
Kba-10/3-T-2	Transformer				10.000	6.079	60.8	6.023	60.2

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Kse-10/1-TG-1n2	Transformer				62.500	42.384	67.8	41.269	66.0
Kse-10/1-TG-2n2	Transformer				15.000	10.772	71.8	10.488	69.9
MKi-10/1-T-1	Transformer				20.000	9.514	47.6	9.339	46.7
MKi-10/3-T-1	Transformer				20.000	12.244	61.2	11.950	59.8
Msh-10/1-T-1	Transformer				10.000	7.417	74.2	7.300	73.0
Msh-10/1-T-1F	Transformer				20.000	15.888	79.4	15.637	78.2
Nbg-10/1-T-1n	Transformer				20.000	5.713	28.6	5.651	28.3
Nbg-10/1-T-2n	Transformer				20.000	5.713	28.6	5.651	28.3
Nde-10/1-T-1n	Transformer				20.000	6.585	32.9	6.503	32.5
Nde-10/1-T-2n	Transformer				20.000	6.585	32.9	6.503	32.5
Rwi-10/1-T-1n	Transformer				10.000	3.846	38.5	3.785	37.9
Sha-20/10-T-1n	Transformer				90.000	45.178	50.2	44.374	49.3
Sha-20/10-T-2n	Transformer				90.000	45.178	50.2	44.374	49.3

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
10-Kba-Msh(S/C)	-18.973	-3.793	19.170	3.429	197.5	-364.3	95.5	96.8	1.31
10-Kba-Rwi(S/C)	6.918	2.212	-6.910	-2.418	8.6	-205.9	95.5	95.3	0.18
1-Jb1-Jb3	-7.113	-5.189	7.115	5.190	1.6	1.5	100.2	100.2	0.03
10-Bre-Nde-1(S/C)	21.458	6.016	-21.420	-6.073	37.8	-56.4	100.6	100.3	0.25
10-Bre-Jb1(S/C)	50.024	8.807	-49.656	-8.272	367.8	535.1	100.6	99.6	0.97
10-Bre-Nde-2(S/C)	-21.414	-6.219	21.420	6.073	6.5	-146.8	100.3	100.3	0.05
10-Bre-Sha-2	-43.245	-10.523	43.296	9.722	50.2	-800.7	100.6	100.8	0.20
10-Bre-Sha-1	-43.245	-10.523	43.296	9.722	50.2	-800.7	100.6	100.8	0.20
10-Gha-MKi(S/C)	-4.955	-1.767	4.958	1.541	2.6	-225.6	98.9	99.0	0.10
10-Gko-Jb1(S/C)	-30.107	-9.495	30.218	9.577	110.6	82.1	99.0	99.6	0.67
10-Gko-MKi(S/C)	-2.290	-3.548	2.291	3.392	1.1	-156.3	99.0	99.0	0.09
10-Gso-Msh(S/C)	47.847	10.578	-46.955	-9.464	892.4	1113.9	99.2	96.8	2.47
10-Gso-Nde-1(S/C)	-58.488	-14.931	58.872	15.489	383.6	557.4	99.2	100.2	0.91
10-Gso-Nde-2(S/C)	58.921	15.452	-58.872	-15.489	48.6	-36.8	100.3	100.2	0.13
10-Jb1-Jb2(S/C)	-18.517	-7.573	18.523	7.551	5.8	-22.1	99.6	99.7	0.06
10-Jb1-Nbg(S/C)	23.357	6.454	-23.302	-6.510	55.4	-56.0	99.6	99.2	0.41
10-MKi-Nbg(S/C)	12.548	2.651	-12.535	-2.800	12.9	-149.0	99.2	99.0	0.16
Bre-10/1-T-1	-14.950	-4.914	15.009	6.223	59.5	1309.2	99.4	100.6	1.18
Gha-10/1-T-1n	-4.948	-1.626	4.955	1.767	7.0	140.6	100.6	98.9	1.63
Gko-10/1-T-1	-10.809	-3.554	10.850	4.370	40.8	815.4	100.0	99.0	1.00
Gko-10/1-T-2	-10.893	-3.577	10.934	4.399	41.1	821.5	100.0	99.0	1.00
Gko-10/1-T-3	-10.574	-3.477	10.614	4.275	39.9	797.6	100.0	99.0	1.00
Gso-10/1-T-1F	-10.597	-3.483	10.641	4.353	43.5	870.2	100.0	99.2	0.74
Jb1-10/1-T-1	-5.932	-1.174	5.962	1.563	29.9	388.8	100.2	99.6	0.59
Jb1-10/1-T-2	-5.932	-1.174	5.962	1.563	29.9	388.8	100.2	99.6	0.59
Jb1-10/1-T-F1	-12.634	-2.854	12.675	3.688	41.7	834.3	100.2	99.6	0.59
Jb2-10/.6-TG-1	9.300	4.507	-9.261	-3.775	38.5	731.9	103.0	99.7	3.32
Jb2-10/.6-TG-2	9.300	4.507	-9.261	-3.775	38.5	731.9	103.0	99.7	3.32
Jb3-1/0-TG-1	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-2	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-3	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-4	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-5	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Jb3-1/0-TG-6	-1.186	-0.865	1.200	0.950	14.2	85.0	100.2	100.4	4.28
Kba-10/3-T-1	-6.004	-0.486	6.027	0.791	23.4	304.6	99.6	95.5	4.11
Kba-10/3-T-2	-6.004	-0.486	6.027	0.791	23.4	304.6	99.6	95.5	4.11
Kse-10/1-TG-1n2	40.000	14.015	-39.921	-10.460	79.0	3555.0	103.0	100.3	2.71
Kse-10/1-TG-2n2	10.000	4.004	-9.964	-3.275	36.4	728.2	103.0	100.3	2.71

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
MKi-10/1-T-1	-8.872	-2.916	8.895	3.375	23.0	459.0	99.8	99.0	0.78
MKi-10/3-T-1	-11.353	-3.731	11.391	4.492	38.0	760.3	99.2	99.0	0.20
Msh-10/1-T-1	-7.253	-0.826	7.283	1.408	29.1	582.2	99.0	96.8	2.18
Msh-10/1-T-1F	-15.537	-1.769	15.599	3.016	62.4	1247.0	99.0	96.8	2.18
Nbg-10/1-T-1n	-5.369	-1.765	5.377	1.930	8.2	164.9	100.8	99.2	1.55
Nbg-10/1-T-2n	-5.369	-1.765	5.377	1.930	8.2	164.9	100.8	99.2	1.55
Nde-10/1-T-1n	-6.178	-2.031	6.189	2.251	11.0	220.6	100.3	100.3	0.02
Nde-10/1-T-2n	-6.178	-2.031	6.189	2.251	11.0	220.6	100.3	100.3	0.02
Rwi-10/1-T-1n	-3.596	-1.182	3.608	1.332	11.6	150.2	99.9	95.3	4.65
Sha-20/10-T-1n	-43.296	-9.722	43.361	12.683	65.8	2960.6	100.8	100.0	0.79
Sha-20/10-T-2n	-43.296	-9.722	43.361	12.683	65.8	2960.6	100.8	100.0	0.79
					3225.0	22392.8			

Alert Summary Report

	% Alert Settings
	Critical
Loading	
Bus	100.0
Cable	100.0
Reactor	100.0
Line	100.0
Transformer	100.0
Panel	100.0
Protective Device	100.0
Generator	101.0
Inverter/Charger	100.0
Bus Voltage	
OverVoltage	105.0
UnderVoltage	95.0
Generator Excitation	
OverExcited (Q Max.)	101.0
UnderExcited (Q Min.)	100.0

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	86.723	25.365	90.356	95.98 Lagging
Source (Non-Swing Buses):	100.800	49.733	112.401	89.68 Lagging
Total Demand:	187.523	75.098	202.001	92.83 Lagging
Total Motor Load:	28.200	9.269	29.684	95.00 Lagging
Total Static Load:	156.098	43.436	162.029	96.34 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	3.225	22.393		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

2. 潮流計算報告書

3) 2023 年断面（要約）

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
10-Kba/Msh/Rwi-B	110.000	645.0	0	0	0	0	0	0	0	0	23.092	97.4	125.7	19.5
B-1-Jb1-Jb3-1	15.000	99999.0	0	0	0	0	0	0	0	0	8.808	80.8	336.7	0.3
B-1-Jb1-Jb3-2	15.000	99999.0	0	0	0	0	0	0	0	0	8.810	80.8	336.7	0.3
B-10-Bre-Gso-1	110.000	99999.0	0	0	0	0	0	0	0	0	37.900	93.0	197.1	0.2
B-10-Bre-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	72.175	98.2	375.3	0.4
B-10-Bre-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	71.218	98.5	375.5	0.4
B-10-Bre-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	37.828	93.0	197.6	0.2
B-10-Bre-Sha-1D	110.000	99999.0	0	0	0	0	0	0	0	0	64.586	96.2	335.8	0.3
B-10-Bre-Sha-1DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	64.586	96.2	335.8	0.3
B-10-Bre-Sha-2D	110.000	99999.0	0	0	0	0	0	0	0	0	64.521	96.5	334.5	0.3
B-10-Bre-Sha-2DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	64.521	96.5	334.5	0.3
B-10-Gha-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	6.290	94.0	33.5	0.0
B-10-Gha-MKi-2	110.000	99999.0	0	0	0	0	0	0	0	0	6.222	95.1	33.1	0.0
B-10-Gko-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	39.953	94.5	212.5	0.2
B-10-Gko-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	40.219	94.3	212.1	0.2
B-10-Gko-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	3.369	34.1	17.9	0.0
B-10-Gko-MKi-2	110.000	645.0	0	0	0	0	0	0	0	0	3.223	35.7	17.1	2.7
B-10-Gso-Msh-1	110.000		0	0	0	0	0	0	0	0	58.980	96.8	311.4	
B-10-Gso-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	58.328	97.2	312.4	0.3
B-10-Gso-Nde-1	110.000	99999.0	0	0	0	0	0	0	0	0	72.807	96.1	384.4	0.4
B-10-Gso-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	73.480	95.8	383.9	0.4
B-10-Jb-Grid-1	110.000		0	0	0	0	0	0	0	0	12.207	81.9	64.4	
B-10-Jb1-Jb2-1	110.000	99999.0	0	0	0	0	0	0	0	0	22.841	81.0	120.4	0.1
B-10-Jb1-Jb2-2	110.000	99999.0	0	0	0	0	0	0	0	0	22.837	81.0	120.3	0.1
B-10-Jb1-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	31.074	95.3	163.8	0.2
B-10-Jb1-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	30.969	95.4	164.2	0.2
B-10-Kba-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	23.310	97.7	124.8	0.1
B-10-Kba-Rwi-2	110.000	99999.0	0	0	0	0	0	0	0	0	8.570	94.3	46.8	0.0
B-10-Mki-Grid-1	110.000		0	0	0	0	0	0	0	0	18.028	83.2	95.8	
B-10-MKi-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	17.483	96.3	92.7	0.1
B-10-MKi-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	17.490	96.2	93.0	0.1
B-20-Sha-Grid-1	220.000		0	0	0	0	0	0	0	0	133.106	93.7	349.3	
Bre-1-B-1	15.000	2000.0	2.700	0.887	15.338	5.041	0	0	0	0	18.988	95.0	729.9	36.5
Bre-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	129.172	96.2	671.7	21.3
C-BN	110.000		0	0	0	0	0	0	0	0	37.803	93.1	197.3	
C-GN	110.000		0	0	0	0	0	0	0	0	73.406	95.8	384.1	
C-Kab-3-B	30.000		0	0	0	-3.008	0	0	0	0	3.008	0.0	57.8	
C-Msh-1-B	15.000		0	0	0	-5.091	0	0	0	0	5.091	0.0	194.2	
C-Rwi-B-1	15.000		0	0	0	0	0	0	0	0	0	0.0	0.0	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
G-Jb2-10-B	110.000	99999.0	0	0	0	0	0	0	0	0	22.837	81.0	120.3	0.1
G-Jb3-1-B	15.000	99999.0	0	0	0	0	0	0	0	0	8.810	80.8	336.7	0.3
G-Kse-1-B2	110.000	99999.0	0	0	0	0	0	0	0	0	51.463	96.9	268.9	0.3
Gha-1-B-1	15.000	800.0	0.885	0.291	5.019	1.650	0	0	0	0	6.214	95.0	239.1	29.9
Gha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	6.290	94.0	33.5	1.1
Gko-1-B-1	15.000	2500.0	7.700	2.531	31.039	10.202	0	0	0	0	40.778	95.0	1563.5	62.5
Gko-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	42.154	92.3	224.2	7.1
Gso-1-B-1	15.000	2000.0	1.890	0.621	10.892	3.580	0	0	0	0	13.455	95.0	513.5	25.7
Gso-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	72.807	96.1	384.4	12.2
Jb1-1-B-1	15.000	2500.0	5.640	1.854	32.404	10.651	0	0	0	0	40.046	95.0	1530.8	61.2
Jb1-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	103.906	94.9	547.8	17.4
Jb2-.6-B-1	6.600	3150.0	0	0	0	0	0	0	0	0	24.084	77.2	2005.1	63.7
Jb2-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	22.837	81.0	120.3	3.8
Jb2-10-B-2	110.000	3150.0	0	0	0	0	0	0	0	0	22.837	81.0	120.3	3.8
Jb3-1-B-1	15.000	800.0	0	0	0	0	0	0	0	0	8.810	80.8	336.7	42.1
Jb3-1-B-2	15.000	800.0	0	0	0	0	0	0	0	0	8.810	80.8	336.7	42.1
Jb3-1-B-2d	15.000	410.0	0	0	0	0	0	0	0	0	4.405	80.8	168.3	41.1
Kba-3-B-1	30.000	800.0	1.430	0.470	12.905	4.242	0	0	0	0	15.089	95.0	290.0	36.3
Kba-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	14.629	98.4	79.6	2.5
Kse-1-B-5	11.000	3150.0	0	0	0	0	0	0	0	0	42.102	95.0	2145.4	68.1
Kse-1-B-6	11.000	3150.0	0	0	0	0	0	0	0	0	10.672	93.7	543.8	17.3
Kse-10-B3	110.000	3150.0	0	0	0	0	0	0	0	0	51.463	96.9	268.9	8.5
MKi-1-B-1	15.000	2000.0	1.590	0.523	9.098	2.990	0	0	0	0	11.251	95.0	430.9	21.5
MKi-3-B-1	30.000	2000.0	2.055	0.675	11.919	3.917	0	0	0	0	14.709	95.0	279.8	14.0
MKi-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	35.093	90.7	186.5	5.9
Msh-1-B-1	15.000	2000.0	4.110	1.351	23.716	7.795	0	0	0	0	29.290	95.0	1117.2	55.9
Msh-10-B-1	110.000	3150.0	0.620	0.204	5.360	1.762	0	0	0	0	58.328	97.2	312.4	9.9
N-Jb3-.04-1	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
N-Jb3-.04-2	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
N-Jb3-.04-3	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
N-Jb3-.04-4	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
N-Jb3-.04-5	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
N-Jb3-.04-6	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2189.9	
Nbg-1-B-1	15.000	2500.0	1.890	0.621	10.779	3.543	0	0	0	0	13.336	95.0	511.7	20.5
Nbg-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	30.969	95.4	164.2	5.2
Nde-1-B-1	15.000	2500.0	2.190	0.720	12.459	4.095	0	0	0	0	15.420	95.0	592.3	23.7
Nde-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	89.109	95.4	465.5	14.8
Rwi-1-B-1	15.000	800.0	0.420	0.138	3.728	1.225	0	0	0	0	4.366	95.0	169.2	21.2
Rwi-10-B-1	110.000	3150.0	0.420	0.138	3.498	1.150	0	0	0	0	8.570	94.3	46.8	1.5
Sha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	129.042	96.5	668.9	21.2
Sha-20-B-1	220.000	3150.0	0	0	0	0	0	0	0	0	133.106	93.7	349.3	11.1

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
		Ampacity	Loading		Capability	Loading (input)		Loading (output)	
ID	Type	(Amp)	Amp	%	(MVA)	MVA	%	MVA	%
1-Jb1-Jb3	Cable	480.37	336.69	70.09					
10-Bre-Jb1(S/C)	Line	443.00	375.50	84.76					
10-Bre-Nde-1R(S/C)	Line	581.00	197.30	33.96					
10-Bre-Nde-2(S/C)	Line	581.00	197.62	34.01					
10-Bre-Sha-1	Line	1162.00	335.83	28.90					
10-Bre-Sha-2	Line	1162.00	335.83	28.90					
10-Gha-MKi(S/C)	Line	581.00	33.48	5.76					
10-Gko-Jb1(S/C)	Line	581.00	212.53	36.58					
10-Gko-MKi(S/C)	Line	581.00	17.92	3.08					
10-Gso-Msh-R(D/C)	Line	581.00	312.36	53.76					
10-Gso-Nde-1R(S/C)	Line	581.00	384.36	66.15					
10-Gso-Nde-2(S/C)	Line	581.00	384.12	66.11					
10-Jb1-Jb2(S/C)	Line	581.00	120.43	20.73					
10-Jb1-Nbg(S/C)	Line	581.00	164.21	28.26					
10-Kba-Msh(S/C)	Line	443.00	125.73	28.38					
10-Kba-Rwi(S/C)	Line	443.00	46.76	10.56					
10-MKi-Nbg(S/C)	Line	581.00	92.97	16.00					
Bre-10/1-T-1	Transformer				20.000	19.734	98.7	18.988	94.9
Gha-10/1-T-1n	Transformer				20.000	6.290	31.4	6.214	31.1
Gko-10/1-T-1	Transformer				15.000	14.118	94.1	13.657	91.0
Gko-10/1-T-2	Transformer				15.000	14.225	94.8	13.761	91.7
Gko-10/1-T-3	Transformer				15.000	13.811	92.1	13.360	89.1
Gso-10/1-T-1F	Transformer				15.000	13.951	93.0	13.455	89.7
Jb1-10/1-T-1	Transformer				10.000	7.877	78.8	7.674	76.7
Jb1-10/1-T-2	Transformer				10.000	7.877	78.8	7.674	76.7
Jb1-10/1-T-F1	Transformer				20.000	16.873	84.4	16.437	82.2
Jb2-10/.6-TG-1	Transformer				15.000	12.042	80.3	11.418	76.1
Jb2-10/.6-TG-2	Transformer				15.000	12.042	80.3	11.418	76.1
Jb3-1/0-TG-1	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-2	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-3	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-4	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-5	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-6	Transformer				1.625	1.531	94.2	1.468	90.4
Kba-10/3-T-1	Transformer				10.000	7.314	73.1	7.218	72.2
Kba-10/3-T-2	Transformer				10.000	7.314	73.1	7.218	72.2

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Kse-10/1-TG-1n2	Transformer				62.500	42.102	67.4	41.067	65.7
Kse-10/1-TG-2n2	Transformer				15.000	10.672	71.1	10.410	69.4
MKi-10/1-T-1	Transformer				20.000	11.503	57.5	11.251	56.3
MKi-10/3-T-1	Transformer				20.000	15.143	75.7	14.709	73.5
Msh-10/1-T-1	Transformer				10.000	9.150	91.5	8.950	89.5
Msh-10/1-T-1F	Transformer				20.000	19.599	98.0	19.170	95.8
Nbg-10/1-T-1n	Transformer				20.000	6.755	33.8	6.668	33.3
Nbg-10/1-T-2n	Transformer				20.000	6.755	33.8	6.668	33.3
Nde-10/1-T-1n	Transformer				20.000	7.827	39.1	7.710	38.6
Nde-10/1-T-2n	Transformer				20.000	7.827	39.1	7.710	38.6
Rwi-10/1-T-1n	Transformer				10.000	4.448	44.5	4.366	43.7
Sha-20/10-T-1n	Transformer				90.000	66.553	73.9	64.521	71.7
Sha-20/10-T-2n	Transformer				90.000	66.553	73.9	64.521	71.7

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
10-Kba-Msh(S/C)	-22.494	-5.218	22.770	4.985	275.9	-232.3	96.4	98.0	1.61
10-Kba-Rwi(S/C)	8.093	2.649	-8.081	-2.853	11.6	-204.5	96.4	96.2	0.20
1-Jb1-Jb3	-7.114	-5.193	7.116	5.195	1.6	1.5	100.7	100.7	0.03
10-Bre-Nde-1R(S/C)	35.252	13.917	-35.184	-13.824	67.6	93.2	100.9	100.6	0.38
10-Bre-Jb1(S/C)	70.904	13.489	-70.166	-12.195	737.3	1293.1	100.9	99.5	1.39
10-Bre-Nde-2(S/C)	-35.166	-13.940	35.184	13.824	18.6	-115.8	100.5	100.6	0.09
10-Bre-Sha-2	-62.140	-17.607	62.245	16.987	105.1	-619.9	100.9	101.2	0.31
10-Bre-Sha-1	-62.140	-17.607	62.245	16.987	105.1	-619.9	100.9	101.2	0.31
10-Gha-MKi(S/C)	-5.914	-2.143	5.917	1.922	3.8	-220.4	98.6	98.7	0.12
10-Gko-Jb1(S/C)	-37.764	-13.042	37.942	13.341	178.3	299.2	98.7	99.5	0.88
10-Gko-MKi(S/C)	-1.149	-3.167	1.150	3.011	0.7	-156.7	98.7	98.7	0.07
10-Gso-Msh-R(D/C)	57.110	14.734	-56.708	-13.649	401.8	1085.4	99.4	98.0	1.41
10-Gso-Nde-1R(S/C)	-69.955	-20.180	70.301	21.124	346.6	943.9	99.4	100.3	0.88
10-Gso-Nde-2(S/C)	70.372	21.144	-70.301	-21.124	70.5	19.7	100.5	100.3	0.16
10-Jb1-Jb2(S/C)	-18.492	-13.407	18.499	13.390	7.6	-16.9	99.5	99.6	0.08
10-Jb1-Nbg(S/C)	29.625	9.379	-29.534	-9.320	91.2	59.0	99.5	99.0	0.56
10-MKi-Nbg(S/C)	16.841	4.692	-16.817	-4.805	24.0	-112.5	99.0	98.7	0.25
Bre-10/1-T-1	-18.038	-5.929	18.124	7.808	85.4	1878.9	100.1	100.9	0.81
Gha-10/1-T-1n	-5.904	-1.940	5.914	2.143	10.1	202.3	100.0	98.6	1.42
Gko-10/1-T-1	-12.973	-4.266	13.032	5.431	58.2	1164.5	100.4	98.7	1.72
Gko-10/1-T-2	-13.074	-4.293	13.133	5.466	58.7	1173.2	100.4	98.7	1.72
Gko-10/1-T-3	-12.691	-4.173	12.748	5.313	57.0	1139.2	100.4	98.7	1.72
Gso-10/1-T-1F	-12.782	-4.201	12.845	5.446	62.2	1244.5	100.8	99.4	1.43
Jb1-10/1-T-1	-7.492	-1.662	7.539	2.282	47.7	620.2	100.7	99.5	1.15
Jb1-10/1-T-2	-7.492	-1.662	7.539	2.282	47.7	620.2	100.7	99.5	1.15
Jb1-10/1-T-F1	-15.946	-3.988	16.013	5.319	66.5	1330.7	100.7	99.5	1.15
Jb2-10/.6-TG-1	9.300	7.650	-9.250	-6.695	50.3	954.9	105.1	99.6	5.44
Jb2-10/.6-TG-2	9.300	7.650	-9.250	-6.695	50.3	954.9	105.1	99.6	5.44
Jb3-1/0-TG-1	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Jb3-1/0-TG-2	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Jb3-1/0-TG-3	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Jb3-1/0-TG-4	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Jb3-1/0-TG-5	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Jb3-1/0-TG-6	-1.186	-0.866	1.200	0.950	14.0	84.2	100.7	100.9	4.26
Kba-10/3-T-1	-7.167	-0.852	7.201	1.284	33.3	432.6	100.1	96.4	3.74
Kba-10/3-T-2	-7.167	-0.852	7.201	1.284	33.3	432.6	100.1	96.4	3.74
Kse-10/1-TG-1n2	40.000	13.135	-39.922	-9.628	78.0	3507.8	103.0	100.5	2.53
Kse-10/1-TG-2n2	10.000	3.727	-9.964	-3.012	35.7	714.8	103.0	100.5	2.53

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
MKi-10/1-T-1	-10.688	-3.513	10.721	4.170	32.9	657.3	100.5	98.7	1.75
MKi-10/3-T-1	-13.974	-4.593	14.029	5.701	55.4	1108.4	101.2	98.7	2.43
Msh-10/1-T-1	-8.856	-1.290	8.898	2.132	42.1	841.4	100.9	98.0	2.90
Msh-10/1-T-1F	-18.970	-2.764	19.060	4.566	90.1	1802.2	100.9	98.0	2.90
Nbg-10/1-T-1n	-6.335	-2.082	6.346	2.314	11.6	231.6	100.3	99.0	1.34
Nbg-10/1-T-2n	-6.335	-2.082	6.346	2.314	11.6	231.6	100.3	99.0	1.34
Nde-10/1-T-1n	-7.325	-2.407	7.340	2.718	15.5	310.5	100.2	100.5	0.27
Nde-10/1-T-2n	-7.325	-2.407	7.340	2.718	15.5	310.5	100.2	100.5	0.27
Rwi-10/1-T-1n	-4.148	-1.363	4.164	1.566	15.6	202.4	99.3	96.2	3.11
Sha-20/10-T-1n	-62.245	-16.987	62.383	23.189	137.8	6202.5	101.2	100.0	1.25
Sha-20/10-T-2n	-62.245	-16.987	62.383	23.189	137.8	6202.5	101.2	100.0	1.25
					3871.9	36473.5			

Alert Summary Report

	% Alert Settings Critical
Loading	
Bus	100.0
Cable	100.0
Reactor	100.0
Line	100.0
Transformer	100.0
Panel	100.0
Protective Device	100.0
Generator	101.0
Inverter/Charger	100.0
Bus Voltage	
OverVoltage	105.0
UnderVoltage	95.0
Generator Excitation	
OverExcited (Q Max.)	101.0
UnderExcited (Q Min.)	100.0

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Jb2-.6-B-1	Bus	Over Voltage	6.600	kV	6.935	105.1	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	124.765	46.379	133.106	93.73 Lagging
Source (Non-Swing Buses):	100.800	54.862	114.763	87.83 Lagging
Total Demand:	225.565	101.241	247.244	91.23 Lagging
Total Motor Load:	33.540	11.024	35.305	95.00 Lagging
Total Static Load:	188.153	53.744	195.678	96.15 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	3.872	36.474		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

2. 潮流計算報告書

4) 2026 年断面（要約）

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
10-Kba/Msh/Rwi-B	110.000	645.0	0	0	0	0	0	0	0	0	28.928	98.6	158.9	24.6
B-1-Jb1-Jb3-1	15.000	99999.0	0	0	0	0	0	0	0	0	8.810	80.8	336.0	0.3
B-1-Jb1-Jb3-2	15.000	99999.0	0	0	0	0	0	0	0	0	8.812	80.8	336.0	0.3
B-10-Bre-Gso-1	110.000	99999.0	0	0	0	0	0	0	0	0	60.702	98.0	316.3	0.3
B-10-Bre-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	112.291	96.4	585.1	0.6
B-10-Bre-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	111.166	96.8	585.5	0.6
B-10-Bre-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	60.407	98.1	316.6	0.3
B-10-Bre-Sha-1D	110.000	99999.0	0	0	0	0	0	0	0	0	99.094	96.6	516.3	0.5
B-10-Bre-Sha-1DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	99.094	96.6	516.3	0.5
B-10-Bre-Sha-2D	110.000	99999.0	0	0	0	0	0	0	0	0	99.303	96.6	515.0	0.5
B-10-Bre-Sha-2DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	99.303	96.6	515.0	0.5
B-10-Gha-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	8.223	93.7	43.9	0.0
B-10-Gha-MKi-2	110.000	99999.0	0	0	0	0	0	0	0	0	8.158	94.6	43.5	0.0
B-10-Gko-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	54.911	94.2	292.8	0.3
B-10-Gko-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	55.507	93.8	292.3	0.3
B-10-Gko-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	1.975	29.8	10.5	0.0
B-10-Gko-MKi-2	110.000	645.0	0	0	0	0	0	0	0	0	1.826	32.2	9.7	1.5
B-10-Gso-Msh-1	110.000		0	0	0	0	0	0	0	0	73.719	98.3	391.0	
B-10-Gso-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	72.726	98.8	391.7	0.4
B-10-Gso-Nde-1	110.000	99999.0	0	0	0	0	0	0	0	0	91.361	97.5	484.6	0.5
B-10-Gso-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	92.401	97.2	484.2	0.5
B-10-Jb-Grid-1	110.000		0	0	0	0	0	0	0	0	12.207	81.9	64.3	
B-10-Jb1-Jb2-1	110.000	99999.0	0	0	0	0	0	0	0	0	22.843	81.0	120.3	0.1
B-10-Jb1-Jb2-2	110.000	99999.0	0	0	0	0	0	0	0	0	22.839	81.0	120.2	0.1
B-10-Jb1-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	43.698	94.3	230.1	0.2
B-10-Jb1-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	43.416	94.5	230.5	0.2
B-10-Kba-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	29.380	98.6	158.3	0.2
B-10-Kba-Rwi-2	110.000	99999.0	0	0	0	0	0	0	0	0	10.935	94.1	60.2	0.1
B-10-Mki-Grid-1	110.000		0	0	0	0	0	0	0	0	18.028	83.2	96.1	
B-10-MKi-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	25.425	95.2	135.0	0.1
B-10-MKi-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	25.384	95.1	135.3	0.1
B-20-Sha-Grid-1	220.000		0	0	0	0	0	0	0	0	204.945	93.8	537.8	
Bre-1-B-1	15.000	2000.0	3.525	1.159	20.100	6.607	0	0	0	0	24.869	95.0	954.2	47.7
Bre-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	198.188	96.6	1032.6	32.8
C-BN	110.000		0	0	0	0	0	0	0	0	60.447	98.1	316.4	
C-GN	110.000		0	0	0	0	0	0	0	0	92.261	97.2	484.4	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
C-Kab-3-B	30.000		0	0	0	-5.964	0	0	0	0	5.964	0.0	115.1	
C-Msh-1-B	15.000		0	0	0	-10.066	0	0	0	0	10.066	0.0	386.2	
C-Rwi-B-1	15.000		0	0	0	0	0	0	0	0	0	0.0	0.0	
G-Jb2-10-B	110.000	99999.0	0	0	0	0	0	0	0	0	22.839	81.0	120.2	0.1
G-Jb3-1-B	15.000	99999.0	0	0	0	0	0	0	0	0	8.812	80.8	336.0	0.3
G-Kse-1-B2	110.000	99999.0	0	0	0	0	0	0	0	0	52.896	94.3	277.2	0.3
Gha-1-B-1	15.000	800.0	1.140	0.375	6.550	2.153	0	0	0	0	8.095	95.0	309.4	38.7
Gha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	8.223	93.7	43.9	1.4
Gko-1-B-1	15.000	2500.0	10.040	3.300	40.954	13.461	0	0	0	0	53.678	95.0	2045.9	81.8
Gko-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	55.573	93.1	296.4	9.4
Gso-1-B-1	15.000	2000.0	2.475	0.813	14.135	4.646	0	0	0	0	17.484	95.0	670.3	33.5
Gso-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	91.361	97.5	484.6	15.4
Jb1-1-B-1	15.000	2500.0	7.350	2.416	42.427	13.945	0	0	0	0	52.397	95.0	1998.2	79.9
Jb1-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	144.406	94.3	760.5	24.1
Jb2-.6-B-1	6.600	3150.0	0	0	0	0	0	0	0	0	24.084	77.2	2003.1	63.6
Jb2-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	22.839	81.0	120.2	3.8
Jb2-10-B-2	110.000	3150.0	0	0	0	0	0	0	0	0	22.839	81.0	120.2	3.8
Jb3-1-B-1	15.000	800.0	0	0	0	0	0	0	0	0	8.812	80.8	336.0	42.0
Jb3-1-B-2	15.000	800.0	0	0	0	0	0	0	0	0	8.812	80.8	336.0	42.0
Jb3-1-B-2d	15.000	410.0	0	0	0	0	0	0	0	0	4.406	80.8	168.0	41.0
Kba-3-B-1	30.000	800.0	1.820	0.598	16.281	5.351	0	0	0	0	19.058	95.0	367.9	46.0
Kba-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	18.257	99.7	100.3	3.2
Kse-1-B-5	11.000	3150.0	0	0	0	0	0	0	0	0	42.602	93.9	2170.9	68.9
Kse-1-B-6	11.000	3150.0	0	0	0	0	0	0	0	0	12.500	80.0	624.6	19.8
Kse-10-B3	110.000	3150.0	0	0	0	0	0	0	0	0	52.896	94.3	277.2	8.8
MKi-1-B-1	15.000	2000.0	2.070	0.680	11.931	3.922	0	0	0	0	14.738	95.0	562.5	28.1
MKi-3-B-1	30.000	2000.0	2.685	0.883	15.183	4.990	0	0	0	0	18.809	95.0	362.4	18.1
MKi-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	43.553	91.2	232.2	7.4
Msh-1-B-1	15.000	2000.0	5.250	1.726	29.948	9.843	0	0	0	0	37.050	95.0	1421.3	71.1
Msh-10-B-1	110.000	3150.0	0.790	0.260	6.751	2.219	0	0	0	0	72.726	98.8	391.7	12.4
N-Jb3-.04-1	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
N-Jb3-.04-2	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
N-Jb3-.04-3	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
N-Jb3-.04-4	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
N-Jb3-.04-5	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
N-Jb3-.04-6	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2185.2	
Nbg-1-B-1	15.000	2500.0	2.475	0.813	14.338	4.713	0	0	0	0	17.698	95.0	673.7	26.9
Nbg-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	43.416	94.5	230.5	7.3

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Nde-1-B-1	15.000	2500.0	2.865	0.942	16.450	5.407	0	0	0	0	20.331	95.0	777.4	31.1
Nde-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	113.005	96.6	592.2	18.8
Rwi-1-B-1	15.000	800.0	0.540	0.177	4.771	1.568	0	0	0	0	5.591	95.0	217.2	27.1
Rwi-10-B-1	110.000	3150.0	0.540	0.177	4.411	1.450	0	0	0	0	10.935	94.1	60.2	1.9
Sha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	198.605	96.6	1030.0	32.7
Sha-20-B-1	220.000	3150.0	0	0	0	0	0	0	0	0	204.945	93.8	537.8	17.1

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
					Capability	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	(MVA)	MVA	%	MVA	%
1-Jb1-Jb3	Cable	480.37	335.96	69.94					
10-Bre-Jb1-R(D/C)	Line	1162.00	585.48	50.39					
10-Bre-Nde-1R(S/C)	Line	581.00	316.39	54.46					
10-Bre-Nde-2(S/C)	Line	581.00	316.56	54.49					
10-Bre-Sha-1	Line	1162.00	516.30	44.43					
10-Bre-Sha-2	Line	1162.00	516.30	44.43					
10-Gha-MKi(S/C)	Line	581.00	43.91	7.56					
10-Gko-Jb1(S/C)	Line	581.00	292.83	50.40					
10-Gko-MKi(S/C)	Line	581.00	10.53	1.81					
10-Gso-Msh-R(D/C)	Line	581.00	391.73	67.42					
10-Gso-Nde-1R(S/C)	Line	581.00	484.61	83.41					
10-Gso-Nde-2(S/C)	Line	581.00	484.42	83.38					
10-Jb1-Jb2(S/C)	Line	581.00	120.31	20.71					
10-Jb1-Nbg(S/C)	Line	581.00	230.55	39.68					
10-Kba-Msh(S/C)	Line	443.00	158.94	35.88					
10-Kba-Rwi(S/C)	Line	443.00	60.25	13.60					
10-MKi-Nbg(S/C)	Line	581.00	135.32	23.29					
Bre-10/1-T-1	Transformer				20.000	12.742	63.7	12.434	62.2
Bre-10/1-T-1F	Transformer				20.000	12.742	63.7	12.434	62.2
Gha-10/1-T-1n	Transformer				20.000	8.223	41.1	8.095	40.5
Gko-10/1-T-1	Transformer				15.000	11.038	73.6	10.767	71.8
Gko-10/1-T-1F	Transformer				30.000	22.075	73.6	21.534	71.8
Gko-10/1-T-2	Transformer				15.000	11.121	74.1	10.849	72.3
Gko-10/1-T-3	Transformer				15.000	10.798	72.0	10.533	70.2
Gso-10/1-T-1F	Transformer				15.000	8.947	59.6	8.742	58.3
Gso-10/1-T-2F	Transformer				15.000	8.947	59.6	8.742	58.3
Jb1-10/1-T-1	Transformer				10.000	7.195	72.0	7.018	70.2
Jb1-10/1-T-2	Transformer				10.000	7.195	72.0	7.018	70.2
Jb1-10/1-T-F1	Transformer				20.000	15.412	77.1	15.033	75.2
Jb1-10/1-T-F2	Transformer				20.000	15.412	77.1	15.033	75.2
Jb2-10/.6-TG-1	Transformer				15.000	12.042	80.3	11.420	76.1
Jb2-10/.6-TG-2	Transformer				15.000	12.042	80.3	11.420	76.1
Jb3-1/0-TG-1	Transformer				1.625	1.531	94.2	1.469	90.4

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Jb3-1/0-TG-2	Transformer				1.625	1.531	94.2	1.469	90.4
Jb3-1/0-TG-3	Transformer				1.625	1.531	94.2	1.469	90.4
Jb3-1/0-TG-4	Transformer				1.625	1.531	94.2	1.469	90.4
Jb3-1/0-TG-5	Transformer				1.625	1.531	94.2	1.469	90.4
Jb3-1/0-TG-6	Transformer				1.625	1.531	94.2	1.469	90.4
Kba-10/3-T-1	Transformer				10.000	9.129	91.3	9.051	90.5
Kba-10/3-T-2	Transformer				10.000	9.129	91.3	9.051	90.5
Kse-10/1-TG-1n2	Transformer				62.500	42.602	68.2	41.427	66.3
Kse-10/1-TG-2n2	Transformer				15.000	12.500	83.3	11.919	79.5
MKi-10/1-T-1	Transformer				20.000	15.177	75.9	14.738	73.7
MKi-10/3-T-1	Transformer				20.000	19.555	97.8	18.809	94.0
Msh-10/1-T-1	Transformer				10.000	6.727	67.3	6.667	66.7
Msh-10/1-T-1F	Transformer				20.000	14.410	72.1	14.281	71.4
Msh-10/1-T-2F	Transformer				20.000	14.410	72.1	14.281	71.4
Nbg-10/1-T-1n	Transformer				20.000	9.001	45.0	8.849	44.2
Nbg-10/1-T-2n	Transformer				20.000	9.001	45.0	8.849	44.2
Nde-10/1-T-1n	Transformer				20.000	10.370	51.9	10.166	50.8
Nde-10/1-T-2n	Transformer				20.000	10.370	51.9	10.166	50.8
Rwi-10/1-T-1n	Transformer				10.000	5.728	57.3	5.591	55.9
Sha-20/10-T-1n	Transformer				90.000	68.315	75.9	66.202	73.6
Sha-20/10-T-2n	Transformer				90.000	68.315	75.9	66.202	73.6
Sha-20/10-T-3n	Transformer				90.000	68.315	75.9	66.202	73.6

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
10-Kba-Msh(S/C)	-28.514	-4.878	28.956	4.973	442.2	94.3	95.5	97.4	1.91
10-Kba-Rwi(S/C)	10.307	3.521	-10.287	-3.706	19.4	-185.7	95.5	95.3	0.27
1-Jb1-Jb3	-7.115	-5.195	7.116	5.197	1.6	1.5	100.9	101.0	0.02
10-Bre-Nde-1R(S/C)	59.496	12.044	-59.322	-11.610	174.0	433.5	100.7	100.3	0.46
10-Bre-Jb1-R(D/C)	108.207	30.008	-107.649	-27.742	558.6	2266.3	100.7	99.7	1.08
10-Bre-Nde-2(S/C)	-59.274	-11.649	59.322	11.610	47.9	-38.7	100.2	100.3	0.12
10-Bre-Sha-2	-95.701	-25.711	95.949	25.587	248.8	-123.8	100.7	101.2	0.47
10-Bre-Sha-1	-95.701	-25.711	95.949	25.587	248.8	-123.8	100.7	101.2	0.47
10-Gha-MKi(S/C)	-7.707	-2.866	7.714	2.656	6.6	-210.1	98.3	98.5	0.16
10-Gko-Jb1(S/C)	-51.722	-18.443	52.060	19.255	338.7	811.6	98.4	99.7	1.23
10-Gko-MKi(S/C)	0.589	-1.886	-0.588	1.728	0.2	-157.4	98.4	98.5	0.03
10-Gso-Msh-R(D/C)	72.452	13.610	-71.819	-11.450	632.9	2160.7	98.9	97.4	1.51
10-Gso-Nde-1R(S/C)	-89.115	-20.130	89.666	21.728	551.1	1598.2	98.9	100.0	1.02
10-Gso-Nde-2(S/C)	89.779	21.858	-89.666	-21.728	112.2	129.2	100.2	100.0	0.19
10-Jb1-Jb2(S/C)	-18.492	-13.411	18.500	13.394	7.5	-17.0	99.7	99.7	0.08
10-Jb1-Nbg(S/C)	41.228	14.484	-41.048	-14.142	179.9	342.3	99.7	98.8	0.82
10-MKi-Nbg(S/C)	24.195	7.812	-24.144	-7.838	50.8	-25.9	98.8	98.5	0.38
Bre-10/1-T-1	-11.813	-3.883	11.849	4.685	36.5	802.8	100.3	100.7	0.42
Bre-10/1-T-1F	-11.813	-3.883	11.849	4.685	36.5	802.8	100.3	100.7	0.42
Gha-10/1-T-1n	-7.690	-2.528	7.707	2.866	16.9	338.9	100.7	98.3	2.40
Gko-10/1-T-1	-10.265	-3.249	10.301	3.964	35.8	715.3	101.0	98.4	2.56
Gko-10/1-T-1F	-20.342	-7.065	20.374	8.497	31.8	1432.0	101.0	98.4	2.56
Gko-10/1-T-2	-10.345	-3.268	10.381	3.989	36.0	720.6	101.0	98.4	2.56
Gko-10/1-T-3	-10.042	-3.178	10.077	3.878	35.0	699.8	101.0	98.4	2.56
Gso-10/1-T-1F	-8.305	-2.730	8.332	3.260	26.5	530.2	100.4	98.9	1.44
Gso-10/1-T-2F	-8.305	-2.730	8.332	3.260	26.5	530.2	100.4	98.9	1.44
Jb1-10/1-T-1	-6.821	-1.653	6.861	2.169	39.7	516.3	100.9	99.7	1.27
Jb1-10/1-T-2	-6.821	-1.653	6.861	2.169	39.7	516.3	100.9	99.7	1.27
Jb1-10/1-T-F1	-14.510	-3.930	14.566	5.038	55.4	1107.9	100.9	99.7	1.27
Jb1-10/1-T-F2	-14.510	-3.930	14.566	5.038	55.4	1107.9	100.9	99.7	1.27
Jb2-10/.6-TG-1	9.300	7.650	-9.250	-6.697	50.2	953.0	105.2	99.7	5.44
Jb2-10/.6-TG-2	9.300	7.650	-9.250	-6.697	50.2	953.0	105.2	99.7	5.44
Jb3-1/0-TG-1	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25
Jb3-1/0-TG-2	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25
Jb3-1/0-TG-3	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Jb3-1/0-TG-4	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25
Jb3-1/0-TG-5	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25
Jb3-1/0-TG-6	-1.186	-0.866	1.200	0.950	14.0	83.9	101.0	101.1	4.25
Kba-10/3-T-1	-9.051	0.007	9.103	0.679	52.8	686.1	99.7	95.5	4.17
Kba-10/3-T-2	-9.051	0.007	9.103	0.679	52.8	686.1	99.7	95.5	4.17
Kse-10/1-TG-1n2	40.000	14.661	-39.920	-11.070	79.8	3591.7	103.0	100.2	2.84
Kse-10/1-TG-2n2	10.000	7.500	-9.953	-6.557	47.1	942.9	105.0	100.2	4.88
MKi-10/1-T-1	-14.001	-4.602	14.057	5.722	56.0	1119.7	100.9	98.5	2.40
MKi-10/3-T-1	-17.868	-5.873	17.961	7.732	92.9	1858.8	99.9	98.5	1.44
Msh-10/1-T-1	-6.661	-0.284	6.685	0.757	23.6	472.4	100.3	97.4	2.89
Msh-10/1-T-1F	-14.268	-0.609	14.319	1.621	50.6	1011.8	100.3	97.4	2.89
Msh-10/1-T-2F	-14.268	-0.609	14.319	1.621	50.6	1011.8	100.3	97.4	2.89
Nbg-10/1-T-1n	-8.407	-2.763	8.427	3.165	20.1	401.6	101.1	98.8	2.27
Nbg-10/1-T-2n	-8.407	-2.763	8.427	3.165	20.1	401.6	101.1	98.8	2.27
Nde-10/1-T-1n	-9.657	-3.174	9.684	3.709	26.7	534.8	100.7	100.2	0.50
Nde-10/1-T-2n	-9.657	-3.174	9.684	3.709	26.7	534.8	100.7	100.2	0.50
Rwi-10/1-T-1n	-5.311	-1.746	5.337	2.079	25.6	333.3	99.1	95.3	3.82
Sha-20/10-T-1n	-63.966	-17.058	64.111	23.594	145.2	6535.3	101.2	100.0	1.21
Sha-20/10-T-2n	-63.966	-17.058	64.111	23.594	145.2	6535.3	101.2	100.0	1.21
Sha-20/10-T-3n	-63.966	-17.058	64.111	23.594	145.2	6535.3	101.2	100.0	1.21
					5338.4	52378.3			

Alert Summary Report

	% Alert Settings
	Critical
Loading	
Bus	100.0
Cable	100.0
Reactor	100.0
Line	100.0
Transformer	100.0
Panel	100.0
Protective Device	100.0
Generator	101.0
Inverter/Charger	100.0
Bus Voltage	
OverVoltage	105.0
UnderVoltage	95.0
Generator Excitation	
OverExcited (Q Max.)	101.0
UnderExcited (Q Min.)	100.0

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Jb2-.6-B-1	Bus	Over Voltage	6.600	kV	6.942	105.2	3-Phase
Kse-1-B-6	Bus	Over Voltage	11.000	kV	11.555	105.0	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	192.335	70.781	204.945	93.85 Lagging
Source (Non-Swing Buses):	100.800	60.161	117.388	85.87 Lagging
Total Demand:	293.135	130.942	321.051	91.30 Lagging
Total Motor Load:	43.565	14.319	45.858	95.00 Lagging
Total Static Load:	244.231	64.245	252.540	96.71 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	5.338	52.378		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

2. 潮流計算報告書

5) 2028 年断面（詳細）

Electrical Transient Analyzer Program

Load Flow Analysis

Loading Category (1): Design

Generation Category (1): Grid Balance

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	1	11	68	80

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	40	0	0	17	0	42	99

Method of Solution:	Newton-Raphson Method
Maximum No. of Iteration:	9999
Precision of Solution:	0.0001000
System Frequency:	50.00 Hz
Unit System:	Metric
Project Filename:	Rwanda-Imp SSs Ph 2
Output Filename:	C:\Users\3010\Documents\ SugarSync Business\ 2 \Rwanda ETAP Project File\R-LF-2028.lfr

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Bus Input Data

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
10-Kba/Msh/Rwi-B	110.000	1	100.0	0.0								
B-1-Jb1-Jb3-1	15.000	1	100.0	0.0								
B-1-Jb1-Jb3-2	15.000	1	100.0	0.0								
B-10-Bre-Gso-1	110.000	1	100.0	0.0								
B-10-Bre-Jb1-1	110.000	1	100.0	0.0								
B-10-Bre-Jb1-2	110.000	1	100.0	0.0								
B-10-Bre-Nde-2	110.000	1	100.0	0.0								
B-10-Bre-Sha-1D	110.000	1	100.0	0.0								
B-10-Bre-Sha-1DT-F	110.000	1	100.0	0.0								
B-10-Bre-Sha-2D	110.000	1	100.0	0.0								
B-10-Bre-Sha-2DT-F	110.000	1	100.0	0.0								
B-10-Gha-MKi-1	110.000	1	100.0	0.0								
B-10-Gha-MKi-2	110.000	1	100.0	0.0								
B-10-Gko-Jb1-1	110.000	1	100.0	0.0								
B-10-Gko-Jb1-2	110.000	1	100.0	0.0								
B-10-Gko-MKi-1	110.000	1	100.0	0.0								
B-10-Gko-MKi-2	110.000	1	100.0	0.0								
B-10-Gso-Msh-1	110.000	1	100.0	0.0								
B-10-Gso-Msh-2	110.000	1	100.0	0.0								
B-10-Gso-Nde-1	110.000	1	100.0	0.0								
B-10-Gso-Nde-2	110.000	1	100.0	0.0								
B-10-Jb-Grid-1	110.000	1	100.0	0.0								
B-10-Jb1-Jb2-1	110.000	1	100.0	0.0								
B-10-Jb1-Jb2-2	110.000	1	100.0	0.0								
B-10-Jb1-Nbg-1	110.000	1	100.0	0.0								
B-10-Jb1-Nbg-2	110.000	1	100.0	0.0								
B-10-Kba-Msh-2	110.000	1	100.0	0.0								
B-10-Kba-Rwi-2	110.000	1	100.0	0.0								
B-10-Mki-Grid-1	110.000	1	100.0	0.0								
B-10-MKi-Nbg-1	110.000	1	100.0	0.0								
B-10-MKi-Nbg-2	110.000	1	100.0	0.0								
B-20-Sha-Grid-1	220.000	1	100.0	0.0								
Bre-1-B-1	15.000	1	100.0	0.0	5.600	1.840	22.400	7.360				

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
Bre-10-B-1	110.000	1	100.0	0.0								
C-BN	110.000	1	100.0	0.0								
C-GN	110.000	1	100.0	0.0								
C-Kab-3-B	30.000	1	100.0	0.0			0.000	-6.000				
C-Msh-1-B	15.000	1	100.0	0.0			0.000	-10.000				
C-Rwi-B-1	15.000	1	100.0	0.0			0.000	-1.000				
G-Jb2-10-B	110.000	1	100.0	0.0								
G-Jb3-1-B	15.000	1	100.0	0.0								
G-Kse-1-B2	110.000	1	100.0	0.0								
Gha-1-B-1	15.000	1	100.0	0.0	1.365	0.449	7.735	2.542				
Gha-10-B-1	110.000	1	100.0	0.0								
Gko-1-B-1	15.000	1	100.0	0.0	11.960	3.931	47.840	15.724				
Gko-10-B-1	110.000	1	100.0	0.0								
Gso-1-B-1	15.000	1	100.0	0.0	2.940	0.966	16.660	5.476				
Gso-10-B-1	110.000	1	100.0	0.0								
Jb1-1-B-1	15.000	1	100.0	0.0	8.745	2.874	49.555	16.288				
Jb1-10-B-1	110.000	1	100.0	0.0								
Jb2-.6-B-1	6.600	1	103.0	0.0								
Jb2-10-B-1	110.000	1	100.0	0.0								
Jb2-10-B-2	110.000	1	100.0	0.0								
Jb3-1-B-1	15.000	1	100.0	0.0								
Jb3-1-B-2	15.000	1	100.0	0.0								
Jb3-1-B-2d	15.000	1	100.0	0.0								
Kba-3-B-1	30.000	1	100.0	0.0	2.140	0.703	19.260	6.330				
Kba-10-B-1	110.000	1	100.0	0.0								
Kse-1-B-5	11.000	1	103.0	0.0								
Kse-1-B-6	11.000	1	103.0	0.0								
Kse-10-B3	110.000	1	100.0	0.0								
MKi-1-B-1	15.000	1	100.0	0.0	2.475	0.813	14.025	4.610				
MKi-3-B-1	30.000	1	100.0	0.0	3.195	1.050	18.105	5.951				
MKi-10-B-1	110.000	1	100.0	0.0								
Msh-1-B-1	15.000	1	100.0	0.0	6.150	2.021	34.850	11.455				
Msh-10-B-1	110.000	1	100.0	0.0	0.920	0.302	8.280	2.722				
N-Jb3-.04-1	0.400	1	103.0	0.0								
N-Jb3-.04-2	0.400	1	103.0	0.0								

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
N-Jb3-.04-3	0.400	1	103.0	0.0								
N-Jb3-.04-4	0.400	1	103.0	0.0								
N-Jb3-.04-5	0.400	1	103.0	0.0								
N-Jb3-.04-6	0.400	1	103.0	0.0								
Nbg-1-B-1	15.000	1	100.0	0.0	2.940	0.966	16.660	5.476				
Nbg-10-B-1	110.000	1	100.0	0.0								
Nde-1-B-1	15.000	1	100.0	0.0	3.405	1.119	19.295	6.342				
Nde-10-B-1	110.000	1	100.0	0.0								
Rwi-1-B-1	15.000	1	100.0	0.0	0.630	0.207	5.670	1.864				
Rwi-10-B-1	110.000	1	100.0	0.0	0.630	0.207	5.670	1.864				
Sha-10-B-1	110.000	1	100.0	0.0								
Sha-20-B-1	220.000	1	100.0	0.0								
Total Number of Buses: 80					53.095	17.451	286.005	77.003	0.000	0.000	0.000	0.000

Generation Bus				Voltage		Generation			Mvar Limits	
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Min
B-10-Jb-Grid-1	110.000	Voltage Control	1	100.0	0.0	10.000			7.000	0.000
B-10-Mki-Grid-1	110.000	Voltage Control	1	100.0	0.0	15.000			10.000	0.000
B-20-Sha-Grid-1	220.000	Swing	1	100.0	0.0					
Jb2-.6-B-1	6.600	Voltage Control	1	103.0	0.0	18.600			15.300	0.000
Kse-1-B-5	11.000	Voltage Control	1	103.0	0.0	40.000			30.000	0.000
Kse-1-B-6	11.000	Voltage Control	1	103.0	0.0	10.000			7.500	0.000
N-Jb3-.04-1	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-2	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-3	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-4	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-5	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
N-Jb3-.04-6	0.400	Voltage Control	1	103.0	0.0	1.200			0.950	0.000
						100.800	0.000			

Line/Cable Input Data

Line/Cable	Ohms or Siemens/1000 m per Conductor (Cable) or per Phase (Line)								
			Length						
ID	Library	Size	Adj. (m)	% Tol.	#/Phase	T (°C)	R	X	Y
1-Jb1-Jb3	15NCUS3	240	50.0	0.0	1	75	0.094138	0.089300	
10-Bre-Jb1-R(D/C)		282.	7500.0	0.0	2	75	0.072473	0.334693	0.0000034
10-Bre-Nde-1R(S/C)		282.	4000.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Bre-Nde-2(S/C)		282.	2200.0	0.0	1	75	0.072450	0.188633	0.0000061
10-Bre-Sha-1		282.	8600.0	0.0	2	75	0.036268	0.124622	0.0000092
10-Bre-Sha-2		282.	8600.0	0.0	2	75	0.036268	0.124622	0.0000092
10-Gha-MKi(S/C)		282.	7900.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gko-Jb1(S/C)		282.	9100.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gko-MKi(S/C)		282.	5400.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gso-Msh-R(D/C)		282.	19000.0	0.0	2	75	0.072473	0.334693	0.0000034
10-Gso-Nde-1R(S/C)		282.	5400.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Gso-Nde-2(S/C)		282.	2200.0	0.0	1	75	0.072450	0.188633	0.0000061
10-Jb1-Jb2(S/C)		282.	1200.0	0.0	1	75	0.144906	0.426513	0.0000027
10-Jb1-Nbg(S/C)		282.	7800.0	0.0	1	75	0.144920	0.462685	0.0000025
10-Kba-Msh-R(D/C)		282.	25200.0	0.0	2	75	0.072473	0.334693	0.0000034
10-Kba-Rwi(S/C)		176.	7700.0	0.0	1	75	0.232506	0.441167	0.0000026
10-MKi-Nbg(S/C)		282.	6400.0	0.0	1	75	0.144920	0.462685	0.0000025

Line / Cable resistances are listed at the specified temperatures.

2-Winding Transformer Input Data

Transformer		Rating					Z Variation			% Tap Setting		Adjusted	Phase Shift	
ID	Phase	MVA	Prim. kV	Sec. kV	% Z1	X1/R1	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
Bre-10/1-T-1	3-Phase	20.000	110.000	15.000	10.46	22.00	0	0	0	0	0	10.4600	YNyn	0.000
Bre-10/1-T-1F	3-Phase	20.000	110.000	15.000	10.46	22.00	0	0	0	0	0	10.4600	YNyn	0.000
Gha-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Gko-10/1-T-1	3-Phase	15.000	110.000	15.000	9.00	20.00	0	0	5.0	0	0	9.4500	YNyn	0.000
Gko-10/1-T-1F	3-Phase	30.000	110.000	15.000	9.00	45.00	0	0	5.0	0	0	9.4500	YNyn	0.000
Gko-10/1-T-2	3-Phase	15.000	110.000	15.000	8.93	20.00	0	0	5.0	0	0	9.3765	YNyn	0.000
Gko-10/1-T-3	3-Phase	15.000	110.000	15.000	9.20	20.00	0	0	5.0	0	0	9.6600	YNyn	0.000
Gso-10/1-T-1F	3-Phase	15.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Gso-10/1-T-2F	3-Phase	15.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Jb1-10/1-T-1	3-Phase	10.000	110.000	15.000	10.20	13.00	0	0	5.0	0	0	10.7100	YNyn	0.000
Jb1-10/1-T-2	3-Phase	10.000	110.000	15.000	10.20	13.00	0	0	5.0	0	0	10.7100	YNyn	0.000
Jb1-10/1-T-F1	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	0	0	0	10.0000	YNyn	0.000
Jb1-10/1-T-F2	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	0	0	0	10.0000	YNyn	0.000
Jb2-10/.6-TG-1	3-Phase	15.000	110.000	6.600	10.40	19.00	0	0	5.0	0	0	10.9200	YNd	0.000
Jb2-10/.6-TG-2	3-Phase	15.000	110.000	6.600	10.40	19.00	0	0	5.0	0	0	10.9200	YNd	0.000
Jb3-1/0-TG-1	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-2	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-3	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-4	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-5	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Jb3-1/0-TG-6	3-Phase	1.625	15.610	0.400	5.74	6.00	0	0	5.0	0	0	6.0270	YNd	0.000
Kba-10/3-T-1	3-Phase	10.000	110.000	30.000	8.35	13.00	0	0	0	0	0	8.3500	YNyn	0.000
Kba-10/3-T-2	3-Phase	10.000	110.000	30.000	8.35	13.00	0	0	0	0	0	8.3500	YNyn	0.000
Kba-10/3-T-3	3-Phase	10.000	110.000	30.000	8.35	13.00	0	0	0	0	0	8.3500	YNyn	0.000
Kse-10/1-TG-1n2	3-Phase	62.500	110.000	11.000	12.50	45.00	0	0	5.0	0	0	13.1250	YNd	0.000
Kse-10/1-TG-2n2	3-Phase	15.000	110.000	11.000	10.00	20.00	0	0	0	0	0	10.0000	YNd	0.000
MKi-10/1-T-1	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
MKi-10/3-T-1	3-Phase	20.000	110.000	30.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
MKi-10/3-T-2	3-Phase	20.000	110.000	30.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Msh-10/1-T-1	3-Phase	10.000	110.000	15.000	10.20	20.00	0	0	5.0	0	0	10.7100	YNd	0.000
Msh-10/1-T-1F	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	0	0	0	10.0000	YNd	0.000
Msh-10/1-T-2F	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	0	0	0	10.0000	YNd	0.000
Nbg-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Nbg-10/1-T-2n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000

Transformer		Rating					Z Variation			% Tap Setting		Adjusted	Phase Shift	
ID	Phase	MVA	Prim. kV	Sec. kV	% Z1	X1/R1	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
Nde-10/1-T-1n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Nde-10/1-T-2n	3-Phase	20.000	110.000	15.000	10.00	20.00	0	0	5.0	0	0	10.5000	YNyn	0.000
Rwi-10/1-T-1n	3-Phase	10.000	110.000	15.000	10.00	13.00	0	0	5.0	0	0	10.5000	YNd	0.000
Sha-20/10-T-1n	3-Phase	90.000	220.000	110.000	12.50	45.00	0	0	10.0	0	0	13.7500	YNd	0.000
Sha-20/10-T-2n	3-Phase	90.000	220.000	110.000	12.50	45.00	0	0	10.0	0	0	13.7500	YNd	0.000
Sha-20/10-T-3n	3-Phase	90.000	220.000	110.000	12.50	45.00	0	0	10.0	0	0	13.7500	YNd	0.000

2-Winding Transformer Load Tap Changer (LTC) Settings

Transformer	Connected Buses ("*" LTC Side)		Transformer Load Tap Changer Setting					
ID	Primary Bus ID	Secondary Bus ID	% Min. Tap	% Max. Tap	% Step	Regulated Bus ID	% V	kV
Bre-10/1-T-1	* Bre-10-B-1	Bre-1-B-1	-10.00	14.00	1.000	Bre-1-B-1	100.00	15.000
Bre-10/1-T-1F	* Bre-10-B-1	Bre-1-B-1	-10.00	14.00	1.000	Bre-1-B-1	100.00	15.000
Gha-10/1-T-1n	* Gha-10-B-1	Gha-1-B-1	-16.00	16.00	1.300	Gha-1-B-1	100.00	15.000
Gko-10/1-T-1	* Gko-10-B-1	Gko-1-B-1	-16.00	16.00	1.231	Gko-1-B-1	100.00	15.000
Gko-10/1-T-1F	* Gko-10-B-1	Gko-1-B-1	-16.00	16.09	1.231	Gko-1-B-1	100.00	15.000
Gko-10/1-T-2	* Gko-10-B-1	Gko-1-B-1	-15.99	16.00	1.230	Gko-1-B-1	100.00	15.000
Gko-10/1-T-3	* Gko-10-B-1	Gko-1-B-1	-16.00	16.09	1.231	Gko-1-B-1	100.00	15.000
Gso-10/1-T-1F	* Gso-10-B-1	Gso-1-B-1	-16.00	16.00	1.230	Gso-1-B-1	100.00	15.000
Gso-10/1-T-2F	* Gso-10-B-1	Gso-1-B-1	-16.00	16.00	1.230	Gso-1-B-1	100.00	15.000
Jb1-10/1-T-1	* Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Jb1-10/1-T-2	* Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Jb1-10/1-T-F1	* Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Jb1-10/1-T-F2	* Jb1-10-B-1	Jb1-1-B-1	-16.00	16.00	1.230	Jb1-1-B-1	100.00	15.000
Kba-10/3-T-1	* Kba-10-B-1	Kba-3-B-1	-8.00	8.00	1.000	Kba-3-B-1	100.00	30.000
Kba-10/3-T-2	* Kba-10-B-1	Kba-3-B-1	-8.00	8.00	1.000	Kba-3-B-1	100.00	30.000
Kba-10/3-T-3	* Kba-10-B-1	Kba-3-B-1	-8.00	8.00	1.000	Kba-3-B-1	100.00	30.000
MKi-10/1-T-1	* MKi-10-B-1	MKi-1-B-1	-16.00	16.00	1.300	MKi-1-B-1	100.00	15.000
MKi-10/3-T-1	* MKi-10-B-1	MKi-3-B-1	-16.00	16.00	1.300	MKi-3-B-1	100.00	30.000
MKi-10/3-T-2	* MKi-10-B-1	MKi-3-B-1	-16.00	16.00	1.300	MKi-3-B-1	100.00	30.000
Msh-10/1-T-1	* Msh-10-B-1	Msh-1-B-1	-10.00	10.00	1.250	Msh-1-B-1	100.00	15.000
Msh-10/1-T-1F	* Msh-10-B-1	Msh-1-B-1	-10.00	10.00	1.250	Msh-1-B-1	100.00	15.000
Msh-10/1-T-2F	* Msh-10-B-1	Msh-1-B-1	-10.00	10.00	1.250	Msh-1-B-1	100.00	15.000
Nbg-10/1-T-1n	* Nbg-10-B-1	Nbg-1-B-1	-16.00	16.00	1.300	Nbg-1-B-1	100.00	15.000
Nbg-10/1-T-2n	* Nbg-10-B-1	Nbg-1-B-1	-16.00	16.00	1.300	Nbg-1-B-1	100.00	15.000
Nde-10/1-T-1n	* Nde-10-B-1	Nde-1-B-1	-16.00	16.00	1.230	Nde-1-B-1	100.00	15.000

2-Winding Transformer Load Tap Changer (LTC) Settings

Transformer	Connected Buses ("*" LTC Side)		Transformer Load Tap Changer Setting					
ID	Primary Bus ID	Secondary Bus ID	% Min. Tap	% Max. Tap	% Step	Regulated Bus ID	% V	kV
Nde-10/1-T-2n	*Nde-10-B-1	Nde-1-B-1	-16.00	16.00	1.230	Nde-1-B-1	100.00	15.000
Rwi-10/1-T-1n	*Rwi-10-B-1	Rwi-1-B-1	-16.00	16.00	1.230	Rwi-1-B-1	100.00	15.000
Sha-20/10-T-1n	*Sha-20-B-1	Sha-10-B-1	-10.00	10.00	0.850	Sha-10-B-1	102.00	112.200
Sha-20/10-T-2n	*Sha-20-B-1	Sha-10-B-1	-10.00	10.00	0.850	Sha-10-B-1	102.00	112.200
Sha-20/10-T-3n	*Sha-20-B-1	Sha-10-B-1	-10.00	10.00	0.850	Sha-10-B-1	102.00	112.200

Branch Connections

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
Bre-10/1-T-1	2W XFMR	Bre-10-B-1	Bre-1-B-1	2.37	52.25	52.30	
Bre-10/1-T-1F	2W XFMR	Bre-10-B-1	Bre-1-B-1	2.37	52.25	52.30	
Gha-10/1-T-1n	2W XFMR	Gha-10-B-1	Gha-1-B-1	2.62	52.43	52.50	
Gko-10/1-T-1	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.15	62.92	63.00	
Gko-10/1-T-1F	2W XFMR	Gko-10-B-1	Gko-1-B-1	0.70	31.49	31.50	
Gko-10/1-T-2	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.12	62.43	62.51	
Gko-10/1-T-3	2W XFMR	Gko-10-B-1	Gko-1-B-1	3.22	64.32	64.40	
Gso-10/1-T-1F	2W XFMR	Gso-10-B-1	Gso-1-B-1	3.50	69.91	70.00	
Gso-10/1-T-2F	2W XFMR	Gso-10-B-1	Gso-1-B-1	3.50	69.91	70.00	
Jb1-10/1-T-1	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	8.21	106.78	107.10	
Jb1-10/1-T-2	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	8.21	106.78	107.10	
Jb1-10/1-T-F1	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	2.50	49.94	50.00	
Jb1-10/1-T-F2	2W XFMR	Jb1-10-B-1	Jb1-1-B-1	2.50	49.94	50.00	
Jb2-10/.6-TG-1	2W XFMR	Jb2-10-B-2	Jb2-.6-B-1	3.83	72.70	72.80	
Jb2-10/.6-TG-2	2W XFMR	Jb2-10-B-2	Jb2-.6-B-1	3.83	72.70	72.80	
Jb3-1/0-TG-1	2W XFMR	Jb3-1-B-2	N-Jb3-.04-1	66.03	396.21	401.67	
Jb3-1/0-TG-2	2W XFMR	Jb3-1-B-2	N-Jb3-.04-2	66.03	396.21	401.67	
Jb3-1/0-TG-3	2W XFMR	Jb3-1-B-2	N-Jb3-.04-3	66.03	396.21	401.67	
Jb3-1/0-TG-4	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-4	66.03	396.21	401.67	
Jb3-1/0-TG-5	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-5	66.03	396.21	401.67	
Jb3-1/0-TG-6	2W XFMR	Jb3-1-B-2d	N-Jb3-.04-6	66.03	396.21	401.67	
Kba-10/3-T-1	2W XFMR	Kba-10-B-1	Kba-3-B-1	6.40	83.25	83.50	
Kba-10/3-T-2	2W XFMR	Kba-10-B-1	Kba-3-B-1	6.40	83.25	83.50	
Kba-10/3-T-3	2W XFMR	Kba-10-B-1	Kba-3-B-1	6.40	83.25	83.50	
Kse-10/1-TG-1n2	2W XFMR	Kse-10-B3	Kse-1-B-5	0.47	20.99	21.00	
Kse-10/1-TG-2n2	2W XFMR	Kse-10-B3	Kse-1-B-6	3.33	66.58	66.67	
MKi-10/1-T-1	2W XFMR	MKi-10-B-1	MKi-1-B-1	2.62	52.43	52.50	
MKi-10/3-T-1	2W XFMR	MKi-10-B-1	MKi-3-B-1	2.62	52.43	52.50	
MKi-10/3-T-2	2W XFMR	MKi-10-B-1	MKi-3-B-1	2.62	52.43	52.50	
Msh-10/1-T-1	2W XFMR	Msh-10-B-1	Msh-1-B-1	5.35	106.97	107.10	
Msh-10/1-T-1F	2W XFMR	Msh-10-B-1	Msh-1-B-1	2.50	49.94	50.00	
Msh-10/1-T-2F	2W XFMR	Msh-10-B-1	Msh-1-B-1	2.50	49.94	50.00	
Nbg-10/1-T-1n	2W XFMR	Nbg-10-B-1	Nbg-1-B-1	2.62	52.43	52.50	
Nbg-10/1-T-2n	2W XFMR	Nbg-10-B-1	Nbg-1-B-1	2.62	52.43	52.50	
Nde-10/1-T-1n	2W XFMR	Nde-10-B-1	Nde-1-B-1	2.62	52.43	52.50	
Nde-10/1-T-2n	2W XFMR	Nde-10-B-1	Nde-1-B-1	2.62	52.43	52.50	
Rwi-10/1-T-1n	2W XFMR	Rwi-10-B-1	Rwi-1-B-1	8.05	104.69	105.00	

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
Sha-20/10-T-1n	2W XFMR	Sha-20-B-1	Sha-10-B-1	0.34	15.27	15.28	
Sha-20/10-T-2n	2W XFMR	Sha-20-B-1	Sha-10-B-1	0.34	15.27	15.28	
Sha-20/10-T-3n	2W XFMR	Sha-20-B-1	Sha-10-B-1	0.34	15.27	15.28	
1-Jb1-Jb3	Cable	B-1-Jb1-Jb3-1	B-1-Jb1-Jb3-2	0.21	0.20	0.29	
10-Bre-Jb1-R(D/C)	Line	B-10-Bre-Jb1-2	B-10-Bre-Jb1-1	0.45	2.07	2.12	0.3120199
10-Bre-Nde-1R(S/C)	Line	B-10-Bre-Gso-1	C-BN	0.48	1.53	1.60	0.1208885
10-Bre-Nde-2(S/C)	Line	C-BN	B-10-Bre-Nde-2	0.13	0.34	0.37	0.1626596
10-Bre-Sha-1	Line	B-10-Bre-Sha-2DT-F	B-10-Bre-Sha-1DT-F	0.26	0.89	0.92	0.9599407
10-Bre-Sha-2	Line	B-10-Bre-Sha-2D	B-10-Bre-Sha-1D	0.26	0.89	0.92	0.9599407
10-Gha-MKi(S/C)	Line	B-10-Gha-MKi-1	B-10-Gha-MKi-2	0.95	3.02	3.17	0.2387549
10-Gko-Jb1(S/C)	Line	B-10-Gko-Jb1-2	B-10-Gko-Jb1-1	1.09	3.48	3.65	0.2750214
10-Gko-MKi(S/C)	Line	B-10-Gko-MKi-1	B-10-Gko-MKi-2	0.65	2.06	2.16	0.1631995
10-Gso-Msh-R(D/C)	Line	B-10-Gso-Msh-1	B-10-Gso-Msh-2	1.14	5.26	5.38	0.7904503
10-Gso-Nde-1R(S/C)	Line	C-GN	B-10-Gso-Nde-1	0.65	2.06	2.16	0.1631995
10-Gso-Nde-2(S/C)	Line	C-GN	B-10-Gso-Nde-2	0.13	0.34	0.37	0.1626596
10-Jb1-Jb2(S/C)	Line	B-10-Jb1-Jb2-2	B-10-Jb1-Jb2-1	0.14	0.42	0.45	0.0394709
10-Jb1-Nbg(S/C)	Line	B-10-Jb1-Nbg-1	B-10-Jb1-Nbg-2	0.93	2.98	3.13	0.2357326
10-Kba-Msh-R(D/C)	Line	B-10-Kba-Msh-2	10-Kba/Msh/Rwi-B	1.51	6.97	7.13	1.0483870
10-Kba-Rwi(S/C)	Line	B-10-Kba-Rwi-2	10-Kba/Msh/Rwi-B	1.48	2.81	3.17	0.2444020
10-MKi-Nbg(S/C)	Line	B-10-MKi-Nbg-1	B-10-MKi-Nbg-2	0.77	2.45	2.56	0.1934217
Bre-10-C-1	Tie Breakr	B-10-Bre-Jb1-1	Bre-10-B-1				
Bre-10-C-2	Tie Breakr	B-10-Bre-Sha-1DT-F	Bre-10-B-1				
Bre-10-C-3	Tie Breakr	B-10-Bre-Sha-1D	Bre-10-B-1				
Bre-10-C-4	Tie Breakr	B-10-Bre-Gso-1	Bre-10-B-1				
Gha-10-C-1	Tie Breakr	B-10-Gha-MKi-1	Gha-10-B-1				
Gko-10-C-1	Tie Breakr	B-10-Gko-Jb1-1	Gko-10-B-1				
Gko-10-C-2	Tie Breakr	B-10-Gko-MKi-1	Gko-10-B-1				
Gso-10-C-1	Tie Breakr	B-10-Gso-Nde-1	Gso-10-B-1				
Gso-10-C-2	Tie Breakr	B-10-Gso-Msh-1	Gso-10-B-1				
Jb1-1-C-1	Tie Breakr	Jb1-1-B-1	B-1-Jb1-Jb3-1				
Jb1-10-C-1	Tie Breakr	B-10-Jb1-Jb2-1	Jb1-10-B-1				
Jb1-10-C-2	Tie Breakr	B-10-Jb-Grid-1	Jb1-10-B-1				
Jb1-10-C-3	Tie Breakr	B-10-Bre-Jb1-2	Jb1-10-B-1				
Jb1-10-C-4	Tie Breakr	B-10-Gko-Jb1-2	Jb1-10-B-1				
Jb1-10-C-5	Tie Breakr	B-10-Jb1-Nbg-1	Jb1-10-B-1				
Jb2-10-C-1	Tie Breakr	B-10-Jb1-Jb2-2	Jb2-10-B-1				
Jb3-1-C-1	Tie Breakr	B-1-Jb1-Jb3-2	Jb3-1-B-1				
Kba-10-C-1	Tie Breakr	10-Kba/Msh/Rwi-B	Kba-10-B-1				
MKi-10-C-1	Tie Breakr	MKi-10-B-1	B-10-Mki-Grid-1				

CKT/Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
MKi-10-C-2	Tie Breakr	B-10-Gko-MKi-2	MKi-10-B-1				
MKi-10-C-3	Tie Breakr	B-10-MKi-Nbg-2	MKi-10-B-1				
MKi-10-C-4	Tie Breakr	B-10-Gha-MKi-2	MKi-10-B-1				
Msh-10-C-1	Tie Breakr	B-10-Gso-Msh-2	Msh-10-B-1				
Msh-10-C-2	Tie Breakr	B-10-Kba-Msh-2	Msh-10-B-1				
Nbg-10-C-1	Tie Breakr	B-10-Jb1-Nbg-2	Nbg-10-B-1				
Nbg-10-C-2	Tie Breakr	B-10-MKi-Nbg-1	Nbg-10-B-1				
Nde-10-C-1	Tie Breakr	B-10-Bre-Nde-2	Nde-10-B-1				
Nde-10-C-2	Tie Breakr	B-10-Gso-Nde-2	Nde-10-B-1				
Nde-10-C-3	Tie Breakr	G-Kse-1-B2	Nde-10-B-1				
Rwi-10-C-1	Tie Breakr	B-10-Kba-Rwi-2	Rwi-10-B-1				
Sha-10-C-1	Tie Breakr	Sha-10-B-1	B-10-Bre-Sha-2DT-F				
Sha-10-C-2	Tie Breakr	Sha-10-B-1	B-10-Bre-Sha-2D				
Sha-20-C-Grid	Tie Breakr	B-20-Sha-Grid-1	Sha-20-B-1				
C-Rwinkwabu-SW	Tie Switch	Rwi-1-B-1	C-Rwi-B-1				
S-Jb2-10-B-1	Tie Switch	Jb2-10-B-1	G-Jb2-10-B				
S-Jb2-10-B-2	Tie Switch	G-Jb2-10-B	Jb2-10-B-2				
S-Jb3-1-B-1	Tie Switch	Jb3-1-B-1	G-Jb3-1-B				
S-Jb3-1-B-2	Tie Switch	G-Jb3-1-B	Jb3-1-B-2				
S-Jb3-1-B-2d	Tie Switch	Jb3-1-B-2	Jb3-1-B-2d				
S-Kba-Bus	Tie Switch	Kba-3-B-1	C-Kab-3-B				
S-Kse-1-B2	Tie Switch	G-Kse-1-B2	Kse-10-B3				
S-Musha-Bus	Tie Switch	Msh-1-B-1	C-Msh-1-B				

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
10-Kba/Msh/Rwi-B	110.000	95.480	-13.5	0	0	0	0	B-10-Kba-Msh-2	-33.985	-5.569	189.3	98.7	
								B-10-Kba-Rwi-2	12.233	3.244	69.6	96.7	
								Kba-10-B-1	21.752	2.325	120.3	99.4	
B-1-Jb1-Jb3-1	15.000	100.743	-13.6	0	0	0	0	B-1-Jb1-Jb3-2	-7.114	-5.194	336.5	80.8	
								Jb1-1-B-1	7.114	5.194	336.5	80.8	
B-1-Jb1-Jb3-2	15.000	100.768	-13.6	0	0	0	0	B-1-Jb1-Jb3-1	7.116	5.195	336.5	80.8	
								Jb3-1-B-1	-7.116	-5.195	336.5	80.8	
B-10-Bre-Gso-1	110.000	100.438	-7.3	0	0	0	0	C-BN	79.479	7.390	417.1	99.6	
								Bre-10-B-1	-79.479	-7.390	417.1	99.6	
B-10-Bre-Jb1-1	110.000	100.438	-7.3	0	0	0	0	B-10-Bre-Jb1-2	138.699	46.109	763.8	94.9	
								Bre-10-B-1	-138.699	-46.109	763.8	94.9	
B-10-Bre-Jb1-2	110.000	98.898	-8.9	0	0	0	0	B-10-Bre-Jb1-1	-137.747	-42.022	764.3	95.6	
								Jb1-10-B-1	137.747	42.022	764.3	95.6	
B-10-Bre-Nde-2	110.000	99.826	-8.1	0	0	0	0	C-BN	-79.093	-6.491	417.3	99.7	
								Nde-10-B-1	79.093	6.491	417.3	99.7	
B-10-Bre-Sha-1D	110.000	100.438	-7.3	0	0	0	0	B-10-Bre-Sha-2D	-123.264	-32.532	666.2	96.7	
								Bre-10-B-1	123.264	32.532	666.2	96.7	
B-10-Bre-Sha-1DT-F	110.000	100.438	-7.3	0	0	0	0	B-10-Bre-Sha-2DT-F	-123.264	-32.532	666.2	96.7	
								Bre-10-B-1	123.264	32.532	666.2	96.7	
B-10-Bre-Sha-2D	110.000	101.042	-6.8	0	0	0	0	B-10-Bre-Sha-1D	123.678	32.982	664.9	96.6	
								Sha-10-B-1	-123.678	-32.982	664.9	96.6	
B-10-Bre-Sha-2DT-F	110.000	101.042	-6.8	0	0	0	0	B-10-Bre-Sha-1DT-F	123.678	32.982	664.9	96.6	
								Sha-10-B-1	-123.678	-32.982	664.9	96.6	
B-10-Gha-MKi-1	110.000	97.171	-10.2	0	0	0	0	B-10-Gha-MKi-2	-9.214	-3.506	53.2	93.5	
								Gha-10-B-1	9.214	3.506	53.2	93.5	
B-10-Gha-MKi-2	110.000	97.366	-10.0	0	0	0	0	B-10-Gha-MKi-1	9.224	3.310	52.8	94.1	
								MKi-10-B-1	-9.224	-3.310	52.8	94.1	
B-10-Gko-Jb1-1	110.000	97.347	-10.0	0	0	0	0	B-10-Gko-Jb1-2	-62.904	-23.249	361.6	93.8	
								Gko-10-B-1	62.904	23.249	361.6	93.8	
B-10-Gko-Jb1-2	110.000	98.898	-8.9	0	0	0	0	B-10-Gko-Jb1-1	63.420	24.633	361.1	93.2	
								Jb1-10-B-1	-63.420	-24.633	361.1	93.2	
B-10-Gko-MKi-1	110.000	97.347	-10.0	0	0	0	0	B-10-Gko-MKi-2	2.261	-1.663	15.1	-80.6	
								Gko-10-B-1	-2.261	1.663	15.1	-80.6	
B-10-Gko-MKi-2	110.000	97.366	-10.0	0	0	0	0	B-10-Gko-MKi-1	-2.260	1.510	14.7	-83.2	
								MKi-10-B-1	2.260	-1.510	14.7	-83.2	
B-10-Gso-Msh-1	110.000	98.319	-9.5	0	0	0	0	B-10-Gso-Msh-2	84.886	18.610	463.9	97.7	

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								Gso-10-B-1	-84.886	-18.610	463.9	97.7	
B-10-Gso-Msh-2	110.000	96.418	-12.1	0	0	0	0	B-10-Gso-Msh-1	-83.995	-15.246	464.7	98.4	
								Msh-10-B-1	83.995	15.246	464.7	98.4	
B-10-Gso-Nde-1	110.000	98.319	-9.5	0	0	0	0	C-GN	-104.755	-26.616	577.0	96.9	
								Gso-10-B-1	104.755	26.616	577.0	96.9	
B-10-Gso-Nde-2	110.000	99.826	-8.1	0	0	0	0	C-GN	105.695	29.203	576.5	96.4	
								Nde-10-B-1	-105.695	-29.203	576.5	96.4	
B-10-Jb-Grid-1	110.000	98.898	-8.9	10.000	7.000	0	0	Jb1-10-B-1	10.000	7.000	64.8	81.9	
B-10-Jb1-Jb2-1	110.000	98.898	-8.9	0	0	0	0	B-10-Jb1-Jb2-2	-18.491	-13.384	121.1	81.0	
								Jb1-10-B-1	18.491	13.384	121.1	81.0	
B-10-Jb1-Jb2-2	110.000	98.982	-8.8	0	0	0	0	B-10-Jb1-Jb2-1	18.498	13.367	121.0	81.1	
								Jb2-10-B-1	-18.498	-13.367	121.0	81.1	
B-10-Jb1-Nbg-1	110.000	98.898	-8.9	0	0	0	0	B-10-Jb1-Nbg-2	50.608	18.702	286.3	93.8	
								Jb1-10-B-1	-50.608	-18.702	286.3	93.8	
B-10-Jb1-Nbg-2	110.000	97.862	-9.7	0	0	0	0	B-10-Jb1-Nbg-1	-50.329	-18.041	286.8	94.1	
								Nbg-10-B-1	50.329	18.041	286.8	94.1	
B-10-Kba-Msh-2	110.000	96.418	-12.1	0	0	0	0	10-Kba/Msh/Rwi-B	34.181	5.507	188.5	98.7	
								Msh-10-B-1	-34.181	-5.507	188.5	98.7	
B-10-Kba-Rwi-2	110.000	95.192	-13.7	0	0	0	0	10-Kba/Msh/Rwi-B	-12.207	-3.416	69.9	96.3	
								Rwi-10-B-1	12.207	3.416	69.9	96.3	
B-10-Mki-Grid-1	110.000	97.366	-10.0	15.000	10.000	0	0	MKi-10-B-1	15.000	10.000	97.2	83.2	
B-10-MKi-Nbg-1	110.000	97.862	-9.7	0	0	0	0	B-10-MKi-Nbg-2	30.290	10.339	171.7	94.6	
								Nbg-10-B-1	-30.290	-10.339	171.7	94.6	
B-10-MKi-Nbg-2	110.000	97.366	-10.0	0	0	0	0	B-10-MKi-Nbg-1	-30.208	-10.261	172.0	94.7	
								MKi-10-B-1	30.208	10.261	172.0	94.7	
* B-20-Sha-Grid-1	220.000	100.000	0.0	248.083	98.646	0	0	Sha-20-B-1	248.083	98.646	700.6	92.9	
Bre-1-B-1	15.000	100.547	-11.3	0	0	28.246	9.281	Bre-10-B-1	-14.123	-4.640	569.1	95.0	
								Bre-10-B-1	-14.123	-4.640	569.1	95.0	
Bre-10-B-1	110.000	100.438	-7.3	0	0	0	0	Bre-1-B-1	14.175	5.782	80.0	92.6	-3.000
								Bre-1-B-1	14.175	5.782	80.0	92.6	-3.000
								B-10-Bre-Jb1-1	138.699	46.109	763.8	94.9	
								B-10-Bre-Sha-1DT-F	-123.264	-32.532	666.2	96.7	
								B-10-Bre-Sha-1D	-123.264	-32.532	666.2	96.7	
								B-10-Bre-Gso-1	79.479	7.390	417.1	99.6	
C-BN	110.000	99.953	-8.0	0	0	0	0	B-10-Bre-Gso-1	-79.176	-6.546	417.2	99.7	
								B-10-Bre-Nde-2	79.176	6.546	417.2	99.7	
C-GN	110.000	99.586	-8.3	0	0	0	0	B-10-Gso-Nde-1	105.536	28.951	576.8	96.4	
								B-10-Gso-Nde-2	-105.536	-28.951	576.8	96.4	
C-Kab-3-B	30.000	100.654	-16.8	0	0	0.000	-6.079	Kba-3-B-1	0.000	6.079	116.2	0.0	

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
C-Msh-1-B	15.000	100.037	-16.7	0	0	0.000	-10.007	Msh-1-B-1	0.000	10.007	385.0	0.0	
C-Rwi-B-1	15.000	100.929	-17.3	0	0	0.000	-1.019	Rwi-1-B-1	0.000	1.019	38.8	0.0	
G-Jb2-10-B	110.000	98.982	-8.8	0	0	0	0	Jb2-10-B-1	18.498	13.367	121.0	81.1	
								Jb2-10-B-2	-18.498	-13.367	121.0	81.1	
G-Jb3-1-B	15.000	100.768	-13.6	0	0	0	0	Jb3-1-B-1	7.116	5.195	336.5	80.8	
								Jb3-1-B-2	-7.116	-5.195	336.5	80.8	
G-Kse-1-B2	110.000	99.826	-8.1	0	0	0	0	Nde-10-B-1	49.848	31.850	311.0	84.3	
								Kse-10-B3	-49.848	-31.850	311.0	84.3	
Gha-1-B-1	15.000	100.578	-12.8	0	0	9.190	3.021	Gha-10-B-1	-9.190	-3.021	370.2	95.0	
Gha-10-B-1	110.000	97.171	-10.2	0	0	0	0	Gha-1-B-1	9.214	3.506	53.2	93.5	-5.200
								B-10-Gha-MKi-1	-9.214	-3.506	53.2	93.5	
Gko-1-B-1	15.000	100.674	-14.2	0	0	60.447	19.868	Gko-10-B-1	-12.168	-3.851	488.0	95.3	
								Gko-10-B-1	-24.113	-8.375	975.9	94.5	
								Gko-10-B-1	-12.262	-3.874	491.7	95.4	
								Gko-10-B-1	-11.903	-3.768	477.4	95.3	
Gko-10-B-1	110.000	97.347	-10.0	0	0	0	0	Gko-1-B-1	12.219	4.863	70.9	92.9	-6.155
								Gko-1-B-1	24.158	10.400	141.8	91.9	-6.155
								Gko-1-B-1	12.313	4.892	71.4	92.9	-6.150
								Gko-1-B-1	11.953	4.757	69.4	92.9	-6.155
								B-10-Gko-Jb1-1	-62.904	-23.249	361.6	93.8	
								B-10-Gko-MKi-1	2.261	-1.663	15.1	-80.6	
Gso-1-B-1	15.000	100.580	-13.3	0	0	19.794	6.506	Gso-10-B-1	-9.897	-3.253	398.7	95.0	
								Gso-10-B-1	-9.897	-3.253	398.7	95.0	
Gso-10-B-1	110.000	98.319	-9.5	0	0	0	0	Gso-1-B-1	9.934	4.003	57.2	92.8	-4.920
								Gso-1-B-1	9.934	4.003	57.2	92.8	-4.920
								B-10-Gso-Nde-1	-104.755	-26.616	577.0	96.9	
								B-10-Gso-Msh-1	84.886	18.610	463.9	97.7	
Jb1-1-B-1	15.000	100.743	-13.6	0	0	59.039	19.405	Jb1-10-B-1	-8.304	-2.110	327.3	96.9	
								Jb1-10-B-1	-8.304	-2.110	327.3	96.9	
								Jb1-10-B-1	-17.659	-4.996	701.2	96.2	
								Jb1-10-B-1	-17.659	-4.996	701.2	96.2	
								B-1-Jb1-Jb3-1	-7.114	-5.194	336.5	80.8	
Jb1-10-B-1	110.000	98.898	-8.9	0	0	0	0	Jb1-1-B-1	8.363	2.883	46.9	94.5	-4.920
								Jb1-1-B-1	8.363	2.883	46.9	94.5	-4.920
								Jb1-1-B-1	17.742	6.653	100.6	93.6	-4.920
								Jb1-1-B-1	17.742	6.653	100.6	93.6	-4.920
								B-10-Jb1-Jb2-1	-18.491	-13.384	121.1	81.0	
								B-10-Jb-Grid-1	-10.000	-7.000	64.8	81.9	
								B-10-Bre-Jb1-2	-137.747	-42.022	764.3	95.6	

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								B-10-Gko-Jb1-2	63.420	24.633	361.1	93.2	
								B-10-Jb1-Nbg-1	50.608	18.702	286.3	93.8	
Jb2-.6-B-1	6.600	104.453	-5.2	18.600	15.300	0	0	Jb2-10-B-2	9.300	7.650	1008.5	77.2	
								Jb2-10-B-2	9.300	7.650	1008.5	77.2	
Jb2-10-B-1	110.000	98.982	-8.8	0	0	0	0	B-10-Jb1-Jb2-2	18.498	13.367	121.0	81.1	
								G-Jb2-10-B	-18.498	-13.367	121.0	81.1	
Jb2-10-B-2	110.000	98.982	-8.8	0	0	0	0	Jb2-.6-B-1	-9.249	-6.684	60.5	81.1	
								Jb2-.6-B-1	-9.249	-6.684	60.5	81.1	
								G-Jb2-10-B	18.498	13.367	121.0	81.1	
Jb3-1-B-1	15.000	100.768	-13.6	0	0	0	0	B-1-Jb1-Jb3-2	7.116	5.195	336.5	80.8	
								G-Jb3-1-B	-7.116	-5.195	336.5	80.8	
Jb3-1-B-2	15.000	100.768	-13.6	0	0	0	0	N-Jb3-.04-1	-1.186	-0.866	56.1	80.8	
								N-Jb3-.04-2	-1.186	-0.866	56.1	80.8	
								N-Jb3-.04-3	-1.186	-0.866	56.1	80.8	
								G-Jb3-1-B	7.116	5.195	336.5	80.8	
								Jb3-1-B-2d	-3.558	-2.598	168.3	80.8	
Jb3-1-B-2d	15.000	100.768	-13.6	0	0	0	0	N-Jb3-.04-4	-1.186	-0.866	56.1	80.8	
								N-Jb3-.04-5	-1.186	-0.866	56.1	80.8	
								N-Jb3-.04-6	-1.186	-0.866	56.1	80.8	
								Jb3-1-B-2	3.558	2.598	168.3	80.8	
Kba-3-B-1	30.000	100.654	-16.8	0	0	21.653	7.117	Kba-10-B-1	-7.218	-0.346	138.2	99.9	
								Kba-10-B-1	-7.218	-0.346	138.2	99.9	
								Kba-10-B-1	-7.218	-0.346	138.2	99.9	
								C-Kab-3-B	0.000	-6.079	116.2	0.0	
Kba-10-B-1	110.000	95.480	-13.5	0	0	0	0	Kba-3-B-1	7.251	0.775	40.1	99.4	-6.000
								Kba-3-B-1	7.251	0.775	40.1	99.4	-6.000
								Kba-3-B-1	7.251	0.775	40.1	99.4	-6.000
								10-Kba/Msh/Rwi-B	-21.752	-2.325	120.3	99.4	
Kse-1-B-5	11.000	105.657	-3.7	40.000	30.000	0	0	Kse-10-B3	40.000	30.000	2483.8	80.0	
Kse-1-B-6	11.000	104.725	-4.6	10.000	7.500	0	0	Kse-10-B3	10.000	7.500	626.5	80.0	
Kse-10-B3	110.000	99.826	-8.1	0	0	0	0	Kse-1-B-5	-39.896	-25.298	248.4	84.5	
								Kse-1-B-6	-9.953	-6.551	62.6	83.5	
								G-Kse-1-B2	49.848	31.850	311.0	84.3	
MKi-1-B-1	15.000	100.496	-14.8	0	0	16.640	5.469	MKi-10-B-1	-16.640	-5.469	670.8	95.0	
MKi-3-B-1	30.000	100.438	-13.1	0	0	21.459	7.053	MKi-10-B-1	-10.729	-3.527	216.4	95.0	
								MKi-10-B-1	-10.729	-3.527	216.4	95.0	
MKi-10-B-1	110.000	97.366	-10.0	0	0	0	0	MKi-1-B-1	16.719	7.062	97.8	92.1	-6.500
								MKi-3-B-1	10.763	4.190	62.3	93.2	-5.200
								MKi-3-B-1	10.763	4.190	62.3	93.2	-5.200

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								B-10-Mki-Grid-1	-15.000	-10.000	97.2	83.2	
								B-10-Gko-MKi-2	-2.260	1.510	14.7	-83.2	
								B-10-MKi-Nbg-2	-30.208	-10.261	172.0	94.7	
								B-10-Gha-MKi-2	9.224	3.310	52.8	94.1	
Msh-1-B-1	15.000	100.037	-16.7	0	0	41.026	13.485	Msh-10-B-1	-7.764	-0.658	299.8	99.6	
								Msh-10-B-1	-16.631	-1.410	642.2	99.6	
								Msh-10-B-1	-16.631	-1.410	642.2	99.6	
								C-Msh-1-B	0.000	-10.007	385.0	0.0	
Msh-10-B-1	110.000	96.418	-12.1	0	0	8.618	2.832	Msh-1-B-1	7.797	1.307	43.0	98.6	-5.000
								Msh-1-B-1	16.700	2.800	92.2	98.6	-5.000
								Msh-1-B-1	16.700	2.800	92.2	98.6	-5.000
								B-10-Gso-Msh-2	-83.995	-15.246	464.7	98.4	
								B-10-Kba-Msh-2	34.181	5.507	188.5	98.7	
N-Jb3-.04-1	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2188.9	78.4	
N-Jb3-.04-2	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2188.9	78.4	
N-Jb3-.04-3	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2	1.200	0.950	2188.9	78.4	
N-Jb3-.04-4	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2188.9	78.4	
N-Jb3-.04-5	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2188.9	78.4	
N-Jb3-.04-6	0.400	100.925	-11.4	1.200	0.950	0	0	Jb3-1-B-2d	1.200	0.950	2188.9	78.4	
Nbg-1-B-1	15.000	101.143	-12.5	0	0	19.983	6.568	Nbg-10-B-1	-9.991	-3.284	400.2	95.0	
								Nbg-10-B-1	-9.991	-3.284	400.2	95.0	
Nbg-10-B-1	110.000	97.862	-9.7	0	0	0	0	Nbg-1-B-1	10.020	3.851	57.6	93.3	-5.200
								Nbg-1-B-1	10.020	3.851	57.6	93.3	-5.200
								B-10-Jb1-Nbg-2	-50.329	-18.041	286.8	94.1	
								B-10-MKi-Nbg-1	30.290	10.339	171.7	94.6	
Nde-1-B-1	15.000	101.210	-11.4	0	0	23.170	7.615	Nde-10-B-1	-11.585	-3.808	463.8	95.0	
								Nde-10-B-1	-11.585	-3.808	463.8	95.0	
Nde-10-B-1	110.000	99.826	-8.1	0	0	0	0	Nde-1-B-1	11.623	4.569	65.7	93.1	-3.690
								Nde-1-B-1	11.623	4.569	65.7	93.1	-3.690
								B-10-Bre-Nde-2	-79.093	-6.491	417.3	99.7	
								B-10-Gso-Nde-2	105.695	29.203	576.5	96.4	
								G-Kse-1-B2	-49.848	-31.850	311.0	84.3	
Rwi-1-B-1	15.000	100.929	-17.3	0	0	6.406	2.105	Rwi-10-B-1	-6.406	-1.087	247.8	98.6	
								C-Rwi-B-1	0.000	-1.019	38.8	0.0	
Rwi-10-B-1	110.000	95.192	-13.7	0	0	5.768	1.896	Rwi-1-B-1	6.439	1.521	36.5	97.3	-7.380
								B-10-Kba-Rwi-2	-12.207	-3.416	69.9	96.3	
Sha-10-B-1	110.000	101.042	-6.8	0	0	0	0	Sha-20-B-1	-82.452	-21.988	443.3	96.6	
								Sha-20-B-1	-82.452	-21.988	443.3	96.6	
								Sha-20-B-1	-82.452	-21.988	443.3	96.6	

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	%PF	%Tap
								B-10-Bre-Sha-2DT-F	123.678	32.982	664.9	96.6	
								B-10-Bre-Sha-2D	123.678	32.982	664.9	96.6	
Sha-20-B-1	220.000	100.000	0.0	0	0	0	0	Sha-10-B-1	82.694	32.882	233.5	92.9	-5.100
								Sha-10-B-1	82.694	32.882	233.5	92.9	-5.100
								Sha-10-B-1	82.694	32.882	233.5	92.9	-5.100
								B-20-Sha-Grid-1	-248.083	-98.646	700.6	92.9	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# Indicates a bus with a load mismatch of more than 0.1 MVA

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
10-Kba/Msh/Rwi-B	110.000	645.0	0	0	0	0	0	0	0	0	34.438	98.7	189.3	29.4
B-1-Jb1-Jb3-1	15.000	99999.0	0	0	0	0	0	0	0	0	8.808	80.8	336.5	0.3
B-1-Jb1-Jb3-2	15.000	99999.0	0	0	0	0	0	0	0	0	8.811	80.8	336.5	0.3
B-10-Bre-Gso-1	110.000	99999.0	0	0	0	0	0	0	0	0	79.822	99.6	417.1	0.4
B-10-Bre-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	146.162	94.9	763.8	0.8
B-10-Bre-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	144.014	95.6	764.3	0.8
B-10-Bre-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	79.359	99.7	417.3	0.4
B-10-Bre-Sha-1D	110.000	99999.0	0	0	0	0	0	0	0	0	127.485	96.7	666.2	0.7
B-10-Bre-Sha-1DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	127.485	96.7	666.2	0.7
B-10-Bre-Sha-2D	110.000	99999.0	0	0	0	0	0	0	0	0	128.000	96.6	664.9	0.7
B-10-Bre-Sha-2DT-F	110.000	99999.0	0	0	0	0	0	0	0	0	128.000	96.6	664.9	0.7
B-10-Gha-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	9.858	93.5	53.2	0.1
B-10-Gha-MKi-2	110.000	99999.0	0	0	0	0	0	0	0	0	9.800	94.1	52.8	0.1
B-10-Gko-Jb1-1	110.000	99999.0	0	0	0	0	0	0	0	0	67.063	93.8	361.6	0.4
B-10-Gko-Jb1-2	110.000	99999.0	0	0	0	0	0	0	0	0	68.036	93.2	361.1	0.4
B-10-Gko-MKi-1	110.000	99999.0	0	0	0	0	0	0	0	0	2.806	80.6	15.1	0.0
B-10-Gko-MKi-2	110.000	645.0	0	0	0	0	0	0	0	0	2.718	83.2	14.7	2.3
B-10-Gso-Msh-1	110.000		0	0	0	0	0	0	0	0	86.902	97.7	463.9	
B-10-Gso-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	85.368	98.4	464.7	0.5
B-10-Gso-Nde-1	110.000	99999.0	0	0	0	0	0	0	0	0	108.084	96.9	577.0	0.6
B-10-Gso-Nde-2	110.000	99999.0	0	0	0	0	0	0	0	0	109.655	96.4	576.5	0.6
B-10-Jb-Grid-1	110.000		0	0	0	0	0	0	0	0	12.207	81.9	64.8	
B-10-Jb1-Jb2-1	110.000	99999.0	0	0	0	0	0	0	0	0	22.826	81.0	121.1	0.1
B-10-Jb1-Jb2-2	110.000	99999.0	0	0	0	0	0	0	0	0	22.823	81.1	121.0	0.1
B-10-Jb1-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	53.953	93.8	286.3	0.3
B-10-Jb1-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	53.465	94.1	286.8	0.3
B-10-Kba-Msh-2	110.000	99999.0	0	0	0	0	0	0	0	0	34.621	98.7	188.5	0.2
B-10-Kba-Rwi-2	110.000	99999.0	0	0	0	0	0	0	0	0	12.676	96.3	69.9	0.1
B-10-Mki-Grid-1	110.000		0	0	0	0	0	0	0	0	18.028	83.2	97.2	
B-10-MKi-Nbg-1	110.000	99999.0	0	0	0	0	0	0	0	0	32.006	94.6	171.7	0.2
B-10-MKi-Nbg-2	110.000	99999.0	0	0	0	0	0	0	0	0	31.903	94.7	172.0	0.2
B-20-Sha-Grid-1	220.000		0	0	0	0	0	0	0	0	266.976	92.9	700.6	
Bre-1-B-1	15.000	2000.0	5.600	1.840	22.646	7.441	0	0	0	0	29.731	95.0	1138.1	56.9
Bre-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	254.969	96.7	1332.4	42.3
C-BN	110.000		0	0	0	0	0	0	0	0	79.446	99.7	417.2	
C-GN	110.000		0	0	0	0	0	0	0	0	109.435	96.4	576.8	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
C-Kab-3-B	30.000		0	0	0	-6.079	0	0	0	0	6.079	0.0	116.2	
C-Msh-1-B	15.000		0	0	0	-10.007	0	0	0	0	10.007	0.0	385.0	
C-Rwi-B-1	15.000		0	0	0	-1.019	0	0	0	0	1.019	0.0	38.8	
G-Jb2-10-B	110.000	99999.0	0	0	0	0	0	0	0	0	22.823	81.1	121.0	0.1
G-Jb3-1-B	15.000	99999.0	0	0	0	0	0	0	0	0	8.811	80.8	336.5	0.3
G-Kse-1-B2	110.000	99999.0	0	0	0	0	0	0	0	0	59.154	84.3	311.0	0.3
Gha-1-B-1	15.000	800.0	1.365	0.449	7.825	2.572	0	0	0	0	9.673	95.0	370.2	46.3
Gha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	9.858	93.5	53.2	1.7
Gko-1-B-1	15.000	2500.0	11.960	3.931	48.487	15.937	0	0	0	0	63.628	95.0	2432.7	97.3#
Gko-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	67.657	93.0	364.8	11.6
Gso-1-B-1	15.000	2000.0	2.940	0.966	16.854	5.540	0	0	0	0	20.836	95.0	797.3	39.9
Gso-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	108.084	96.9	577.0	18.3
Jb1-1-B-1	15.000	2500.0	8.745	2.874	50.294	16.531	0	0	0	0	62.147	95.0	2374.4	95.0
Jb1-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	177.565	93.6	942.4	29.9
Jb2-.6-B-1	6.600	3150.0	0	0	0	0	0	0	0	0	24.084	77.2	2017.0	64.0
Jb2-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	22.823	81.1	121.0	3.8
Jb2-10-B-2	110.000	3150.0	0	0	0	0	0	0	0	0	22.823	81.1	121.0	3.8
Jb3-1-B-1	15.000	800.0	0	0	0	0	0	0	0	0	8.811	80.8	336.5	42.1
Jb3-1-B-2	15.000	800.0	0	0	0	0	0	0	0	0	8.811	80.8	336.5	42.1
Jb3-1-B-2d	15.000	410.0	0	0	0	0	0	0	0	0	4.405	80.8	168.3	41.0
Kba-3-B-1	30.000	800.0	2.140	0.703	19.513	6.414	0	0	0	0	22.792	95.0	435.8	54.5
Kba-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	21.876	99.4	120.3	3.8
Kse-1-B-5	11.000	3150.0	0	0	0	0	0	0	0	0	50.000	80.0	2483.8	78.9
Kse-1-B-6	11.000	3150.0	0	0	0	0	0	0	0	0	12.500	80.0	626.5	19.9
Kse-10-B3	110.000	3150.0	0	0	0	0	0	0	0	0	59.154	84.3	311.0	9.9
MKi-1-B-1	15.000	2000.0	2.475	0.813	14.165	4.656	0	0	0	0	17.515	95.0	670.8	33.5
MKi-3-B-1	30.000	2000.0	3.195	1.050	18.264	6.003	0	0	0	0	22.588	95.0	432.8	21.6
MKi-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	51.611	92.0	278.2	8.8
Msh-1-B-1	15.000	2000.0	6.150	2.021	34.876	11.463	0	0	0	0	43.185	95.0	1661.6	83.1
Msh-10-B-1	110.000	3150.0	0.920	0.302	7.698	2.530	0	0	0	0	85.368	98.4	464.7	14.8
N-Jb3-.04-1	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
N-Jb3-.04-2	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
N-Jb3-.04-3	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
N-Jb3-.04-4	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
N-Jb3-.04-5	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
N-Jb3-.04-6	0.400		0	0	0	0	0	0	0	0	1.531	78.4	2188.9	
Nbg-1-B-1	15.000	2500.0	2.940	0.966	17.043	5.602	0	0	0	0	21.035	95.0	800.5	32.0
Nbg-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	53.465	94.1	286.8	9.1

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Nde-1-B-1	15.000	2500.0	3.405	1.119	19.765	6.496	0	0	0	0	24.389	95.0	927.5	37.1
Nde-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	134.521	95.9	707.3	22.5
Rwi-1-B-1	15.000	800.0	0.630	0.207	5.776	1.898	0	0	0	0	6.743	95.0	257.1	32.1
Rwi-10-B-1	110.000	3150.0	0.630	0.207	5.138	1.689	0	0	0	0	12.676	96.3	69.9	2.2
Sha-10-B-1	110.000	3150.0	0	0	0	0	0	0	0	0	256.001	96.6	1329.8	42.2
Sha-20-B-1	220.000	3150.0	0	0	0	0	0	0	0	0	266.976	92.9	700.6	22.2

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
1-Jb1-Jb3	Cable	480.37	336.53	70.06					
10-Bre-Jb1-R(D/C)	Line	1162.00	764.30	65.77					
10-Bre-Nde-1R(S/C)	Line	581.00	417.18	71.80					
10-Bre-Nde-2(S/C)	Line	581.00	417.25	71.82					
10-Bre-Sha-1	Line	1162.00	666.20	57.33					
10-Bre-Sha-2	Line	1162.00	666.20	57.33					
10-Gha-MKi(S/C)	Line	581.00	53.25	9.17					
10-Gko-Jb1(S/C)	Line	581.00	361.58	62.23					
10-Gko-MKi(S/C)	Line	581.00	15.13	2.60					
10-Gso-Msh-R(D/C)	Line	581.00	464.71	79.98					
10-Gso-Nde-1R(S/C)	Line	581.00	576.99	99.31					
10-Gso-Nde-2(S/C)	Line	581.00	576.77	99.27					
10-Jb1-Jb2(S/C)	Line	581.00	121.14	20.85					
10-Jb1-Nbg(S/C)	Line	581.00	286.75	49.35					
10-Kba-Msh-R(D/C)	Line	581.00	189.31	32.58					
10-Kba-Rwi(S/C)	Line	443.00	69.89	15.78					
10-MKi-Nbg(S/C)	Line	581.00	171.98	29.60					
Bre-10/1-T-1	Transformer				20.000	15.309	76.5	14.866	74.3
Bre-10/1-T-1F	Transformer				20.000	15.309	76.5	14.866	74.3
Gha-10/1-T-1n	Transformer				20.000	9.858	49.3	9.673	48.4
Gko-10/1-T-1	Transformer				15.000	13.151	87.7	12.763	85.1
Gko-10/1-T-1F	Transformer				30.000	26.301	87.7	25.526	85.1
Gko-10/1-T-2	Transformer				15.000	13.250	88.3	12.860	85.7
Gko-10/1-T-3	Transformer				15.000	12.865	85.8	12.486	83.2
Gso-10/1-T-1F	Transformer				15.000	10.711	71.4	10.418	69.5
Gso-10/1-T-2F	Transformer				15.000	10.711	71.4	10.418	69.5
Jb1-10/1-T-1	Transformer				10.000	8.846	88.5	8.568	85.7
Jb1-10/1-T-2	Transformer				10.000	8.846	88.5	8.568	85.7
Jb1-10/1-T-F1	Transformer				20.000	18.948	94.7	18.352	91.8
Jb1-10/1-T-F2	Transformer				20.000	18.948	94.7	18.352	91.8
Jb2-10/.6-TG-1	Transformer				15.000	12.042	80.3	11.411	76.1
Jb2-10/.6-TG-2	Transformer				15.000	12.042	80.3	11.411	76.1
Jb3-1/0-TG-1	Transformer				1.625	1.531	94.2	1.468	90.4

CKT / Branch		Cable & Reactor			Transformer				
		Ampacity (Amp)	Loading Amp		Capability (MVA)	Loading (input)		Loading (output)	
ID	Type			%		MVA	%	MVA	%
Jb3-1/0-TG-2	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-3	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-4	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-5	Transformer				1.625	1.531	94.2	1.468	90.4
Jb3-1/0-TG-6	Transformer				1.625	1.531	94.2	1.468	90.4
Kba-10/3-T-1	Transformer				10.000	7.292	72.9	7.226	72.3
Kba-10/3-T-2	Transformer				10.000	7.292	72.9	7.226	72.3
Kba-10/3-T-3	Transformer				10.000	7.292	72.9	7.226	72.3
Kse-10/1-TG-1n2	Transformer				62.500	50.000	80.0	47.240	75.6
Kse-10/1-TG-2n2	Transformer				15.000	12.500	83.3	11.915	79.4
MKi-10/1-T-1	Transformer				20.000	18.150	90.7	17.515	87.6
MKi-10/3-T-1	Transformer				20.000	11.549	57.7	11.294	56.5
MKi-10/3-T-2	Transformer				20.000	11.549	57.7	11.294	56.5
Msh-10/1-T-1	Transformer				10.000	7.905	79.1	7.792	77.9
Msh-10/1-T-1F	Transformer				20.000	16.933	84.7	16.690	83.5
Msh-10/1-T-2F	Transformer				20.000	16.933	84.7	16.690	83.5
Nbg-10/1-T-1n	Transformer				20.000	10.734	53.7	10.517	52.6
Nbg-10/1-T-2n	Transformer				20.000	10.734	53.7	10.517	52.6
Nde-10/1-T-1n	Transformer				20.000	12.489	62.4	12.195	61.0
Nde-10/1-T-2n	Transformer				20.000	12.489	62.4	12.195	61.0
Rwi-10/1-T-1n	Transformer				10.000	6.616	66.2	6.497	65.0
Sha-20/10-T-1n	Transformer				90.000	88.992	98.9	85.334	94.8
Sha-20/10-T-2n	Transformer				90.000	88.992	98.9	85.334	94.8
Sha-20/10-T-3n	Transformer				90.000	88.992	98.9	85.334	94.8

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
10-Kba-Msh-R(D/C)	-33.985	-5.569	34.181	5.507	195.5	-62.3	95.5	96.4	0.94
10-Kba-Rwi(S/C)	12.233	3.244	-12.207	-3.416	26.1	-172.6	95.5	95.2	0.29
1-Jb1-Jb3	-7.114	-5.194	7.116	5.195	1.6	1.5	100.7	100.8	0.03
10-Bre-Nde-1R(S/C)	79.479	7.390	-79.176	-6.546	302.6	844.8	100.4	100.0	0.49
10-Bre-Jb1-R(D/C)	138.699	46.109	-137.747	-42.022	952.0	4086.4	100.4	98.9	1.54
10-Bre-Nde-2(S/C)	-79.093	-6.491	79.176	6.546	83.2	54.4	99.8	100.0	0.13
10-Bre-Sha-2	-123.264	-32.532	123.678	32.982	414.5	450.0	100.4	101.0	0.60
10-Bre-Sha-1	-123.264	-32.532	123.678	32.982	414.5	450.0	100.4	101.0	0.60
10-Gha-MKi(S/C)	-9.214	-3.506	9.224	3.310	9.7	-195.0	97.2	97.4	0.20
10-Gko-Jb1(S/C)	-62.904	-23.249	63.420	24.633	516.5	1384.4	97.3	98.9	1.55
10-Gko-MKi(S/C)	2.261	-1.663	-2.260	1.510	0.5	-153.0	97.3	97.4	0.02
10-Gso-Msh-R(D/C)	84.886	18.610	-83.995	-15.246	890.7	3364.1	98.3	96.4	1.90
10-Gso-Nde-1R(S/C)	-104.755	-26.616	105.536	28.951	781.3	2334.7	98.3	99.6	1.27
10-Gso-Nde-2(S/C)	105.695	29.203	-105.536	-28.951	159.0	252.3	99.8	99.6	0.24
10-Jb1-Jb2(S/C)	-18.491	-13.384	18.498	13.367	7.6	-16.1	98.9	99.0	0.08
10-Jb1-Nbg(S/C)	50.608	18.702	-50.329	-18.041	278.4	660.8	98.9	97.9	1.04
10-MKi-Nbg(S/C)	30.290	10.339	-30.208	-10.261	82.1	78.0	97.9	97.4	0.50
Bre-10/1-T-1	-14.123	-4.640	14.175	5.782	51.9	1142.0	100.5	100.4	0.11
Bre-10/1-T-1F	-14.123	-4.640	14.175	5.782	51.9	1142.0	100.5	100.4	0.11
Gha-10/1-T-1n	-9.190	-3.021	9.214	3.506	24.3	485.0	100.6	97.2	3.41
Gko-10/1-T-1	-12.168	-3.851	12.219	4.863	50.6	1011.3	100.7	97.3	3.33
Gko-10/1-T-1F	-24.113	-8.375	24.158	10.400	45.0	2024.6	100.7	97.3	3.33
Gko-10/1-T-2	-12.262	-3.874	12.313	4.892	50.9	1018.7	100.7	97.3	3.33
Gko-10/1-T-3	-11.903	-3.768	11.953	4.757	49.5	989.3	100.7	97.3	3.33
Gso-10/1-T-1F	-9.897	-3.253	9.934	4.003	37.5	750.0	100.6	98.3	2.26
Gso-10/1-T-2F	-9.897	-3.253	9.934	4.003	37.5	750.0	100.6	98.3	2.26
Jb1-10/1-T-1	-8.304	-2.110	8.363	2.883	59.4	772.3	100.7	98.9	1.85
Jb1-10/1-T-2	-8.304	-2.110	8.363	2.883	59.4	772.3	100.7	98.9	1.85
Jb1-10/1-T-F1	-17.659	-4.996	17.742	6.653	82.9	1657.1	100.7	98.9	1.85
Jb1-10/1-T-F2	-17.659	-4.996	17.742	6.653	82.9	1657.1	100.7	98.9	1.85
Jb2-10/.6-TG-1	9.300	7.650	-9.249	-6.684	50.9	966.3	104.5	99.0	5.47
Jb2-10/.6-TG-2	9.300	7.650	-9.249	-6.684	50.9	966.3	104.5	99.0	5.47
Jb3-1/0-TG-1	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26
Jb3-1/0-TG-2	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26
Jb3-1/0-TG-3	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Jb3-1/0-TG-4	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26
Jb3-1/0-TG-5	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26
Jb3-1/0-TG-6	-1.186	-0.866	1.200	0.950	14.0	84.1	100.8	100.9	4.26
Kba-10/3-T-1	-7.218	-0.346	7.251	0.775	33.0	429.1	100.7	95.5	5.17
Kba-10/3-T-2	-7.218	-0.346	7.251	0.775	33.0	429.1	100.7	95.5	5.17
Kba-10/3-T-3	-7.218	-0.346	7.251	0.775	33.0	429.1	100.7	95.5	5.17
Kse-10/1-TG-1n2	40.000	30.000	-39.896	-25.298	104.5	4701.7	105.7	99.8	5.83
Kse-10/1-TG-2n2	10.000	7.500	-9.953	-6.551	47.4	948.6	104.7	99.8	4.90
MKi-10/1-T-1	-16.640	-5.469	16.719	7.062	79.6	1592.8	100.5	97.4	3.13
MKi-10/3-T-1	-10.729	-3.527	10.763	4.190	33.2	663.0	100.4	97.4	3.07
MKi-10/3-T-2	-10.729	-3.527	10.763	4.190	33.2	663.0	100.4	97.4	3.07
Msh-10/1-T-1	-7.764	-0.658	7.797	1.307	32.4	649.0	100.0	96.4	3.62
Msh-10/1-T-1F	-16.631	-1.410	16.700	2.800	69.5	1390.1	100.0	96.4	3.62
Msh-10/1-T-2F	-16.631	-1.410	16.700	2.800	69.5	1390.1	100.0	96.4	3.62
Nbg-10/1-T-1n	-9.991	-3.284	10.020	3.851	28.3	567.0	101.1	97.9	3.28
Nbg-10/1-T-2n	-9.991	-3.284	10.020	3.851	28.3	567.0	101.1	97.9	3.28
Nde-10/1-T-1n	-11.585	-3.808	11.623	4.569	38.1	761.2	101.2	99.8	1.38
Nde-10/1-T-2n	-11.585	-3.808	11.623	4.569	38.1	761.2	101.2	99.8	1.38
Rwi-10/1-T-1n	-6.406	-1.087	6.439	1.521	33.4	433.9	100.9	95.2	5.74
Sha-20/10-T-1n	-82.452	-21.988	82.694	32.882	242.1	10894.0	101.0	100.0	1.04
Sha-20/10-T-2n	-82.452	-21.988	82.694	32.882	242.1	10894.0	101.0	100.0	1.04
Sha-20/10-T-3n	-82.452	-21.988	82.694	32.882	242.1	10894.0	101.0	100.0	1.04
					7446.3	79029.3			

Alert Summary Report

	% Alert Settings Critical
Loading	
Bus	100.0
Cable	100.0
Reactor	100.0
Line	100.0
Transformer	100.0
Panel	100.0
Protective Device	100.0
Generator	101.0
Inverter/Charger	100.0
Bus Voltage	
OverVoltage	105.0
UnderVoltage	95.0
Generator Excitation	
OverExcited (Q Max.)	101.0
UnderExcited (Q Min.)	100.0

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Kse-1-B-5	Bus	Over Voltage	11.00	kV	11.62	105.7	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	248.083	98.646	266.976	92.92 Lagging
Source (Non-Swing Buses):	100.800	75.500	125.940	80.04 Lagging
Total Demand:	348.883	174.146	389.931	89.47 Lagging
Total Motor Load:	53.095	17.451	55.889	95.00 Lagging
Total Static Load:	288.342	77.666	298.618	96.56 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	7.446	79.029		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

3. 三相短絡電流計算報告書

1) 2018 年断面

Short-Circuit Summary Report

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
10-Kba/Msh/Rwi-B	110.000	10-Kba/Msh/Rwi-B	Open Air					2.294	4.185				2.187
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	2.294	4.185	2.294	2.294	0.005	
B-1-Jb1-Jb3-1	15.000	B-1-Jb1-Jb3-1	Open Air					11.059	27.946				9.990
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	11.059	27.946	10.844	11.363	3.395	
B-1-Jb1-Jb3-2	15.000	B-1-Jb1-Jb3-2	Open Air					11.015	27.710				9.956
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
B-10-Bre-Gso-1	110.000	B-10-Bre-Gso-1	Open Air					14.274	32.457				13.885
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
B-10-Bre-Jb1-1	110.000	B-10-Bre-Jb1-1	Open Air					14.274	32.457				13.885
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
B-10-Bre-Jb1-2	110.000	B-10-Bre-Jb1-2	Open Air					20.757	49.315				20.290
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
B-10-Bre-Nde-2	110.000	B-10-Bre-Nde-2	Open Air					10.444	22.376				10.107
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
B-10-Bre-Sha-1D	110.000	B-10-Bre-Sha-1D	Open Air					14.274	32.457				13.885
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
B-10-Bre-Sha-2D	110.000	B-10-Bre-Sha-2D	Open Air					13.658	31.309				13.324
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	13.658	31.309	13.579	14.536	5.188	
B-10-Gha-MKi-1	110.000	B-10-Gha-MKi-1	Open Air					9.334	20.064				9.226
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.334	20.064	9.334	9.337	0.235	
B-10-Gha-MKi-2	110.000	B-10-Gha-MKi-2	Open Air					18.916	44.674				18.543
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
B-10-Gko-Jb1-1	110.000	B-10-Gko-Jb1-1	Open Air					15.389	34.647				15.041
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	15.389	34.647	15.384	15.406	0.819	
B-10-Gko-Jb1-2	110.000	B-10-Gko-Jb1-2	Open Air					20.757	49.315				20.290
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
B-10-Gko-MKi-1	110.000	B-10-Gko-MKi-1	Open Air					15.389	34.647				15.041
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	15.389	34.647	15.384	15.406	0.819	
B-10-Gso-Msh-2	110.000	B-10-Gso-Msh-2	Open Air					3.796	7.133				3.600
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	3.796	7.133	3.796	3.796	0.028	
B-10-Gso-Nde-1	110.000	B-10-Gso-Nde-1	Open Air					7.261	14.562				6.989
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	7.261	14.562	7.233	7.238	0.273	
B-10-Gso-Nde-2	110.000	B-10-Gso-Nde-2	Open Air					10.444	22.376				10.107
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
B-10-Jb1-Jb2-1	110.000	B-10-Jb1-Jb2-1	Open Air					20.757	49.315				20.290
	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
B-10-Jb1-Jb2-2	110.000	B-10-Jb1-Jb2-2	Open Air					18.061	41.682				17.710
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	18.061	41.682	17.982	18.064	1.719	
B-10-Jb1-Nbg-1	110.000	B-10-Jb1-Nbg-1	Open Air					20.757	49.315				20.290

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
B-10-Jb1-Nbg-1	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
B-10-Jb1-Nbg-2	110.000	B-10-Jb1-Nbg-2	Open Air					15.316	34.403				15.048
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
B-10-Kba-Msh-2	110.000	B-10-Kba-Msh-2	Open Air					3.796	7.133				3.600
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	3.796	7.133	3.796	3.796	0.028	
B-10-Kba-Rwi-2	110.000	B-10-Kba-Rwi-2	Open Air					2.042	3.705				1.953
	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.042	3.705	2.042	2.042	0.004	
B-10-MKi-Nbg-1	110.000	B-10-MKi-Nbg-1	Open Air					15.316	34.403				15.048
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
B-10-MKi-Nbg-2	110.000	B-10-MKi-Nbg-2	Open Air					18.916	44.674				18.543
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
Bre-1-B-1	15.000	Bre-1-B-1	Open Air					8.143	21.236				7.622
	15.000	Bre-10/1-CL-1	CB	63.000	25.000	26.681	9.320	8.143	21.236	8.143	9.254	4.396	
Bre-10-B-1	110.000	Bre-10-B-1	Open Air					14.274	32.457				13.885
	110.000	Bre-10/1-CH-1	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
	110.000	Bre-10-C-2	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	14.274	32.457	14.168	14.857	4.471	
G-Jb2-10-B	110.000	G-Jb2-10-B	Open Air					18.061	41.682				17.710
G-Jb3-1-B	15.000	G-Jb3-1-B	Open Air					11.015	27.710				9.956
Gha-10-B-1	110.000	Gha-10-B-1	Open Air					9.334	20.064				9.226
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.334	20.064	9.334	9.337	0.235	
	110.000	Gha-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	9.334	20.064	9.334	9.337	0.235	
Gko-1-B-1	15.000	Gko-1-B-1	Open Air					20.065	51.246				18.583
	15.000	Gko-10/1-CL-1	CB	63.000	25.000	26.681	9.320	20.065	51.246	20.065	21.324	7.219	
	15.000	Gko-10/1-CL-2	CB	63.000	25.000	26.681	9.320	20.065	51.246	20.065	21.324	7.219	
	15.000	Gko-10/1-CL-3	CB	63.000	25.000	26.681	9.320	20.065	51.246	20.065	21.324	7.219	
Gko-10-B-1	110.000	Gko-10-B-1	Open Air					15.389	34.647				15.041
	110.000	Gko-10/1-CH-3	CB	80.000	40.000	42.689	14.911	15.389	34.647	15.384	15.406	0.819	
	110.000	Gko-10/1-CH-2	CB	80.000	40.000	42.689	14.911	15.389	34.647	15.384	15.406	0.819	
	110.000	Gko-10/1-CH-1	CB	80.000	40.000	42.689	14.911	15.389	34.647	15.384	15.406	0.819	
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	15.389	34.647	15.384	15.406	0.819	
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	15.389	34.647	15.384	15.406	0.819	
Gso-1-B-1	15.000	Gso-1-B-1	Open Air					9.901	24.319				9.492
	15.000	Gso-10/1-CL-1	CB	63.000	25.000	26.681	9.320	9.901	24.319	9.901	10.230	2.570	
	15.000	Gso-10/1-CL-2F	CB	63.000	25.000	26.681	9.320	9.901	24.319	9.901	10.230	2.570	
Gso-10-B-1	110.000	Gso-10-B-1	Open Air					7.261	14.562				6.989
	110.000	Gso-10-C-2	CB	80.000	31.500	33.618	11.743	7.261	14.562	7.233	7.238	0.273	
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	7.261	14.562	7.233	7.238	0.273	
	110.000	Gso-10/1-CH-1	CB	80.000	31.500	33.618	11.743	7.261	14.562	7.233	7.238	0.273	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Gso-10-B-1	110.000	Gso-10/1-CH-2F	CB	80.000	31.500	33.618	11.743	7.261	14.562	7.233	7.238	0.273	
Jb1-1-B-1	15.000	Jb1-1-B-1	Open Air					11.059	27.946				9.990
	15.000	Jb1-10/1-CL-1	CB	63.000	25.000	26.681	9.320	11.059	27.946	10.844	11.363	3.395	
	15.000	Jb1-10/1-CL-2	CB	63.000	25.000	26.681	9.320	11.059	27.946	10.844	11.363	3.395	
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	11.059	27.946	10.844	11.363	3.395	
Jb1-10-B-1	110.000	Jb1-10-B-1	Open Air					20.757	49.315				20.290
	110.000	Jb1-10/1-CH-2	CB	80.000	40.000	42.689	14.911	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10/1-CH-1	CB	80.000	40.000	42.689	14.911	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10-C-2	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	20.757	49.315	20.655	20.877	3.037	
Jb2-.6-B-1	6.600	Jb2-.6-B-1	Open Air					39.961	104.006				26.850
	6.600	Jb2-.6-CG-1	CB	125.000	31.500	33.618	11.743	39.961	104.006	37.162*	41.598*	18.692*	
	6.600	Jb2-10/.6-CL-2	CB	125.000	31.500	33.618	11.743	39.961	104.006	37.162*	41.598*	18.692*	
	6.600	Jb2-10/.6-CL-1	CB	125.000	31.500	33.618	11.743	39.961	104.006	37.162*	41.598*	18.692*	
	6.600	Jb2-.6-CG-2	CB	125.000	31.500	33.618	11.743	39.961	104.006	37.162*	41.598*	18.692*	
	6.600	Jb2-.6-CG-3	CB	125.000	31.500	33.618	11.743	39.961	104.006	37.162*	41.598*	18.692*	
Jb2-10-B-1	110.000	Jb2-10-B-1	Open Air					18.061	41.682				17.710
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	18.061	41.682	17.982	18.064	1.719	
Jb2-10-B-2	110.000	Jb2-10-B-2	Open Air					18.061	41.682				17.710
	110.000	Jb2-10/.6-CH-1	CB	80.000	31.500	33.618	11.743	18.061	41.682	17.982	18.064	1.719	
	110.000	Jb2-10/.6-CH-2	CB	80.000	31.500	33.618	11.743	18.061	41.682	17.982	18.064	1.719	
Jb3-1-B-1	15.000	Jb3-1-B-1	Open Air					11.015	27.710				9.956
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
Jb3-1-B-2	15.000	Jb3-1-B-2	Open Air					11.015	27.710				9.956
	15.000	Jb3-1/0-CH-1	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
	15.000	Jb3-1/0-CH-2	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
	15.000	Jb3-1/0-CH-3	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
Jb3-1-B-2d	15.000	Jb3-1-B-2d	Open Air					11.015	27.710				9.956
	15.000	Jb3-1/0-CH-4	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
	15.000	Jb3-1/0-CH-5	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
	15.000	Jb3-1/0-CH-6	CB	63.000	25.000	26.681	9.320	11.015	27.710	10.800	11.255	3.169	
Kba-3-B-1	30.000	Kba-3-B-1	Open Air					2.107	4.862				1.956
	30.000	Kba-10/3-CL-1	CB	31.500	12.500	13.340	4.660	2.107	4.862	2.107	2.116	0.186	
Kba-10-B-1	110.000	Kba-10-B-1	Open Air					2.294	4.185				2.187
	110.000	Kba-10/3-CH-1	CB	80.000	31.500	33.618	11.743	2.294	4.185	2.294	2.294	0.005	
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	2.294	4.185	2.294	2.294	0.005	
MKi-3-B-1	30.000	MKi-3-B-1	SwtchGear					4.426	11.551				4.228
	30.000	MKi-10/3-CL-1	CB	31.500	12.500	13.340	4.660	4.426	11.551	4.426	4.935	2.184	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
MKi-10-B-1	110.000	MKi-10-B-1	Open Air					18.916	44.674				18.543
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
	110.000	MKi-10-C-2	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
	110.000	MKi-10/3-CH-1	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
	110.000	MKi-10-C-1	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
	110.000	MKi-10/1-CH-1	CB	80.000	31.500	33.618	11.743	18.916	44.674	18.910	19.105	2.720	
Msh-1-B-1	15.000	Msh-1-B-1	Open Air					9.699	22.450				8.836
	15.000	Msh-10/1-CL-1	CB	40.000	16.000	17.076	5.965	9.699	22.450	9.699	9.754	1.035	
	15.000	Msh-10/1-CL-1F	CB	40.000	16.000	17.076	5.965	9.699	22.450	9.699	9.754	1.035	
Msh-10-B-1	110.000	Msh-10-B-1	Open Air					3.796	7.133				3.600
	110.000	Msh-10/1-CH-1	CB	80.000	40.000	42.689	14.911	3.796	7.133	3.796	3.796	0.028	
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	3.796	7.133	3.796	3.796	0.028	
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	3.796	7.133	3.796	3.796	0.028	
	110.000	Msh-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	3.796	7.133	3.796	3.796	0.028	
N-Jb3-.04-1	0.400	N-Jb3-.04-1	Bus					55.710	132.641				55.254
N-Jb3-.04-2	0.400	N-Jb3-.04-2	Bus					55.710	132.641				55.254
N-Jb3-.04-3	0.400	N-Jb3-.04-3	Bus					55.710	132.641				55.254
N-Jb3-.04-4	0.400	N-Jb3-.04-4	Bus					55.710	132.641				55.254
N-Jb3-.04-5	0.400	N-Jb3-.04-5	Bus					55.710	132.641				55.254
N-Jb3-.04-6	0.400	N-Jb3-.04-6	Bus					55.710	132.641				55.254
Nbg-10-B-1	110.000	Nbg-10-B-1	Open Air					15.316	34.403				15.048
	110.000	Nbg-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
	110.000	Nbg-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	15.316	34.403	15.310	15.329	0.759	
Nde-1-B-1	15.000	Nde-1-B-1	Open Air					15.038	37.811				14.549
	15.000	Nde-10/1-CL-1n	CB	80.000	25.000	26.681	9.320	15.038	37.811	15.038	16.147	5.881	
	15.000	Nde-10/1-CL-2n	CB	80.000	31.500	33.618	11.743	15.038	37.811	15.038	16.147	5.881	
Nde-10-B-1	110.000	Nde-10-B-1	Open Air					10.444	22.376				10.107
	110.000	Nde-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
	110.000	Nde-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
	110.000	Nde-10-C-3	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	10.444	22.376	10.321	10.451	1.645	
Rwi-1-B-1	15.000	Rwi-1-B-1	Open Air					3.580	8.259				3.469
	15.000	Rwi-10/1-CL-1n	CB	31.500	25.000	26.681	9.320	3.580	8.259	3.580	3.594	0.317	
Rwi-10-B-1	110.000	Rwi-10-B-1	Open Air					2.042	3.705				1.953
	110.000	Rwi-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	2.042	3.705	2.042	2.042	0.004	
	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.042	3.705	2.042	2.042	0.004	
Sha-10-B-1	110.000	Sha-10-B-1	Open Air					13.658	31.309				13.324

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Sha-10-B-1	110.000	Sha-20/10-CL-1n	CB	80.000	31.500	33.618	11.743	13.658	31.309	13.579	14.536	5.188	
	110.000	Sha-10-C-1	CB	80.000	31.500	33.618	11.743	13.658	31.309	13.579	14.536	5.188	
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	13.658	31.309	13.579	14.536	5.188	
Sha-20-B-1	220.000	Sha-20-B-1	Open Air					33.069	81.661				33.050
	220.000	Sha-20-C-Grid	CB	80.000	31.500	33.618	11.743	33.069	81.661*	33.069*	33.849*	7.224	
	220.000	Sha-20/10-CH-1n	CB	80.000	31.500	33.618	11.743	33.069	81.661*	33.069*	33.849*	7.224	

ip is calculated using method C
Ib does not include decay of non-terminal faulted indunction motors
Ik is the maximum steady state fault current
Idc is based on X/R from Method C and Ib as specified above

LV CB duty determined based on service rating.
Total through current is used for device duty.

* Indicates a device with calculated duty exceeding the device capability.

\# Indicates a device with calculated duty exceeding the device marginal limit. (95 % times device capability)

3. 三相短絡電流計算報告書

2) 2021 年断面

Short-Circuit Summary Report

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
10-Kba/Msh/Rwi-B	110.000	10-Kba/Msh/Rwi-B	Open Air					2.382	4.347				2.252
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	2.382	4.347	2.382	2.382	0.007	
B-1-Jb1-Jb3-1	15.000	B-1-Jb1-Jb3-1	Open Air					18.771	47.907				17.374
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	18.771	47.907	18.557	19.812	6.939	
B-1-Jb1-Jb3-2	15.000	B-1-Jb1-Jb3-2	Open Air					18.626	47.101				17.252
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
B-10-Bre-Gso-1	110.000	B-10-Bre-Gso-1	Open Air					17.838	41.687				17.340
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
B-10-Bre-Jb1-1	110.000	B-10-Bre-Jb1-1	Open Air					17.838	41.687				17.340
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
B-10-Bre-Jb1-2	110.000	B-10-Bre-Jb1-2	Open Air					22.655	53.036				22.094
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
B-10-Bre-Nde-2	110.000	B-10-Bre-Nde-2	Open Air					12.093	25.884				11.679
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
B-10-Bre-Sha-1D	110.000	B-10-Bre-Sha-1D	Open Air					17.838	41.687				17.340
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
B-10-Bre-Sha-2D	110.000	B-10-Bre-Sha-2D	Open Air					17.543	41.691				17.116
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	17.543	41.691	17.464	19.320	8.262	
B-10-Gha-MKi-1	110.000	B-10-Gha-MKi-1	Open Air					9.495	20.309				9.369
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.495	20.309	9.495	9.498	0.232	
B-10-Gha-MKi-2	110.000	B-10-Gha-MKi-2	Open Air					19.591	45.853				19.144
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
B-10-Gko-Jb1-1	110.000	B-10-Gko-Jb1-1	Open Air					16.030	35.747				15.610
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	16.030	35.747	16.026	16.046	0.801	
B-10-Gko-Jb1-2	110.000	B-10-Gko-Jb1-2	Open Air					22.655	53.036				22.094
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
B-10-Gko-MKi-1	110.000	B-10-Gko-MKi-1	Open Air					16.030	35.747				15.610
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	16.030	35.747	16.026	16.046	0.801	
B-10-Gso-Msh-2	110.000	B-10-Gso-Msh-2	Open Air					4.020	7.535				3.779
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	4.020	7.535	4.020	4.020	0.029	
B-10-Gso-Nde-1	110.000	B-10-Gso-Nde-1	Open Air					8.035	16.011				7.704
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	8.035	16.011	8.013	8.016	0.203	
B-10-Gso-Nde-2	110.000	B-10-Gso-Nde-2	Open Air					12.093	25.884				11.679
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
B-10-Jb1-Jb2-1	110.000	B-10-Jb1-Jb2-1	Open Air					22.655	53.036				22.094
	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
B-10-Jb1-Jb2-2	110.000	B-10-Jb1-Jb2-2	Open Air					19.462	44.273				19.051
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	19.462	44.273	19.392	19.458	1.601	
B-10-Jb1-Nbg-1	110.000	B-10-Jb1-Nbg-1	Open Air					22.655	53.036				22.094

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
B-10-Jb1-Nbg-1	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
B-10-Jb1-Nbg-2	110.000	B-10-Jb1-Nbg-2	Open Air					15.975	35.516				15.659
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
B-10-Kba-Msh-2	110.000	B-10-Kba-Msh-2	Open Air					4.020	7.535				3.779
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	4.020	7.535	4.020	4.020	0.029	
B-10-Kba-Rwi-2	110.000	B-10-Kba-Rwi-2	Open Air					2.112	3.834				2.004
	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.112	3.834	2.112	2.112	0.005	
B-10-MKi-Nbg-1	110.000	B-10-MKi-Nbg-1	Open Air					15.975	35.516				15.659
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
B-10-MKi-Nbg-2	110.000	B-10-MKi-Nbg-2	Open Air					19.591	45.853				19.144
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
Bre-1-B-1	15.000	Bre-1-B-1	Open Air					8.402	21.981				7.735
	15.000	Bre-10/1-CL-1	CB	63.000	25.000	26.681	9.320	8.402	21.981	8.402	9.578	4.600	
Bre-10-B-1	110.000	Bre-10-B-1	Open Air					17.838	41.687				17.340
	110.000	Bre-10/1-CH-1	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
	110.000	Bre-10-C-2	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	17.838	41.687	17.732	18.736	6.052	
G-Jb2-10-B	110.000	G-Jb2-10-B	Open Air					19.462	44.273				19.051
G-Jb3-1-B	15.000	G-Jb3-1-B	Open Air					18.626	47.101				17.252
Gha-10-B-1	110.000	Gha-10-B-1	Open Air					9.495	20.309				9.369
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.495	20.309	9.495	9.498	0.232	
	110.000	Gha-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	9.495	20.309	9.495	9.498	0.232	
Gko-1-B-1	15.000	Gko-1-B-1	Open Air					20.608	52.544				18.701
	15.000	Gko-10/1-CL-1	CB	63.000	25.000	26.681	9.320	20.608	52.544	20.608	21.870	7.320	
	15.000	Gko-10/1-CL-2	CB	63.000	25.000	26.681	9.320	20.608	52.544	20.608	21.870	7.320	
	15.000	Gko-10/1-CL-3	CB	63.000	25.000	26.681	9.320	20.608	52.544	20.608	21.870	7.320	
Gko-10-B-1	110.000	Gko-10-B-1	Open Air					16.030	35.747				15.610
	110.000	Gko-10/1-CH-3	CB	80.000	40.000	42.689	14.911	16.030	35.747	16.026	16.046	0.801	
	110.000	Gko-10/1-CH-2	CB	80.000	40.000	42.689	14.911	16.030	35.747	16.026	16.046	0.801	
	110.000	Gko-10/1-CH-1	CB	80.000	40.000	42.689	14.911	16.030	35.747	16.026	16.046	0.801	
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	16.030	35.747	16.026	16.046	0.801	
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	16.030	35.747	16.026	16.046	0.801	
Gso-1-B-1	15.000	Gso-1-B-1	Open Air					6.542	16.603				6.061
	15.000	Gso-10/1-CL-1F	CB	63.000	25.000	26.681	9.320	6.542	16.603	6.542	6.952	2.351	
Gso-10-B-1	110.000	Gso-10-B-1	Open Air					8.035	16.011				7.704
	110.000	Gso-10-C-2	CB	80.000	31.500	33.618	11.743	8.035	16.011	8.013	8.016	0.203	
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	8.035	16.011	8.013	8.016	0.203	
	110.000	Gso-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	8.035	16.011	8.013	8.016	0.203	
Jb1-1-B-1	15.000	Jb1-1-B-1	Open Air					18.771	47.907				17.374

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Jb1-1-B-1	15.000	Jb1-10/1-CL-1	CB	63.000	25.000	26.681	9.320	18.771	47.907	18.557	19.812	6.939	
	15.000	Jb1-10/1-CL-2	CB	63.000	25.000	26.681	9.320	18.771	47.907	18.557	19.812	6.939	
	15.000	Jb1-10/1-CL-F1	CB	63.000	25.000	26.681	9.320	18.771	47.907	18.557	19.812	6.939	
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	18.771	47.907	18.557	19.812	6.939	
Jb1-10-B-1	110.000	Jb1-10-B-1	Open Air					22.655	53.036				22.094
	110.000	Jb1-10/1-CH-2	CB	80.000	40.000	42.689	14.911	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10/1-CH-1	CB	80.000	40.000	42.689	14.911	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10-C-2	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	22.655	53.036	22.566	22.750	2.884	
	110.000	Jb1-10/1-CH-F1	CB	80.000	40.000	42.689	14.911	22.655	53.036	22.566	22.750	2.884	
Jb2-.6-B-1	6.600	Jb2-.6-B-1	Open Air					40.149	104.448				27.037
	6.600	Jb2-.6-CG-1	CB	125.000	31.500	33.618	11.743	40.149	104.448	37.349*	41.778*	18.721*	
	6.600	Jb2-10/.6-CL-2	CB	125.000	31.500	33.618	11.743	40.149	104.448	37.349*	41.778*	18.721*	
	6.600	Jb2-10/.6-CL-1	CB	125.000	31.500	33.618	11.743	40.149	104.448	37.349*	41.778*	18.721*	
	6.600	Jb2-.6-CG-2	CB	125.000	31.500	33.618	11.743	40.149	104.448	37.349*	41.778*	18.721*	
	6.600	Jb2-.6-CG-3	CB	125.000	31.500	33.618	11.743	40.149	104.448	37.349*	41.778*	18.721*	
Jb2-10-B-1	110.000	Jb2-10-B-1	Open Air					19.462	44.273				19.051
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	19.462	44.273	19.392	19.458	1.601	
Jb2-10-B-2	110.000	Jb2-10-B-2	Open Air					19.462	44.273				19.051
	110.000	Jb2-10/.6-CH-1	CB	80.000	31.500	33.618	11.743	19.462	44.273	19.392	19.458	1.601	
	110.000	Jb2-10/.6-CH-2	CB	80.000	31.500	33.618	11.743	19.462	44.273	19.392	19.458	1.601	
Jb3-1-B-1	15.000	Jb3-1-B-1	Open Air					18.626	47.101				17.252
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
Jb3-1-B-2	15.000	Jb3-1-B-2	Open Air					18.626	47.101				17.252
	15.000	Jb3-1/0-CH-1	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
	15.000	Jb3-1/0-CH-2	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
	15.000	Jb3-1/0-CH-3	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
Jb3-1-B-2d	15.000	Jb3-1-B-2d	Open Air					18.626	47.101				17.252
	15.000	Jb3-1/0-CH-4	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
	15.000	Jb3-1/0-CH-5	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
	15.000	Jb3-1/0-CH-6	CB	63.000	25.000	26.681	9.320	18.626	47.101	18.410	19.374	6.035	
Kba-3-B-1	30.000	Kba-3-B-1	Open Air					3.417	7.520				3.200
	30.000	Kba-10/3-CL-1	CB	31.500	12.500	13.340	4.660	3.417	7.520	3.417	3.421	0.168	
	30.000	Kba-10/3-CL-2	CB	31.500	12.500	13.340	4.660	3.417	7.520	3.417	3.421	0.168	
Kba-10-B-1	110.000	Kba-10-B-1	Open Air					2.382	4.347				2.252
	110.000	Kba-10/3-CH-1	CB	80.000	31.500	33.618	11.743	2.382	4.347	2.382	2.382	0.007	
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	2.382	4.347	2.382	2.382	0.007	
	110.000	Kba-10/3-CH-2	CB	80.000	31.500	33.618	11.743	2.382	4.347	2.382	2.382	0.007	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
MKi-3-B-1	30.000	MKi-3-B-1	SwtchGear					4.491	11.709				4.237
	30.000	MKi-10/3-CL-1	CB	31.500	12.500	13.340	4.660	4.491	11.709	4.491	5.001	2.199	
MKi-10-B-1	110.000	MKi-10-B-1	Open Air					19.591	45.853				19.144
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
	110.000	MKi-10-C-2	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
	110.000	MKi-10/3-CH-1	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
	110.000	MKi-10-C-1	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
	110.000	MKi-10/1-CH-1	CB	80.000	31.500	33.618	11.743	19.591	45.853	19.586	19.775	2.724	
Msh-1-B-1	15.000	Msh-1-B-1	Open Air					10.068	23.385				8.979
	15.000	Msh-10/1-CL-1	CB	40.000	16.000	17.076	5.965	10.068	23.385	10.068	10.128	1.101	
	15.000	Msh-10/1-CL-1F	CB	40.000	16.000	17.076	5.965	10.068	23.385	10.068	10.128	1.101	
Msh-10-B-1	110.000	Msh-10-B-1	Open Air					4.020	7.535				3.779
	110.000	Msh-10/1-CH-1	CB	80.000	40.000	42.689	14.911	4.020	7.535	4.020	4.020	0.029	
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	4.020	7.535	4.020	4.020	0.029	
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	4.020	7.535	4.020	4.020	0.029	
	110.000	Msh-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	4.020	7.535	4.020	4.020	0.029	
N-Jb3-.04-1	0.400	N-Jb3-.04-1	Bus					57.538	136.517				57.322
N-Jb3-.04-2	0.400	N-Jb3-.04-2	Bus					57.538	136.517				57.322
N-Jb3-.04-3	0.400	N-Jb3-.04-3	Bus					57.538	136.517				57.322
N-Jb3-.04-4	0.400	N-Jb3-.04-4	Bus					57.538	136.517				57.322
N-Jb3-.04-5	0.400	N-Jb3-.04-5	Bus					57.538	136.517				57.322
N-Jb3-.04-6	0.400	N-Jb3-.04-6	Bus					57.538	136.517				57.322
Nbg-10-B-1	110.000	Nbg-10-B-1	Open Air					15.975	35.516				15.659
	110.000	Nbg-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
	110.000	Nbg-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	15.975	35.516	15.970	15.986	0.728	
Nde-1-B-1	15.000	Nde-1-B-1	Open Air					15.546	39.274				14.938
	15.000	Nde-10/1-CL-1n	CB	80.000	25.000	26.681	9.320	15.546	39.274	15.546	16.651	5.965	
	15.000	Nde-10/1-CL-2n	CB	80.000	31.500	33.618	11.743	15.546	39.274	15.546	16.651	5.965	
Nde-10-B-1	110.000	Nde-10-B-1	Open Air					12.093	25.884				11.679
	110.000	Nde-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
	110.000	Nde-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
	110.000	Nde-10-C-3	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	12.093	25.884	11.970	12.055	1.425	
Rwi-1-B-1	15.000	Rwi-1-B-1	Open Air					3.629	8.390				3.491
	15.000	Rwi-10/1-CL-1n	CB	31.500	25.000	26.681	9.320	3.629	8.390	3.629	3.645	0.341	
Rwi-10-B-1	110.000	Rwi-10-B-1	Open Air					2.112	3.834				2.004
	110.000	Rwi-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	2.112	3.834	2.112	2.112	0.005	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Rwi-10-B-1	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.112	3.834	2.112	2.112	0.005	
Sha-10-B-1	110.000	Sha-10-B-1	Open Air					17.543	41.691				17.116
	110.000	Sha-20/10-CL-1n	CB	80.000	31.500	33.618	11.743	17.543	41.691	17.464	19.320	8.262	
	110.000	Sha-10-C-1	CB	80.000	31.500	33.618	11.743	17.543	41.691	17.464	19.320	8.262	
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	17.543	41.691	17.464	19.320	8.262	
	110.000	Sha-20/10-CL-2n	CB	80.000	31.500	33.618	11.743	17.543	41.691	17.464	19.320	8.262	
Sha-20-B-1	220.000	Sha-20-B-1	Open Air					33.866	83.374				33.811
	220.000	Sha-20-C-Grid	CB	80.000	31.500	33.618	11.743	33.866	83.374*	33.866*	34.624*	7.205	
	220.000	Sha-20/10-CH-1n	CB	80.000	31.500	33.618	11.743	33.866	83.374*	33.866*	34.624*	7.205	
	220.000	Sha-20/10-CH-2n	CB	80.000	31.500	33.618	11.743	33.866	83.374*	33.866*	34.624*	7.205	

ip is calculated using method C
Ib does not include decay of non-terminal faulted induntion motors
Ik is the maximum steady state fault current
Idc is based on X/R from Method C and Ib as specified above

LV CB duty determined based on service rating.
Total through current is used for device duty.

* Indicates a device with calculated duty exceeding the device capability.

\# Indicates a device with calculated duty exceeding the device marginal limit. (95 % times device capability)

3. 三相短絡電流計算報告書

3) 2028 年断面

Short-Circuit Summary Report

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
10-Kba/Msh/Rwi-B	110.000	10-Kba/Msh/Rwi-B	Open Air					3.246	7.069				2.990
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	3.246	7.069	3.246	3.249	0.124	
B-1-Jb1-Jb3-1	15.000	B-1-Jb1-Jb3-1	Open Air					26.960	69.118				24.334
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
B-1-Jb1-Jb3-2	15.000	B-1-Jb1-Jb3-2	Open Air					26.642	67.350				24.080
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
B-10-Bre-Gso-1	110.000	B-10-Bre-Gso-1	Open Air					22.958	56.456				21.933
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
B-10-Bre-Jb1-1	110.000	B-10-Bre-Jb1-1	Open Air					22.958	56.456				21.933
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
B-10-Bre-Jb1-2	110.000	B-10-Bre-Jb1-2	Open Air					25.420	61.139				24.341
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
B-10-Bre-Nde-2	110.000	B-10-Bre-Nde-2	Open Air					14.241	32.231				13.477
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
B-10-Bre-Sha-1D	110.000	B-10-Bre-Sha-1D	Open Air					22.958	56.456				21.933
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
B-10-Bre-Sha-2D	110.000	B-10-Bre-Sha-2D	Open Air					22.786	56.750				21.931
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	
B-10-Gha-MKi-1	110.000	B-10-Gha-MKi-1	Open Air					9.755	20.840				9.536
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.755	20.840	9.755	9.757	0.228	
B-10-Gha-MKi-2	110.000	B-10-Gha-MKi-2	Open Air					20.651	48.406				19.854
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
B-10-Gko-Jb1-1	110.000	B-10-Gko-Jb1-1	Open Air					17.041	38.156				16.281
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	17.041	38.156	17.039	17.060	0.837	
B-10-Gko-Jb1-2	110.000	B-10-Gko-Jb1-2	Open Air					25.420	61.139				24.341
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
B-10-Gko-MKi-1	110.000	B-10-Gko-MKi-1	Open Air					17.041	38.156				16.281
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	17.041	38.156	17.039	17.060	0.837	
B-10-Gso-Msh-2	110.000	B-10-Gso-Msh-2	Open Air					5.196	11.298				4.741
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	5.196	11.298	5.196	5.201	0.222	
B-10-Gso-Nde-1	110.000	B-10-Gso-Nde-1	Open Air					9.085	19.565				8.490
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	9.085	19.565	9.069	9.077	0.391	
B-10-Gso-Nde-2	110.000	B-10-Gso-Nde-2	Open Air					14.241	32.231				13.477
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
B-10-Jb1-Jb2-1	110.000	B-10-Jb1-Jb2-1	Open Air					25.420	61.139				24.341

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
B-10-Jb1-Jb2-1	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
B-10-Jb1-Jb2-2	110.000	B-10-Jb1-Jb2-2	Open Air					21.463	49.724				20.696
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	21.463	49.724	21.392	21.492	2.063	
B-10-Jb1-Nbg-1	110.000	B-10-Jb1-Nbg-1	Open Air					25.420	61.139				24.341
	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
B-10-Jb1-Nbg-2	110.000	B-10-Jb1-Nbg-2	Open Air					16.944	37.811				16.383
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
B-10-Kba-Msh-2	110.000	B-10-Kba-Msh-2	Open Air					5.196	11.298				4.741
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	5.196	11.298	5.196	5.201	0.222	
B-10-Kba-Rwi-2	110.000	B-10-Kba-Rwi-2	Open Air					2.781	5.816				2.579
	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.781	5.816	2.781	2.782	0.049	
B-10-MKi-Nbg-1	110.000	B-10-MKi-Nbg-1	Open Air					16.944	37.811				16.383
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
B-10-MKi-Nbg-2	110.000	B-10-MKi-Nbg-2	Open Air					20.651	48.406				19.854
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
Bre-1-B-1	15.000	Bre-1-B-1	Open Air					16.609	43.456				14.938
	15.000	Bre-10/1-CL-1	CB	63.000	25.000	26.681	9.320	16.609	43.456	16.609	18.795	8.798	
	15.000	Bre-10/1-CL-1F	CB	63.000	25.000	26.681	9.320	16.609	43.456	16.609	18.795	8.798	
Bre-10-B-1	110.000	Bre-10-B-1	Open Air					22.958	56.456				21.933
	110.000	Bre-10/1-CH-1	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
	110.000	Bre-10-C-3	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
	110.000	Bre-10-C-4	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
	110.000	Bre-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	22.958	56.456	22.848	23.903	7.025	
	110.000	Bre-10-C-2	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
	110.000	Bre-10-C-1	CB	80.000	40.000	42.689	14.911	22.958	56.456	22.848	23.903	7.025	
G-Jb2-10-B	110.000	G-Jb2-10-B	Open Air					21.463	49.724				20.696
G-Jb3-1-B	15.000	G-Jb3-1-B	Open Air					26.642	67.350				24.080
Gha-10-B-1	110.000	Gha-10-B-1	Open Air					9.755	20.840				9.536
	110.000	Gha-10-C-1	CB	80.000	31.500	33.618	11.743	9.755	20.840	9.755	9.757	0.228	
	110.000	Gha-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	9.755	20.840	9.755	9.757	0.228	
Gko-1-B-1	15.000	Gko-1-B-1	Open Air					32.051	81.599				28.452
	15.000	Gko-10/1-CL-1	CB	63.000	25.000	26.681	9.320	32.051	81.599*	32.051*	33.997*	11.337*	
	15.000	Gko-10/1-CL-2	CB	63.000	25.000	26.681	9.320	32.051	81.599*	32.051*	33.997*	11.337*	
	15.000	Gko-10/1-CL-3	CB	63.000	25.000	26.681	9.320	32.051	81.599*	32.051*	33.997*	11.337*	
	15.000	Gko-10/1-CL-1F	CB	63.000	25.000	26.681	9.320	32.051	81.599*	32.051*	33.997*	11.337*	
Gko-10-B-1	110.000	Gko-10-B-1	Open Air					17.041	38.156				16.281
	110.000	Gko-10/1-CH-3	CB	80.000	40.000	42.689	14.911	17.041	38.156	17.039	17.060	0.837	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Gko-10-B-1	110.000	Gko-10/1-CH-2	CB	80.000	40.000	42.689	14.911	17.041	38.156	17.039	17.060	0.837	
	110.000	Gko-10/1-CH-1	CB	80.000	40.000	42.689	14.911	17.041	38.156	17.039	17.060	0.837	
	110.000	Gko-10-C-2	CB	80.000	31.500	33.618	11.743	17.041	38.156	17.039	17.060	0.837	
	110.000	Gko-10-C-1	CB	80.000	31.500	33.618	11.743	17.041	38.156	17.039	17.060	0.837	
	110.000	Gko-10/1-CH-1F	CB	80.000	40.000	42.689	14.911	17.041	38.156	17.039	17.060	0.837	
Gso-1-B-1	15.000	Gso-1-B-1	Open Air					12.094	30.597				11.136
	15.000	Gso-10/1-CL-1F	CB	63.000	25.000	26.681	9.320	12.094	30.597	12.094	12.738	3.998	
	15.000	Gso-10/1-CL-2F	CB	63.000	25.000	26.681	9.320	12.094	30.597	12.094	12.738	3.998	
Gso-10-B-1	110.000	Gso-10-B-1	Open Air					9.085	19.565				8.490
	110.000	Gso-10-C-2	CB	80.000	31.500	33.618	11.743	9.085	19.565	9.069	9.077	0.391	
	110.000	Gso-10-C-1	CB	80.000	31.500	33.618	11.743	9.085	19.565	9.069	9.077	0.391	
	110.000	Gso-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	9.085	19.565	9.069	9.077	0.391	
	110.000	Gso-10/1-CH-2F	CB	80.000	31.500	33.618	11.743	9.085	19.565	9.069	9.077	0.391	
Jb1-1-B-1	15.000	Jb1-1-B-1	Open Air					26.960	69.118				24.334
	15.000	Jb1-10/1-CL-1	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
	15.000	Jb1-10/1-CL-2	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
	15.000	Jb1-10/1-CL-F1	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
	15.000	Jb1-1-C-1	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
	15.000	Jb1-10/1-CL-F2	CB	63.000	25.000	26.681	9.320	26.960	69.118*	26.746*	28.771*	10.603*	
Jb1-10-B-1	110.000	Jb1-10-B-1	Open Air					25.420	61.139				24.341
	110.000	Jb1-10/1-CH-2	CB	80.000	40.000	42.689	14.911	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10/1-CH-1	CB	80.000	40.000	42.689	14.911	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10-C-5	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10-C-1	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10-C-2	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10-C-3	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10-C-4	CB	80.000	31.500	33.618	11.743	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10/1-CH-F1	CB	80.000	40.000	42.689	14.911	25.420	61.139	25.327	25.688	4.289	
	110.000	Jb1-10/1-CH-F2	CB	80.000	40.000	42.689	14.911	25.420	61.139	25.327	25.688	4.289	
Jb2-.6-B-1	6.600	Jb2-.6-B-1	Open Air					40.368	105.230				27.226
	6.600	Jb2-.6-CG-1	CB	125.000	31.500	33.618	11.743	40.368	105.230	37.568*	42.209*	19.240*	
	6.600	Jb2-10/.6-CL-2	CB	125.000	31.500	33.618	11.743	40.368	105.230	37.568*	42.209*	19.240*	
	6.600	Jb2-10/.6-CL-1	CB	125.000	31.500	33.618	11.743	40.368	105.230	37.568*	42.209*	19.240*	
	6.600	Jb2-.6-CG-2	CB	125.000	31.500	33.618	11.743	40.368	105.230	37.568*	42.209*	19.240*	
	6.600	Jb2-.6-CG-3	CB	125.000	31.500	33.618	11.743	40.368	105.230	37.568*	42.209*	19.240*	
Jb2-10-B-1	110.000	Jb2-10-B-1	Open Air					21.463	49.724				20.696
	110.000	Jb2-10-C-1	CB	80.000	31.500	33.618	11.743	21.463	49.724	21.392	21.492	2.063	

3-Phase Fault Currents

Bus		**Device**		**Device Capacity (kA)**				**Short-Circuit Current (kA)**					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Jb2-10-B-2	110.000	Jb2-10-B-2	Open Air					21.463	49.724				20.696
	110.000	Jb2-10/.6-CH-1	CB	80.000	31.500	33.618	11.743	21.463	49.724	21.392	21.492	2.063	
	110.000	Jb2-10/.6-CH-2	CB	80.000	31.500	33.618	11.743	21.463	49.724	21.392	21.492	2.063	
Jb3-1-B-1	15.000	Jb3-1-B-1	Open Air					26.642	67.350				24.080
	15.000	Jb3-1-C-1	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
Jb3-1-B-2	15.000	Jb3-1-B-2	Open Air					26.642	67.350				24.080
	15.000	Jb3-1/0-CH-1	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
	15.000	Jb3-1/0-CH-2	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
	15.000	Jb3-1/0-CH-3	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
Jb3-1-B-2d	15.000	Jb3-1-B-2d	Open Air					26.642	67.350				24.080
	15.000	Jb3-1/0-CH-4	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
	15.000	Jb3-1/0-CH-5	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
	15.000	Jb3-1/0-CH-6	CB	63.000	25.000	26.681	9.320	26.642	67.350*	26.427*	27.780*	8.564	
Kba-3-B-1	30.000	Kba-3-B-1	Open Air					4.928	11.745				4.514
	30.000	Kba-10/3-CL-1	CB	31.500	12.500	13.340	4.660	4.928	11.745	4.928	4.974	0.673	
	30.000	Kba-10/3-CL-2	CB	31.500	12.500	13.340	4.660	4.928	11.745	4.928	4.974	0.673	
	30.000	Kba-10/3-CL-3	CB	31.500	12.500	13.340	4.660	4.928	11.745	4.928	4.974	0.673	
Kba-10-B-1	110.000	Kba-10-B-1	Open Air					3.246	7.069				2.990
	110.000	Kba-10/3-CH-1	CB	80.000	31.500	33.618	11.743	3.246	7.069	3.246	3.249	0.124	
	110.000	Kba-10-C-1	CB	80.000	31.500	33.618	11.743	3.246	7.069	3.246	3.249	0.124	
	110.000	Kba-10/3-CH-2	CB	80.000	31.500	33.618	11.743	3.246	7.069	3.246	3.249	0.124	
	110.000	Kba-10/3-CH-3	CB	80.000	31.500	33.618	11.743	3.246	7.069	3.246	3.249	0.124	
MKi-3-B-1	30.000	MKi-3-B-1	SwtchGear					8.517	22.082				8.025
	30.000	MKi-10/3-CL-1	CB	31.500	12.500	13.340	4.660	8.517	22.082	8.517	9.361	3.884	
	30.000	MKi-10/3-CL-2	CB	31.500	12.500	13.340	4.660	8.517	22.082	8.517	9.361	3.884	
MKi-10-B-1	110.000	MKi-10-B-1	Open Air					20.651	48.406				19.854
	110.000	MKi-10-C-3	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10-C-2	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10-C-4	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10/3-CH-1	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10-C-1	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10/1-CH-1	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
	110.000	MKi-10/3-CH-2	CB	80.000	31.500	33.618	11.743	20.651	48.406	20.648	20.832	2.759	
Msh-1-B-1	15.000	Msh-1-B-1	Open Air					15.393	37.498				13.370
	15.000	Msh-10/1-CL-1	CB	40.000	16.000	17.076	5.965	15.393	37.498	15.393	15.674	2.958	
	15.000	Msh-10/1-CL-1F	CB	40.000	16.000	17.076	5.965	15.393	37.498	15.393	15.674	2.958	
	15.000	Msh-10/1-CL-2F	CB	40.000	16.000	17.076	5.965	15.393	37.498	15.393	15.674	2.958	

3-Phase Fault Currents

Bus		Device		Device Capacity (kA)				Short-Circuit Current (kA)					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Msh-10-B-1	110.000	Msh-10-B-1	Open Air					5.196	11.298				4.741
	110.000	Msh-10/1-CH-1	CB	80.000	40.000	42.689	14.911	5.196	11.298	5.196	5.201	0.222	
	110.000	Msh-10-C-2	CB	80.000	40.000	42.689	14.911	5.196	11.298	5.196	5.201	0.222	
	110.000	Msh-10-C-1	CB	80.000	40.000	42.689	14.911	5.196	11.298	5.196	5.201	0.222	
	110.000	Msh-10/1-CH-1F	CB	80.000	31.500	33.618	11.743	5.196	11.298	5.196	5.201	0.222	
	110.000	Msh-10/1-CH-2F	CB	80.000	31.500	33.618	11.743	5.196	11.298	5.196	5.201	0.222	
N-Jb3-.04-1	0.400	N-Jb3-.04-1	Bus					58.371	138.250				58.164
N-Jb3-.04-2	0.400	N-Jb3-.04-2	Bus					58.371	138.250				58.164
N-Jb3-.04-3	0.400	N-Jb3-.04-3	Bus					58.371	138.250				58.164
N-Jb3-.04-4	0.400	N-Jb3-.04-4	Bus					58.371	138.250				58.164
N-Jb3-.04-5	0.400	N-Jb3-.04-5	Bus					58.371	138.250				58.164
N-Jb3-.04-6	0.400	N-Jb3-.04-6	Bus					58.371	138.250				58.164
Nbg-10-B-1	110.000	Nbg-10-B-1	Open Air					16.944	37.811				16.383
	110.000	Nbg-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
	110.000	Nbg-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
	110.000	Nbg-10-C-2	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
	110.000	Nbg-10-C-1	CB	80.000	31.500	33.618	11.743	16.944	37.811	16.941	16.957	0.736	
Nde-1-B-1	15.000	Nde-1-B-1	Open Air					16.358	41.944				15.265
	15.000	Nde-10/1-CL-1n	CB	80.000	25.000	26.681	9.320	16.358	41.944	16.358	17.660	6.657	
	15.000	Nde-10/1-CL-2n	CB	80.000	31.500	33.618	11.743	16.358	41.944	16.358	17.660	6.657	
Nde-10-B-1	110.000	Nde-10-B-1	Open Air					14.241	32.231				13.477
	110.000	Nde-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
	110.000	Nde-10/1-CH-2n	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
	110.000	Nde-10-C-1	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
	110.000	Nde-10-C-3	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
	110.000	Nde-10-C-2	CB	80.000	31.500	33.618	11.743	14.241	32.231	14.118	14.207	1.593	
Rwi-1-B-1	15.000	Rwi-1-B-1	Open Air					3.876	9.448				3.649
	15.000	Rwi-10/1-CL-1n	CB	31.500	25.000	26.681	9.320	3.876	9.448	3.876	3.943	0.719	
Rwi-10-B-1	110.000	Rwi-10-B-1	Open Air					2.781	5.816				2.579
	110.000	Rwi-10/1-CH-1n	CB	80.000	31.500	33.618	11.743	2.781	5.816	2.781	2.782	0.049	
	110.000	Rwi-10-C-1	CB	80.000	31.500	33.618	11.743	2.781	5.816	2.781	2.782	0.049	
Sha-10-B-1	110.000	Sha-10-B-1	Open Air					22.786	56.750				21.931
	110.000	Sha-20/10-CL-1n	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	
	110.000	Sha-10-C-1	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	
	110.000	Sha-10-C-2	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	
	110.000	Sha-20/10-CL-2n	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	
	110.000	Sha-20/10-CL-3n	CB	80.000	31.500	33.618	11.743	22.786	56.750	22.710	24.859	10.111	

3-Phase Fault Currents

Bus		**Device**		**Device Capacity (kA)**				**Short-Circuit Current (kA)**					
ID	kV	ID	Type	Making Peak	Ib sym	Ib asym	Idc	I"k	ip	Ib sym	Ib asym	Idc	Ik
Sha-20-B-1	220.000	Sha-20-B-1	Open Air					34.636	85.537				34.498
	220.000	Sha-20-C-Grid	CB	80.000	31.500	33.618	11.743	34.636	85.537*	34.636*	35.452*	7.561	
	220.000	Sha-20/10-CH-1n	CB	80.000	31.500	33.618	11.743	34.636	85.537*	34.636*	35.452*	7.561	
	220.000	Sha-20/10-CH-2n	CB	80.000	31.500	33.618	11.743	34.636	85.537*	34.636*	35.452*	7.561	
	220.000	Sha-20/10-CH-3n	CB	80.000	31.500	33.618	11.743	34.636	85.537*	34.636*	35.452*	7.561	

ip is calculated using method C
Ib does not include decay of non-terminal faulted induction motors
Ik is the maximum steady state fault current
Idc is based on X/R from Method C and Ib as specified above

LV CB duty determined based on service rating.
Total through current is used for device duty.

* Indicates a device with calculated duty exceeding the device capability.

\# Indicates a device with calculated duty exceeding the device marginal limit. (95 % times device capability)

Ref. No. RW-01

Date: 15th April 2015

To: Eng. William BIHOYIKI
Ag. Head of Electricity Transmission Unit
Energy Utility Corporation Limited
Rwanda Energy Group

Eng. NGIZWENAYO Dieudonné
Director of Energy Planning and Design
Energy Development Corporation Limited
Rwanda Energy Group

Preparatory Survey on
The Project for Improvement of Substations and Distribution Network Phase 2.

Subject: Resettlement and Land Acquisition Criteria

Dear Eng. BIHOYIKI and Eng. NGIZWENAYO

We would like to ask you to clarify resettlement and land acquisition criteria for preparation of an Abbreviated Resettlement Action Plan on the captioned project.

We understand that there is no formal regulations/guidelines concerning Right of Way or electrical line clearance in Rwanda and EDCL/EUCL have applied different criteria to projects in the past. For the captioned project, the Right of Way for each electrical line is set and indicated in Table 2.2.1-2 Electrical Conditions (p.20) in the Field Report singed by the JICA Study Team, EDCL and EUCL on 2 April 2015. Hence, it was our understanding that these ROW are the criteria for land acquisition and resettlement. We understood that lands will be acquired only where towers are constructed and required areas will vary depending on the type of tower. We also understood that for resettlement, ALL structures such as houses and shops and trees within the ROW should be resettled.

However, through telephonic communications between me and Eng. BIHOKI, we learned that there is an additional condition, that “the structures and trees with a certain distance from the lowest conductor are not subject of resettlement,” which is not indicated in the Field Report, nor mentioned during discussions between the JICA Study Team and EUCL/EDCL.

Please present criteria in writing including the following information.

1. The ROW for each electrical line.

2. Criteria for Land Acquisition

3. Criteria for Resettlement such as a minimum clearance (in meters) from the lowest conductor or any other conditions applicable.

We would like to ask you to present criteria by **22 April 2015** as this information is required in a report submitted by the JICA Study Team to the JICA Head Quarter.

We hope you understand the importance of this clarification and common understanding on this issue among all parties involved. Without clear criteria, we are not able to embark on the preparation of a resettlement action plan; hence it may lead to a delay in implementing the project.

Your prompt reaction is highly appreciated.

Sincerely yours,

Asami KABASAWA
JICA Study Team
Yachiyo Engineering Co.,Ltd

Rwanda Energy Group | Energy Utility Corporation Limited

Kigali, 16 April 2015

Ref: 11.07.023/........./15/MD/LVM/WB/kf

Attn: Ms.Asami KABASAWA
JICA Phase-II Study Team,
Yachiyo Engineering Co.,Ltd,
Tel :+(81)-3-5906-3749,
Fax: :+(81)-3-3221-5705.

Dear Ms.Kabasawa;

Ref : Preparatory Survey on The Project for Improvement of Substations and Distribution Network JICA-Phase 2.

Sub: ROW, Resettlement and Land Acquisition Criteria

Reference is made to the letter No.RW-01 dated on 15th April 2014, requesting for the information related to ROW, Land acquisition and Resettlement criteria for the preparation of Resettlement Action Plan on the captioned project above (Improvement of Substations and Distribution Network JICA-Phase2).

I would like to inform you that, the ROW of 15kV Single circuit indicated in the Table2.2.1-2 Electrical Conditions (pg17) of the Field Report signed by EUCL and EDCL representatives on 2nd April, 2015 is revised as 10m width (5m+5m) instead of 6m wide (3m+3m). All other information as requested are here with attached:

Yours Sincerely,

William BIHOYIKI
Ag. Head of Electricity Transmission Unit

Cc:

- DOP-EUCL
- Director of Planning-EDCL
- MD-EDCL;
- CEO-REG

PREPARATORY SURVEY ON IMPROVEMENT OF SUBSTATIONS AND DISTRIBUTION NETWORK JICA-PHASE 2 IN THE REPUBLIC OF RWANDA

Table A: Criteria for Resettlement

No	Items	ROW, Land Acquisition and Criteria for Resettlement
1	ROW	110kV T/L: 15m width (7.5m +7.5m) 15kV D/L for double circuits: 10m width (5m +5m) 15kV D/L for Single circuit: 10m width (5m +5m)
2	Land Acquisition	Lands are acquired only where towers will be erected. The details of lands required for towers (GIS coordinates, surface area, height, etc...,) will be provided after lines (Line route, Line profile and Tower spotting) design is completed.
3	Resettlement of structures lived or used by people such as houses, shops, etc.	A minimum vertical clearance from the lowest conductor to the top of structures is 5m. This is applied to the transmission line (110kV) and all distribution lines (15kV) of the captioned project. Structures within ROW that do not meet the above minimum clearance, meaning the distance between the lowest conductor and the top of structures is less than 5m, are subject of resettlement.
4	Resettlement of trees	All trees within ROW must be removed.
5	Resettlement of other objects	Other objects within ROW not meeting the minimum clearance will be evaluated based on social impacts and safety.

N.B:

The minimum clearance for this project is established with reference to the international standards such as IEC and other good practice. The clearance is set with an additional distance as a precautionary safety measure.

BIHOGIKI William
Ag. Head of ETU,
16/04/15

Kazungu Frederick
Project Manager (JICA-2 Project)
16/04/2015

RDB | RWANDA DEVELOPMENT BOARD

Kigali....07/05/2015.........
Ref.: RDB/3/EC/JDK/.107../05/15

Mr Emmanuel KAMANZI
Managing Director
Energy Development Corporation Limited
P.O.Box 537 Kigali-Rwanda
Tel.: + (250) 252 573 666

Dear Sir,

Re: Transmission of Terms of Reference for Environmental Impact Assessment (EIA) study.

Reference made to your letter REF Nº 11.07.023/401/DIR-MD/EK/pk submitting the brief for the construction and improvement of substations, electrical transmission lines & distribution of network in Kigali (Gasogi, Kabuga and Ndera);

After review and analysis of the document, the field visit and consideration of the provisions of laws and regulations governing EIA in Rwanda, we would like to inform you that the project falls in the category of those projects that have to undertake an environment impact assessment study prior to their implementation.

It is in this regard that the attached Terms of Reference were prepared to guide the conduct of EIA study for the project. The certificate of approval will be issued after review and approval of the EIA study report.

Sincerely,

for

Imbabazi Gashugi

Clare AKAMANZI
Chief Operating Officer

RWANDA DEVELOPMENT BOARD (RDB) OSC

Cc:
- Mayor of Kigali City
- Director General of REMA
- Managing Director/EUCL
- Mayor of Gasabo District

Corner Blvd. de L'Umuganda (Airport Rd) & Nyarutarama Road, P. O. Box 6239, Gishushu, Kigali, Rwanda. Email: info@rdb.rw

EIA TERMS OF REFERENCE

CONSTRUCTION AND IMPROVEMENT OF SUBSTATIONS, ELECTRICAL TRANSMISSION LINES & DISTRIBUTION OF NETWORK IN KIGALI

A. Introduction

These Terms of Reference (TOR) outline the aspects of an Environmental Impact Assessment (EIA) which when thoroughly addressed will provide a comprehensive evaluation of the site, in terms of predicted environmental impacts, needed mitigation strategies, potentially viable alternatives to the development proposed and all related legislation.

Special consideration should be given to:

Upland Areas: Issues such as slope stability, impact on drainage patterns, property etc. should be examined. The path of the corridor cleared of vegetation for transmission lines and substations should be the major focus of this exercise.

Rivers/ Riverine Areas: Issues such as erosion and siltation, macro-invertebrate habitat destruction, disrupting of regular flow of the river and the possible impact of upstream activities on the wetland.

Distinct Terrestrial Forest Types: Issues relating to the specific growth form of the vegetation, the carrying capacity, the successional stage of the forest and the projected level of disturbance which the forest can withstand.

Sites located within and adjacent to areas listed as protected or having protected species: The main issue(s) of concern will in part be determined by the local legislation as well as GoR responsibilities under applicable international conventions. The impact of the development on the specific sensitivities of the protected area should be highlighted. Mitigation of impacts should assess if the post mitigation status would be acceptable in the protected area context. Alternative sites should be rigorously evaluated.

Socio–Economic issues such as land acquisition and impact of these conveyances on daily subsistence and commerce in the community should be closely examined.

B. **Terms of Reference**

The Environmental Impact Assessment should:

1) Provide a complete description of the corridor proposed for development. This should include a description of the main elements of the development, highlighting areas to be reserved for construction, the creation of verges and other green areas.
2) Identify the major environmental issues of concern through the presentation of baseline data which should include social and cultural considerations. Assess public perception of the proposed development.
3) Outline the Legislations and Regulations relevant to the project and highlight how compliant the project is and will be throughout its life span.
4) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
5) Identify mitigation actions to be taken to minimize adverse impacts and quantify associated costs.
6) Design a Monitoring Plan which should ensure that the mitigation plan is adhered to.
7) Describe the alternatives to the project that could be considered at that

site

C. Tasks

To ensure that a thorough Environmental Impact Assessment is carried out, it is expected that the following tasks be undertaken:

1. Description of the Project

Provide a comprehensive description of the project, noting areas to be reserved for construction, verges and proposed green areas. This will also include an account of activities and features which will introduce risks or generate impact (negative and positive) on the environment. This should involve the use of maps; site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post construction plans. If the project is to be done on a phased basis it is expected that all phases be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids be included.

The need and objectives of the project should clearly elaborated in the report.

2. Description of the Environment

This task involves the generation of baseline data which is used to describe the study area as follows:

i) Physical environment

ii) biological environment

iii) socio-economic and cultural constraints.

It is expected that methodologies employed to obtain baseline and other data be clearly detailed.

Baseline data should include:

(A) Physical

i) a detailed description of the existing **geology** and **hydrology.** Special emphasis should be placed on storm water run-off and drainage patterns. Any slope stability issues that could arise should be thoroughly explored.

ii) **Water quality** of any existing rivers, ponds, or streams in the vicinity of the corridor or substation. Quality Indicators should include but not necessarily be limited to suspended solids, turbidity, oil and grease.

iii) Climatic conditions and air quality in the area of influence including particulate matter, NO_X, SO_X, wind speed and direction, precipitation, relative humidity and ambient temperatures,

iv) Noise levels of the undeveloped site and the ambient noise in the area of influence.

v) Topographic/relief aspect of the project corridor should be presented, together with the type of rock/soil (geology)

v) Obvious sources of pollution existing and extent of contamination.

(B) Biological

Present a detailed description of the flora and fauna (aquatic and terrestrial) in the proposed corridor of influence, with special emphasis on rare, endemic, protected or endangered species. Migratory species should also be considered. There may be the need to incorporate micro-organisms to obtain an accurate baseline assessment. Generally, species dependence, niche specificity, community structure and diversity ought to be considered.

(C) Socio-economic & cultural

Present and projected population; present and proposed land use; planned development activities, issues relating to squatting and relocation, community structure, employment, distribution of income, goods and services; recreation; public health and safety; cultural peculiarities, aspirations and attitudes should be explored. The historical importance of the area should also be examined. While this analysis is being conducted, it is expected that an assessment of public perception of the proposed development be conducted. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires.

3 - Legislative and Regulatory Considerations

Outline the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels.

The examination of the legislation will include those pertinent to electrical transmission line construction and operation projects and the appropriate international convention where applicable.

Emphasis should be put on showing how compliant the project is or will be with relation to the listed laws and regulations.

Demonstrate how the project goes in line with City Master Plan.

For the purpose of compliance monitoring, an institutional and administrative framework should be set in accordance and relevance of roles with regard to this specific project.

4 - Identification of Potential Impacts

Identify the major environmental and public health issues of concern and indicate their relative importance to the design and operation of the development. Identify potential impacts as they relate to, (but are not restricted by) the following:

- public health and safety
- change in drainage pattern
- flooding potential
- aesthetics
- landscape impacts of excavation and construction
- loss of natural features, habitats and species by construction and operation
- pollution of potable, surface and ground water
- air pollution
- socio-economic and cultural impacts.
- risk assessment
- noise

Distinguish between significant positive and negative impacts, direct and indirect, long term and immediate impacts. Identify trigger, avoidable reversible and irreversible impacts. Characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should be represented in matrix form with separate matrices for pre and post mitigation scenarios. An exhaustive list of impacts including a numerical weighting based on a stated methodology should be included.

5 Mitigation

Prepare guidelines for avoiding, as far as possible, any adverse impacts due to proposed usage of the corridor and utilizing of existing environmental attributes for optimum development. Quantify and assign financial and economic values to mitigating methods. Mitigation measures should be tangible and concrete actions.

6 Monitoring

Design a plan to monitor implementation of mitigatory or compensatory measures and project impacts during and post construction and decommissioning of the power plant. An Environmental Management Plan for the long term operations of the development should also be prepared.

An outline monitoring programme should be included in the EIA, and a detailed version submitted to RDB for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report should include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.
- Frequency of reporting to REMA

The Monitoring report should also include, at minimum:

- Raw data collected. Tables and graphs are to be used where appropriate
- Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
- Recommendations
- Appendices of data and photographs if necessary.

7 - Project Alternatives

Examine alternatives to the project including the no-action alternative. This examination of project alternatives should incorporate the use history of the overall area in which the corridor is located and previous uses of the site itself. Refer to REMA guidelines for EIA preparation.

All Findings must be presented in the **EIA report** and must reflect the headings in the body of the TORs, as well as references. One hard copy and an electronic copy with Word and PDF files of the report should be submitted. The report should include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.