REPUBLIC OF RWANDA
Ministry of Infrastructure (MININFRA)
Rwanda Electricity Corporation (RECO)

PREPARATORY SURVEY
ON
THE PROJECT
FOR
UPGRADING, REHABILITATION AND EXPANSION OF SUBSTATIONS AND DISTRIBUTION NETWORK
IN
THE REPUBLIC OF RWANDA

Preparatory Survey Report

January 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
MITSUBISHI RESEARCH INSTITUTE, INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the Project for Upgrading, Rehabilitation and Expansion of Substations and Distribution Network in the Republic of Rwanda, and organized a survey team headed by Mr. Akihisa MANITA of Nippon Koei Co., Ltd (and consist of NIPPON KOEI Co., Ltd. and MITSUBISHI RESEARCH INSTITUTE Inc.) between May 8, 2010 and December 22, 2010.

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

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

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

January 2011

Kyoko KUWAJIMA
Director General,
Industrial Development Department
Japan International Cooperation Agency

Executive Summary

Executive Summary

1. Country Overview

Rwanda is a landlocked country located in Central Africa. Rwanda's countryside is covered by grasslands and small farms extending over rolling hills, with areas of rugged mountains that extend southeast from a chain of volcanoes in the northwest. The divide between the Congo and Nile drainage systems extends from north to south through western Rwanda at an average elevation of almost 2,750 m. On the western slopes of this ridgeline, the land slopes abruptly toward Lake Kivu, one of the Great Lakes, and the Ruzizi River valley, which form the western boundary with the Democratic Republic of the Congo and constitute part of the Great Rift Valley. The eastern slopes are more moderate, with rolling hills extending across central uplands at gradually reducing altitudes, to the plains, swamps, and lakes of the eastern border region.

Although Rwanda is located only two degrees south of the equator, Rwanda's high elevation makes the climate temperate. The average daily temperature near Lake Kivu, at an altitude of 4,800 feet (1,463m) is 73 °F (22.8°C). During the two rainy seasons (February-May and September-December), heavy downpours occur almost daily, alternating with sunny weather. Annual rainfall averages 800 mm but is generally heavier in the western and northwestern mountains than in the eastern savannas.

Negative growth was recorded since the civil war broke out in 1990. The country further suffered from a fatal blow due to the massacre incident in 1994. Afterwards by 1999, GDP recovered to the same level as before the civil war, with the support from donor countries and sound economic policies.

As of 2009, the GDP was US$5.10 billion and GNI per person was US$510 as of 2009. The proportion in GDP of the Primary Industry (agriculture, forestry and fishery), the Second Industry (mining and manufacturing) and the Tertiary Industry (commercial and service) is 36.4%, 14.2% and 43.7%, respectively. However, according to the classification of OECD/DAC, Rwanda is classified as Least Developed Countries (LDC) and approximately 30% of the people in this country are living below the poverty line. Considering such circumstances, President Paul Kagame is aiming at the job development and energetic economy by the realization of industrial development including the Information-Communication Technology (ICT) industry funded from overseas mainly.

2. Background of Project

As of 2008, the country-wide electrification rate of Rwanda is extremely low at 5%. Even in cities like Kigali City, the rate is estimated to be only 25% (approximately 3% in rural areas). The low rate of electrification adversely affects the raising of living standard, improvement of public services, and development of industry.

The electric power supply for urban areas, like Kigali City, has been provided by Electrogaz, a state-controlled company. However, most of the present distribution lines are constructed in the 1880s, and thus have already aged and deteriorated due to insufficient maintenance during the civil war. Such facilities are causing electrical faults. It is also difficult to repair the faults because of shortage in the availability of their spare parts. Unrecovered system or delay in the recovery of the fault may cause a nationwide blackout. Therefore, it is difficult to maintain stable continuous supply by relying on the existing facilities.

According to Rwanda Vision 2020 which is a long-term plan up to 2020, the Government of Rwanda aims at raising the electrification rate of general households to 35% by 2020. Also, according to the Economic Development Poverty Reduction Strategy (EDPRS) which is the middle term strategy for 2008-2012 prepared on the basis of Rwanda Vision 2020, the Government of Rwanda plans to increase electrified households from 97,000 in 2008 to 350,000 in 2012. It also intends to improve the electrification rate of medical agencies and public schools to 100% and 50% respectively by 2012.

To achieve the target, the Ministry of Infrastructure prepared the “Electricity Access Rollout Program” (EARP) through the fund of World Bank, which is the comprehensive electricity development plan in Rwanda. All self-funded or donor-funded projects related to electricity development in Rwanda shall follow EARP. Thus, this project follows the provision under EARP.

3. Outline of Study Result and Contents of the Project

Investigation periods are as follows:

- First Field Survey: May 8, 2010 ~ June 28, 2010
- Second Field Survey: December 11, 2010 ~ December 22, 2010

The Project consists of the following 4 components. The outline of each component is described as below.

(1) Rehabilitation of Substations (Jabana and Gikondo in Kigali)

Jabana and Gikondo substations located in Kigali City are classified as highly important, and are vital in serving the power system of the country. Rehabilitation for these substations would

bring large benefit in stabilizing operation and ensuring reliability of the power supply system.

The scope of works for this component is described as below.

1) Jabana Substation
- Replacement of main transformers to increase capacity (existing 6 MVA x 2 10 MVA x 2)
- Replacement of 110 kV outdoor switchgears and 15 kV indoor switchgear (except the circuit breaker and current transformer in the 110 kV Birembo feeder)
- Replacement of 110 kV protection and control panel
- New installation of console-type panel box and unification of the existing 110 kV transmission line control and supervisory system (Human interface unit)
- New installation of disconnecting switch on the 110 kV Musha feeder at Birembo Substation

2) Gikondo Substation
- Replacement of 110 kV outdoor switchgears
- New installation of 110 kV double buse (pipe type)

(2) Upgrading of Substations (Musha and Rwinkwavu in Eastern Province)

Power system voltage in Musha and Rwinkwavu substations will be upgraded from the existing 70 kV to 110 kV, through the Project. This is expected to be beneficial from the viewpoint of reinforcement, loss reduction and increase of reliability of the power supply system in the country. By upgrading these two substations, the existing 70 kV power system between Birembo and Rwinkwavu substations will be upgraded to 110 kV. Hence, the Project would offer large benefits to the existing and new customers in the eastern province.

The scope of works for this component is described as below.

1) Musha Substation
- Replacement of main transformer to increase capacity (existing 2.5MVAx1→10MVAx1)
- New installation of 110 kV outdoor switchgear and 15 kV indoor switchgear
- New installation of 110 kV protection and control panel
- Replacement of the existing transmission towers (2 towers)

2) Rwinkwavu Substation
- Replacement of main transformer to increase capacity (existing 2.5MVA x 1→6MVA x 1)
- New installation of 110kV outdoor switchgear and 15kV indoor switchgear
- New installation of 110kV protection and control panel

(3) Upgrading of Distribution Network in Huye from 6.6 kV to 30 kV

The voltage level of the distribution network in Huye will be upgraded from the existing 6.6 kV to 30 kV. The Project is to be beneficial from the viewpoint of loss reduction of the power system and improvement of the quality of electricity.

The scope of works for this component is described as below.

- Upgrading of the existing substations, switching stations and distribution transformers

(4) Expansion of Distribution Network in Kigali

The electrified regions in Kigali are located at the center of the city and most of the regions outside the center of Kigali are non-electrified. The main purpose of the Project is to increase electrification access through expansion of the 15 kV and 400 V distribution network in Kigali.

The scope of works for this component is described as below.

- Expansion of the distribution network (15 kV middle voltage lines – 25.0 km, 0.4 kV low voltage lines – 30.6 km)
- New installation of 15/0.4 kV distribution transformers (18 sets)

4. Construction Time Schedules

Items such as the contract of the Consultant, preparation of tender documents, tendering and the form of contract for the Contractor are mainly included in the detailed design stage of the Project. The work period for the said stage is expected to be about six months after exchange of notes (E/N) is concluded between both countries. Meanwhile, the preparation of design drawings for approval, manufacturing, transportation, erection works, trial operation and taking-over are included in the procurement and construction stages. The corresponding work period for said stages are about between 20 and 24 months, respectively, after the permission on the contract of the Contactor is issued by the Ministry of Foreign Affairs (MOFA) of Japan.

5. Project Evaluation

It is expected that the Project will contribute to the following, mainly through the implementation of rehabilitation and upgrading of substations in Kigali, in the eastern province and Huye, including the distribution network in Kigali.

i) Prevention of adverse impacts such as long-term power outages affecting the existing customers in Kigali and Huye, by replacing the deteriorated equipment at the substations and

distribution network

ii) Supply of the stable power

iii) Increase of the present electrification rate

Therefore, the beneficial effects lead to positive impacts not only to the national economy, but also to the country's welfare, education and healthcare. Considering this, it is judged that the validity of the implementation of the Project is very high.

(1) Quantifiable Effects

The quantifiable effects due to the Project are as follows:

1) The following new customers are expected to be provided with power services led by the increase of main transformer's capacity and expansion of distribution network

: General Consumers - 45,263 households (approximately 195,000 persons)
: Schools - 65 sites
: Health Centers - 9 sites

2) Prevention of adverse impacts such as long-term power outages affecting the following existing customers by replacing the deteriorated equipment at the substations and distribution network

: General Consumers – 70,165 households (approximately 301,000 persons)
: Schools - 95 sites
: Hospitals – 11 sites
: Health Centers - 67 sites

3) Reduction of carbon dioxide emission, which reaches about 328 tons/year, through the improvement of the distribution loss ratio

: 328 [ton/year]

(2) Qualitative Effects

The qualitative effects due to the Project are as follows:

1) Beneficial effects to general customers

Through the implementation of the Project, new customers will be provided with brighter and safer lights than the kerosene lamps currently used. In this way, it is expected to realize the benefits such as i) improvement of education level by secure the learning period of children, and ii) increase of living standards by making it possible for people, particularly women, to work in their houses. In addition, the use of much needed home electronics such

as television or stereo sets will become more possible. Thus, this leads to significant improvement of life style of new customers. It is noted that the volume of quality information available through television networks are expected to directly benefit to the improvement of life style and living standard of households.

Moreover, mobile phones, which have absolute importance in ensuring living convenience for people in rural areas, will now serve as easy communication means of accessing the capital town of Kigali City. Especially, the users in the eastern province will benefit from the stable power supply for the battery charger of mobile phones. As the existing customers are provided with a more stable power supply, damages to personal computers and battery chargers for mobile phones due to frequent voltage fluctuations are minimized.

2) Beneficial effects to medical facilities

Through the implementation of the Project, it is expected that medical facilities will improve their service levels due to the acceleration of introduction of advanced medical facilities and personal computers. Ensuring a stable power supply is indispensable at hospitals and medical centers, especially, for nighttime medical treatment of patients, particularly those pregnant. It becomes possible to prevent the degradation of drugs or vaccines with the stable power supplied to refrigerators used as storage. There were reports that many general medical centers could not perform their duties during power shortage since most of them do not have diesel generators or other temporary power facilities.

Considering the above circumstances, the beneficial effects brought by the implementation of the Project to medical facilities is significant.

3) Beneficial effects to educational facilities

At present, the educational system in Rwanda consists of primary schools and secondary schools. The current school system in the country adopts a two-part system (7:00 a.m. to 12:00 p.m., 12:00 p.m. to 6:00 p.m.) since the number of students in each school far exceeds the accommodation capacity of the facilities. According to information confirmed through interviews with school officials of the non-electrified schools in Kigali, they strongly need electrification in order to solve their present problems. As an example, without stable power for electric lighting, school teachers find it difficult to prepare educational materials during early hours in the morning before sunrise.

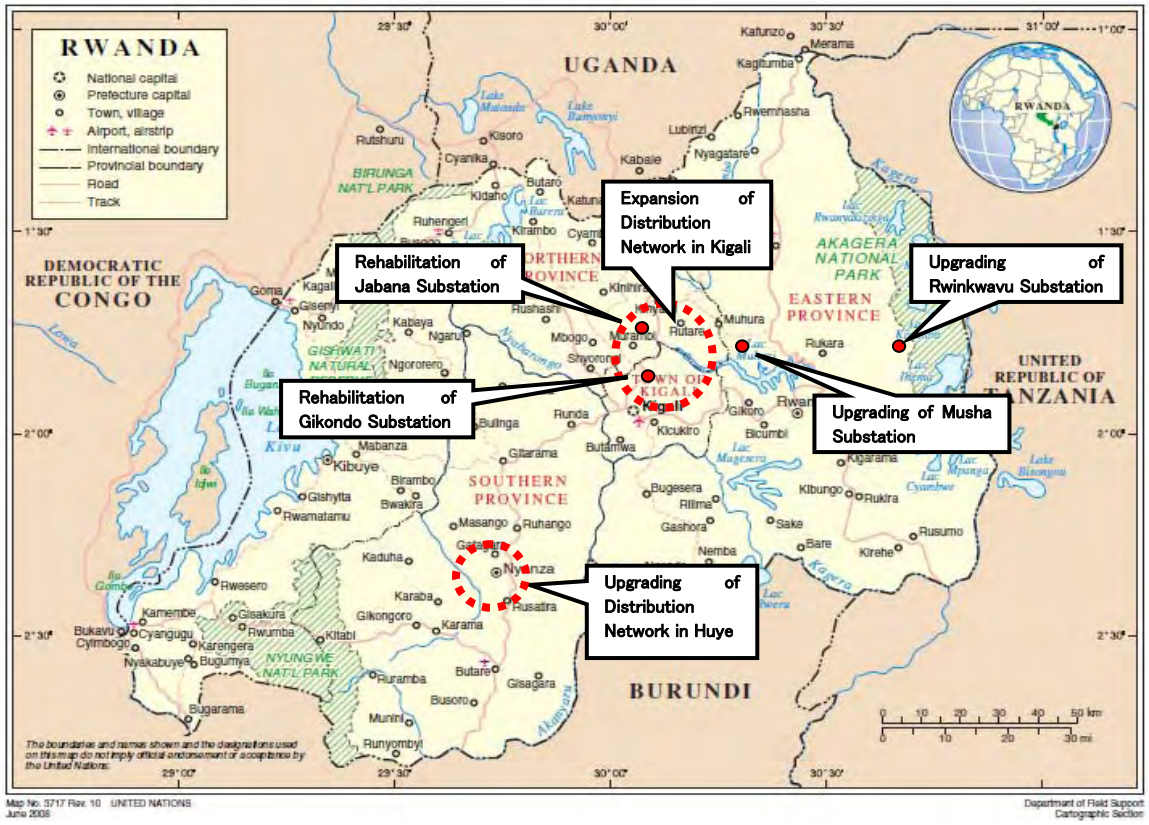
In addition, the introduction of electrical facilities required for education such as computers, projectors, photocopy machines and lightings are also expected to enhance the education system in the country.

4) Decentralization of residents in Kigali

Although the public houses are concentrated in Kigali City at present, there are still many which are deprived of electrical services due to the generally high price of the commodity.

The planned areas for expansion of distribution network in Kigali under the Project are located in suburban areas in Kigali City. Therefore, there is a possibility that many residents living now in the center of Kigali City will move to such planned areas after electrification is implemented under the Project, and their life environmental will be improved significantly by obtaining the benefits as described in the above 1) to 3).

Location Map



(Source：Prepared by the JICA Study Team)

Preparatory Survey on
The Project for Upgrading, Rehabilitation and Expansion of Substations and Distribution Network
in the Republic of Rwanda

Preparatory Survey Report

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Abbreviations

A/P:	Authorization to Pay
ANSI:	American National Standard Institute
B/A:	Banking Arrangement
BTC:	Belgian Technical Cooperation
CB:	Circuit Breaker
CO2:	Carbon Dioxide
DAC:	Development Assistance Committee
D/L:	Distribution Line
EDPRS:	Economic Development Poverty Reduction Strategy
E/N:	Exchange Notes
EIA:	Environmental Impact Assessment
EIR:	Environmental Impact Report
EEC:	European Economic Community
EU:	European Union
F/S	Feasibility Study
IEC:	The International Electrotechnical Commission
GDP:	Gross Domestic Product
GNI:	Gross National Income
GIS:	Gas Insulated Switchgear
GOR:	Government of Rwanda
GWh:	Gigawatt hour= 10^9 Wh
ICT:	Information and Communications Technology
IEEE:	The Institute of Electrical and Electronics Engineer
IT:	Information Technology
JCS	Japanese Cable Makers' Association Standard
JEC:	Japan Electrotechnical Committee
JEM:	Japan Electric Machine Industry Association
JICA:	Japan International Cooperation Agency
JIS:	Japanese Industrial Standards
kV:	kilovolt = 10^3 V
kW:	kilowatt = 10^3 W
kWh:	kilowatt hour = 10^3 Wh
LDC:	Least Developed Country
MININFRA:	Ministry of Infrastructure
MVA:	Megavolt Ampere = 10^6 VA
MW:	Megawatt = 10^6 W
NEC:	National Electrical Code
O&M:	Operation and Maintenance
ODA:	Official Development Assistance
OECD:	Organization for Economic Co-operation and Development
OECF:	Overseas Economic Cooperation Fund
OFID:	OPEC Fund for International Development
PCB:	Poly Chlorinated Biphenyl
PF:	Power Factor
PPP:	Public Private Partnership
RDB:	Rwanda Development Board
RECO:	Rwanda Electricity Corporation
REMA:	Rwanda Environment Management Authority
RURA:	Rwanda Utilities Regulatory Agency
RWASCO:	Rwanda Water and Sanitation Corporation
RWF:	Rwanda Franc
SCADA:	Supervisory Control And Data Acquisition
SF6:	Sulfur Hexafluoride
S/S:	Substation
TICAD:	Tokyo International Conference on African

TPP:	Thermal Power Plant
UERP:	Urgent Electricity Rehabilitation Program
US$:	United State Dollar
WB:	The World Bank

Chapter 1
Background of the Project

Chapter 1 Background of the Project

1-1 Basic Concept of the Project

(1) Upstream Plan and Objectives of the Project

As of 2008, the country-wide electrification rate of Rwanda is extremely low at 5%. Even in cities like Kigali City, the rate is estimated to be only 25% (approximately 3% in rural areas). The low rate of electrification adversely affects the raising of living standard, improvement of public services, and development of industry.

The electric power supply for urban areas, like Kigali City, has been provided by Electrogaz, a state-controlled company. However, most of the present distribution lines are constructed in the 1880s, and thus have already aged and deteriorated due to insufficient maintenance during the civil war. Such facilities are causing electrical faults. It is also difficult to repair the faults because of shortage in the availability of their spare parts. Unrecovered system or delay in the recovery of the fault may cause a nationwide blackout. Therefore, it is difficult to maintain stable continuous supply by relying on the existing facilities.

(2) Relation of Development Policy of Power Sector in Rwanda and this Project

According to Rwanda Vision 2020 which is a long-term plan up to 2020, the Government of Rwanda aims at raising the electrification rate of general households to 35% by 2020. Also, according to the Economic Development Poverty Reduction Strategy (EDPRS) which is the middle term strategy for 2008-2012 prepared on the basis of Rwanda Vision 2020, the Government of Rwanda plans to increase electrified households from 97,000 in 2008 to 350,000 in 2012. It also intends to improve the electrification rate of medical agencies and public schools to 100% and 50% respectively by 2012.

To achieve the target, the Ministry of Infrastructure prepared the “Electricity Access Rollout Program” (EARP) through the fund of World Bank, which is the comprehensive electricity development plan in Rwanda. All self-funded or donor-funded projects related to electricity development in Rwanda shall follow EARP. Thus, this project follows the provision under EARP.

1-2 Environmental Impact Assessment (EIA)

(1) EIA

In February 2010, the project brief was submitted by the executing agencies. namely the Rwanda Electricity Corporation (RECO) and Rwanda Water and Sanitation Corporation (RWASO) to the Rwanda Development Board (RDB), which is in charge of EIA. As a result of the screening conducted by RDB, RECO and RWASCO were informed that the conduct of EIA is only necessary for the expansion of the distribution network project in Kigali but not for the other three projects. This notification was contained in an official document, RDB/3/EC/039/05/10 dated 13 May, 2010. Additionally, RDB imposed specific implementation conditions during the construction phase and the operation phase of the target substations in this project, as described below.

During the construction phase:

1) The project site shall be fenced using materials that comply with Kigali construction by-laws;
2) No construction works shall be carried out during night hours in order to avoid disturbance to local people living in the vicinity of the project site;
3) Soil that would likely generate dust shall be watered before and after any work. There shall not be heaps of soil at the construction site, otherwise these shall be covered in order to prevent dust pollution;
4) Workers shall be provided with personal protective equipment and shall be insured;
5) National construction practice standards shall be complied with;
6) Warning signs shall be posted close to the project site to inform drivers of vehicles to reduce speed while approaching the worksite.

During the operation phase:

7) Storm water shall be collected and stored for reuse;
8) Staff of the substation shall be provided with toilets which should be properly managed in order to avoid any pollution of soil and water bodies;
9) Solid wastes shall be managed by segregating them at their production point (segregation at source) according to their type. Each type of waste shall have its appropriate treatment;
10) Fire extinguishers shall be provided, installed and regularly serviced for emergency use;
11) Staff of substations and equipment shall be insured;
12) Warning signs shall be posted at strategic points within the substations;

13) The management of RECO and RWASCO shall set up an internal environmental management plan focusing on health, security and environmental measures for its substation staff;

14) The management of RECO and RWASCO commits to execute the mitigation measures proposed in their project document, including the conditions described above during the project life cycle.

In accordance with the proper implementation procedure of Rwanda, RECO and RWASCO are currently working in cooperation with related organizations to acquire EIA related to the expansion of the distribution network project in Kigali by the end of January, 2011.

(2) Expropriation Procedure

Land expropriation is necessary for upgrading the power transmission lines for Musha Substation in the eastern province, for upgrading the distribution network in Huye in the southern province, and for the expansion of the distribution network in Kigali. In Rwanda, the expropriation procedure is set by Law N 18/2007 of 19/04/2007 relating to expropriation in the public interest (Figure 1.2-1).

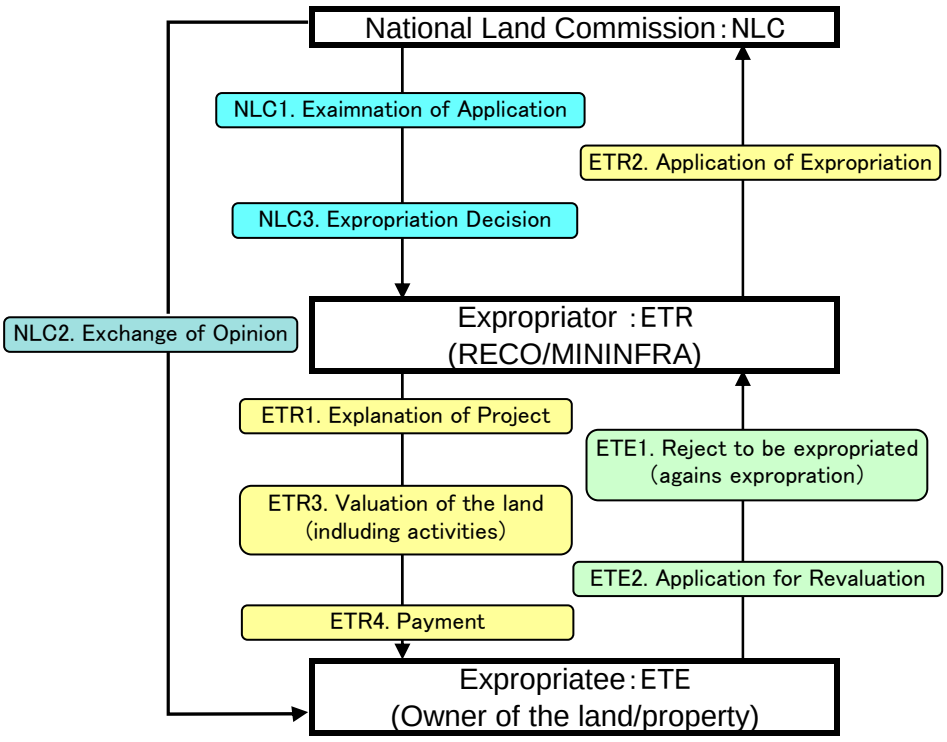


Figure 1.2-1 Expropriation Procedure

(3) Study Team's View

This project is classified as Category B due to the necessity of land expropriation associated with the upgrading of the power transmission lines for Musha Substation in the eastern province, building a new ring main unit (RMU) for the distribution network in Huye in the southern province, and expanding the distribution network in Kigali. However, no resettlement issues are expected. Expropriation of the land will be properly pursued in accordance with the applicable law in Rwanda as described in (2) above.

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) Upstream Plan

The Republic of Rwanda has been reconstructing its social economy which was damaged by the genocide, and is attempting toward further development of the whole country. The Government of Rwanda recognizes the importance of infrastructure development in the local community including the improvement of energy supply to urban and rural areas. As of 2008, the average electrification rate of the whole country is very low at approximately 5%. It is assumed that the rate in urban area is 25%, while that in rural area is only 3%. Such low electrification ratio seems to be an obstacle in improving the livelihood level of the people in Rwanda.

In order to address such situation, the Ministry of Infrastructure (MININFRA) has formulated the "National Energy Policy and National Energy Strategy 2009-2012". Said formulation sets concrete targets such as 1) increase the number of new customers up to 350,000 by year 2012, from 97,000 as of 2008, 2) increase the electrification ratio of medical institutions, administrative institutions and schools up to 100%, 100% and 50%, respectively. In order to achieve the above targets, relevant organizations in Rwanda are making efforts to develop the power sector with the assistance of other international organizations and donors.

Meanwhile, the deterioration of equipment in substations and distribution network which were constructed in the 1970s or 80s has caused high-level transmission and distribution losses and delay of restoration from any power outage related to defects of distribution network facilities. Therefore, rehabilitation and replacement of such deteriorated equipment is urgently required to increase electrification ratio and stabilize power supply to serve the capital town of the country.

(2) Objective of Project

The Project will be implemented aiming to avoid large-scale power outages across the country, which are caused by the deteriorated equipment in substations and distribution network in Kigali, Eastern Province and Huye City. Furthermore, the Project is expected to realize the stable power supply and improvement of the electrification ratio through the increase of the capacity of main transformers and the integration of the voltage level under the Project.

Furthermore, one of the objectives of the Project is also to contribute to the improvement of the electrification ratio in Kigali, which is the capital city noted for rapid increase of population and power demand in recent years, through the implementation of expansion of distribution network.

(3) Outline of the Project

The Project outline and the benefits gained from the implementation of the Project are described below.

1) Rehabilitation of Substations (Jabana and Gikondo in Kigali)

Jabana and Gikondo substations located in Kigali City are classified as highly important, and are vital in serving the power system of the country. Rehabilitation for these substations would bring large benefit in stabilizing operation and ensuring reliability of the power supply system.

Through the implementation of the Project on the rehabilitation of Jabana and Gikondo substations, the following benefits are expected. Based on these benefits, the Project is considered to be highly valid.

a) Increase of new customers led by the increase of the main transformer's capacity at Jabana Substation

: General customers (18,000 household = approximately 77,000 persons), Schools (24 sites), Health centers (3 sites)

b) Prevention of adverse impacts such as long-term power outages to the existing customers in Kigali by replacing the deteriorated equipment of the substations

: General customers (59,010 household = approximately 253,000 persons), Schools (80 sites), Hospitals (7 sites), Health centers (29 sites)

2) Upgrading of Substations (Musha and Rwinkwavu in Eastern Province)

Power system voltage in Musha and Rwinkwavu substations will be upgraded from the existing 70 kV to 110 kV, through the Project. This is expected to be beneficial from the viewpoint of reinforcement, loss reduction and increase of reliability of the power supply system in the country. By upgrading these two substations, the existing 70 kV power system between Birembo and Rwinkwavu substations will be upgraded to 110 kV. Hence, the Project would offer large benefits to the existing and new customers in the eastern province.

Through the implementation of the Project on the upgrading of Musha and Rwinkwavu substations, the following benefits are expected. Therefore, the Project is considered to be highly valid.

a) Increase of new customers led by the increase of the main transformer's capacity at Musha and Rwinkwavu substations

: General customers (24,750 households = approximately 107,000 persons), Schools (33 sites), Health centers (4 sites)

b) Prevention of adverse impact, such as long-term power outage, to the existing customers in the eastern province by replacing the deteriorated equipment of substations

: General customers (6,512 household = approximately 28,000 persons), Schools (9 sites), Hospitals (2 sites), Health centers (24 sites)

c) Reduction of carbon dioxide emission through the improvement of distribution loss ratio

: 65 [ton/year]

d) Standardization of the method of operation and maintenance (O&M), and ensuring compatibility of spare parts of all substations across the country with the integration of voltage level

3) Upgrading of Distribution Network in Huye from 6.6 kV to 30 kV

The voltage level of the distribution network in Huye will be upgraded from the existing 6.6 kV to 30 kV. The Project is to be beneficial from the viewpoint of loss reduction of the power system and improvement of the quality of electricity.

Through the upgrading of the distribution network in Huye, the following benefits are expected. Therefore, the Project is considered to be highly valid.

a) Prevention of adverse impacts such as long-term power outages to the existing customers in Huye by replacing the deteriorated equipment of substations and distribution network

: General customers (4,643 households = approximately 20,000 persons), Schools (6 sites), Hospitals (2 sites), Health center (14 sites)

b) Reduction of carbon dioxide emission by improvement of distribution loss ratio

: 328 [ton/year]

c) Standardization of method of O&M, and ensuring compatibility of spare parts among the substations and distribution network across the country with the integration of voltage level

d) Improvement of system to reduce occurrence of power outages

4) Expansion of Distribution Network in Kigali

The electrified regions in Kigali are located at the center of the city and most of the regions outside the center of Kigali are non-electrified. The main purpose of the Project is to increase electrification access through expansion of the 15 kV and 400 V distribution network in Kigali.

Through the implementation of the Project on expansion of distribution network in Kigali, the following benefits will be expected. Therefore, the Project is considered to be highly valid.

a) Increase of the number of new customers led by the expansion of distribution network in Kigali

: General consumers (2,513 households = approximately 11.000 persons), Schools (8 sites), Health centers (2 sites)

The benefits expected to be gained through the implementation of the Project are shown in Table 2.1-1. The project site is shown in Fig 2.1-1.

1) Secure land for RMU in Huye (4 sites) and new transmission tower (2 sites)
2) Acquire the construction permission required for the construction of burial cable for distribution network in Huye
3) Ensure access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations
4) Construct the roads outside the sites of Musha and Rwinkwavu substations
5) The following issues related to power shutdown works

5)-1. Nomination and allocation of responsible person for this work from RECO

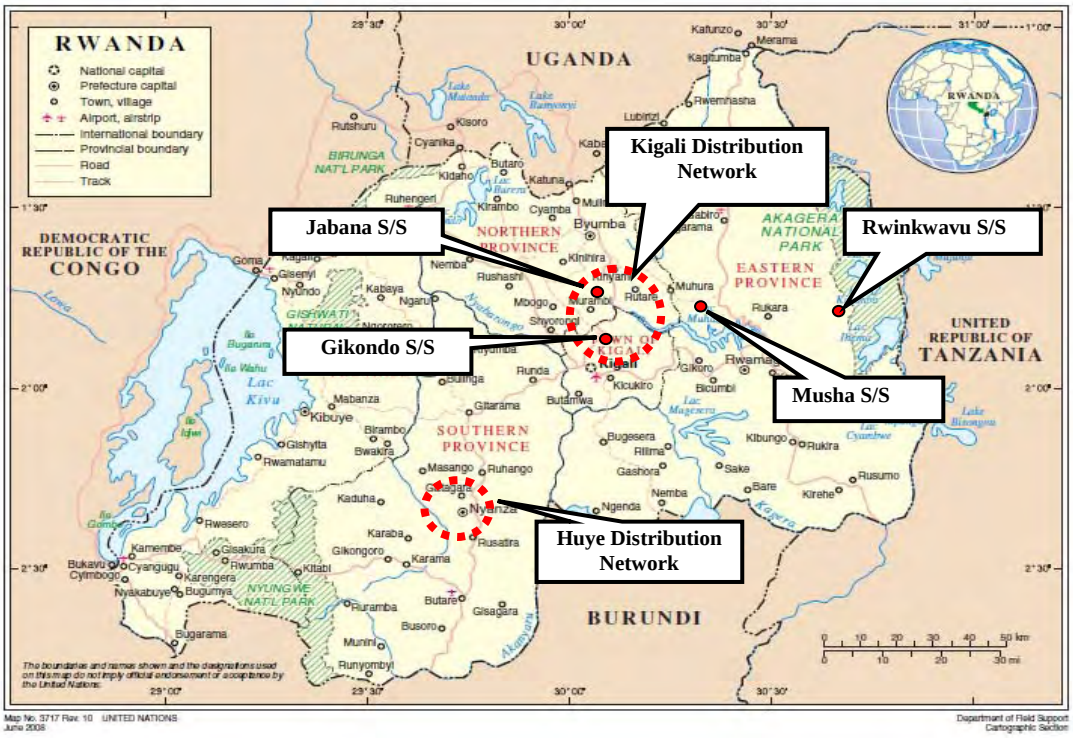
5)-2. Overall coordination of this work by the above responsible person

6) Provide the temporary storage yard with gate and fence for all project sites
7) Prepare the service wires which connect the low voltage line (400/230V) to the customers
8) Prepare the suitable storage facilities for equipment containing PCB
9) Provide water into the water tank in Musha and Rwinkwavu substations
10) Dismantle the existing substations after completion of new substations in Musha and Rwinkwavu substations
11) Relocation and modification of SCADA system

Table 2.1-1 Benefits of the Project

Name of Component	New Customers			Existing Customers			Amount of CO_2 Reduction [ton/year]
	Household (Persons)	School	Health Center	Household (Persons)	School	Medical Institution (Hospital + Health Center)	
1)Rehabilitation of Substations (Jabana and Gikondo)	18,000 (77,000)	24	3	59,010 (253,000)	80	36 (7+29)	-
2)Upgrading of Substations (Musha and Rwinkwavu)	24,750 (107,000)	33	4	6,512 (28,000)	9	26 (2+24)	65
3)Upgrading of the Distribution Network in Huye	-	-	-	4,643 (20,000)	6	16 (2+14)	328
4)Expansion of the Distribution Network in Kigali	2,513 (11,000)	8	2	-	-	-	-
Total	45,263 (195,000)	65	9	70,165 (301,000)	95	78 (11+67)	393

（Source: Prepared by the JICA Study Team）



（Source: Prepared by the JICA Study Team）

Fig 2.1-1 Project Site

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Design

The scope of works for the Project is described below.

I. Rehabilitation of Substations (Jabana and Gikondo Substations in Kigali)

1) Jabana Substation

- Replacement of main transformers to increase capacity (existing 6 MVA x 2⇒10 MVA x 2)
- Replacement of 110 kV outdoor switchgears and 15 kV indoor switchgear (except the circuit breaker and current transformer in the 110 kV Birembo feeder)
- Replacement of 110 kV protection and control panel
- New installation of console-type panel box and unification of the existing 110 kV transmission line control and supervisory system (Human interface unit)
- New installation of disconnecting switch on the 110 kV Musha feeder at Birembo Substation

2) Gikondo Substation

- Replacement of 110 kV outdoor switchgears
- New installation of 110 kV double buse (pipe type)

II. Upgrading of Substations (Musha and Rwinkwavu Substations in Eastern Province)

1) Musha Substation

- Replacement of main transformer to increase capacity (existing 2.5MVAx1⇒10MVAx1)
- New installation of 110 kV outdoor switchgear and 15 kV indoor switchgear
- New installation of 110 kV protection and control panel
- Replacement of the existing transmission towers (2 towers)

2) Rwinkwavu Substation

- Replacement of main transformer to increase capacity (existing 2.5MVA x 1⇒6MVA x 1)
- New installation of 110kV outdoor switchgear and 15kV indoor switchgear
- New installation of 110kV protection and control panel

III. Upgrading of Distribution Network in Huye from 6.6 kV to 30 kV

- Upgrading of the existing substations, switching stations and distribution transformers

IV. Expansion of Distribution Network in Kigali

- Expansion of the distribution network (15 kV middle voltage lines – 25.0 km, 0.4 kV low voltage lines – 30.6 km)
- New installation of 15/0.4 kV distribution transformers (18 sets)

The SCADA system established by the Government of Netherlands is scheduled to start the operation from October 2010. The modification works related to the SCADA system will be carried out by the Rwandan side.

(2) Policy for Natural Conditions

At present, there are meteorological weather stations in Kigali, Huye and Eastern Province as described below.

- Kigali City: Kigali Station
- Eastern Province: Kibumgo Station
- Huye City: Rubona Station

The Kibumgo and Rubona Stations had not served their functions as meteorological weather station after suffering from huge damage caused by the civil war in 1994. However, these stations have been operating properly since 2009, when MININFRA conducted and completed the Project for the reconstruction of said stations.

The meteorological data collected at said two stations since the year 1994 do not exist due to above circumstances, therefore, the meteorological data on temperature, humidity and rainfall recorded at Kigali Station for the past decade is adopted and discussed below.

1) Temperature

Rwanda is classified into the Savanna climate area. The season is divided into the rainy season experienced in March - May and October - November for five months, and dry season in June - September and December - February for 7 months. The temperature in Kigali is not so high even at daytime during the dry season, because the altitude of Kigali is relatively high. The monthly average temperature for the past decade in Kigali is show in Table 2.2-1.

Table 2.2-1 Monthly Average Temperature (Unit: ℃)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2000	20.9	20.6	20.1	20.3	20.9	21.3	21.6	22.7	22.7	21.2	19.8	20.3
2001	19.5	20.6	19.8	20.6	20.2	20.5	20.5	21.1	20.8	20.1	19.8	20.4
2002	20.0	21.3	19.7	19.9	21.0	21.3	22.0	22.4	22.3	20.6	19.9	19.8
2003	21.3	22.0	21.0	20.7	20.5	21.2	21.5	22.0	20.7	20.9	20.2	20.8
2004	21.2	20.9	20.9	20.2	21.3	20.8	21.6	22.4	21.4	21.5	20.2	20.9
2005	21.4	22.8	20.6	21.1	20.5	21.1	21.7	22.2	22.1	20.9	20.3	21.9
2006	21.8	22.2	20.6	20.2	20.6	21.0	21.8	22.2	22.4	22.3	19.8	20.1
2007	21.3	20.9	21.1	21.0	20.8	20.4	21.0	21.3	21.3	20.4	20.2	20.8
2008	20.8	20.6	19.6	20.3	20.8	20.4	21.0	22.0	22.0	20.8	21.2	21.7
2009	20.9	20.1	20.8	20.2	20.6	21.4	21.4	22.5	22.4	21.1	20.6	20.7

(Source: Meteorology Department, MININFRA, June 2010)

2) Humidity

Kigali City has relatively high humidity. Records show that this occur for many days, exceeding 80% humidity for seven months in a year except for 5 months from June to October. The monthly average humidity over the past decade in Kigali is shown in Table 2.2-2.

Table 2.2-2 Monthly Average Humidity (Unit: %)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2000	69.1	68.8	77.1	77.4	71.4	56.7	47.7	48.8	54.2	67.8	81.2	78.2
2001	80.9	74.8	80.9	79.2	79.6	65.6	63.1	62.5	70.9	78.4	81.5	78.6
2002	80.7	71.0	81.2	82.9	75.9	59.9	53.5	51.5	57.8	71.3	78.4	81.5
2003	70.5	65.1	74.3	79.4	78.5	63.7	55.7	59.2	73.4	74.1	77.8	71.4
2004	74.3	73.2	78.0	82.5	69.9	56.9	47.7	55.0	64.7	68.5	78.5	76.7
2005	72.6	63.1	79.1	76.8	78.8	67.0	50.8	57.5	64.5	73.1	77.5	66.5
2006	65.6	65.6	79.4	83.6	78.8	64.7	57.5	57.8	59.7	65.5	85.9	85.1
2007	80.3	80.2	76.5	79.0	81.7	75.6	65.1	65.6	71.7	78.8	82.8	72.5
2008	76.6	77.9	83.0	82.0	76.6	71.3	58.7	60.6	65.6	77.7	77.4	71.8
2009	78.1	83.3	80.9	85.3	83.2	68.4	56.1	59.1	64.3	77.5	83.2	81.9

(Source: Meteorology Department, MININFRA, June 2010)

3) Rainfall

The annual rainfall in Kigali is considered to be relatively low with approximately 700-1,200 mm on average. It is observed that the highest season of rainfall in Rwanda occurs for a total of four months in a year, i.e., March-April and October-November. It was recorded that the monthly average during such months is approximately 120 mm. The monthly average rainfall over the past decade in Kigali is shown in Table 2.2-3.

Table 2.2-3 Monthly Average Rainfall (Unit: mm)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2000	22.1	58.2	100.7	84.1	51.3	0	0	5.4	32.6	129.2	144.2	76.3
2001	80.3	60.8	257.3	84.3	61.4	0.2	120.8	21.8	86.1	225.9	185	98.9
2002	155	65.7	98.9	156	145.6	0	0	0.2	34.6	99.7	116.5	131.7
2003	60.3	29.8	74.6	121.7	49.9	0	0	65.1	147.5	106.7	101.1	49.5
2004	67	71.8	114.3	201.4	23.1	4	0	15.1	74.6	70.7	75.8	82.8
2005	64.6	41.8	134.3	91.6	88	10.3	0	41.6	112.4	128.2	55.3	30
2006	22.7	90.6	112.2	218	117.8	5.3	14.5	25.1	35.4	57.4	210.2	141.4
2007	53.1	161	40.6	134.7	124.5	39.5	65	21.2	68	163.9	125.3	50.9
2008	76.7	73.5	154.8	115	63	58.9	7.4	13.3	34.5	64.8	55.5	39
2009	103.6	183.5	97.4	116.9	99.4	0	0.8	14	21.1	132.1	122.7	69.1

(Source: Meteorology Department, MININFRA, June 2010)

4) Altitude

The average altitude in Rwanda is approximately 1,600 m. The highest altitude is recorded to be 4,507 m at Mt. Karisimbi in the northern area, while the lowest altitude recorded is 950 m at

Rusizi Plains in the western province. The altitudes of the substations under the Project are shown in Table 2.2-4.

Table 2.2-4 Altitudes of Substations

Substation	Altitude(m)
Jabana	1,391
Gikondo	1,447
Birembo	1,492
Musha	1,573
Rwinkwavu	1,365

（Source：Prepared by the JICA Study Team）

5) Conclusion on the Climate Design Criteria

The design standard specified by RECO is shown in Table 2.2-5. Said standard considers more severe conditions than the actual meteorological data mentioned in the above items 1) - 4). Therefore, the design for the Project shall conform to the climate design criteria of RECO in view of the long-term safe operation after completion of the Project.

Table 2.2-5 Design Standard of RECO

Item	Design Standard	
Surrounding Maximum Temperature	°C	45
Surrounding Minimum Temperature	°C	-5
Daily Average Maximum Temperature	°C	25
Daily Average Minimum Temperature	°C	5
Yearly Average Temperature	°C	20
Maximum Insolation	W/m²	1,035
Yearly Thunderstorm Days	-	100
Maximum Wind Velocity -Ground Height: 0 - 30m - Ground Height:30 - 50m	 m/s m/s	 35 45
Average Relative Humidity	% rel.	70
Yearly Average Rainfall	mm/a	1,450
Altitude	M	2,000

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

(3) Policy for Social and Economic Status

As of 2009, the GDP was US$5.10 billion and GNI per person was US$510 as of 2009. The proportion in GDP of the Primary Industry (agriculture, forestry and fishery), the Second Industry (mining and manufacturing) and the Tertiary Industry (commercial and service) is 36.4%, 14.2% and 43.7%, respectively. However, according to the classification of OECD/DAC, Rwanda is classified as Least Developed Countries (LDC) and approximately 30% of the people in this country are living below the poverty line.

The Government of Rwanda is implementing economic policies by setting the Public Investment Program (1996), Rwanda Vision 2020 (2000, economic target after 20 years is set), Full Poverty Reduction Strategy Paper (F-PRSP, 2000), Economic Development and Poverty Reduction Strategy (EDPRS (Second Generation PRSP), 2007).

Considering such circumstances, President Paul Kagame is aiming at the job development and energetic economy by the realization of industrial development including the Information-Communication Technology (ICT) industry funded from overseas mainly.

(4) Policy for Construction and Procurement Conditions

In recent years, a lot of large-sized buildings have been constructed in Kigali. General construction materials such as reinforcing bars, cement, sand and gravel can be procured locally. On the other hand, electric power cables and other electrical materials have not been manufactured in Rwanda. Moreover, the widely distributed imported materials do not satisfy the requirements of the Project specifications and hence, it is planned to procure the required electrical materials from Japan or from third world countries.

(5) Policy for Local Construction and Consultant Companies

As for the local construction and consulting firms in Rwanda, the number of engineers who have completed university level is very few. In addition, they have also insufficient work experiences compared with those from the neighboring countries in Africa.

Therefore, management and instructions of Japanese or third world countries' engineers are indispensable during the construction stage of the Project. Especially, it is necessary for Japanese engineers to appropriately supervise the construction works to ensure safety, especially the involved power shutdown works which are deemed dangerous.

(6) Policy for Operation and Maintenance

The implementing agency of the Project is RECO which is under the control of MININFRA.

According to RECO, they have a total of 520 engineers in their Electricity Department as of June 2010. These consist of 290 engineers who are engaged in O&M of power stations, transmission lines and substations, and 230 who are assigned in 15 station offices tasked to manage the distribution network system across the country.

RECO has accomplished many projects funded by several international donors. Therefore, it can be judged that their overall technical qualifications have reached the acceptable level.

Moreover, RECO's O&M staff allocated at each substation corresponds to the respective substation size. It appears that there are no problems with regard to the fundamental structure of

RECO for O&M at the existing substations.

(7) Policy for Setting of Grade of Equipment and Material

The specifications for the equipment and materials related to the Project are classified as normal standard specifications. Hence, it is planned to procure the major equipment (i.e. circuit breaker, disconnecting switch) and materials of large number quantities of procurement (i.e. 30-kV cable) from the third world countries, not only from Japan, in consideration of reducing the project cost.

(8) Policy for Construction/Procurement Method and Construction Schedule

Items such as the contract of the Consultant, preparation of tender documents, tendering and the form of contract for the Contractor are mainly included in the detailed design stage of the Project. The work period for the said stage is expected to be about six months after exchange of notes (E/N) is concluded between both countries. Meanwhile, the preparation of design drawings for approval, manufacturing, transportation, erection works, trial operation and taking-over are included in the procurement and construction stages. The corresponding work period for said stages are about between 20 and 24 months, respectively, after the permission on the contract of the Contactor is issued by the Ministry of Foreign Affairs (MOFA) of Japan. There are two routes that may be utilized for the transportation of general cargo to the country. These are via Mombassa Port in Kenya, and Dar es Salaam in Tanzania.

The route via Mombassa Port accounts for about 65% of the past projects in the country and was utilized for other projects implemented by Japan Grant Aid.

However, it is planned to utilize the route via Dar es Salaam for the Project as the corresponding transportation expenses is less costly than the other. RECO has many experiences in using this route through the past projects.

(9) Relation with Laws and Regulations

1) Laws and Regulations

a) Law related to the power sector

The related law applied to the power sector in Rwanda is the fundamental law (Organic Law N° 39/2001 of 13/09/2001 establishing an agency for the regulation of certain public utilities) issued by the Rwanda Utilities Regulatory Agency (RURA) in June 2001. It consists of seven chapters with 53 articles and stipulates the organizational structure of the coordinating committee and the basic regulation of the law related to the power sector in the country.

b) Law related to environment

The law related to environment is referred to the fundamental law (Organic Law N° 04/2005 of 08/04/2005 determining the modalities of protection, conservation and promotion of environment in Rwanda) established in July 2005. It consists of seven chapters with 118 articles, and contains ideal concepts on protection, preservation and enhancement of environment in the country.

The EIA is stipulated in sub-articles 67-70 of Volume 3, Chapter 3, Article 4 of the law. In sub-article 67, it is mentioned that all projects should be subject to assessment of environmental impact prior to obtaining permission for implementation. This law is also applied not only for every project, but also for programs and policies which could possibly affect the environment of the country.

c) Law related to land

The law related to land is referred to the fundamental law (Organic Law N° 08/2005 of 14/07/2005 determining the use and management of land in Rwanda) established in July 2005. It consists of seven chapters with 89 articles and stipulates the role of state, the right and duty of landowners, the institutions for land adjustment and land management, etc.

The law for the land acquisition concerning public interest's activities is Law N° 18/2007 of 19/04/2007. This is related to expropriation in the public interest enacted in April, 2007.

This law consists of five chapters with 31 articles, and provides the organization structure, the procedure, the light of land owner and buyer, land assessment and fair compensations, etc.

2) Applicable Standards

Various equipment and materials required for the Project are basically procured from Japan and third world countries. Therefore, the following standards are applied to the design, manufacturing, inspection and tests for said equipment and materials.

- International Electromechanical Commission (IEC)
- National Electrical Code (NEC)
- Japanese Industrial Standards (JIS)
- Japanese Electrotechnical Committee (JEC)
- Japan Electrical Manufacturers' Association (JEM)
- Japanese Cable Standard (JCS)

2-2-2 Basic Design (Facility Plan/Equipment Plan)

2-2-2-1 Facility Plan

(1) Substation Equipment

The demand forecast for four subject substations up to year 2025 based on the Master Plan prepared by FICHTNER in December, 2009, is shown in Table 2.2-6.

Table 2.2-6 Demand Forecast up to the Year 2025 Prepared by FICHTNER

[Unit: MW]

Name of Substations	2005	2010	2015	2020	2025	Average Yearly Increasing Rate [%]
Jabana	8.15	11.64	22.22	39.06	62.98	10.76
Gikondo	17.3	25.02	48.19	85.54	138.59	10.96
Musha	0.85	3.50	7.63	13.86	22.55	17.81
Rwinkwavu	0.07	0.24	0.72	1.44	2.33	19.16

（Source：Study for Updating the Electricity Master Plan, FICHTNER, December 2009）

The demand forecast considering the actual peak demand of each substation as of May 2010 is shown in Table 2.2-7.

The average yearly rate increase of 19.16% at Rwinkwavu Substation between 2005 and 2025 is remarkably high according to Table 2.2-6. However, the 17.81% rate at Musha Substation shall be applied to the design of Rwinkwavu Substation, because there is no precise background and reason for the rapid increase of demand at said substation.

Table 2.2-7 Demand Forecast up to the Year 2025 Prepared by the JICA Study Team

[Unit: MW]

Name of Substation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Average Yearly Increasing Rate [%]
Jabana	8.39	9.29	10.29	11.40	12.63	13.99	15.49	17.16	19.00	21.05	23.31	25.82	28.60	31.68	35.09	38.86	10.76
Gikondo	22.4	24.86	27.58	30.60	33.96	37.68	41.81	46.39	51.47	57.11	63.37	70.32	78.03	86.58	96.07	106.60	10.96
Musha	2.20	2.59	3.05	3.60	4.24	4.99	5.88	6.93	8.16	9.62	11.33	13.35	15.73	18.53	21.83	25.71	17.81
Rwinkwavu	2.00	2.36	2.78	3.27	3.85	4.54	5.35	6.30	7.42	8.74	10.30	12.13	14.30	16.84	19.84	23.38	17.81

（Source: Prepared by the JICA Study Team）

Jabana Substation

The capacity of the existing transformer at Jabana Substation in Kigali is 12 MVA (6 MVA×2). If the power factor (PF) is assumed to be 0.9, it becomes 10.8 MW.

The peak demand at Jabana Substation as of May 2010 was 8.39 MW, which will increase up to 11.40 MW in 2013 according to the demand forecast in Table 2.2-7. The existing transformer capacity becomes insufficient for the peak demand and thus, it is necessary to increase the transformer's capacity.

It is judged that the Project, which plans to install new main transformers of 20 MVA (10 MVA×2) at Jabana Substation is appropriate, because the said capacity is expected to sufficiently serve the future power demand until 2017.

Gikondo Substation

As of May, 2010, the peak demand at Gikondo Substation in Kigali was 22.4MW. It reaches only 55.3% of the installed capacity of the existing transformer which is 45 MVA (= 40.5 MW). Therefore, it is judged to be not necessary to increase the transformer capacity at Gikondo Substation for the time being.

Musha Substation

The capacity of the existing transformer at Musha Substation in the Eastern Province is 2.5 MVA (2.5 MVA×1). With the PF assumed as 0.9, the capacity becomes 2.25 MW. The peak demand at the substation as of May 2010, which was 2.2 MW, is expected to increase up to 2.59 MW in 2011 according to Table 2-7. The existing transformer capacity thus becomes insufficient for the demand and therefore, it is necessary to increase its capacity.

It is judged that the Project, which plans to install a new 10 MVA (10 MVA×1) transformer at the Musha Substation is appropriate because said capacity is expected to sufficiently serve the future power demand until 2018.

Rwinkwavu Substation

The capacity of the existing transformer at Rwinkwavu Substation in the Eastern Province is 2.5 MVA (2.5 MVA×1). Assuming a PF of 0.9, this becomes 2.25 MW. The peak demand at the substation as of May 2010, which was 2.0 MW, is expected to increase up to 2.36 MW in 2011 according to Table 2-7. This demand is greater than the existing transformer capacity and as a result, it thus becomes necessary to increase the transformer's capacity.

It is judged that the Project, which plans to install a new 6 MVA (6 MVA×1) transformer at Rwinkwavu Substation, is appropriate because said capacity is expected to sufficiently serve the future power demand until 2016.

The list of transformer capacities at subject substations is shown in Table 2.2-8.

Table 2.2-8 Transformer Capacity at Subject Substations

Name of Substations	Transformer Capacity (Present Conditions) [MVA]		Transformer Capacity (Future Planning) [MVA]	
Jabana	12.0	Insufficient Capacity in 2012	20.0	Correspond to Demand until 2017
Musha	2.5	Insufficient Capacity in 2010	10.0	Correspond to Demand until 2018
Rwinkwavu	2.5	Insufficient Capacity in 2010	6.0	Correspond to Demand until 2016

(Source: Prepared by the JICA Study Team)

The facility plan for each substation for the Project is described below.

Jabana Substation

a) Utilization of the Existing Concrete Foundation

The existing equipment to be replaced under the Project is extremely larger and heavier than the replacement units. Also, it is confirmed through site investigation that the existing foundations do not exhibit signs of deterioration such as surface cracks or leakages of reinforcement rust. Therefore, the existing foundations can be utilized for the Project, except those for the main transformers, in order to shorten the construction period.

b) Renewal of the Structure

All of the existing steel structures for the outdoor equipment are to be cut at 30 cm above the foundation top, and new structures are to be connected to them by means of lapped joints.

c) Utilization of the Existing Control Cables

The existing control cables will be utilized basically, as they remain in good condition.

d) Rehabilitation of the 15 kV Switchgear System and Installation of a New Control Supervisory Board

All of the 15 kV switchgear systems will be replaced under the Project. After dismantling of the existing relay racks, 110 kV and 15 kV console-type control and supervisory systems will be newly installed.

Gikondo Substation

a) Installation of Pipe Bus

After dismantling the existing bus, new pipe-type double bus will be installed.

b) Arrangement of 110kV Feeder Equipment

New 110 kV feeders for Mont Kigali and for Jabana substations will be installed at the available space adjacent to the existing feeder bays, in order to minimize the duration of shutdown.

c) Utilization of the Existing Concrete Foundation

The existing equipment to be replaced under the Project is relatively larger and heavier than the replacement units. Also, it is confirmed through site investigation that the existing foundations do not exhibit any signs of deterioration such as surface cracks or leaks of rust from their reinforcement bars. Therefore, said existing foundations can be utilized for the

Project, except those of main transformers, in order to contribute in shortening the construction period.

d) Rehabilitation of Structure

All of the existing steel structures for the outdoor equipment are to be cut at 30cm above the foundation top, and new structures are to be connected to them by means of lapped joint.

e) Replacement of Control Cable

The existing cables will be replaced with new ones as the latter is severely deteriorated due to the observed damage of the duct cover.

Musha Substation

a) Upgrading of Voltage Level

The existing voltage level of 7 0kV is to be upgraded to 110 kV. To meet the new voltage level, all the 110 kV outdoor and indoor equipment will be newly installed.

b) Reconstruction of the Transmission Tower (2 sets)

Since dead-end towers set at both sides of the substation are of suspension-type, they need to be reconstructed as a dead-end type.

c) Modification from T-connection to Pi-connection

As the existing 70 kV substation was built just under the existing transmission line, the connection for said substation was designed considering T-connection. However, for the new 110kV substation, this shall be upgraded to Pi-connection.

d) New Construction of Control Building

A new control building will be constructed, because the existing one has insufficient space and is already superannuated.

Rwinkwavu Substation

a) Upgrading of Voltage Level

The existing voltage level 70kV is to be upgraded to 110kV. To meet the new voltage level, all the 110 kV outdoor and indoor equipment will be newly installed.

b) New Construction of Control Building

A new control building will be constructed, because the existing one has insufficient space and is already superannuated.

Birembo Substation

a) New Installation of Disconnecting Switch (DS)

The feeder for Gasogi Substation is connected to the 70 kV-side of the 70/110 kV auto-transformer being installed transiently. However, this is to be disconnected, and reconnected to the 110 kV bus to switch the feeder voltage to 110 kV. A new disconnecting switch should then be installed to connect the feeder to the bus.

(2) Distribution Equipment

Distribution Network in Huye

a) Upgrading of Voltage Level

The voltage level of the existing middle voltage (MV) lines of 6.6 kV will be upgraded and integrated to 30 kV. Due to this upgrading, the existing 6.6 kV substations, switching stations and distribution transformers will be completely replaced with 30 kV equipment under the Project.

b) Middle Voltage Lines

The 30 kV middle voltage (MV) lines in Huye will be installed underground as requested by RECO, in order to preserve the view of the city which is the former capital of Rwanda.

The buried depth to be applied for the underground cables shall be 1 m in accordance with the standard of RECO. Meanwhile, the existing 400 V low voltage lines will be utilized for the Project.

c) Installation Site of Ring Main Unit (RMU)

The RMUs are planned to be installed at the vacant land adjacent to the existing substations and switching stations. Although the number of RMUs to be installed will be for 21 sites, only two of these, Buye 1 and Rango, have available spaces. Thus, these spaces will be utilized for such installation works.

Distribution Network in Kigali

As for the distribution network in Kigali, RECO requested the expansion of the existing network at eight areas inside Kigali City during the first site study. (15 kV MV lines: 90.4 km, 400 V LV lines: 87.3 km, distribution transformers: 49 units)

It is planned by the Study Team to carry out the expansion of the distribution network at four top priority areas, which are highly beneficial and urgent considering the result of prioritization study. As shown in Table 2.2-9, prioritization is based on selection criteria such as the ratio of the rough material cost and the number of new customers, the distance

from the center of Kigali, and the number of existing schools and hospitals.

Table 2.2-9 Prioritization of Distribution Network in Kigali

Area			D/L Route	MV Line	LV Line	New Customers (A)		Cost (B)	Selection Criteria								Total Score	Priority
									New Customers(A)/ Cost(B)		Distance from Center of Kigali		Existing Schools		Existing Health Center			
									50%		30%		10%		10%			
				[km]	[km]			[M.US$]	Rate	Score (1)	Distance [km]	Score (2)	Number	Score (3)	Number	Score (4)		
i	Muhima	Rulindo/Gasabo	Masoro-Rusine	5.77	9.45	581	2,381	5.44	437.74	1	32.9	1	9	10	3	10	2.8	7
	Kacyiru	Gasabo	Rusine-Rutunga	22.02	15.75	1250												
	Kacyiru	Gasabo	Rutunga-Gikomero-Gicaca	19.21	15.75	550												
ii	Gikondo	Kicukiro	Kagarama-Gahanga & Krembure	6.94	6.30	389	743	1.56	477.44	1	12.6	10	4	3	1	3	4.1	4
	Gikondo	Kicukiro	Gahanga-Mulinja	4.55	7.35	354												
iii	Kanombe	Kicukiro	Masaka-Ruyaga	2.97	2.31	308	556	0.97	571.01	3	24.0	4	4	3	0	0	3.0	6
	Kanombe	Kicukiro	Masaka-Rusheshe	5.83	4.62	248												
iv	Kanombe	Kicukiro	Kanombe-Karama1	1.52	2.10	100	610	0.79	775.32	5	13.5	10	2	1	0	0	5.6	3
	Kanombe	Kicukiro	Kanombe-Karama2	4.36	4.73	510												
v	Kanombe	Gasabo	Rusororo-Mbandazi	3.00	3.78	480	480	0.42	1,143.68	10	24.1	4	1	0	0	0	6.2	1
vi	Kanombe	Rwamagana	Rugende-Muyumbu	4.59	6.30	680	680	0.67	1,008.73	9	26.8	3	1	0	1	3	5.7	2
vii	Kanombe	Gasabo	Gasogi S/S-Jurwe	1.62	2.10	150	250	0.49	511.87	2	17.7	7	3	2	1	3	3.6	5
	Kanombe	Gasabo	Musave center-Musave	2.07	2.10	100												
viii	Kacyiru	Gasabo	Nduba	9.93	9.03	400	400	1.17	340.81	0	33.2	0	2	1	2	6	0.7	8
Total				94.38	91.67	6,100	6,100	11.51	-	-	-		-	-	-	-	-	-

（Source: Prepared by the JICA Study Team）

The distance of distribution lines and number of distribution transformers at the prioritized four areas in Table 2.2-9 is shown in Table 2.2-10.

Table 2.2-10 Prioritized Areas of Distribution Network in Kigali

No.	Area		Distribution Route	15kV MV Line [km]	400V LV Line [km]	Distribution Transformer
1	Kanombe	Gasabo	Rusororo-Mbandazi	3.00	3.78	2
2	Kanombe	Rwamagana	Rugende-Muyumbu	4.59	6.30	3
3	Kanombe	Kicukiro	Kanombe-Karama1-Karama2	5.88	7.04	4
4	Gikondo	Kicukiro	Kagarama-Gahanga and Krembure-Gahanga-Mulinja	11.49	13.65	9
Total				24.96	30.77	18

（Source: Prepared by the JICA Study Team）

(3) Civil and Building Facility

The Musha and Rwinkwavu substations will be upgraded to 110 kV substations and would require construction of new concrete foundation for the equipment and new control building.

1) Subsurface Conditions of Project Sites

a) Musha Substation Site

The ground at the site is covered with laterite that goes down to around 5 m - 7 m below the surface. It subsequently becomes more consolidated as it goes deeper. Based on the field survey conducted up to 15 m depth below the surface, no rock layer was encountered. No

soft soil layer was also found that would call for special attention in the design of foundation, such as settlement. A cliff as high as 3 m, was made during the previous construction (land reclamation) behind the existing control house. Its surface, however, does not show any signs of deterioration of soil as often found in soft clay. Thus, this would justify the soundness of the soil quality at the site.

b) Rwinkwavu Substation

Ground surface at the site is covered with laterite silt that goes down to around 2 m - 5 m below the surface. It subsequently becomes more consolidated as it goes deeper. Based on field survey conducted until 15 m depth below the surface, no rock layer was encountered. No soft soil layer was also found that would call for special attention in the design of foundation, such as settlement.

2) Design of Equipment Foundation

a) Type of foundation

Isolated footing types (without foundation piles) will be used as foundation considering that the ground is good enough to bear the expected loads from the equipment. These will be constructed as reinforced concrete.

b) Load Bearing Capacity of Ground

As a result of the measurement of the load-bearing capacity, it is confirmed that both sites have sufficient capacities as shown in table 2.2-11:

Table 2.2-11 Load Bearing Capacity

Substation	Sandy Soil (t/m^2)	Clay (t/m^2)
Musha Substation	49	51
Rwinkwavu Substation	32	32

(Source: Prepared by the JICA Study Team)

Lower values of the above should be employed as design load bearing capacity of the ground.

c) Countermeasure for Soft Ground

As discussed previously, considerably large-scale land reclamation work is called for to accommodate the new substation structure. It is likely that a portion of some of the equipment's footings will be on the reclaimed land. It is noted to be uneconomical and time-consuming to further bury the footing down to the original ground in order to gain necessary ground resistance.

To counter such a case, cyclopean concrete foundation is recommended under the footing.

Wet rubble masonry work for this purpose is one of the most popular indigenous techniques.

3) Control Building

The basic criteria for the design of the control buildings at Musha and Rwinkwavu substations are:

a) As there is no earthquake in Rwanda, seismic design need not be considered,

b) Structural framing of building will be of reinforced concrete with footings and columns, and non-load-bearing brick masonry walls,

c) Use of concrete will be minimized. Instead, wet rubble masonry will be extensively used to economize and save time. Strip foundation for brick walls will be of this type,

d) Doors will be steel, aluminum or wood according to the function of the room. Windows will be of aluminum. There will be no importation of door and window materials from any industrialized country,

e) Interior rooms will be furnished with false ceilings. Interior walls will be rendered with cement mortar and then painted.

4) Air Conditioning System

In Rwanda, despite its location being directly under the equator, air conditioning is not generally used owing to the high altitude of the ground. Some of the existing substations in fact have room coolers in cubicles and control rooms, which are intended for auxiliary purposes only. Most of the time, keeping the main doors open to allow fresh air seems sufficient. This practice, however, is not good during the dry season as the room might be infiltrated with dust that is harmful to the electrical equipment.

As a result, it is recommended to keep the doors closed whenever the interior space becomes vulnerable to dust. In order to enable this operation, split-type air conditioners will be provided to the cubicles and control rooms.

5) Domestic Water Supply System

At both existing substations, water for domestic consumption is neither available nor is regularly delivered by water tank trucks. In planning the new substations however, countermeasures must be taken to remedy the situation. While excavating for a hole to accommodate deep well pump is too expensive, an alternative is to utilize rain water. Rain falling on the roof of the control house will be collected and stored in an underground water reserve tank. Collected water in the tank will be supplied to the lavatory or other places through a pneumatic water supply unit installed in the water tank.

During the dry season in Rwanda, which is about four consecutive months, water stored during the wet season should be consumed. Capacity of the tank must be large enough to cater to the needs in the dry season. Assuming a 20 liter/ person/ day demand for flushing toilet bowls and for minimal cooking uses, the effective capacity of the water tank will have to be at least 7.5 tons.

During the rainy season, there is, at minimum, 120 mm precipitation per month, therefore, it is quite easy to secure this volume of rain water.

6) Plumbing and Sanitary System

The lavatory in the existing substation is a rudimentary night soil pit type, with a hole on the floor. Absence of water makes it impossible to flush sewage. The water supply system as proposed in the previous paragraph will at least enable to manually flush a toilet using a pail filled with water. Flushing with a cistern tank would consume too much water. On top of this, water closets will be of squat-type to enable manual flushing.

Sewage from the water closet will be treated by a septic tank before being discharged out of the compound. Capacity of the septic tank will be 5.0 m3, assuming 70% of the water is consumed for flushing water. This will be retained in the tank for 90 days in accordance to the design criteria for septic tanks in Japan.

7) Gate and Fence

The gate will be constructed of light gauge steel box sections, while fence will be of chain link mesh with steel posts.

8) Access Road and Internal Pavement

Although the access roads to both substations have no surface pavement after branching off from the primary public road, paved roads will be provided inside the substation compound, in consideration of inspection and maintenance services. Asphalt paved road shall be provided for transformer maintenance while pavement block pathways for daily inspection of the outdoor switchgear yard.

In addition, the entire ground of the outdoor switchgear yard will be covered by gravel surface. The front yard of the control house will be provided with lawn planting.

9) Retaining Wall

As discussed previously, land reclamation work involving excavation and filling is required at both substations. In order to protect slopes of land against erosion which were provided as part of reclamation works, scourge or sliding retaining wall is required. In comparison, sodding is relatively unstable until roots are put firmly on the ground. Moreover, slope surface becomes

considerably large. A retaining wall is superior in this regard and is therefore recommended. Wet rubble masonry wall are abundantly used in Rwanda as discussed previously and therefore, it is the most suitable material. Other types of retaining walls such as (a) gravity type with concrete, (b) cantilever type in reinforced concrete, (c) buttress type in reinforced concrete, (d) concrete block, (e) concrete sheet pile and (f) wedge stone masonry wall are all less favorable than the wet rubble masonry considering cost, construction time, availability of materials and skills, and difficulty of construction.

10) Storm Drainage Ditches

Similar to the retaining wall, storm drainage ditches to keep the ground free from storm water will be constructed of rubble wet masonry.

2-2-2-2 Equipment Plan

(1) Design Standard

The design standard for the Project is as mentioned in Clause 2.1.(9) of this report.

(2) Main Equipment

The list of major equipment necessary for the Project is shown as follows.

Table 2.2-12 (1) Summary of Major Equipment (Jabana Substation)

Project Details		Major Equipment		Q'ty	Unit
		Name of Equipment	Technical Particulars		
Rehabilitation of Substation	Jabana Substation	(1)110/15kV Transformer	10MVA, ONAN, 50Hz, 3-phase, Ynyn+d, OLTC 27tap	2	set
		(2)110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Operable for single-phase reclosing, Motor-driving spring charge type, O-0.3s-CO-3m-CO	2	set
		(3)110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Three-phase gang operation, Motor-driving spring charge type, CO-15s-CO	1	set
		(4)110kV Disconnector	1,250A, 31.5kA, 3-phase, double rotating post type with single air break, motor-driving earthing mechanism	2	set
		(5)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, without earthing mechanism	5	set
		(6)110kV Current Transformer	100/1-1-1A, Class 0.5x1 + 5P20x2, single-phase, 30VA	6	set
		(7)110kV	200-100/1-1-1A, Class	6	set

		Current Transformer	0.5x1 + 5P20x2, Single-phase, 30VA		
		(8)110kV Capacitor Voltage Transformer	110/√3:0.11/√3:0.11/√3kV, Class 0.5 x 3P, 30VA, Single-phase	9	set
		(9)102kV Lightning Arrester	20kA, Metal-Oxide, Single-phase	12	set
		(10) Feeder Adaptation Unit	Outdoor cubicle type, incl. terminal blocks, auxiliary relay	1	set
		(11)110kV Console-type Control and Supervisory Panel	Console-type panel enclosure, for mounting existing equipment	1	set
		(12)110/15kV Console-type Control and Supervisory Panel for Transformer	Console-type panel for TR1 and TR2, incl. digital protective relays and human machine interface	1	set
		(13) 15kV Console-type Control and Supervisory Panel	Console-type panel for 15kV switchgears, incl. digital protective relays and Human machine interface	1	set
		(14) 15kV Indoor switchgear (GIS)	15kV cubicle type double bus system, with CPU	1	set
		(16) Cables, cable accessories, Earthing-materials, miscellaneous materials		1	lot
		(17) Cables and accessories for temporary works		1	lot

（Source: Prepared by the JICA Study Team）

Table 2.2-12 (2) Summary of Major Equipment (Birembo Substation)

Project Details		Major Equipment		Q'ty	Unit
		Name of Equipment	Technical Particulars		
Rehabilitation of Substation	Birembo Substation	(1)110kV Disconnector	1,250A, 31.5kA, 3-phase, double rotating post type with single air break, without Earthing mechanism	1	set
		(2) Structural Beam	Structural Beams between bus supporting structures for setting disconnectors, approx 11m span x 1 no.	1	lot
		(4) Cables, cable accessories, Earthwork materials, miscellaneous materials		1	lot

（Source: Prepared by the JICA Study Team）

Table 2.2-12 (3) Summary of Major Equipment (Gikondo Substation)

Project Details		Major Equipment		Q'ty	Unit
		Name of Equipment	Technical Particulars		
Rehabilitation of Substation	Gikondo Substation	(1) 110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Operable for single-phase reclosing, Motor-driving spring charge type, O-0.3s-CO-3m-CO	2	set
		(2)110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Three-phase gang operation, Motor-driving spring charge type,	2	set

			CO-15s-CO		
		(3)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, Motor-driving earthing mechanism	2	set
		(4)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, without earthing mechanism	12	set
		(5)110kV Current Transformer	200-100/1-1-1A, Class 0.5x1 + 5P20x2, Single-phase, 30VA	6	set
		(6)110kV Capacitor Voltage Transformer	110/√3:0.11/√3:0.11/√3kV, Class 0.5 x 3P, 30VA, Single-phase	6	set
		(7) 102kV Lightning Arrester	20kA, Metal-Oxide, Single-phase	6	set
		(8) 110kV Support Insulator	-	21	set
		(9) 110kV Pipe Bus	120mm dia. 10mm thick, 31.5kA, 3-phase, including supporting structures	1	set
		(10)Structural Beam	Structural beams between bus supporting structures for setting disconnectors, approx 13m span x 10 nos.	1	set
		(11)Gantry Structures	H-section steel with truss beam (12 m high)	2	set
		(12) Cables, cable accessories, Earthwork materials, miscellaneous materials		1	lot
		(13) Cables and accessories for temporary works		1	lot

（Source: Prepared by the JICA Study Team）

Table 2.2-12 (4) Summary of Major Equipment (Musha Substation)

Project Details		Major Equipment		Q'ty	Unit
		Name of Equipment	Technical Particulars		
Upgrading of Substation	Musha Substation	(1)110/15kVTransformer	10MVA, ONAN, 50Hz, 3-phase, Ynyn+d, OLTC 17tap	1	set
		(2)110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Operable for single-phase reclosing, Motor-driving spring charge type, O-0.3s-CO-3m-CO	2	set
		(3)110kV Circuit Breaker	1, 250A, 31.5kA, 50Hz, 3-phase, Three-phase gang operation, motor-driving spring charge type, CO-15s-CO	1	set
		(4)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, Motor-driving earthing mechanism	2	set
		(5)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, without earthing mechanism	3	set
		(6)110kVCurrent Transformer	100/1-1-1A, Class 0.5x1 + 5P20x2, Single-phase, 30VA	3	set
		(7)110kVCurrent Transformer	200-100/1-1-1A, Class 0.5x1 + 5P20x2,	6	set

			Single-phase, 30VA		
		(8)110kVCapacitor Voltage Transformer	110/√3:0.11/√3:0.11/√3kV, Class 0.5 x 3P, 30VA, Single-phase	9	set
		(9)102kV Lightning Arrester	20kA, Metal-Oxide, Single-phase	9	set
		(10) Feeder Adaptation Unit	Outdoor Cubicle type, incl.terminal blocks, auxiliary relay	1	set
		(11) 110kV Console-type Control and Supervisory Panel	Console-type control and supervisory panel for transformer, and feeders for Gasogi and Kabarondo, incl. digital protective relays and human machine interface	1	set
		(12)15kV Console-type Control and Supervisory Panel	Console-type panel for 15kV switchgears, incl. digital protective relays and human machine interface	1	set
		(13)15kV Indoor Switchgear	15kV cubicle type single bus system, with CPU、	1	set
		(15)AC Distribution Panel		1	set
		(16)DC Distribution Panel		1	set
		(17)110V Batteries	Valve regulated lead-acid type, 150Ah/10Hr	1	set
		(18)Battery Charger	DC110V、40A	1	set
		(19)15/0.4kV Station Service Transformer	50kVA, ONAN, 50Hz, 3-phase	1	set
		(20)Steel Structures	H20m gantry type steel structure consist of truss column and truss beams	1	lot
		(21)110kV Dead-end type transmission line towers	Dead-end type, 1cct	2	set
		(22) Cables, Cable accessories, Earthing-materials, Miscellaneous materials		1	lot
		(23) Cables and accessories for temporary works		1	lot

（Source: Prepared by the JICA Study Team）

Table 2.2-12 (5) Summary of Major Equipment (Rwinkwavu Substation)

Project Details		Major Equipment		Q'ty	Unit
		Name of Equipment	Technical Particulars		
	Rwinkwavu Substation	(1)110/15kV Transformer	6MVA、ONAN、50Hz、3 phase、Ynyn+d、OLTC 17tap]	1	set
		(2)110kV Circuit Breaker	1,250A, 31.5kA, 50Hz, 3-phase, Operable for single-phase reclosing, Motor-driving spring charge type, O-0.3s-CO-3m-CO	1	set
		(3)110kV Disconnector	1,250A, 31.5kA, 3-phase, Double rotating post type with single air break, Motor-driving earthing mechanism	1	set
		(4)110kV Current Transformer	100/1-1-1A, Class 0.5x1 + 5P20x2, Single-phase, 30VA	3	set

Upgrading of Substation		(5)110kV Capacitor Voltage Transformer	110/√3:0.11/√3:0.11/√3kV, Class 0.5 x 3P, 30VA, Single-phase	3	set
		(6)102kV Lightning Arrester	20kA, Metal-Oxide, Single-phase	6	set
		(7) Feeder Adaptation Unit	Outdoor cubicle type, incl.terminal blocks, auxiliary relay	1	set
		(8)110kV Console-type Control and Supervisory Panel	Console-type control and supervisory panel for transformer, and feeders for Kabarondo, incl. digital protective relays and human machine interface	1	set
		(9)15kV Console-type Control and Supervisory Panel	Console-type panel for 15kV switchgears, incl. digital protective relays and human machine interface	1	set
		(10)15kV Indoor Switchgear	15kV cubicle type single bus system, with CPU	1	set
		(12) AC Distribution Panel		1	set
		(13) DC Distribution Panel		1	set
		(14)110V Batteries	Valve regulated lead-acid type, 150Ah/10Hr	1	set
		(15)Battery Charger	DC110V、40A	1	set
		(16)15/0.4kV Station Service Transformer	50kVA, ONAN, 50Hz, 3-phase	1	set
		(17)Steel Structures	H20m gantry type steel structure consist of truss column and truss beams	1	lot
		(18) Cables, Cable Accessories, Earthing-materials, Miscellaneous materials		1	lot
		(19) Cables and accessories for temporary works		1	lot

（Source: Prepared by the JICA Study Team）

Table 2.2-12 (6)　Summary of Major Equipment (Distribution Network in Huye)

Project Details	Major Equipment		Q'ty	Unit
	Name of Equipment	Technical Particulars		
Distribution Network in Huye	(1)36kV RMU Type-1	LBS×4, LBS（Fuse:16A）×1	2	set
	(2)36kV RMU Type -2	LBS×3, LBS（Fuse:16A）×1	1	set
	(3)36kV RMU Type -3	LBS ×3, LBS（Fuse:6A）×1	1	set
	(4)36kV RMU Type -4	LBS×2, LBS（Fuse:25A）×1	1	set
	(5)36kV RMU Type -5	LBS×2, LBS（Fuse:16A）×1	4	set
	(6)36kV RMU Type -6	LBS×2, LBS（Fuse:10A）×1	2	set
	(7)36kV RMU Type -7	LBS×2, LBS（Fuse: 6A）×1	1	set
	(8)36kV RMU Type -8	Incoming Feeder×1, LBS（Fuse:25A）×1	1	set
	(9)36kV RMU Type -9	Incoming Feeder×1, LBS（Fuse:10A）×1	2	set
	(10)36kV RMU Type -10	Incoming Feeder×1, LBS（Fuse:6A）×1	3	set
	(11)36kV RMU Type-11	VCB×2, LBS（Fuse:16A）×1	2	set
	(12)36kV RMU Type -12	VCB×3	1	set
	(13)30/0.4kVOutdoor	25 ～ 630kVA 、ONAN 、	20	set

	Transformer	50Hz、3 phases 4wires		
	(14)Indoor low voltage distribution board (20 sets)		1	lot
	(15) Cables, Cable accessories, Earthing-materials		1	lot
	(16)Cable materials for temporary power supply		1	lot

(Source: Prepared by the JICA Study Team)

Table 2.2-12 (7) Summary of Major Equipment (Distribution Network in Kigali)

Project Details	Major Equipment		Q'ty	Unit
	Name of Equipment	Technical Particulars		
Distribution Network in Kigali	1)15kV Conductor	ACSR70mm	74,877	m
	2)Ground Wire	Steel 35mm	24,959	m
	3)Concrete Pole-12m (for MV)	9kN	324	set
	4)15/0.4kV Distribution Transformer	50 ～ 400kVA 、ONAN 、50Hz、3 phases 4wires	18	set
	5)Concrete Pole-12m (for LV)	8kN	620	set
	6)LV(400V) ABC Cable	50mm2 ×3C + Neutral 50mm2 more	24,045	m
		35mm2 ×3C + Neutral 50mm2 more	6,720	m
	7)Outdoor Low Voltage Distribution Board		1	lot
	8)Miscellaneous Materials		1	lot

(Source: Prepared by the JICA Study Team)

(3) Basic Design

1) Substation Facilities

Basic design of substation-related facilities is performed following the design standards of RECO.

a) Standard Design Requirements

Table 2.2-13 Withstand Voltage of Equipment

Rated Voltage	Value at 1,000 m above sea		
	Un (kVms)	15	110
Maximum Voltage	Um (kVms)	20	138.0
Power frequency withstand voltage 50Hz, 1 min. - to earth - across isolating distance	Upf (kVms)	 43 51	 208 260
Lightning impulse withstand voltage 1.2/50ms - to earth - across isolating distance	Uli (kVpeak)	 107 123	 505 627

(Source: Technical Specifications of Urgent Electricity Rehabilitation Project, RECO)

Table 2.2-14 Creep Distance

Item	Creep Distance (mm/kV r.m.s)
110kV Outdoor Equipment	31
15kV Equipment	25

(Source: Technical Specifications of Urgent Electricity Rehabilitation Project, RECO)

Table 2.2-15 Earthworks System

System	Earthworks System
110kV	Neutral solidly earthed
15kV	Neutral solidly earthed
400-230V	3-phase 4-wire, Neutral solidly earthed

（Source: Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

Table 2.2-16 Short-Circuit Levels

System	Short-Circuit Level (kAeff, 3s)
110kV	31.5
15kV	25
400-230V	7.5

（Source: Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

b) Transformer

New main transformers are to be installed at Jabana Substation, Musha Substation and Rwinkuwavu Substation. Also new station service transformers are to be installed at Musha Substation and Rwinkuwavu Substation. Transformers shall be designed as required by IEC 60076 and JIS C4304. Other requirements on individual transformers are as follows.

Table 2.2-17 Technical Particulars of Main Transformers

Description	Jabana S/S	Musha S/S	Rwinkuwavu S/S
Rated Output (MVA)	10 (ONAN)	10 (ONAN)	6 (ONAN)
Required Numbers (nos.)	2	1	1
Primary / Secondary Voltages	110/15kV	110/15kV	110/15kV
Vector Group	YnynO+d	YnynO+d	YnynO+d
On-load Tap Changer (OLTC)	On-load, 27tap	On-load, 17tap	On-load, 17tap
	±13 x 1.23	±8 x 1.25	±8 x 1.25
Impedance	11%	11%	11%

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

Table 2.2-18 Technical Particulars of Station Service Transformers

Description	Musha S/S	Rwinkuwavu S/S
Rated Output (MVA)	50 (ONAN)	50 (ONAN)
Type	Oil-Immersed	Oil-Immersed
Primary / Secondary Voltages	15kV/400-230V	15kV/400-230V
Vector Group	Dyn11	Dyn11
On-load Tap Changer (OLTC)	No-load, ±5%, 5tap	No-load, ±5%, 5tap
Impedance	6%	6%

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

c) 110 kV Circuit Breaker and Other Outdoor Substation Equipment

Circuit breakers for 110 kV transmission line feeder shall be of single-phase re-closing type, while those for other circuits shall be for three-phase gang operation type. Circuit breakers shall be designed as required by IEC 62271 and JEC 2300. Other requirements on

individual transformers are as follows.

Table 2.2-19 Technical Particulars of Circuit Breakers

Description	Requirements
Type	3-phase SF6 insulated
Rated Current	1250A
Rated Operation Sequence	
- single-phase re-closing type	O - 0.3s – CO - 3 min - CO
- 3-phase gang operation type	CO - 15s – CO

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

Table 2.2-20 Technical Particulars of Other Outdoor Substation Equipment

110kV Outdoor Switchgear Equipment	Requirements	
Disconnector	For T/L Feeder	For Other
	3-phase outdoor type, with earthing switches, double rotating post type with single air break type	3-phase outdoor type, without earthing switches, double rotating post type with single air break type
	1250A	1250A
Capacitor Voltage Transformer	For Metering	For Protection
	Accuracy Class 0.5	Accuracy Class 1P
	Oil-immersed, Sealed type, 110kV / 110V/√3 / 110V/3	
Current Transformer	For Metering	For Protection
	Accuracy Class 0.5	Accuracy Class 5P20
	Oil-immersed, Sealed type, 1250A	
Lightning Arrester	Outdoor, Explosion-proof, Metal Oxcide Gapless type	
	Rated Voltage : 102kV, Rated Discharge Current : 20kA	

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

d) 15kV Indoor Switchgear Equipment

Indoor switchgears of 15 kV are to be installed at Jabana Substation, Musha Substation and Rwinkuwavu Substation. The priority 15kV switchgear for Jabana Substation is to be of the GIS double bus type as requested by RECO. Those for other substations are to be of general single bus type. The 15 kV switchgear shall be designed as required by IEC 62271. Other requirements on individual transformers are as follows.

Table 2.2-21 Technical Particulars of 15kV Indoor Switchgear

Description	Jabana S/S	Musha S/S	Rwinkuwav S/S
Type	Metal-clad type GIS, SF6	Metal-clad type	Metal-clad type
Outdoor/Indoor	Indoor type		
Circuit Breaker	VCB		
Protection, etc	With CPU Box		

（Source：Technical Specifications of Urgent Electricity Rehabilitation Project, RECO）

2) Distribution Line Facilities

Distribution Line Network Facilities in Huye

a) Cables

Table 2.2-22 Technical Particulars of Cables

Description	Requirements
Rated voltage (kV)	18/30(36)
Insulating Materials	XLPE(chemical)
Sectional Area (mm^2)	95
Construction	twisted 3-core Underground Cable

（Source: Technical Reference of Conductor, Insulated Power Cables）

b) Ring Main Unit（RMU)

RMUs are to be installed to form 30 kV power network.

Table 2.2-23 Technical Particulars of Ring Main Unit

Description	VCB	LBS	FUSE
Rated Voltage (kV)	36	36	36
Rated Current（A)	630	630	200*
Rated Current of Bus Bars（A)	630	630	630
Installation	Indoor	Indoor	Indoor

*FUSE switch （Source: Catalogues of ABB and SCHNIDER）

c) Distribution Line Transformer

Eighteen outdoor-type transformers and 1 no. of indoor-type transformer are to be installed. These shall conform to IEC 60076 and JIS C4304. Other requirements on individual transformers are as follows.

Table 2.2-24 Technical Particulars of Distribution Line Transformers

Description	Requirements
Rated Output (kVA)	25,75,100,160,200,250,400,500,630
Type	Outdoor/Indoor, oil-immersed self cooling type
Primary/Secondary Voltage	30kV/400-230V
Connection	Δ-Y, 3-phase, 3-wire / 3-phase, 4-wire

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

d) LV Distribution Board

New indoor-type LV distribution board shall be installed in the RMU house.

Table 2.2-25 LV Distribution Board

Description	Requirements
Construction	Indoor-use Self-support type
Materials	SPHC Sheet Steel
Numbers of I/O Circuits	I/O : 1/4 to 1 6
Mounted Equipment	LV Circuit Breakers

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

Distribution Line Network Facilities in Huye

a) Conductors and Cables

Aluminum Conductor Steel Reinforce (ACSR) shall be used for medium voltage (MV) while Aerial Bundled Cables (ABC) for low voltage lines (LV).

Table 2.2-26 Technical Particulars of ACSR

Description	Requirements
Raged Voltage(kV)	15
Construction	Aluminum Conductor Steel Reinforced
Sectional Area (mm^2)	70

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

Table 2.2-27 Technical Particulars of ABC

Description	Requirements
Rated Voltage (kV)	0.6/ 1
Insulating Materials	Black XLPE
Sectional Area (mm^2)	50,35
Inscription for cores	phases :1, 2, 3 neutral : 4 Street Light : EP1,EP2

（Source：AEPE Program, Actualization Study of Electricity Master Plan）

b) Distribution Line Transformers

New pole-mounted type transformers shall be installed. These shall be conform to IEC 60076 and JIS C4304. Other requirements on individual transformers are as follows.

Table 2.2-28 Technical Particulars of Distribution Line Transformer

Description	Requirements
Rated Output (kVA)	50,100,160,200,250,400
Type	Outdoor use, oil-immersed self cooling type
Primary/Secondary Voltages	15kV/400-230V
Connection	Δ-Y, 3-phase, 3-wire / 3-phase, 4-wire

(Source: AEPE Program, Actualization Study of Electricity Master Plan）

c) Lightning Arrester

Lightning arresters shall be installed at branching points of the network and at outgoing circuits of the distribution line transformers.

Table 2.2-29 Technical Particulars of Lightning Arresters

Description	Requirements
Rated Voltage（kV)	22
Rated Discharge Current（kA)	2.5

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

d) MV Circuit Breakers

MV circuit breakers shall be installed at branching points and outgoing circuits.

Table 2.2-30 Technical Particulars of MV Circuit Breaker

Description	Requirements
Construction	Outdoor type
Rated Voltage（kV)	15kV,
Fuse (A)	10,16,25,31.5A
Short Circuit Level（kA)	25

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

e） LV Distribution Board

Outdoor type LV distribution boards are to be installed.

Table 2.2-31 LV Distribution Board

Description	Requirements
Construction	Outdoor use self supporting type
Materials	SPHC Sheet Steel
Numbers of I/O Circuits	I/O : 1/4 to 16
Mounted Equipment	LV Circuit Breakers

（Source: AEPE Program, Actualization Study of Electricity Master Plan）

2-2-3 Outline Design Drawing

(1) Jabana Substation

The list of outline design drawings related to Jabana Substation is shown in Table 2.2-32.

Table 2.2-32 List of Outline Design Drawings Related to Jabana Substation

No.	Drawing No.	Drawing Title
1	DWG No.SS-01	Single Line Diagram
2	DWG No.SS-02	Outdoor Switchgear Layout
3	DWG No.SS-03	Indoor Switchgear Layout
4	DWG No.SS-04	Single Line Diagram (Birembo Substation)

(2) Gikondo Substation

The list of outline design drawings related to Gikondo Substation is shown in Table 2.2-33.

Table 2.2-33 List of Outline Design Drawing Related to Gikondo Substation

No.	Drawing No.	Drawing Title
1	DWG No.SS-05	Single Line Diagram
2	DWG No.SS-06	Plan of Outdoor Switchgear
3	DWG No.SS-07	Section of Outdoor Switchgear

(3) Musha Substation

The list of outline design drawings related to Musha Substation is shown in Table 2.2-34.

Table 2.2-34 List of Outline Design Drawing Related to Musha Substation

No.	Drawing No.	Drawing Title
1	DWG No.SS-08	Single Line Diagram
2	DWG No.SS-09	Outdoor Switchgear Layout

(4) Rwinkwavu Substation

The list of outline design drawings related to Rwinkwavu Substation is shown in Table 2.2-35.

Table 2.2-35 List of Outline Design Drawing Related to Rwinkwavu Substation

No.	Drawing No.	Drawing Title
1	DWG No.SS-10	Single Line Diagram
2	DWG No.SS-11	Outdoor Switchgear Layout

(5) Distribution Network in Huye

The list of outline design drawings related to distribution network in Huye is shown in Table 2.2-36.

Table 2.2-36 List of Outline Design Drawing Related to Distribution Network in Huye

No.	Drawing No.	Drawing Title
1	DWG No.HDS-01	Route Map
2	DWG No.HDS-02	Single Line Drawing
3	DWG No.HDS-03	Building Planning for Ring Main Unit (RMU) - TYPE A, B-1, B-2, B-3, B-4）

(6) Distribution Network in Kigali

The list of outline design drawings related to distribution network in Kigali is shown in Table 2.2-37.

Table 2.2-37 List of Outline Design Drawing Related to Distribution Network in Kigali

No.	Drawing No.	Drawing Title
1	DWG No.KDS-01	Route Map
2	DWG No.KDS-02	MV Distribution pole with Support Structure（1/2,2/2）
3	DWG No.KDS-03	LV Distribution pole with Support Structure

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The project is to be implemented through the framework of a grant aid program from the

Government of Japan (GoJ), under following sequence:

a) After approval of the Project by GoJ, E/N and Grant Agreement(G/A) with JICA

b) Tender preparation by JICA and the Consultant and Tender for Project Equipment and make contract based on tender procedure

c) Contractor nominated from among Japanese corporations will execute the works based on contract requirements

(1) Implementation Agency of Rwandan Side

In this Project, the responsible organization and executing organization for the Rwandan side are as follows:

- Responsible organization: MININFRA
- Implementing organization : RECO

MININFRA is responsible for the whole management of the Project and for the coordination of all parties concerned from both countries.

The responsible sections in the electricity department of RECO at each stage of the progress of the Project are as follows:

- Study and Design Stage : Study and Planning Section
- Construction Stage : Project Implementation Section
- O&M Stage : Power Operation Section

(2) Consultant

Based on the results of the preparatory survey and discussions with Rwandan side, the Consultant will complete the tender documents conforming to the requirements of the grant aid rules of Japan. The process includes tender calling, replies to tender queries, attendance to tender closing and opening, evaluation of tender results, assistance during tender negotiations and conclusion of the implementation contracts. This process comprises of meetings among concerned parties before commencing site works, approval process of design drawings, factory inspection before shipment, supervision of site erection works, preparation of progress report during site construction, issue of interim certificates, and attendance to site tests before taking over.

After completion of the Project, the Consultant will issue a completion certificate, process for taking over, prepare completion report and initiate defects liability tests to be carried out one year after the taking over.

(3) Contractor

The Contractor which is selected through the tendering will carry out the procurement and installation works for the Project in accordance with the grant aid rules of Japan.

Under the Project, various works such as civil, building, substation, distribution network, etc. will be executed in parallel. These construction works are closely related with each other in the work schedule. A Japanese contractor will take overall responsibilities for executing the whole works which include ensuring quality, guarantee of equipment characteristics, defects liability, schedule management, etc.

In accordance with the specifications prepared by the Consultant, the Contractor will carry out civil design, manufacturing, factory inspection, packing for export, transport to site, erection, site tests and taking-over of all equipment related to the Project. During the construction works and required tests at the site, the Contractor will perform transfer of technology to RECO engineers.

2-2-4-2 Implementation Conditions

(1) Construction Circumstances

Construction circumstances in Rwanda are mentioned in Clause 2.1.(4). It is necessary to take proper measures as protection from rain during wet season (March to May & October to December) to avoid softening of soil while executing foundation works.

(2) Consideration on Construction

During the construction works for the Project, it is necessary to consider safety sufficiently in order to avoid unlawful entry of outsiders to the Project site. Especially, this is considering that the site will be frequently accessed by local residents and traffic vehicles related to construction works after the commencement of the civil works.

In the rehabilitation of distribution network in Huye, there are a number of underground cables of MV and LV distribution lines. Thus, care should be taken in order to avoid injury to workers such as electric shocks and power failure accidents which could be caused by wrongly cutting of the existing cables. As precaution against these circumstances, it is necessary to search for existing cables and other buried objects prior to the commencement of road excavation works.

In the expansion of the distribution network in Kigali, the roads for the subject areas are almost unpaved and very narrow. This crucially influences the overall schedule of the Project which might cause damaging of distribution poles and other equipment while being transported. Therefore, it is necessary to conduct a site survey of the road width, its shoulder and the ruggedness of the roads prior to transportation of distribution poles and other equipment.

Furthermore, it is necessary to consider road conditions after raining and the sloping land in order to immediately address issues such as slipping, burying, slope collapse, etc.

(3) Consideration on Procurement

It is planned to procure the major equipment from Japan or from third world countries. Meanwhile, conformity to contract specifications of other materials from the country of origin shall be confirmed. In order for the construction works to progress smoothly, it is indispensable to carry out procurement and transportation based on the construction plan. Therefore, the Contractor is required to carry out comprehensive procurement management, including manufacturing and transportation.

2-2-4-3 Scope of Works

(1) Demarcation of Construction Works

The demarcation of construction works of the Project between the Japanese side and Rwandan side is shown in Table 2.2-38.

Table 2.2-38 Demarcation of Construction Works

No.	Items to be Undertaken	Japanese Side	Rwandan Side
1	To secure land for RMU in Huye (4 sites) and new transmission towers (2 sites) for Musha Substation		○
2	To ensure access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations		○
3	To construct the parking lot and roads within the sites of Musha and Rwinkwavu substations	○	
4	To construct the roads outside the sites of Musha and Rwinkwavu substations		○
5	To construct gates and fences in and around the site of Musha and Rwinkwavu substations	○	
6	To provide the temporary storage yard with gate and fence for all project sites		○
7	The following issues related to power shutdown works 1) Nomination and allocation of responsible person for this work from RECO 2) Overall coordination of this work by the above responsible person		○
8	To construct the control buildings in Musha and Rwinkwavu substations	○	
9	To construct the foundation structure and install the equipment related to substations	○	
10	To construct the foundation structure and install the equipment related to distribution network	○	
11	To conduct the testing and commissioning of substation and	○	

	distribution equipment		
12	To prepare the service wires which connect the low voltage line (400/230V) with customers		○
13	To provide the city water during the construction	○	
14	To provide the electricity during the construction	○	
15	To prepare the suitable storage facilities for equipment containing PCB		○
16	To install the toilet and drainage system in Musha and Rwinkwavu substations	○	
17	To provide water into the water tank in Musha and Rwinkwavu substations		○
18	To dismantle the existing substations after completion of new substations in Musha and Rwinkwavu substations		○
19	Relocation and modification if the SCADA system		○

（Source: Prepared by the JICA Study Team）

(2) Demarcation of Procurement and Installation

The demarcation between the Japanese side and Rwandan side for the procurement and installation works under the Project is shown in Table 2.2-39.

Table 2.2-39 Demarcations of Procurement and Installation Works

No.	Items	Japanese side	Rwandan side
1.	**Substation Equipment**		
(1)	Main transformer	○	
(2)	Outdoor switchgear	○	
(3)	Indoor equipment	○	
(4)	Miscellaneous materials (steel structure and cable etc.)	○	
(5)	Civil and building materials	○	
2.	**Distribution Equipment**		
(1)	30 kV Ring Main Unit (RMU)	○	
(2)	Distribution transformer	○	
(3)	Outdoor switching facilities (lightning arrester, fuse, etc.)	○	
(4)	Concrete pole	○	
(5)	Steel pole	○	
(6)	Distribution cable	○	
(7)	Miscellaneous materials (insulator, etc.)	○	
(8)	Civil and building materials	○	

（Source: Prepared by the JICA Study Team）

2-2-4-4 Construction Supervision

The GoJ will at first confirm the adequacy of the Project referring to the terms of grant aid conditions based on the result of the preparatory study. After that, an E/N is concluded between

the two concerned governments. Subsequently, the Project implementation will commence. In executing the detailed design and project supervision, the Consultant will pay due attention to the following:

(a) Background of the project implementation

(b) Contents of the Preparatory Survey Study

(c) The framework of grant aid assistance from Japan

(d) The contents of the Exchange of Notes agreed between the two governments

(e) Site working conditions

(f) Stakeholders in the future concerned on this project

(1) Basic Policies of Construction Supervision

For smooth execution of the Project, it is required that a senior engineer with ample experience in similar types of services and with enough understanding on the contents of the Project will be nominated as the Project Manager. Moreover, an efficient organization for execution consisting of staff for detailed design, tendering procedures, review and approval of design, factory inspection, and site supervision needs to be established. The following engineers will be assigned for the Project to ensure work progress:

- Project Manager
- Electrical Engineer for Site Supervision
- Civil and Building Engineer for Site Supervision
- Inspection Engineer

1) Schedule Management

The Consultant shall manage and supervise the whole phase of works execution of the Contractor so that the project works will be surely executed on schedule, through the three basic principles given below:

a) For each facility, progress of the manufacture, transportation and erection of equipment and materials must be reviewed all the time. The progress of the Rwandan side's works shall also be confirmed.

b) Process of works by both of the Japanese contractor and Rwandan side shall be confirmed and coordinated.

c) Scheduled meetings shall be held at appropriate times for overall schedule management and to determine adjustments, if necessary. The scheduled meetings will be held weekly during the site erection period and daily during the site test period.

2) Safety Management

a) A meeting for safety measures shall be held daily before starting the works and a safety patrol shall be carried out periodically.

b) In case many works are executed at the same place, necessary safety measures shall be taken to avoid accidents, by confirming proper working methods and schedules of concerned parties.

c) Appropriate countermeasure shall be taken for surrounding areas openings and energized equipment inside substation sites

3) Quality Control

a) The Contractor is to submit drawings, specifications, and calculation data for approval of the Consultant, who will review the submitted documents to confirm conformity to applicable standards, contract specifications, etc.

b) The Consultant will attend factory inspections before shipment of major equipment to confirm whether facilities have been manufactured according to the applicable standards and contract specifications.

c) The completed works will be tested at the site before the takeover.

(2) Procurement Management Plan

a) Necessary steps/measures on tax exemption of imported goods at the port of Dar es Salaam in Tanzania shall be confirmed for smooth documentation to avoid delays in completion.

b) Necessary steps/measures on tax exemption or refunding tax of locally supplied materials shall be confirmed.

2-2-4-5 Quality Control Plan

(1) Quality Control of Equipment and Materials to be Supplied

Quality of equipment and materials to be supplied under the project will be controlled in the following steps:

1) Review of Design Drawings and Specifications

After conclusion of the contract, the Consultant will review drawings, specifications, and calculations submitted for approval by the Contractor. This is intended to verify conformity to applied standards, contract specifications, etc. The Consultant will approve them if there are no problems, or give necessary comments. The Consultant will perform such services in Japan. Equipment and materials will be manufactured after said approval is obtained.

2) Factory Inspection

After equipment is manufactured, it will be subject to factory inspection by the Contractor before delivery to the site. The purpose of this inspection is to confirm that the equipment is manufactured in accordance with applied standards and contract specifications. Generally, visual inspection and characteristics tests are carried out. The tests of major equipment are also attended by the Consultant.

3) Site Supervision and Tests on Completion

The Consultant will carry out construction supervision with cooperation of RECO engineers so that the site construction and erection works are performed in accordance with the contract specifications. Completion tests are to be performed before taking over to confirm whether the works are completed in accordance with the specifications or not.

(2) Quality Control of Civil Works

1) Review of Construction Drawings

Structural design and construction drawings are to be prepared and will be subject to review and approval by the Consultant. These review and approval services will be performed in Japan.

2) Inspection of Materials to be Used

The Consultant will inspect all materials before being used for the works. These tests will be performed at the supply origins or at site as required.

3) Construction Supervision at Site

With cooperation of RECO engineers, the Consultant will carry out construction supervision of the soil filling, concreting (concrete quality and arrangement of steel bars), erection of steel frames, etc. as well as attend to some work items.

2-2-4-6 Procurement Plan

(1) Purchasing Sources

The list of procurement of main equipment is shown in Table 2.2-40. From the viewpoint of reduction of Project cost, it is planned to procure major equipment (i.e. circuit breaker, disconnecting switch) and large quantity of materials (i.e. 30 kV cable) from third world countries. Furthermore, since the Project type is the first in Rwanda, which is intended for the power sector through grant aid project, it is planned to adopt the production of the main transformer from a Japanese manufacturer in order to ensure high quality equipment,

Meanwhile, in case the country of origin is not specified for the procurement of materials from

third world countries, there is a possibility that the bidder will adopt a product in the country that offers low price but of low quality. Therefore procurement of major equipment from third world countries shall be restricted to those who are members of the Development Assistance Committee (12 of the United States, Britain, France, Germany, Italy, Canada, Belgium, the Netherlands, Portugal, Norway, Denmark, and Japan countries), or OECD-affiliate countries. However, electrical cables and other miscellaneous materials do not usually specify the country of origin.

Table 2.2-40 Procurement of Major Equipment

No.	Item	Local	Japan	Third countries	
				DAC	Other
1.	Substation Facilities				
(1)	Transformer		○		
(2)	Outdoor Switchgear		○	○	
(3)	Indoor Switchgear		○	○	
(4)	Miscellaneous		○		○
2.	Distribution Facilities				
(1)	30 kV Indoor Switchgear（RMU）			○	
(2)	Distribution Transformer		○	○	
(3)	15 kV Outdoor Switchgear		○		
(4)	Concrete Pole	○			
(5)	Conductor, Cable		○		○
(6)	Miscellaneous		○		○

（Source: Prepared by the JICA Study Team）

(2) Local Procurement

Concrete poles and construction materials will be procured in Rwanda.

1) Concrete Poles

Out of the distribution line materials, the NPD-CONTRACO is the only manufacturer of concrete poles in the country. Said company has the ability to manufacture 50 poles per day from their past experience with projects carried out by RECO. Thus, it is judged that they are capable and available for the Project.

2) Construction Materials

a) Cement

Although cement is generally imported from Uganda and its neighboring countries, it is also possible to manufacture it in the Rwanda.

b) River Sand and Aggregates

In general, river sand and aggregates are picked in the country, and they are distributed to the market in Kigali.

c) Reinforcing Bars

Reinforcing bars are generally imported from Kenya, Uganda and other countries, and are distributed to the market in Kigali.

d) Bricks

Bricks are commonly manufactured in the country, and are distributed to the market in Kigali. Therefore onshore procurement of bricks is possible.

e) Fittings

Windows and doors for buildings are imported from South Africa and other countries, and are distributed to the market in Kigali.

f) Electrical Materials

Lighting fixtures and air conditioners are imported from South Africa and other countries, and are distributed to the market in Kigali.

(3) Transportation Plan

1) Landing Port and Transport Routes

Since there are no international ports in Rwanda, equipment and materials related to the Project are generally imported via Mombasa Port or Dar es Salaam Port. Comparison table for the landing port and transport route is shown in Table 2.2-41.

Table 2.2-41 Comparison Table for Landing Port and Transport Route

Item	Mombasa Port (Kenya)	Dar es Salaam Port (Tanzania)
Haul Distance to Kigali	Approx.1,680 km	Approx.1,550 km
Transport Route	Mombasa⇒Nairobi⇒Kampala⇒Kigali	Dar es Salaam⇒Rusumo⇒Kigali
Necessary Time to Kigali	Approx. 10～20 days	Approx. 8～15 days
Number of Border	2 places	1 place
Detention Period	Approx. 10 days	Approx. 15 days
Number of Container	Approx. 0.48 Million TEU in 2006	Approx. 0.30 Million TEU in 2006 year

(Source: Prepared by the JICA Study Team)

a) Limitation of Transportation

The main transformers are the heaviest equipment in the Project, weighing approximately 20 tons. The highest transformer is 3 m tall, including the packing materials at the transportation stage. It seems possible to deliver said equipment through inland transportation without any troubles. Moreover, the route from Mombassa Port to Rwanda also has no limitation on transportation, which is the same as the route of Dar es Salaam Port, according to information from local transportation companies.

b) Customs Clearance

Customs clearance is carried out at customs offices located in the country's border. According to the information from local transportation companies, customs is free at the crossing point in the neighboring countries, and shall then be paid at the final destination in Rwanda. In the inland transportation for the Project, cargo inspection is scheduled to be carried out at the border. Cargoes are then transported to the project sites directly. It is necessary for the Contractor to confirm with the Rwandan side in advance about the official procedure for acquisition of the certificate of tax exemption which will be issued by the Ministry of Finance and the Contractor will go through the procedure of application for obtaining the said certificate without any delay.

c) Landing Port and Inland Transportation Route

There are two (2) routes for transporting general cargo to the country, namely, via Mombassa Port in Kenya and via Dar es Salaam in Tanzania.

The route via Mombassa Port accounts for about 65% of the past projects in the country and was utilized for other projects implemented through Japan grant aid.

However, it is planned to utilize the route via Dar es Salaam for the Project as it is less costly than other alternative and RECO has many experiences in using this route during their past projects.

2) Final Destination

Since equipment and materials for the Project are of large quantities, storage yard shall be prepared by RECO, and equipment and materials will be transported to said storage yard by the Contractor.

However, since there are many long distance rough and muddy roads between the main roads to the storage yard for Musha and Rwinkwavu substations, accidents and troubles during transportation seem to occur, especially during rainy seasons. Therefore, such roads shall be repaired by RECO before commencement of the transportation stage.

2-2-4-7 Initial Training and Operational Management Instructions

Initial training and operation instructions will be given to support RECO engineers who are engaged in the O&M of subject substations and distribution network. This is sustainably attained by the transfer of technical knowledge through the Project. By this training, it is expected that RECO engineers will be able to completely perform O&M works themselves including initiating appropriate countermeasures against any troubles and suitable management of manuals and

drawings.

(1) Guidance Instructor and Trainees

Table 2.2-42 Initial Training and Operational Management Instructions

Instructor	Project Site	Trainees	
		Person in Charge	Number
Guidance Engineer from the Contractor	Jabana Substation	- Chief Engineer	1
		- Operator (Electrical and Communication)	3
		- Maintenance Staff	1
	Gikondo Substation	- Chief Engineer	1
		- Operator (Electrical and Communication)	3
		- Maintenance Staff	1
	Musha Substation	- Chief Engineer	1
		- Operator (Electrical and Communication)	2
		- Maintenance Staff	1
	Rwinkwavu Substation	- Chief Engineer	1
		- Operator (Electrical and Communication)	2
		- Maintenance Staff	1
	Distribution Network in Huye	- Chief Engineer	1
		- Operator (Electrical)	2
		- Maintenance Staff	1
	Distribution Network in Kigali	- Chief Engineer	1
		- Maintenance Staff	2
		Total	25

（Source: Prepared by the JICA Study Team）

(2) Contents of Training Program

Table 2.2-43 Training Program on O&M Works

Items	Contents
1. General inspection of equipment	Daily inspection(Appearance check） Periodical inspection（insulation tests、change of phase, cleaning of filter）
2.Emergency procedure and repairing method	Explanation of electrical hazard and emergency operation and repairing method in each component
3. Replacement item and its method	Lecture on replacement method for replacement of defect and consumable parts
4. Prohibit operation and reset of system	Confirmation on prohibition of operation of equipment through OJT.
5. Explanation of equipment functions and drawings and related data	Using “as built drawing, O/M manuals and related document”, function of equipment to be checked referring the documents.

（Source: Prepared by the JICA Study Team）

2-2-4-8 Implementation Schedule

The implementation schedule for the Project is shown in Table 2.2-44.

Table 2.2-44 Implementation Schedule

		Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Tendering works	Procurement	Consultant contract																								
		Equipment specification Review of Tender Document																								
		Approval of tender document																								
		Tender announcement																								
		Tender																								
		Tender Evaluation																								
		Contractor contract																								
		Approval of contract by Ministry of Foreign Affairs																								
Procurement control	Schedule of construction work	**Procurement of Equipment**																								
		− Design																								
		− Manufacturing																								
		− Factory inspection, sea and inland transportation																								
		Construction of facilities																								
		1. Jabana Substation																								
		(1) Preparation & Cleanup																								
		(2) Installation of Control Panels																								
		(3) Installation of Mukungwa Feeder Equipment																								
		(4) Installation of Gikondo Feeder Equipment																								
		(5) Installation of No.1Transformer																								
		(6) Installation of No.2Transformer																								
		(7) Installation of 15kV Distribution Panel																								
		(8) Adjustment, trial operation/ instruction																								
		2. Gikondo Substation																								
		(1) Preparation & Cleanup																								
		(2) Installation of A Bus−bar																								
		(3) Installation of B Bus−bar																								
		(4) Installation of Jabana Feeder Equipment																								
		(5) Installation of Mont Kigali Feeder Equipment																								
		(6) Adjustment, trial operation/ instruction																								
		3. Birembo Substation																								
		(1) Construction of Outdoor Switchgear																								
		(2) Adjustment, trial operation/ instruction																								
		4. Musha Substation																								
		(1) Preparation & Cleanup																								
		(2) Civil Works																								
		(3) Construction works for building																								
		(4) Installation of Outdoor Equipment																								
		(5) Installation of Indoor Equipment																								
		(6) Construction of Transmission Line Tower																								
		(7) Adjustment, trial operation/ instruction																								
		5. Rwinkwavu Substation																								
		(1) Preparation & Cleanup																								
		(2) Civil Works																								
		(3) Construction works for building																								
		(4) Installation of Outdoor Equipment																								
		(5) Installation of Indoor Equipment																								
		(6) Adjustment, trial operation/ instruction																								
		6. Upgrade of Distribution Networks in Huye																								
		(1) Route survey																								
		(2) Preparation & Cleanup																								
		(3) Construction works for building																								
		(4) Construction of Underground Cable																								
		(5) Installation of RMU and Transformer																								
		(6) Adjustment, trial operation/ instruction																								
		7. Expansion of Distribution Networks in Kigali																								
		(1) Route survey																								
		(2) Preparation & Cleanup																								
		(3) Construction of Concrete Poles																								
		(4) Installation of Equipment, Wiring of Overhead Line																								
		(5) Adjustment, trial operation/ instruction																								

(Source: Prepared by the JICA Study Team)

2-3 Obligations of Recipient Country

2-3-1 Responsibility of Recipient Country

Items to be arranged by the Rwandan side for the implementation of the grant aid project from Japan are as follows:

(1) Arrangement on Tax Exemption

Customs clearance and tax exemption for importing equipment/materials and tax exemption for customs clearance, value-added tax, income or corporate tax or local taxes or related taxes to be imposed to Japanese people(s) or any corporate body engaged in the project works under the procurement contract of materials and equipment under a grant aid project.

(2) Extension of Convenience

Obtaining entry and stay permits to Japanese people(s) or corporate body engaged in the project works under the procurement contract of materials and equipment during execution of contract

(3) Documentation of Banking and Authorization to Payment

Processing of banking arrangement (B/A) and issuance of Authorization to Pay (A/P) with its charges.

2-3-2 Undertaking of the Recipient Country

In relation to the implementation of the project, the following services and works are to be executed by the Rwandan side.

(1) Execution before Start

- Securing land for RMU in Huye (four sites namely, Aerodrome, Sorwal, Telecom and Cyarwa) and new transmission tower (two sites)
- Ensuring access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations
- Provision of temporary storage yard with gate and fence for all project sites
- Prepare suitable storage facilities for equipment containing PCB

(2) Execution during Installation

- Construction roads outside the sites of Musha and Rwinkwavu substations
- Addressing the following issues related to power shutdown works

1) Nomination and allocation of responsible person from RECO for this works

2) Overall coordination of these works by the above responsible person

(3) Execution after Completion

- Preparation of service wires which connect the low voltage line (400/230V) to the customers
- Provision of water into the water tank in Musha and Rwinkwavu substations
- Dismantlement of the existing substations after completion of new substations in Musha and Rwinkwavu

2-4 Project Operation Plan

(1) Operation and Maintenance (O&M) Personnel

After completion of this project, the subject substations will be operated by the Power Operation Section under the control of Electricity Department in RECO. The O&M for the distribution networks in Huye and Kigali will be conducted by Huye Station and Kigali Station, respectively, under the control of RECO.

The number of O&M staff for the subject substations and distribution network as of June 2010 is as follows: (The staff for distribution network will only be engaged for maintenance works.)

- Jabana Substation : 6
- Gikondo Substation : 21
- Musha Substation : 4
- Rwinkwavu Substation : 4
- Huye Distribution Network : 7
- Kigali Distribution Network: 13

a) Operation of System Switching: Operate switchgear in accordance with the order of Load Dispatching Center (LDC).

b) Data Logging: At each hour, log voltage, current, power factor and frequency, etc. in the logging sheet.

c) Countermeasures for Troubles: Emergency operation to recover substations. In case emergency situations arose at each substation which seems to be difficult to repair, the substation staff will contact the staff of Gikondo Substation and respond to such troubles in accordance with their instructions.

d) Operation and Check: Carry out the daily and periodic maintenance and checks.

Regarding the present conditions of O&M related to the existing substations and distribution network by RECO, it can be judged that suitable responses without any particular problems have been taken during occurrences of any accidents and troubles at substations.

However, it is required to improve the technical level of the power system administrator in RECO, because Rwanda is aiming at the realization of strengthening and expanding the power system in the country in order to meet the rapid increase of power demand.

Considering the above, it is expected that appropriate training and education for RECO engineers through the Project will be implemented.

(2) Maintenance and Check Works

Items to be subject to daily maintenance and check works are described below.

Maintenance and check works consist of daily perambulation and periodic checks (3 months – 6 years). Items subject to daily perambulation and periodic check are shown in Table 2.4-1.

Table 2.4-1 Items to be Subject to Daily Maintenance and Check Works

-	Equipment	Daily Perambulation	Periodic Checks (3 months interval, if not mentioned)
Substation	Main Transformer	-Abnormal noise/vibration -Temperature rise -Insulation oil level -Oil leakage	-Silica gel check & replace -N2 gas pressure check -Oil deterioration test (1 year)
	Control/Relay Boards	-Meters & indication lamps	-Cleaning -Relay function test (5-6 years)
	15kV Indoor Cubicles	-Abnormal noise/vibration -Meters & indication lamps	-Cleaning -Circuit breaker operation test -Relay function test (5-6 years)
	Batteries	-Deformation of terminals and cell cases	-Voltage measurement -Equalizing charge
Distribution Network	Ring Main Unit（RMU）	-Meters & Indication lamps	-Circuit breaker operation test -Relay function test (5-6 years)
	Distribution Transformer	-Oil leakage	-

（Source: Prepared by the JICA Study Team）

2-5 Project Cost Estimation

2-5-1 Project Cost Estimation

(1) Expenses Borne by the Rwandan Side

In case the project is executed under a grant aid, expenses to be borne by the Rwandan side are as follows:

Table 2.5-1 Expenses Borne by Rwandan Side

1) Secure land for RMU in Huye (4 sites) and new transmission tower (2 sites)	RWF	1,380,000 (=230m^2 x 6,000RWF/m^2)	(¥ 218,000)
2) Ensure access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations	RWF	14,400,000 (=2,400m^2 x 6,000RWF/m^2)	(¥ 2,275,000)
3) Construct the roads outside the sites of Musha and Rwinkwavu substations)		14,400,000 (=2,400m^2 x 6,000RWF/m^2)	(¥ 2,275,000)
4) Arrange temporary storage yard with gate and fence for all project sites	RWF	0 *Utilization of the existing storage yard	(¥ 0)
5) Prepare the service wires which connect the low voltage line (400/230V) to the customers	RWF	140,728,000 (=2,513 x 56,000RWF/connection)	(¥ 22,235,000)
6) Prepare suitable storage facilities for equipment containing PCB	RWF	0 *Utilization of the existing storage yard	(¥ 0)
7) Dismantle the existing substations after completion of new substations in Musha and Rwinkwavu substations	RWF	12,650,000 (=2 S/S x 6,325,000RWF)	(¥ 2,000,000)
8) Relocation and modification of SCADA system	RWF	54,608,000 (=4 S/S x 13,652,000RWF)	(¥ 8,628,000)
Total	RWF	238,166,000	(¥ 37,630,000)

Exchange Rate：1RWF=¥0.158 (As of June, 2010)

（Source: Prepared by the JICA Study Team）

In addition to the above, expenditures for the Bank Agreement (B/A) and Authorization to Pay (A/P) for obtaining import permit from the government and others will be arranged. For smooth execution of such duties, the Rwandan side needs to secure the required budget in advance.

2-5-2 O&M Cost

(1) Assignment Plan for O&M Staff

The assignment plan for members of the O&M staff is as follows;

Table 2.5-2 Assignment Plan for O&M Staff

Project Site	Trainee	
	Person in Charge	Number
Jabana Substation	- Chief Engineer	1
	- Operator (Electrical and Communication)	3
	- Maintenance Staff	2
Gikondo Substation	- Chief Engineer	2
	- Operator (Electrical and Communication)	12
	- Maintenance Staff	7
Musha Substation	- Chief Engineer	1
	- Operator (Electrical and Communication)	2
	- Maintenance Staff	1
Rwinkwavu Substation	- Chief Engineer	1
	- Operator (Electrical and Communication)	2
	- Maintenance Staff	1
Distribution Network in Huye	- Chief Engineer	1
	- Operator (Electrical)	3
	- Maintenance Staff	3
Distribution Network in Kigali	- Chief Engineer	1
	- Maintenance Staff	12
Total		55

（Source: Prepared by the JICA Study Team）

(2) Operation and Maintenance Cost

The O&M costs consist of equipment maintenance cost, employment cost and management cost.

In total, O&M cost is summarized in Table 2.5-3.

Table 2.5-3 O&M Cost

Items		RWF（JP Yen）
1)Personnel Expenses	a) Chief Engineer -7 staff (=7staff x 536,744RWF/M x 12M)	45,086,000 (7,123,000)
	b) Operator (Electrical & Communication) -22 staff (=22staff x 294,690RWF/M x 12M)	77,798,000 (12,292,000)
	c) Maintenance Staff -26 staff (=26staff x 294,690RWF/M x 12M)	91,943,000 (14,527,000)
2)Maintenance Fee	-	3,848,000 (608,000)
3)Other Expenses	-	3,652,000 (577,000)
Total	-	222,327,000 (35,128,000)

Exchange Rate：1RWF=¥0.158 (As of June, 2010)

（Source: Prepared by the JICA Study Team）

2-6 Other Relevant Issues

1) The Rwandan side shall secure land for RMU in Huye (4 sites) and new transmission towers for Musha Substation (2 sites) in accordance with the applicable law in Rwanda as described in Clause 1-2.(2) prior to the commencement of the Project.

2) The Rwandan side shall get the permission of EIA related to the expansion of the distribution network project in Kigali from the Rwanda Development Board (RDB) in accordance with the applicable law in Rwanda prior to the commencement of the Project.

3) The Rwandan side shall nominate and allocate the responsible person from RECO for power shutdown works related to the rehabilitation and upgrading of substations under the Project in order to prevent the delay of the construction schedule caused by the insufficient coordination required for the shutdown works.

Chapter 3
Project Evaluation

Chapter 3 Project Evaluation

3-1 Recommendations

3-1-1 Prerequisites for the Implementation of the Project

The Rwandan side is required to confirm to bear/undertake the following administrative matters and arrangements.

1) The Rwanda Electricity Corporation (RECO) shall get the permission for conducting EIA from the Rwanda Development Board (RDB) prior to the commencement of the Project.
2) Securing land for RMU in Huye (4 sites) and new transmission towers (2 sites) for Musha Substation
3) Acquiring construction permission required for the installation of buried cable for the distribution network in Huye
4) Ensuring access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations
5) Provision of temporary storage yard with gate and fence for all project sites
6) Addressing the following issues related to power shutdown works

   6)-1. Nomination and allocation of responsible person from RECO for this work

   6)-2. Overall coordination of this work by the above responsible person

7) Preparation of suitable storage facilities for equipment containing PCB

3-1-2 Prerequisites and External Conditions for the Successful Completion of the Project

1) The current organization structure of the Ministry of Infrastructure (MININFRA) and Rwanda Electricity Corporation (RECO) is to be operated without any particular change.
2) Constructing roads outside the sites of Musha and Rwinkwavu substations
3) Preparation of the service wires which connect the low voltage line (400/230V) to the customers
4) Provision of water into the water tank at Musha and Rwinkwavu substations
5) Dismantlement of existing substations after completion of the new substations in Musha and Rwinkwavu

6) Relocation and modification of the SCADA system

3-2 Project Evaluation

3-2-1 Validity of the Project

It is expected that the Project will contribute to the following, mainly through the implementation of rehabilitation and upgrading of substations in Kigali, in the eastern province and Huye, including the distribution network in Kigali.

i) Prevention of adverse impacts such as long-term power outages affecting the existing customers in Kigali and Huye, by replacing the deteriorated equipment at the substations and distribution network

ii) Supply of the stable power

iii) Increase of the present electrification rate

Therefore, the beneficial effects lead to positive impacts not only to the national economy, but also to the country's welfare, education and healthcare. Considering this, it is judged that the validity of the implementation of the Project is very high.

3-2-2 Effectiveness

(1) Quantifiable Effects

The quantifiable effects due to the Project are as follows:

1) The following new customers are expected to be provided with power services led by the increase of main transformer's capacity and expansion of distribution network

: General Consumers - 45,263 households (approximately 195,000 persons)

: Schools - 65 sites

: Health Centers - 9 sites

2) Prevention of adverse impacts such as long-term power outages affecting the following existing customers by replacing the deteriorated equipment at the substations and distribution network

: General Consumers – 70,165 households (approximately 301,000 persons)

: Schools - 95 sites

: Hospitals – 11 sites

: Health Centers - 67 sites

3) Reduction of carbon dioxide emission, which reaches about 328 tons/year, through the improvement of the distribution loss ratio.

(2) Qualitative Effects

The qualitative effects due to the Project are as follows:

1) Beneficial effects to general customers

Through the implementation of the Project, new customers will be provided with brighter and safer lights than the kerosene lamps currently used. In this way, it is expected to realize the benefits such as i) improvement of education level by secure the learning period of children, and ii) increase of living standards by making it possible for people, particularly women, to work in their houses. In addition, the use of much needed home electronics such as television or stereo sets will become more possible. Thus, this leads to significant improvement of life style of new customers. It is noted that the volume of quality information available through television networks are expected to directly benefit to the improvement of life style and living standard of households.

Moreover, mobile phones, which have absolute importance in ensuring living convenience for people in rural areas, will now serve as easy communication means of accessing the capital town of Kigali. Especially, the users in the eastern province will benefit from the stable power supply for the battery charger of mobile phones. As the existing customers are provided with a more stable power supply, damages to personal computers and battery chargers for mobile phones due to frequent voltage fluctuations are minimized.

2) Beneficial effects to medical facilities

Through the implementation of the Project, it is expected that medical facilities will improve their service levels due to the acceleration of introduction of advanced medical facilities and personal computers. Ensuring a stable power supply is indispensable at hospitals and medical centers, especially, for nighttime medical treatment of patients, particularly those pregnant. It becomes possible to prevent the degradation of drugs or vaccines with the stable power supplied to refrigerators used as storage. There were reports that many general medical centers could not perform their duties during power shortage since most of them do not have diesel generators or other temporary power facilities.

Considering the above circumstances, the beneficial effects brought by the implementation of the Project to medical facilities is significant.

3) Beneficial effects to educational facilities

At present, the educational system in Rwanda consists of primary schools and secondary schools. The current school system in the country adopts a two-part system (7:00 a.m. to 12:00 p.m., 12:00 p.m. to 6:00 p.m.) since the number of students in each school far exceeds the accommodation capacity of the facilities. According to information confirmed through interviews with school officials of the non-electrified schools in Kigali, they strongly need electrification in order to solve their present problems. As an example, without stable power for electric lighting, school teachers find it difficult to prepare educational materials during early hours in the morning before sunrise.

In addition, the introduction of electrical facilities required for education such as computers, projectors, photocopy machines and lightings are also expected to enhance the education system in the country.

4) Decentralization of residents in Kigali

Although the public houses are concentrated in Kigali City at present, there are still many which are deprived of electrical services due to the generally high price of the commodity.

The planned areas for expansion of distribution network in Kigali under the Project are located in suburban areas in Kigali City. Therefore, there is a possibility that many residents living now in the center of Kigali City will move to such planned areas after electrification is implemented under the Project, and their life environmental will be improved significantly by obtaining the benefits as described in the above 1) to 3).

APPENDICES

1. **Member List of the Study Team**
2. **Study Schedule**
3. **List of Parties Concerned in the Recipient Country**
4. **Minutes of Discussions**
5. **Drawings**

Appendix-1

Member List of the Study Team

Member of the Study Team

Preparatory Survey on the Project for Upgrading, Rehabilitation and Expansion of Substations and Distribution Network in the Republic of Rwanda

1. Mr. Toshiyuki HAYASH (1st & 2nd Field Survey)
   Team Leader
   (Senior Representative, JICA Senior Advisor)
2. Mr. Masanobu MAYUSUMI (1st & 2nd Field Survey)
   Planning Management
   (Electric Power Division, Natural Resources and Energy Group, Industrial Development Department, JICA)
3. Mr. Akihisa MANITA (1st & 2nd Field Survey)
   Team Leader / Power Supply Planning
   (NIPPON KOEI Co., Ltd.)
4. Mr. Akira SHIMIZU (1st & 2nd Field Survey)
   Substation Equipment / Facility Planning
   (NIPPON KOEI Co., Ltd.)
5. Mr. Hideo FUKUI (1st Field Survey)
   Distribution Facility Planning
   (NIPPON KOEI Co., Ltd.)
6. Mr. Shinya OSUMI (1st Field Survey)
   Civil and Foundation Structure / Nature Condition Study (Topographic and Geological Survey)
   (NIPPON KOEI Co., Ltd.)
7. Mr. Masahiro SAKAGAMI (1st Field Survey)
   Communication System Planning
   (NIPPON KOEI Co., Ltd.)
8. Mr. Norio SHIGETOMI (1st & 2nd Field Survey)
   Environmental and Social Considerations
   (MITSUBISHI RESERARCH INSTITUTE, INC.)
9. Mr. Eiji MATSUDA (1st Field Survey)
   Procurement Planner / Cost Estimator
   (NIPPON KOEI Co., Ltd.)
10. Mr. Masahiro FUKUMORI (1st Field Survey)
    Coordinator
    (NIPPON KOEI Co., Ltd.)

Appendix-2

Study Schedule

Study Schedule (First Field Survey)

No.	M/D		Week	JICA		Consultant							
				HAYASHI	MAYUSUMI	MANITA	SHIMIZU	FUKUI	OSUMI	SAKAGAMI	SHIGETOMI	MATSUDA	FUKUMORI
1	5	8	Sat			Narita→Dubai→Nairobi→Kigali			Narita→Dubai→Nairobi→Kigali				Narita→Dubai→Nairobi→Kigali
2	5	9	Sun										
3	5	10	Mon			Courtesy call to JICA Office, MININFRA and RECO			Courtesy call to JICA Office, MININFRA and RECO				Courtesy call to JICA Office, MININFRA and RECO
4	5	11	Tue			Site Survey for substations in Kigali			Preparation of site measurement for substations in Kigali				Site Survey for substations in Kigali
5	5	12	Wed			Site Survey for distribution network in Kigali			Site Survey for distribution network in Kigali				Site Survey for distribution network in Kigali
6	5	13	Thu			Site Survey for substations in Eastern Province			Preparation of site measurement for substations in Eastern Province				Site Survey for substations in Eastern Province
7	5	14	Fri			Site Survey for distribution network in Huye			Site Survey for distribution network in Huye				Site Survey for distribution network in Huye
8	5	15	Sat			Internal meeting, Data arrangement			Internal meeting, Data arrangement				Internal meeting, Data arrangement
9	5	16	Sun	Narita→Dubai→Nairobi→Kigali		Data arrangement			Data arrangement				Data arrangement
10	5	17	Mon			Discussion with RECO			Monitoring of site measurement and topographic survey				Monitoring of site measurement and topographic survey
11	5	18	Tue	Courtesy call to Embassy of Japan in Rwanda Donor hearing (World Bank, AfDB, EU) Discussion with MININFRA & RECO					Courtesy call to Embassy of Japan in Rwanda Donor hearing (World Bank, AfDB, EU) Discussion with MININFRA & RECO				Courtesy call to Embassy of Japan in Rwanda Donor hearing (World Bank, AfDB, EU) Discussion with MININFRA & RECO
12	5	19	Wed	Discussion with MININFRA & RECO					Discussion with MININFRA & RECO				Discussion with MININFRA & RECO
13	5	20	Thu										
14	5	21	Fri	Signing of M/D, Report to JICA Rwanda Office				Kansai→Dubai→Nairobi→Kigali	Signing of M/D, Report to JICA Rwanda Office		Narita→Dubai→Nairobi→Kigali		Signing of M/D, Report to JICA Rwanda Office
15	5	22	Sat	Internal meeting		Internal meeting, Data arrangement					Internal meeting, Data arrangement		
16	5	23	Sun			Data arrangement					Data arrangement		
17	5	24	Mon	Discussion with MININFRA & RECO for the project for RECO's capacity building fir efficient power system development		Discussion with RECO	Discussion with MININFRA & RECO for the project for RECO's capacity building fir efficient power system development	Site survey for distribution network in Kigali	Discussion with RECO		Discussion with RECO	Discussion with RECO	Site survey for distribution network in Kigali
18	5	25	Tue									Site Survey for substations in Kigali	
19	5	26	Wed									Site survey for distribution network in Kigali	
20	5	27	Thu						Kigali→Nairobi→Dubai→Narita			Site Survey for substations in Eastern Province	
21	5	28	Fri									Site survey for distribution network in Huye	
22	5	29	Sat	Kigali→Nairobi→Dubai→Narita		Internal meeting, Data arrangement		Internal meeting, Data arrangement		Narita→Dubai→Nairobi→Kigali	Internal meeting, Data arrangement		
23	5	30	Sun			Data arrangement		Data arrangement			Data arrangement		
24	5	31	Mon			Site Survey for substations in Kigali		Site Survey for substations in Kigali		Discussion with RECO	Site Survey for substations in Kigali	Hearing to the local contractors	Site Survey for substations in Kigali
25	6	1	Tue								Site survey for distribution network in Kigali		
26	6	2	Wed			Site Survey for Gikondo substation in Kigali					Site Survey for substations in Eastern Province	Preparation of implementation schedule	
27	6	3	Thu							Site Survey for substations in Kigali	Site survey for distribution network in Huye		
28	6	4	Fri								Discussion with RECO		Kigali→Nairobi→Dubai→Narita
29	6	5	Sat			Internal meeting, Data arrangement				Internal meeting, Data arrangement			
30	6	6	Sun			Data arrangement				Data arrangement			
31	6	7	Mon			Site Survey for Jabana substation in Kigali		Site survey for distribution network in Huye		Site Survey for substations in Eastern Province		Preparation of implementation schedule	
32	6	8	Tue										
33	6	9	Wed							Site survey for distribution network in Huye	Discussion with RECO, MININFRA and RDB	Construction planning and cost estimation	
34	6	10	Thu			Site Survey for Rwinkwavu substation in Kigali				Discussion with RECO			
35	6	11	Fri							Discussion with RECO			
36	6	12	Sat			Internal meeting, Data arrangement				Internal meeting, Data arrangement			
37	6	13	Sun			Data arrangement				Data arrangement			
38	6	14	Mon			Site Survey for Musha substation in Eastern Province		Outline design and preparation of implementation schedule		Outline design and preparation of implementation schedule	Discussion with RECO	Construction planning and cost estimation	
39	6	15	Tue										
40	6	16	Wed			Outline design and preparation of implementation schedule							
41	6	17	Thu							Kigali→Nairobi→Dubai→Narita			
42	6	18	Fri										
43	6	19	Sat			Internal meeting, Data arrangement						Internal meeting, Data arrangement	
44	6	20	Sun			Data arrangement						Data arrangement	
45	6	21	Mon			Outline design and preparation of implementation schedule						Construction planning and cost estimation	
46	6	22	Tue										
47	6	23	Wed									Kigali→Nairobi→Dubai→Narita	
48	6	24	Thu										
49	6	25	Fri			Report to JICA Rwanda Office, MININFRA & RECO							
50	6	26	Sat			Internal meeting, Data arrangement							
51	6	27	Sun			Kigali→Nairobi→Dubai→Narita		Kigali→Nairobi→Dubai→Knasai					
52	6	28	Mon.										

Study Schedule (Second Field Survey)

No.	M/D		Week	JICA		Consultant		
				HAYASHI	MAYUSUMI	MANITA	SHIMIZU	SHIGETOMI
1	12	11	Sat	Haneda→Dubai→Nairobi→Kigali	Arrival Kigali from Ghana	Haneda→Dubai→Nairobi→Kigali		
2	12	12	Sun		Preparation of M/D			
3	12	13	Mon	Courtesy call to JICA Office, MININFRA and RECO Site Visit of Gikondo S/S (Discussion for SCADA System with RECO and PSI Explanation and Discussion on Draft Final Report				
4	12	14	Tue	Explanation and Discussion on Draft Final Report				
5	12	15	Wed	Explanation and Discussion on Draft Final Report				
6	12	16	Thu	Signing of M/D Report to JICA Rwanda Office				
7	12	17	Fri	Kigali→Nairobi→Dubai→Haneda		Additional Site Survey at Kigali Distribution Network		
8	12	18	Sat			Internal Meeting、Preparation of Final Report		
9	12	19	Sun			Preparation of Final Report		
10	12	20	Mon			Discussion on the result of Site Survey with RECO Report to Embassy of Japan in Rwanda Site Survey for the Temporary Storage Yards		
11	12	21	Tue			Kigali→Nairobi→Dubai→Haneda		
12	12	22	Wed					

Appendix-3

List of Parties Concerned in the Recipient Country

List of Parties Concerned Person in the Republic of Rwanda

The Preparatory Study on the Project for Upgrading and Expansion of Substations and Distribution Network in the Republic of Rwanda (Outline Design Study)

(1) Ministry of Infrastructure (MININFRA)

Ms. Coletha U. RUHAMYA	Minister of State in charge of Energy and Water
Mr. Yussuf UWAMAHORO	Energy Sector Coordinator
Ms. Eva PAUL	External Links and Donor Coordination
Mr. Nelson LUJARA	Expert in Electricity
Mr. John NTAGANDA	Head of Meteorology Department
Mr. Syidio GAKWISI	In charge of Meteorological Data Management

(2) Rwanda Electricity Corporation (RECO)

Mr. Yves MUYANGE	Acting Managing Director
Mr. Charles KANYAMIHIGO	Director of Electrical Department
Mr. Fred UKWISHAKA	Acting Coordinator of EARP (Electricity Access Roll-out Program)
Mr. Theotime RUTAYISIRE	Director of Human Resources
Mr. Patrice MANIRAKIZA	Director of Planning Section
Mr. GASHEMA Innocent	Head of Training and career Center Section
Mr. Dieudonne NGIZWENAYA	Head of Transmission Line Maintenance
Mr. Claver Gakwavu	Engineer of Electrical Department
Mr. Rugema FAUSTIN	Head of Electricity Network Section ion Kigali Station
Mr. Habyalimana SIMON	Head of Sub-section of Central Maintenance
Mr. Hodaari BIGAJU	Head of Operation and Maintenance of Gikondo Substation
Mr. TUYISENGE Vedaste	Manager of Huye Station
Mr. Leoniolas NZIRORERA	Engineer of Kigali Station
Mr. Vincent Mpaka	Head of Power Operations
Mr. Donath Harerimana	Engineer in charge of Power Plant
Mr. Pascal Mutesa	Manager of National Control Center (NCC)
Mr. William Bihoyiki	Head of Project Implementation Unit
Mr. Methode Rutagungura	Head of Kigali Station

(3) World Bank (WB)

Mr. Erik Fern Strom	Energy Specialist

(4) African Development Bank (AfDB)

Mr. RUTABOBA Ephrem	Consultant

(5) Embassy of Netherlands

Mr. Fred Smiet	First Secretary Regional Affaires

(6) Embassy of Japan

Mr. Kunio HATANAKA	Embassy of Japan
Mr. Shigeru KONDO	Counselor
Ms. Ayala HOSOKAWA	Third Secretary

(7) JICA Rwanda Office

Mr. Hiroshi MURAKAMI	Resident Representative
Mr. Masato KOINUMA	Deputy Resident Representative
Mr. Shingo KIKUCHI	Program Manager
Mr. Samuel SANGWA	Program Coordinator

Appendix-4

Minutes of Discussions

Minutes of Discussions
on Preparatory Survey on the Project for
Upgrading, Rehabilitation and Expansion of Substations and Distribution Networks
in the Republic of Rwanda (Basic Design Study)

Based on the result of Preparatory Study conducted from 25th October to 16th November 2009, the Government of Japan decided to conduct the second Preparatory Study (Basic Design Study) on the Project for Upgrading and Expansion of Substations and Distribution Networks (hereinafter referred to as "the Project"), and entrusted the study to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Republic of Rwanda (hereinafter referred to as "Rwanda") the Preparatory Study (Basic Design Study) Team (hereinafter referred to as "the Team"), which was headed by Mr. Toshiyuki Hayashi, Senior Advisor, JICA, and the Team is scheduled to stay in the country from 9th May to 27th June, 2010.

The Team held discussions with the concerned officials of the Government of Rwanda and RECO (hereinafter referred to as "the Rwandan side"). In the course of the discussions, both the Rwandan side and the Team (hereinafter referred to as "both parties") have confirmed the main items described in the Attachment.

Kigali, Rwanda, May 28, 2010

Toshiyuki HAYASHI
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency

Coletha U. RUHAMYA
Minister of State in charge of Energy and Water
Ministry of Infrastructure
Republic of Rwanda

Yves MUYANGE
Acting Managing Director
Rwanda Electricity Corporation
Republic of Rwanda

ATTACHMENT

1. Objective of the Project

The objective of the Project is to upgrade, rehabilitate and expand substations and distribution networks in Rwanda.

2. Project Site

The Project sites are located in the City of Kigali, in the City of Huye and in Eastern Province as shown in Annex-1.

3. Responsible and Implementing Organizations

(1) The responsible ministry is the Ministry of Infrastructure (MININFRA).
(2) The implementing Organization of the Government of Rwanda is Rwanda Electricity Corporation (RECO).
(3) The organization charts of MININFRA and RECO are shown in Annex-2 and Annex-3 respectively.

4. Components Requested by the Rwandan Side

The Team has reconfirmed the components requested by the Rwandan side as described below and will progress the basic design study based on the components.

JICA will assess the appropriateness of the requested components and will report it to the Government of Japan.

(1) Rehabilitation of Substations: Jabana and Gikondo

The detailed scope of the component for Jabana and Gikondo S/S is shown in Annex-4 and Annex-5 respectively.

(2) Upgrading of Substations: Musha and Rwinkwavu

The detailed scope of the component for Musha and Rwinkwavu S/S is shown in Annex-6 and Annex-7 respectively.

(3) Upgrading of Distribution Networks in Huye from 6.6kV to 30kV

The detailed scope of the component for distribution networks in Huye is shown in Annex-8.

(4) Expansion of Distribution Networks in Kigali

The proposed areas for expansion of distribution networks in Kigali are shown in Annex-9. Both parties confirmed that the detailed site investigation relevant to the expansion of distribution networks in Kigali will be carried out from May 24, 2010 by the Team based on the list prepared by RECO and shown in Annex-9.

In addition to the above, both parties agreed the following components are related to the Project.

(5) Buildings for Substations

Both parties confirmed the buildings of substations relevant to the Project as below:

1) The new buildings at Musha and Rwinkwavu substations in eastern province will be constructed through the Project,
2) The necessity of the expansion of the existing building at Jabana substation in Kigali will be reviewed in consideration of the arrangement of equipment supplied by the Project,
3) The necessity of the construction of new buildings at three substations in Huye (Hospital-1, Ngoma and Butare Nord) will be reviewed in consideration of the operation and maintenance work, the overall project cost, and other aspects; and.
4) The existing building at Gikondo substation in Kigali will be utilized.

The Team requested Rwandan side to secure the land for new buildings adjacent to the existing buildings in case the new buildings will be constructed.

(6) A Disconnecting Switch (DS) for 110kV at Birembo Substation

The Rwandan side requested to supply and install a new 110kV Disconnecting Switch (DS) on the new 110kV feeder at Birembo substation. The said 110kV DS is required for power supply to Musha substation, which will be upgraded from the existing 70kV to 110kV through the Project.

(7) A Future Feeder at Rwinkwavu Substation

Both parties agreed that enough land space and equipment space in control room required for the new 110kV future feeder will be considered in the basic design of this substation.

5. Japan's Grant Aid Scheme

(1) The Rwandan side has understood the Japan's Grant Aid Scheme explained by the Team as described in Annex-10.

(2) The Rwandan side will take the necessary measures, as described in Annex-11, for smooth implementation of the Project as prerequisites for the Japan's Grant Aid to be implemented.

6. Schedule of the Survey

(1) The Team will continue the Survey in Rwanda until June 27, 2010.

(2) JICA will prepare the draft report in English and dispatch a mission to Rwanda in order to explain its contents around October 2010.

(3) In case that the contents of the report are accepted in principal by the Government of Rwanda, JICA will complete the final report and send it to the Government of Rwanda by December 2010.

7. Environmental and Social Considerations

(1) The Team has confirmed that the Rwandan side received the result of screening for the Project from the Rwanda Development Board (RDB) by the official letter No. RDB/3/EC/039/05/10 dated May 13, 2010.

According to the result of the screening, RDB has instructed that the full EIA is required for the component of expansion of distribution networks in Kigali while the full EIA is not required for the other components.

Accordingly, both parties confirmed that the Rwandan side complete all necessary procedures in line with the Rwandan's law in order to obtain the permission for implementation of the Project including the implementation of the Environmental Impact Assessment Study and the submission of the Environmental Impact Assessment Report (EIR) for the component of expansion of distribution networks in Kigali.

The Rwandan side agreed to get the permission for implementation of the Project issued by the RDB by the end of March 2011.

(2) The Team requested the Rwandan side to comply with the JICA Guidelines for Environmental and Social Consideration (hereinafter referred to as "JICA Guidelines") as well as Rwandan laws and regulations.

8. Other Relevant Issues

(1) Coordination among relevant donors and agencies

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

(2) Counterpart Personnel

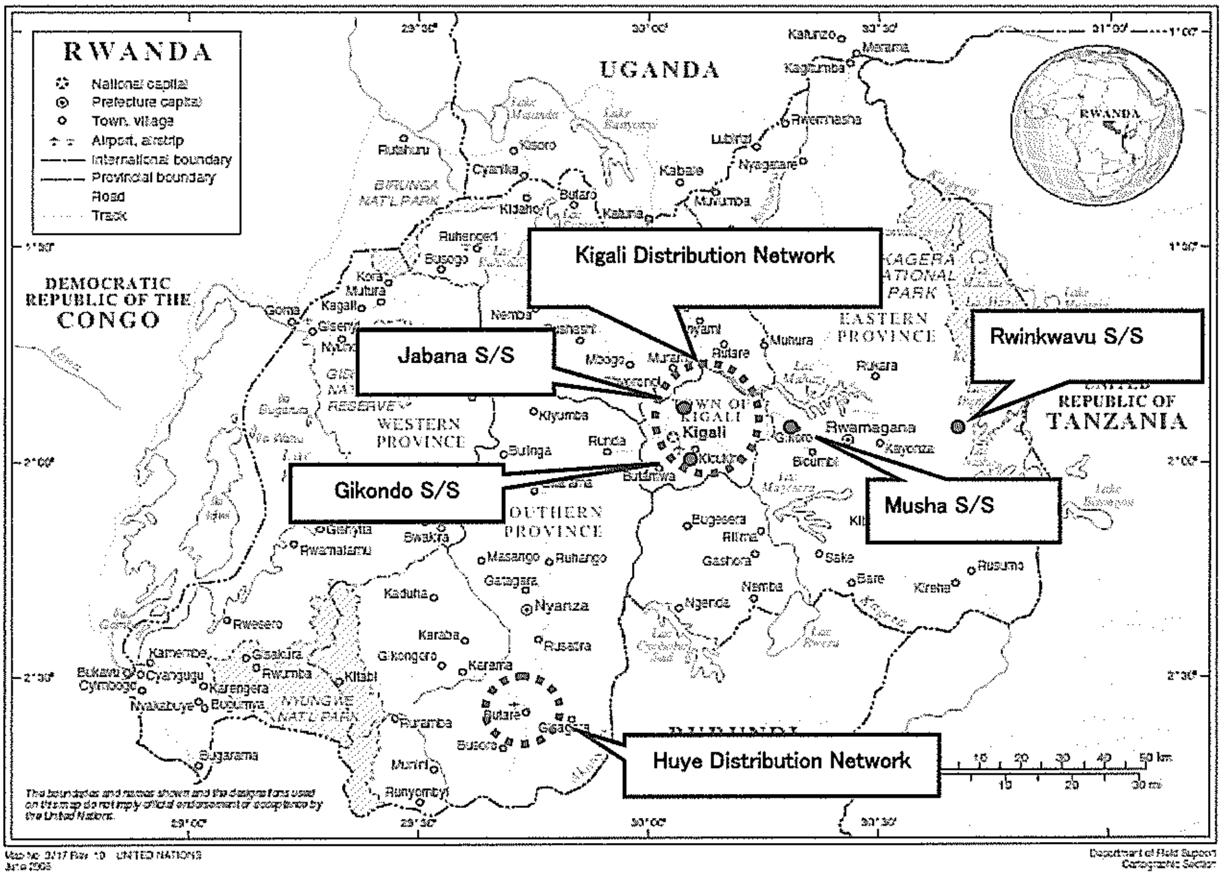
The Team requested the Rwandan side that necessary number of counterpart personnel shall be assigned to the Team and necessary arrangements with related organizations shall be made during the Survey in Rwanda.

(3) Questionnaires

The Team requested the Rwandan side that the answers to the questionnaires which the Team had already submitted to the Rwandan side shall be given to the Team by May 31, 2010.

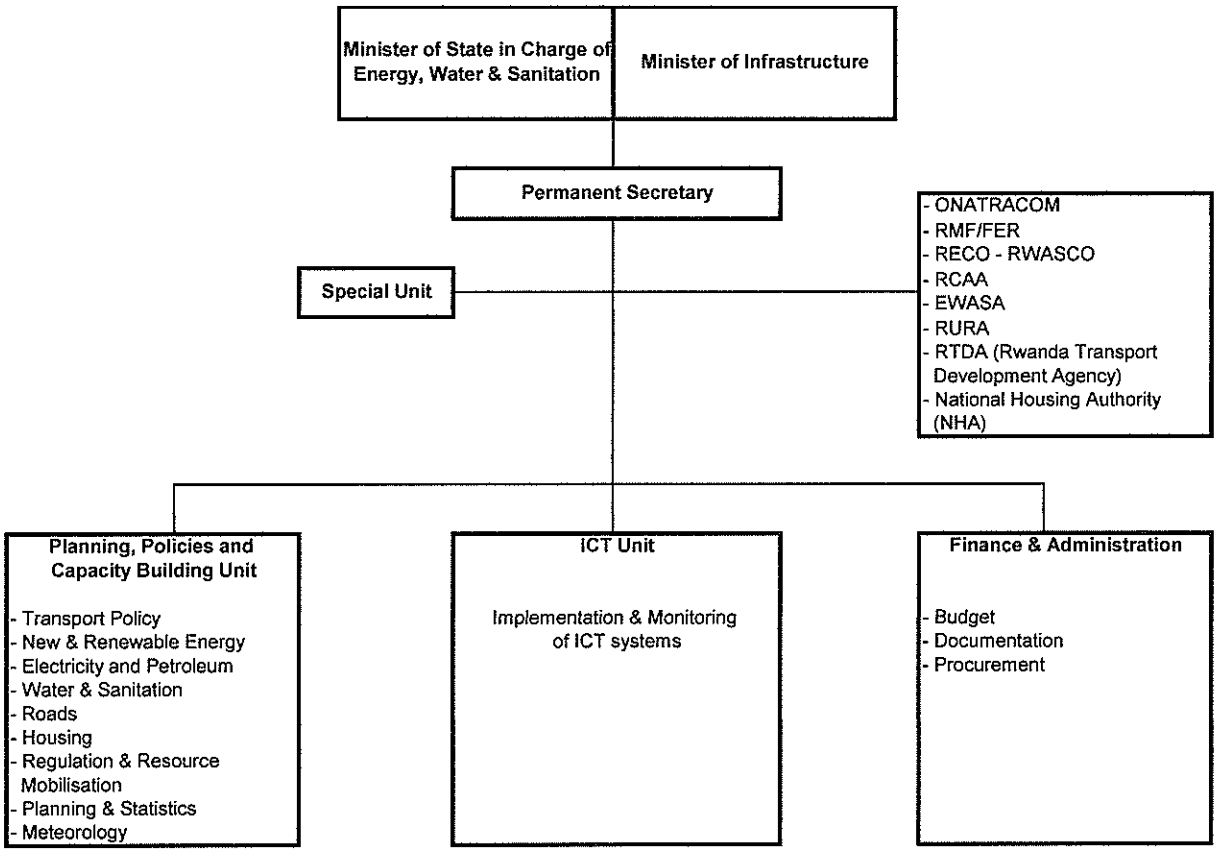
(End)

Annex-1



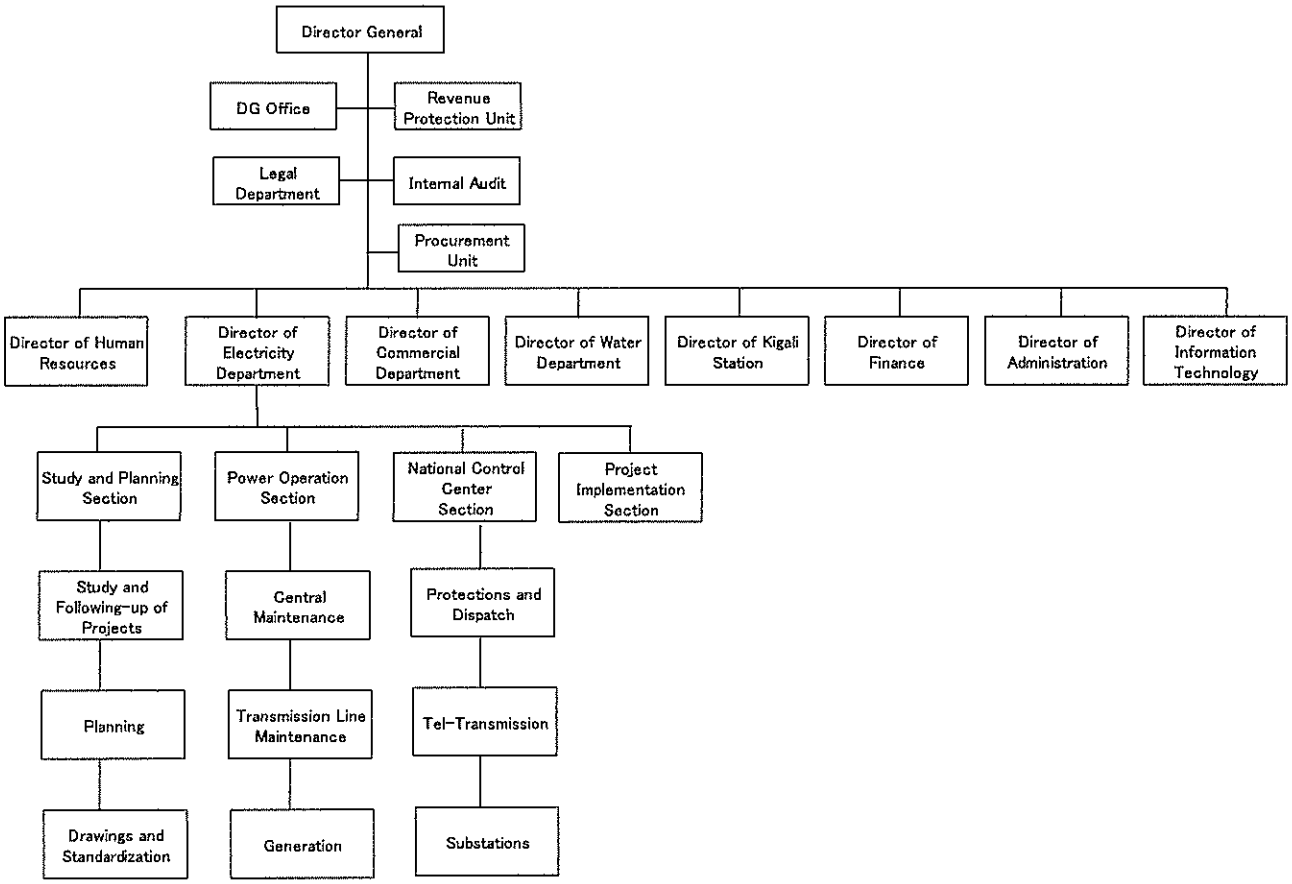
Project Sites

Annex-2



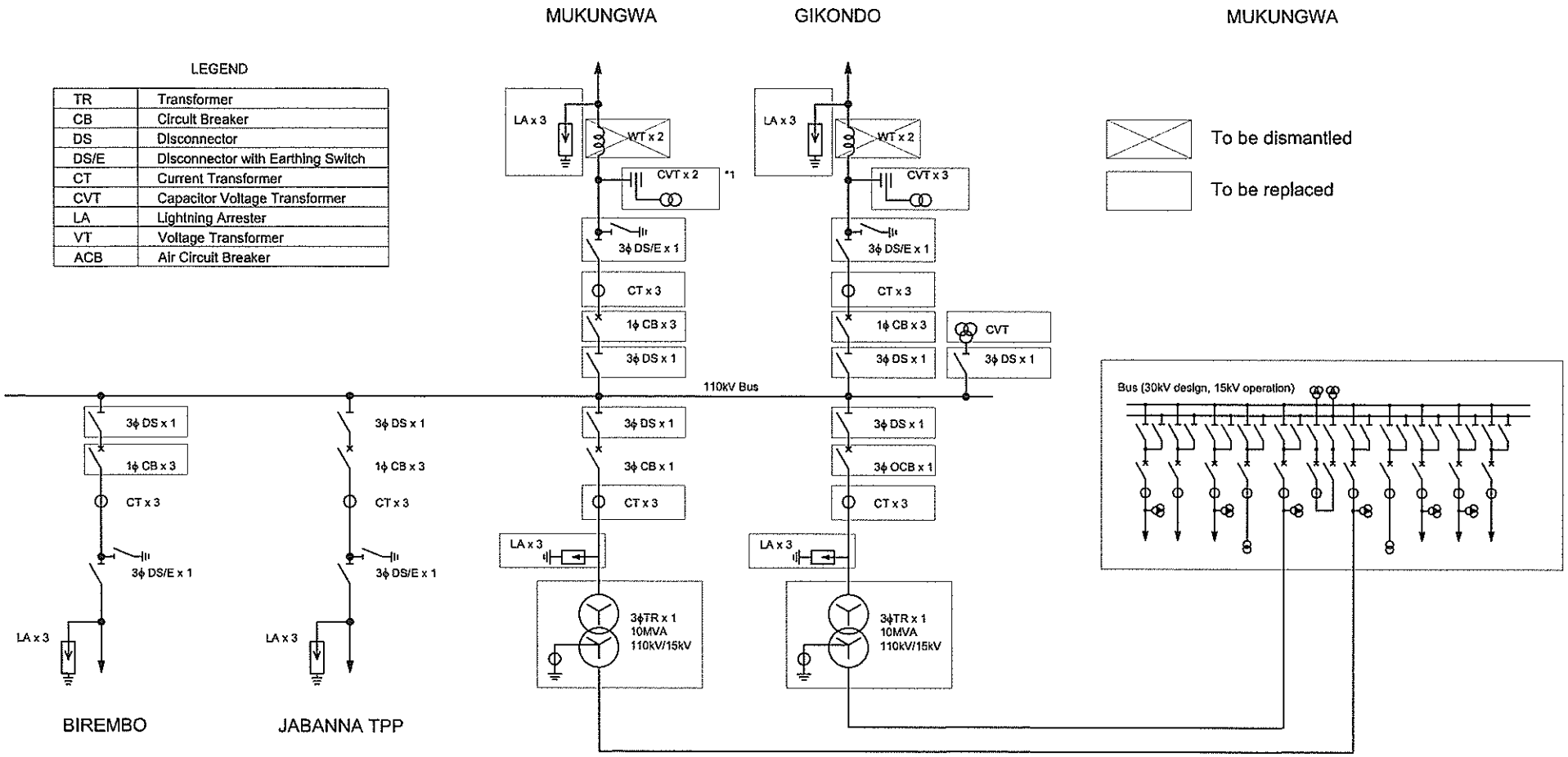
Organization Chart of MININFRA

Annex-3



Organization Chart of RECO

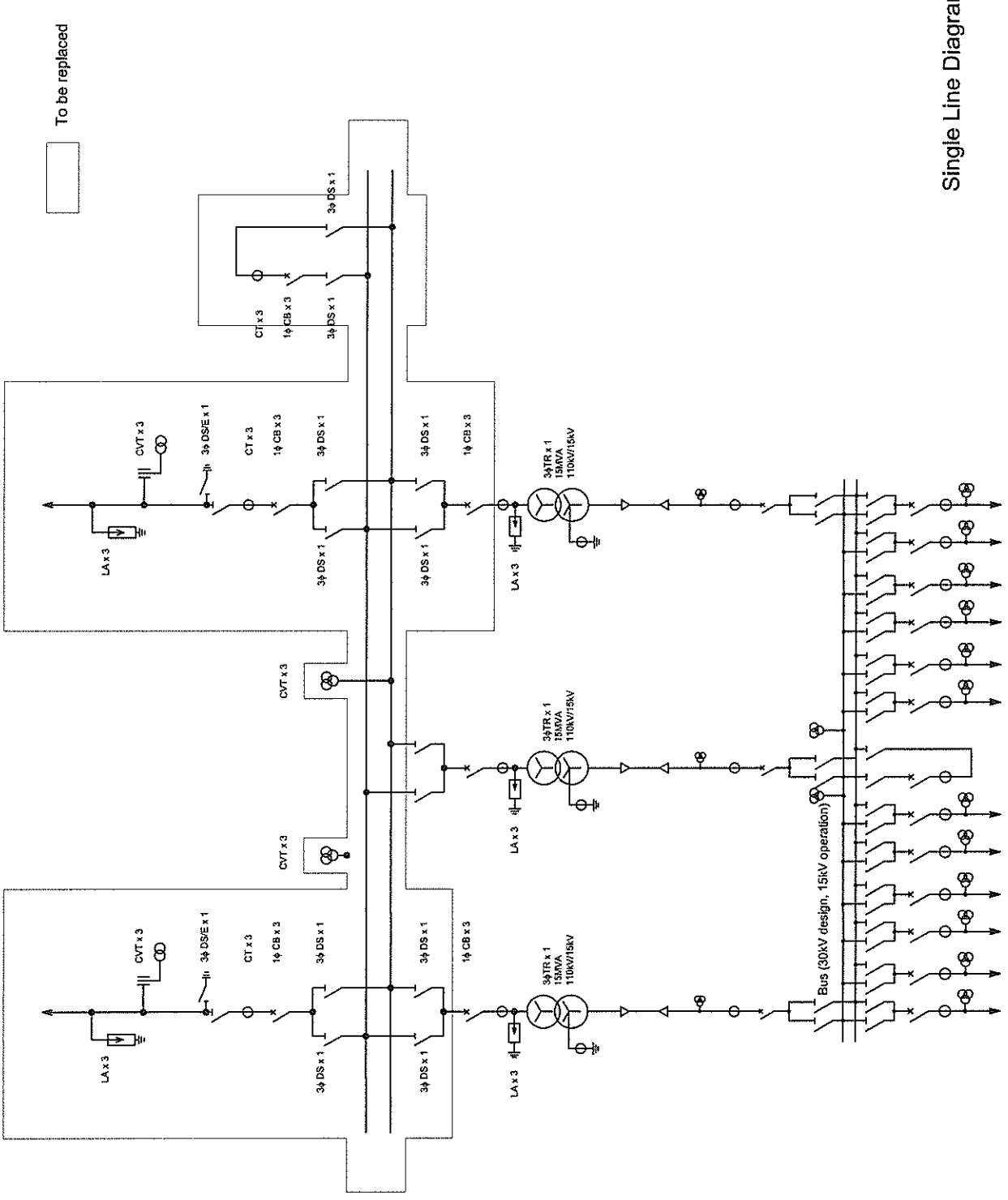
*1: Existing CVT for MUKUNGWA is only 2 nos. but requested 3 nos. for synchronizing.

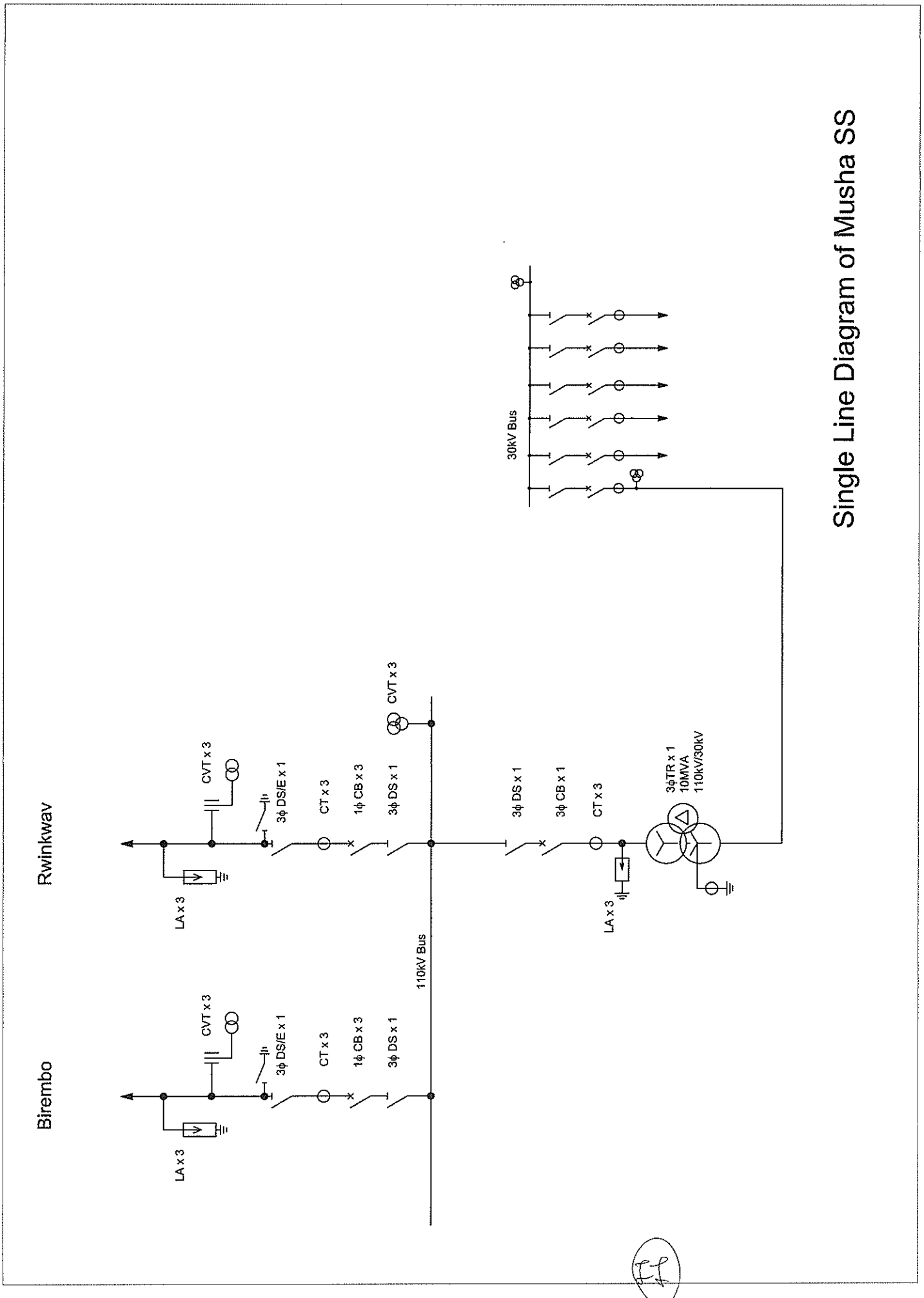


Single Line Diagram of Jabana SS

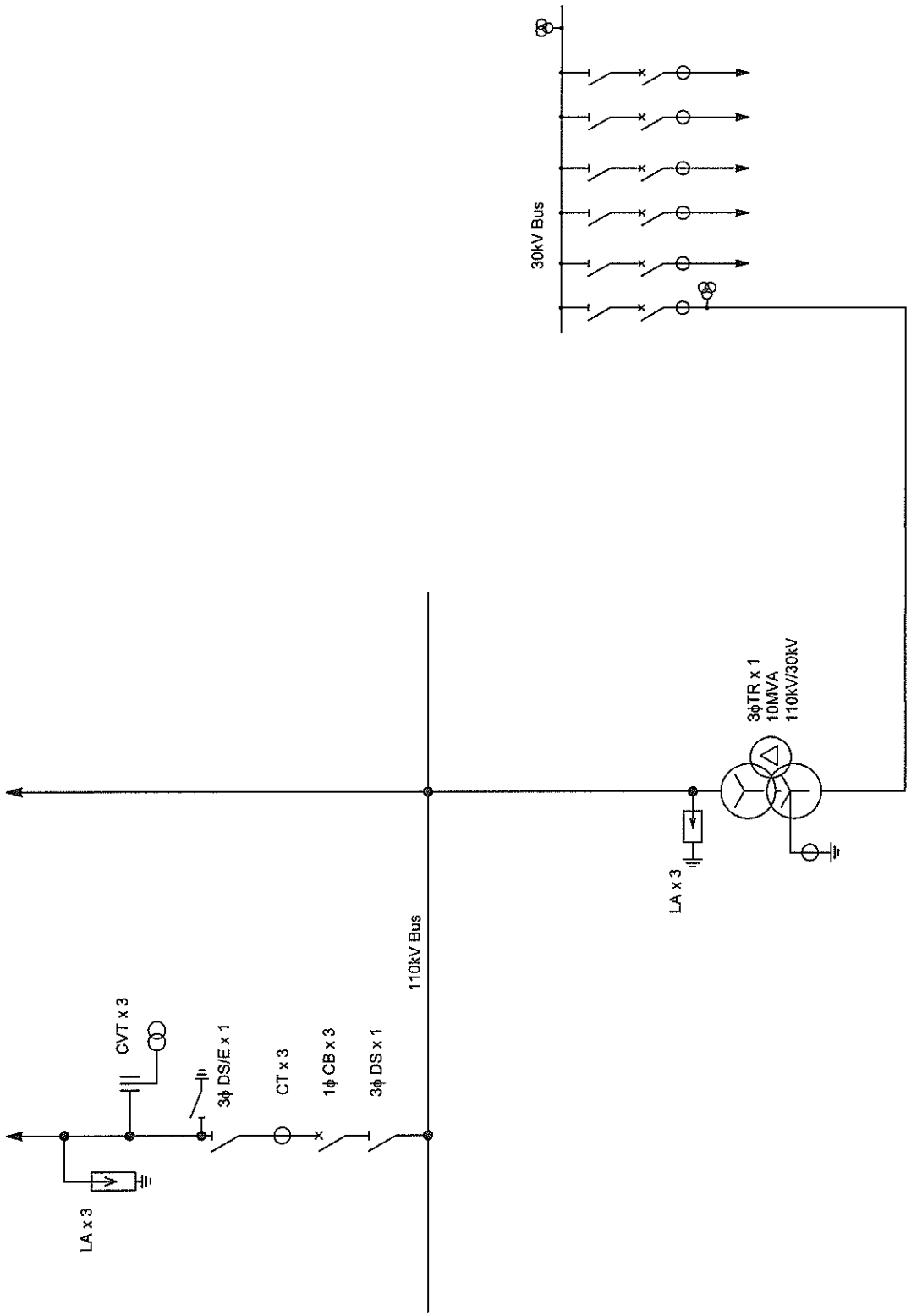
Annex-4

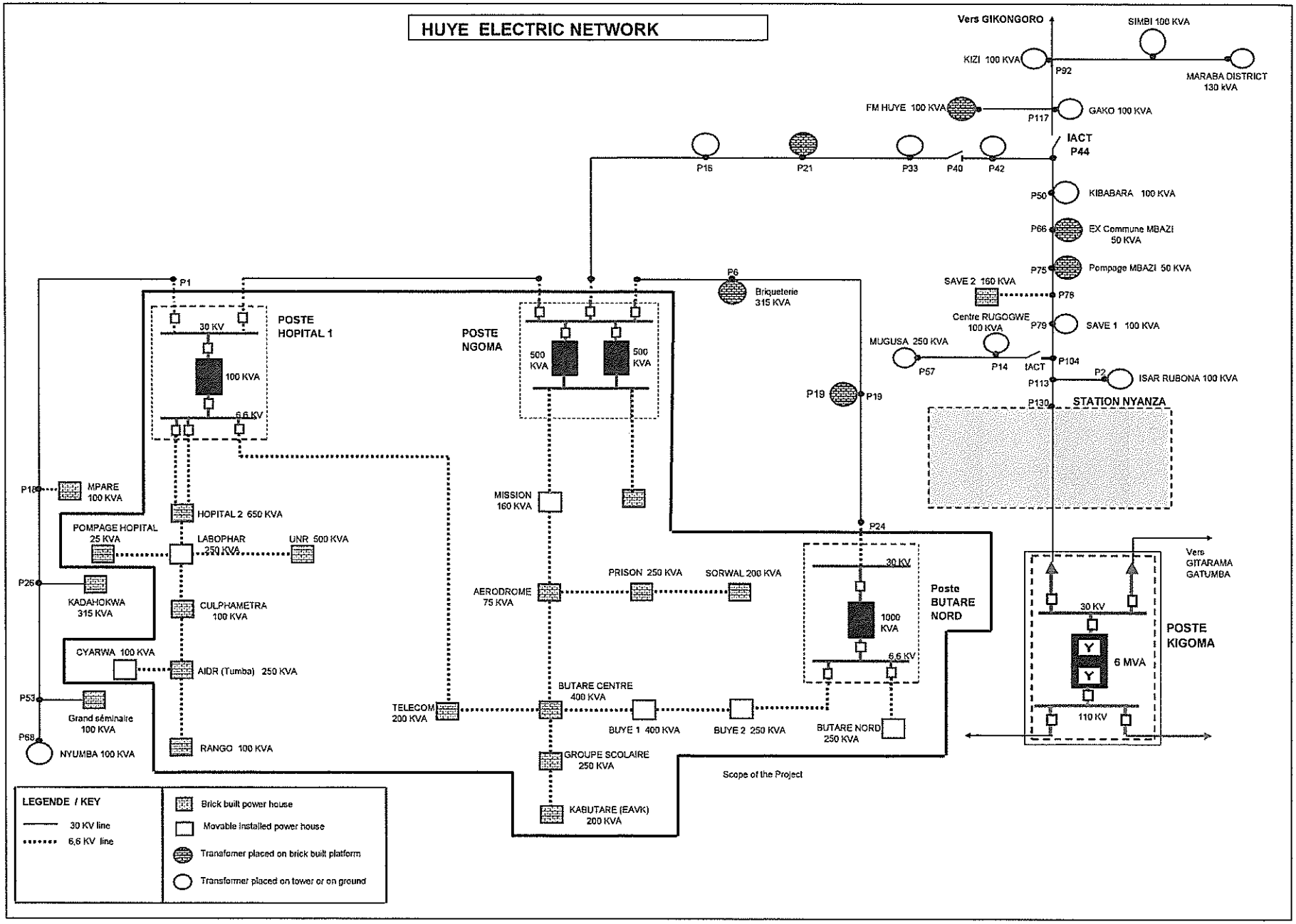
Single Line Diagram of Gikondo SS




Single Line Diagram of Musha SS
Birembo
Rwinkwav
LA x 3
CVT x 3
3ϕ DS/E x 1
CT x 3
1ϕ CB x 3
3ϕ DS x 1
110kV Bus
CVT x 3
3ϕ DS x 1
3ϕ CB x 1
CT x 3
LA x 3
3ϕTR x 1
10MVA
110kV/30kV
30kV Bus

Single Line Diagram of Rwinkwavu SS




HUYE ELECTRIC NETWORK
Vers GIKONGORO
SIMBI 100 KVA
KIZI 100 KVA
P92
MARABA DISTRICT 130 kVA
FM HUYE 100 KVA
P117
GAKO 100 KVA
IACT P44
P16
P21
P33
P40
P42
P50
KIBABARA 100 KVA
P66
EX Commune MBAZI 50 KVA
P75
Pompage MBAZI 50 KVA
SAVE 2 160 KVA
P78
Centre RUGOGWE 100 KVA
P79
SAVE 1 100 KVA
MUGUSA 250 KVA
P57
P14
IACT
P104
P113
P2
ISAR RUBONA 100 KVA
P130
STATION NYANZA
P1
POSTE HOSPITAL 1
30 KV
100 KVA
6,6 KV
POSTE NGOMA
500 KVA
500 KVA
P6
Briqueterie 315 KVA
P19
P19
P18
MPARE 100 KVA
HOPITAL 2 650 KVA
POMPAGE HOPITAL 25 KVA
LABOPHAR 250 KVA
UNR 500 KVA
P26
KADAHOKWA 315 KVA
CULPHAMETRA 100 KVA
CYARWA 100 KVA
AIDR (Tumba) 250 KVA
P53
Grand séminaire 100 KVA
P68
NYUMBA 100 KVA
RANGO 100 KVA
MISSION 160 KVA
AERODROME 75 KVA
PRISON 250 KVA
SORWAL 200 KVA
TELECOM 200 KVA
BUTARE CENTRE 400 KVA
BUYE 1 400 KVA
BUYE 2 250 KVA
BUTARE NORD 250 KVA
GROUPE SCOLAIRE 250 KVA
KABUTARE (EAVK) 200 KVA
P24
30 KV
1000 KVA
6,6 KV
Poste BUTARE NORD
Vers GITARAMA GATUMBA
30 KV
Y
Y
6 MVA
110 KV
POSTE KIGOMA
Scope of the Project
LEGENDE / KEY
30 KV line
6,6 KV line
Brick built power house
Movable installed power house
Transformer placed on brick built platform
Transformer placed on tower or on ground

Annex-8

Proposed Areas for Expansion of Distribution Network in Kigali

Antenna	District	Line Route	MV Line in Km	LV line in Km	Transformers	New Customers
Muhima	Rulindo/Gasabo	Masoro- Rusine	6	10	4	581
Kacyiru	Gasabo	Rusine-Rutunga-	16	15	7	1,250
Kacyiru	Gasabo	Rutunga-Gikomero-Gicaca	16	14	7	550
Gikondo	Kicukiro	Kagarama -Gahanga & Karembure	8	7	6	389
Gikondo	Kicukiro	Gahanga - Mulinja	6	6	3	354
Kanombe	Kicukiro	Masaka-Ruyaga	3	2	2	308
Kanombe	Kicukiro	Masaka-Rusheshe	7	4	3	248
Kanombe	Kicukiro	Kanombe-Karama1	2	2	1	100
Kanombe	Kicukiro	Kanombe-Karama2	4	5	3	510
Kanombe	Gasabo	Rusororo- Mbandazi	3	4	2	480
Kanombe	Rwamagana	Rugende-Muyumbu	5	18	3	680
Kanombe	Gasabo	Ndera-Jurwe	5	3	1	150
Kanombe	Gasabo	Bumbongo-Musave	1	3	1	100
Kacyiru	Gasabo	Nduba	11	9	5	400
Total			92	101	48	6,100

Annex-9

Annex-10

JAPAN'S GRANT AID

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

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

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

・Preparatory Survey (hereinafter referred to as "the Survey")

- The Survey conducted by JICA

・Appraisal &Approval

-Appraisal by The GOJ and JICA, and Approval by the Japanese Cabinet

・Determination of Implementation

-The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and a recipient country

・Implementation

-Implementation of the Project on the basis of the G/A

The flow chart of Japan's Grant Aid Procedures is show in Annex-10-1.

2. Preparatory Survey

(1) Contents of the Survey

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

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

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

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

(2) Selection of Consultants

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

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

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

(4) Necessity of "Verification"

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

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

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

(6) "Proper Use"

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

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

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

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

(9) Authorization to Pay (A/P)

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

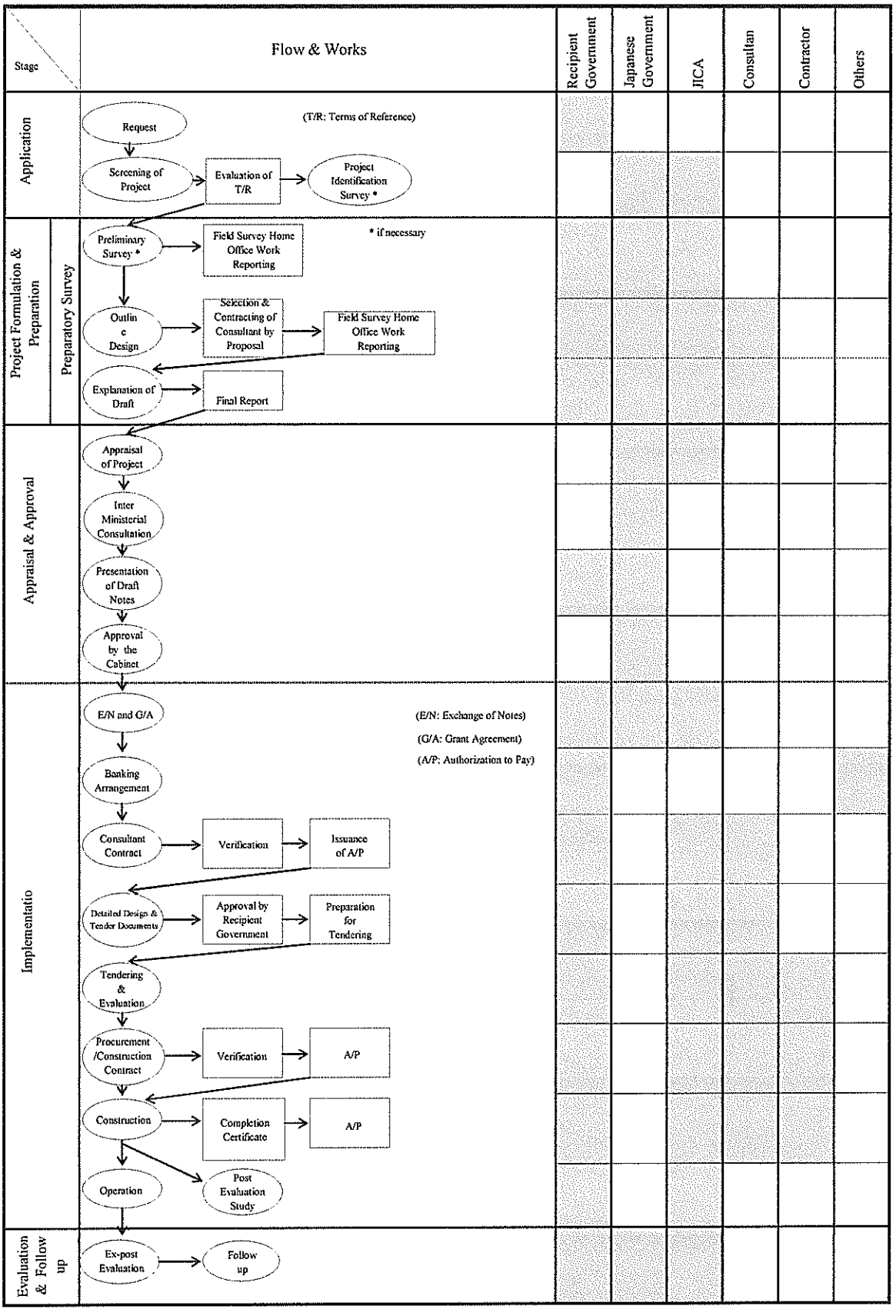
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Annex-10-1

Flow Chart of Japan's Grant Aid Procedures



Annex-11

Major Undertakings to be taken by Each Government

No	Items	To be covered by the Grant	To be covered by Recipient
1	To secure land	-	●
2	To ensure access to the site and expropriate when needed	-	●
3	To construct gates and fences in and around the site	●	-
4	To construct the parking lot	●	-
5	To construct roads		
	1) Within the site	●	-
	2) Outside the site	-	●
6	To construct the building	●	-
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1)Electricity		
	a.The service wires which connect low voltage line (400/230V) with customers	-	●
	b.The main circuit breaker and transformer *This is applicable only for expansion of distribution line	●	-
	2)Water Supply		
	a.The city water distribution main to the site	N/A	N/A
	b.The supply system within the site (receiving and/or elevated tanks)	●	-
	3)Drainage		
	a.The city drainage main (for storm, sewer and others) to the site	N/A	N/A
	b.The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	-
	4)Gas Supply		
	a.The city gas main to the site	N/A	N/A
	b.The gas supply system within the site	N/A	N/A
	5)Telephone System		
	a.The telephone trunk line to the main distribution frame / panel (MDF) of the building	N/A	N/A
	b.The MDF and the extension after the frame / panel	N/A	N/A
	6)Furniture and Equipment		
	a.Basic furniture	●	-
	b.Project equipment	●	-
8	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P	-	●
	2) Payment commission	-	●
9	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine(Air) transportation of the products from Japan to the recipient country	●	-
	2)Tax and customs clearance of the products at the port of disembarkation	-	●
	3) Internal transportation from the port of disembarkation to the project site	●	-

10	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	-	●
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, referred to the Agreement of Technical Cooperation between the Government of Japan and the Government of the Republic of Rwanda signed on January 14, 2005	-	●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid	-	●
13	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment	-	●

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

Minutes of Discussions
on
Preparatory Survey
on
The Project for
Upgrading, Rehabilitation and Expansion of Substations and Distribution Network in the Republic of Rwanda

(Explanation on Draft Final Report)

In May to June 2010, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Upgrading and Expansion of Substations and Distribution Network (hereinafter referred to as "the Project") to the Republic of Rwanda (hereinafter referred to as "Rwanda"), and through discussions, field survey and the result of technical examination in Japan, JICA prepared a Draft Final Report of the study.

In order to explain and to consult with the concerned officials of the Government of Rwanda and RECO (hereinafter referred to as "the Rwandan side") on the contents of the Draft Final Report, JICA sent to Rwanda the Preparatory Survey Team for Draft Final Report Explanation (hereinafter referred to as "the Team"), which is headed by Mr. Toshiyuki HAYASHI, Senior Advisor of JICA, from December 12 to 21, 2010.

As a result of the discussions, the both sides confirmed the main items described in the attached sheets.

Kigali, Rwanda, December 16, 2010

Toshiyuki HAYASHI
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency

Marie Claire MUKASINE
Permanent Secretary
Ministry of Infrastructure
Republic of Rwanda

Yves MUYANGE
Acting Managing Director
Rwanda Electricity Corporation
Republic of Rwanda

ATTACHMENT

1. Contents of the Draft Final Report

The Rwandan side agreed and accepted in principal the contents of the Draft Final Report explained by the Team.

2. Project Title

Upon the request of JICA, the Rwandan side agreed to change the project title as below.

- New Title: The Project for Improvement of Substations and Distribution Network

3. Responsible and Implementing Organizations

(1) The responsible ministry is the Ministry of Infrastructure (MININFRA).

(2) The implementing Organization of the Government of Rwanda is Rwanda Electricity Corporation (RECO).

(3) The organization charts of MININFRA and RECO are shown in Annex-1 and Annex-2 respectively.

4. Japan's Grant Aid Scheme

The Rwandan side reconfirmed the Japan's Grant Aid Scheme and the necessary measures to be taken by the Rwandan side explained by the Team as described in Annex-3 and Annex-4 respectively.

5. SCADA System

(1) Consideration of SCADA System

While the objective of Japan's Grant Aid Scheme is "to avoid large-scale power outage across the country, which are caused by the deteriorated equipment in substations and distribution network in Kigali, Eastern Province and Huye City," it has been confirmed that the SCADA system has been introduced by RECO into their power system and the SCADA system has to be considered in JICA Grant Aid Scheme.

Both sides confirmed that all equipment JICA will provide at the target substations, namely Jabana Substation, Gikondo Substation, Musha Substation, Rwinkwavu Substation and Birembo Substation, has to be compatible with the SCADA System.

In order to facilitate smooth implementation of JICA Grant Aid Scheme, both sides agreed JICA Grant Aid Scheme will cover the works up to Bay Control Unit (BCU*) of respective target substations.

The detailed coverage is described in the Diagram of Demarcation between JICA and RECO attached in Annex-5.

It has also been confirmed that the communication protocol between Interface Module (IM*) in

* As BCU, IM and FAU are used commonly in RECO, the same words are used in this document. However, as these technical terms are not necessarily used commonly throughout the world, BCU, IM and FAU may be substituted with other terms with equivalent functions.

Feeder Adaptation Unit (FAU*) and BCU will be in accordance with IEC 60870-5-103/IEC 61850.

At the same time, RECO agreed that they will provide the data and information necessary for preparing specifications to make the equipment compatible with the SCADA System.

(2) Completion of SCADA System related with the target substations

Both sides agreed that RECO will complete the necessary relocation and modification of the SCADA System after the demarcation point of BCU at the target substations. In order to ensure the relocation and modification work to be completed, RECO informed JICA that they would enter into "Repair and Modification Agreement" with PSI, which has been working with RECO for design and construction of the SCADA System.

6. Other Relevant Issues

(1) The Rwandan side explained the latest progress of EIA study for the component of expansion of distribution network in Kigali.

The Rwandan side agreed to obtain EIA permission for the above component from the Rwanda Development Board (RDB) by the end of January 2011.

(2) The Rwandan side agreed to ensure the adequate storage facilities for equipment containing PCB after dismantling them from the existing substations under the Project and the distribution network in Huye by the end of January 2011.

(3) The Rwandan side requested that the construction schedule of Huye and Kigali distribution networks shall be shifted ahead of the current schedule in the Implementation Schedule attached in the Draft Final Report. The Team explained that the said request will be considered carefully at the Detailed Design Stage of the Project.

(4) The Rwandan side promised to ensure the temporary storage yard with gate and fence for all project sites in Kigali, Eastern province and Huye.

(5) The Rwandan side accepted the contents of the Environmental Checklist and the Monitoring Form attached as Annex-6 and Annex-7 respectively.

(6) The Rwandan side explained that there are authorizations and regulations required for the construction works of the Project including the permission for occupancy of roads for the component of upgrading of distribution network in Huye. Upon the request of the Contractor at the construction stage, the Rwandan side shall obtain the required permissions.

(7) The both sides agreed the basic policy and procedure of the shutdown works at the substations under the Project in accordance with the Memorandum signed by the both sides on June 25, 2010.

(8) The Rwandan side agreed to allocate the budget to be borne by them as shown in Annex-8.

(9) The both sides agreed that all the information related to the Project including the outline design drawings, technical specifications, and estimated project cost of the Project as described in Annex-8 shall not be released to any outside parties before conclusion of all the contracts related to the Project.

[List of Annex]

Annex-1: Organization Chart of MININFRA
Annex-2: Organization Chart of RECO
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Annex-4: Major Undertakings to be taken by Each Government
Annex-5: Diagram of Demarcation between JICA and RECO
Annex-6: Environmental Checklist
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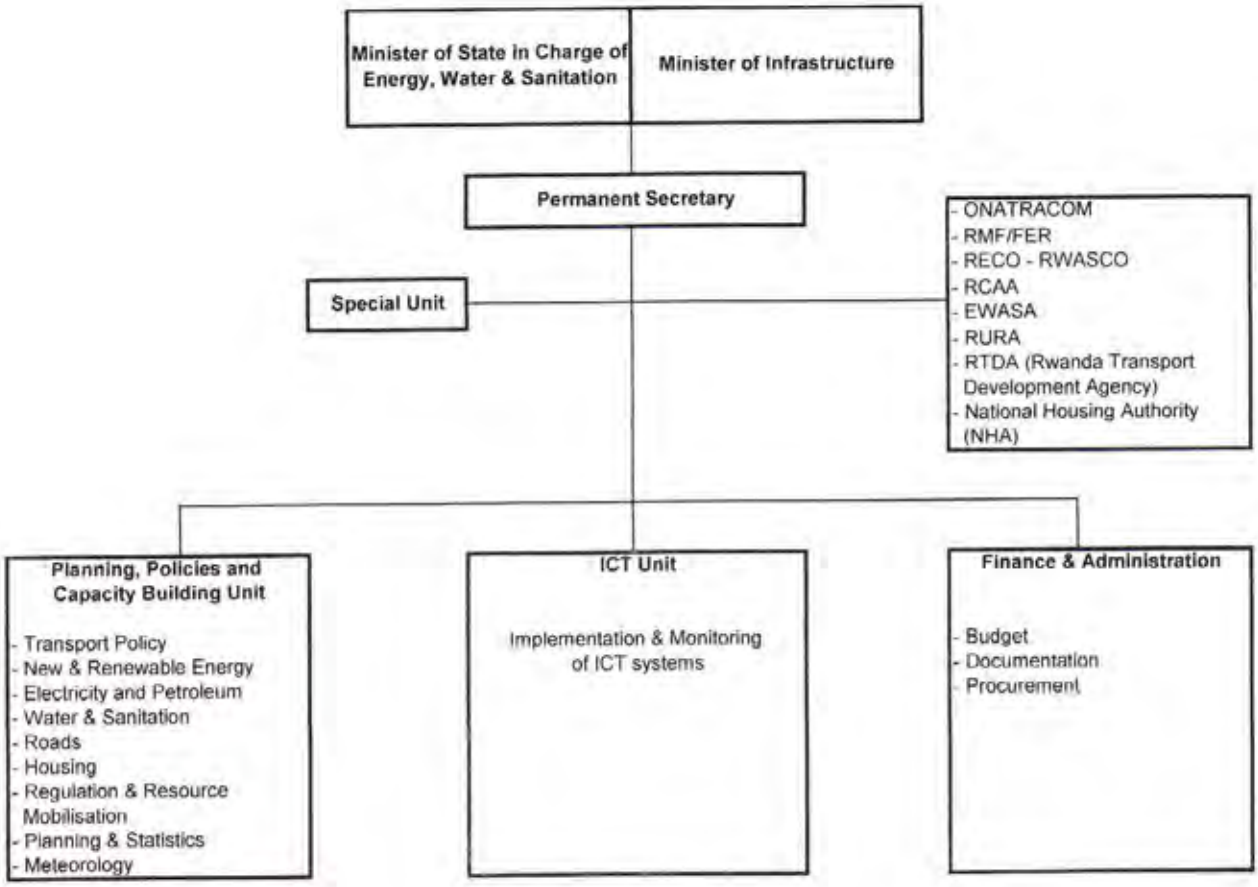
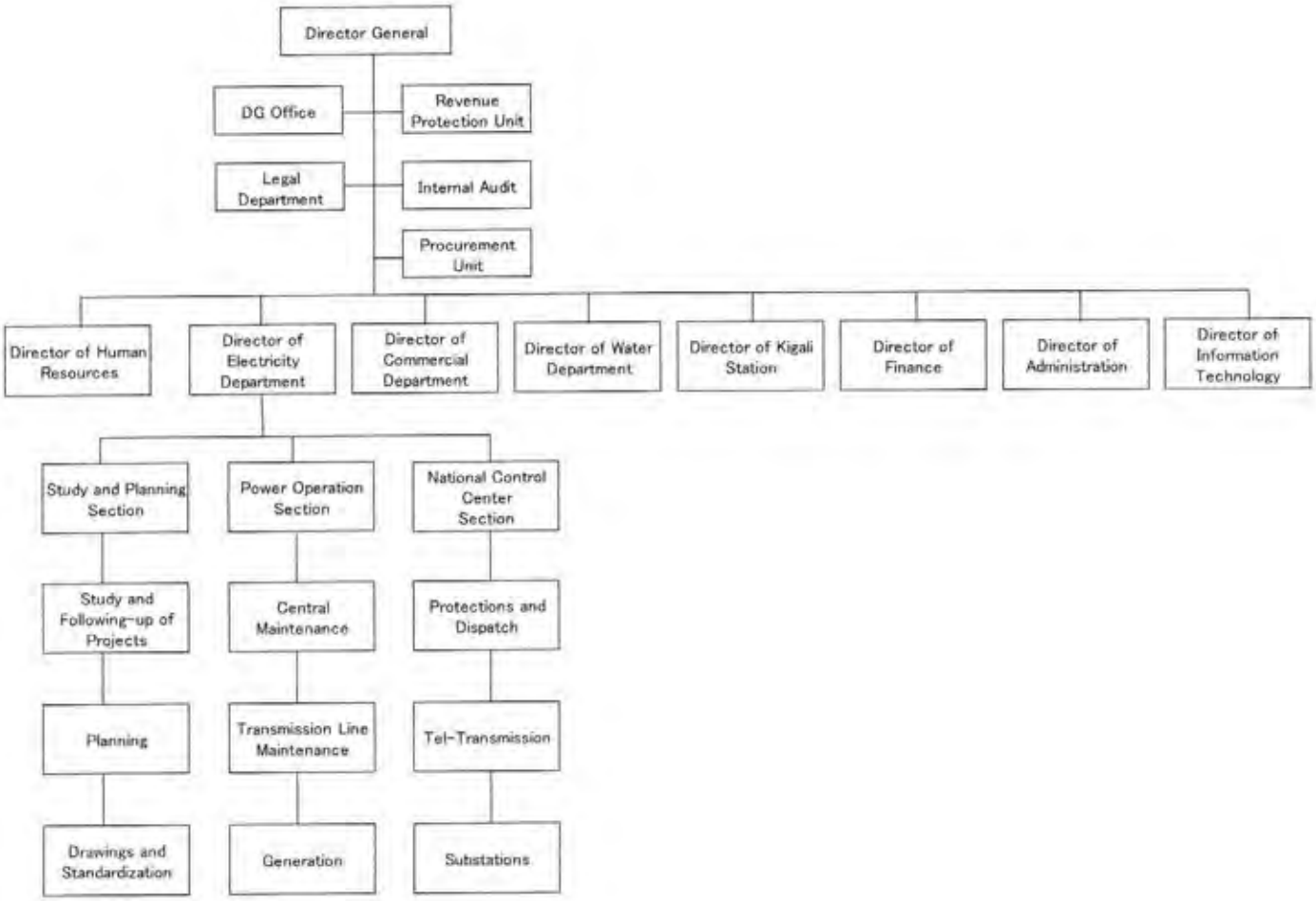
Annex-8: Estimated Project Cost (Confidential)

Annex-1



Organization Chart of MININFRA

Annex-2



Organization Chart of RECO

JAPAN'S GRANT AID

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

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

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

・Preparatory Survey (hereinafter referred to as "the Survey")

- The Survey conducted by JICA

・Appraisal &Approval

-Appraisal by The GOJ and JICA, and Approval by the Japanese Cabinet

・Determination of Implementation

-The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and a recipient country

・Implementation

-Implementation of the Project on the basis of the G/A

The flow chart of Japan's Grant Aid Procedures is show in Annex-3 (5/5).

2. Preparatory Survey

(1) Contents of the Survey

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

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

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

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

(2) Selection of Consultants

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

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

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

(4) Necessity of "Verification"

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

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

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-4.

(6) "Proper Use"

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

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

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

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

(9) Authorization to Pay (A/P)

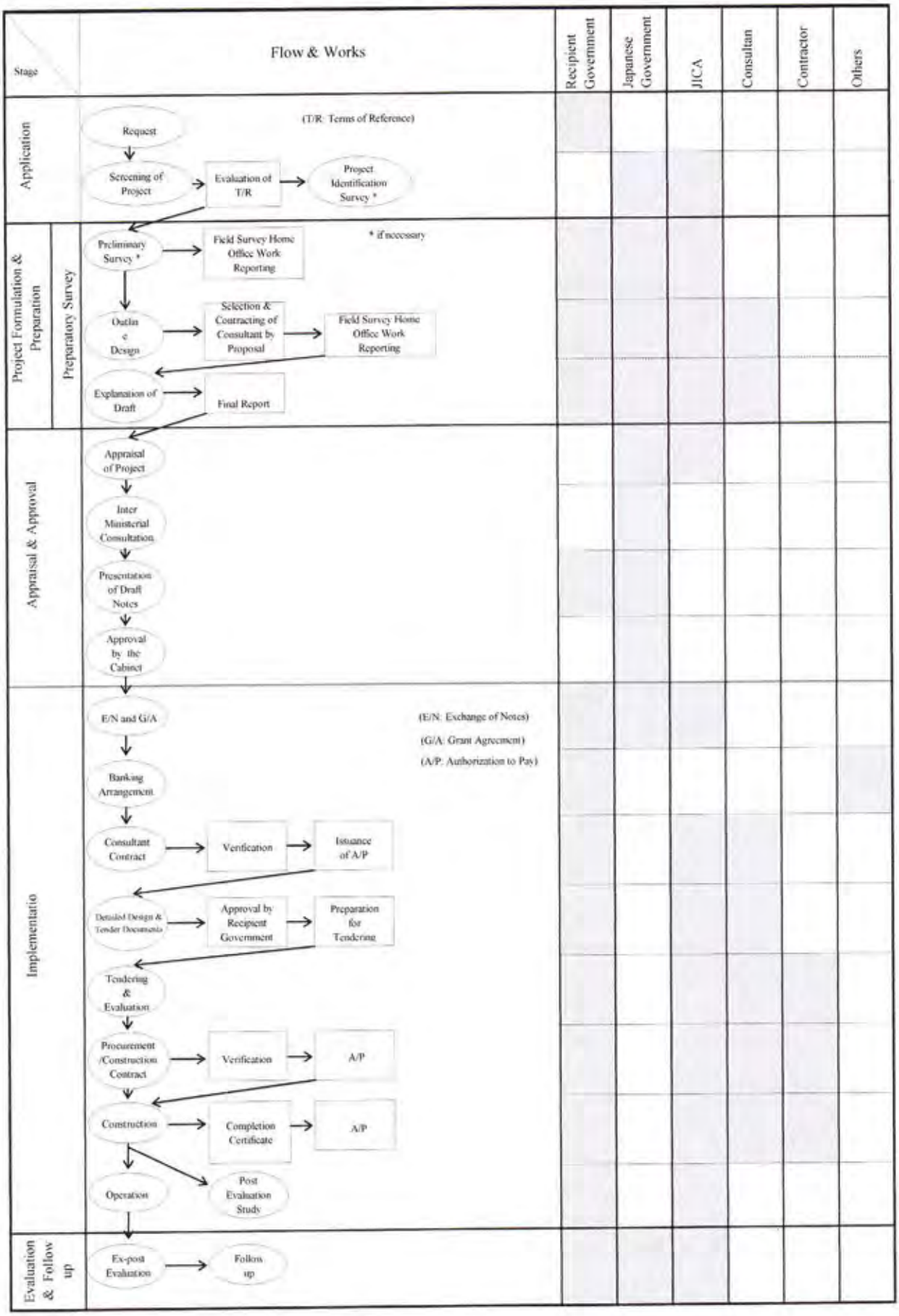
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.

(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Flow Chart of Japan's Grant Aid Procedures

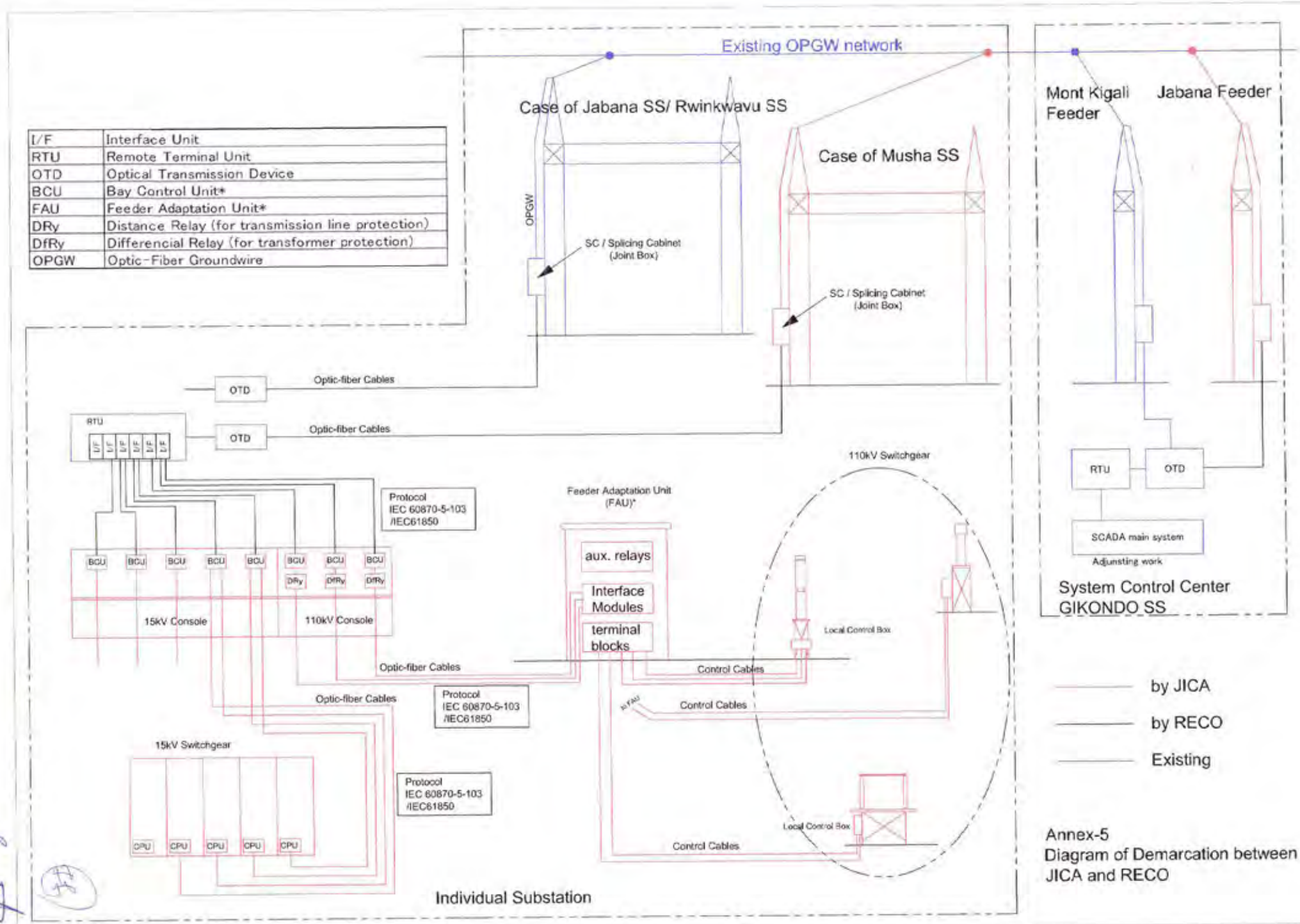


Major Undertakings to be taken by Each Government

No	Items	To be covered by the Grant	To be covered by Recipient side
1	To secure land for RMU in Huye (4 sites) and new transmission tower (2 sites)	-	•
2	To ensure access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations	-	•
3	To construct gates and fences in and around the sites of Musha and Rwinkwavu substations	•	-
4	To construct the parking lot in the sites of Musha and Rwinkwavu substations	•	-
5	To construct roads		
	1) Within the sites of Musha and Rwinkwavu substations	•	-
	2) Outside the sites of Musha and Rwinkwavu substations	-	•
6	To construct the control buildings in Musha and Rwinkwavu substations	•	-
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1)Electricity		
	a. To provide the electricity during the construction	•	-
	b. To prepare service wires which connect low voltage line (400/230V) with customers after completion of expansion of 15kV distribution network in Kigali	-	•
	2)Water Supply		
	a. To provide the city water during the construction	•	-
	b. To provide water into the water tank in Musha and Rwinkwavu substations * Water tank will be provided by the Grant.	-	•
	3)Drainage		
	a.The city drainage main (for storm, sewer and others) to the site	N/A	N/A
	b. To install the toilet and drainage system in Musha and Rwinkwavu substations	•	-
	4)Gas Supply		
	a.The city gas main to the site	N/A	N/A
	b.The gas supply system within the site	N/A	N/A
	5)Telephone System		
	a.The telephone trunk line to the main distribution frame / panel (MDF) of the building	N/A	N/A
	b.The MDF and the extension after the frame / panel	N/A	N/A
	6)Furniture and Equipment		
	a.Basic furniture	•	-
	b.Project equipment	•	-
8	To provide temporary storage yard with gate and fence for all project sites	-	•
9	Following issues related to power shutdown works 1) Nomination and allocation of responsible person for power shutdown works related to the Project from RECO 2) Overall coordination of the said works by the above responsible person	-	•
10	To construct the foundation structure and install the equipment related to substations	•	-
11	To construct the foundation structure and install the equipment related to distribution network	•	-

12	To conduct the testing and commissioning of substation and distribution equipment	•	-
13	To arrange the adequate storage facilities for equipment containing PCB	-	•
14	To dismantle the existing substations after completion of new substations in Musha and Rwinkwavu substations	-	•
15	Relocation and modification of the SCADA system	-	•
16	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P	-	•
	2) Payment commission	-	•
17	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine(Air) transportation of the products from Japan to the recipient country	•	-
	2)Tax and customs clearance of the products at the port of disembarkation	-	•
	3) Internal transportation from the port of disembarkation to the project site	•	-
18	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	-	•
19	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract. This will be included into the Grant Agreement (G/A)	-	•
20	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid	-	•
21	To bear all the expenses, other than those covered by the Grant Aid such as procurement and installation cost of equipment and materials including consulting services, necessary for the implementation of the Project	-	•

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)



I/F	Interface Unit
RTU	Remote Terminal Unit
OTD	Optical Transmission Device
BCU	Bay Control Unit*
FAU	Feeder Adaptation Unit*
DRy	Distance Relay (for transmission line protection)
DfRy	Differencial Relay (for transformer protection)
OPGW	Optic-Fiber Groundwire

Annex-5
Diagram of Demarcation between JICA and RECO

Environmental Checklist: 14. Power Transmission and Distribution Lines (1)

Annex-6

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country's government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	① This case is composed of the following four items. EIA is only necessary for expansion of the distribution network of the Kigali city, but EIR is scheduled to be drafted in the future. a. Rehabilitation of Substations (Jabana substation and Gikondo substation) b. Upgrading of Substations (Musha substation and Rwinkwavu substation) c. Upgrading of Distribution Network (Huye city) d. Expansioin of Distribution Network (Kigali city) ② For three items other than d., it has been confirmed by the document from RDB (RDB/3/EC/039/05/10) that EIA is not necessary. To be finally approved upon the completion of EIA. ③ In order for above-mentioned three items a., b., and c. to be approved, there are collateral conditions, but these conditions are expected to be fulfilled. ④ Not applicable.
	(2) Explanation to the Public	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	① It is planned based on the EIA guideline after the submission of EIR. ② Responses are properly made according to the EIA Procedure Flowchart described in the EIA guideline.
2 Mitigation Measures	(1) Water Quality	① Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If water quality degradation is anticipated, are adequate measures considered?	① During the site grading upon the Upgrading of Substation (Musha substation and Rwinkwavu substation), soil runnoff might be expected from cut and fill areas. Therefore, adequage measures such as development and monitoring of a site dranage plan, the use of silt fencing, reduced slope angles, and re-vegetation are taken to minimize the impacts.
	(1) Protected Areas	① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	① Not applicable.

1) Regarding the term "Country's Standard"

Environmental Checklist: 14. Power Transmission and Distribution Lines (2)

Annex-6

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
3 Natural Environment	(2) Ecosystem	① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife, and livestock? ⑤ Is there a possibility that improved access by the project will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? ⑥ In cases where the project site is located in undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	① Not applicable. ② Not applicable. ③ Not applicable. ④ Not applicable. ⑤ For Upgrading of Rwinkwavu substation and Expansion of Distribution Network of Kigali city, partial deforestation is necessary. However, the areas to be deforested is minimized, so as the impacts from it. ⑥ Not applicable.
3 Natural Environment	(3) Topography and Geology	① Is there a soft ground on the route of power transmission lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? ② Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? ③ Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	① Upgrading of Distribution Network (Huye city) and Expansion of Distribution Network (Kigali city) are scheduled, but there is no place where such conditions apply. ②Upgrading of Substation (Musha substation and Rwinkwavu substation) is scheduled, but there is no place where such conditions apply. ③ During the site grading upon the Upgrading of Substation (Musha substation and Rwinkwavu substation), soil runnoff might be expected from cut and fill areas. Therefore, adequage measures such as development and monitoring of a site dranage plan, the use of silt fencing, reduced slope angles, and re-vegetation are taken to minimize the impacts.
4 Social	(1) Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impacts of resettlement?	① Not applicable. ② Not applicable. ③ Not applicable. ④ Not applicable. ⑤ Not applicable. ⑥ Not applicable. ⑦ Not applicable.

1) Regarding the term "Country's Standard"

Environmental Checklist: 14. Power Transmission and Distribution Lines (3) **Annex-6**

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
Environment	(2) Living and Livelihood	① Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? ② Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? ③ Is there a possibility that installation of structures, such as power line towers will cause a radio interference? If significant radio interference is anticipated, are adequate measures considered?	① RDB's approval conditions include prohibition of nighttime construction, dust-suppression, and warning to the drivers of general vehicles during the construction phase of a., b., c. Therefore, adverse affects of noise, dust and traffic is expected to be very small. Moreover, acquisition of privately-owned land is necessary for the Upgrading of Distribution Network (Huye city) and Expansion of Distribution Network (Kigali city), but no adverse affects is anticipated since the acquisition is done in accordance with applicable law. ② Maximum of 50 workers are expected during the construction phase associated with the project. However, the number of workers are very limited (small) during other phase of the project, therefore, possibility of diseases to be introduced is quite low. ③ Not applicable.
	(3) Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	① Not applicable.
	(4) Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	① Not applicable.
4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	① Where ethnic minorities and indigenous peoples are living in the rights-of-way, are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? ② Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples?	① Not applicable. ② Not applicable.
5 Others	(1) Impacts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? ④ If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	① Mitigation measures are planned in the project briefs, and mitigation measures are prepared by RECO & RWASCO. Those mitigation measures should be implemented in accordance with the document from RDB (RDB/3/EC/039/05/10). ② For Upgrading of Rwinkwavu substation and Expansion of Distribution Network of Kigali city, partial deforestation is necessary. However, the areas to be deforested is minimized, so as to avoid the impacts from it. ③ No adverse affect to social environment is admitted. ④ It is planned in the project briefs. The RDB document of (RDB/3/EC/039/05/10) states that securing safety is the prerequisite for the implementation.

1) Regarding the term "Country's Standard"

Environmental Checklist: 14. Power Transmission and Distribution Lines (4) **Annex-6**

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
	(2) Monitoring	① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? ② Are the items, methods and frequencies included in the monitoring program judged to be appropriate? ③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? ④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	① Monitoring of soil runoff is planned in the project briefs. ② To be confirmed as soon as the detailed plan of the project is set. ③ To be confirmed as soon as the detailed plan of the project is set. ④ It is not prescribed by the law.
6 Note	Note on Using Environmental Checklist	① If necessary, the impacts to transboundary or global issues should be confirmed. (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	① Extra attention is required for disposal of transformer/circuit breaker/current transformer/CVT containing PCBs upon the upgrade. Storage in the stockyard of RECO & RWASCO is currently planned.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

1) Regarding the term "Country's Standard"

Annex-7

MONITORING FORM

-If environmental reviews indicate the need of monitoring by JBIC, JBIC undertakes monitoring for necessary items that are decided by environmental reviews. JBIC undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase or development, operation and mine closure) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Compliance with the prerequisite for the implementation by the RDB document (RDB/3/EC/039/05/10)	

2. Mitigation Measures

- Waste

Monitoring Item	Monitoring Results during Report Period
Disposal of transformer/circuit breaker/current transformer/CVT containing PCBs upon the upgrade.	

Project Cost Estimation (Confidential)

The Project cost is estimated hereunder. However, it is noted that the estimated cost is subject to further examination for Approval of Grant Aid.

1. Cost to be borne by Japanese side: Approximately JP¥2,594 Million

The break down of the estimated project cost to be borne by Japanese side is as follows.

Items	Amount (Million JP¥)
1. Procurement and Installation Cost of Equipment and Materials	2,442
2. Consulting Service	152
Total (1+2)	2,594

2. Cost to be borne by Rwandan side: Approximately 460.5 Million RWF (equiv. JP¥72.8 Million)

The break down of the estimated project cost to be borne by Rwandan side is as follows.

(1) One time expense for the Project

Items	Amount (RWF)	Equivalent (JP¥)
1. Secure land for RMU in Huye (4 sites) and new transmission tower (2 sites)	1,380,000	218,000
2. Ensure access to and expropriate the sites of Birembo, Musha and Rwinkwavu substations	14,400,000	2,275,000
3. Construct the roads outside the sites of Musha and Rwinkwavu substations)	14,400,000	2,275,000
4. Prepare the service wires which connect the low voltage line (400/230V) to the customers	140,728,000	22,235,000
5. Dismantle the existing substations after completion of new substations in Musha and Rwinkwavu substations	12,650,000	2,000,000
6. Relocation and modification of the SCADA system	54,608,000	8,628,000
Total (1+2+3+4+5+6)	238,166,000	37,630,000

In addition to the above table, the expenditures for Bank Arrangement (B/A) and Authorization to Pay (A/P) for obtaining import permit from the government and others

(2) Operation and Maintenance Cost (annual cost)

The budget for annual operation cost for substations and distribution network related to the Project will be arranged for procurement of spare parts, operation staff management, periodical inspection of the equipment by RECO and general expenses so as to ensure the sustainable operation of the equipment procured by the Project. The breakdown of operation and maintenance cost is as below.

Items	Amount (RWF)	Equivalent (JP¥)
1. Personnel Expenses	214,827,000	33,943,000
2. Maintenance Fee	3,848,000	608,000
3. Other Expenses (Management Cost and others)	3,652,000	577,000
Total (1+2+3)	222,327,000	35,128,000

3. Cost Estimate Conditions

(1) Time of cost estimation: June 2010

(2) Current exchange rates: 1RWF=JP¥0.158

(3) Others: The above cost estimation was made according to the procurement rules and guideline of Japanese's Grant Aid

Appendix-5

Drawings

LIST OF OUTLINE DESIGN DRAWINGS RELATED TO JABANA SUBSTATION

NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.SS-01	SINGLE LINE DIAGRAM
2	DWG NO.SS-02	OUTDOOR SWITCHGEAR LAYOUT
3	DWG NO.SS-03	INDOOR SWITCHGEAR LAYOUT
4	DWG NO.SS-04	SINGLE LINE DIAGRAM (BIREMBO SUBSTATION)

LIST OF OUTLINE DESIGN DRAWING RELATED TO GIKONDO SUBSTATION

NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.SS-05	SINGLE LINE DIAGRAM
2	DWG NO.SS-06	PLAN OF OUTDOOR SWITCHGEAR
3	DWG NO.SS-07	SECTION OF OUTDOOR SWITCHGEAR

LIST OF OUTLINE DESIGN DRAWING RELATED TO MUSHA SUBSTATION

NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.SS-08	SINGLE LINE DIAGRAM
2	DWG NO.SS-09	OUTDOOR SWITCHGEAR LAYOUT

LIST OF OUTLINE DESIGN DRAWING RELATED TO RWINKWAVU SUBSTATION

NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.SS-10	SINGLE LINE DIAGRAM
2	DWG NO.SS-11	OUTDOOR SWITCHGEAR LAYOUT

LIST OF OUTLINE DESIGN DRAWING RELATED TO DISTRIBUTION NETWORK IN HUYE

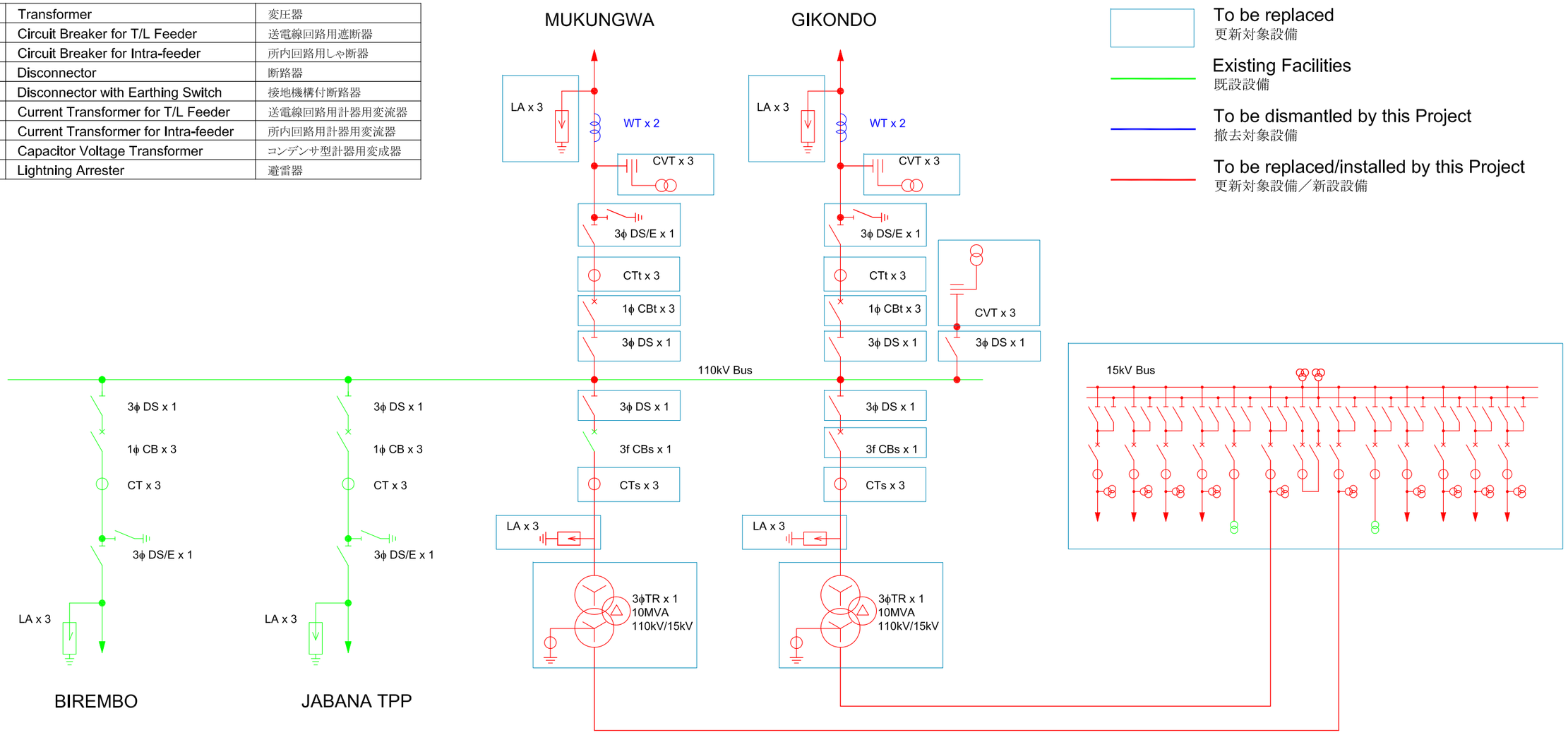
NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.HDS-01	ROUTE MAP
2	DWG NO.HDS-02	SINGLE LINE DRAWING
3	DWG NO.HDS-03	BUILDING PLANNING FOR RING MAIN UNIT (RMU) - TYPE A, B-1, B-2, B-3, B-4）

LIST OF OUTLINE DESIGN DRAWING RELATED TO DISTRIBUTION NETWORK IN KIGALI

NO.	DRAWING NO.	DRAWING TITLE
1	DWG NO.KDS-01	ROUTE MAP
2	DWG NO.KDS-02	MV DISTRIBUTION POLE WITH SUPPORT STRUCTURE（1/2,2/2）
3	DWG NO.KDS-03	LV DISTRIBUTION POLE WITH SUPPORT STRUCTURE

LEGEND

TR	Transformer	変圧器
CBt	Circuit Breaker for T/L Feeder	送電線回路用遮断器
CBs	Circuit Breaker for Intra-feeder	所内回路用しゃ断器
DS	Disconnector	断路器
DS/E	Disconnector with Earthing Switch	接地機構付断路器
CTt	Current Transformer for T/L Feeder	送電線回路用計器用変流器
CTs	Current Transformer for Intra-feeder	所内回路用計器用変流器
CVT	Capacitor Voltage Transformer	コンデンサ型計器用変成器
LA	Lightning Arrester	避雷器



	THE PROJECT FOR UPGRADING AND EXPANSION OF SUBSTATION AND DISTRIBUTION NETWORK IN THE REPUBLIC OF RWANDA	DRAWING TITLE	DRAW. NO.	PREPARED BY	SHIMIZU
		JABANA SUBSTATION SINGLE LINE DIAGRAM JABANA変電所 単線結線図	SS-01	CHECKED BY	SHIMIZU
				APPROVED BY	MANITA
				DATE	Nov.05, 2010

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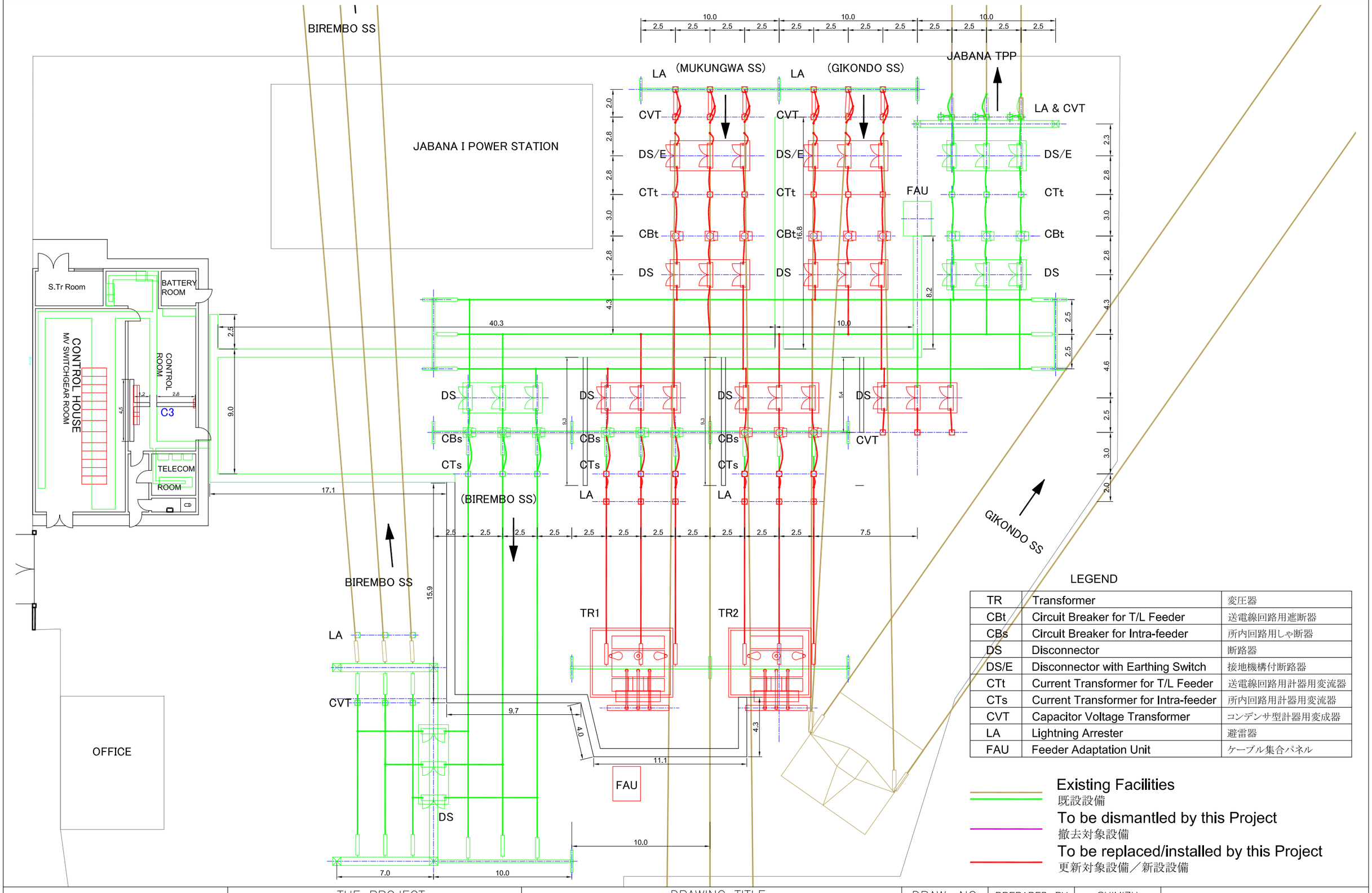


LEGEND

TR	Transformer	変圧器
CBt	Circuit Breaker for T/L Feeder	送電線回路用遮断器
CBs	Circuit Breaker for Intra-feeder	所内回路用しゃ断器
DS	Disconnector	断路器
DS/E	Disconnector with Earthing Switch	接地機構付断路器
CTt	Current Transformer for T/L Feeder	送電線回路用計器用変流器
CTs	Current Transformer for Intra-feeder	所内回路用計器用変流器
CVT	Capacitor Voltage Transformer	コンデンサ型計器用変成器
LA	Lightning Arrester	避雷器
FAU	Feeder Adaptation Unit	ケーブル集合パネル

Existing Facilities
既設設備

To be dismantled by this Project
撤去対象設備

To be replaced/installed by this Project
更新対象設備／新設設備

THE PROJECT
FOR
UPGRADING AND EXPANSION OF SUBSTATION AND DISTRIBUTION NETWORK IN THE REPUBLIC OF RWANDA

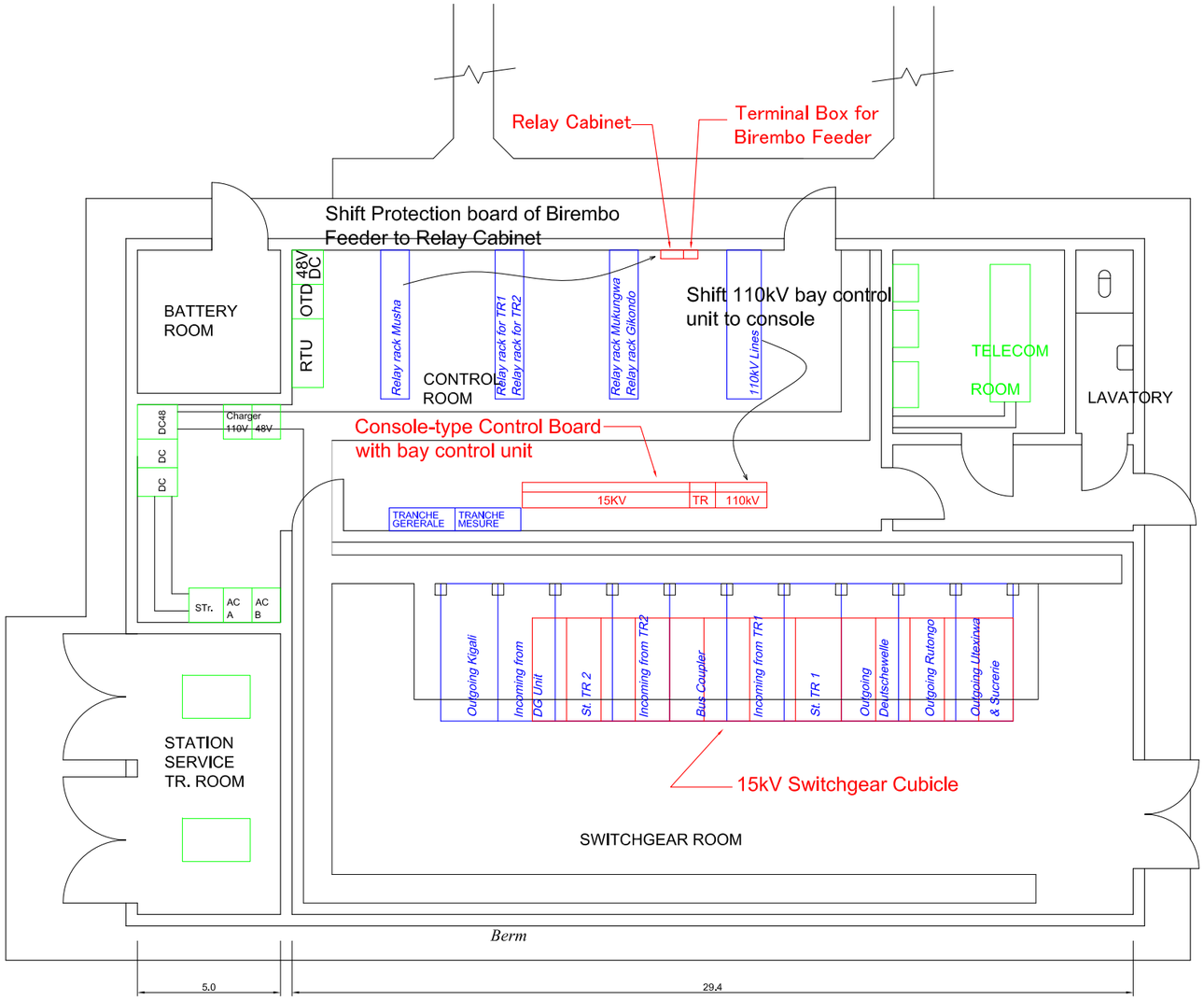
DRAWING TITLE

JABANA SUBSTATION OUTDOOR SWITCHGEAR LAYOUT (1/250)
JABANA変電所 屋外機器配置図 (1/250)

DRAW. NO. SS−02

PREPARED BY	SHIMIZU
CHECKED BY	SHIMIZU
APPROVED BY	MANITA
DATE	Nov.05, 2010

NIPPON KOEI CO., LTD



LEGEND

110kV	Console-type Supervisory & Control Panel for Transformer	変圧器用コンソール型監視制御盤
110kV	Console-type Supervisory & Control Panel for 110kV Feeders	110kV送電線用コンソール型監視制御盤
15kV	Console-type Supervisory & Control Panel for 15kV Feeders	15kV開閉装置用コンソール型監視制御盤

Existing Facilities
既設設備
To be dismantled by this Project
撤去対象設備
To be replaced/installed by this Project
更新対象設備／新設設備

	THE PROJECT FOR UPGRADING AND EXPANSION OF SUBSTATION AND DISTRIBUTION NETWORK IN THE REPUBLIC OF RWANDA	DRAWING TITLE	DRAW. NO.	PREPARED BY	SHIMIZU
		JABANA SUBSTATION INDOOR EQUIPMENT LAYOUT (1/200) JABANA変電所屋内機器配置図 (1/200)	SS-003	CHECKED BY	SHIMIZU
				APPROVED BY	MANITA
				DATE	Nov.05, 2010
					NIPPON KOEI CO., LTD