Tanzania Electric Supply Company Ltd. (TANESCO)
Ministry of Energy and Minerals
The United Republic of Tanzania

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
REHABILITATION OF SUBSTATIONS
AND CONSTRUCTION OF
NEW LINES AND SUBSTATIONS
IN DAR ES SALAAM
IN
THE UNITED REPUBLIC OF TANZANIA

JANUARY 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

WEST JAPAN ENGINEERING CONSULTANTS, INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to the Consortium consist of Yachiyo Engineering Co., Ltd. and West Japan Engineering Consultants, Inc..

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

January, 2014

Hidetoshi IRIGAKI

Director General,

Industrial Development and Public Policy Department

Japan International Cooperation Agency

SUMMARY

SUMMARY

① Overview of the Country

The United Republic of Tanzania (hereinafter referred to as "Tanzania") is situated in the eastern part of the African continent and the largest country in East Africa. Tanzania has a total land area of approximately 945,000 km^2 (roughly 2.5 times bigger than Japan) and a population of approximately 44.92 million. It is a unitary republic that was formed by the amalgamation of Tanganyika on the mainland and the island of Zanzibar in 1964.

Regarding the economy, the Government of Tanzania had promoted the socialism after independence. However, the Government of Tanzania adopted market-oriented economic reforms under support from the World Bank and IMF from 1986. The gross domestic product (GDP) growth rate recorded more than 6.0% from 2002 and GDP growth rate is projected at more than 6.0% annually until 2017. Meanwhile, the gross national income (GNI) per capita is low at US$570 (2012, according to the World Bank), and the major challenge facing the Government of Tanzania concerns how to translate high economic growth into reduction of poverty.

To implement policies, the most important issue is that the Government of Tanzania has to secure the budget. In terms of fiscal management, Tanzania has a perennial fiscal deficit whereby expenditure exceeds revenue. And it depends on the support of bilateral or multilateral assistance to secure the necessary budget. Accordingly, it is unable to independently finance the construction and upgrading of large-scale public facilities and has no choice but to depend on assistance from donors.

② Background of the Project

The Energy Sector of Tanzania plays a significant role for economic growth rates in excess of 6% per annum, and power demand expansion is outpacing economic growth with a program of accelerated electrification and vitalized economic activity. However, during the period of privatization of TANESCO from 1992 to 2006, there was no public support from the government or other donors and reinforcement of facilities to meet increasing demand or maintenance/repair of existing facilities were hardly carried out. Therefore, many existing equipment and facilities have become old and there are many problems probably caused by aging degradation. Moreover, the capacity of substations and transmission and distribution facilities cannot catch up with the rapidly increasing demand and the existing facilities chronically have to have overload operation, and the situation is critical with frequent power outage in many places.

To improve the situation, the Tanzanian government formulated Power System Master Plan (2012 Update) with 25-year forecasts from 2008 to promote enhancements for power supply facilities and development of key transmission, distribution and substation facilities. Especially, regarding transmission and distribution network, the Power System Master Plan to provide the stable power supply to the city with high power demand was formulated, and JICA implemented the Study for

Rehabilitation of Distribution Facilities in Major Cities in Tanzania in 2002 and this resulted in formulation of master plan for expansion and improvement of transmission and distribution network. This report indicated the necessity of reinforcement of the transmission and distribution network and the necessary measure for improvement of reliability of stable power supply based on the construction of 132kV transmission line and secondary substations.

It was against such a background that the Government of Tanzania issued the request to the Government of Japan for the improvement and expansion of transmission and distribution facilities to realize the improvement of infrastructure for the stable power supply based on the aforementioned Power System Master Plan.

③ Outline of the study findings and Project contents

In response to the request, JICA dispatched the Survey Team to Tanzania from February 24 to April 6, 2013 (first field survey) and from May 11 to May 25, 2013 (second field survey) in order to reconfirm the contents of the request and discuss the contents for implementation with related agencies on the Tanzanian side (responsible government agency: Ministry of Energy and Minerals (MEM), and implementing agency: TANESCO), and survey the Project sites and gather related materials and data.

On returning to Japan, the Survey Team examined the necessity, social and economic impacts and validity of the Project based on the field survey materials and compiled the findings into the draft preparatory survey report. JICA dispatched the Survey Team to Tanzania for the third field survey (outline explanations) from September 28 to October 9, 2013 in order to explain and discuss the draft preparatory survey report and reach a basic agreement with the Tanzanian counterparts.

The Project plan compiled based on the survey findings targets the procurement and installation for the improvement of transmission and distribution lines and substation facilities, and the construction of new substations and related facilities. The Outline of the Basic Plan is as follows;

Outline of the Basic Plan

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
Procurement of Equipment and Installation Plan	1. Reinforcement of Ilala Substation (132/33/11 kV) and 132 kV Transmission line (approximately 7.5 km)	
	(1) Equipment to be supplied and installed for Reinforcement of Ilala Substation	
	1) 132 kV Circuit Breakers (CB), Disconnecting Switches (DS) (including modification material of the existing DS), Current Transformers, Lightning Arresters, Busbar materials for extension and other necessary materials	1 lot
	2) 60 MVA,132/33 kV Transformer	2 sets
	3) 315 kVA, 33/0.4-0.23 kV Station Service Transformer	2 sets
	4) 33 kV Switchgear (Indoor type, Protection relays mounted)	24 panel
	5) 11 kV Switchgear (Indoor type, Protection relays mounted)	20 panel
	6) Control System (Micro SCADA system)	1 lot
	7) Metering Panel (Watt-hour meters)	1 lot
	8) Transformer Voltage Regulating Panel (132/33 kV and 33/11 kV Transformers)	1 lot
	9) Protection Panels (132/33 kV and 33/11 kV Transformer Protection, 132 kV Transmission Line Protection)	1 lot
	10) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	11) Uninterruptible Power Supply System	1 lot
	12) AC Distribution Panels	1 lot
	13) 33 kV Lightning Arresters	30 phase
	14) 11 kV Lightning Arresters	45 phase
	15) 33 kV and 11 kV Cables	1 lot
	16) Other materials (Low Voltage Cables, Earthing materials and others)	1 lot
	17) New Control Building (Approximately 1,013 m^2, Single story)	1 lot
	18) Substation Civil Works (Roads in Substation, Oil Separator, Equipment Foundations, Cable trenches and others)	1 lot
	19) Modification Works at Ubungo Substation (Replacement of 132 kV CTs and Overhead Bypass Conductors, and others)	1 lot
	(2) Materials to be supplied and installed for Reinforcement of 132 kV Transmission Line	
	1) Double circuits of Transmission lines (TACSR 240 mm^2)	Approx. 7.5 km
	2) Insulators	1 lot
	3) Accessories	1 lot

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
	2. Expansion of Msasani Substation (33/11 kV) and Construction of 33 kV Distribution Line (Approximately 7.6 km)	
	(1) Equipment to be supplied and installed for Expansion of Msasani Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	5 panel
	5) 11 kV Switchgear Panel (Outdoor type, for extension of existing Switchgears)	1 lot
	6) Control System (Micro SCADA system)	1 lot
	7) Metering Panel (Watt-hour meters)	1 lot
	8) Transformer Voltage Regulating Panel	1 lot
	9) AC Distribution Panel	1 lot
	10) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	11) 33 kV Lightning Arresters	6 phase
	12) 11 kV Lightning Arresters	12 phase
	13) 33 kV and 11 kV Cables	1 lot
	14) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	15) New Control Building (Approximately 169 m^2, Single story)	1 lot
	16) 33 kV Switchgear Panels (for Makumbusho Substation)	1 lot
	17) Modification works of Control panels and metering panels (for Makumbusho Substation)	1 lot
	18) 33 kV Cables (for Makumbusho Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot
	3. Construction of Muhimbili Substation (33/11kV) and 33kV Distribution Lines (Approximately 2.0 km)	
	(1) Equipment to be supplied and installed for Construction of Muhimbili Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	15) 33 kV Cables (for New City Center Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
	4. Construction of Jangwani Beach Substation (33/11 kV) and 33 kV Distribution Line (Approximately 6.5 km)	
	(1) Equipment to be supplied for Construction of Jangwani Beach Substation	
	1) 15 MVA, 33/11 kV Transformer	1set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	15) 33 kV Switchgear Panels (for Tegeta Substation)	1 lot
	16) Modification works of Control panels and metering panels (for Tegeta Substation)	1 lot
	17) 33 kV Cables (for Tegeta Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot
	5. Construction of Mwananyamala Substation (33/11 kV) and 33 kV Distribution Lines (Approximately 1.1 km)	
	(1) Equipment to be supplied for Construction of Mwananyamala Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	15) 33 kV Switchgear Panels (for Makumbusho Substation)	1 lot
	16) Modification Works of Control panels and metering panels (for Makumbusho Substation)	1 lot
	17) 33 kV Cables (for Makumbusho Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
Procurement Plan	(1) Spare Parts, Testing Equipment and Maintenance Tools	1 lot

④ Project implementation schedule and cost estimation

In the event where the Project is implemented based on the Japan's Grant Aid scheme, the total cost of the Project will be (*confidential*). The costs to be borne by the Tanzanian side will be approximately 196.8 million yen. The contents and costs to be borne by the Tanzanian side are as given below:

① Securing of land for material storage (Approximately 1,500,000 JPY)
② Payment of bank commission based on banking: (Approximately 5,000,000 JPY)
・Commission of the Authorization to Pay (A/P)
・Payment commission
③ Registration for Japanese supervisors and engineers for construction period: (Approximately 3,400,000 JPY)
④ Expenses for necessary power outages during construction period: (Approximately 1,400,000 JPY)
⑤ RAP Compensation: (Approximately 26,000,000 JPY)
⑥ Expenses for relocation of gravesites (Approximately 10,600,000 JPY)
⑦ Expenses for EIA procedures (Approximately 2,900,000 JPY)
⑧ Excess weight charges for domestic transport: (Approximately 6,400,000 JPY)
⑨ Expenses for substations: (Approximately 76,100,000 JPY)
(Leveling the land, Removing the un-used equipment, Construction of fences and gates, etc.)
⑩ Expenses for 132kV transmission lines: (Approximately 5,300,000 JPY)
(Leveling the land for the work space, removing the un-used conductor, insulators and accessories, etc.)
⑪ Expenses for 33kV distribution lines: (Approximately 58,200,000 JPY)
(Replacement of the existing 11kV distribution line interfered with the new 33kV distribution line, Construction of 11kV distribution line from new 33/11kV substations)

The implementation schedule for the Project including the detailed design will be approximately 28 months.

(1) Relevance

The Project is deemed to be highly appropriate as an aid undertaking since it will aid realization of development plans and energy policy in Tanzania and impart benefits for the general public of Tanzania.

(2) Efficiency

1) Quantitative effects

Outcome indicator	Base value (2012) (Current value)	Target (2019) (3 years after the completion of the Project)
1. No. of beneficiaries *1		
	381,225 households	428,602 households
2. Equipment capacity		
132 kV transmission line (Ubungo Substation – Ilala Substation)	200MVA	440MVA
132/33 kV transformer (Ilala Substation)	210MVA	240MVA
33/11 kV transformer) (Reinforced, expanded and constructed substations)	45MVA	105MVA
3. Power outage time and frequency *2		
	26.3 hours/month	23.7 hours/month
4. Percentage of voltage drop		
	4.8% *3	4.3% *3
5. Power loss		
Kinondoni Region	16.4%	12.7% *4
Ilala Region	14.9%	11.2% *4

*1 Number of households is calculated based on the number of residents in Kinondoni and Ilala regions (4 numbers per household) and electrification rate in Dar es Salaam. Number of households in 2019 is calculated with Table 3-4-1.2. (2012 Population and Housing Census, March 2013)

*2 Power outage time of 33 kV systems at Ilala Substation is used as the current value for the monthly average power outage time. The target is set at 10% lower than the current level.

*3 Percentage of voltage drop of the 33 kV system at the Ilala Substation is used as the current value. The target is set at 10% lower than the current level.

*4 Calculated with reference to the Power System Master Plan (2012 Update) and Annual Report 2011.

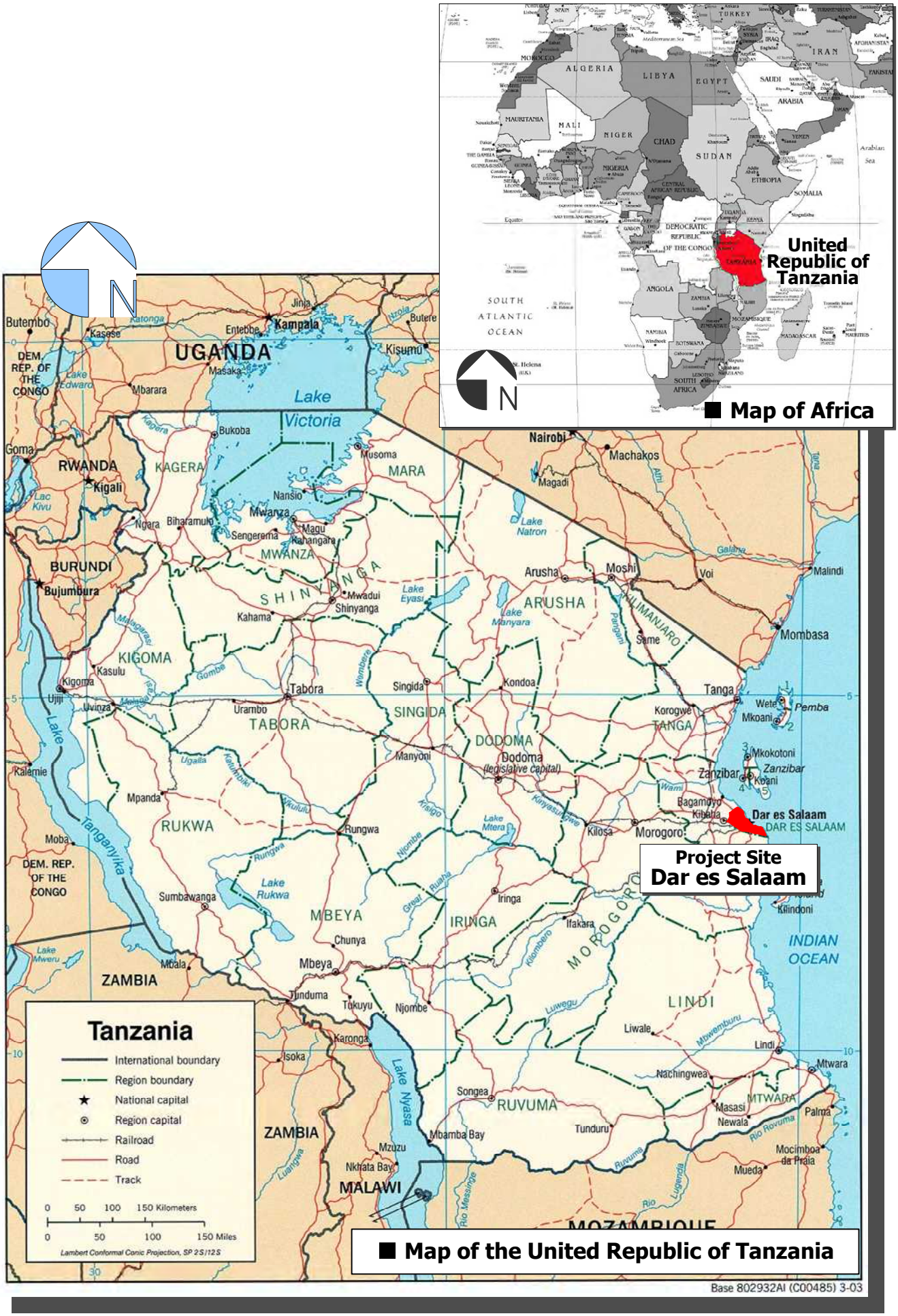
2) Qualitative effects

Indirect effects of the Project will be that it will contribute to the stable operation of hospitals and schools, improving the living environment for residents in the Project target area and improving productivity in factories.

To sum up, since Project implementation can be expected to have major effects, it is confirmed to be relevant for implementation under the Grant Aid scheme of the Government of Japan. Moreover, the Tanzanian side is deemed to possess adequate personnel and budget for implementing the Project and conducting operation and maintenance after implementation.

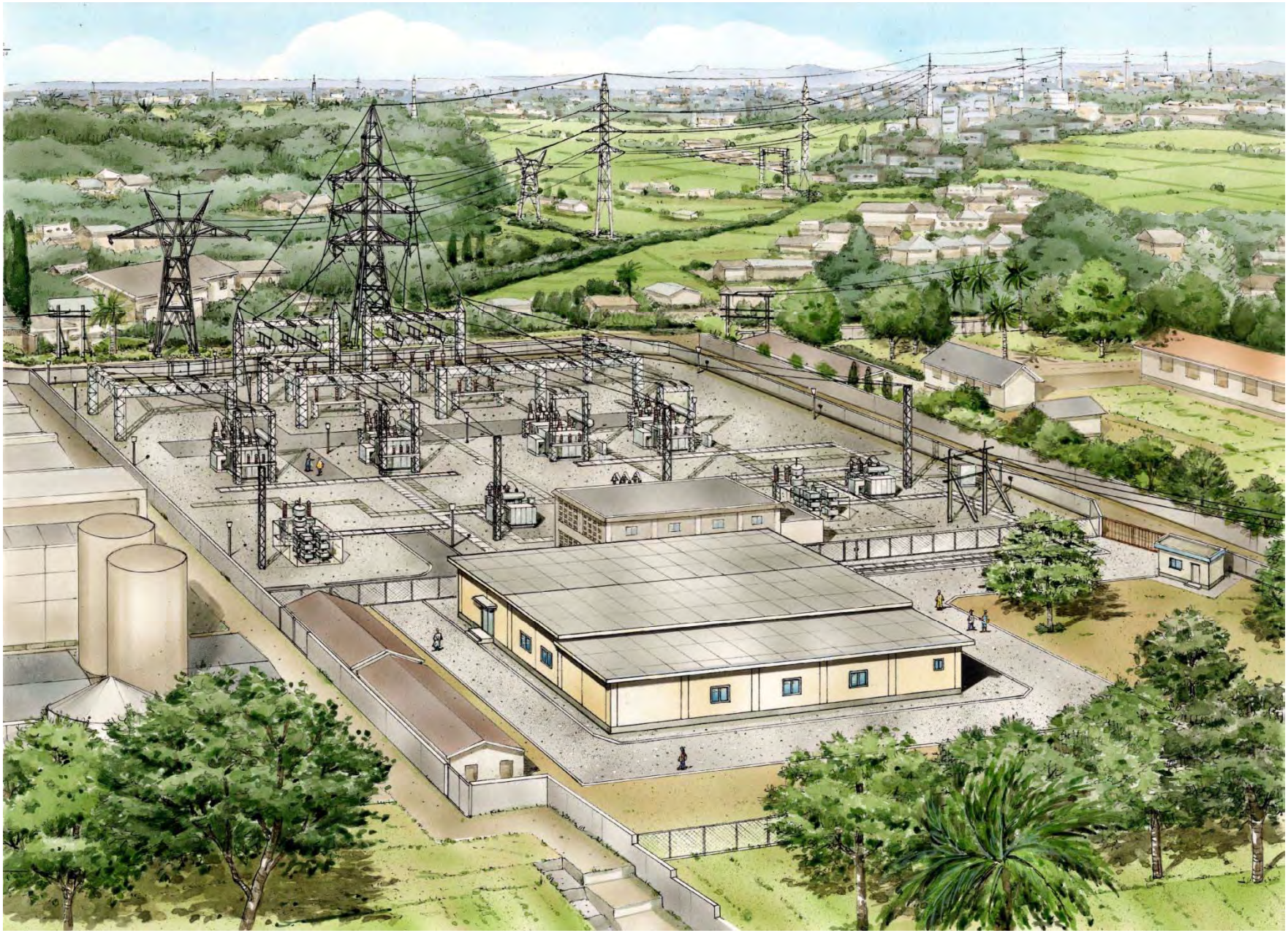
Contents

[Appendices]



Location of the Project Site

Location of the Project Site (detail)



Architectural Rendering of Ilala Substation

List of Figures and Tables

Chapter 1

Chapter 2

Chapter 3

Abbreviations

AC	Alternate Current
ACSR	Aluminum Conductor Steel Reinforced
APHA	The American Public Health Association
ARAP	Abbreviated Resettlement Action Plan
AfDB	African Development Bank
BS	British Standards
DAC	Development Assistance Committee
DAWASCO	Dar es Salaam Water and Sewerage Corporation
DC	Direct Current
DCC	Distribution Control Center
EA	Environmental Audit
E/N	Exchange of Notes
EDCF	Economic Development Cooperation Fund
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMA	Environmental Management Act
EMP	Environmental Management Plan
EPA	United States Environmental Protection Agency
EU	European Union
EWURA	Energy and Water Utility Regulatory Authority
G/A	Grant Agreement
GDP	Gross Domestic Product
GNI	Gross National Income
IBA	Important Bird Area
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IDA	International Development Association
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature and Natural Resources
JICA	Japan International Cooperation Agency
KIA	Substation Kilimanjaro International Airport
MCC	Millennium Challenge Corporation
MCCB	Molded Case Circuit Breaker
MEM	Ministry of Energy and Minerals
MP	Monitoring Plan
NEAC	National Environmental Advisory Committee
NEMC	National Environmental Management Council

NESC	National Environmental Standards Committee
NGO	Non-Governmental Organizations
NPES	National Poverty Eradication Strategy
NSGRP	National Strategy for Growth and Reduction of Poverty
O&M	Operation and Maintenance
OJT	On the Job Training
OLTC	On-load tap changer
ONAN	Oil Natural Air Natural
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PEA	Preliminary Environmental Assessment
PRS	Poverty Reduction Strategy
PRSP	Poverty Reduction Strategy Paper
PSMP	Power System Master Plan
ROW	Right of Way
RTU	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition System
SIDA	Swedish International Development Cooperation Agency
TAC	Technical Advisory Committee
TACSR	Thermal-Resistant Aluminum Alloy Conductors Steel Reinforced
TANESCO	Tanzania Electric Supply Company Ltd.
TANROADS	Tanzania National Roads Agency
TBS	Tanzania Bureau of Standards
TEDAP	Tanzania Energy Development and Access Expansion Project
TOR	Terms of Reference
TPDF	Tanzanian People's Defense Force
UPS	Uninterruptible Power Supply
VCB	Vacuum Circuit Breaker
WB	World Bank
WCST	Wild life Conservation Society Tanzania
WHO	World Health Organization

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

The Energy Sector of Tanzania plays a significant role for economic growth rates in excess of 6% per annum, and power demand expansion is outpacing economic growth with a program of accelerated electrification and vitalized economic activity. However, during the period of privatization of TANESCO from 1992 to 2006, there was no public support from the government or other donors and reinforcement of facilities to meet increasing demand or maintenance/repair of existing facilities were hardly carried out. Therefore, many existing equipment and facilities have become old and there are many problems probably caused by aging degradation. Moreover, the capacity of substations and transmission and distribution facilities cannot catch up with the rapidly increasing demand and the existing facilities chronically have to have overload operation, and the situation is critical with frequent power outage in many places.

To improve the situation, the Tanzanian government formulated Power System Master Plan (2012 Update) with 25-year forecasts from 2008 to promote enhancements for power supply facilities and development of key transmission, distribution and substation facilities. Especially, regarding transmission and distribution network, the Power System Master Plan to provide the stable power supply to the city with high power demand was formulated, and JICA implemented the Study for Rehabilitation of Distribution Facilities in Major Cities in Tanzania in 2002 and this resulted in formulation of master plan for expansion and improvement of transmission and distribution network. This report indicated the necessity of reinforecement of the transmission and distribution network and the necessary measure for improvement of reliability of stable power supply based on the construction of 132kV transmission line and secondary substations.

It was against such a background that the Government of Tanzania issued the request to the Government of Japan for the improvement and expansion of transmission and distribution facilities to realize the improvement of infrastructure for the stable power supply based on the aforementioned Power System Master Plan.

This project aims to improve and enhance transmission, distribution and substation facilities in Dar es Salaam in order to achieve the provision of stable power supply to medical institution and public facilities and the reliability of quality for electricity services. Moreover, in the operation of the power system, this project shall contribute to improving the reduction of power loss, frequent power interruption, voltage drop and low power factor caused by the deterioration and overload operation.

Table 1-1.1 shows the results of evaluating the Project components based on assessment items such as the urgency, relevance, necessity and beneficial effect, etc. according to the final requested contents and analysis in Japan confirmed in the first field survey.

Table 1-1.1 Outline of the Requested Components

Priority	Substation	Components
1	Ilala substation (132/33/11kV) (Reinforcement)	• Reinforcement of Ilala substation Including two sets of 60 MVA Transformer (132/33 kV) • Reinforcement of existing 132kV transmission line (approximately 7.5km: from Ubungo substation to Ilala substation)
2	Msasani substation (33/11kV) (Expansion)	• Expansion of Msasani substation Including a set of 15 MVA Transformer (33/11kV) • Construction of 33kV distribution line (approximately 7.6 km: from Makumbusho substation to Msasani substation)
3	Muhimbili substation (33/11kV) (New construction)	• Construction of Muhimbili substation Including a set of 15 MVA Transformer (33/11kV) • Construction of 33kV distribution line (approximately 2.0km: from NCC (New City Center) substation to Muhimbili substation)
4	Jangwani Beach substation (33/11kV) (New construction)	• Construction of Jangwani Beach substation Including a set of 15 MVA Transformer (33/11kV) • Construction of 33kV distribution line (approximately 6.5 km: from Tegeta substation to Jangwani Beach substation)
5	Mwananyamala substation (33/11kV) (New construction)	• Construction of Mwananyamala substation Including a set of 15 MVA Transformer (33/11kV) • Construction of 33kV distribution line (approximately 1.1 km: from Makumbusho substation to Mwananyamala substation)

1-2 Natural Conditions

The city of Dar es Salaam is located in the southeast of Tanzania, with Dar es Salaam Port on the eastern coast. The region is in the tropics and 0-55 meters above sea level.

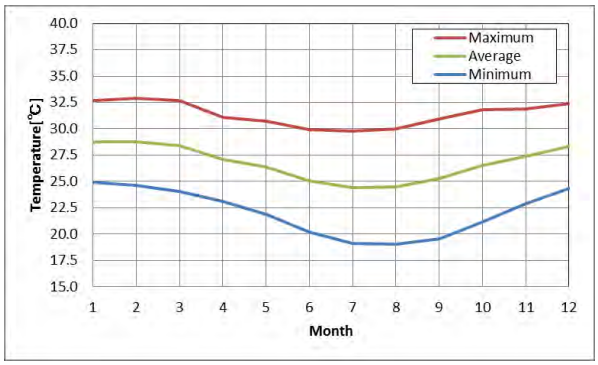
1-2-1 Location

The project sites are located in a coastal zone at latitude 6°42′ south and longitude 39°16′ east, facing the Indian Ocean. A plain stretches for 15-16 kilometers from the coast to the inland area.

1-2-2 Climate (Temperature, Precipitation, Relative Humidity, Wind Velocity and Lightning Strike)

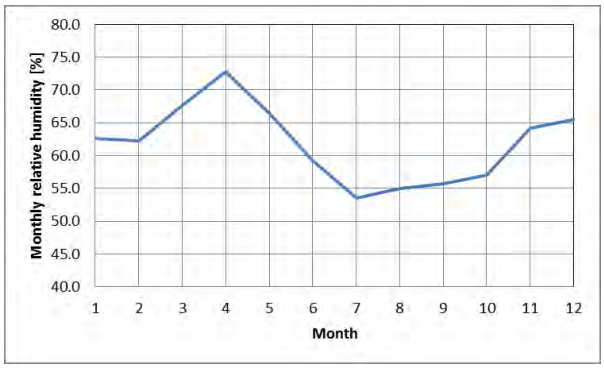
(1) Temperature, Precipitation and Relative Humidity

Figures 1-2-2.1 to 1-2-2.4 are the graphs of temperature, relative humidity, precipitation and number of rainy days in the Dar es Salaam Region. The figures show the monthly average values from 2002 to 2011. In the coastal area including the region, it is hot and humid with high average temperature and humidity. From December to March, it is hot and the highest temperature exceeds 30 degrees Celsius on many days. From June to September, it is relatively cool and the lowest temperature is below 20 degrees Celsius. There are two rainy seasons – the long rains from March to May and the short rains from November to December.



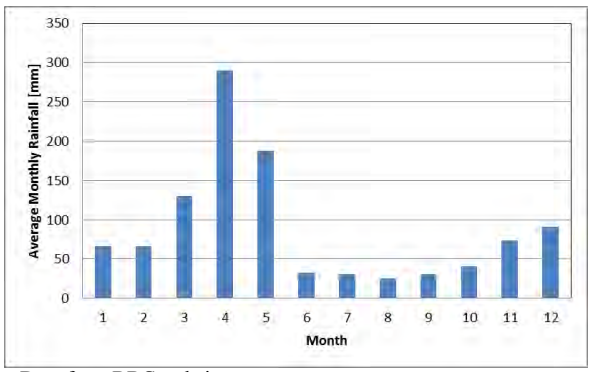
Data from Tanzania Meteorological Agency

Figure 1-2-2.1 Monthly Average Temperature



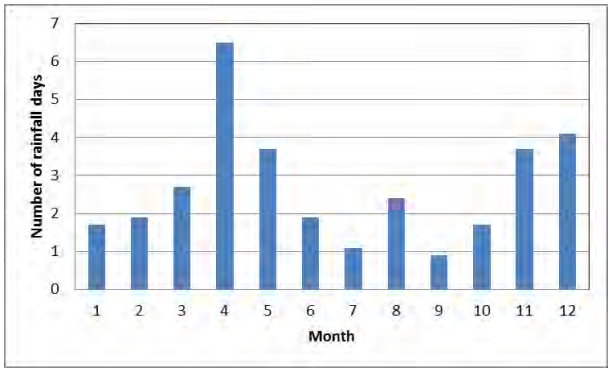
Data from Tanzania Meteorological Agency

Figure 1-2-2.2 Monthly Average Relative Humidity



Data from BBC website

Figure 1-2-2.3 Monthly Average Precipitation



Data from Tanzania Meteorological Agency

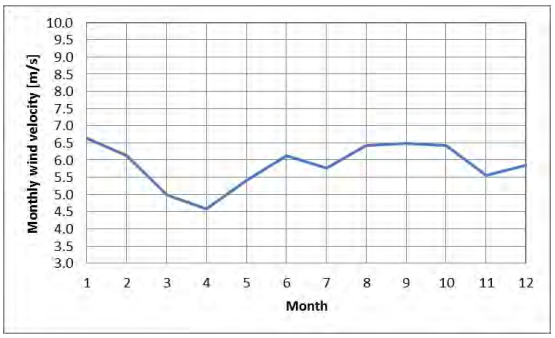
Figure 1-2-2.4 No. of Rainy Days of Each Month

(2) Wind Velocity

Figure 1-2-2.5 shows the average wind velocity in Dar es Salaam Region measured by the Tanzania Meteorological Agency. The figure shows monthly average wind velocity from 2002 to 2011. The annual average wind velocity is 5.9 m/s. According to the Tanzania Meteorological Agency, in Dar es Salaam Region it is rare to have such strong winds that affect electric equipment and cyclones in the Indian Ocean very rarely approaches to the coastal area in East Africa. The greatest wind velocity ever recorded is 24 m/s.

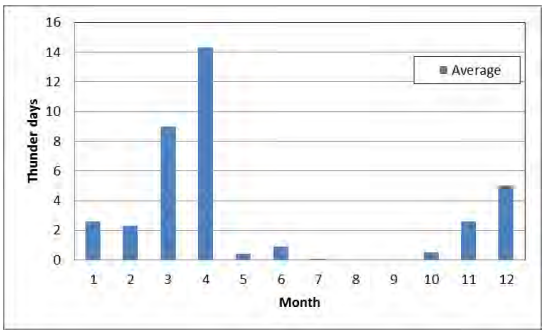
(3) Lightning

Figure 1-2-2.6 shows the number of days of lightning in Dar es Salaam Region recorded by the Tanzania Meteorological Agency. The figure shows monthly average from 2002 to 2011. Rainy seasons have more days of lightning, e.g., in April, there is lightning every other day. From May to October, there is little lightning. There were 29 days of lightning in 2011.



Data from Tanzania Meteorological Agency

Figure 1-2-2.5 Monthly Average Wind Velocity



Data from Tanzania Meteorological Agency

Figure 1-2-2.6 No. of Days of Lightning (Each Month)

1-3 Environmental and Social Consideration

1-3-1 Environmental Impact Examination

1-3-1-1 Project Components

The Project has two principal components; the new construction and reinforcement of substations, and new installation and improvement of the transmission and distribution lines. These components will be installed in Ilala Region and Kinondoni Region in Dar es Salaam. Detailed project description is available in the Chapter 2.

Project components are summarized as follows:

- **New substations**
  Jangwani Beach substation, Muhimbili substation, Mwananyamala substation
- **Reinforcement / Expansion of the existing substations**
  Ilala substation, Msasani substation
- **33kV Distribution line (New)**
  Tegeta substation to Jangwani Beach substation (6.5km)
  Makumbusho substation to Mwananyamala substation (1.1km)
  Makumbusho substation to Msasani substation (7.6km)
  New City Center substation to Muhimbili substation (2.0km)
- **132kV Transmission line (Reinforcement)**
  Ubungo substation to Ilala substation (7.5km)

1-3-1-2 Characteristics of the Project area

(1) Topography and Soils

Altitude of Dar es Salaam is less than 200 m.a.s.l. Area is generally flat to gently undulating plains, slope range 0-3% developed on old alluvial terrace no longer flooded. Major soils are well drained, moderately deep to deep, red, yellowish red or orange sands and loamy sands with sandy loams in subsoil, weak structure and very low natural fertility. Mixed alluvial deposits occur on recent flood plains along Msimbazi valley and Mzinga rivers. The areas are subject to frequent flooding.

(2) Protected area

There are several forest conservation areas near the project area as below. However all of them are more than 10km away from the project area. No other protected area such as national parks is located in and around the project area.

- Ruvu North Forest Reserve: Northwest of Dar es Salaam. Located about 10km west of Tegeta.
- Pande Forest Reserve: Northwest of Dar es Salaam. Located about 10km west of Tegeta.

- Pugu Forest Reserve: West of Dar es Salaam. Located more than 10km west of city center of Dar es Salaam.
- Kazimzumbwi Forest Reserve: West of Dar es Salaam. Located more than 10km west of city center of Dar es Salaam.
- Vikindu Forest Reserve: Located about 15km south of the city center of Dar es Salaam.

(3) River

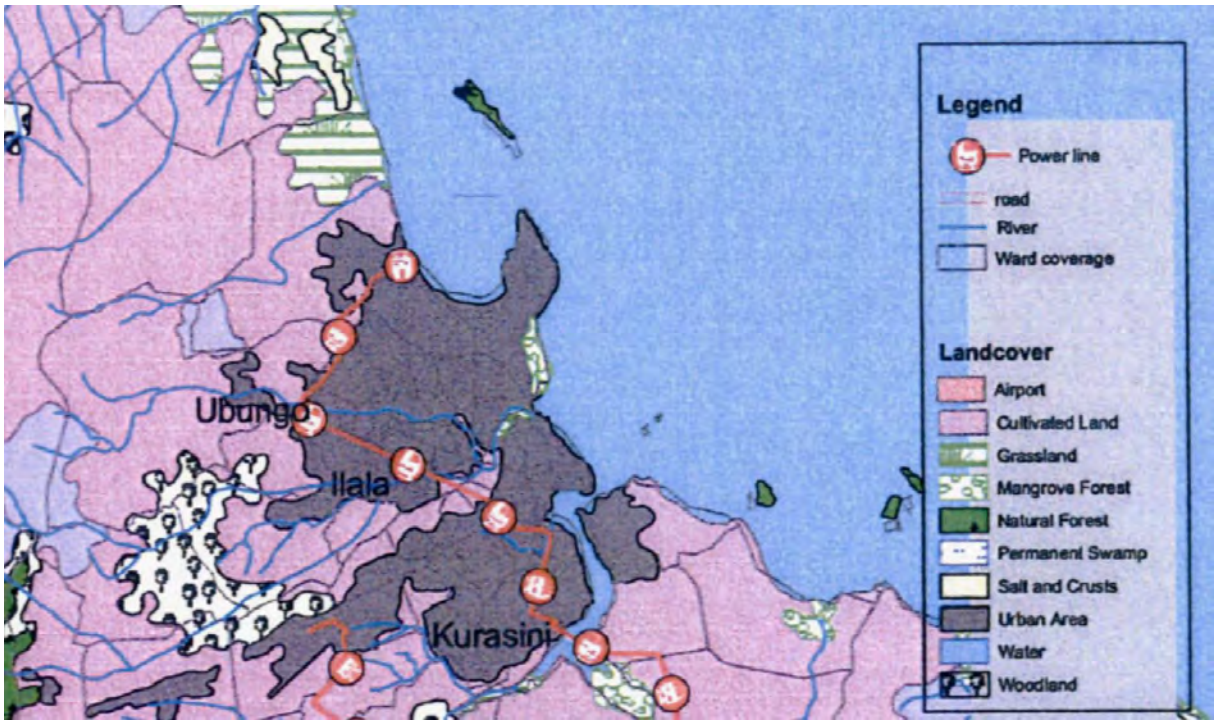
Msimbazi river is located in the project area. The length of river is about 35km and the basin area is about 300km^2. It has three tributaries; Sinza river, Ubungo river and Luhanga river. These rivers flow through the industrial area, urban area, residential area and cultivated area in Dar es Salaam. Because of the effluent from these areas, these rivers are highly polluted and there is no fish living in these rivers.

(4) Land use and Ecosystem

In Dar es Salaam, most of the vegetation and fauna have been lost or displaced due to intensive urban development of residential areas, infrastructures and gardens. In the city center where the project is undertaken, no large wild mammals are seen except for small mammals, birds some reptiles, amphibians and fish along the Msimbazi creek river and its estuary. Common animals on the project site seen include birds, butterflies, grasshoppers, ants of various kinds, etc. Since the proposed site is within an area used by other stakeholders, there are no big fauna reported or observed.

The main natural vegetation includes coastal shrubs, Miombo, woodland, coastal swamps and mangrove trees. The vegetation within the Municipal vicinity is evergreen. However most of the natural vegetation and trees have been cleared and only few remain on isolated spots.

Land use in Dar es Salaam is shown in Figure 1-3-1-2.1. Dark grey area is urban area.



Source: ESIA for Reinforcement and Upgrade of Dar es Salaam, Kilimanjaro and Arusha Transmission and Distribution System Project, 2005

Figure 1-3-1-2.1 Land use in Dar es Salaam

1-3-1-3 Legal Framework on Environmental and Social Consideration in Tanzania

(1) The process of Environmental Impact Assessment (EIA) and its permit

According to "the Environmental Impact Assessment and Audit Regulations, 2005" which is made under "the Environmental Management Act, No.20 of 2004", the Project is on a mandatory list (the First Schedule, Mandatory list A, 7-(1)) requiring EIA. The screening decision letter of NEMC on May 7th 2013 requires the Project to undertake a full EIA.

TANESCO has secured necessary budget for EIA and has been implementing EIA procedure in accordance with the steps shown in Table 1-3-1-3.1. If any covenants are imposed on the EIA certificate, TANESCO has to comply with it in implementing the Project. Thus, it is necessary to incorporate the content of the covenants into the project plan and the tender documents.

Table 1-3-1-3.1 Steps for obtaining EIA certificate

	Step	Responsible body	2013										2014			
			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	EIA budget approval	TANESCO														
2	EIA registartion	TANESCO														
3	Project Brief	TANESCO														
4	Screening	NEMC														
5	Scoping Report	TANESCO														
6	Approval of Scoping Report	NEMC														
7	EIA study	TANESCO														
8	Submission of EIA report to NEMC	TANESCO														
9	EIA report review	NEMC and TAC														
10	EIA report modification	TANESCO														
11	Approval of EIA certificate	Minister														

(2) Other permits related to the project

Following other permits are required to obtain for this project.

Table 1-3-1-3.2 Other permits related to the Project

Permit	Description
Land use permit for Jangwani Beach substation site	TANESCO obtained a land use permit from Tanzania People's Defence Force (TPDF) on December 2, 2011.
Land use permit for Muhimbili substation site	TANESCO obtained a permit to use the land of Muhimbili National Hospital. TANESCO sent an acceptance letter of the Hospital's permit to the Hospital on September 24th, 2012.
Permit to use Road Reserve	TANESCO has obtained the permission to use road reserve to construct 33kV distribution line from TANROADS and Ilala Municipality on 4th July 2013 and from Kinondoni Municipality on 3rd July 2013.
Safety Inspection Permit issued by the Ministry of Labor, Youth Development and Sports	This permit is required for construction and operation phase according to Occupational Health and Safety Act No.5 of 2003. TANESCO will obtain it before construction starts.
Building Permits by Dar es Salaam City Council	TANESCO will obtain the building permits to construct substation buildings from Dar es Salaam City Council. This permit is stipulated in the City Council By-law. After making a contact with the Contractor, the process for obtaining the permit starts.
Permission from the Ministry of Infrastructure, to transport heavy loads from the port of entry to the site	TANROADS overloaded charges are paid to the Ministry of Infrastructure for issuance of road permit to transport the equipment of abnormal weights and sizes. The contractor will obtain this permit before transporting heavy loads.

(3) Relevant legislation and regulation

1) The Environmental Management Act, 2004

The Environmental Management Act (EMA) is the principal legislation governing environmental management in Tanzania. Cap 191 provides for the legal and institutional framework for dealing with environmental issues. It also regulates the roles of the National Environment Management Council (NEMC) and the National Environmental Advisory Committee (NEAC). Under this Act, NEMC is mandated to undertake enforcement, compliance, review and monitoring of environmental impact assessment and has a role of facilitating public participation in environmental decision making, exercise general supervision and coordinating over all matters relating to the environment. The Act also requires the Council to determine whether the proposed project should be subjected to an EIA, to approve consultants to undertake the EIA study, to invite public comments and also to have the statutory authority to review EIS and to recommend to the Minister for approval and issuance of EIA certificate.

Section 81, subsection 1 in Part VI, requires project proponents or developers to undertake an Environmental Impact Assessment (EIA) at his/her own cost prior to commencement or

financing of a project or undertaking. The types of projects requiring EIA are listed in the third schedule of the Act. Section 82 makes EIA mandatory to all projects that fall under the EIA mandatory list (Schedule 3). Among the 16 listed project types, this project falls under the type "10. Electrical infrastructure." Any development project cannot be implemented without EIA according to this act.

Section 110 of Part VIII requires project proponents or any person not to discharge any hazardous substance, chemical, oil or mixture containing oil in any waters or any other segment of the environment. Part IX requires project proponents to manage and dispose waste including hazardous waste in appropriate manner. Section 141 of Part X requires project proponents to comply with environmental quality standards and criteria. Section 147 of Part X states that National Environmental Standards Committee (NESC) sets noise and vibration standards and NESC also establishes noise levels and noise emission standards applicable to construction sites, plants , machinery, motor vehicles, aircraft, including sonic booms, industrial and commercial activities.

Part XVI requires project proponents, which a licence or order has been issued under this Act, to take all reasonable steps to prevent that body corporate from contravening or failing to comply with the licence or order.

Section 186 and Section 187 provide the penalty for committing an offence against the standards regulated under this Act. Any person who commits an offence is liable on conviction to a fine of less than ten million shillings or to imprisonment for less than seven years or to both.

Any person discharges any pollutant into the environment contrary to the provisions of this Act, commits an offence and is liable on conviction to a fine of less than fifty million shillings or to imprisonment for less than twelve years. In addition, the court may direct that person to pay the full cost of cleaning up the polluted environment and of removing the pollution; or clean up the polluted environment and remove the effects of pollution to the satisfaction of the Council.

2) Environmental Impact Assessment and Audit Regulations, 2005

The Environmental Impact Assessment and Audit Regulations No. 349 of 2005 were made pursuant to Section 82 and Section 230 of the Environmental Management Act No. 20 of 2004. The regulations provide the basis for undertaking Environmental Impact Assessments and Environmental Audits for various types of development projects with significant environmental impacts. In addition, the regulations set out the procedures for carrying out review and approval of Environmental Impact Assessments.

Part III of the Regulation deals with project registration and screening procedures. Regulation 5 requires the applicant for the EIA Certificate to submit a project brief to NEMC in the format set out in the Third Schedule of the EMA (2005) and First Schedule of the Regulations. The Third Schedule also provides the format for project registration. Regulation 6(1) specifies the content

of the project brief. NEMC subsequently undertakes a screening of the project based on the submitted project brief and registration form and decides if the developer will have to carry out environmental assessment.

Regulation 46(1) classifies projects into two types:

- Type A: projects requiring a mandatory EIA; and
- Type B: projects requiring a Preliminary Environmental Assessment (PEA)

3) Stages of Environmental Impact Assessment (EIA) process in Tanzania

Given below are key steps of EIA process according to the Environmental Management Act, 2004 and the Environmental Impact Assessment and Audit Regulations, 2005:

Table 1-3-1-3.3 EIA process

Stage	Description
Registration	The proponent is required to register a project with NEMC by submitting duly filled EIA application form.
Screening	Screening is an initial review step in the EIA process. Thus, the EIA application forms and Project Brief are screened in order to assess and establish the category of project and determine the level of EIA required. This is done by NEMC within 5 working days after submission of EIA application forms.
Scoping	If the screening indicates that a full EIA is required, identification of main issues of concern through scoping will be conducted by the developer through his Consultant. This is done by consulting all the relevant concerned parties. Draft terms of references (ToR) will then be prepared to guide the impact assessment study. A Scoping Report and draft Terms of Reference (ToR) are submitted to NEMC for review and approval. This is done within 10 days after submission of the Scoping Report.
Impact Assessment	Conducting EIA study is done after approval of ToR by NEMC. The Consultant uses the ToR to conduct the actual EIA study. The crucial task is to identify likely impacts, assess and evaluate their severity and magnitude and propose mitigation measures to minimise potential negative impacts and enhance positive benefits. The output of this stage is an EIA report , also known as Environmental Impact Statement (EIS). This includes an Environmental Management plan (EMP) as well as a Monitoring Plan (MP) that outline management and monitoring of anticipated impacts, including those, which affect local communities in the project area. Public consultation is mandatory when conducting an EIA and the proponent (through his consultant) must meet key stakeholders to get their views.
Review	Once the proponent has submitted an EIA report (EIS), NEMC conducts site verification visit. The site visit is conducted to verify information provided in the EIS report. NEMC then coordinates a cross-sectoral Technical Advisory Committee (TAC) to review the EIS. The TAC is composed of members from sectors responsible for environment and resource management. Review of EIS

Stage	Description
	is completed by NEMC within 60 days from the date it was received by NEMC, and this is as required by EMA 2004. The Minister may within 30 days, upon receipt of recommendations of the Council approve or disapprove the EIS.
Public hearing	As part of the review process a public hearing may be necessary to address public concerns over a proposed activity or project. Normally this takes place when major concerns have been raised by the public and potential negative impacts of the proposed project are perceived to be far reaching. Other critical factors that may necessitate public hearing are sensitivity of the site location, type and scale of project, technology used, multiple land use considerations, presence of relocation and resettlement issues, cumulative impacts and any other factor related to a particular project that might cause public concern.
Environmental decision-making	After submission of the final version of the EIS, NEMC assesses it in order to ascertain whether all the TAC comments and recommendations have been adequately addressed by the consultant. Thereafter terms and conditions for issuance of the EIA Certificate are prepared by NEMC. Approval/disapproval of the EIS is done by the Minister responsible for Environment as stipulated in EMA 2004 section 92 (1).
Appeals	Both the proponent and the affected or interested parties have the right to appeal. If there is dissatisfaction on the decision reached, provision for appeal to the Environmental Tribunal or Court of law is provided by law.
Project implementation	This is conducted according to the terms and conditions of approval and is guided by the Environmental Management and Monitoring Plans.
Monitoring	Day to day internal monitoring (also known as routine monitoring) is done by the developer (project management team), but compliance monitoring is done by NEMC in collaboration with key stakeholders and regulatory bodies.
Environmental Audit	There are two levels of Environmental Audits, i.e. Environmental Impact Audit and Environmental Management Audit. Environmental Impact Audit involves comparing the impacts predicted in an EIS with those that actually occur after implementation of the project while Environmental Management Audit involves checks against adherence to plans, mitigation measures and general compliance of terms and conditions.

4) Screening and Evaluation Criteria of EIA

- **At the Stage of Screening**

The following shall be screening criteria:

- The project will not substantially use natural resources.
- Potential residual impacts on the environment are likely to be minor, of little significance and easily mitigated.
- The type of project, its environmental impacts and measures for managing them are well

understood in Tanzania.

- Reliable means exist for ensuring that impact management measures can and will be adequately planned and implemented.
- The project will not displace significant numbers of people, families or communities.
- The project is not located in, and will not affect, any environmentally sensitive areas such as;

  - national parks, wetlands, Productive agricultural land;
  - important archaeological, historical and cultural sites;
  - areas containing rare or endangered flora or fauna;
  - areas containing unique or outstanding scenery;
  - mountains or developments on or near steep hill-slopes;
  - dry tropical forests (e.g. Brachystegia woodlands);
  - development near high population concentrations or industrial activities where further development could create significant environmental problems; and
  - prime ground-water re-charge areas or areas of importance for surface run off of water.

- The project type will not result in:

  Policy initiatives which may affect the environment such as changes in agricultural pricing subsidies or the tobacco liberation; major changes in land tenure; or changes in water use though irrigation, drainage promotion or dams, changes in fishing practices.

- The project will not cause:

  - adverse socio economic impact;
  - land degradation;
  - water pollution;
  - air pollution;
  - damage to wildlife and habitat;
  - adverse impact on climate and hydrological cycle; and
  - creation of by-products, residual or waste materials which require handling and disposal in a manner that is not regulated by existing authorities

- The project will not cause significant public concern because of potential environmental changes. The following are guiding principles:

  - is the impact positive, mainly begin or harmful;
  - what is the scale of the impact in terms of area affected numbers of people or wildlife;
  - what is the intensity of the impact;
  - what will be the duration of the impact;
  - will there be cumulative effects from the impact;
  - are the effects politically controversial;
  - have the main economic, ecological and social costs been quantified;
  - will the impact vary by social group or gender; and
  - is there any international impact due to the proposal projects.

- The project will not necessitate further development, which is likely to have a significant impact on the environment.

- **At the Evaluation Stage of Environmental Impact Statement (EIS)**

According to the section 24, PART VI of Environmental Impact Assessment and Audit Regulations, 2005, the following is NEMC's screening criteria during the examination stage of EIS.

Table 1-3-1-3.4 Evaluation Criteria of EIS

Review Area 1	Description of the Development, Local Environmental and Baseline Conditions ・ Description of the development ・ Local environmental and baseline conditions
Review Area 2	Identification and evaluation of key impacts ・ Identification of key impacts and its evaluation ・ Residual impacts ・ Cumulative impacts ・ Prediction of impact magnitude ・ Assessment of impact significance
Review Area 3	Alternatives, mitigations, EMP, and commitment
Review Area 4	Stakeholder participation and communication of results ・ Stakeholder participation ・ Presentation ・ Composition of the stakeholders ・ Non-technical summary

[Source] Environmental Impact Assessment and Audit Regulations, 2005

5) Environmental Standards in Tanzania

The Tanzania Bureau of Standards is the designated national authority (TBS Act 1975) for developing all kinds of national standards, including environmental standards. The TBS Act establishes the National Environment Standards Committee (NESC) which is responsible for developing environmental standards. The Environment Management Act 2004, recognizes the existence of the NESC.

Part X enumerates the types of environmental standards to be established, they include water quality, discharge of effluent into water, air quality, control of noise and vibration pollution, sub-sonic vibrations, soil quality, control of noxious smells, light pollution, and electromagnetic waves and microwaves. Development of national environmental standards is still at its infancy stage. Only 9 compulsory environmental standards (those that require compulsory compliance) have been developed so far. Although, it is not stated in the Acts, in the absence of national standards, project proponents are encouraged to use international standards such as those of WHO, World Bank, British Standards (BS), EU, American Public Health Association (APHA), US Environmental Protection Agency (EPA) etc.

(4) Relevant Institutions to this project

Table 1-3-1-3.5 Relevant Institutions to this project

Level	Institution	Responsibilities
Project owner	TANESCO	Project implementation, mitigation measures, monitoring of all environmental issues and supervision of contractors.
National level	Vice President's Office, Minister Responsible for	Issue an Environmental Certificate and environmental management conditions having received project

Level	Institution	Responsibilities
	Environment	recommendation from NEMC (Category A and Category B subprojects).
	National Environmental Management Council (NEMC)	Review the project's Environmental Impact Assessment (EIA). Ensure that the project EIA is implemented according to the conditions of the EIA certificate. Recommend to the Minister Responsible for Environment to grant an EIA Certificate after the project proponent have followed all EIA process for Category A and B sub projects. Issue directives based on monitoring and evaluation reports.
	Ministry of Land and Human Settlements Development	Advice and monitoring all issues, which will be related with Land Acquisition and Resettlement.
	Tanzania National Roads Agency (TANROADS)	Issue permit on transporting heavy and abnormal loads such as transformers and generator engines.
	Occupational Safety & Health Authority (OSHA)	Workplace inspections. Industrial hygiene surveys. Issues guidelines, regulations and standards. Health examinations of workers, Training of workers and employers.
Regional	Dar es Salaam Regional Secretariats	Environmental coordination of all advice on environmental management in their respective regions.
Local	Municipal Council	Overseeing municipal development activities and issuing of permit. Monitoring the project implementation activities for the benefit of the municipal environment. Collaborate with the project developer to ensure that mitigation measures address adverse impacts.
	Ward Council	Planning environmental management programs within their respective wards. Reporting on environmental activities of projects within the wards. Mobilizing and capacity building of the population within the wards in regard to environmental management and protection. Implementing ward environmental management and protection programs within the ward.

1-3-1-4 Comparison of Alternative Options

In order to reduce negative environmental and social impacts including land acquisition and displacement, and also overall project costs, while maximizing the outcome of the project, the Team reviewed its original proposal and has proposed alternative options for this project. Following alternatives are compared as shown in Table 1-3-1-4.1.

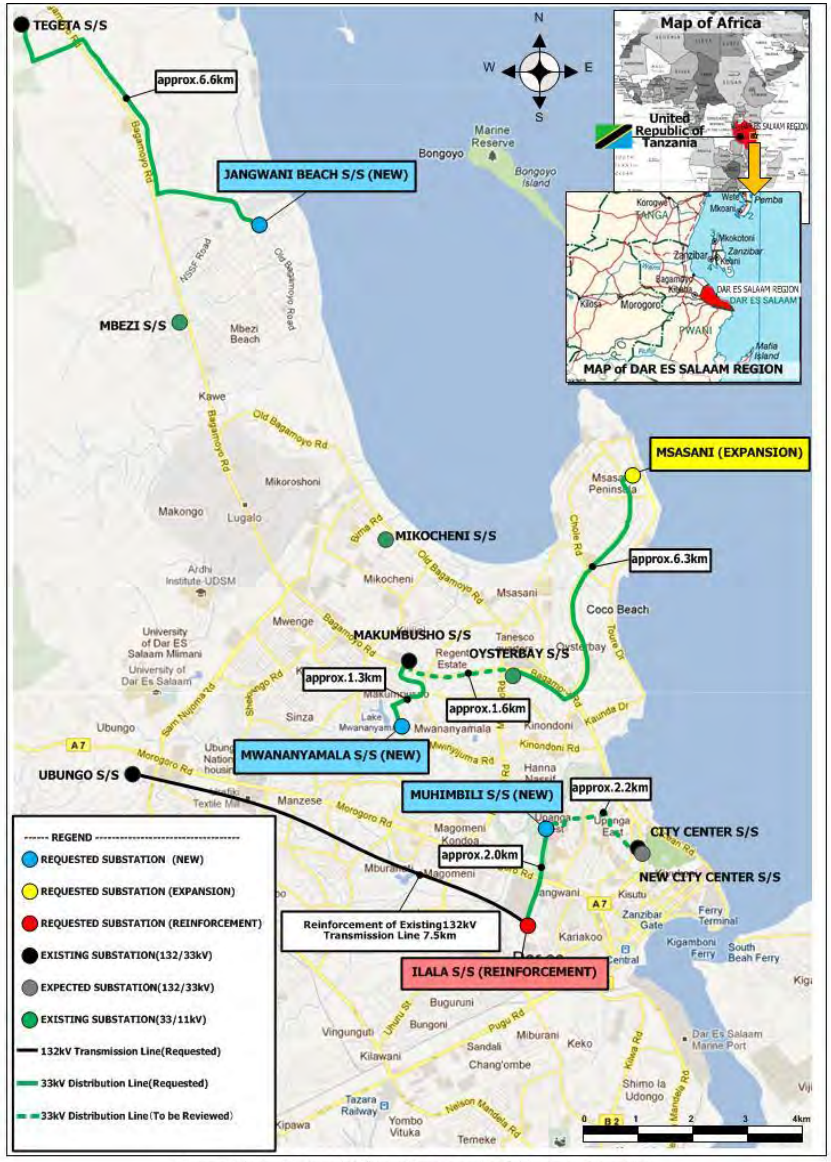
- Alternative 1 (Alt-1) : The original proposal by TANESCO.
- Alternative 2 (Alt-2) : Proposed alternative option by the Team. The distribution line from Ilala substation to Muhimbili substation is rerouted to the line from New City Center substation to Muhimbili substation.

- Alternative 3 (Alt-3) : No project implementation (Zero option).

The zero option of Alt-3 will not solve to improve current vulnerable power supply situation such as power interruption, voltage fluctuations and voltage drop technically. The original proposal by TANESCO of Alt-1 will cause a lot of relocation especially in the area between Muhimbili substation and Ilala substation and might have some minor impact on natural environment since the distribution line crosses Jangwani swamp, which is a part of the important bird area. The proposed alternative option of Alt-2 will cause less relocation compared to Alt-1 with no significant negative impact on natural environment. Thus, Alt-2 is most recommended for this project.

Table 1-3-1-4.1 Comparison of Alternative Options

Item		Alt-1	Alt-2	Alt-3 (zero option)
Outline of the Option	Length	Transmission: 7.5 km Distribution : 17.8 km	Transmission: 7.5 km Distribution : 17.2km	Transmission: 0 km Distribution : 0 km
	Major component	Substations (5) : - Ilala - Msasani - Mwananyamala (new) - Muhimbili (new) - Jangwani Beach (new) 132kV Transmission line: Ubungo substation – Ilala substation (7.5 km) 33kV Distribution line: 1) Ilala – Mubimbili (2.0km) 2) Tegeta–Jangwani Beach (6.6 km) 3) Makumbusho- Mwananyamala (1.3 km) 4) Makumbusho- Msasani (7.9 km)	Substations (5) : Same as Alt-1 132kV Transmission line: Same as Alt-1 33kV Distribution line: 1) New City Center-Muhimbili (2.0 km) 2) Tegeta–Jangwani Beach (6.5 km) 3) Makumbusho- Mwananyamala (1.1 km) 4) Makumbusho- Msasani (7.6 km)	n/a
Technical Aspect		- Less Technical Loss - Less Load-shedding - Financial Recovery by connecting to Waiting customers, and the above less facts.	- Same as Alt-1	- No Improvement of Electric Supply Reliability for existing and waiting customers
Benefit		Beneficiary: 1,092,500 household	Beneficiary: 1,092,500 household	Beneficiary: 0 people
Environmental and Social Impact	Social Environment	➢ A lot of informal settlers are within ROW of the distribution line from Ilala substation to Muhimbili substation. More than 50 houses would be affected along this line. ➢ Some houses within ROW of the transmission line will be relocated. ➢ Constrution of Mwananyanamala substation causes relocation of 62 people.	➢ No relocation is expected with the distribution line from Muhimbili to New City Center substation. ➢ Some houses within ROW of the transmission line will be relocated. ➢ Construction of Mwananyanamala substation causes relocation of 62 people.	No impact
	Natural Environment	➢ Distribution line from Ilala substation to Muhimbili substation passes along Jangwani swamp area. The line is expected to be constructed with towers and it might affect water birds passing by this swamp since the swamp is Important Bird Area (IBA). ➢ Some roadside trees will be cut down.	➢ No significant negative impact to natural environment is expected since all components are located in city area. ➢ Some roadside trees will be cut down.	No impact



Location Map of the Requested Components
(New, Expansion, Reinforcement Substations, and Transmission and Distribution Line)

a) Alt-1

b) Alt-2

Figure 1-3-1-4.1 Comparison of Alternative Options a) Alt-1, b) Alt-2

1-3-1-5 Environmental Scoping

Environmental Scoping below is undertaken by the JICA study team. The scoping is applicable to Alternative-2, which is most feasible at this stage.

Table 1-3-1-5.1 Provisional Environmental Scoping

Environmental Item	Provisional Scoping of Impact		Description
	Construction	Operation	
1. Pollution Control			
Air Quality	B-	D	**Construction:** Some emission of exhaust gas and dust from vehicles and heavy construction machinery will be expected. **Operation:** No air emission is expected.
Water quality	D	D	**Construction:** No large scale alternation of the topography or civil engineering work is expected, thus water pollution due to soil runoff will is limited. **Operation:** No wastewater discharge from the project site is expected.
Waste	B-	B-	**Construction:** Rehabilitation of Ilala substation will involve replacement of existing transformers. In addition, there are a lot of industrial waste and materials stored in the compound of Ilala substation, which will be needed to be disposed or relocated prior to construction. Proper management of these wastes and materials is needed. **Operation:** Some extent of industrial waste will be produced through maintenance activity.
Soil Contamination	B-	B-	**Construction/Operation:** If spillage of insulation oil from transformers occurs, it would cause soil and groundwater contamination.
Noise and Vibration	B-	B-	**Construction:** Construction work could produce some extent of noise and vibration. **Operation:** Transformers will produce some extent of noise.
Ground Subsidence	D	D	**Construction:** No large scale groundwater extraction and no large scale alternation of topography or civil engineering work are expected for the installation work and no ground subsidence is anticipated to occur. **Operation:** No large scale groundwater extraction is expected, thus no ground subsidence is anticipated to occur.
Odor	D	D	**Construction:** No offensive odor is anticipated to originate from construction work. **Operation:** No offensive odor is anticipated to originate from the transmission and distribution facilities.
Bottom Sediment	D	D	**Construction:** The installation works will not affect bottom sediment due to soil erosion from the works as no large scale alternation of topography or civil engineering work is expected. **Operation:** Operation and maintenance work will not affect bottom sediment due to soil erosion.
2. Natural Environment			
Protected Areas	D	D	**Construction/Operation:** The project is not located within the protected area.
Ecosystem	B-	B-	**Construction/Operation:** Jangwani swamp area, which is part of the Important Bird Area (IBA), is adjacent to the project site. The project might affect the avi-fauna around this swamp.
Hydrology	D	D	**Construction:** The construction work will not involve any major alternation of the topography or civil engineering works, the construction work will not affect groundwater and rivers. **Operation:** The operation and maintenance work will not involve any major alternation of the topography.
Topography and Geology	D	D	**Construction:** The construction work will not involve any major alternation of the topography or civil engineering works, no impacts are anticipated on the local topography or geology. **Operation:** The operation and maintenance work will not involve any major alternation of the topography.
3. Social Environment			
Resettlement	B-	D	**Construction:** Acquiring Muwananyamala substation site involves resettlement of 62 people. Within the required space for installation work of a new 132kV power cable from Ubungo substation to Ilala substation, some encroachers are observed and they are required to be relocated. **Operation:** The operation and maintenance work will not involve resettlement.

Environmental Item	Provisional Scoping of Impact		Description
	Construction	Operation	
Living and livelihood	B+	B+	**Construction:** Opportunities for employment could increase during construction. **Operation:** Improvement of power supply could improve livelihood in Dar es Salaam.
Heritage	D	D	**Construction/Operation:** There is no cultural and historical heritage in the project site.
Landscape	D	D	**Construction/Operation:** No significant change in landscape is expected.
Ethnic Minorities and Indigenous People	D	D	**Construction/Operation:** There is no ethnic minority and indigenous people in the project area.
Land Use and Natural Resources	B-	D	**Construction:** The construction of Mwananyamala substation involves acquiring private residential plots. Except this substation site, no major land use change is expected. **Operation:** Operation and maintenance work will not involve land use alternation.
Water Use	D	D	**Construction/Operation:** The project will not involve large scale extraction of water.
Existing Social Infrastructure and Institution	B-	D	**Construction:** There is a water supply facility adjacent to Muhimbili substation site. Construction work for this substation might affect the facility. Proper management of construction work is required in this site. **Operation:** Operation and maintenance work will not affect existing social infrastructure and institution.
Misdistribution of Benefit and Damage	B-	D	**Construction:** Appropriate attention to equal employment of local work force could avoid misdistribution of benefits and damage. **Operation:** The project will improve electricity supply in Dar es Salaam as a public service. Therefore, misdistribution of benefit and damage is not expected.
Gender/Children's right	D	D	**Construction/Operation:** No significant impact on gender and children's right are expected.
Local Conflict of Interest	D	D	**Construction/Operation:** The project will improve the local electricity supply as public service. This item is, therefore irrelevant.
HID/AIDS and diseases	D	D	**Construction/Operation:** As the scale of the construction, operation and maintenance work is small and local laborers will be employed, there is no tangible risk of a disaster or occurrence of infectious diseases due to the mass inflow of laborers from other areas.
Working Condition	B-	B-	**Construction:** Injuries due to accidents or incidence of diseases could increase during construction. **Operation:** Risks of electrocution and falling from high places would be expected.
4. Others			
Accidents	B-	B-	**Construction:** As Ilala substation is close to a primary school and Msasani substation and Mwanyamala substation sites are close to residential houses, risks of traffic accidents due to transportation of construction materials around these sites would be increased. **Operation:** Although it is rare, the overhead cables may be cut and dangled due to accidents or disasters.
Electromagnetic waves	D	B-	**Construction:** Construction works will not produce electromagnetic waves. **Operation:** The power lines and electrical equipment will emit electric and magnetic fields (EMF).

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

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

C+/-: Extent of positive/negative impact is unknown

D+/-: No impact is expected

1-3-1-6 TOR of the Environmental and Social Consideration Survey

Based on the result of the provisional environmental scoping, the Team decided the TOR of the environmental and social consideration survey on this project as shown in Table 1-3-1-6.1.

Table 1-3-1-6.1 TOR of the Environmental and Social Consideration Survey

Item	Survey item	Method
Comparison of the alternatives	Review the alternatives to the TANESCO's original proposal ・ Comparison of the routes of 33kV distribution line ・ Boundary of the substation sites	・ Review the alternatives to minimize relocation and land acquisition and to maximize the impact of the Project ・ Site survey ・ Interview with relevant institution on habitat of bird
Waste	Waste management and disposal in constructing substations especially for Ilala substation	・ Review existing information ・ Site survey at Ilala substation ・ Survey on waste management of Ilala substation
Soil and groundwater contamination	Measures to prevent leakage of insulation oil at substation sites	・ Site survey at substation sites ・ Survey on groundwater level at substation sites ・ Information gathering on coverage of water supply system in Dar es Salaam city ・ Consider mitigation measures
Noise	Noise emission level and its impact on the adjacent area	・ Confirm land use of each substation site according to the Land use plan of Municipal council ・ Interview with Tanzania Bureau of Standards (TBS) about the noise standard ・ Comparison between noise emission level at substations and noise standard ・ Site survey ・ Consider mitigation measures
Ecosystem	Impact on birds around the project sites especially near Jangwani swamp	・ Interview with WCST (Wild life Conservation Society Tanzania) ・ Information gathering on birds in Jangwani swamp ・ Site survey ・ Interview with the Transmission Department and the Distribution Department of TANESCO on bird strike
Resettlement	Extent of resettlement and land acquisition	・ Site survey, review existing information ・ Conduct survey on resettlement and develop an abbreviated resettlement action plan
Existing Social Infrastructure and Institution	Impact on the existing social infrastructure and institution	・ Site survey, interview ・ Review existing information
Accident	Accident risks around the project sites in construction and operation	・ Site survey ・ Information gathering on policy and action of TANESCO on health and safety issue
Electromagetic Waves	Impact of the electromagnetic waves by 132kVtransmission line and 33kV distribution lines	・ Confirm emission level of electromagnetic waves from 132kV transmission line and 33kV distribution lines and compare with the guideline of ICNIRP ・ Site survey

1-3-1-7 Result of Survey on Environmental and Social Consideration

Based on the TOR of the environmental and social consideration survey, the Team conducted the survey and the result is shown below.

Item	Finding / Issue
Waste	The Environmental (Solid Waste Management) Regulations, 2009, and Environmental Management (Hazardous Waste Control and Management) Regulations, 2009 are the main Tanzanian legislation regulating both non-hazardous and hazardous waste management under the Environmental Management Act, 2004. According to the Environmental Management (Hazardous Waste Control and Management) Regulations 2009, hazardous waste shall be classified in accordance with the criteria set out in the Third Schedule on the basis of listed waste streams, constituents and other wastes to be controlled which are hazardous under Part I of the First Schedule, read with or combined with hazardous characteristics listed under Part II of the First Schedule. At the time of site visit, disposed transformers were observed to be stored near the entrance of Ilala substation without proper labeling/sign board. The site management states that these transformers will be sold to external vendors. Also, some other wastes and materials including new transformers for distribution facility were stored in and around the proposed area of the new control building. Based on site management and JICA study team's visual observation, the substation was not equipped with either designated hazardous waste or domestic waste storage shed. At the time of the site visit, an approximately 10 m^2 oil stain was observed on bare soil in the east of the current control building. Before construction, these wastes and materials should be transferred or disposed properly in accordance with the regulation. According to the Ilala Reginal Manager of TANESCO, there is no PCB contained transformers in Ilala substation.  Figure 1-3-1-7.1 Disposed transformers stored near the entrance of Ilala substation  Figure 1-3-1-7.2 Wastes and materials stored in the proposed new control building area

Item	Finding / Issue
Soil and groundwater contamination	According to the Environmental Management (Soil Quality Standards) Regulations, 2007, made under Section 144, 145 and 230 (s) of the Environmental Management Act, 2004, no person is allowed to discharge any hazardous substance, chemical, oil or mixture containing oil on any soils . A person who discharges these substances on any soils or any other segment of the environment commits an offence. The person convicted of the offence under this regulation may be ordered by the court to pay the cost of the removal, including any costs which may be incurred by the Government or Government agency in the restoration of the soil environment damaged or destroyed as a result of the discharge. Regarding soil contamination, potential areas of concern at the project sites are the areas for installing transformers in the substation sites. Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. Insulating oil is a hazardous material and leakage/spillage of insulating oil from transformers might cause soil contamination. Some of the transformers in the TANESCO's substations were observed to be without secondary containment under the transformers and oil stain was also observed around those transformers.  Figure 1-3-1-7.3 Transformer without secondary containment in Ubungo substation (drums of insulating oils are on the ground and oil stain was observed)  Figure 1-3-1-7.4 Insulating Oil used in the TANESCO's substations

<table>
<tr><th>Item</th><th>Finding / Issue</th></tr>
<tr><td></td><td>According to a soil investigation performed in March 2013 by the JICA study team for the proposed substation sites, groundwater is located at a depth of 4.5m to 10.0m (Table 1-3-1-7.1). Since the groundwater depth is around 4 to 6m below ground level in the areas of Muhimbili, Mwananyamala and Jangwani Beach site and is overlaid by moderate permeable materials, groundwater vulnerability is assumed to be moderate for these areas.

Table 1-3-1-7.1 Groundwater level at each substation site
<table><tr><th>Substation site name</th><th>Ilala</th><th>Muhimbili</th><th>Mwananyamala</th><th>Jangwani Beach</th><th>Msasani</th></tr><tr><td>Groundwater level</td><td>GL -9.0 m</td><td>GL -6.5 m</td><td>GL -4.5 m</td><td>GL -4.5 m</td><td>GL -10.0m</td></tr></table>
According to the Dar es Salaam City Profile (2004), the water supply for the Dar es Salaam City is under the Dar es Salaam Water Supply& Sewerage Company (DAWASCO), which controls about 95% of water being consumed daily and the rest 5 % is contributed by shallow and deep wells owned both privately and by public. Out of total population of Kinondoni Municipalities, 60% of the population have direct access to clean and safe water while the rest 40 % have no direct access. In Temeke Municipality, 68% of its population are served with clean and safe water the rest have no direct access. In Ilala Municipality 52% of its population are served with clean and safe water, and the remaining population have no direct access.</td></tr>
<tr><td>Noise</td><td>Noise in the form of buzzing or humming will be generated from transformers. The anticipated noise levels generated from transformers is 72dBA for 33/11kV 15MVA transformer and 80dBA from 132/33kV 60 MVA transformer. According to the Land use plan of Ilala and Kinondoni Municipal Council, the land classification of Mwananyamala substation site is “Residential” and rest of the sites are classified as “Institution.” For “Residential,” the maximum permissive noise level is 50dBA(day)/35dBA(night) according to TBS standards shown in Table 1-3-1-7.2. The noise level guideline for “Institutional” in the IFC EHS Guidelines adopts the maximum permissive noise level of 55dBA(day)/45dBA(night) value (Table 1-3-1-7.3), and it is equivalent to the value for “Mixed residential (with some commercial and entertainment)” in the TBS standards.</td></tr>
</table>

Item	Finding / Issue

Table 1-3-1-7.2 Maximum permissive noise level for general environment by TBS standards

Facility	DAY (6:00-22:00)	NIGHT (22:00-6:00)
Any building used as hospital, convalescence home, home for the aged, sanatorium, and learning institutions, conference rooms, public library, and environmental and recreational site.	45 dBA	35 dBA
Residential building	50 dBA	35 dBA
Mixed residential (with some commercial and entertainment)	55 dBA	45 dBA
Residential and Industry/small scale production and commerce	60 dBA	50 dBA
Industrial area	70 dBA	60 dBA

(TZS932:2007 Acoustics-General tolerance limits for environmental noise)

Table 1-3-1-7.3 Noise Level Guidelines by IFC EHS guidelines

Receptor	Daytime (7:00-22:00)	Nighttime (22:00-7:00)
Residential; institutional; educational	55 dBA	45 dBA
Industrial; commercial	70 dBA	70 dBA

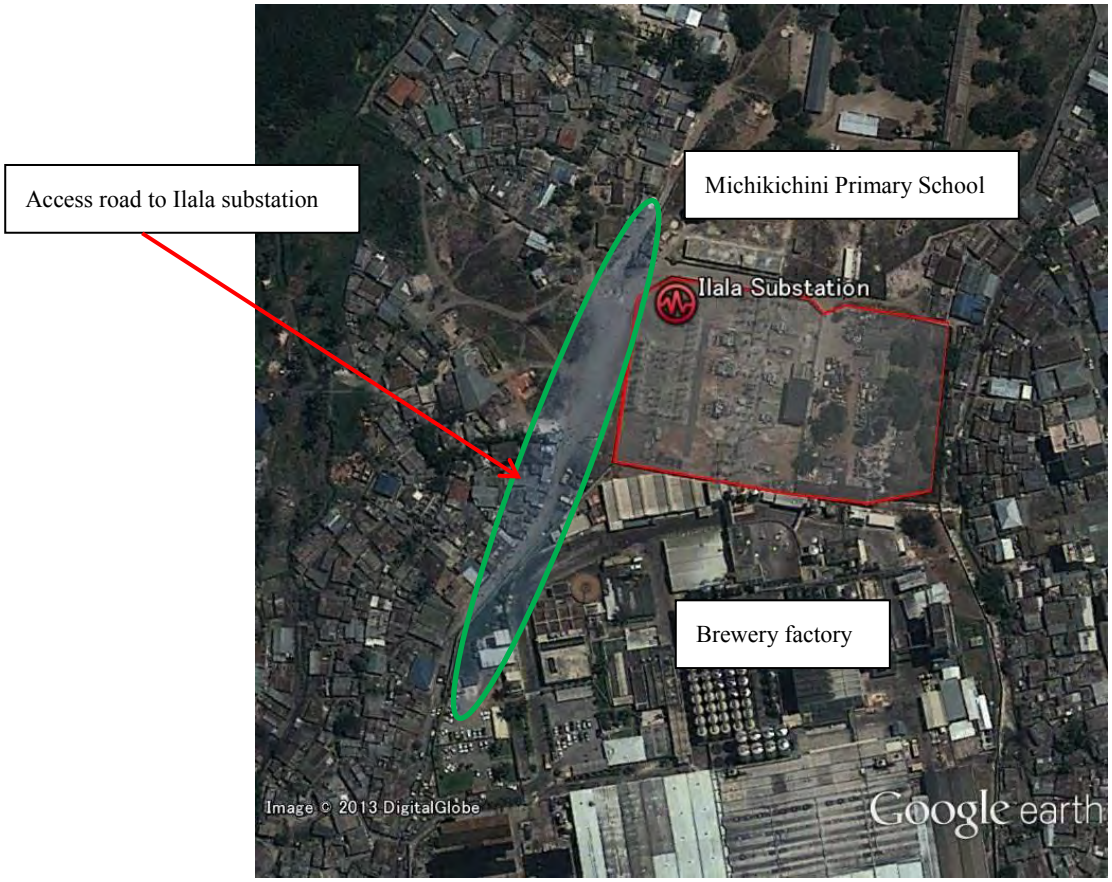
(IFC General EHS Guidelines: Environmental Noise Management)

To comply with the above mentioned maximum permissive noise level, considering the site surroundings, noise mitigation measures of installing sound-proof walls will be considered at Mwananyamala substation, Jangwani Beach substation and Muhimbili substation.

<table>
<tr><th>Item</th><th>Finding / Issue</th></tr>
<tr><td>Ecosystem</td><td>Since the original proposal from TANESCO was including the 33kV distribution line from Muhimbili substation to Ilala substation with steel towers and this line passes along Jangwani swap, the Team had an interview with Wild life Conservation Tanzania (WCST) on wild birds flying into the swamp and potential impact of the project on these birds. According to WCST, the major birds flying into the swamp are shown in Tale 1-3-1-7.4. All of them are common species and there is no endangered or vulnerable species specified by IUCN. Thus, there is little concern on these birds.
According to the Transmission Department and the Distribution Department of TANESCO, there is a bird strike problem in Mwanza area but there is no such problem in Dar es Salaam city so far. In Dar es Salaam city, they have a problem with crows, which are exotic species.

Table 1-3-1-7.4 Major wild bird species flying into Jangwani swamp (Interview with WCST)
<table>
<tr><th></th><th>Common name</th><th>Scientific name</th><th>IUCN category</th></tr>
<tr><td>1.</td><td>Greater Flamingo</td><td>Phoenicopterus roseus</td><td>Least Concern</td></tr>
<tr><td>2.</td><td>Grey Heron</td><td>Ardea cinerea</td><td>Least Concern</td></tr>
<tr><td>3.</td><td>Black- headed Heron</td><td>Ardea melanocephala</td><td>Least Concern</td></tr>
<tr><td>4.</td><td>Cattle Egret</td><td>Bubulcus ibis</td><td>Least Concern</td></tr>
<tr><td>5.</td><td>Little Egrets</td><td>Egreta garzetta</td><td>Least Concern</td></tr>
<tr><td>6.</td><td>Yellow -billed Stork</td><td>Mycteria ibis</td><td>Least Concern</td></tr>
<tr><td>7.</td><td>Sacred Ibis</td><td>Threskiornis aethiopica</td><td>Least Concern</td></tr>
<tr><td>8.</td><td>Hamerkop</td><td>Scopus umbretta</td><td>Least Concern</td></tr>
<tr><td>9.</td><td>Malachite Kingfisher</td><td>Corythornis cristata</td><td>Least Concern</td></tr>
<tr><td>10.</td><td>Striped kingfisher</td><td>Halcyon chelicuti</td><td>Least Concern</td></tr>
<tr><td>11.</td><td>Grey -headed Kingfisher</td><td>Halcyon leucocephala</td><td>Least Concern</td></tr>
<tr><td>12.</td><td>Lilac-breasted Rollers</td><td>Coracias caudatus</td><td>Least Concern</td></tr>
</table>
</td></tr>
<tr><td>Resettlement</td><td>See 1-3-2-1</td></tr>
<tr><td>Existing Social Infrastructure and Institution</td><td>At Muhimbili substation site, there is a water tower and also is a semi-basement concrete water tank of Muhimbili hospital in the east of the site. The construction work will not affect the water tower. While the water tank is close to the substation site, it is expected that there is no impact on this tank as far as the construction work is done carefully.</td></tr>
</table>

Item	Finding / Issue
Accident	Ilala substation is located in the south of Michikichini Primary School across the road and Muwananyamala substation site is located in the middle of residential area. Because of this location, these two sites have a risk of accident involving students and neighborhood residents with construction vehicles and machineries during the construction phase. The access road to Ilala substation is unpaved and narrow with shops and houses on the west side as shown in Figure 1-3-1-7.5 and Figure 1-3-1-7.6. This road is the route to and from the school for the students and the community road for the neighborhood residents.  Figure 1-3-1-7.5 Access road to Ilala substation

Item	Finding / Issue
	 Figure 1-3-1-7.6 Aerial photo around Ilala substation (Google earth, 2013)

Item	Finding / Issue
Electromagetic Waves	Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device (e.g. power lines and electrical equipment). Even though there is no concrete scientific evidence, it is thought that electromagnetic waves along power lines may cause health problems to the people who are directly exposed to them for long period of time. Since there is no specific guideline on exposure to electromagnetic waves in Tanzania, the Team has evaluated potential exposure by the transmission line and distribution line to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The exposure levels are expected to remain below the ICNIRP recommendation as shown in Table 1-3-1-7.5.

Table 1-3-1-7.5 Approximate value of General Public exposure to electric and magnetic fields

Source	Electric Field (V/m)	Magnetic Field (μT)
132kV Transmission Line		
Case1: Between Tower No.1 and No.25		
Under the Line (GL)	Approx. 1,400	Approx. 18
Around Wayleave	Approx. 570	Approx. 11
Case2: Connection to Substations		
Worst	Approx. 2,500	Approx. 30
33kV Distribution Line		
Under the Line (GL)	Approx. 920	Approx. 9
Around Wayleave	Approx. 770	Approx. 8
Exposure limits for general public exposure (ICNIRP)	Max. 5,000	Max. 100

(Source: JICA study Team)

1-3-1-8 Evaluation of Potential Impact

Based on the results of the environmental and social consideration survey, the Team evaluated the potential impact of the Project as shown in Table 1-3-1-8.1.

Table 1-3-1-8.1 Evaluation of Potential Impact

Environmental Item	Provisional Scoping of Impact		Scoping after the survey		Description
	Constructio	Operation	Constructio	Operation	
1.Pollution Control					
Air Quality	B-	D	B-	D	Same as the provisional environmental scoping.
Water quality	D	D	B-	B-	**Construction:** During construction of the substations, some amount of water discharge is expected but no hazardous effluent water discharge is expected. The discharged water is penetrated into the ground. **Operation:** Sewage water will be discharged from Ilala substation and it will be treated with a septic tank and then infiltrated into the ground after separating sludge. Because of this treatment, water pollution to surrounding area is not expected. Secondary containment with oil-water separator will be installed under each transformer at substation sites to retain insulation oil in case of oil leakage from transformers. This prevents leaked oil from soil and groundwater pollution.
Waste	B-	B-	B-	B-	Same as the provisional environmental scoping.
Soil Contamination	B-	B-	B-	B-	**Construction/Operation:** If insulation oil is leaked from transformers, it may cause soil and groundwater pollution. 132/33kV 60MVA transformer would contain around 30,000L of insulation oil. 33/11kV 15MVA transformer with OLTC would contain around 9,000L of insulating oil.
Noise and Vibration	B-	B-	B-	B-	**Construction:** While installation work for transmission cable and distribution lines would not produce high level continuous noise, construction work for substations would produce some extent of noise in operating construction vehicles and machineries. Management of daily construction work period and construction vehicles and machineries would reduce noise impact to surrounding area. **Operation:** 132/33kV 60MVA transformer will produce 80dBA of noise at the source. 33/11kV 15MVA transformer will produce 72dBA of noise.

Environmental Item	Provisional Scoping of Impact		Scoping after the survey		Description
	Constructio	Operation	Constructio	Operation	
					Since Mwananyamala substation is closely located to neighborhood houses, it is difficult to reduce noise level to appropriate level (eg. 45dBA during nighttime at site boundary) only with attenuation in distance. It is necessary to have appropriate mitigation measures for this substation. As for Muhimbili substation and Jangwani Beach substation, residential houses and hospital facilities are also closely located, and it is necessary to have appropriate mitigation measures such as location of transformer and installation of wall. These substations are expected to have such mitigation measures and the impact would be mitigated.
Ground Subsidence	D	D	D	D	Same as the provisional environmental scoping.
Odor	D	D	D	D	Same as the provisional environmental scoping.
Bottom Sediment	D	D	D	D	Same as the provisional environmental scoping.
2.Natural Environment					
Protected Areas	D	D	D	D	Same as the provisional environmental scoping.
Ecosystem	B-	B-	D	D	**Construction/Operation:** Although the original proposal from TANESCO included the distribution line from Ilala substation to Muhimbili substation with steel towers, the alternative route from New city center substation to Muhimbili substation is proposed instead of that route. Because of this change, there will be no impact on Jangwani swamp. In addition, birds flying into Jangwani swamp are not endangered species but common species and there is no bird strike problem with transmission and distribution line in Dar es Salaam so far. Thus, the Project would not have any negative impact on existing ecosystem.
Hydrology	D	D	D	B-	**Operation/Operation:** If insulation oil leaks from the transformers at the substation sites, it may infiltrate into the ground and then into groundwater (aquifer) under the substation sites. This would cause groundwater pollution.
Topography and Geology	D	D	D	D	Same as the provisional environmental scoping.

Environmental Item	Provisional Scoping of Impact		Scoping after the survey		Description
	Constructio	Operation	Constructio	Operation	
3.Social Environment					
Resettlement	B-	D	B-	D	**Construction:** Construction of Mwananyamala substation involves land acquisition and resettlement of 62 people. Installation of 132kV transmission cable between Ubungo substation and Ilala substation would not involve land acquisition and it will be installed to existing towers having established wayleaves. Since a few informal houses seem to be within the project affected area, they would be relocated. There are also 250 graves, which have to be relocated, in the project affected area of transmission line. The distribution line will be constructed within the existing road reserve of TANROADS and the Municipality and it does not involve land acquisition. If there is any building/structure within the road reserve, the distribution line is expected to be installed avoiding them. Thus, the distribution line would not cause resettlement.
Living and livelihood	B+	B+	B+	B+	Same as the provisional environmental scoping.
Heritage	D	D	D	D	Same as the provisional environmental scoping.
Landscape	D	D	D	D	Same as the provisional environmental scoping.
Ethnic Minorities and Indigenous People	D	D	D	D	Same as the provisional environmental scoping.
Land Use and Natural Resources	B-	D	B-	D	Same as the provisional environmental scoping.
Water Use	D	D	D	D	Same as the provisional environmental scoping.
Existing Social Infrastructure and Institution	B-	D	B-	D	Same as the provisional environmental scoping.
Misdistribution of	B-	D	B-	D	Same as the provisional environmental scoping.

Environmental Item	Provisional Scoping of Impact		Scoping after the survey		Description
	Constructio	Operation	Constructio	Operation	
Benefit and Damage					
Gender/Children's right	D	D	D	D	Same as the provisional environmental scoping.
Local Conflict of Interest	D	D	D	D	Same as the provisional environmental scoping.
HID/AIDS and diseases	D	D	D	D	**Construction/Operation:** This project would involve about 100 workers in construction phase. In operation phase, about 6 to 7 workers for Ilala substation and 1 security guard for each rest of the substations would be deployed. The project do not expect any adverse impact regarding infectious diseases because no massive influx of workers is expected as most labors can be supplied locally for the construction works.
Working Condition	B-	B-	B-	B-	Same as the provisional environmental scoping.
3.Others					
Accidents	B-	B-	B-	B-	Same as the provisional environmental scoping.
Electromagnetic waves	D	B-	D	D	**Operation:** The extent of electric field and magnetic field produced by the transmission line and distribution line was compared with the guidelines on limits of exposure to static magnetic fields developed by ICNIRP (International Commission on Non-Ionizing Radiation Protection). The extent of electromagnetic field produced by the 132kV transmission line and 33kV distribution line is below the guideline level at the ground under the cable and around the boundary of wayleaves. Considering this, the project would not cause negative impact by electromagnetic waves from the power cable.

A+/-: Significant positive/negative impact is expected
B+/B-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown
D+/-: No impact is expected

1-3-1-9 Mitigation Measures

To mitigate potential negative impact by the project, following mitigation measures should be taken. Cost of mitigation measures is included in the project total cost.

Table 1-3-1-9.1 Mitigation Measures

Impact		Mitigation measures	Cost	Implementing Organization	Responsible Organization
1	Waste	Construction waste will be transported to the appropriate disposal site with preventing from flying apart and falling off. Soil waste from construction at Ilala substation will be used for preparation of Muhimbili substation site to minimize the disposal amount when it is possible. The construction sites will be managed to minimize the amount of waste produced by the Project. As for industrial waste disposal site, TANESCO and the contractor will consult with Dar es Salaam city council. Industrial waste such as waste oil and sludge will be treated and disposed by the qualified contractor. The qualification for the waste disposal company will be issued by municipalities. TANESCO and the contractor will confirm if the waste disposal company has the qualification from the municipality. TANESCO will ensure the contractor not to fly apart and fall off the waste during transporting construction waste.	Included in the contractor's daily work	TANESCO, Contractor	TANESCO, Contractor
2	Soil and groundwater Contamination	Secondary containment made of concrete or asphalt will be installed under each transformer to prevent insulation oil from leaking out of the substation site in case of oil leakage. Base of the containment will be constructed during foundation work for transformers and then outside walls will be constructed after installing transformers. The containment will be equipped with oil-water separator connected to storm water drainage. This prevents insulation oil from running off the substation site in case if oil leakage. If insulation oil is leaked from a transformer, ballast in the containment will be retrieved. If any oil film is observed in the oil-water separator during daily management activity, absorptive treatment will be conducted.	US$2,000 to $4,000 per transformer	TANESCO, Contractor	TANESCO, Contractor

Impact		Mitigation measures	Cost	Implementing Organization	Responsible Organization
		Volume of secondary containment will be determined taking into account of the insulation oil amount of each transformer. According to Japanese standard on electrical equipment, the volume of facility preventing leaked oil from running off should be 50% volume of the amount of insulation oil plus water amount necessary to put out a fire.  			
3	Noise	**Mwananyamala substation:** The transformer will be located near the center of the substation site to keep enough distance from adjacent houses. Since it is difficult to reduce noise level below 45dBA during nighttime only with attenuation in distance, sound barrier wall will be installed around the transformer. Noise reduction effect with the wall is 25dBA at a maximum. The specification of noise barrier wall such as location and material will be determined considering the specification and characteristic of the transformer. **Jangwani Beach substation:**	US$50,000	Contractor	Contractor

Impact		Mitigation measures	Cost	Implementing Organization	Responsible Organization
		The transformer will be located to keep enough distance from adjacent houses. Since noise reduction is not enough with attenuation in distance, installation of sound barrier wall will be considered. **Muhimbili substation:** Some facilities of Muhimbili hospital are located in the north of the substation site. The transformer will be located with enough distance from those facilities. Since noise reduction is not enough with attenuation in distance, installation of sound barrier wall will be installed.			
4	Resettlement	Except Mwananyamala substation, construction and reinforcement of the substations will not involve resettlement. The distribution line will be constructed within the existing road reserve of TANROADS and the Municipality and it does not involve land acquisition. If there is any building/structure within the road reserve, the distribution line is expected to be installed avoiding them. Thus, the distribution line would not cause resettlement. Construction of Mwananyamala substation involves land acquisition and resettlement of 62 people. Installation of 132kV transmission cable between Ubungo substation and Ilala substation would not involve land acquisition and it will be installed to existing towers having established wayleaves. Since a few informal houses seem to be within the project affected area, these would be relocated. In order to reduce project affected people, the work space is modified. Remaining impact will be mitigated through developing the policy for the abbreviated resettlement plan (ARAP) in consistent with JICA's safeguard policy	See ARAP policy	TANESCO	TANESCO

Impact		Mitigation measures	Cost	Implementing Organization	Responsible Organization
		and World Bank OP 4.12. TANESCO will take necessary measures based on this ARAP policy.			
5	Existing Social Infrastructure and Institution	The boundary of Muhimbili substation site is close to the semi-basement concrete water tank of Muhimbili hospital. If the water distribution pipe from the water tank is expected to be affected by the construction work, the pipe would be rerouted before the construction of the substation as necessary. During the construction of the substation, the contractor should be careful enough not to damage the water tank and its function.	US$200～400	Contractor	Contractor
6	Accident	According to TANESCO's Health and Safety Policy and Contractors' Occupational Health and Safety Guidelines, the Contractor will prepare a Contractor's Occupational Health and Safety Management Plan, including details of occupational health and safety procedures to prevent accidents and other OHS related incidents. Based on this plan, the contractor will implement prevention measures for accident and occupational health and safety issues to reduce its risks. The plan ensures safety for neighborhood and accident prevention within the construction site. To prevent the electrification and fire caused by distribution equipment and facility, enough distance between power cable and structures nearby should be maintained. The route for construction vehicle should be determined to minimize the risk of traffic accident. The contractor will consider the hours with high volume of traffic in developing the construction schedule.	Included in the contractor's daily work	Contractor	Contractor

1-3-1-10 Environmental Monitoring Plan

Based on the above mentioned mitigation measures, the Team developed the draft environmental monitoring plan as shown in Table 1-3-1-10.1.

Table 1-3-1-10.1 Draft Environmental Monitoring Plan

Environmental Item	Item	Location	Frequency	Responsible body
Construction Phase				
Permit	• Issuance of EIA certificate • Compliance with the covenants of EIA certificate	N/A	Before the construction	TANESCO
Waste	Types of the waste, amount, disposal method	Construction sites	Once a month	TANESCO, Contractor
Resettlement	• Relocated households • Affected households • Compensation • Grave removal	Project affected area	Once a month	TANESCO
Existing Social Infrastructure and Institution	Impact on the water tank in Muhimbili hospital site	Muhimbili sibstation site	During the construction of Muhimbili substation	Contractor
Accident	• Implementation of health and safety management plan • Accident record	Construction sites	Once a month	TANESCO, Contractor
Operational Phase				
Waste	Types of the waste, amount, disposal method	Substation sites	Once a month for 6 months after starting its operation	TANESCO
Soil and groundwater contamination	Leakage of insulation oil	Substation sites	Once a month for 6 months after starting its operation	TANESCO
Noise	Equivalent continuos A-weighted sound pressure level (L_{Aeq}) • Daytime 6:00-22:00 • Nighttime 22:00-6:00	• Residential area adjacent to Mwananyamala substation • Hospital area adjacent to Muhimbili substation • Residential area adjacent to Jangwani Beach substation	Once a month for 6 months after starting its operation	TANESCO

1-3-1-11 Stakeholder Consultation

Based on the section 178 of "the Environmental Management Act, 2004" and the Section 17 of "the Environmental Impact Assessment and Audit Regulations, 2005", TANESCO had stakeholder consultations during the course of Environmental Impact Assessment study. It is held four times at the stage of Scoping, Detail survey for preparing ESIA report, Review of ESIA report, and Disclosure process of ESIA report. Following stakeholders were consulted during the EIA study. TANESCO explained outline of the project, potential impact of the project and its mitigation measures at the consultation meetings.

- Municipal Authorities: Ilala, Kinondoni
- Tanzania National Roads Agency (TANROADS)
- The Dar es Salaam Water and Sewerage Authority (DAWASA)
- Tanzania Telecommunication Company (TTCL)
- Local Communities:
  - ✓ Mchikichini, Upanga East and Upanga West in Ilala Municipal Council
  - ✓ Makurumla, Kawe, Mzimuni, Kunduchi, Wazo, Msasani, Mabibo, Ubungo, Mikocheni and Makumbusho ward in Kinondoni Municipal Council

Concerns raised by the participants in the stakeholder consultations are incorporated in the Environmental and Social Management (ESMP) and Monitoring Plans (EMP).

Followings are the comments from the participants in the stakeholder consultations.

- Municipal Authorities: Ilala, Kinondoni
  - ✓ TANESCO should now opt using the underground cables instead of overhead transmission lines.
  - ✓ If TANESCO project is going to affect people compensation procedures should be done in order to avoid misunderstanding with the community and communication should pass through Municipal offices, ward and Mtaa levels in order to make them aware of what is going on about the project.
  - ✓ TANESCO should educate the community about the project in order to avoid conflict, there might be different challenges but if education will be clearly provided the project will be successful.

- TANROADS
  - ✓ TANESCO should have good plan with their project in order to avoid using road reserve. Using road reserve is not a proper plan so the company should prepare for compensation when implementing the project regardless the cost. Using underground cables is the best option nowadays so the company should opt using this method.
  - ✓ Those who will be found in the road reserve are encroachers and are not entitled for compensation. But if TANESCO is going to use area which is out of the road reserve then compensation should be paid.

- ✓ TANESCO have a big challenge concerning theft of their properties and these thieves do cooperate with TANESCO staff so security should be increased in the transformers and other properties.
- ✓ TANESCO should protect the environment, the behavior of cutting trees during clearance of the line and leave trees is bad and it brings bad reputation to the company. After pruning trees cleaning should be done.

- DAWASA
  - ✓ Surveyor from TANESCO should observe what is inside the proposed route and it will be good to have a joint survey with DAWASA officers in order to observe what is in the proposed route and advice accordingly.
  - ✓ In order to make a project success they advice TANESCO to pass the distribution line (from Tegeta S/S on the way to Bagamoyo road project) on the left side of the road from the substation because they have another large water pipe project on the right side which is expected to start soon. But if that option will not be good for TANESCO then the company will have to wait until we are done with our water project.

- TTCL
  - ✓ The project is good in order to make it successful there must be cooperation between TTCL, DAWASA, TANROADS and respective municipals. He advised TANESCO to arrange a day so as to have site visit to conduct joint survey with all stakeholders as this will enable the company to have a good plan with the project after identifying all properties which belongs to other companies in the proposed route.

- Local Communities
  - ✓ How the project would be beneficial to the community.

    The ESIA team thanked the residents for their participation and responded to their questions informing them that the project has its benefits and drawbacks. Some of the benefits highlighted were:
    - ➢ Gains in the local and national economy thus leading to increase in revenue.
    - ➢ Access to reliable power.
    - ➢ Improved security in the area due to street lightning.
    - ➢ Direct and indirect skilled and non-skilled employment opportunities

  - ✓ How safe would one be if he/she lives near the substation?
    - ➢ For safety issues, it is highly recommended that no one lives too close to the substation and this would be adhered to.
    - ➢ It will be built by experienced personnel.
    - ➢ Perimeter fencing, Security and lightning.
    - ➢ Entry to the substation is restricted, only authorized officers will be allowed

  - ✓ Some of the drawbacks of the projects identified were:

- Air and noise pollution during construction.
- Possibility of occurrence of accidents on the site during construction.
- It was responded that In view of occupational health and safety concerns, the proponent will ensure health, safety and welfare of workers to prevent accidents in the course of employment and additionally provision of PPE would reduce the impacts of dust and minimize exposure to a variety of hazards respectively.

✓ Wanted to know whether the locals would be employed during the construction and operation phases of the project.
- The team emphasized that locals will be given first priority in employment especially casual employment, the contractor will be advised to contract locals in the project area.

✓ Compensation of the properties to the affected people to be done before construction of the project and that proper valuation of properties and payment be made in time and should be adequate to enable PAPs get alternative housing.
- It was responded that in deed compensation will be paid before construction starts according to Land Acts 1999.
- The valuation process is vested to Chief Government Valuer and TANESCO being public company cannot pay beyond the Chief Government Valuer's opinion.

✓ Awareness on the valuation and compensation of the properties procedures to the affected people by the project. This is because most people are unaware of the procedures involved during valuation and compensation exercise.
- TANESCO agreed that is the problem during the valuation exercise and promised to continue raising awareness during the detailed ESIA study. Further, TANESCO will ensure that engaged valuers conduct awareness meetings with PAPs before the valuation of properties starts.

✓ Wanted to know how will issues relating HIV/AIDS to the construction workers and community be dealt.
- It was responded that HIV/AIDS awareness within the community is very high but the project will continue to educate and sensitize workers and the community on how to avoid spread HIV/AIDS during the project implementation.
- Adverts and brochures will be erected and distributed to workers to warn and to remind people to take care for themselves.

Figure 1-3-1-11.1 Stakeholder consultation during the process of EIA in Upanga West.

1-3-2 Land Acquisition and Resettlement

1-3-2-1 Project component related to land acquisition and resettlement

(1) Substation

Acquiring Mawananyamala substation site involves relocation of 62 people. Two plots of land, Plot No.76 and No.77 of Block 2 in Mwananyamala area, will be acquired for this substation. TANESCO has obtained agreement on selling of "Right of Occupancy" from the land owner of Plot No.77 on June 18, 2012 and from the owner of Plot No. 76 on June 15, 2012. TANESCO completed valuation process of these plots in January 2013 and compensation value is Tsh 417,890,494.90 in total. Rest of the substation sites are not expected to involve involuntary resettlement. Other substation sites do not involve resettlement.

(2) 132kVTransmission line from Ubungo substation to Ilala substation

Since the Project would contribute to replacing the existing power line to new ones for the transmission line from Ubungo substation to Ilala substation, the project does not involve new land acquisition for this component. Therefore, the project affected area for the 132kV transmission line for this project is defined as follows.

- The area that falls within the area/work space required for installation work of a new power line and maintenance activity (including area occupied by the towers);
- The area required for access pathway to the towers

During the course of this study, the Team set necessary work space, and only a few houses around Tower No.5 are the project affected houses by the work space. There are 250 graves within the work space and its relocation process is now undertaken.

Transmission Department of TANESCO has been conducting the way leave management activity throughout Tanzania. They are removing and relocating illegal structures within the wayleaves to secure safety. They will deal with the illegal structures outside the project affected area within the wayleaves of the transmission line between Ubungo and Ilala substation in the course of this management activity.

(3) Distribution line

Since the distribution lines will be constructed within the existing road reserve of TANROADS, Kinondoni Municipality and Ilala Municipality, the construction of distribution line does not involve land acquisition. Therefore, no resettlement derived from land acquisition is expected. If there is any building/structure within the road reserve, the distribution line is expected to be installed avoiding them. Thus, the distribution line would not cause resettlement.

1-3-2-2 Legal Framework in Land Acquisition and Resettlement

(1) Relevant legislation and regulation on Land Acquisition and Resettlement in Tanzania

Relevant legal system of land acquisition and involuntary resettlement is described in Table 1-3-2-2.1

Table 1-3-2-2.1 Relevant Legal System of Land Acquisition and Involuntary Resettlement

National Policies	National Land Policy, 1997
	National Environmental Policy, 1997
	National Human Settlement Development Policy, 2007
Legal Framework	The Land Act (No.6), 1999
	Village Land Act (No.7), 1999
	The Land Acquisition Act, 1967
	The National Land Use Planning Commission Act (No.3), 1984
	Urban Planning Act, 2007
	Land use Planning Act, 2007
	Graves (Removal) Act, 1969
	Local Government (District Authorities) Act
	Local Government (Urban Authorities) Act
	Land (Forms) Regulations, 2001
	Land (Assessment of the Value of Land for Compensation) Regulations, 2001
	Land (Compensation Claims) Regulations, 2001
	Land (Management of the Land Compensation Fund) Regulations, 2001
	The Village Land Regulations, 2001

1) The Land Act (No. 6), 1999

The major function of this land act is to promote the fundamentals of the "National Land Policy" through giving clear classification and tenure of land, land administration procedures, rights and

incidents of land occupation, granted rights of occupancy, conversion of interests in land, dispositions affecting land, land leases, mortgaging of land, easements and analogous rights, co-occupation and partitioning and, settlement of land disputes. One of the pertinent issues when dealing with land is the right of occupancy. According to the Land Act, 1999, the right of occupancy is given in two categories that separate citizens and non-citizens rights to occupy land.

- For a citizen or in a group of two or more formed in association, partnership or corporate body will enjoy the right of being granted the right of occupancy or derivative of a granted right of occupancy.
- For a non-citizen, or in a group whether formed into a corporate body under the Companies Ordinance or otherwise, (including corporate bodies whose majority shareholders or owners are non-citizens) may only obtain a right of occupancy or derivative right for purposes of investment prescribed under the Tanzania investment act 1997.

2) Land (Assessment of the Value of Land for Compensation) Regulations, 2001

This regulation defines the land assessment and its compensation as below.

- The basis for assessment of the value of any land and unexhausted improvement for purposes of compensation, under the Act shall be the market value of such land.
- The market value of any land and unexhausted improvement shall be arrived at by use of comparative method evidenced by actual recent, sales of similar properties or by use of income approach or replacement cost method
- Every assessment of the value of land and unexhausted improvement for the purposes of payment of compensation by Government or Local Government Authority shall be verified by the Chief Valuer of the Government or his representative.
- The interest upon any compensation shall be paid by the Government or the local government authority only where there is no prompt payment of compensation made.
- For the purpose of computing interest payable upon compensation "prompt payment of compensation" means payment of compensation within six months after the subject land has been acquired or revoked.
- Where amount of compensation remains unpaid for six months after acquisition or revocation, interest at the average percentage rate of interest offered by commercial banks on fixed deposits shall be recoverable until such compensation is paid.

3) Land (Compensation Claims) Regulations, 2001

These Regulations shall apply to all applications or claims for compensation against the Government or local government authority or any public body or institution under the Act who may claim compensation. The following may claim compensation:

- The holder of a granted right of occupancy in respect of general or reserved land which is transferred to village land under Section 5 of the Act or in respect of land the subject of a

right of occupancy which is compulsorily acquired by the President for public purposes under Section 22 of the Act or in respect of a right of occupancy which has been revoked under Section 49 of the Act;

- The holder of a granted customary right of occupancy in respect of land which is declared to be hazardous land under section 7 of the Act;
- The holder of a customary right of occupancy where the land becomes the subject of a granted right of occupancy in favor of another person and such holder is moved or relocated under section 34 of the Act.
- The occupier of land which he has obtained under or as a consequence of a disposition by a holder of a granted or customary right of occupancy where such occupier is refused a right of occupancy under section 54 of the Act;
- The occupier of land in any urban or peri urban area where such land is acquired by the President under section 60 of the Act.

The Land (Assessment of Value for compensation) Regulation 2001 shall apply to any application or claim for compensation by any person occupying land. The Commissioner or the authorized officer shall cause a notice to be published on a public notice board and serve a notice in a prescribed form on every occupier.

- notifying the occupier of the land which is the subject of compensation;
- requiring the occupier to submit his claim for compensation;
- requiring the occupier to appear physically on such date, time and place where assessment shall be done.

The Commissioner or the authorized officer shall cause the valuation for compensation purposes to be undertaken. The Commissioner or the authorized officer shall prepare a compensation schedule and submit to the Fund, together with the claim for compensation.

- The Fund shall, within not more than thirty days from the date (missing) for compensation and compensation schedule from the Commissioner or authorized officer make verification and accept or reject payment.
- This regulation shall apply to all applications or claims for compensation against the Government or local government authority or any public body or institution under the Act.
- The compensation under section 156 of the Act shall apply against a non-government corporate body, association or group of persons in whose favor a public right of way is created.

Compensation shall take the form of monetary compensation. Without prejudice to the generality of the above, compensation may, at the option of the government, take the form of all or a combination of or any of the following;

- a plot of land of comparable quality, extent and productive potential to the land lost;
- a building or buildings of comparable quality extent and use comparable to the building or

buildings lost;

- Plants and seedlings;
- regular supplies of grain and other basic foodstuff for a specified time.

4) Project affected people and Compensation

Based on The Land Act (No.6), 1999 and Land (Assessment of the Value Land for Compensation) Regulation, 2001, the basis for assessment of the value of any land and unexhausted improvement for purposes of compensation shall be the market value of such land. Where amount of compensation remains unpaid for six months after acquisition or revocation, interest at the average percentage rate of interest offered by commercial banks on fixed deposits shall be recoverable until such compensation is paid.

Table 1-3-2-2.2 Compensation package

Category	Compensation
Compensation for lost assets	Compensation at market value
Disturbance allowances	Multiplying value of the land by average percentage rate of interest offered by commercial banks on fixed deposits for twelve months at the time of loss of interest in land.
Transport allowance	Equivalent to transporting 12 tons of goods for a 20 km. distance price determined by area
Accommodation allowance	Cash money to rent the same structure per month x 36 months
Loss of rental income	Lump sum cash payment for 36 months rent per tenant
Loss of profit allowance	Profit of the business per month x 36months
Compensation for loss of income	Payment in lieu of wages while rebuilding

(Road Sector Compensation and Resettlement Guidelines, United Republic of Tanzania, February 2009)

(2) JICA's Policy on Resettlement

According to the JICA's Environmental and Social Consideration Guidelines (April, 2010), following s are the JICA's policy on resettlement.

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

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

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

IV. Compensation must be based on the full replacement cost[1] as much as possible.

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

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

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

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

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

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

X. Affected people are to be identified and recorded as early as possible in order to

[1] Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

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

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

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

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

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

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

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

(3) Gap Analysis and Resettlement Policy for this project

Result of the gap analysis between JICA's safeguard policy and laws of Tanzania is shown in Table 1-3-2-2.3 as well as the draft resettlement policy.

Table 1-3-2-2.3 Gap Analysis and Resettlement Policy for this project

No.	JICA Guidelines	Laws of Tanzania	Gap between JICA Guidelines and Laws of Tanzania	Resettlement Policy for this project
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	No specific provisions on avoiding involuntary resettlement and loss of means of livelihood although these can come from Environmental and Social Impact Assessment (ESIA)	Avoiding involuntary resettlement is not mentioned in Tanzania land laws	Consider alternative alignment to avoid unnecessary loss of livelihoods
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	When displacement is unavoidable, compensation will be given as follows (Land Act, 1999 – Cap 113, Part II Section 3 (1) (g) , Section 34 and 156) Market value of unexhausted improvement [2] , disturbance allowance, transport allowance, accommodation allowance and loss of profits, although depreciated replacement value is given and valuation is often not done properly because some aspects that need to be included are not taken into account – for example, using market values is sometimes ignored and information to affected persons is not sufficiently provided	Full replacement value (market value) plus transaction costsare not mentioned in Tanzania laws Measures to minimize impacts are not explicit in Tanzania laws	Consider full replacement value (market value plus transaction cost into compensation package)
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels	Livelihood restoration is not addressed although, sometimes done through provision of alternative affected social services- for example, providing an alternative health facility or a school are cases in point.	Livelihood restoration is not explicit in Tanzania laws	This ARAP should consider PAPs whose strictures have partially been affected by the project to compensate for the areas/size affected unless the area affected is larger and it impacts on it affect the quality of the livelihood, which will then result to full compensationof

[2] Land Act, 1999 interprets unexhausted improvement as anything or any quality permanently attached to the land directly resulting from the expenditure of capital or labor by an occupier or any person acting in his behalf and increasing the productive capacity, the utility, the sustainability of its environmental quality and includes trees standing crops and growing produce whether of an agricultural or horticulture nature. This condition has been amended by the Land (Amendment Act), 2004 by replacing Subsection 8 and 9 of the Land Act 1999 to allow for sale land without unexhausted improvements. For development purposes or as joint venture.

No.	JICA Guidelines	Laws of Tanzania	Gap between JICA Guidelines and Laws of Tanzania	Resettlement Policy for this project
	to pre-project levels. (JICA GL)			the value of the structure. Prepare a livelihood restoration plan, including transitional support(for example putting in place deliberate policies to employ affected persons between the transition period so that they can have some work and earn income as well as providing alternative services points while new social services are being developed for them etc.) to ensure standards of living are restored and improved
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Market values but usually in practice provide with depreciated replacement values (although the law does not direct the use of depreciated values)	Full replacement cost not paid	Consider adopting full replacement value (market valuesplus transaction costs)
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Compensation must be provided prior to displacement (Land Acquisition Act, 1967 (15- (1)) and Land Act 1999- Cap 113)	Tanzania laws does not have consideration of other assistance to project affected persons	Consider provision of other assistance (for example affirmative policies to employ affected persons, provision of support on land acquisition, payment of land and related fees, and power or water utilities , provision of temporary social services etc. to ease the burden on affected persons) beside statutory compensation
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	For large scale involuntary resettlement compensation must be provided (Land Acquisition Act 1967 Part II Section 11 and Land Cap 113, Part II Section 3 (1) (g))	Tanzania Law does not consider Resettlement Action Plan as mandatory	Using JICA GL, consider RAP as mandatory tool to manage impacts
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their	Prior to conducting valuation affected people and local authorities are informed about the project, its effect, valuation and	The level of consultation in Tanzania laws is not as detailed as in others including JICA GL and WB	Consider adopting detailed and sufficient consultations and information sharing with affected

No.	JICA Guidelines	Laws of Tanzania	Gap between JICA Guidelines and Laws of Tanzania	Resettlement Policy for this project
	communities based on sufficient information made available to them in advance. (JICA GL)	compensation process(Land Act Cap. 113 Section 34 (6), 35 (3))		persons
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Prior to conducting valuation affected people and local authorities are informed about the project, its effect, valuation and compensation process(Land Act Cap. 113 Section 34 (6), 35 (3) and Part XIV Section 168 (1) and 169 (1) and (2). And Land Acquisition Act Part II Section 7(1))	The level of consultation in Tanzania laws is not as detailed as in others including JICA GL and WB	Consider adopting detailed and sufficient consultations and information sharing with affected persons
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	In Tanzania land laws, Resettlement Action Plan is not mandatory, although compensation is required	There is no sufficient participation of affected persons in planning, implementation and monitoring of Resettlement Action Plan	Consider ensuring effective and appropriate participation of affected persons in planning, implementation and monitoring of RAP
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Tanzania land laws provides a mechanism for dealing with grievances including lodging complaints to the courts (Land Acquisition Act 1967, Section 13 (1) and (2) and Land Act, Cap 113. Part XIII Section 167 (1))	Tanzania grievance mechanism is not easily accessible to affected persons	Provide an easily accessible grievance mechanism procedures to all affected persons
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Affected People are identified during the valuation exercise and the valuation date is the eligible cut-off date[3]	Socio-Economic baseline survey is not undertaken as part of the valuation exercise	Undertake socio-economic baseline data collection as part of the valuation exercise

[3] This is adopted as best practice but not provided in any land law in Tanzania

No.	JICA Guidelines	Laws of Tanzania	Gap between JICA Guidelines and Laws of Tanzania	Resettlement Policy for this project
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of valuation but have invested on land will be eligible for compensation of assets but not land (recognized as tenants) Land Act Cap 133	Tanzania Law does not recognize encroachers	Informal settlers who havepermanent structures and graves in the way leave should be for compensated but not for land. i
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Compensation for land can either be in form of cash or land based)Land Act Cap 113 Section 49 (3) for cash transactions and Land Acquisition Act , 1967 Section 11 (2)	There is no preference to land based resettlement strategies	Where appropriate preference to land based resettlement strategies should be adopted, especially taking into account land scarcity in Dar es Salaam
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	-	The law is silent about provision of support during transition and for livelihood restoration	Consider providing support during transition (for example for acquiring new lands, paying for land registration as well as temporary social services) and for livelihood restoration
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	-	There is no attention for particular group of project affected persons in Tanzania land laws, all PAPs are treated in equally in the compensation process	Assess existence of such groups during socio-economic survey in the proposed site and pay particular attention to their needs if found to be available, especially, women, children and elderly person.
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	For projects that affect a large size of people, a Land Use Plan is required to accommodate the project. (Land Use Planning Act, 2007. Section 23, 32 and 35 and Village Land Use Guidelines on 2002)	ARAP is not mandatory in the Tanzania law	Adopt ARAP for this project as part of best practice to manage impacts

1-3-2-3 Scope of Land Acquisition and Resettlement

Scope of the land acquisition and resettlement is as described in 1-3-2-1. Acquiring Mawananyamala substation site involves relocation of 62 people, while other substations do not involve resettlement.

Since JICA's Grant Aid would contribute to replacing the existing temporal power cable to a new cable for the transmission line from Ubungo substation to Ilala substation, the project does not involve new land acquisition for this component. Only a few informal houses around Tower No.5 are expected to be the project affected houses by the work space for the transmission line. Since the distribution lines will be constructed within the existing road reserve of TANROADS, Kinondoni Municipality and Ilala Municipality, the construction of distribution line does not involve land acquisition. If there is any building/structure within the road reserve, the distribution line is expected to be installed avoiding them. Thus, the distribution line would not cause resettlement.

If there is any people who have to be relocated because of the project, an abbreviated resettlement action plan (ARAP) will be developed as necessary. The main objective of the ARAP is to provide an agreed plan for the compensation and resettlement of persons who will be affected by the project implementation. The plan provides a road map for resolving displacement, resettlement and compensation issues related to project implementation. The ARAP has also developed mitigation measures through consultation with PAPs, several relevant authorities, including government at both national and local level.

1-3-2-4 Eligibility for Compensation and Resettlement Assistance

The basic principle governing compensation is that none of the PAPs should be made worse off by the project displacements. A registered valuer will conduct inspection of all the affected properties within the finally selected project sites. Compensation details for each identified property will be provided in individual compensation schedules which will be signed by Ward Executive Officers, District Commissioners and Regional Commissioners of relevant areas. The Chief Government Valuer will approve the valuation report before being submitted to the Commissioner for Lands in Dar es Salaam. Notices to claim compensation will be served to all owners of affected properties within the project sites. The "cut-off" date for eligibility for compensation and resettlement measures will be determined by the date on which these notifications were served. The entitlement matrix will be developed during the ARAP survey based on the resettlement policy described in Table 1-3-2-2.3.

1-3-2-5 Grievance Mechanism

Taking into account the complexity of resolving disputes and grievances, PAPs will be informed about various grievance redress procedures and of their right to appeal if not satisfied. During surveys and inventory of PAPs and their properties, and in various consultative and stakeholder engagements, PAPs will be informed about the grievance and dispute redress procedures. PAPs will also become aware of the extent of damages to properties, crops and commercial activities that the Project would entail.

Section 13 (1) of the Land Acquisition Act 1967 includes provision regarding any land that is acquired where there is a dispute or disagreement. The Act elaborates disputes and stipulates the timeframe (six weeks) for resolving them before the aggrieved party can institute a suit in a court of law for resolution. The Land Act, 1999 and supporting regulations improves Section 13(1) of the Land Acquisition Act by establishing Land Tribunals at the Ward and District levels. If not satisfied with decisions of the Land Tribunal, the aggrieved party is obliged to take the matter to the court. If the local courts and/or the Land Tribunals cannot settle the matter, the matter will go to the High Court for resolution. The High Court of Tanzania and Court of Appeal is the highest appellate "judge" in this system. The decision of the High Court would be final.

The procedures for compensation dispute resolution prescribed by the Land Acts are cumbersome and costly, taking into account the fact that most of the PAPs have limited knowledge about legal issues and their rights with respect to the laws. Thus, the Grievance and dispute resolution structures will be established at local level in order to listen to complaints brought to them by PAPs and solve them before a decision to go to court is undertaken by the PAP. Considering this, a simplified grievance redress mechanism will be established, that will enable timely settlement of grievances to the PAPs. The grievance procedures will be anchored and administered at the local level to facilitate access, flexibility and openness to all PAPs.

1-3-2-6 Institutional Framework

The compensation process and ARAP implementation arrangements envisaged for this project have several steps involving individual PAPs, affected communities, respective Local Government Authorities (e.g., regional and district councils) , TANESCO and the Ministry of Energy and Minerals, Ministry of Housing and Human Settlement and the TANROADS.

The overall responsibility for resettlement lies with the Ministry of Energy and Minerals and payments will be made through the fiscal authority of TANESCO as the project implementer. Once compensation payments have been made to PAPs through an agreed arrangement, TANESCO and district government authorities will have a critical role to play to ensure that PAPs are using their entitlements for the purpose of relocation consistent with the timing in the vacancy agreements.

1-3-2-7 Implementation Schedule

In developing the ARAP, the compensation schedule will be developed based on the approved valuation reports. It will also have to be approved by the Chief Government Valuer and to submit it to TANESCO. Approval of the compensation schedules signifies the official instruction to TANESCO to pay compensation to the PAPs.

Upon receipt of the approved compensation schedules, TANESCO will make out cheques in the name of the Compensation Fund and forward these, together with the compensation schedules, to the relevant municipalities. TANESCO will post notices in the affected areas advising beneficiaries to collect their compensation payments from the relevant municipal offices. The municipalities will be

responsible for the actual payment of compensation to each beneficiary. In the presence of local leaders, each beneficiary will be required to sign for the receipt of the compensation due on the compensation schedule.

Demolition of structures and destruction of crops and trees will not commence until beneficiaries have received their entitlements. Displaced property owners will have the right to salvage material and assets from their plots and harvest and standing crops before a date advised at the time of compensation payment.

To ensure timely completion of resettlement activities, district authorities will facilitate the resettlement process. TANESCO will urge all PAPs to vacate within the time frame that will be agreed between the two parties.

1-3-2-8 Implementation Budget

Based on the resettlement policy described in the table 1-3-2-2.3, the cost of resettlement implementation will be calculated. The total cost for compensation is derived from the approved valuation and compensation schedules reports which show the different categories of payments (i.e. replacement cost of houses, land market value, disturbance and transport allowances, etc.). TANESCO is responsible for providing the resettlement implementation cost based on the ARAP.

1-3-2-9 Monitoring and Evaluation

ARAP implementation will be closely monitored by both TANESCO and independent firm to provide TANESCO an effective basis for assessing resettlement progress and to identify potential difficulties and problems. Broadly, the monitoring and evaluation (M&E) system will involve:

- Administrative monitoring, including but not limited to daily planning, implementation, feedback and trouble shooting, individual PAP file maintenance, progress reporting
- Socio-economic monitoring, including but not limited to: case studies; using baseline information to compare the PAPs' socio-economic conditions over time; looking at the issues of vacating properties, asset demolition, and the salvaging of materials; and tracking morbidity and mortality, communal harmony, consultations, number of grievances filed and resolutions; and
- Impact evaluation and monitoring, including but not limited to income changes over time, with a special focus on livelihoods restoration or improvement.

Monitoring the progress of ARAP execution will be carried out through internal monitoring processes by TANESCO. The indicators of achievement of objectives during ARAP implementation are of two kinds; 1) Process Indicators that reflect project inputs, expenditure, staff deployment, etc., and 2) Output Indicators that reflect results in terms of numbers of PAPs compensated. Process indicators related to the physical progress of work will focus on items such as:

- Grievance redress procedures: status and functionality
- Opening of bank accounts

- Disbursement of compensation payments and receipt by PAPs
- Number of households and businesses displaced and resettled
- Structures rebuilt/replaced
- Progress and completion of scheduled activities
- Meetings with PAPs and other stakeholders
- Financial status of the Project

Output indicators will be the same as those collected during the socio-economic survey to evaluate changes in living standards against pre-project levels.

1-3-2-10 Stakeholder Consultation

The public participation process for resettlement will be taken into account particular feature of the Project. In connection with the requirement that displaced persons to be meaningfully consulted, consultations will be made through meetings and interviews involving stakeholders at national, regional, district, and ward levels, the local government and central government as well as NGOs that operate in the project area.

The main objective of public participation is to enable stakeholders learn about the project, its impacts and how they will be mitigated, especially the issues about compensation, relocation and to secure their cooperation. Other objectives include assisting stakeholders to understand applicable laws and regulations governing compensation and to involve stakeholders in census, socio-economic surveys, and inventory of households and affected assets for Resettlement Action Plan preparation.

Stakeholders/institutions for Resettlement Action Planning and Implementation would be as follows:

(a) TANESCO
(b) Ministry of Lands, Housing and Human Settlements
(c) Ministry of Energy and Minerals
(d) Local Government Authorities (Ilala Municipal, Kinondoni Municipal, etc)
(e) Project-affected Persons
(f) Local communities
(g) NGOs and CBOs
(h) TANROADS

The ARAP will be disclosed to prior to appraisal. In Tanzania the resettlement action plan will be made available to the public for a period of six weeks in the relevant municipal and ward offices. This disclosure will be advertised in newspapers and on radio stations commonly accessed by the local population. It will be available in full in English and in summary in Kiswahili. During this period people will be given the opportunity to respond to the ARAP, in writing or verbally, to the relevant Municipal Director or Ward Executive Officer who will then pass on the responses to TANESCO.

1-3-3 Others

1-3-3-1 Environmental Checklist

Based on the JICA's Guidelines for Environmental and Social Considerations (April, 2010), the study team has reviewed the Project with TANESCO using the Environmental Checklist: Power Transmission and Distribution lines as shown in Table 1-3-3-1.1.

Table 1-3-3-1.1 Environmental Checklist: Power Transmission and Distribution lines

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a) Y	(a) The draft EIA report was developed on December 23rd, 2013. According to "the Environmental Impact Assessment and Audit Regulations, 2005" which is made under "the Environmental Management Act, No.20 of 2004", the Project is on a mandatory list (the First Schedule, Mandatory list A, 7-(1)) requiring EIA. On May 7th 2013, National Environmental Management Council (NEMC) made a decision that this project requires a full Environmental Impact Assessment (EIA) study. TANESCO secured a necessary budget for EIA and developed the draft EIA report.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	(b) TANESCO will submit the EIA report and will obtain the Environmental Certificate approved by the Minister.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N	(c) See (b)
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) Y	(d) Following permits are required to obtain for this project. ➢ **Land use permit** for Jangwani Beach substation site: TANESCO obtained a land use permit from Tanzania People's Defence Force (TPDF) on December 2, 2011.
			Y	➢ **Land use permit** for Muhimbili substation site: TANESCO obtained a permit to use the land of Muhimbili National Hospital. TANESCO sent an acceptance letter of the Hospital's permit to the Hospital on October 15th, 2013.
			Y	➢ **Permit to use road reserve:** TANESCO has obtained the permission to use road reserve to construct 33kV distribution line from TANROADS and Ilala Municipality on 4th July 2013 and from Kinondoni Municipality on 3rd July 2013.
			N	➢ **Safety Inspection Permit** issued by the Ministry of Labor, Youth Development and Sports: This permit is required for construction and operation phase according to Occupational Health and Safety Act No.5 of 2003. TANESCO will obtain it before construction starts.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			N	➢ **Building Permits** by Dar es Salaam City Council: TANESCO will obtain the building permits to construct substation buildings from Dar es Salaam City Council. This permit is stipulated in the City Council By-law. After making a contact with Contractor, the process for obtaining the permit starts.
			N	➢ **Permission from the Ministry of Infrastructure, to transport heavy loads from the port of entry to the site** (TANROADS overloaded charges are paid to the Ministry of Infrastructure for issuance of road permit to transport the equipment of abnormal weights and sizes.): Contractor will obtain this permit before transporting heavy loads.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	(a) Based on the section 178 of "the Environmental Management Act, 2004" and the Section 17 of "the Environmental Impact Assessment and Audit Regulations, 2005", TANESCO had stakeholder consultations during the course of Environmental Impact Assessment study. It is held four times at the stage of Scoping, Detail survey for preparing ESIA report, Review of ESIA report, and Disclosure process of ESIA report. Following stakeholders were consulted during the EIA study. TANESCO explained outline of the project, potential impact of the project and its mitigation measures at the consultation meetings. ・ Municipal Authorities: Ilala, Kinondoni ・ Tanzania National Roads Agency (TANROADS) ・ The Dar es Salaam Water and Sewerage Authority (DAWASA) ・ Tanzania Telecommunication Company (TTCL) ・ Local Communities: ✓ Mchikichini, Upanga East and Upanga West in Ilala Municipal Council ✓ Makurumla, Kawe, Mzimuni, Kunduchi, Wazo, Msasani, Mabibo, Ubungo, Mikocheni and Makumbusho ward in Kinondoni Municipal Council EIA report will be disclosed to the public. EIA Report Disclosure is the task of the National Environmental Management Council (NEMC) established under section 16 of the Environmental Management Act, 2004. The task is clarified in "PART VIII ACCESS TO ENVIRONMENTAL IMPACT STATEMENTS AND INFORMATION" in the Environmental Impact Assessment and Audit Regulations, 2005.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the	(b)Y	(b) Concerns raised by the participants in the stakeholder consultations are incorporated in the Environmental and Social Management (ESMP) and Monitoring Plans (EMP).

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		project design?		
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) In order to reduce negative environmental and social impacts including land acquisition and displacement, and also overall project costs, while maximizing the outcome of the project, the Team reviewed its original proposal and has proposed alternative options for this project. Following alternatives are compared as shown (see the details in the report). ➢ Alternative 1 (Alt-1) : The original proposal by TANESCO. ➢ Alternative 2 (Alt-2) : Proposed alternative option by the Team. The distribution line from Ilala substation to Muhimbili substation is rerouted to the line from New City Center substation to Muhimbili substation. ➢ Alternative 3 (Alt-3) : No project implementation (Zero option). The zero option of Alt-3 will not solve the existing electrical problems; power disruption, voltage fluctuations and voltage drop by over load. The original proposal by TANESCO of Alt-1 will cause a lot of relocation and might have some minor impact on natural environment. The proposed alternative option of Alt-2 will cause less relocation compared to Alt-1 with no significant negative impact on natural environment. Thus, Alt-2 is most recommended for this project.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	(a) N	(a) Although small earthmoving activities will be expected at Muhimbili substation site, there is hardly any possibility of degradation in downstream basin. Since magnitude of those earthmovings are small scale and countermeasures will be taken against soil erosion during the construction phase.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a	(a) N	(a) The project sites are not located in protected areas.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		possibility that the project will affect the protected areas?		
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are	N	(a)-(f): The project is located in the city area of Dar es Salaam and most of the vegetation and fauna have been lost or displaced due to intensive urban development of residential areas, infrastructures and gardens. There is no special habitat of endangered fauna and flora in the project area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		adequate measures for preventing such impacts considered? (f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?		
	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	(a)N	(a)(b) Altitude of Dar es Salaam is less than 200 m.a.s.l. Area is generally flat to gently undulating plains, slope range 0-3% developed on old alluvial terrace no longer flooded. No major alternations of the local topography or large-scale civil engineering work will occur under the project, making slope failures, landslides or soil runoff highly unlikely.
		(b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	(b)N	
		(c) 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?	(c)Y	(c) The preparation of the substation sites could have an adverse impact on soils through excavation for the foundations of the site. This potential impact will, however, be short-lived on the flat land or temporary since it is expected that exposed areas will be covered quickly by vegetative re-growth to stabilize the soil and minimize erosion. TANESCO will apply erosion control practices such as compaction and early re-vegetation to promote soil conservation.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation?	(a) Y	(a) Acquiring Mawananyamala substation site involves relocation of 62 people, while other substations do not involve resettlement. Since JICA's Grant Aid would contribute to replacing the existing temporal power cable to a

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?		new cable for the transmission line from Ubungo substation to Ilala substation, the project does not involve new land acquisition for this component. Only a few informal houses around Tower No.5 are expected to be the project affected houses by the work space for the transmission line. Since the distribution lines will be constructed within the existing road reserve of TANROADS, Kinondoni Municipality and Ilala Municipality, the construction of distribution line does not involve land acquisition. If there is any building/structure within the road reserve, the distribution line is expected to be installed avoiding them. Thus, the distribution line would not cause resettlement. If there is any people who have to be relocated because of the project, an abbreviated resettlement action plan (ARAP) will be developed to mitigate negative impact as necessary. TANESCO will implement ARAP before the commencement of the construction.
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b)Y	(b) In developing the ARAP, consultation with project affected people will be held. TANESCO will explain resettlement assistance based on the ARAP. The ARAP will be made available to the public for a period of six weeks in the relevant municipal and ward offices as follows: ➢ Newspaper to inform the RAP to public. ➢ Municipal ➢ Regional commissioner 0ffice ➢ Ward office ➢ TANESCO website ➢ Language: Swahili / English
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c)Y	(c) In the course of developing the abbreviated resettlement action plan (ARAP), socioeconomic survey is conducted. Full replacement cost and restoration of livelihoods and living standards will be considered in developing the ARAP.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) Y	(d) According to the Tanzanian law, compensation must be provided prior to displacement. TANESCO will pay compensation prior to the resettlement.
		(e) Are the compensation policies	(e)Y	(e) The ARAP will contain the compensation policies.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		prepared in document?		
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f)Y	(f) In developing the ARAP, existence of such groups will be assessed during socio-economic survey in the proposed site and pay particular attention to their needs if found to be available, especially, women, children and elderly person.
		(g) Are agreements with the affected people obtained prior to resettlement?	(g)Y	(g) In developing the ARAP, agreement with the affected people will be obtained prior to resettlement.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h)Y	(h) In developing the ARAP, the organizational framework will be established to implement resettlement. TANESCO and other responsible organization will secure necessary resource to implement the plan.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i)Y	(i) The ARAP will contain a monitoring plan for its proper implementation.
		(j) Is the grievance redress mechanism established?	(j)Y	(j) In developing the ARAP, the grievance mechanism will be developed.
	(2) Living and Livelihood	(a) 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?	(a)Y	(a) The project will cause involuntary resettlement and it may affect adversely the living conditions of inhabitants. To minimize this impact, the ARAP will be developed and implemented. Construction work could affect access to public services and traffic by the local people. However, the construction works will be done within the limited areas and in short-term. The adverse impact is not serious and is limited. Construction observers will direct local people and traffic passing safely.
		(b) Is there a possibility that diseases, including infectious diseases, such as HIV will be	(b) N	(b) The project do not expect any adverse impact regarding infectious diseases because no massive influx of workers is expected as most labors can be supplied locally for the construction works. However, with the introduction of some migrant workers into the communities along the project sites, mitigation measures will be

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?		considered to minimize the potential risk of spread of sexually transmitted diseases (STD) including HIV/AIDS.
		(c) Is there any possibility that installation of structures, such as power line towers will cause radio interference? If any significant radio interference is anticipated, are adequate measures considered?	(c)N	(c) The new 132kV transmission power cable will be installed on the existing power line towers from Ubungo substation to Ilala substation by replacing current temporal 33kV power cable. Required way leave of 40m width is secured and no radio interference is anticipated. Some informal settlers exist within the way leave, but the way leave will be cleared during the way leave management activity by the transmission department of TANESCO. The planned construction of 33kV distribution line does not expect radio interference which will negatively affect local people.
		(d) Are the compensations for transmission wires given in accordance with the domestic law?	(d)Y	(d) Compensation will be provided based on the ARAP.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no prominent archaeological, historical, cultural or religious site to consider at the project sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) No significant impact is expected on landscape because there are no special natural and cultural landscapes around the project sites. However, some trees will be cut down. The distribution lines will be designed and routed to avoid tall/large trees as much as possible.
	(5) Ethnic Minorities and	(a) Are considerations given to reduce impacts on the culture and	N/A	(a)(b): There are no settlements of ethnic minorities or indigenous people in and along the project sites.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Indigenous Peoples	lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?		
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a)Y	(a) In accordance with relevant laws such as the Occupational Health and Safety Act, 2003; Electricity Ordinance Cap.131, Fire Act no. 3 of 2003, Employment and Labour Relations Act 2004, TANESCO has developed "Health and Safety Policy, revised in 2008" and "Contractors' Occupational Health and Safety Guidelines, revised in 2011."The project will follow these policy and guidelines.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b)Y	(b) Safety rules, protection code & safe working practice are in place in line with TANESCO's Health and Safety Policy and adhered to during project implementation.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c)Y	(c) Upon being awarded a contract to work within TANESCO controlled premises, the Contractor will prepare a Contractor's Occupational Health and Safety Management Plan, including details of occupational health and safety procedures to prevent accidents and other OHS related incidents. In this Contractor's OHS Management Plan, the Contractor is also required to include a Disaster and Emergency Response Plan. This plan will detail the emergency measures and procedures that the Contractor has put in place for their own employees. The Contractor's Occupational Health and Safety Management Plan must be approved by TANESCO before the contractor commences work. In addition to the Contractor's Occupational Health and Safety Management Plan that Contractors will submit prior to commencement of work, regular OHS audits which will be conducted by the

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				Contractor and their records kept.
		(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d)Y	(d) Security guards on the project shall be trained on appropriate measures to take in handling and dealing with the general public. This shall be included in regular safety communications to be done by the contractor.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a) Y	(a) According to TANESCO's Health and Safety Policy and Contractors' Occupational Health and Safety Guidelines, the Contractor will prepare a Contractor's Occupational Health and Safety Management Plan, including details of occupational health and safety procedures to prevent accidents and other OHS related incidents. The Contractor shall abide by all environmental concerns according to the requisite of environmental laws and the Environmental Impact Assessment (EIA). The Contractor will be given a copy of any relevant EIAs that have been conducted by TANESCO or other entities. Prior to beginning any work activity, a Site-Specific Environmental Management Plan should be completed by the Contractor to determine if adequate measures are in place to prevent and manage environmental likely environmental impacts. TANESCO will issue guidelines for the preparation of the Contractor's Site-Specific Environmental Management Plan.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b)N	(b) The project site is located in city area of Dar es Salaam and little adverse impact on natural environment is expected. However, an environmental officer will be assigned to the project to monitor project construction activities to ensure impacts are mitigated.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c)Y	(c)The construction activities can affect neighboring shops, residents and schools. According to TANESCO's Contractors' Occupational Health and Safety Guidelines, contractor shall abide by all mitigation measures based on good practice, professionalism and as specified in the Site-Specific Environmental Management Plan, Environmental Impact Assessment (EIA), and/or Environmental Impact Audit.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are	(a)Y	(a) As part of the environmental assessment process, an Environmental and Social Monitoring Plan will be prepared and it will be implemented by TANESCO.

<table>
<tr><th>Category</th><th>Environmental Item</th><th>Main Check Items</th><th>Yes: Y
No: N</th><th>Confirmation of Environmental Considerations
(Reasons, Mitigation Measures)</th></tr>
<tr><td></td><td></td><td>considered to have potential impacts?</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(b) What are the items, methods and frequencies of the monitoring program?</td><td>(b)Y</td><td>(b) Items, methods and frequencies of monitoring will be included in the Environmental and Social Monitoring Plan. In accordance with the project implementation, necessary monitoring should be undertaken with defined frequency and timing during construction and operation stages. Project monitoring activities focus on significant environmental and social concern as follows (provisional):
➢ Construction stage
<table><tr><td>Item</td><td>Permit, Waste, Resettlement, Existing infrastructure, Accident</td></tr><tr><td>Frequency</td><td>Every month</td></tr><tr><td>Responsible for monitoring</td><td>TANESCO and Contractor</td></tr><tr><td>Reporting</td><td>TANESCO will report to NEMC and JICA</td></tr><tr><td>Disclosure</td><td>Result of monitoring will be disclosed to the public.</td></tr></table>➢ Operation stage
<table><tr><td>Item</td><td>Waste, Soil and groundwater contamination, Noise</td></tr><tr><td>Frequency</td><td>Every month for 6 months after construction</td></tr><tr><td>Responsible for monitoring</td><td>TANESCO</td></tr><tr><td>Reporting</td><td>TANESCO will report to NEMC and JICA</td></tr><tr><td>Disclosure</td><td>Result of monitoring will be disclosed to the public.</td></tr></table></td></tr>
<tr><td></td><td></td><td>(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?</td><td>(c)Y</td><td>(c) Monitoring framework will be established in developing the Environmental and Social Monitoring Plan.</td></tr>
<tr><td></td><td></td><td>(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the</td><td>(d)Y</td><td>(d) According to the Environmental Impact Assessment and Audit Regulations, 2005, National Environmental Management Council (NEMC) will give order to TANESCO for submission of the monitoring reports, if necessary.</td></tr>
</table>

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		format and frequency of reports from the proponent to the regulatory authorities?		

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Outline of the Project

2-1-1 Overall objectives and Project purpose

While Tanzania has recorded economic growth rates in excess of 6% per annum with vitalized economic activity, power demand expansion is outpacing economic growth. Due to facility enhancements in response to growing power demands and insufficient maintenance for existing equipment and facilities, many existing equipment and facilities are deteriorating. Response to the increased demands has resulted in a chronic overload, with decreased power quality, frequent outages and other major obstacles to social and economic activity.

This project aims to develop and enhance power transmission, distribution and substation facilities in Dar es Salaam based on the aforementioned Power System Master Plan in order to support economic growth in the city and develop stable power supply and infrastructure. This shall contribute to improve the chronic overloads from enhanced transmission and distribution capacities and to reduce power outages, transmission losses and voltage drop rates.

2-1-2 Outline of the Project

To achieve the overall objectives, this project shall procure and install the equipment and materials needed to repair and build new transmission, distribution and substation facilities, as well as build all related facilities in Dar es Salaam, Tanzania's largest commercial city. This shall contribute to improve the chronic overload and quality of power supply, enable power supply to new consumers, and vitalize city economic activity and operation of schools, hospitals and other public facilities.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

The Project scope was centered on consumers in Kinondoni and Ilala regions in Dar es Salaam. The Project shall enhance key substations needed for stable, more reliable power supply and expand existing substations and build new substations urgently needed to cover increased demands, as well as procure and install the equipment and materials for maintaining the transmission and distribution lines for these facilities. It aims to satisfy power demand forecast for the target year, set 10 years from start of service for project facilities.

Also, designs for new substations shall take into account the safety of local residents, landscapes and other environmental and social considerations.

2-2-1-2 Plan for Natural Conditions

(1) Temperature Conditions

The average annual maximum and minimum temperatures for the Project area are 31.4˚C and 22.1˚C, respectively. Mornings are humid at an average relative humidity of 82%, while afternoons are relatively more livable at 61.8%.

Power supply facilities used under the Project shall account for the above temperatures and relative humidity. Care shall also be taken such that the equipment shall operate properly with no obstacles to O&M in the external air temperatures, temporary temperature increases from direct sunlight and high humidity.

(2) Rainfall and Lightning

Annual rainfall for the Project area averages roughly 1,000 mm. By month, rainfall amounts are concentrated in the heavy rains from March to May, with another lighter rainy season with relatively more rainfall in November and December. These rainy periods shall be fully accounted for when forming outdoor work schedules for equipment installation, civil and construction works in the Project construction plans.

There is also lightning during rainy periods. With the risk of lightning striking towers during overhead transmission and distribution line work, lightning shall be properly accounted for in work schedules involving such work. Transmission lines and substation facilities must also be equipped with sufficient protection against lightning surges from power lines.

(3) Wind

The Dar es Salaam record for maximum wind speed is relatively low at 45 knots per hour (approx. 23.15 m/s).

(4) Salt Damage

The Project area is located within 5 kilometers of the coast and thus includes measures against salt damage.

2-2-1-3 Plan for Socioeconomic Conditions

This project is in urban area along trunk roads with heavy traffic and near residential areas. Phone, water, sewage and other infrastructural facilities are also buried where the distribution poles shall be constructed. Thus, to the extent possible, work should not interfere with local residents and traffic or obstruct existing structures and buried objects. Distribution line design shall also maintain safe separation distances from nearby residences and stores along road boundaries.

2-2-1-4 Plan for Construction Conditions

Dar es Salaam has good construction conditions. There is much large-scale construction activity for

various commercial facilities and office buildings and multiple general contractors which handle such construction work, including electrical contractors. Thus, the project construction plan utilizes local contractors. Local procurement should be an option for Labors, transportation vehicles and construction equipment. From orders received, local subcontractors should also be an option for project substation construction as well as general workers for substation construction, civil engineering and construction, and power line construction.

However, highly skilled engineers are needed during equipment installation and for post-installation adjustments and testing, so local contractors cannot be used for anything besides Labors. Japanese engineers shall be sent to fulfill these roles.

Locally procured materials shall be used to the extent possible in the interest of nurturing the local industry. The aggregate, cement, rebar and other civil works and construction materials can be procured locally in Tanzania. However, the substation facilities as well as transmission and distribution equipment and materials needed for the Project are not manufactured locally. Such equipment shall be procured from Japan or third countries, accounting for factors such as past introduction of existing equipment and Tanzanian O&M capacity.

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

The project construction plan utilizes local contractors for substation construction, civil engineering and construction and power line construction. Labors, transportation vehicles and construction materials and equipment can be procured locally with relative ease.

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

TANESCO has experience with a number of cooperation projects with other donors and similar scale power projects with Japan's Grant Aid, including a project for the reinforcement of transmission and distribution facilities in Dar es Salaam completed in October 2010. They also have experience in O&M for substation, transmission and distribution facilities provided to Tanzania by past Japanese grant aid. TANESCO is considered capable in terms of O&M for substations, transmission and distribution facilities and shall handle O&M for such power supply facilities scheduled to be developed and procured in the Project.

However, TANESCO does have financial difficulties. These difficulties delay updates to substation, transmission and distribution equipment in aging facilities and impair procurement of expensive replacement and spare parts, resulting in overloading, electrical accidents and outages. TANESCO training plans for its engineers and operators is also considered insufficient; engineers do not possess sufficient knowledge or skill regarding recently introduced substation, transmission and distribution facilities. Proper O&M skill shall be transferred by Japanese engineers to TANESCO engineers during the Project. Japanese engineers shall train local engineers on O&M for power supply facilities on the job during the construction period, and Japanese side shall also provide O&M manuals. Japanese side shall also provide the minimum required spare parts and testing equipment for more effective, more efficient facility O&M.

JICA has a technical cooperation project called the Project for Capacity Development of Efficient Distribution and Transmission Systems, scheduled for five years from 2009. For this TCP, JICA conducts technical training for TANESCO engineers, electricians and technicians working with transmission and distribution systems, produces training materials and trains instructors. Also targeting engineers in regional offices, the training is anticipated to build O&M capacity for transmission and distribution facility engineers at TANESCO, who shall be in charge of O&M after project completion.

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

The following basic plan for the scope and skill levels for project equipment and material procurement and installed facility construction has been formulated in light of the conditions given above.

(1) Planned Scope for Facilities and Equipment

The Project shall develop power supply facilities to supply stable power to social and public facilities and residents living in the Project area, based on power demand forecasts for the target year 2025. The Japanese side shall procure and install the essential facilities, with the Tanzanian side responsible for equipment it can procure and install to encourage Tanzania to continue O&M of power supply facilities by itself.

In order to keep the designs economical, equipment specifications shall use standard products conforming to international standards when possible. They are compatible with existing facilities and equipment when selecting the configuration and specifications for essential equipment. Still, Dar es Salaam power demands are expected to be revised further upward in the future. Thus, in consideration of the future power demands, it is important to discuss equipment configurations and specifications with some margin built in.

Essential facilities for the collectively selected equipment and facilities shall be built.

(2) Plan for Setting Grades

Care shall be taken not to deviate from the technical levels of TANESCO when designing the power supply facilities procured and installed in the Project, conforming to existing facility configurations, TANESCO technical standards and construction manuals.

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

The Project consists of multiple sites (substations) and shall hang distribution and transmission lines spanning a respective 17.2km and 7.5km simultaneously, involving forced power outages in the economic and industrial centers of the city. Work teams need to be formed appropriately, the construction methods used need to be well known to local contractors and engineers, and a management system must be put in place so that work progresses safely and swiftly.

2-2-2 Basic Plan

2-2-2-1 Procurement of Equipment and Installation Plan

Table 2-2-2-1.1 Procurement of Equipment and Installation Plan

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
Procurement of Equipment and Installation Plan	1. Reinforcement of Ilala Substation (132/33/11 kV) and 132 kV Transmission line (approximately 7.5 km)	
	(1) Equipment to be supplied and installed for Reinforcement of Ilala Substation	
	1) 132 kV Circuit Breakers (CB), Disconnecting Switches (DS) (including modification material of the existing DS), Current Transformers, Lightning Arresters, Busbar materials for extension and other necessary materials	1 lot
	2) 60 MVA,132/33 kV Transformer	2 sets
	3) 315 kVA, 33/0.4-0.23 kV Station Service Transformer	2 sets
	4) 33 kV Switchgear (Indoor type, Protection relays mounted)	24 panel
	5) 11 kV Switchgear (Indoor type, Protection relays mounted)	20 panel
	6) Control System (Micro SCADA system)	1 lot
	7) Metering Panel (Watt-hour meters)	1 lot
	8) Transformer Voltage Regulating Panel (132/33 kV and 33/11 kV Transformers)	1 lot
	9) Protection Panels (132/33 kV and 33/11 kV Transformer Protection, 132 kV Transmission Line Protection)	1 lot
	10) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	11) Uninterruptible Power Supply System	1 lot
	12) AC Distribution Panels	1 lot
	13) 33 kV Lightning Arresters	30 phase
	14) 11 kV Lightning Arresters	45 phase
	15) 33 kV and 11 kV Cables	1 lot
	16) Other materials (Low Voltage Cables, Earthing materials and others)	1 lot
	17) New Control Building (Approximately 1,013 m^2, Single story)	1 lot
	18) Substation Civil Works (Roads in Substation, Oil Separator, Equipment Foundations, Cable trenches and others)	1 lot
	19) Modification Works at Ubungo Substation (Replacement of 132 kV CTs and Overhead Bypass Conductors, and others)	1 lot
	(2) Materials to be supplied and installed for Reinforcement of 132 kV Transmission Line	
	1) Double circuits of Transmission lines (TACSR 240 mm^2)	Approx. 7.5 km
	2) Insulators	1 lot
	3) Accessories	1 lot
	2. Expansion of Msasani Substation (33/11 kV) and Construction of 33 kV Distribution Line (Approximately 7.6 km)	
	(1) Equipment to be supplied and installed for Extension of Msasani Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	5 panel
	5) 11 kV Switchgear Panel (Outdoor type, for extension of existing Switchgears)	1 lot
	6) Control System (Micro SCADA system)	1 lot
	7) Metering Panel (Watt-hour meters)	1 lot
	8) Transformer Voltage Regulating Panel	1 lot
	9) AC Distribution Panel	1 lot
	10) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	11) 33 kV Lightning Arresters	6 phase
	12) 11 kV Lightning Arresters	12 phase
	13) 33 kV and 11 kV Cables	1 lot
	14) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	15) New Control Building (Approximately 169 m^2, Single story)	1 lot
	16) 33 kV Switchgear Panels (for Makumbusho Substation)	1 lot
	17) Modification works of Control panels and metering panels (for Makumbusho Substation)	1 lot
	18) 33 kV Cables (for Makumbusho Substation)	1 lot

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot
	3. Construction of Muhimbili Substation (33/11kV) and 33kV Distribution Line (Approximately 2.0 km)	
	(1) Equipment to be supplied and installed for Construction of Muhimbili Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot
	4. Construction of Jangwani Beach Substation (33/11 kV) and 33 kV Distribution Line (Approximately 6.5 km)	
	(1) Equipment to be supplied and installed for Construction of Jangwani Beach Substation	
	1) 15 MVA, 33/11 kV Transformer	1set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	15) 33 kV Switchgear Panels (for Tegeta Substation)	1 lot
	16) Modification works of Control panels and metering panels (for Tegeta Substation)	1 lot
	17) 33 kV Cables (for Tegeta Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot

	The Project for Rehabilitation of Substations and Construction of New Lines and Substations in Dar es Salaam	Q'ty
	5. Construction of Mwananyamala Substation (33/11 kV) and 33 kV Distribution Lines (Approximately 1.1 km)	
	(1) Equipment to be supplied for Construction of Mwananyamala Substation	
	1) 15 MVA, 33/11 kV Transformer	1 set
	2) 50 kVA, 33/0.4-0.23 kV Station service Transformer	1 set
	3) 33 kV Switchgear Panel (Indoor type, Protection relays mounted)	3 panel
	4) 11 kV Switchgear Panel (Indoor type, Protection relays mounted)	4 panel
	5) Control System (Micro SCADA system)	1 lot
	6) Metering Panel (Watt-hour meters)	1 lot
	7) Transformer Voltage Regulating Panel	1 lot
	8) AC Distribution Panel	1 lot
	9) DC Supply System (Batteries, Chargers and DC Distribution Panels)	1 lot
	10) 33 kV Lightning Arresters	6 phase
	11) 11 kV Lightning Arresters	12 phase
	12) 33 kV and 11 kV Cables	1 lot
	13) Other Materials (Low Voltage Cables, Earthing materials and others)	1 lot
	14) New Control Building (Approximately 169 m^2, Single story)	1 lot
	15) 33 kV Switchgear Panels (for Makumbusho Substation)	1 lot
	16) Modification Works of Control panels and metering panels (for Makumbusho Substation)	1 lot
	17) 33 kV Cables (for Makumbusho Substation)	1 lot
	(2) Materials to be supplied and installed for Construction of 33 kV Distribution Line	
	1) 33 kV Distribution Line (ACSR 150 mm^2)	1 lot
	2) Grounding Wires (AAC 30 mm^2)	1 lot
	3) Steel Poles	1 lot
	4) Insulators	1 lot
	5) Accessories	1 lot
	6) Earthing Materials	1 lot
Procurement Plan	(1) Spare Parts, Testing Equipment and Maintenance Tools	1 lot

2-2-2-2 Dar es Salaam Power Demand Forecast and Power System

Dar es Salaam power demand as used in the Project is estimated based on the Power System Master Plan (2012 Update, hereinafter the PSMP) formulated by the Tanzanian government. Table 2-2-2-2.1 below gives the Dar es Salaam power demand forecast from the PSMP, but subdivided estimates are required due to system analysis in the study.

Table 2-2-2-2.1 Dar es Salaam power demand forecast from the PSMP

Units: MW

Area	Substation Load Distribution Along 2015/2020/2025				
	Bus No.	Bus Name	2015	2020	2035
Dar es Salaam	5189	Ubungo-2		321.32	646.36
	5190	Ubungo-1	248.51	175.41	188.91
	5218	Ubungo 33	62.04	93.05	100.20
	5205	Chalinze 33	4.34	6.50	7.01
	5207	Ilala 33	75.49	113.22	121.93
	5210	Mtoni	20.24	30.36	32.70
	5217	Mlindizi 33	13.45	20.17	21.72
	5247	F zone1	124.74	51.40	55.36
	5248	F zone2	94.21	38.82	41.81
	5250	F zone3	32.36	13.34	14.37
	5294	Kunduchi 33	91.34	37.63	40.53
	5709	Dar-2		126.53	436.55
	5709	Dar-2		68.31	115.73
		Total	766.72	1096.06	1823.18

Source: Power System Master Plan (2012 Update)

The Study Team obtained the records for power demand in Dar es Salaam by region from TANESCO for the past five years back to 2009. Tables 2-2-2-2.2 up to 2-2-2-2.5 give the obtained demand results and PSMP demand forecast.

Table 2-2-2-2.2 Dar es Salaam power demand by region (2012)

(Unit:MW)

		2012												Peak	Rate
Peak Demand		1	2	3	4	5	6	7	8	9	10	11	12		
1	Power System Master Plan (2012)													490.1	
2	Zonal														
	Dar es Salaam	376.0	364.3	369.1	360.6	341.3	368.4	350.1	350.0	376.1	385.4	389.0	408.1	408.1	
3	Regional														
	Kinondoni North	120.2	111.7	165.0	117.5	106.2	101.7	107.2	119.0	114.3	117.0	108.0	100.0	165.0	31%
	Kinondoni South	120.0	114.9	114.9	110.3	99.7	63.0	69.2	56.0	87.8	52.6	52.6	78.2	120.0	22%
	Ilala	182.0	182.0	157.4	156.0	149.3	162.6	150.0	152.0	158.8	0.0	182.0	174.4	182.0	34%
	Temeke	66.2	66.2	66.2	66.3	66.3	66.3	67.5	66.3	67.9	67.8	67.8	69.5	69.5	13%
														536.5	100%

Source: Created based on materials from TANESCO

Table 2-2-2-2.3 Dar es Salaam power demand by region (2011)

(Unit:MW)

		2011												Peak	Rate
Peak Demand		1	2	3	4	5	6	7	8	9	10	11	12		
1	Power System Master Plan (2012)													485.1	
2	Zonal														
	Dar es Salaam	348.1	331.2	363.7	374.8	335.8	330.6	373.3	376.7	350.9	379.5	379.8	426.6	426.6	
3	Regional														
	Kinondoni North	108.1	119.0	97.7	97.9	96.3	100.9	92.6	128.1	129.6				129.6	27%
	Kinondoni South	53.3	85.9	86.9	70.0	62.5	81.1	80.0	91.7	90.0				91.7	19%
	Ilala	193.0	171.0	184.0	125.0	170.0	169.0	155.7	150.7	161.2				193.0	40%
	Temeke	64.3	65.0	65.0	65.0	65.0	66.2	66.2	66.2	66.2				66.2	14%
														480.5	100%

Source: Created based on materials from TANESCO

Table 2-2-2-2.4 Dar es Salaam power demand by region (2010)

(Unit:MW)

		2010												Peak	Rate
Peak Demand		1	2	3	4	5	6	7	8	9	10	11	12		
1	Power System Master Plan (2012)													472.6	
2	Zonal														
	Dar es Salaam	350.4	361.2	370.3	373.0	346.0	339.0	369.0	344.0	337.0	371.0	360.0	359.6	373.0	
3	Regional														
	Kinondoni North	120.0	121.0	119.0	119.0	100.0	85.7	82.0	86.4	135.0	92.6	98.2	99.4	135.0	23%
	Kinondoni South	65.0	90.4	90.0	53.9	50.0	53.7	42.2	52.0	50.1	48.3	96.6	90.1	96.6	16%
	Ilala	218.9	219.1	222.8	215.6	207.3	300.0	208.0	200.0	192.0	202.7	201.5	184.1	300.0	50%
	Temeke	65.0	65.0	62.0	64.0	64.0	64.2	64.2	64.2	64.3	64.3	64.3	64.3	65.0	11%
														596.6	100%

Source: Created based on materials from TANESCO

Table 2-2-2-2.5 Dar es Salaam power demand by region (2009)

(Unit:MW)

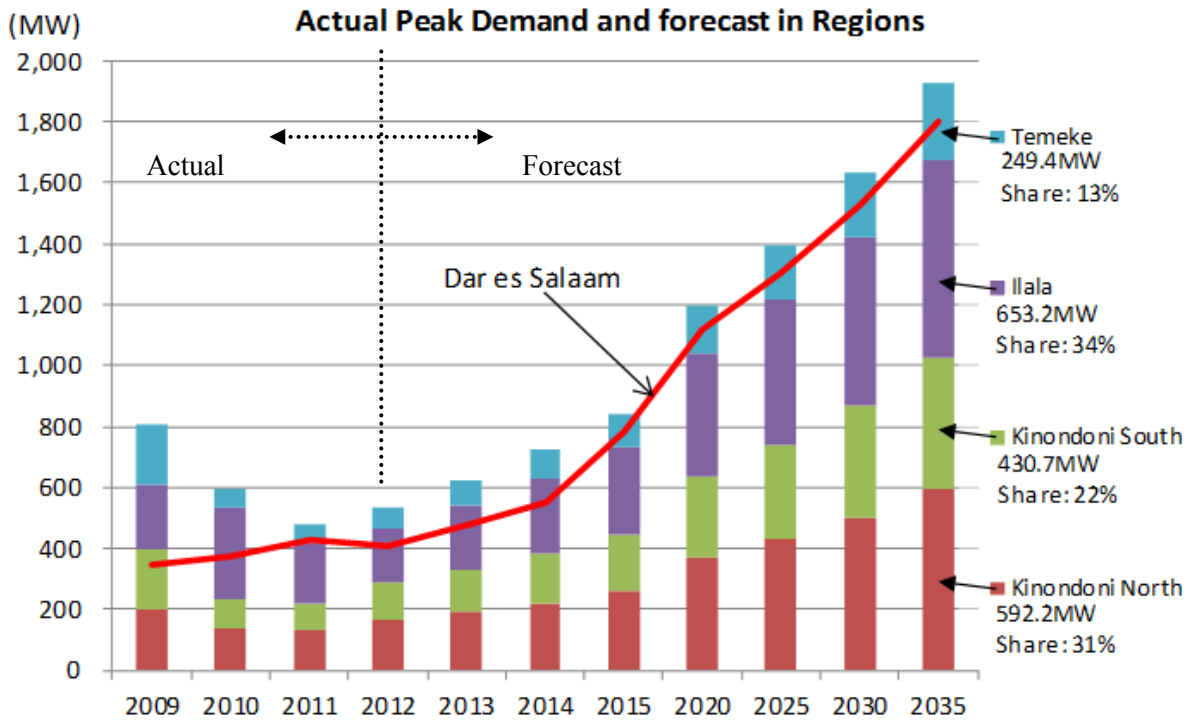
		2009												Peak	Rate
Peak Demand		1	2	3	4	5	6	7	8	9	10	11	12		
1	Power System Master Plan (2012)													373.0	
2	Zonal														
	Dar es Salaam	311.4	323.0	324.7	321.4	344.6	331.6	326.0	325.5	320.3	322.5	350.1	356.6	356.6	
3	Regional														
	Kinondoni North		197.0		96.0	96.0	96.0	96.0	97.1	96.0		106.0	118.4	197.0	24%
	Kinondoni South		197.0	72.0	68.3	70.0	70.0	72.6	80.0	64.5		65.0	65.0	197.0	24%
	Ilala		197.0		199.0	201.0	184.5	176.0	173.1	191.6		209.1	215.3	215.3	27%
	Temeke		197.0	62.5	61.8	61.8	63.0	62.5	62.0	62.8		66.0	65.0	197.0	24%
														806.3	100%

Source: Created based on materials from TANESCO

Note that the total for peak demand values by region are greater than the overall peak demand value for Dar es Salaam as the regional peak demand values differ from day to day. Power demand forecast in the study divide PSMP peak demand values among the substations.

Proportions for each regional allotment are taken from the latest figures in 2012. Applying PSMP power estimates up to 2035 yields Figure 2-2-2-2.1. Power demand forecast from the study are given in Table 2-2-2-2.6.

Figure 2-2-2-2.2 is a power system diagram for Dar es Salaam.



Source: Created based on materials from TANESCO

Figure 2-2-2-2.1 Power demand forecast up to 2035 (by region in Dar es Salaam)

Table 2-2-2-2.6 Power demand forecast up to 2035

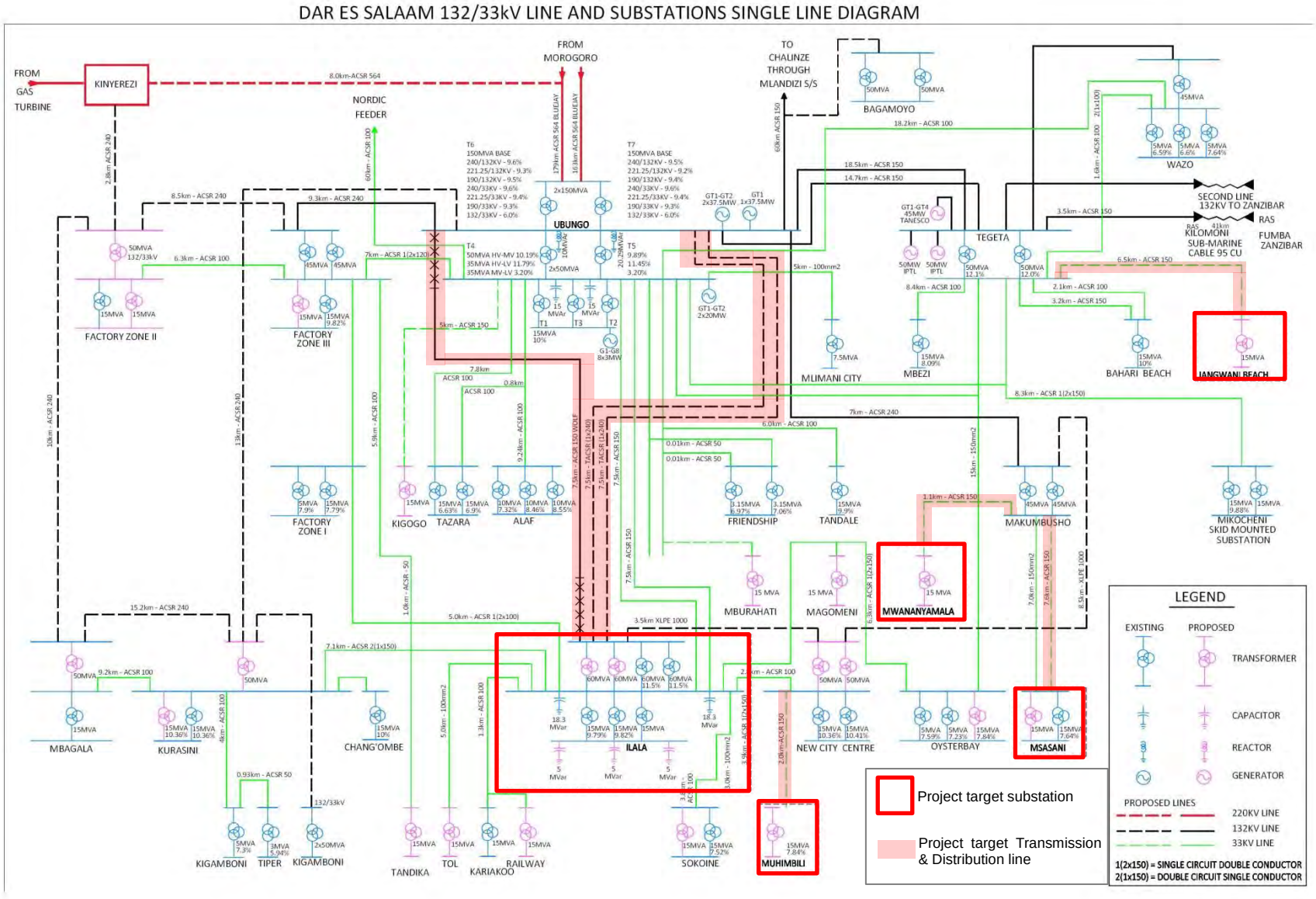
Power Factor of Load: 0.9　　Unit　P: MW　Q: MVar　S: MVA

Demand Forecast beased on Power System Master Plan 2012 Update									2015					2020					2025					2030					2035				
Demand Forecast for Dar es Salaam						Voltage(kV)			784					1,120					1,305					1,526					1,802				
Region	Name of Bus	Total Capacity			Remarks	Bus	Pri.	Sec.	Total	Share	P	Q	S	Total	Share	P	Q	S	Total	Share	P	Q	S	Total	Share	P	Q	S	Total	Share	P	Q	S
Kinondoni North	Makumbusho 33kV	45MVA	×	2	*1	132	132	33	241	10%	81	39	90	344	10%	115	56	128	401	10%	134	65	149	469	10%	157	76	175	554	10%	186	90	206
	Msasani 11kV	15MVA	×	2		33	33	11	30.75%	2%	16	8	17	30.75%	2%	22	11	25	30.75%	2%	26	13	29	30.75%	2%	31	15	34	30.75%	2%	36	17	40
	Mwananyamala 11kV	15MVA	×	1		33	33	11		1%	8	4	9		1%	11	5	12		1%	13	6	14		1%	15	7	17		1%	18	9	20
	Tegeta (Kunduchi) 33kV	50MVA	×	2	*2	132	132	33		10%	76	37	85		10%	109	53	121		10%	127	62	141		10%	149	72	165		10%	176	85	195
	Jangwani Beach 11kV	15MVA	×	1		33	33	11		1%	8	4	9		1%	11	5	12		1%	13	6	14		1%	15	7	17		1%	18	9	20
	Mtoni 132kV	30MVA 25MVA	× ×	2 1		132	132	33		7%	53	25	58		7%	75	36	83		7%	87	42	97		7%	102	50	114		7%	121	58	134
Kinondoni South	Ubungo 33kV	–	–	–		132	132	33	175 22.37%	20%	154	74	171	250 22.37%	20%	220	106	244	292 22.37%	20%	256	124	284	341 22.37%	20%	299	145	333	403 22.37%	20%	353	171	393
	Chalinze 33kV	15MVA	×	1		132	132	33		1%	8	4	9		1%	11	5	12		1%	13	6	14		1%	15	7	17		1%	18	9	20
	Mlindizi 33kV	10MVA	×	2		132	132	33		2%	14	7	15		2%	20	9	22		2%	23	11	25		2%	27	13	30		2%	32	15	35
Ilala	Ilala 33kV	60MVA	×	4		132	132	33	266	14%	110	53	122	380	14%	157	76	174	443	14%	183	88	203	518	14%	214	103	237	611	14%	252	122	280
	Ilala 11kV	15MVA	×	3		33	33	11	33.92%	3%	24	11	26	33.92%	3%	34	16	37	33.92%	3%	39	19	43	33.92%	3%	46	22	51	33.92%	3%	54	26	60
	Factory Zone 2 33kV	50MVA	×	1		132	132	33		3%	24	11	26		3%	34	16	37		3%	39	19	43		3%	46	22	51		3%	54	26	60
	Factory Zone 3 33kV	45MVA	×	2	*3	132	132	33		6%	46	22	52		6%	66	32	74		6%	77	37	86		6%	90	44	100		6%	107	52	119
	Factory Zone 1 33kV	15MVA	×	3	*4	33	33	11		2%	16	8	17		2%	22	11	25		2%	26	13	29		2%	31	15	34		2%	36	17	40
	New City Center 33kV	50MVA	×	2	*5	132	132	33		5%	39	19	44		5%	56	27	62		5%	65	32	72		5%	76	37	85		5%	90	44	100
	Muhimbili 11kV	15MVA	×	1		33	33	11		1%	8	4	9		1%	11	5	12		1%	13	6	14		1%	15	7	17		1%	18	9	20
Temeke	Kurasini 33kV	50MVA	×	1		132	132	33	101	6%	47	23	52	145	6%	67	33	75	169	6%	78	38	87	198	6%	92	44	102	233	6%	108	52	120
	Mbagala 33kV	50MVA	×	1		132	132	33	12.95%	7%	54	26	61	12.95%	7%	78	38	86	12.95%	7%	91	44	101	12.95%	7%	106	51	118	12.95%	7%	125	61	139
								Total		100%	784	380	871		100%	1,119	542	1,244		100%	1,305	632	1,450		100%	1,526	739	1,695		100%	1,801	872	2,002

*1:Except for Msasani and Mwananyamala
*2:Except for Jangwani Beach
*3:Except for Factory Zone 1
*4:Supplied from Factory Zone 3
*5:Except for Muhimbili

Project target year

Source: Created based on materials from TANESCO



Source: Created based on data from TANESCO

Figure 2-2-2-2.2 Dar es Salaam power system diagram

2-2-2-3 Power System Analysis

(1) Study Objectives for Power System Analysis

Besides there being multiple power systems, power production and consumption must continually be balanced. Power supply facilities in Dar es Salaam are currently developed according to the PSMP. Coupled with plans to construct large thermal power plants and other factors, short-circuit capacity for the Dar es Salaam power system should increase. In the present study, power flow analysis for development of these facilities was conducted. Short-circuit current for circuit breakers and other major equipment shall be set to reflect this in outline design.

(2) Basic Plan for Power Flow Analysis

1) Scope

Radial Power Distribution System in Dar es Salaam is set to the end connection.

2) Sections for analysis

Peak sections for 2015, 2020 and 2025.

3) Confirmation of secured power supply facilities with power flow calculations

Power Flow analysis shall be performed for each section using system analysis software PSS/.E Ver. 33 to study the effects on Project flow improvements and considerations for future transmission and distribution facility plans.

Note that once project scope has been clarified, it shall be clarified which transmission and distribution lines are critical to be commissioned and make possible recommendations to the Tanzanian side to manifest the effects as planned.

4) Maintain proper voltage

Power flow analysis for heavy and light loads shall be performed in 2015, 2020, and 2025 (target year section) to calculate bus voltages and verify need for capacitor banks in the Project.

5) Confirmation of rated short circuit current exceeding ratings of circuit breakers with short circuit current calculations

Three-phase short circuit current in each bus for 2015, 2020 and 2025 (target year section) shall be calculated to evaluate and review rated short-time current for the Project circuit breaking equipment.

Figure 2-2-2-3.1 shows the flow from the performed power system analyses.

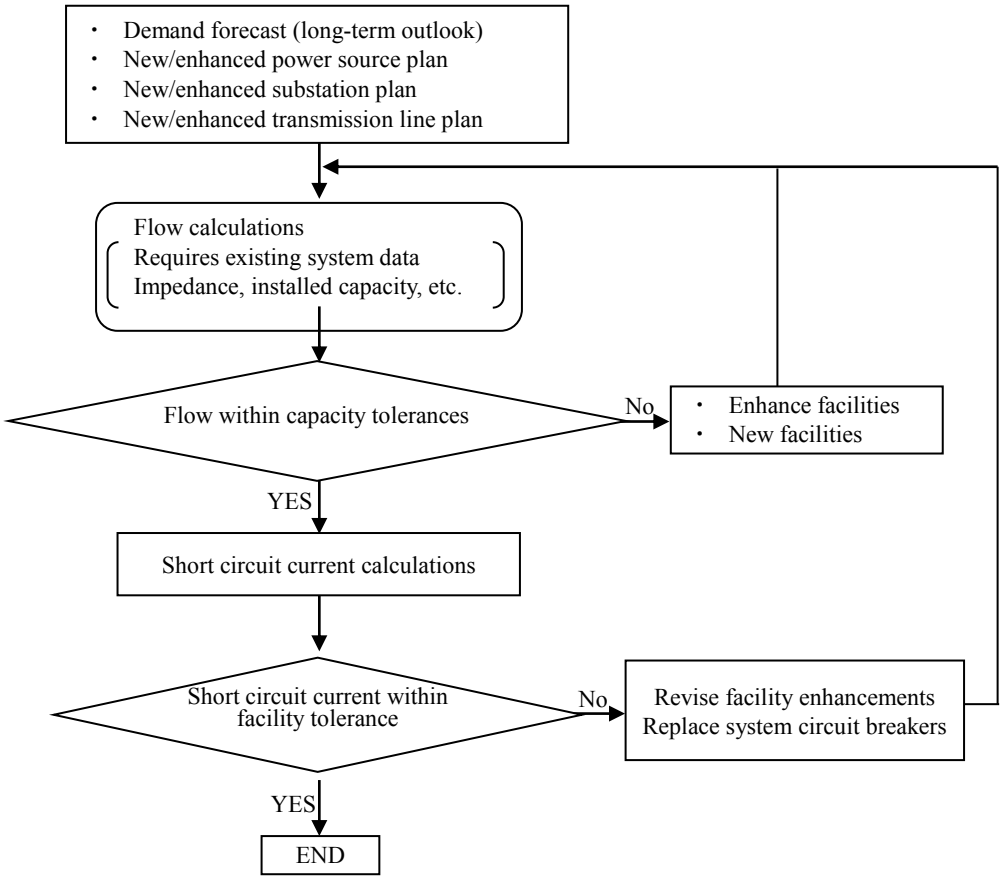


Figure 2-2-2-3.1 Work flow for power system analysis

(3) Analysis Prerequisites

1) The outputs for each substation are set as given below.

Table 2-2-2-3.1 Outputs for each substation

	Nominal Voltage	2015	2020	2025
	kV	P (MW)	P (MW)	P (MW)
Ubungo	132	312.47	312.47	312.47
Kinyerezi	132	312.00	552.10	552.10
Tegeta	132	114.42	114.42	114.42

2) The loads for each bus are set according to the power demand forecast up to 2035 as given in Table 2-2-2-2.6.

3) If the bus voltages deviate from their adjustment ranges of 0.95 to 1.05 per unit, the next step shall be adjusting voltage with a transformer tap. Transformer taps in voltage adjustment can change the adjustable range by ±10%. This precondition is adapted in order to make the result of analysis easier though voltage dead-band for tap-changing, which is approximately less than 0.5%, is different from the actual operation.

4) The load power factor shall be 0.9, but in the study 0.86, the power factor confirmed in

materials collected in a study requested by the Tanzanian side on need for 11 kV capacitor banks at Ilala substation.

5) The system configuration shall set the 132kV transmission line between New City Center and Makumbusho substation and between Factory Zone 3 and Factory Zone 2 substation to "open". Even though 132kV transmission lines between substations compose a loop system to improve reliability, open-loop system is adapted in this analysis because, in case of a loop system in high load factor, it might become overloaded in order not to control shunt current well, and ratio of the shunt current changes by transition of the load factor that is unfavorable operation.

(4) Analysis Procedure

1) Analyze for the target year with a load power factor of 0.86 and review the need for capacitor banks.

2) If needed, connect capacitor banks to the Ilala substation and analyze.

3) Perform a power flow analysis for each section in 2015, 2020 and 2025 with power factor of 0.9 based on the results of steps 1) and 2).

(5) Analysis Data

Analysis normally requires existing data on transmission and distribution lines, transformers and generators. As data is incomplete for this plan, data from field studies shall be used in the analysis. Items with unknown line specifications, line placements and generator data shall be calculated with constant numbers of similar items and standard line arrangement conditions.

1) Transmission and distribution line data
Line constants for each transmission and distribution line shall be calculated and used based on locally obtained materials and the PSMP.

2) Transformer data
Set based on locally obtained materials, the PSMP and power system analysis data prepared by TANESCO.

3) Generator data
Set based on locally obtained materials, the PSMP and existing generator data and rated to 80% of maximum generator output.

(6) Analysis and the result

1) Review for necessity of 11kV Capacitor Banks at Ilala substation

Figure 2-2-2-3.2 shows the result of power flow with 0.86 load power factor in 2025 without 11kV capacitor banks at Ilala substation and Figure 2-2-2-3.3 shows the result of power flow with 0.86 load power factor in 2025 with 11kV capacitor banks at Ilala substation.

The 11kV bus voltage at Ilala substation indicates 10.484kV and the load at 132/33kV transformer indicates 62.5MVA at the Project target year 2025. Though the voltage value is within positive and negative 5%, it should be desired to avoid unstable voltage fluctuation on the heavy load. Because voltage drop is higher with large reactive power at power transformer, it is also desired to achieve and operative effect by reducing reactive power at power transformer since the effect is lighter by changing tap voltage. In addition, it is not recommended to operate 132/33kV transformer with 4% overload.

On the other hand, the 11kV bus voltage at Ilala substation recovers up to 10.761kV by using 11kV capacitor banks and the load at 132/33kV transformer indicates 60.7MVA at the Project target year 2025. This is around 1% overload and it might be able to endure continuous operation.

In order to expect multiplier effect in terms of saving transformer capacity and saving voltage drop with reduced reactive power, it is considerable to install 11kV capacitor banks at Ilala substation.

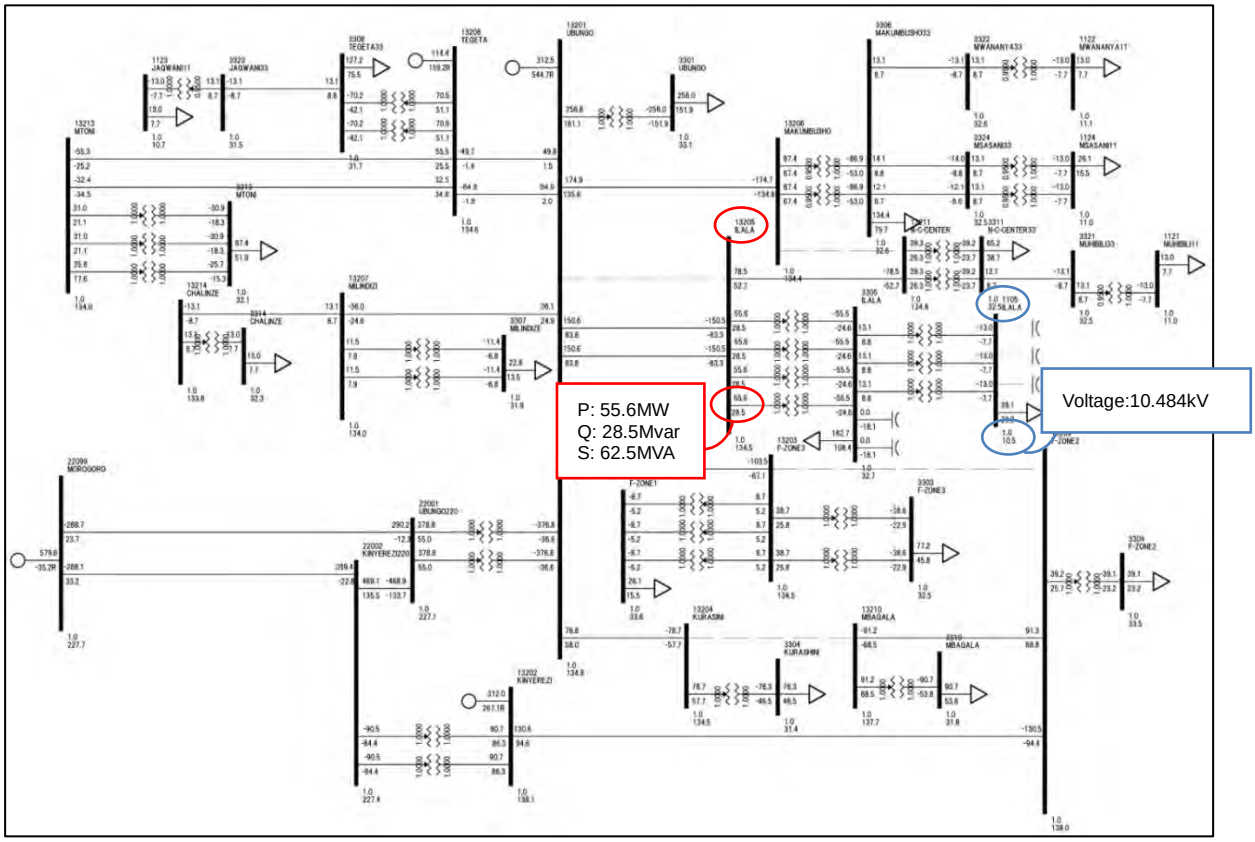


Figure 2-2-2-3.2 Power flow with 0.86 load power factor in 2025
without 11kV capacitor banks at Ilala substation

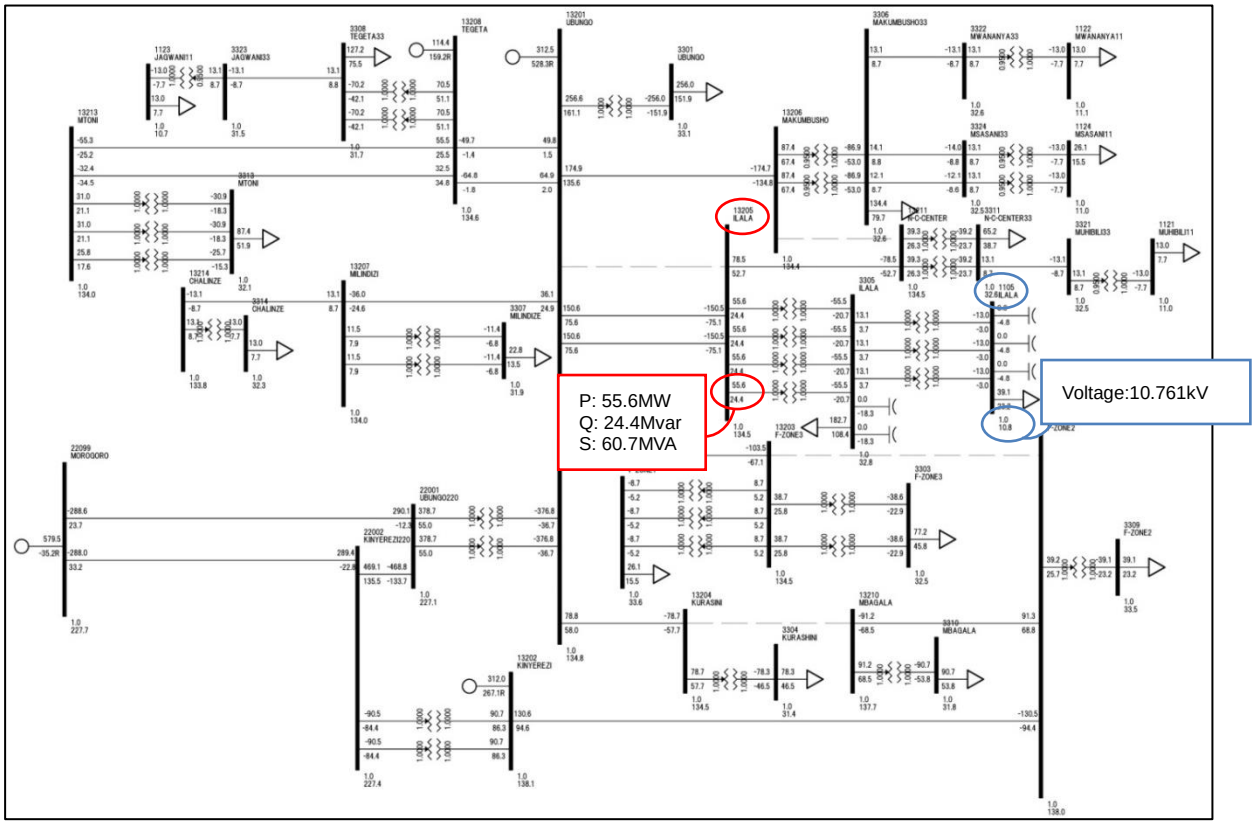


Figure 2-2-2-3.3 Power flow with 0.86 load power factor in 2025
with 11kV capacitor banks at Ilala substation

2) The result of analysis at each peak section

① Result of voltage value

Table 2-2-2-3.2 shows transformer taps and Table 2-2-2-3.3 shows the result of voltage values. Note that transformer taps were adjusted only when each peak sectional voltage exceeded positive and negative 5% of ranges.

Note that the result in case of review for necessity of 11kV capacitor banks at Ilala substation is indicated as well.

Table 2-2-2-3.2 Transformer Taps

						Winding Ratio (p.u.)				
Bus No.	From Bus Name	kV	Bus No.	To Bus Name	kV	2025 without Capacitor	2025 with Capacitor	2015 with Capacitor	2020 with Capacitor	2025 with Capacitor
						PF 0.86	PF 0.86	PF 0.90	PF 0.90	PF 0.90
1105	ILALA	11	3305	ILALA	33	1.00	1.00	1.00	1.00	1.00
1105	ILALA	11	3305	ILALA	33	1.00	1.00	1.00	1.00	1.00
1105	ILALA	11	3305	ILALA	33	1.00	1.00	1.00	1.00	1.00
1121	MUHIBILI	11	3321	MUHIBILI	33	0.95	0.95	1.00	1.00	0.95
1122	MWANANYA	11	3322	MWANANYA	33	0.95	0.95	1.00	0.95	0.95
1123	JAGWANI	11	3323	JAGWANI	33	0.95	0.95	1.00	0.95	0.90
1124	MSASANI	11	3324	MSASANI	33	0.95	0.95	1.00	0.95	0.95
1124	MSASANI	11	3324	MSASANI	33	0.95	0.95	1.00	0.95	0.95
3301	UBUNGO	33	13201	UBUNGO	132	1.00	1.00	1.00	1.00	1.00
3303	F-ZONE3	33	13203	F-ZONE3	132	1.00	1.00	1.00	1.00	1.00
3303	F-ZONE3	33	13203	F-ZONE3	132	1.00	1.00	1.00	1.00	1.00
3304	KURASHINI	33	13204	KURASINI	132	1.00	1.00	1.00	1.00	0.95
3305	ILALA	33	13205	ILALA	132	1.00	1.00	1.00	1.00	1.00
3305	ILALA	33	13205	ILALA	132	1.00	1.00	1.00	1.00	1.00
3305	ILALA	33	13205	ILALA	132	1.00	1.00	1.00	1.00	1.00
3305	ILALA	33	13205	ILALA	132	1.00	1.00	1.00	1.00	1.00
3306	MAKUMBUSHO	33	13206	MAKUMBUSHO	132	0.95	0.95	1.00	0.95	0.95
3306	MAKUMBUSHO	33	13206	MAKUMBUSHO	132	0.95	0.95	1.00	0.95	0.95
3307	MILINDIZE	33	13207	MILINDIZI	132	1.00	1.00	1.00	1.00	1.00
3307	MILINDIZE	33	13207	MILINDIZI	132	1.00	1.00	1.00	1.00	1.00
3308	TEGETA	33	13208	TEGETA	132	1.00	1.00	1.00	1.00	0.95
3308	TEGETA	33	13208	TEGETA	132	1.00	1.00	1.00	1.00	0.95
3309	F-ZONE2	33	13209	F-ZONE2	132	1.00	1.00	1.00	1.00	1.00
3310	MBAGALA	33	13210	MBAGALA	132	1.00	1.00	1.00	1.00	1.00
3311	N-C-CENTER	33	13211	N-C-CENTER	132	1.00	1.00	1.00	1.00	1.00
3311	N-C-CENTER	33	13211	N-C-CENTER	132	1.00	1.00	1.00	1.00	1.00
3313	MTONI	33	13213	MTONI	132	1.00	1.00	1.00	1.00	1.00
3313	MTONI	33	13213	MTONI	132	1.00	1.00	1.00	1.00	1.00
3313	MTONI	33	13213	MTONI	132	1.00	1.00	1.00	1.00	1.00
3314	CHALINZE	33	13214	CHALINZE	132	1.00	1.00	1.00	1.00	1.00
3320	F-ZONE1	33	13203	F-ZONE3	132	1.00	1.00	1.00	1.00	1.00
3320	F-ZONE1	33	13203	F-ZONE3	132	1.00	1.00	1.00	1.00	1.00
3320	F-ZONE1	33	13203	F-ZONE3	132	1.00	1.00	1.00	1.00	1.00
13201	UBUNGO	132	22001	UBUNGO	220	1.00	1.00	1.00	1.00	1.00
13201	UBUNGO	132	22001	UBUNGO	220	1.00	1.00	1.00	1.00	1.00
13202	KINYEREZI	132	22002	KINYEREZI	220	1.00	1.00	1.00	1.00	1.00
13202	KINYEREZI	132	22002	KINYEREZI	220	1.00	1.00	1.00	1.00	1.00

Note: Red numbers show adjusted p.u. value

Table 2-2-2-3.3 Result of voltage value

			2025 without Capacitor		2025 with Capacitor		2015 with Capacitor		2020 with Capacitor		2025 with Capacitor	
			PF:	0.86	PF:	0.86	PF:	0.90	PF:	0.90	PF:	0.90
Base kV	Bus No.	Bus Name	p.u.	kV	p.u.	kV	p.u.	kV	p.u.	kV	p.u.	kV
11	1105	ILALA	0.953	10.484	0.978	10.761	1.020	11.216	0.990	10.894	0.971	10.677
11	1121	MUHIBILI11	1.002	11.026	1.003	11.029	0.987	10.854	0.959	10.552	0.994	10.930
11	1122	MWANANYA11	1.005	11.053	1.005	11.053	0.961	10.566	1.031	11.344	1.003	11.032
11	1123	JAGWANI11	0.970	10.668	0.970	10.668	0.972	10.691	0.989	10.878	1.086	11.945
11	1124	MSASANI11	1.001	11.011	1.001	11.011	0.959	10.545	1.029	11.314	1.000	10.995
33	3301	UBUNGO	1.003	33.099	1.003	33.099	1.012	33.399	0.998	32.918	0.987	32.561
33	3303	F-ZONE3	0.984	32.469	0.984	32.469	1.003	33.102	0.984	32.475	0.971	32.027
33	3304	KURASHINI	0.950	31.360	0.950	31.360	0.988	32.601	0.961	31.700	0.998	32.944
33	3305	ILALA	0.990	32.663	0.994	32.802	1.016	33.515	0.995	32.845	0.981	32.370
33	3306	MAKUMBUSHO33	0.988	32.604	0.988	32.604	0.979	32.294	1.003	33.096	0.981	32.366
33	3307	MILINDIZE	0.967	31.918	0.967	31.918	0.995	32.842	0.972	32.079	0.956	31.548
33	3308	TEGETA33	0.959	31.654	0.959	31.654	0.991	32.716	0.966	31.881	1.004	33.142
33	3309	F-ZONE2	1.014	33.475	1.014	33.475	1.030	33.980	1.023	33.749	1.024	33.789
33	3310	MBAGALA	0.964	31.825	0.964	31.825	1.007	33.231	0.988	32.614	0.983	32.429
33	3311	N-C-CENTER33	0.986	32.545	0.986	32.551	1.005	33.152	0.986	32.535	0.973	32.096
33	3313	MTONI	0.972	32.083	0.972	32.083	0.997	32.898	0.975	32.165	0.959	31.647
33	3314	CHALINZE	0.978	32.281	0.978	32.281	1.000	33.007	0.980	32.333	0.965	31.855
33	3320	F-ZONE1	1.017	33.551	1.017	33.551	1.019	33.620	1.007	33.241	0.998	32.944
33	3321	MUHIBILI33	0.985	32.515	0.985	32.518	1.004	33.135	0.985	32.512	0.972	32.066
33	3322	MWANANYA33	0.988	32.588	0.988	32.588	0.978	32.287	1.003	33.083	0.980	32.350
33	3323	JAGWANI33	0.956	31.532	0.956	31.532	0.990	32.657	0.963	31.789	1.001	33.040
33	3324	MSASANI33	0.984	32.472	0.984	32.472	0.977	32.225	1.000	32.997	0.977	32.248
132	13201	UBUNGO	1.021	134.772	1.021	134.772	1.021	134.772	1.011	133.386	1.002	132.264
132	13202	KINYEREZI	1.046	138.072	1.046	138.072	1.045	137.940	1.045	137.940	1.050	138.600
132	13203	F-ZONE3	1.019	134.495	1.019	134.495	1.020	134.627	1.009	133.175	1.000	132.013
132	13204	KURASINI	1.019	134.455	1.019	134.455	1.020	134.614	1.009	133.148	1.000	131.987
132	13205	ILALA	1.019	134.482	1.019	134.495	1.020	134.666	1.009	133.201	1.000	132.026
132	13206	MAKUMBUSHO	1.018	134.389	1.018	134.389	1.020	134.587	1.008	133.096	0.999	131.921
132	13207	MILINDIZI	1.015	134.006	1.015	134.006	1.018	134.376	1.006	132.805	0.997	131.564
132	13208	TEGETA	1.020	134.640	1.020	134.640	1.020	134.640	1.009	133.188	1.000	132.000
132	13209	F-ZONE2	1.045	137.966	1.045	137.966	1.045	137.887	1.044	137.861	1.049	138.508
132	13210	MBAGALA	1.043	137.676	1.043	137.676	1.044	137.742	1.043	137.650	1.047	138.257
132	13211	N-C-CENTER	1.019	134.442	1.019	134.468	1.020	134.653	1.009	133.175	1.000	132.000
132	13213	MTONI	1.015	133.967	1.015	133.967	1.017	134.284	1.005	132.660	0.995	131.380
132	13214	CHALINZE	1.014	133.835	1.014	133.835	1.017	134.284	1.005	132.673	0.996	131.406
220	22001	UBUNGO220	1.032	227.106	1.032	227.106	1.033	227.216	1.030	226.644	1.032	226.952
220	22002	KINYEREZI220	1.034	227.436	1.034	227.436	1.034	227.524	1.032	227.106	1.035	227.590
220	22099	MOROGORO	1.035	227.700	1.035	227.700	1.035	227.700	1.040	228.800	1.050	231.000

As shown in the table, voltage values are within positive and negative 5% of rages and voltage taps are adjusted within positive and negative 10% in every case.

② The result of power flow

Table 2-2-2-3.4 shows the result of power flow at each sectional peak. The results are come from comparison for rated current of circuit breakers and sustained current of transmission and distribution lines and it can be determined as reasonable values at every section.

Note that the result in case of review for necessity of 11kV capacitor banks at Ilala substation is indicated as well.

Table 2-2-2-3.4 The result of power flow

				Power flow				
Rated Voltage	Substation	Rated Current (Circuit Breaker)	Sustained Current (T&D lines)	2025 without Capacitor	2025 with Capacitor	2015 without Capacitor	2020 without Capacitor	2025 without Capacitor
				PF 0.86	PF 0.86	PF 0.90	PF 0.90	PF 0.90
33kV	Makumbusho	800A	397A	278A	278A	159A	222A	266A
	Mwananyamala	800A						
33kV	Makumbusho	800A	397A	294A	294A	168A	235A	282A
	Msasani	800A						
33kV	Tegeta	800A	397A	288A	288A	157A	232A	260A
	Jangwani Beach	800A						
33kV	New City Center	–	397A	279A	279A	154A	227A	269A
	Muhimbili	800A						
132kV	Ubungo 1	3150A	962A	738A	722A	397A	592A	707A
	Ilala 1	1200A						
132kV	Ubungo 2	3150A	962A	738A	722A	397A	592A	707A
	Ilala 2	3150A						

③ Short circuit current

Table 2-2-2-3.5 shows short circuit current. The results are come from comparison for rated short-time current of circuit breakers and short-time allowable current of transmission and distribution lines and it can be determined as reasonable values at every section.

Table 2-2-2-3.5 Short circuit current

Rated Voltage	Substation	Short-time allowable current (T&D lines)	Rated Short-time Current (Circuit Breaker)	Short Circuit Current
33kV	Makumbusho	29.52kA	25kA	18.1kA
	Mwananyamala		25kA	15.3kA
33kV	Makumbusho	29.52kA	25kA	18.1kA
	Msasani		25kA	8.0kA
33kV	Tegeta	29.52kA	25kA	12.2kA
	Jangwani Beach		25kA	7.0kA
33kV	New City Center	29.52kA	–	15.6kA
	Muhimbili		25kA	12.1kA
132kV	Ubungo	53.09kA	31.5kA	24.6kA
	Ilala		25kA	21.2kA

Notes: Short circuit current for Ubungo Substation is calculated with two sets of 220/132kV transformer.

From Figure 2-2-2-3.4 up to Figure 2-2-2-3.6 show the result of power flow at year of 2015, 2020 and 2025 sectional power flow and Table 2-2-2-3.6 shows line constants.

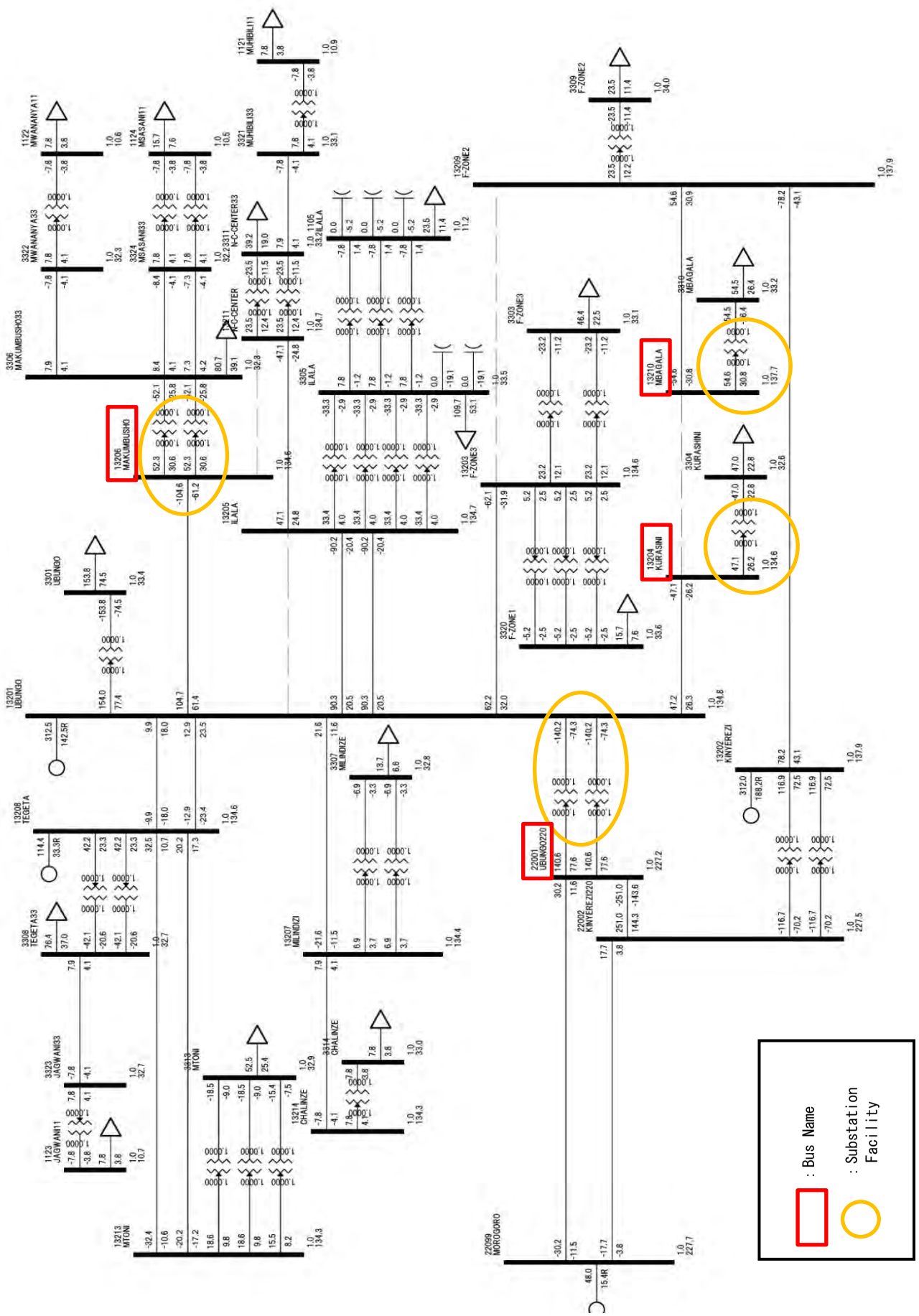


Figure 2-2-2-3.4
Power flow with 0.90 load power factor in 2015 with 11kV capacitor banks at Ilala substation

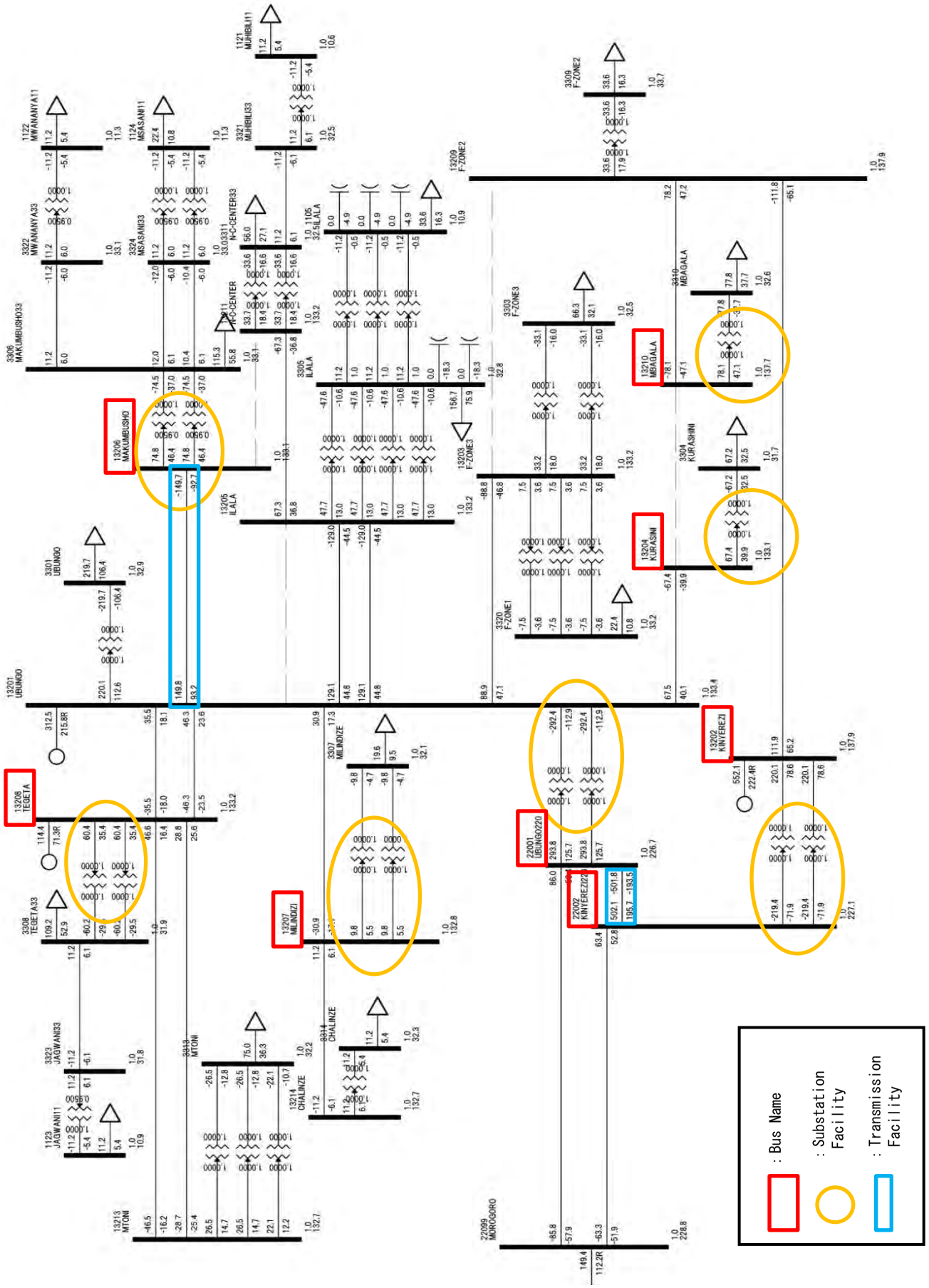


Figure 2-2-2-3.5
Power flow with 0.90 load power factor in 2020 with 11kV capacitor banks at Ilala substation

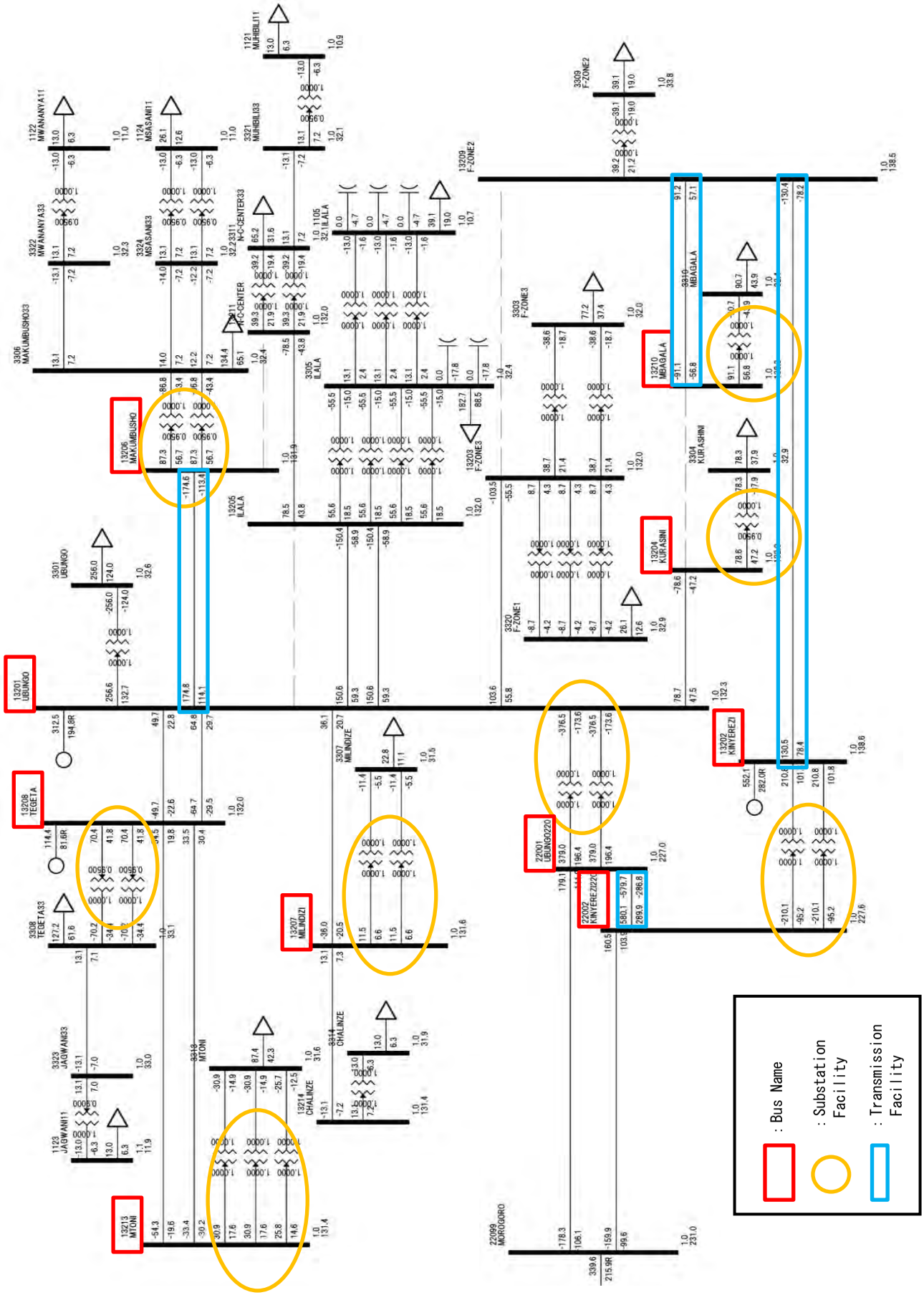


Figure 2-2-2-3.6
Power flow with 0.90 load power factor in 2025 with 11kV capacitor banks at Ilala substation

Base capacity= 10 MVA Frequency= 50 Hz

	From	To	Rating		Line Information				TYPE	Line Constant										For Analysis: (10MVA Base, pu value)			
			Nominal Voltage [kV]	Rated Current @Base Capacity [A]	Laying Method	Spec. of Conductor				Resistance R	Inductance L	Capacitance C	Length [km]	Resistance R	Inductance L	Reactance XL	Capacitance C	Sustained Current	Short-time allowable current	Resistance [A・Ω /V√3]	Reactance [A・Ω /V√3]	Capacitance [A・Ω /V√3]	Sustained Capacity
						Materials	Core	Size (mm2)		[Ω /km]	[mH/km]	[μ F/km]		[Ω]	[mH]	[Ω]	[μ F]	[A]	[kA]	p.u.	p.u.	p.u.	[MVA]
1	MAKUMBUSHO	MWANANYA	33	175	O/H	Al	1*3	150	ACSR(Dingo)	0.18000	1.30516	0.00885	0.913	0.16434	1.19161	0.37417	0.00808	397	29.52	0.0015091	0.0034359	0.0004440	22.69
			33	175	U/G	Cu	1*3	300	XLPE	0.06060	0.51147	0.22152	0.160	0.00970	0.08184	0.02570	0.03544	545	80.40	0.0000890	0.0002360	0.0019471	31.15
			33						**Total**				**1.073**	**0.17404**	**1.27344**	**0.39986**	**0.04353**	**397**	**29.52**	**0.0015981**	**0.0036718**	**0.0023912**	**22.69**
2	MAKUMBUSHO	MSASANI	**33**	**175**	**O/H**	**Al**	**1*3**	**150**	**ACSR(Wolf)**	**0.18070**	**1.12229**	**0.01036**	**7.600**	**1.37332**	**8.52937**	**2.67822**	**0.07876**	**405**	**29.41**	**0.0126108**	**0.0245934**	**0.0043267**	**23.15**
3	MAKUMBUSHO	MSASANI	33	175	O/H	Al	1*3	150	ACSR(Dingo)	0.18000	1.30516	0.00885	7.452	1.34136	9.72603	3.05397	0.06597	397	29.52	0.0123174	0.0280438	0.0036243	22.69
			33	175	U/G	Cu	1*3	300	XLPE	0.06060	0.51147	0.22152	0.100	0.00606	0.05115	0.01606	0.02215	545	80.40	0.0000556	0.0001475	0.0012170	31.15
			33						**Total**				**7.552**	**2.72074**	**18.30655**	**5.74826**	**0.16688**	**397**	**29.52**	**0.0123730**	**0.0281913**	**0.0048413**	**22.69**
4	TEGETA	JAGWANI	33	175	O/H	Al	1*3	150	ACSR(Dingo)	0.18000	1.30516	0.00885	6.429	1.15722	8.39086	2.63473	0.05692	397	29.52	0.0106264	0.0241940	0.0031268	22.69
			33	175	U/G	Cu	1*3	300	XLPE	0.06060	0.51147	0.22152	0.090	0.00545	0.04603	0.01445	0.01994	545	80.40	0.0000501	0.0001327	0.0010953	31.15
			33						**Total**				**6.519**	**1.16267**	**8.43689**	**2.64918**	**0.07685**	**397**	**29.52**	**0.0106765**	**0.0243268**	**0.0042221**	**22.69**
5	N-C-CENTER	MUHIBILI	33	175	O/H	Al	1*3	150	ACSR(Dingo)	0.18000	1.30516	0.00885	1.589	0.28602	2.07390	0.65120	0.01407	397	29.52	0.0026264	0.0059798	0.0007728	22.69
			33	175	U/G	Cu	1*3	300	XLPE	0.06060	0.51147	0.22152	0.370	0.02242	0.18925	0.05942	0.08196	545	80.40	0.0002059	0.0005457	0.0045028	31.15
			33						**Total**				**1.959**	**0.30844**	**2.26314**	**0.71063**	**0.09603**	**397**	**29.52**	**0.0028323**	**0.0065255**	**0.0052756**	**22.69**
6	UBUNGO	F-ZONE3	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**9.300**	**1.07229**	**12.34901**	**3.87759**	**0.08087**	**583**	**46.11**	**0.0006154**	**0.0022254**	**0.0011107**	**133.29**
7	UBUNGO	KURASINI	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**13.000**	**1.49890**	**17.26205**	**5.42028**	**0.11304**	**583**	**46.11**	**0.0008603**	**0.0031108**	**0.0015526**	**133.29**
8	UBUNGO	ILALA	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**TACSR**	**0.11840**	**1.33055**	**0.00868**	**7.500**	**0.88800**	**9.97911**	**3.13344**	**0.06508**	**962**	**53.09**	**0.0005096**	**0.0017983**	**0.0008938**	**219.94**
9	UBUNGO	ILALA	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**TACSR**	**0.11840**	**1.33055**	**0.00868**	**7.500**	**0.88800**	**9.97911**	**3.13344**	**0.06508**	**962**	**53.09**	**0.0005096**	**0.0017983**	**0.0008938**	**219.94**
10	UBUNGO	ILALA	**132**	**44**	**O/H**	**Al**	**1*3**	**150**	**ACSR(Wolf)**	**0.18070**	**1.38663**	**0.00831**	**7.500**	**1.35525**	**10.39970**	**3.26551**	**0.06235**	**405**	**29.41**	**0.0007778**	**0.0018741**	**0.0008563**	**92.60**
11	UBUNGO	MAKUMBUSHO	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.26056**	**0.00918**	**7.000**	**0.80710**	**8.82391**	**2.77071**	**0.06425**	**583**	**46.11**	**0.0004632**	**0.0015902**	**0.0008825**	**133.29**
12	UBUNGO	MILINDIZI	**132**	**44**	**O/H**	**Al**	**1*3**	**150**	**ACSR(Wolf)**	**0.18070**	**1.37283**	**0.00840**	**60.000**	**10.84200**	**82.36970**	**25.86409**	**0.50400**	**405**	**29.41**	**0.0062225**	**0.0148439**	**0.0069222**	**92.60**
13	UBUNGO	TEGETA	**132**	**44**	**O/H**	**Al**	**1*3**	**150**	**ACSR(Wolf)**	**0.18070**	**1.38663**	**0.00831**	**18.500**	**3.34295**	**25.65259**	**8.05491**	**0.15380**	**405**	**29.41**	**0.0019186**	**0.0046229**	**0.0021123**	**92.60**
14	UBUNGO	TEGETA	132	44	O/H	Al	1*3	150	ACSR(Wolf)	0.18070	1.38663	0.00831	13.900	2.51173	19.27411	6.05207	0.11556	405	29.41	0.0014415	0.0034734	0.0015871	92.60
			132	44	U/G	Cu	1*3	300	XLPE	0.06060	0.51147	0.22152	0.800	0.04848	0.40918	0.12848	0.17721	545	80.40	0.0000278	0.0000737	0.0024339	124.60
			132										**14.700**	**2.56021**	**19.68329**	**6.18055**	**0.29277**	**405**	**29.41**	**0.0014694**	**0.0035471**	**0.0040210**	**92.60**
15	KINYEREZI	F-ZONE2	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**2.800**	**0.32284**	**3.71798**	**1.16745**	**0.02435**	**583**	**46.11**	**0.0001853**	**0.0006700**	**0.0003344**	**133.29**
16	F-ZONE3	F-ZONE2	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**8.500**	**0.98005**	**11.28673**	**3.54403**	**0.07391**	**583**	**46.11**	**0.0005625**	**0.0020340**	**0.0010152**	**133.29**
17	KURASINI	MBAGALA	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**15.200**	**1.75256**	**20.18332**	**6.33756**	**0.13218**	**583**	**46.11**	**0.0010058**	**0.0036373**	**0.0018153**	**133.29**
18	ILALA	N-C-CENTER	**132**	**44**	**U/G**	**Al**	**1*3**	**1,000**	**XLPE**	**0.02860**	**0.56177**	**0.37173**	**3.500**	**0.10010**	**1.96620**	**0.61739**	**1.30106**	**831**	**180.00**	**0.0000574**	**0.0003543**	**0.0178693**	**189.99**
19	MAKUMBUSHO	N-C-CENTER	**132**	**44**	**U/G**	**Al**	**1*3**	**1,000**	**XLPE**	**0.02860**	**0.56177**	**0.37173**	**8.500**	**0.24310**	**4.77506**	**1.49937**	**3.15973**	**831**	**180.00**	**0.0001395**	**0.0008605**	**0.0433968**	**189.99**
20	MILINDIZI	CHALINZE	**132**	**44**	**O/H**	**Al**	**1*3**	**150**	**ACSR(Wolf)**	**0.18070**	**1.37283**	**0.00840**	**37.000**	**6.68590**	**50.79465**	**15.94952**	**0.31080**	**405**	**29.41**	**0.0038372**	**0.0091538**	**0.0042687**	**92.60**
21	TEGETA	MTONI	132	44	O/H	Al	1*3	150	ACSR(Wolf)	0.18070	1.38663	0.00831	3.500	0.63245	4.85319	1.52390	0.02910	405	29.41	0.0003630	0.0008746	0.0003996	92.60
			132	44	Marine	Cu	1*3	95	Sub-Marine	0.24699	0.81490	0.01453	41.000	10.12639	33.41071	10.49096	0.59562	315	25.46	0.0058118	0.0060210	0.0081804	72.02
			132						**Total**				**44.500**	**10.75884**	**38.26390**	**12.01487**	**0.62472**	**315**	**25.46**	**0.0061747**	**0.0068956**	**0.0085801**	**72.02**
22	TEGETA	MTONI	132	44	O/H	Al	1*3	150	ACSR(Wolf)	0.18070	1.38663	0.00831	26.000	4.69820	36.05229	11.32042	0.21615	405	29.41	0.0026964	0.0064970	0.0029686	92.60
			132	44	Marine	Cu	1*3	300	Sub-Marine	0.06000	0.69999	0.01710	37.200	2.23200	26.03948	8.17640	0.63595	560	80.40	0.0012810	0.0046926	0.0087344	128.03
			132						**Total**				**63.200**	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**405**	**29.41**	**0.0039774**	**0.0111896**	**0.0117031**	**92.60**
23	F-ZONE2	MBAGALA	**132**	**44**	**O/H**	**Al**	**1*3**	**240**	**ACSR(Hawk)**	**0.11530**	**1.32785**	**0.00870**	**10.000**	**1.15300**	**13.27850**	**4.16945**	**0.08696**	**583**	**46.11**	**0.0006617**	**0.0023929**	**0.0011943**	**133.29**
24	UBUNGO	KINYEREZI	**220**	**26**	**O/H**	**Al**	**1*3**	**564**	**BJOY1**	**0.05070**	**1.24565**	**0.00929**	**10.000**	**0.50700**	**12.45650**	**3.91134**	**0.09294**	**1165**	**104.90**	**0.0001048**	**0.0008081**	**0.0007658**	**443.92**
25	UBUNGO	MOROGORO	**220**	**26**	**O/H**	**Al**	**1*3**	**564**	**BJOY1**	**0.05070**	**1.24565**	**0.00929**	**179.000**	**9.07530**	**222.97143**	**70.01303**	**1.66355**	**1165**	**104.90**	**0.0018751**	**0.0144655**	**0.0137087**	**443.92**
26	KINYEREZI	MOROGORO	**220**	**26**	**O/H**	**Al**	**1*3**	**564**	**BJOY1**	**0.05070**	**1.24565**	**0.00929**	**163.400**	**8.28438**	**203.53928**	**63.91133**	**1.51857**	**1165**	**104.90**	**0.0017116**	**0.0132048**	**0.0125139**	**443.92**

(7) Recommendation of review for facility expansion and/or reinforcement

It is recommended to determine the necessity of Substation and Transmission facility expansion and/or reinforcement since the following facilities are assumed to become overloaded by the result of analysis based on the power demand forecast in PSMP

1) From the result of power flow in 2015 (Refer to marked points in Figure 2-2-2-3.4)

【Substation installed capacity】

① Kurasini substation installed capacity (132/33kV) might be overloaded. (Around104~108%)

② Mbagala substation installed capacity (132/33kV) might be overloaded. (Around121~125%)

③ Ubungo substation installed capacity (220/132kV) might be overloaded. (Around106~107%)

④ Makumbusho substation installed capacity (132/33kV) might be overloaded. (Around129~135%)

2) From the result of power flow in 2020 (Refer to marked points in Figure 2-2-2-3.5)

【Substation installed capacity】

① Kurasini substation installed capacity (132/33kV) might be overloaded. (Around 149~157%)

② Mbagala substation installed capacity (132/33kV) might be overloaded. (Around 173~182%)

③ Ubungo substation installed capacity (220/132kV) might be overloaded. (Around 209~213%)

④ Makumbusho substation installed capacity (132/33kV) might be overloaded. (Around 185~196%)

⑤ Mlindizi substation installed capacity (132/33kV) might be overloaded. (Around 109~113%)

⑥ Tegeta substation installed capacity (132/33kV) might be overloaded. (Around 134~140%)

⑦ Kinyerezi substation installed capacity (220/132kV) might be overloaded. (Around 154~156%)

【Transmission installed capacity】

⑧ [132kV] Ubungo ～ Makumbusho transmission installed capacity might be overloaded.(Around 130%)

⑨ [220kV] Kinyerezi～Ubungo transmission installed capacity might be overloaded.(Around 118%)

3) From the result of power flow in 2025 (Refer to marked points in Figure 2-2-2-3.6)

【Substation installed capacity】

① Kurasini substation installed capacity (132/33kV) might be overloaded. (Around 174~183%)

② Mbagala substation installed capacity (132/33kV) might be overloaded. (Around 202~215%)

③ Ubungo substation installed capacity (220/132kV) might be overloaded. (Around 276~285%)

④ Makumbusho substation installed capacity (132/33kV) might be overloaded. (Around 216~231%)

⑤ Mlindizi substation installed capacity (132/33kV) might be overloaded. (Around 127~132%)

⑥ Tegeta substation installed capacity (132/33kV) might be overloaded. (Around 156~164%)

⑦ Kinyerezi substation installed capacity (220/132kV) might be overloaded. (Around 154~156%)

⑧ Mtoni substation installed capacity (132/33kV) might be overloaded. (Around 114~119%)

【Transmission installed capacity】

⑨ [132kV] Ubungo ～ Makumbusho transmission installed capacity might be overloaded.(Around 155%)

⑩ [220kV] Kinyerezi ～ Ubungo transmission installed capacity might be overloaded.(Around141%)

⑪ [132kV] Kinyerezi ～ F-Zone2 transmission installed capacity might be overloaded.(Around108%)

⑫ [132kV] Mbagala ～ F-Zone2 transmission installed capacity might be overloaded.(Around111%)

2-2-2-4 Basic Plan Overview

(1) Design Conditions

Project design conditions are as follows:

1) Weather conditions

Weather conditions applicable to designs for substation facilities, transmission and distribution line facilities, buildings, and foundations are as shown in Table 2-2-2-4.1.

Table 2-2-2-4.1 Weather Conditions

Area		Dar es Salaam
Elevation		Under 1,000 m
Outside air temperature	High	40˚C
	Low	10˚C
	Average	20˚C
Maximum humidity		97%
Maximum wind speed		45 knots (24 m/s)
Rainfall (Monthly highs)		1,300 mm
Bearing capacity		90 kN/m^2

2) Electrical systems and design conditions

Table 2-2-2-4.2 Electrical Systems and Design Conditions

Item	Transmission System	Substation System	Distribution Substation System		Low Voltage System (Station power supply)	
Frequency	50Hz					—
Phase	3-phase				3-phase/ single-phase	—
Maximum voltage	145kV		36kV	12kV	440V/253V	125V DC
Nominal voltage	132kV		33kV	11kV	400V/230V	110V DC
Lightning impulse withstand voltage	650kV		200kV (170kV)*1	90kV (75kV)*1	2kV	—
Power-frequency withstand voltage	275kV		70kV	28kV	—	—
Grounding system	Direct				—	—
Minimum creepage distance	3,212mm	3,500mm	25mm/kV		—	—
Conductor minimum distance	-	(* 1)			—	—
Phase to Ground(minimum distance)	1,700mm (1,300mm)		500mm (350mm)	300mm (140mm)	—	—
Phase to Phase(minimum distance)	2,500mm (1,700mm)		900mm (500mm)	600mm (180mm)	—	—
Minimum line clearance					—	—
General locations	6.7m	-	5.0m*2	5.0m*2	—	—
Roads	8.0m	-	7.0m*2	7.0m*2	—	—
Railways	9.0m	-	9.0m*2	9.0m*2	—	—
Waterways/sea routes	10.0m	-	10.0m*2	10.0m*2	—	—
Wayleave	40.0m		10.0m	5.0m	—	—

*1: Indoors
*2: Distribution system only

Notes: 1. Conductor minimum separation distance for power lines is set according to relevant specifications and standards. Separation distance for conductors in 33kV and 11kV switchgears is set according to manufacturer specifications.

2. For separation distances for power line conductors and supports in places where TANESCO standards cannot be adapted, TANESCO shall obtain permission from relevant authorities (TANROADS, City council, Municipal council, etc.).

Table 2-2-2-4.3 Wind Loads for Power Lines

Object	132kV Transmission Line	33kV Distribution Line
Conductor	92kg/m^2	50kg/m^2
Steel Pole	-	73kg/m^2
Steel Tower	266kg/m^2	-

* Wind load for 132kV transmission lines is existing design wind velocity
(Steel tower: 38m/s, conductor: 40m/s)

Table 2-2-2-4.4 Distribution Assembly Conditions

Condition	Application
Maximum span (S)	85m
Line sag rate (d), max	3%
Safety factor	2.5+
Maximum temperature	40˚C
Minimum temperature	10˚C

① System voltage

220 kV systems: 220 kV ±5% (209.0 - 220 - 231.0 kV)

132 kV systems: 132 kV±5% (125.4 - 132 - 138.6 kV)

33 kV systems: 33 kV ±5% (31.35 - 33 - 34.65 kV)

② Frequency

Acceptable variation (Electric Utility Industry Law: 50 Hz ±2.5% (51.25 - 50 - 48.75 Hz)

Variation from automatic frequency adjustments: 50 Hz ±0.2 Hz (50.2 - 50 - 49.8 Hz)

③ Short circuit current values

The following was obtained by summarizing and calculating locally collected data:

Table 2-2-2-4.5 Substation Short Circuit Current Values

Substation Name	132 kV	33 kV	11 kV
Ubungo Substation	24.6 kA	-	-
Ilala Substation	21.2 kA	28.0 kA	19.5 kA
Msasani Substation	-	8.0 kA	11.4 kA
Muhimbili Substation	-	12.1 kA	12.8 kA
Mwananyamala Substation	-	15.3 kA	13.8 kA
Jangwani Beach Substation	-	7.0 kA	10.2 kA
Tegeta Substation	-	12.2 kA	-
Makumbusho Substation	-	18.1 kA	-
New City Center Substation	-	15.6 kA	-
Oyster Bay Substation	-	17.3 kA	-

(2) Applicable Standards and Units Used

Substation systems, transmission and distribution facilities are generally designed in accordance with IEC standards or equivalent Japanese standards.

(3) Protection Coordination

1) Protection Relay Application

Protection relays applied for 132 kV Transmission lines, 33 kV & 11 kV Distribution lines and Transformers under this project shall be as same application method as at present as follows;

- 132 kV Transmission lines: Distance relay for main & Time over current relay for back-up,
- 33 kV Distribution lines: Time over current and instantaneous over current relay,
- 11 kV Distribution lines: Time over current and instantaneous over current relay and
- Transformers: Current Ratio differential relay and time over current relay.

As for capacitor bank protection, additional unbalance detection relay shall be equipped because the capacitor bank consists of plural capacitors connected in parallel for each phase and there is a case that over current relay cannot detect the single or few sets of capacitor failure of which fault current flows little unless ground or short circuit fault occurs.

The protection relays to be provided shall be modern digital type which has a flexible setting feature, self-diagnostic function and no mechanical deterioration even though the existing protection relays used in Ilala and Msasani substations are mechanical movement type.

2) Protection Coordination

Where to use over current relays the operation time settings shall be maintained the relationship "long" to "short" to the equipment protected from upstream side of the current flow and shall be quick enough to trip before reaching the capability limit of the protected equipment.

As the neutral point of transmission and distribution lines in Tanzanian system is grounded directly, fault current of ground fault and short circuit becomes the same level, it was found in the existing system that there is the case of mis-coordination between distribution line feeder over current relay for short current protection and low voltage side of transformer main over current relay for ground fault protection. In order to avoid the case above, over current relay shall be equipped each phase and no ground fault relay in common return circuit of current transformer secondary is required.

Since the transmission lines interconnected to 132 kV bus at Ilala substation would be loop configuration after the newly constructed transmission line to New City Center, the settings of these distance relays of protective impedance zones and operation times of the zones for Ubungo, New City Center and Ilala substations shall be well coordinated and tested at the Project execution stage.

(4) Detailed Design of the Equipment and Facilities

1) Substations

① Ilala Substation (Reinforcement)

(a) General

The following basic concept is applied for reinforcement and rehabilitation of Ilala Substation.

- Existing 132 kV equipment should be used as much as possible.
- 90 MVA transformer (T1) should be replaced with new 60 MVA transformer in order to have parallel operation with existing transformers (T2 and T5).
- Two new 60 MVA transformers (T1 above and T7) shall be installed parallel with Transformers T2 and T5.
- Existing 15 MVA transformers (T3, T4 and T6) should be used.
  (Note; Defective transformer T3 has been planned to be replaced with new one under AfDB Project)
- Indoor type 33 kV switchgears should be installed in new control building, instead of existing outdoor type switchgears.
- Indoor type 11 kV switchgears should be installed instead of existing switchgears, as well.
- All control and protection panels should be renewed and installed in new control building, except following panel.
  - 132 kV Transmission line protection panel for New City Center substation, supplied under Finnish Project.
- All control and power cables should be replaced with new ones.
- Entire earthing system in the substation shall be considered and all equipment earthing shall be connected to new earthing system including existing equipment.
- Temporary cables may be used for exchanging existing connections in order to reduce shutdown time and range as much as possible.
- In accordance with Environmental Regulation, noise level at the boundary shall be controlled less than maximum permissive noise level.

Following items should be done by TANESCO.

- Temporary Oil storage and disposal for Transformer T1 (90 MVA)
- Abandoned transformer and all other materials at 132 kV yard should be removed for new equipment installation.
- Trees, steel towers for Antennas, waste materials and others scattered in front of control building should be removed for construction of new control building.
- The following works in relation with GCC and NCC SCADA system;-
  1) Newly installed Multiplexers in new Control building and the connection between the Multiplexers and Micro SCADA System of Ilala Substation,

2) Modification works of existing SCADA System, required for new equipment, such as 132/33 kV Transformers, 132 kV Switchgears and equipment/system in Ilala Substation of the Project,

- Supply of 48 V DC Batteries and Chargers,
- Un-utilized wires, porcelain insulators and their hardware on second circuit of the 132 kV towers should be removed for new conductor installation before commencement of the Project.
- Coordination works in relation with Shutdown (time and range) for the Project between associated agencies.

(b) Basic Design

Table 2-2-2-4.6 indicates equipment to be supplied by the Japanese side, according to the equipment requested by Tanzanian government and the Single Line Diagram is shown in Fig. SS-E-01.

Table 2-2-2-4.6 Equipment List for Ilala Substation supplied by the Japanese side

NO.	Equipment supplied by the Japanese side	Q'ty	Unit	Remarks
(1)	60 MVA, 132/33 kV Transformer	2	set	- 2 x 60 MVA transformers (T1 and T7) shall be provided. - Expansion of 132 kV Bus and outdoor type switchgear for additional one (1) bay for 60 MVA transformer (T7) with associated structures and foundations shall be provided. - Removal of existing 90 MVA Transformer for replacement is required at construction stage. The works include removal of insulation oil from the tank.
(2)	33 kV Switchgear	24	panel	Indoor type new 33 kV Switchgear panels shall be installed. Note; 1. Protection relays are mounted on respective panels. 2. Existing two (2) sets of 33 kV Capacity Banks shall be utilized. 3. New two (2) sets of Station service transformers shall be provided.
(3)	11 kV Switchgear	20	panel	Indoor type new 11 kV Switchgear panels shall be installed. Note; 1. Protection relays are mounted on respective panels. 2. Three sets of new 11 kV, 5 Mvar Capacitor Banks shall be provided.
(4)	Control Panels	1	lot	Micro SCADA System shall be applied. See item (16) in this list.
(5)	132 kV Transmission Line Protection Panels complete with relays	1	lot	- Transmission line protection panel(s) complete with relays shall be provided for two Ubungo lines (UB1 & UB2). - T/L Protection Panel for New City Center line (NC) which is planned to be installed under the Finnish Project shall be relocated to the newly

NO.	Equipment supplied by the Japanese side	Q'ty	Unit	Remarks
				constructed control building and re-used.
(6)	132/33 kV Transformer Protection Panels complete with relays	1	lot	Four (4) sets of 132/33 kV Transformer protection panels complete with relays shall be provided.
(7)	33/11 kV Transformer Protection Panels complete with relays	1	lot	Three (3) sets of 33/11 kV Transformer protection panels complete with relays shall be provided.
(8)	AC Distribution Panels	1	lot	Suitable numbers of feeders shall be supplied.
(9)	DC Distribution Panels	1	lot	Ditto
(10)	Battery and Charger	1	set	110 V DC Batteries and their chargers shall be provided. (Capacity calculation with DC load duration time should be conducted.) In addition, Uninterruptible Power Supply system shall be provided for Micro SCADA System (See item No. (16) below in the list).
(11)	New Control Building	1	lot	New control building consisting of Switchgear room, Control room, Battery room, etc shall be constructed.
(12)	33 kV Power Cables	1	lot	- Power cables with necessary materials for laying and connection - Temporary cables, cable-heads and associated materials during the construction period should be considered.
(13)	11 kV Power Cables	1	lot	Ditto
(14)	Control Cables & CT Cables	1	lot	Control cables and CT cables shall be re-newed.
(15)	Earthing conductors and accessories	1	lot	- Entire earthing system in the substation shall be considered - Overhead grounding wires for new 132 kV switchgear and transformer area shall be modified.
(16)	Substation micro SCADA system	1	lot	- Server and Client (Work Station-HMI) with Bay Control Unit (BCU) system shall be provided for controlling and supervising of the substation. - The system includes Transformer voltage regulating system which covers four (4) units of 132/33 kV transformers and three (3) units of 33/11 kV transformers. - The system can communicate with Tanzania SCADA system (GCC and DCC SCADA system) via multiplexer equipment which is provided by Tanzania side.
(17)	Basic Training on substation operation and maintenance	1	lot	- Training on an OJT basis. - Trainees should be selected by Tanzanian side.
(18)	TACSR conductor (240 mm^2) and associated hardware for 132 kV Ilala-Ubungo Transmission Lines	1	lot	- In order to increase the transmission line capacity, thermal resistant type conductor "TACSR 240 mm^2" shall be installed on the existing double circuit transmission line towers. The reinforcement of the towers shall be conducted by the Japanese side, if necessary. It should be noted that the existing single circuit transmission line towers can be used by Tanzanian side. - CTs for both Ilala and Ubungo substations on

NO.	Equipment supplied by the Japanese side	Q'ty	Unit	Remarks
				the circuits shall be replaced with higher ratio ones. (See item No. (20) below) - The modifications on Tanzanian GCC and DCC SCADA system caused by the above transmission line modification should be done by Tanzanian side.
(19)	Porcelain insulators and associated hardware for the above	1	lot	- Porcelain insulators for 132 kV line and its associated materials shall be provided.
(20)	Others (The materials not requested by Tanzanian side)	1	lot	Due to the replacement of the 132 kV conductors, the following 132 kV equipment and materials shall be replaced with suitable rated ones. - The existing 132 kV CB on Ubungo No. 1 (UB1) line with 1,200 A current rating. - Two (2) sets of 132 kV CT with 1,200/1/1/1 A on Ilala-Ubungo lines at both Ilala and Ubungo Substations. (Total 12 phases of CT) - 132 kV Overhead Conductors with 1,200 A capacity on both Ubungo No. 1 (UB1) and No.2 (UB2) lines. - At Ubungo Substation, 132 kV Overhead bypass line conductors of two Ilala circuits. In addition to the above, the equipment listed below should be replaced with new ones;- - 132 kV Disconnecting Switches (DS) on the busbar side of UB1, T1 and T2 circuits with 25 kA-2 sec. - 132 kV DSs (including Earthing Switches) on the line side of UB1 and UB2, and on the busbar side of UB2 and T5 circuits with remote control unit, due to adapt Substation micro SCADA system.

(c) Specifications of Main Equipment

Table 2-2-2-4.7 Specifications of Main Equipment

No.	Equipment	Specifications	Q'ty
IL-1	132 kV Gas Circuit Breaker (CB) 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Operating Sequence 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Equipment to be applied	 Three-pole, outdoor use, porcelain (creepage distance: 3,500 mm or longer, complete with operating mechanism) 145 kV or higher 1,200 A or higher 25 kA or higher O-0.3 sec.-CO-3 min.-CO 650 kV or higher 275 kV or higher DC 110 V For UB1 bay (replacement) and T7 bay (new installation)	2 sets
IL-2-1	132 kV Disconnecting Switch (DS) 1) Type	 Three-pole, single-throw, outdoor use,	4 sets

No.	Equipment	Specifications	Q'ty
		horizontal double break rotating and insulator type (Insulator creepage distance: 3,500 mm or longer)	
	2) Rated Voltage	145 kV or higher	
	3) Rated Current	1,200 A or higher	
	4) Rated Short-time Current	25 kA-2 sec. or higher	
	5) Lightning Impulse Withstand Voltage	650 kV or higher	
	6) Power Frequency Withstand Voltage (1 min.)	275 kV or higher	
	7) Control Voltage	DC 110 V	
	8) Equipment to be applied	Busbar side DS on T1, T2 and UB1 bays (replacement) and Busbar side DS on T7 bay (new installation)	
IL-2-2	Materials for 132 kV DS modification for "Remote control function" (including Earthing Switches)		1 lot for 4 DSs
	1) Applied DS	Line side DS on UB1 and UB2 bays (with ES), and busbar side DS on UB2 and T5 bays	
	2) Control Voltage	DC 110 V	
IL-3	132 kV Current Transformer (CT)		6 phases
	1) Type	Outdoor use, single phase, oil-filled porcelain type or bushing type, single or double-core, double ratio, hermetically sealed (insulator creepage distance: 3,500 mm or longer)	
	2) Rated Voltage	145 kV or higher	
	3) Rated Primary Current	1,200 A	
	4) Rated Secondary Current	1/1/1 A	
	5) Tolerances	Core 1: Class 0.5 or higher Core 2,3: Class 5P20 or higher	
	6) Rated Burden	30 VA each or higher	
	7) Rated Short-time Current	25 kA-2 sec. or higher	
	8) Lightning Impulse Withstand Voltage	650 kV or higher	
	9) Power Frequency Withstand Voltage (1 min.)	275 kV or higher	
	10) Equipment to be applied	For UB1 and UB2 bays	
IL-4	132 kV Lightning Arrester		12 phases
	1) Type	Outdoor use, Metal oxide gapless type, single phase (Insulator creepage distance: 3,500 mm or longer)	
	2) Rated Voltage	120 kV	
	3) Rated Discharge Current	10 kA	
	4) Equipment to be applied	For T1, T2, T5 and T7 bays	
IL-5	132 kV Busbar, Supporting structures for Busbars, Insulators and other materials		1 lot
	1) 132 kV Busbars for extension	Hard drawn stranded wire (HDCC 600 mm^2 or higher) or equivalent	
	2) Steel structures for 132 kV Busbar and T7 bays		
	3) Post Insulators for 132 kV busbars	Insulator creepage distance: 3,500 mm or higher	
	4) Tension insulators for 132 kV busbar dead-end towers		

No.	Equipment	Specifications	Q'ty
	5) 132 kV Overhead Conductors 6) Post Insulators for T7 branching circuit 7) Grounding Wires	For UB1 and UB2: THDCC 325 mm^2 Insulator creepage distance: 3,500 mm or higher ACS 55 mm^2 or higher	
IL-6	132/33kV Power Transformer 1) Type 2) Continuous Rated Capacity 3) Rated Primary Voltage 4) Rated Secondary Voltage 5) Type of Cooling 6) Number of phase 7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections 12) Impedances 13) Lightning Impulse Withstand Voltage 14) Power Frequency Withstand Voltage (1 min.) 15) Connections 16) Bushing CT 17) Others	T1 and T7 Outdoor use, with On-load tap changer 60 MVA 132 kV 33 kV ONAN 3 50 Hz 132 kV +10% to -10% 17 taps 1.25% Primary: Star with solidly grounded Secondary: Star with solidly grounded Tertiary: Delta Vector Group: YNyn0(d1) 12.4% Primary: 650 kV or higher Secondary: 170 kV or higher Primary: 275 kV or higher Secondary: 70 kV or higher Neutral on Primary & Secondary: 70 kV or higher Tertiary: 28 kV or higher Primary: Overhead conductors Secondary: Cables Primary: 300/1/1/1 A Secondary: 1,200/1/1/1 A Primary neutral: 300/1 A Secondary neutral: 1,200/1 A Parallel operation should be done with existing transformers T2 (12.40％) and T5 (12.35％)	2 sets
IL-7	33/0.4 kV Station Service Transformer 1) Type 2) Continuous Rated Capacity 3) Rated Primary Voltage 4) Rated Secondary Voltage 5) Type of Cooling 6) Number of phase 7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections 12) Impedances 13) Connections	 Outdoor use, with No-load tap changer 315 kVA 33 kV 400-230 V (three phases, four wires) ONAN 3 50 Hz 33 kV +/-5.0% 5 taps 2.5% Primary: Delta Secondary: Star with solidly grounded Vector Group: Dyn11 approximately 5% Primary & Secondary: Cables	2 sets
IL-8	33 kV Switchgears 1) Type 2) Rated Voltage	 Indoor use, Metal enclosed or Metal clad type 36 kV	24 panels

No.	Equipment	Specifications	Q'ty
	3) Rated Current	Busbar: 2,500 A or higher 132/33 kV Transformer bay: 1,600 A or higher Other bays: 800 A or higher	
	4) Rated Interrupting Current	31.5 kA or higher	
	5) Rated Short-time Current	31.5 kA-2 sec. or higher	
	6) Lightning Impulse Withstand Voltage	170 kV or higher	
	7) Power Frequency Withstand Voltage (1 min.)	70 kV or higher	
	8) Control Voltage	DC 110 V	
	9) Number of Feeders	132/33 kV Transformer secondary : 4 panels 33/11 kV Transformer primary : 3 panels 33/0.4 kV Transformer primary : 2 panels 33 kV Capacitor Banks: 2 panels 33 kV Feeders: 12 panels Bus-tie: 1 panels	
	10) Protection Relays	Overcurrent relays and others	
IL-9	11 kV Switchgears		20 panels
	1) Type	Indoor use, Metal enclosed or Metal clad type,	
	2) Rated Voltage	12 kV	
	3) Rated Current	Busbar: 1,600 A or higher 33/11 kV Transformer: 1,200 A or higher Others: 600 A or higher	
	4) Rated Interrupting Current	25 kA or higher	
	5) Rated Short-time Current	25 kA-2 sec. or higher	
	6) Lightning Impulse Withstand Voltage	75 kV or higher	
	7) Power Frequency Withstand Voltage (1 min.)	28 kV or higher	
	8) Control Voltage	DC 110 V	
	9) Number of Feeders	33/11 kV Transformer secondary: 3 panels 11 kV Feeder: 12 panels 11 kV Capacitor Banks: 3 panels Bustie: 2 panels	
	10) Protection Relays	Over current relays and others	
IL-10	Substation Control System		1 lot
	1) Control System	Micro SCADA system by Control and monitoring servers via local area network (LAN) for all I/O data in a substation, such as status of switchgears, protection relays, local control facilities and other facilities. The Control and monitoring servers should be duplicate system.	
	2) Component	- Substation Control System Panel - 132 kV Transmission Line Bay Control Unit (BCU) - 132/33 kV Transformer BCU - 33/11 kV Transformer BCU	

No.	Equipment	Specifications	Q'ty
		- Control and Monitoring Work Stations - LAN Cables and other necessary materials	
	3) Communication	Gateway unit for communication with GCC SCADA system and DCC SCADA system on IEC-60870-1-101/104 basis	
	4) Control Voltage	230 V AC by UPS	
IL-11	Metering Panel	Watt-hour meters supplied by Tanzanian side are mounted by Japanese side at the Site.	1 lot
IL-12	Transformer Voltage Regulating Panel		1 lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Purpose	Transformer voltage control by OLTC (On-load tap changers) of 4 units of 132/33 kV Transformers and 33/11 kV Transformers	
IL-13	Transformer Protection Relay Panels		1 lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Purpose	- 4 units of 132/33 kV Transformer - 3 units of 33/11 kV Transformer	
IL-14	132 kV Transmission Line Protection Panels		1 lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Purpose	- UB1 & UB2 (new installation) - New City Center supplied by Finland Project (to be relocated)	
IL-15	DC Power Supply System (including DC Distribution Panels)		1 lot
	1) Type	Thyristor type, indoor use, air insulated, metal enclosed self-standing type	
	2) System	Duplicate charger system (Dump-less transfer system)	
	3) Input	400 V AC or 230 V AC	
	4) Output	110 V DC (+/-3 V), 120A Output voltage should be regulated by Silicon droppers or equivalent.	
	5) Batteries	Lead-acid Battery with control valves or equivalent, 700 Ah/10 Hr., 54 cells	
	6) DC Distribution Panels	Indoor use, air insulated, metal enclosed self-standing type, 110 V DC	
IL-16	Uninterruptable Power Supply (UPS)		1 lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type, Inverter type or equivalent	
	2) Input	400 V AC or 230 V AC, and 110 V DC (Substation battery)	
	3) Output	AC 230 V (single phase) +/- 5%, 50 A	
	4) Others	Distribution circuits for UPS output shall be included.	
IL-17	AC Distribution Panel		1 lot

No.	Equipment	Specifications	Q'ty
	1) Type 2) Ratings	Indoor use, air insulated, metal enclosed self-standing type AC 400 - 230 V, three phase and four wires	
IL-18	33kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 33 kV 10 kA 33 kV side of T2 and T5 Transformers (6 phases) 33 kV Feeders (for 8 feeders, 24 phases)	30 phases
IL-19	11kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 12 kV 10 kA 11 kV Feeders (for 15 feeders, 45 phases)	45 phases
IL-20	33 kV, 11 kV Cables 1) Type 2) Purpose 3) Others	 XLPE Cables Between Transformers and 33 kV/11 kV Switchgear panels (including 33 kV temporary cables) Cable sealing ends, Structures for Cable heads and other necessary materials	1 lot
IL-21	Other Materials 1) Low voltage cables 2) Earthing materials 3) Cabling materials 4) 11 kV Capacitor Banks a. Type b. Quantity c. Rated capacity d. Rated voltage e. Rated short-time withstand current f. Accessories 5) Repairing materials for existing cable pits	 600 V power cables and control cables For substation entire earthing (Earthing conductors, earthing rods, connection materials and other necessary materials) Conduits, cable racks and others Outdoor, Three phases/set (Star connection) 3 sets 5 Mvar or higher 12 kV or higher 25 kA-2 sec. or higher Inrush current limiting reactor, Unbalance current detecting CTs, Unbalance current relays and others Concrete blocks, Concrete covers and others	1 lot
IL-22	New Control Building 1) Size and story 2) Structures 3) Lightings 4) Other Facilities	 1,013 m^2, Single story RC structures	 1 lot 1 lot 1 lot 1 lot
IL-23	Construction of other substation facilities 1) Steel Structures 2) Substation Earthing 3) Equipment Foundations 4) Cable Trenches/Ducts 5) Oil storage basin for Transformers	 for Overhead wires including Overhead grounding wires	 1 lot 1 lot 1 lot 1 lot 1 lot

No.	Equipment	Specifications	Q'ty
	(with oil separator) 6) Gravels 7) Fire Extinguishers		1 lot 1 lot 1 lot
IL-24	1) Removal of existing 90 MVA Transformer 2) 33 kV and 11 kV temporary cables	Removal of oil, disassembling and removal of 90 MVA, 132/33 kV Transformer (T1) to vacant space inside the substation 33 kV and 11 kV temporary cables should be used in order to minimize the duration and the range of power system outages.	1 lot 1 lot
Ubungo Substation			
UB-1	132 kV Current Transformer 1) Type 2) Rated Voltage 3) Rated Primary Current 4) Rated Secondary Current 5) Tolerances 6) Rated Burden 7) Rated Short-time Current 8) Lightning Impulse Withstand Voltage 9) Power Frequency Withstand Voltage (1 min.) 10) Equipment to be applied	 Outdoor use, single phase, oil-filled porcelain type or bushing type, single or double-core, double ratio, hermetically sealed (insulator creepage distance: 3,500 mm or longer) 145 kV or higher 1,200 A 1/1/1 A Core 1: Class 1.0 or higher Core 2,3: Class 5P20 or higher 30 VA each or higher 25 kA-2 sec. or higher 650 kV or higher 275 kV or higher For Ilala 1 and Ilala 2 bays	6 phases
UB-2	132 kV Overhead Conductors and other materials 1) 132 kV Overhead Conductors (Bypass conductors for 2 circuits) 2) Other necessary materials	 Hard aluminum stranded wires (HAl 590 mm^2 or higher) or equivalent Terminals, connectors and other necessary materials	1 lot

② Msasani Substation (Expansion)

(a) General

Msasani Substation was constructed in 1993, using "the Japan's Grant Aid Project". The substation is consisting of 1 unit of 15 MVA Transformer and outdoor type 11 kV Switchgears (1 x incoming feeder and 3 x outgoing feeders). Since the substation has almost 14 MVA loads or more continuously, the extension of one more transformer and associated equipment has been requested by the Tanzanian government.

Because the space of the substation is limited, it is impossible to extend existing 33 kV busbars. Consequently, the existing 11 kV switchgear should be connected with new 11 kV switchgear, which is fed from new 15 MVA transformer. New transformer should be as same specification as the one of the existing Transformer (T1) to enable parallel operation of the transformers. (The existing LTC control circuit shall be modified.)

Msasani Substation shall be fed from Makumbusho Substation. According to the site survey and the discussion with the Tanzanian side, one unit of 33 kV feeders shall be extended to existing 33 kV switchgears (No.2 Busbar side). The following basic concept is applied for the extension of Msasani Substation.

- One (1) set of 15 MVA Transformer shall be installed.
- Indoor type 33 kV Switchgear panels shall be supplied for incoming and a new 15 MVA Transformer.
- New indoor type 11 kV Switchgear panels shall be installed and connected with the existing switchgear panel using underground cables.
- Micro SCADA system shall be installed to control and monitor the substation and also to communicate with Tanzanian SCADA system.
- Interface for RTU of DCC SCADA system shall be provided.
- 110 V DC Battery and its Charger shall be supplied.
- Control building shall be constructed to install indoor type new equipment of the Project.
- In accordance with Environmental Regulation, noise level at the boundary shall be controlled less than maximum permissive noise level.

Following items should be done by Tanzanian side.

- Removal of overhead lines between first and second poles of 11 kV MS3 feeder
- Removal of the Diesel generator set installed beside the existing Substation
- RTU and associated communication facilities including 48 V DC Battery and charger system installation
- Optical fiber cable installation between new and existing Substations
- Modification of Optical Multiplexer and/or related communication facilities in existing substation to communicate with additional new substation if necessary
- Modification of SCADA system in DCC to accommodate at new Substation

(b) Substation Equipment

The equipment list for Msasani Substation is shown in Table 2-2-2-4.8 and Single Line Diagram in Fig. SS-E-02. Table 2-2-2-4.9 indicates the necessary equipment at Makumbusho Substation.

Table 2-2-2-4.8 Equipment List at Msasani Substation

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
1.	15 MVA Transformer (T2)	1	set	15 MVA (ONAN) 33+/-10% / 11 kV (17 taps) Parallel operation with existing T1 transformer is required.
2.	50 kVA Station Service Transformer（STR2）	1	Set	50 kVA (ONAN) 33 kV+/-5.0% / 400-230 V
3.	Indoor type 33 kV Switchgear	3	panel	1 x Incoming feeder 1 x 15 MVA Transformer primary 1 x 50 kVA Station Service Transformer

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
4.	Indoor type 11 kV Switchgear	5	Panel	1 x 15 MVA Transformer secondary 3 x Outgoing feeders 1 x Bus Section
5.	Outdoor type 11 kV Switchgear	1	panel	1 panel for connection with new 11 kV Switchgear Modification of LTC control circuits in parallel operation with T2
6.	Micro SCADA System	1	lot	Substation Control system with Bay Control Units
7.	Metering Panel	1	lot	Watt-hour meters (type: EDMIL Mk10E, supplied by the Tanzanian side) are mounted by the Japanese side.
8.	33/11 kV Transformer Control and Protection Panel	1	lot	OLTC (On-Load Tap Changer) Control and Transformer protection
9.	AC Distribution Panels	1	set	400-230 V AC, Three phases, Four wires
10.	110 V DC Batteries and Battery Charger	1	set	Lead-acid batteries with control valves, 55 cells, The Battery capacity should cover the existing equipment, due to deterioration of existing battery system. Thyristor type charger (including DC Distribution panels)
11.	33 kV Cables	1	lot	Between 33 kV Switchgear and first pole of 33 kV Distribution line/15 MVA Transformer
12.	11 kV Cables	1	lot	Between 11 kV Switchgear and first pole of 11 kV feeders/15 MVA Transformer, and between outdoor type 11 kV Switchgear (extension) and new installed indoor use 11 kV Switchgear (Bus Section panel)
13.	Low Voltage Cables	1	lot	Power and control cables
14.	Earthing conductors and accessories	1	lot	Substation earthing
15.	Substation Building	1	lot	Switchgear room, Battery room, etc. The design of Substation building should be considered for future development of the system.

Table 2-2-2-4.9 Equipment List at Makumbusho Substation

No.	Equipment	Q'ty	Unit	Major Specifications
1.	Indoor type 33 kV Switchgear	1	panel	One feeder unit of 33 kV Switchgear panel (feeding for Msasani Substation)
2.	Modification materials for the existing Control panels	1	lot	Mimic buses, Discrepancy switches, Name plates and other necessary materials for Control panel modification
3.	Watt-hour meter	1	lot	Watt-hour meters (type: EDMIL Mk10E supplied by the Tanzanian side) are mounted by the Japanese side.
4.	33 kV Cables	1	lot	33 kV Switchgear to 33 kV first pole inside the substation
5.	Low voltage cables	1	lot	Power and control cables

(c) Specifications of Main Equipment

Table 2-2-2-4.10 Specifications of Main Equipment

No.	Equipment	Specifications	Q'ty
MS-1	33/11 kV Power Transformer		1 set
	1) Type	Outdoor use, with On-load tap changer	
	2) Continuous Rated Capacity	15 MVA	
	3) Rated Primary Voltage	33 kV	
	4) Rated Secondary Voltage	11 kV	
	5) Type of Cooling	ONAN	
	6) Number of phase	3	
	7) Frequency	50 Hz	
	8) Tap Voltages	33 kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding Connections	Primary: Star with solidly grounded Secondary: Star with solidly grounded Tertiary: Delta Vector Group: YNyn0(d1)	
	12) Impedances	Approximately 8.0% (Impedance of the existing transformer; 7.64%)	
	13) Lightning Impulse Withstand Voltage	Primary: 200 kV or higher Secondary: 90 kV or higher	
	14) Power Frequency Withstand Voltage (1 min.)	Primary: 70 kV or higher Secondary: 28 kV or higher	
	15) Connection	Primary & Secondary: Cables	
	16) Bushing CT	Secondary: 1,200/1/1 A Primary neutral: 400/1 A Secondary neutral: 400/1 A	
	17) Others	Parallel operation shall be done with existing transformers T1 (7.64%)	
MS-2	33/0.4 kV Station Service Transformer		1 set
	1) Type	Outdoor use, with No-load tap changer	
	2) Continuous Rated Capacity	50 kVA	
	3) Rated Primary Voltage	33 kV	
	4) Rated Secondary Voltage	400-230 V (three phases, four wires)	
	5) Type of Cooling	ONAN	
	6) Number of phase	3	
	7) Frequency	50 Hz	
	8) Tap Voltages	33 kV +/-5.0%	
	9) Number of taps	5 taps	
	10) Step voltage	2.5%	
	11) Winding Connections	Primary: Delta Secondary: Star with neutral brought out, with solidly grounded Vector Group: Dyn11	
	12) Impedances	approximately 6%	
MS-3	33 kV Switchgears		3 panels
	1) Type	Indoor use, Metal enclosed or Metal clad type	
	2) Rated Voltage	36 kV	
	3) Rated Current	Busbar: 1600 A or higher 33/11 kV Transformer: 800 A or higher Others: 800 A or higher	
	4) Rated Interrupting Current	25 kA or higher	
	5) Rated Short-time Current	25 kA-2 sec. or higher	

No.	Equipment	Specifications	Q'ty
	6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	200 kV or higher 90 kV or higher DC 110 V 33/11 kV Transformer primary: 1 panel 33/0.4 kV Transformer primary: 1 panel Incoming: 1 panel	
MS-4	11 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type, air insulated 12 kV Busbar: 1,200 A or higher Others: 600 A or higher 25 kA or higher 25 kA-2 sec. or higher 75 kV or higher 28 kV or higher DC 110 V 33/11 kV Transformer secondary: 1 panel 11 kV Feeder: 3 panels Panel for Busbar connection: 1 panel (between existing and new 11 kV Switchgears)	5 panels
MS-5	Extension of Existing 11 kV Switchgear (Outdoor use) 1) Purpose 2) Type 3) Manufacturer of existing Switchgear 4) Ratings 5) Number of Feeders 6) Others	 In order to connect the new 11 kV Switchgear (indoor use) to the existing switchgear (outdoor use), the cable connection feeder shall be extended for existing switchgear. Outdoor, metal-enclosed and air insulated type Takaoka Electric Mfg. Co., Ltd. 12 kV, 1200 A, 25 kA Panel for Busbar connection : 1 panel (Busbar extension and cable connection (1,200 A capacity) with new indoor type Switchgear) Modification shall be done for the existing Tap-changer control circuits to enable parallel operation with existing T1 transformer (7.64%).	1 panel
MS-6	Micro SCADA Sytem 1) Control System 2) Component	 Micro SCADA system by Control and monitoring servers via local area network (LAN) for all I/O data in a substation. - Substation Control System Panel - 33/11 kV Transformer BCU - Control and Monitoring Work Stations - LAN Cables and other necessary materials	1 lot

No.	Equipment	Specifications	Q'ty
	3) Communication 4) Control Voltage	Gateway unit for communication with GCC SCADA system and DCC SCADA system on IEC-60870-1-101/104 basis 110 V DC and 230 V AC by UPS	
MS-7	Metering Panel	Watt-hour meters supplied by Tanzanian side are mounted by Japanese side at the Sites.	1 panel
MS-8	33/11 kV Transformer Control and Protection Panel 1) Type 2) Control 3) Protection	 Indoor use, air insulated, metal enclosed self-standing type - Control of OLTC (On-load tap changers) on 33/11 kV Transformers - Transformer's parallel operation control and/or independent operation control Transformer differential protection and over current protection	1 panel
MS-9	AC Distribution Panel 1) Type 2) Ratings	 Indoor use, air insulated, metal enclosed self-standing type AC 400 - 230 V, three phase and four wires	1 lot
MS-10	DC Power Supply System (including DC Distribution Panels) 1) Type 2) System 3) Input 4) Output 5) Batteries 6) DC Distribution Panels	 Thyristor type, indoor use, air insulated, metal enclosed self-standing type Single charger 400 V AC or 230 V AC DC 110 V (+/-3 %) Output voltage should be regulated by Silicon droppers or equivalent. Lead-acid Battery with control valves or equivalent, 700 Ah/10 Hr., 54 cells Indoor use, air insulated, metal enclosed self-standing type, 110 V DC	1 lot
MS-11	33 kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 33 kV 10 kA Top of the first pole of 33 kV incoming and outgoing feeders (3 phases each)	6 phases
MS-12	11 kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 12 kV 10 kA 11 kV side of T2 Transformer (3 phases inside of the cable box) and 11 kV outgoing feeders (3 phases for 3 feeders)	12 phases
MS-13	33 kV, 11 kV Cables 1) Type 2) Purpose	 XLPE Cables Between Transformers and 33 kV/11 kV	1 lot

No.	Equipment	Specifications	Q'ty
	3) Others	Switchgear panels Cable sealing ends, Structures for Cable heads and other necessary materials	
MS-14	Other Materials 1) Low voltage cables 2) Earthing materials 3) Cabling materials	 600 V power cables and control cables For substation entire earthing (Earthing conductors, earthing rods, connection materials and other necessary materials) Conduits, cable racks and others	1 lot
MS-15	33 kV Switchgears for Makumbusho Substation 1) Purpose 2) Type 3) Manufacturer and year 4) Panel type and Serial No. 5) Ratings 6) Number of Feeders 7) Type of Circuit Breaker	 Feeder panel extension for power feeding to Msasani Substation Indoor type, 33 kV Gas insulated Metal Clad Switchgear AREVA (2009) GHA-36-25-08, No. TG092361-1 (Busbar ratings: 1,600 A) 36 kV, 800 A, 25 kA-2 sec. 33 kV Feeder: 1 panel VCB or GCB	1 panel
MS-16	Modification materials for the existing Control panels at Makumbusho Substation	Additional control panel shall be installed next to the existing control panels. The additional panel includes digital meters, mimic buses, discrepancy switches, wiring materials, terminals and other necessary parts.	1 lot
MS-17	Metering Panel at Makumbusho Substation	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 lot
MS-18	New Control Building 1) Size and story 2) Structures 3) Lightings 4) Other Facilities	 169 m^2, Single story RC structures	 1 lot 1 lot 1 lot 1 lot
MS-19	Construction of other substation facilities 1) Steel Structures 2) Substation Earthing 3) Outdoor Lightings 4) Equipment Foundations 5) Cable Trenches/Ducts 6) Oil storage basin for Transformers (with oil separator) 7) Gravels 8) Fire Extinguishers	 for Overhead wires including Overhead grounding wires	 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot

③ Muhimbili Substation (New)

(a) General

In accordance with Tanzanian Government's request, one 15 MVA, 33/11 kV Transformer and its incoming and outgoing switchgears shall be installed.

Since New City Center Substation, which is power source of Muhimbili Substation, will

be constructed newly by the Finnish Project, it is recommended that one feeder of 33 kV switchgear should be considered for Muhimbili Substation at New City Center Substation by the Finnish side.

The following basic concept is applied for new Muhimbili Substation.

- One (1) set of 15 MVA Transformer shall be installed.
- Indoor type 33 kV Switchgear panels shall be supplied for incoming and a new 15 MVA Transformer.
- Indoor type 11 kV Switchgear panels shall be installed and distributed to the area.
- Micro SCADA system shall be installed to control and monitor the substation and also to communicate with Tanzanian SCADA system.
- 110 V DC Battery and its Charger shall be supplied.
- Control building shall be constructed to install indoor type new equipment of the Project.
- In accordance with Environmental Regulation, noise level at the boundary shall be controlled less than maximum permissive noise level.

Following items should be done by the Tanzanian side.

- Multiplexer and associated communication facilities including 48 V DC Battery and charger system installation.
- Optical fiber cable installation between new Substation and DCC SCADA system
- Modification of Optical Multiplexer and/or related communication facilities in existing Substation to communicate with additional new substation if necessary
- Modification of DCC SCADA system to accommodate new Substations

(b) Substation Equipment

The equipment list for Muhimbili Substation is shown in Table 2-2-2-4.11 and Single Line Diagram in Fig. SS-E-03.

Table 2-2-2-4.11 Equipment List at Muhimbili Substation

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
1.	15 MVA Transformer (T1)	1	Set	15 MVA (ONAN) 33+/-10% / 11 kV (17 taps)
2.	50 kVA Station Service Transformer（STR1）	1	Set	50 kVA (ONAN) 33 kV +/-5.0% / 400-230 V
3.	Indoor type 33 kV Switchgear	3	panel	1 x Incoming feeder 1 x 15 MVA Transformer primary 1 x 50 kVA Station Service Transformer
4.	Indoor type 11 kV Switchgear	4	Panel	1 x 15 MVA Transformer secondary 3 x Outgoing feeders
5.	Micro SCADA System	1	lot	Substation Control system with Bay Control Units
6.	Metering Panel	1	lot	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
7.	33/11 kV Transformer Control and Protection Panel	1	lot	OLTC (On-Load Tap Changer) Control and Transformer protection
8.	AC Distribution Panels	1	set	400-230 V AC, Three phases, Four wires
9.	110 V DC Batteries and its Charger	1	set	Lead-acid batteries and its charger (including DC Distribution panels)
10.	33 kV Cables	1	lot	Between 33 kV Switchgear and first pole of 33 kV Distribution line/15 MVA Transformer
11.	11 kV Cables	1	lot	Between 11 kV Switchgear and first pole of 11 kV feeders/15 MVA Transformer
12.	Low Voltage Cables	1	lot	Power and control cables
13.	Earthing conductors and accessories	1	lot	Substation earthing
14.	Substation Building	1	lot	Switchgear room, Battery room, etc. The design of Substation building should be considered for future development of the system.

(c) Specifications of Main Equipment

Table 2-2-2-4.12 Specifications of Main Equipment

No.	Equipment	Specifications	Q'ty
MH-1	33/11 kV Power Transformer		1 set
	1) Type	Outdoor use, with On-load tap changer	
	2) Continuous Rated Capacity	15 MVA	
	3) Rated Primary Voltage	33 kV	
	4) Rated Secondary Voltage	11 kV	
	5) Type of Cooling	ONAN	
	6) Number of phase	3	
	7) Frequency	50 Hz	
	8) Tap Voltages	33 kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding Connections	Primary: Star with solidly grounded Secondary: Star with solidly grounded Tertiary: Delta Vector Group: YNyn0(d1)	
	12) Impedances	Approximately 8%	
	13) Lightning Impulse Withstand Voltage	Primary: 200 kV or higher Secondary: 90 kV or higher	
	14) Power Frequency Withstand Voltage (1 min.)	Primary: 70 kV or higher Secondary: 28 kV or higher,	
	15) Connections	Primary & Secondary: Cables	
	16) Bushing CT	Secondary: 1,200/1/1 A Primary neutral: 400/1 A Secondary neutral: 400/1 A	
MH-2	33/0.4 kV Station Service Transformer		1 set
	1) Type	Outdoor use, with No-load tap changer	
	2) Continuous Rated Capacity	50 kVA	
	3) Rated Primary Voltage	33 kV	
	4) Rated Secondary Voltage	400-230 V (three phases, four wires)	
	5) Type of Cooling	ONAN	
	6) Number of phase	3	

No.	Equipment	Specifications	Q'ty
	7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections 12) Impedances	50 Hz 33 kV +/-5.0% 5 taps 2.5% Primary: Delta Secondary: Star with solidly grounded Vector Group: Dyn11 approximately 6%	
MH-3	33 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type 36 kV Busbar: 1600 A or higher 33/11 kV Transformer: 800 A or higher Others: 800 A or higher 25 kA or higher 25 kA-2 sec. or higher 170 kV or higher 70 kV or higher DC 110 V 33/11 kV Transformer primary: 1 panel 33/0.4 kV Transformer primary: 1 panel Incoming: 1 panel	3 panel
MH-4	11 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type, air insulated 12 kV Busbar: 1,200 A or higher Others: 600 A or higher 25 kA or higher 25 kA-2 sec. or higher 75 kV or higher 28 kV or higher DC 110 V 33/11 kV Transformer secondary: 1 panel 11 kV Feeder: 3 panels	4 panel
MH-5	Micro SCADA Sytem 1) Control System 2) Component 3) Communication	 Micro SCADA system by Control and monitoring servers via local area network (LAN) for all I/O data in a substation. - Substation Control System Panel - 33/11 kV Transformer BCU - Control and Monitoring Work Stations - LAN Cables and other necessary materials Gateway unit for communication with GCC SCADA system and DCC SCADA system on IEC-60870-1-101/104 basis	1 lot
MH-6	Metering Panel	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 panel

No.	Equipment	Specifications	Q'ty
MH-7	33/11 kV Transformer Control and Protection Panel		1 panel
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Control	- Control of OLTC (On-load tap changer) on 33/11 kV Transformer - Transformer's parallel operation control and/or independent operation control (for future use to be considered)	
	3) Protection	Transformer differential protection and overcurrent protection	
MH-8	AC Distribution Panel		1 lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Ratings	AC 400 - 230 V, three phase and four wires	
MH-9	DC Power Supply System (including DC Distribution Panels)		1 lot
	1) Type	Thyristor type, indoor use, air insulated, metal enclosed self-standing type	
	2) System	Single charger	
	3) Input	400 V AC or 230 V AC	
	4) Output	DC 110 V (+/-3 %) Output voltage should be regulated by Silicon droppers or equivalent.	
	5) Batteries	Lead-acid Battery with control valves or equivalent, 700 Ah/10 Hr., 54 cells	
	6) DC Distribution Panels	Indoor use, air insulated, metal enclosed self-standing type, 110 V DC	
MH-10	33 kV Lightning Arrester		6 phases
	1) Type	Outdoor use, Metal oxide gapless type, single phase	
	2) Rated Voltage	33 kV	
	3) Rated Discharge Current	10 kA	
	4) Equipment to be applied	Top of the first pole of 33 kV incoming and outgoing feeders (3 phases each)	
MH-11	11 kV Lightning Arrester		12 phases
	1) Type	Outdoor use, Metal oxide gapless type, single phase	
	2) Rated Voltage	12 kV	
	3) Rated Discharge Current	10 kA	
	4) Equipment to be applied	11 kV side of T1 Transformer (3 phases inside of the cable box) and 11 kV outgoing feeders (3 phases for 3 feeders)	
MH-12	33 kV, 11 kV Cables		1 lot
	1) Type	XLPE Cables	
	2) Purpose	Between Transformers and 33 kV/11 kV Switchgear panels	
	3) Others	Cable sealing ends, Cable head structures and other necessary materials	
MH-13	Other Materials		1 lot
	1) Low voltage cables	600 V power cables and control cables	
	2) Earthing materials	For substation entire earthing (Earthing conductors, earthing rods, connection materials and other necessary materials)	
	3) Cabling materials	Conduits, cable racks and others	

No.	Equipment	Specifications	Q'ty
MH-14	New Control Building 1) Size and story 2) Structures 3) Lightings 4) Other Facilities	 169 m^2, Single story RC structures	 1 lot 1 lot 1 lot 1 lot
MH-15	Construction of other substation facilities 1) Steel Structures 2) Substation Earthing 3) Outdoor Lightings 4) Equipment Foundations 5) Cable Trenches/Ducts 6) Oil storage basin for Transformers (with oil separator) 7) Gravels 8) Fire Extinguishers	 for Overhead wires including Overhead grounding wires	 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot

④ Jangwani Beach Substation (New)

(a) General

Tanzanian Government's request is as same as Muhimbili Substation, i.e., one 15 MVA, 33/11 kV Transformer and its incoming and outgoing switchgears shall be installed.

Jangwani Beach Substation shall be fed from Tegeta Substation. According to the discussion with Tanzanian side and our site survey, one unit of 33 kV feeder shall be extended to existing 33 kV switchgears (No.2 Busbar side). The basic concept is as same as the one for Muhimbili Substation.

(b) Substation Equipment

The equipment list for Jangwani Beach Substation is shown in Table 2-2-2-4.13 and Single Line Diagram in Fig. SS-E-04. Table 2-2-2-4.14 indicates the necessary equipment at Tegeta Substation.

Table 2-2-2-4.13 Equipment List at Jangwani Beach Substation

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
1.	15 MVA Transformer (T1)	1	set	15 MVA (ONAN) 33+/-10% / 11 kV (17 taps)
2.	50 kVA Station Service Transformer (STR1)	1	set	50 kVA (ONAN) 33 kV +/-5.0% / 400-230 V
3.	Indoor type 33 kV Switchgear	3	panel	1 x Incoming feeder 1 x 15 MVA Transformer primary 1 x 50 kVA Station Service Transformer
4.	Indoor type 11 kV Switchgear	4	Panel	1 x 15 MVA Transformer secondary 3 x Outgoing feeders
5.	Micro SCADA System	1	lot	Substation Control system with Bay Control Units
6.	Metering Panel	1	lot	Watt-hour meters supplied by Tanzanian side are mounted by Japanese side at the Sites.

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
7.	33/11 kV Transformer Control and Protection Panel	1	lot	OLTC (On-Load Tap Changer) Control and Transformer protection
8.	AC Distribution Panels	1	set	400-230 V AC, Three phases, Four wires
9.	110 V DC Batteries and its Charger	1	set	Lead-acid batteries and its charger (including DC Distribution panels)
10.	33 kV Cables	1	lot	Between 33 kV Switchgear and first pole of 33 kV Distribution line/15 MVA Transformer
11.	11 kV Cables	1	lot	Between 11 kV Switchgear and first pole of 11 kV feeders/15 MVA Transformer
12.	Low Voltage Cables	1	lot	Power and control cables
13.	Earthing conductors and accessories	1	lot	Substation earthing
14.	Substation Building	1	lot	Switchgear room, Battery room, etc. The design of Substation building should be considered for future development of the system.

Table 2-2-2-4.14 Equipment List at Tegeta Substation

No.	Equipment	Q'ty	Unit	Major Specifications
1.	Indoor type 33 kV Switchgear	1	panel	One feeder unit of 33 kV Switchgear panel (feeding for Jangwani Beach Substation)
2.	Modification materials for the existing Control panels	1	lot	Mimic buses, Control switches, Name plates and other necessary materials for Control panel modification
3.	Watt-hour meter	1	set	To install Watt-hour meter to the existing panel
4.	33 kV Cables	1	lot	33 kV Switchgear to 33 kV first pole inside the Substation
5.	Low voltage cables	1	lot	Power and control cables

(c) Specifications of Main Equipment

Table 2-2-2-4.15 Specifications of Main Equipment

No.	Equipment	Specifications	Q'ty
JB-1	33/11 kV Power Transformer		1 set
	1) Type	Outdoor use, with On-load tap changer	
	2) Continuous Rated Capacity	15 MVA	
	3) Rated Primary Voltage	33 kV	
	4) Rated Secondary Voltage	11 kV	
	5) Type of Cooling	ONAN	
	6) Number of phase	3	
	7) Frequency	50 Hz	
	8) Tap Voltages	33 kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding Connections	Primary: Star with solidly grounded Secondary: Star with solidly grounded Tertiary: Delta	
	12) Impedances	Approximately 8%	
	13) Lightning Impulse Withstand Voltage	Primary: 200 kV or higher Secondary: 90 kV or higher	
	14) Power Frequency Withstand	Primary: 70 kV or higher	

No.	Equipment	Specifications	Q'ty
	Voltage (1 min.) 15) Connection 16) Bushing CT	Secondary: 28 kV or higher Primary & Secondary: Cables Secondary: 1,200/1/1 A Primary neutral: 400/1 A Secondary neutral: 400/1 A	
JB-2	33/0.4 kV Station Service Transformer 1) Type 2) Rated Primary Voltage 3) Rated Secondary Voltage 4) Continuous Rated Capacity 5) Type of Cooling 6) Number of phase 7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections 12) Impedances	 Outdoor use, with No-load tap changer 33 kV 400-230 V (three phases, four wires) 50 kVA ONAN 3 50 Hz 33 kV+/-5.0% 5 taps 2.5% Primary: Delta Secondary: Star with solidly grounded Vector Group: Dyn11 Approximately 6%	1 set
JB-3	33 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type 36 kV Busbar: 1600 A or higher 33/11 kV Transformer: 800 A or higher Others: 800 A or higher 25 kA or higher 25 kA-2 sec. or higher 170 kV or higher 70 kV or higher DC 110 V 33/11 kV Transformer primary: 1 panel 33/0.4 kV Transformer primary: 1 panel Incoming: 1 panel	3 Panel
JB-4	11 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type, air insulated 12 kV Busbar: 1250 A or higher Others: 600 A or higher 25 kA or higher 25 kA-2 sec. or higher 75 kV or higher 28 kV or higher DC 110 V 33/11 kV Transformer secondary: 1 panel 11 kV Feeder: 3 panels	4 panel
JB-5	Micro SCADA Sytem 1) Control System	 Micro SCADA system by Control and monitoring servers via local area network (LAN) for all I/O data in a substation.	1 lot

No.	Equipment	Specifications	Q'ty
	2) Component 3) Communication	- Substation Control System Panel - 33/11 kV Transformer BCU - Control and Monitoring Work Stations - LAN Cables and other necessary materials Gateway unit for communication with GCC SCADA system and DCC SCADA system on IEC-60870-1-101/104 basis	
JB-6	Metering Panel	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 panel
JB-7	33/11 kV Transformer Control and Protection Panel 1) Type 2) Control 3) Protection	 Indoor use, air insulated, metal enclosed self-standing type - Control of OLTC (On-load tap changer) on 33/11 kV Transformers - Transformer's parallel operation control and/or independent operation control (for future use to be considered) Transformer differential protection and overcurrent protection	1 panel
JB-8	AC Distribution Panel 1) Type 2) Ratings	 Indoor use, air insulated, metal enclosed self-standing type AC 400 - 230 V, three phase and four wires	1 lot
JB-9	DC Power Supply System (including DC Distribution Panels) 1) Type 2) System 3) Input 4) Output 5) Batteries 6) DC Distribution Panels	 Thyristor type, indoor use, air insulated, metal enclosed self-standing type Single charger 400 V AC or 230 V AC DC 110 V (+/-3 %) Output voltage should be regulated by Silicon droppers or equivalent. Lead-acid Battery with control valves or equivalent, 700 Ah/10 Hr., 54 cells Indoor use, air insulated, metal enclosed self-standing type, 110 V DC	1 lot
JB-10	33 kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 33 kV 10 kA Top of the first pole of 33 kV incoming and outgoing feeders (3 phases each)	6 phase
JB-11	11 kV Lightning Arrester 1) Type 2) Rated Voltage 3) Rated Discharge Current 4) Equipment to be applied	 Outdoor use, Metal oxide gapless type, single phase 12 kV 10 kA 11 kV side of T1 Transformer (3 phases inside of the cable box) and 11 kV outgoing feeders (3 phases for 3 feeders)	12 phase

No.	Equipment	Specifications	Q'ty
JB-12	33 kV, 11 kV Cables 1) Type 2) Purpose 3) Others	 XLPE Cables Between Transformers and 33/11 kV Switchgear panels Cable sealing ends, Cable head structures and other necessary materials	1 lot
JB-13	Other Materials 1) Low voltage cables 2) Earthing materials 3) Cabling materials	 600 V power cables and control cables For substation entire earthing (Earthing conductors, earthing rods, connection materials and other necessary materials) Conduits, cable racks and others	1 lot
JB-14	33 kV Switchgear for Tegeta Substation 1) Purpose 2) Type 3) Manufacturer and year 3) Panel type and Reference No. 4) Ratings 5) Number of Feeders 6) Type of Circuit Breaker	 Feeder panel extension for power feeding to Jangwani Beach Substation Indoor type, 33 kV Air insulated Metal Clad Switchgear ABB SACE (1994) UNILVER G36, 1.2065.3 (Busbar rating: 1,250 A) 36 kV, 800 A, 25 kA-1 sec. 11 kV Feeder: 1 panel VCB or GCB	1 panel
JB-15	Modification materials for the existing Control panels at Tegeta Substation	Meters, Mimic buses, Control switches, Wiring materials, Terminals and other necessary parts	1 lot
JB-16	Metering Panel at Tegeta Substation	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 lot
JB-17	New Control Building 1) Size and story 2) Structures 3) Lightings 4) Other Facilities	 169 m^2, Single story RC structures	 1 lot 1 lot 1 lot 1 lot
JB-18	Construction of other substation facilities 1) Steel Structures 2) Substation Earthing 3) Outdoor Lightings 4) Equipment Foundations 5) Cable Trenches/Ducts 6) Oil storage basin for Transformers (with oil separator) 7) Gravels 8) Fire Extinguishers	 for Overhead wires including Overhead grounding wires	 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot

⑤ Mwananyamala Substation (New)

(a) General

Tanzanian Government's request is as same as Muhimbili Substation, i.e., one 15 MVA, 33/11 kV Transformer and its incoming and outgoing switchgears shall be installed.

Mwananyamala Substation shall be fed from Makumbusho Substation, as same as

Msasani Substation. According to the discussion with Tanzanian side and our site survey, one unit of 33 kV feeder shall be extended at No.1 Busbar side of existing 33 kV switchgear, which is the other side of the one for Msasani Substation. The basic concept is as same as the one for Muhimbili Substation.

(b) Substation Equipment

The equipment list for Mwananyamala Substation is shown in Table 2-2-2-4.16 and Single Line Diagram in Fig. SS-E-05. Table 2-2-2-4.17 indicates the necessary equipment in Makumbusho Substation.

Table 2-2-2-4.16 Equipment List at Mwananyamala Substation

No.	Equipment supplied by the Japanese side	Q'ty	Unit	Major Specifications
1.	15 MVA Transformer (T1)	1	set	15 MVA (ONAN) 33+/-10% / 11 kV（17 taps）
2.	50 kVA Station Service Transformer	1	set	50 kVA (ONAN) 33 kV +/-5.0% / 400-230 V
3.	Indoor type 33 kV Switchgear	3	panel	1 x Incoming feeder 1 x 15 MVA Transformer primary 1 x 50 kVA Station Service Transformer
4.	Indoor type 11 kV Switchgear	4	Panel	1 x 15 MVA Transformer secondary 3 x Outgoing feeders
5.	Micro SCADA System	1	lot	Substation Control system with Bay Control Units
6.	Metering Panel	1	lot	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side.
7.	33/11 kV Transformer Control and Protection Panel	1	lot	OLTC (On-Load Tap Changer) Control and Transformer protection
8.	AC Distribution Panels	1	set	400-230 V AC, Three phases, Four wires
9.	110 V DC Batteries and its Charger	1	set	Lead-acid batteries and its charger (including DC Distribution panels)
10.	33 kV Cables	1	lot	Between 33 kV Switchgear and first pole of 33 kV Distribution line/15 MVA Transformer
11.	11 kV Cables	1	lot	Between 11 kV Switchgear and first pole of 11 kV feeders/15 MVA Transformer
12.	Low Voltage Cables	1	lot	Power and control cables
13.	Earthing conductors and accessories	1	lot	Substation earthing
14.	Substation Building	1	lot	Switchgear room, Battery room, etc. The design of Substation building should be considered for future development of the system.

Table 2-2-2-4.17 Equipment List at Makumbusho Substation

No.	Equipment	Q'ty	Unit	Major Specifications
1.	Indoor type 33 kV Switchgear	1	panel	One feeder unit of 33 kV Switchgear panel (feeding for Mwananyamala Substation)
2.	Modification materials for the existing Control panels	1	lot	Mimic buses, Discrepancy switches, Name plates and other necessary materials for Control panel modification
3.	Watt-hour meter	1	lot	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.
4.	33 kV Cables	1	lot	33 kV Switchgear to 33 kV first pole inside the Substation
5.	Low voltage cables	1	lot	Power and control cables

(c) Specifications of Main Equipment

Table 2-2-2-4.18 Specifications of Main Equipment

No.	Equipment	Specifications	Q'ty
MW-1	33/11 kV Power Transformer 1) Type 2) Continuous Rated Capacity 3) Rated Primary Voltage 4) Rated Secondary Voltage 5) Type of Cooling 6) Number of phase 7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections 12) Impedances 13) Lightning Impulse Withstand Voltage 14) Power Frequency Withstand Voltage (1 min.) 15) Connection 16) Bushing CT	 Outdoor use, with On-load tap changer 15 MVA 33 kV 11 kV ONAN 3 50 Hz 33 kV +10% to -10% 17 taps 1.25% Primary: Star with solidly grounded Secondary: Star with solidly grounded Tertiary: Delta Approximately 8% Primary: 200 kV or higher Secondary: 90 kV or higher Primary: 70 kV or higher Secondary: 28 kV or higher Primary & Secondary: Cables Secondary: 1,200/1/1 A Primary neutral: 400/1 A Secondary neutral: 400/1 A	1 set
MW-2	Station Service Transformer 1) Type 2) Continuous Rated Capacity 3) Rated Primary Voltage 4) Rated Secondary Voltage 5) Type of Cooling 6) Number of phase 7) Frequency 8) Tap Voltages 9) Number of taps 10) Step voltage 11) Winding Connections	 Outdoor use, with No-load tap changer 50 kVA 33 kV 400-230 V (three phases, four wires) ONAN 3 50 Hz 33 kV +/-5.0% 5 taps 2.5% Primary: Delta Secondary: Star with solidly grounded Vector Group: Dyn11	1 set

No.	Equipment	Specifications	Q'ty
	12) Impedances	Approximately 6%	
MW-3	33 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type 36 kV Busbar: 1600 A or higher 33/11 kV Transformer: 800 A or higher Others: 800 A or higher 25 kA or higher 25 kA-2 sec. or higher 170 kV or higher 70 kV or higher DC 110 V 33/11 kV Transformer primary: 1 panel 33/0.4 kV Transformer primary: 1 panel Incoming: 1 panel	3 panel
MW-4	11 kV Switchgears 1) Type 2) Rated Voltage 3) Rated Current 4) Rated Interrupting Current 5) Rated Short-time Current 6) Lightning Impulse Withstand Voltage 7) Power Frequency Withstand Voltage (1 min.) 8) Control Voltage 9) Number of Feeders	 Indoor use, Metal enclosed or Metal clad type, air insulated 12 kV Busbar: 1,200 A or higher Others: 600 A or higher 25 kA or higher 25 kA-2 sec. or higher 90 kV or higher 28 kV or higher DC 110 V 33/11 kV Transformer secondary: 1 panel 11 kV Feeder: 3 panels	4 panel
MW-5	Micro SCADA Sytem 1) Control System 2) Component 3) Communication	 Micro SCADA system by Control and monitoring servers via local area network (LAN) for all I/O data in a substation - Substation Control System Panel - 33/11 kV Transformer BCU - Control and Monitoring Work Stations - LAN Cables and other necessary materials Gateway unit for communication with GCC SCADA system and DCC SCADA system on IEC-60870-1-101/104 basis	1 lot
MW-6	Metering Panel	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 panel
MW-7	33/11 kV Transformer Control and Protection Panel 1) Type 2) Control	 Indoor use, air insulated, metal enclosed self-standing type - Control of OLTC (On-load tap changer) on 33/11 kV Transformers - Transformer's parallel operation control and/or independent operation	1 panel

No.	Equipment	Specifications	Q'ty
		control (for future use to be considered)	
	3) Protection	Transformer differential protection and overcurrent protection	
MW-8	AC Distribution Panel		1lot
	1) Type	Indoor use, air insulated, metal enclosed self-standing type	
	2) Ratings	AC 400 - 230 V, three phase and four wires	
MW-9	DC Power Supply System (including DC Distribution Panels)		1 lot
	1) Type	Thyristor type, indoor use, air insulated, metal enclosed self-standing type	
	2) System	Single charger	
	3) Input	400 V AC or 230 V AC	
	4) Output	DC 110 V (+/-3 %) Output voltage should be regulated by Silicon droppers or equivalent.	
	5) Batteries	Lead-acid Battery with control valves or equivalent, 100 Ah/10 Hr., 54 cells	
	6) DC Distribution Panels	Indoor use, air insulated, metal enclosed self-standing type, 110 V DC	
MW-10	33 kV Lightning Arrester		6
	1) Type	Outdoor use, Metal oxide gapless type, single phase	phase
	2) Rated Voltage	33 kV	
	3) Rated Discharge Current	10 kA	
	4) Equipment to be applied	Top of the first pole of 33 kV incoming and outgoing feeders (3 phases each)	
MW-11	11 kV Lightning Arrester		12
	1) Type	Outdoor use, Metal oxide gapless type, single phase	phase
	2) Rated Voltage	12 kV	
	3) Rated Discharge Current	10 kA	
	4) Equipment to be applied	11 kV side of T1 Transformer (3 phases inside of the cable box) and 11 kV outgoing feeders (3 phases for 3 feeders)	
MW-12	33 kV, 11 kV Cables		1 lot
	1) Type	XLPE Cables	
	2) Purpose	Between Transformers and 33/11 kV Switchgear panels	
	3) Others	Cable sealing ends, Cable head structures and other necessary materials	
MW-13	Other Materials		1 lot
	1) Low voltage cables	600 V power cables and control cables	
	2) Earthing materials	For substation entire earthing (Earthing conductors, earthing rods, connection materials and other necessary materials)	
	3) Cabling materials	Conduits, cable racks and others	
MW-14	33 kV Switchgears for Makumbusho Substation		1
	1) Purpose	Feeder panel extension for power feeding to Mwananyamala Substation	panel
	2) Type	Indoor type, 33 kV Gas insulated Metal Clad Switchgear	
	3) Manufacturer and year	AREVA (2009)	

No.	Equipment	Specifications	Q'ty
	4) Panel type and Serial No. 5) Ratings 6) Number of Feeders 7) Type of Circuit Breaker	GHA-36-25-08, No. TG092361-1 (Busbar ratings: 1,600 A) 36 kV, 800 A, 25 kA-2 sec. or higher 33 kV Feeder: 1 panel VCB or GCB	
MW-15	Modification materials for the existing Control panels at Makumbusho Substation	Digital meters, mimic buses, discrepancy switches, wiring materials, terminals and other necessary parts. Note; An additional control panel is supplied, when 33 kV feeder extension panel is supplied for Msasani substation. See item MS-15.	1 lot
MW-16	Metering Panel at Makumbusho Substation	Watt-hour meters supplied by the Tanzanian side are mounted by the Japanese side at the Sites.	1 lot
MW-17	New Control Building 1) Size and story 2) Structures 3) Lightings 4) Other Facilities	 169 m^2, Single story RC structures	 1 lot 1 lot 1 lot 1 lot
MW-18	Construction of other substation facilities 1) Steel Structures 2) Substation Earthing 3) Outdoor Lightings 4) Equipment Foundations 5) Cable Trenches/Ducts 6) Oil storage basin for Transformers (with oil separator) 7) Gravels 8) Fire Extinguishers	 for Overhead wires including Overhead grounding wires	 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot 1 lot

⑥ Spare Parts and Maintenance Tools

(a) Spare Parts

Table 2-2-2-4.19 Spare Parts for 5 Substations

	Spare Parts	Ilala S/S	Msasani S/S	Muhimbili S/S	Jangwani Beach S/S	Mwananya-mala S/S
1.	132 kV GCB					
(1)	Trip coil	1				
(2)	Closing coil	1				
(3)	MCCB (Each type)	1				
(4)	Auxiliary relay (each type)	1				
2.	132 kV Disconnecting Switch (DS)					
(1)	MCCB (each type)	1				
(2)	Magnetic contactor (each type)	1				
(3)	Auxiliary relay (each type)	1				
3.	Modification materials for existing 132 kV DS					
(1)	MCCB (each type)	1				
(2)	Magnetic contactor (each type)	1				

	Spare Parts	Ilala S/S	Msasani S/S	Muhimbili S/S	Jangwani Beach S/S	Mwananya-mala S/S
(3)	Auxiliary relay (each type)	1				
4.	132/33 kV and 33/11 kV Transformers					
(1)	132 kV Bushing	1				
(2)	Buchholts relay	1	1	1	1	1
(3)	Oil temperature gauge	1	1	1	1	1
(4)	Oil level gauge	1	1	1	1	1
(5)	MCCB (each type)	1				
(6)	Auxiliary relay (each type)	1				
(7)	Fuse (each type)	100%				
(8)	Lamp (each type)	100%				
	LED lamp (each type, with socket)	1				
5.	33 kV Switchgears					
(1)	Interrupting valves (each type)	3 phases	3 phases	3 phases	3 phases	3 phases
(2)	Lamp (each type)	100%	100%	100%	100%	100%
	LED lamp (each type, with socket)	10%	10%	10%	10%	10%
(3)	MCCB (each type)	1	1	1	1	1
(4)	Protection relay (each type)	1	1	1	1	1
(5)	Auxiliary relay (each type)	3	1	1	1	1
(6)	Magnetic contactor (each type)	1	1	1	1	1
(7)	DC/DC Converter (each type)	1	1	1	1	1
(8)	Trip coil (each type)	1	1	1	1	1
(9)	Closing coil (each type)	1	1	1	1	1
(10)	Space heater (with thermostat)	1	1	1	1	1
(11)	Meter (each type)	1	1	1	1	1
(12)	Switch (each type)	1	1	1	1	1
6.	11 kV Switchgears					
(1)	Circuit Breaker (each type)	1	1	1	1	1
(2)	Lamp (each type)	100%	100%	100%	100%	100%
	LED lamp (each type, with socket)	10%	10%	10%	10%	10%
(3)	Fuse (each type)	1	1	1	1	1
(4)	MCCB (each type)	1	1	1	1	1
(5)	Protection relay (each type)	1	1	1	1	1
(6)	Auxiliary relay (each type)	3	1	1	1	1
(7)	Magnetic contactor (each type)	1	1	1	1	1
(8)	DC/DC Converter (each type)	1	1	1	1	1
(9)	Trip coil (each type)	1	1	1	1	1
(10)	Closing coil (each type)	1	1	1	1	1
(11)	Space heater (with thermostat)	1	1	1	1	1
(12)	Meter (each type)	1	1	1	1	1
(13)	Switch (each type)	1	1	1	1	1
7.	Micro SCADA system					
(1)	Bay control unit (each type)	1	1	1	1	1

	Spare Parts	Ilala S/S	Msasani S/S	Muhimbili S/S	Jangwani Beach S/S	Mwananya-mala S/S
(2)	I/O module (each type)	1	1	1	1	1
(3)	Ethernet switch (each type)	1	1	1	1	1
8.	Transformer Voltage Regulating panel					
(1)	Transformer Voltage Regulator	1				
(2)	MCCB (each type)	1				
(3)	Meter (each type)	1				
(4)	Lamp (each type)	100%				
	LED lamp (each type, with socket)	1				
(5)	Fuse (each type)	1				
9.	Transformer Protection Panel					
(1)	Protection relay (each type)	1				
(2)	MCCB (each type)	1				
(3)	Lamp (each type)	100%				
	LED lamp (each type, with socket)	10%				
(4)	Fuse (each type)	1				
10.	33/11 kV Transformer Control and Protection Panel					
(1)	Protection relay (each type)		1	1	1	1
(2)	Transformer Voltage Regulator		1	1	1	1
(3)	Meter (each type)		1	1	1	1
(4)	Lamp (each type)		100%	100%	100%	100%
	LED lamp (each type, with socket)		10%	10%	10%	10%
(5)	Fuse (each type)		1	1	1	1
(6)	Annunciator unit		1	1	1	1
(7)	Operation switch (each type)		1	1	1	1
11.	132 kV Transmission Line Protection Panel					
(1)	Protection relay (each type)	1				
(2)	MCCB (each type)	1				
(3)	Lamp (each type)	100%				
	LED lamp (each type, with socket)	10%				
(4)	Fuse (each type)	1				
12.	DC Power Supply System					
(1)	MCCB (each type)	1	1	1	1	1
(2)	Meter (each type)	1	1	1	1	1
(3)	Lamp (each type)	100%	100%	100%	100%	100%
	LED lamp (each type, with socket)	10%	10%	10%	10%	10%
(4)	Fuse (each type)	1	1	1	1	1
13.	Uninterruptible Power Supply System					
(1)	MCCB (each type)	1				
(2)	Meter (each type)	1				

	Spare Parts	Ilala S/S	Msasani S/S	Muhimbili S/S	Jangwani Beach S/S	Mwananya-mala S/S
(3)	Lamp (each type)	100%				
	LED lamp (each type, with socket)	10%				
(4)	Fuse (each type)	1				
14.	AC Distribution Panel					
(1)	MCCB (each type)	1	1	1	1	1
(2)	Meter (each type)	1	1	1	1	1
(3)	Lamp (each type)	100%	100%	100%	100%	100%
	LED lamp (each type, with socket)	10%	10%	10%	10%	10%
(4)	Fuse (each type)	1	1	1	1	1
15.	33 kV Arresters					
(1)	33 kV Arrester	3 phases	3 phases	3 phases	3 phases	3 phases
16.	11 kV Arresters					
(1)	11 kV Arrester	3 phases	3 phases	3 phases	3 phases	3 phases
17.	33 kV and 11 kV Cables					
(1)	Outdoor use, 33 kV Cable sealing ends (each type, 3 phase/set)	1	1	1	1	1
(2)	Indoor use, 33 kV Cable sealing ends (each type, 3 phase/set)	1	1	1	1	1
(3)	Outdoor use, 11 kV Cable sealing ends (each type, 3 phase/set)	1	1	1	1	1
(4)	Indoor use, 11 kV Cable sealing ends (each type, 3 phase/set)	1	1	1	1	1

Table 2-2-2-4.20 Spare Parts for Makumbusho and Tegeta Substations

	Spare Parts	Makumbusho S/S	Tegeta S/S
1.	33 kV Switchgears		
(1)	Interrupting valves (each type)	3 phases	3 phases
(2)	Lamp (each type)	100%	100%
	LED lamp (each type, with socket)	10%	10%
(3)	MCCB (each type)	1	1
(4)	Protection relay (each type)	1	1
(5)	Auxiliary relay (each type)	1	1
(6)	Magnetic contactor (each type)	1	1
(7)	DC/DC Converter (each type)	1	1
(8)	Trip coil (each type)	1	1
(9)	Closing coil (each type)	1	1
(10)	Space heater (with thermostat)	1	1
(11)	Meter (each type)	1	1
(12)	Switch (each type)	1	1
2.	Control Panels		
(1)	Auxiliary relay (each type)	1	1
(2)	Meter (each type)	1	1
(3)	Lamp (each type)	100%	100%
	LED lamp (each type, with socket)	10%	10%

	Spare Parts	Makumbusho S/S	Tegeta S/S
(4)	Fuse (each type)	1	1
(5)	Operation switch (each type)	1	1

(b) Testing Equipment and Maintenance Tools for Procurement Equipment

Table 2-2-2-4.21 Testing Equipment and Maintenance Tools

	Tools	Ilala S/S	4×33/11kV S/S
1.	Testing Equipment		
1.1	Oil Insulating Testing Device	1	
1.2	Universal Tester	1	2
1.3	Phase Indicator	1	1
1.4	Protective Relay Fault Analyzer	1	
1.5	Voltage Detector (200 kV AC)	1	1
1.6	Voltage Detector (3～34.5 kV AC)	1	1
1.7	Voltage Detector (600 V AC)	1	1
1.8	Megger (500 V DC)	1	1
1.9	Megger (1,000 V DC)	1	1
1.10	Megger (5,000 V DC)	1	
1.11	Digital Multi-meter	1	1
1.12	Clamp meter	1	1
2.	Maintenance Tools for Substations		
2.1	Electrical Work Tools Tool box, Bolt cutter, Terminal crimping tool, adjustable wrench, Water pump pliers, Cable cutter, Wire stripper, Hammer, Convex rule, Electric knife, Hand saw, Combination cutting pliers with terminal crimping, Cutting pliers, Side cutting pliers, Diagonal cutting pliers, Screw driver (+), Screw driver (-), Torpedo level	1	2

2) 132kV Transmission Line (Ubungo Substation to Ilala Substation)

① Basic items

Using the existing two-circuit transmission towers between Ubungo and Ilala Substations, both circuits shall be wired with thermal resistant conductor to secure transmission capacity to bear the loads for new City Center Substation (132/33/11kV), being built with aid from Finland and the Ilala Substation (132/33/11kV). Figure 2-2-2-4.1 shows an image of the 132kV transmission line reinforcement.

One of the circuits currently used in 240mm^2 ACSR and the other circuit which is currently used with ACSR 150mm^2 lines shall be re-connected with thermal resistant conductors to the steel structures at each substation. No additional steel structure shall be added for either substation.

Note that a steel structure (ST No.13) must be added on Songas grounds.

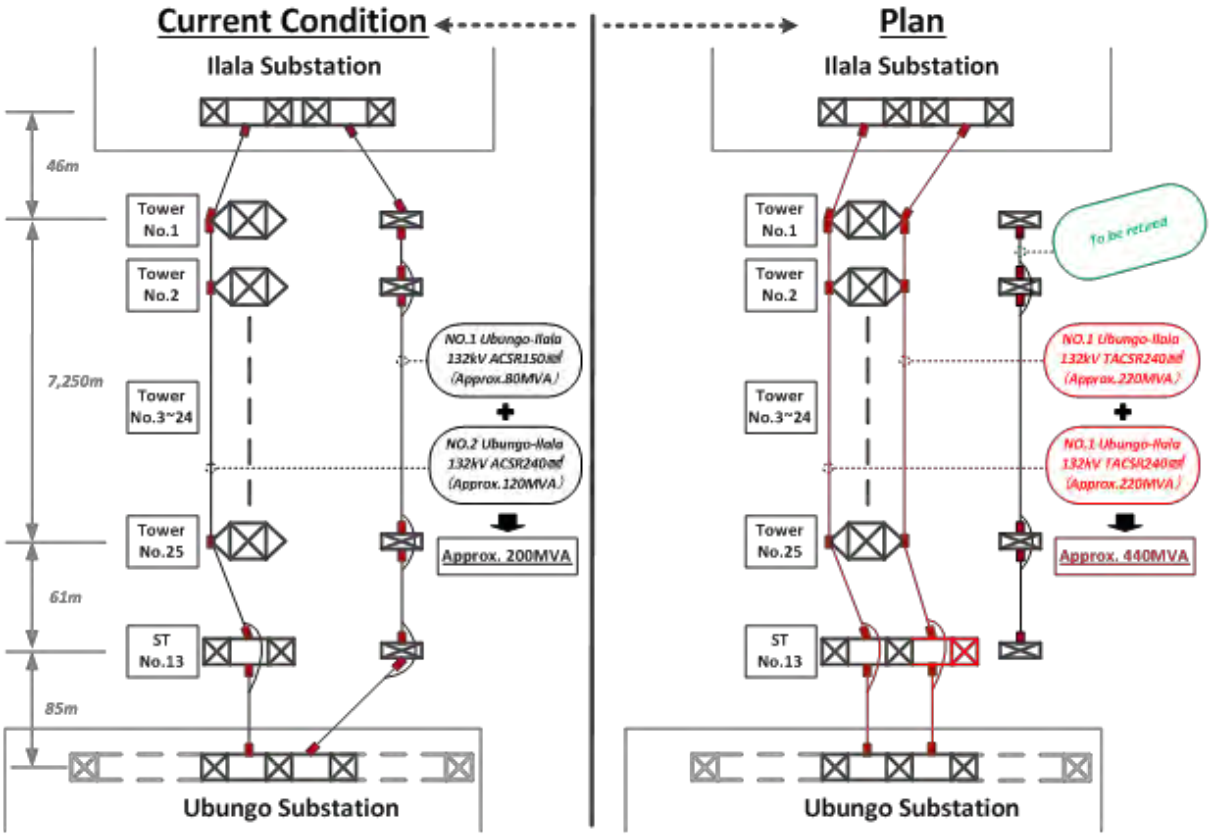


Figure 2-2-2-4.1 Image of 132kV Transmission Line Reinforcement

② Planning

(a) Line arrangement

A vertical line arrangement shall be used, as with existing lines.

(b) Supports

Existing transmission steel towers (standard design span of 300m) shall be used for line supports.

Upon visual inspection, some minor damage and oxidation was noticed on some of the steel towers, but not enough to impact tower strength.

(c) Foundations

Upon visual inspection above the ground, there was no real damage to the foundation.

(d) Conductors

Due to very little allowance of the strength in original design conditions for the existing transmission towers, TACSR 240mm^2 (TACSR) shall be used since TACSR is estimated to be almost the same diameter and weight to existing lines with good thermal resistance and at least 1.6 times of the allowable current.

(e) Insulation

The same 250 mm porcelain insulator of existing lines shall be used.

③ Equipment list

The Material list is shown in Table 2-2-2-4.22.

Bill of Quantities of the Materials for Reinforcement of 132kV Transmission Line ILALA-UBUNGO

Tower No.			ILALA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Str.	Ubungo	Installation	spare	Procurement		Unit
Tower Type				D±0	A+3	A+3	A±0	D±0	A±0	A±0	A±0	A+3	A+3	B+3	A+3	A±0	A+3	A±0	A+3	B+3	A+3	A+3	A±0	A+3	A+3	A±0	C+3	D+3	St13	St12					
Span(m)		No.	46	259	357	268	297	326	302	283	252	356	206	306	311	316	329	336	311	293	328	310	328	320	322	317	217	61	85	**7,442**				
Conductor(3phase×2cc.)		TL-1	276	1,554	2,142	1,608	1,782	1,956	1,812	1,698	1,512	2,136	1,236	1,836	1,866	1,896	1,974	2,016	1,866	1,758	1,968	1,860	1,968	1,920	1,932	1,902	1,302	366	510	**44,652**	10%	**49,117**		m
Grounding wire		TL-2	46																									61	85	**192**	10%	**211**		m
Insulator String	Tension		6	12				12						12						12							12	12	6	6	**90**	0	**90**		set
	Inverted	TL-3																											6		**6**	0	**6**		set
	Suspension	~			6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**		set
	Jumper	TL-12		6																								6	6		**18**	0	**18**		set
Disc Insulator	Tension		66	132				132						132						132							132	132	66	66	**990**	0	**990**		
	Inverted	TL-3																											66		**66**	0	**66**	**2,508**	piece
	Suspension				66	66	66		66	66	66	66	66		66	66	66	66	66		66	66	66	66	66	66					**1,254**	0	**1,254**		
	Jumper			66																								66	66		**198**	0	**198**		
Anchor shaclе	Tension		6	12				12						12						12							12	12	6	6	**90**	0	**90**		
	Inverted	TL-4																											18		**18**	0	**18**	**240**	piece
	Suspension				6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**		
	Jumper			6																								6	6		**18**	0	**18**		
Horn holder eye	Tension		6	12				12						12						12							12	12	6	6	**90**	0	**90**		
	Suspension	TL-5			6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**	**222**	piece
	Jumper			6																								6	6		**18**	0	**18**		
	Inverted	TL-6																											6		**6**	0	**6**		piece
Arcing horn	Tension	TL-7	6	12				12						12						12							12	12	6	6	**90**	0	**90**	**96**	set
	Inverted																												6		**6**	0	**6**		
	Jumper	TL-8		6																								6	6		**18**	0	**18**	**132**	set
	Suspension				6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**		
Horn holder socket eye	Tension	TL-9	6	12				12						12						12							12	12	6	6	**90**	0	**90**	**96**	piece
	Inverted																												6		**6**	0	**6**		
	Jumper	TL-10		6																								6	6		**18**	0	**18**	**132**	piece
	Suspension				6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**		
Clamp for Conductor	Tension	TL-11	6	12				12						12						12							12	12	6	6	**90**	10%	**99**	**106**	piece
	Inverted																												6		**6**	10%	**7**		
	Jumper	TL-12		6																								6	6		**18**	10%	**20**	**145**	piece
	Suspension				6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	10%	**125**		
Dampel Power	IN	TL-13		3	3	6	3	3	6	6	3	3	6	3	6	6	6	6	6	3	6	6	6	6	6	6	6	3	3	3	**129**	0	**129**		set
	OUT	TL-14	3	3	6	3	3	6	6	3	3	6	3	6	6	6	6	6	6	3	6	6	6	6	6	6	3	3	3		**129**	0	**129**		set
Armor Rod		TL-15			6	6	6		6	6	6	6	6		6	6	6	6	6		6	6	6	6	6	6					**114**	0	**114**		piece
Intermediate sleeve for Conductor		TL-16																													**0**	0	**18**		piece
Jumper sleeve for Conductor		TL-17																													**0**	0	**18**		piece
Repair sleeve		TL-18																													**0**	0	**18**		piece
Anchor shackle for grounding wire		TL-19	2	2																							2	2	2		**10**	0	**10**		piece
Suspension clamp for grounding wire		TL-20	2	2																							2	2	2		**10**	10%	**11**		piece
Aero plate		TL-21		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		**52**	0	**52**		piece
Line No. plate		TL-22		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		**52**	0	**52**		set
Phase rotation plate		TL-23		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		**52**	0	**52**		set
National Flag of Japan		TL-24		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		**52**	0	**52**		piece
Hatari plate		TL-25		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		**52**	0	**52**		piece
Steel structure		TL-26																										1			**1**	0	**1**		set

∗ Existing materials will be re-used for the existing line to become a new line. Steel structure No. 13 shall be extended for new line at Songas. 10% of spare materials such as clamps shall be procured.

④ Main specifications for major equipment

A summary of the major equipment related to 132kV transmission line facility enhancements (Ubungo Substation -Ilala Substation) is shown in Table 2-2-2-4.23.

Table 2-2-2-4.23 Summary of Major Equipment (132kV Transmission Line)

No.	Equipment and Materials	Quantity	Unit	Specification
TL-1	Conductor	49,117	m	Applicable standard: IEC or equivalent Type: TACSR (Thermal-Resistant Aluminum Alloy Conductor Steel Reinforcement) Size:240mm^2
TL-2	Grounding wire	211	m	Applicable standard: IEC or equivalent Type: ACS (Aluminum-Clad Steel Wire) Size:55mm2
TL-3	Insulator	1	unit	Applicable standard: IEC or equivalent Type: Porcelain galvanized disk type254mmφ Minimum creepage distance：292mm or more Minimum Electrical-Mechanical failing load：120kN Dry lightning impulse withstand voltage：110kV Wet power frequency withstand test voltage：40kV Power frequency puncture voltage：110kV
TL-4	Anchor shackle for conductor	1	unit	Material: Mild steel Type: Bolt type Coating: Hot dip galvanizing Size: for TACSR240mm^2
TL-5	Horn holder ball eye	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-6	Horn holder ball eye (Inverted)	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-7	Arcing horn (Tension・Inverted)	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-8	Arcing horn (Jumper・Suspension)	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-9	Horn holder socket eye (Tension・Inverted)	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-10	Horn holder socket eye (Jumper・Suspension)	1	unit	Material: Mild steel Coating: Hot dip galvanizing
TL-11	Clamp for conductor (Tension・Inverted)	1	unit	Material: Aluminum alloy casting, Mild steel Coating: Hot dip galvanizing Size: for TACSR240mm^2
TL-12	Clamp for conductor (Jumper・Suspension)	1	unit	Material: Aluminum alloy casting, Mild steel Coating: Hot dip galvanizing Size: for TACSR240mm^2
TL-13	Damper for conductor (In)	1	unit	Material: Mild steel Type: Stockbridge type Coating: Hot dip galvanizing Size: for TACSR240mm^2
TL-14	Damper for conductor (Out)	1	unit	Material: Mild steel Type: Stockbridge type

No.	Equipment and Materials	Quantity	Unit	Specification
				Coating: Hot dip galvanizing Size: for TACSR240mm^2
TL-15	Armor Rod	1	unit	Material: Aluminum alloy casting Size: for TACSR240mm^2
TL-16	Intermediate sleeve for conductor	1	unit	Type: Compression type Size: for TACSR240mm^2
TL-17	Jumper sleeve for conductor	1	unit	Type: Compression type Size: for TACSR240mm^2
TL-18	Repair sleeve	1	unit	Type: Compression type Size: for TACSR240mm^2
TL-19	Anchor shackle for grounding wire	1	unit	Material: Mild steel Type: Bolt type Coating: Hot dip galvanizing Size: for ACS55mm^2
TL-20	Suspension clamp for grounding wire	1	unit	Material: Aluminum alloy casting, Mild steel Coating: Hot dip galvanizing Size: for ACS55mm^2
TL-21	Aero plate	1	unit	Material: Aluminum or stainless Size:700mm×400mm×t2.5mm Accessary: Stainless bolt
TL-22	Line No. plate	1	unit	Material: Aluminum or stainless Size:380mm×380mm×t2.5mm Accessary: Stainless bolt
TL-23	Phase rotation plate	1	unit	Material: Aluminum or stainless Size:150mm×230mm×t2.5mm Accessary: Stainless bolt
TL-24	National Flag of Japan	1	unit	Material: Aluminum or stainless Size:300mm×200mm×t2.5mm High weather resistance Accessary: Stainless bolt
TL-25	Hatari plate	1	unit	Material: Aluminum or stainless Size:300mm×200mm×t2.5mm Accessary: Stainless bolt
TL-26	Steel structure	1	unit	Material: Mild steel Coating: Hot dip galvanizing Size: Post (P1) W1,016mm×D1,516mm×H19,000mm Beam (B1) W15,240mm×D1,516mm×H1,000mm

3) 33kV Distribution Lines

① Basic Concept

Distribution line work shall be for new and expanded substations, and the base substation to supply power shall be 132/33kV substations.

② Planning

(a) Line arrangement

Line arrangement shall generally be horizontal, but accounting for environmental and social aspects, horizontal projections (cantilevers) or vertical arrangement shall be used for locations near existing structures or trees, or for which wayleave is difficult to obtain.

(b) Supports

As the distribution lines for the Project are in a central area of Dar es Salaam, existing 11kV distribution grid shall be present in many areas. As there are also sections crossing highways and streams, safe clearance must be maintained. Further, as TANESCO generally uses wooden poles, durability and strength issues cannot be truly erased. In light of these issues, 12m and 15m steel poles shall be used in the Project.

(c) Conductors

One of the TANESCO standards, ACSR 150mm^2 shall be used.

③ Equipment list

Length of 33kV distribution lines is shown in Table 2-2-2-4.24, and material lists are shown in Table 2-2-2-4.25, 26, 27 and 28.

Table 2-2-2-4.24 Length of 33kV Distribution Line

Distribution Line Name	New City Center-Muhimbili	Makumbusho-Msasani	Makumbusho-Mwananyamala	Tegeta-Jangwani Beach
Overhead line distance	1,589m	7,452m	913m	6,429m
Cable length	370m	100m	160m	90m
Plane distance	2.0km	7.6km	1.1km	6.5km
Spare quantity (10%)	1,748m	8,197m	1,004m	7,072m
Procurement quantity (overhead ground wire)	1,748m	8,197m	1,004m	7,072m
Procurement quantity (power lines)	5,244m	24,592m	3,013m	21,216m

Table 2-2-2-4.25 Material List for 33kV Distribution line (Makumbusho substation ~ Msasani substation)

Part List on Each Pole Type for 11/33kV Distribution Line / 各ポールタイプ 資機材数量表(Msasani)

Part No.		Description	unit	単位	Pole Type																																設計数量	補給数量	調達数量
					A-1		A-2		B		C-1		C-2 (Stay Pole)		C-2 (Stay Wire)		D		E		F		G		H		I-1		I-2 (Stay Pole)		I-2 (Stay Wire)		J		K				
			unit	式	0		90		0		1		17		28		0		0		0		1		1		0		0		0		13		3				
					1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	合計	5%	合計
1	A	Steel pole 12m with Pole Cap	pc	本	1		1	90	1		1	1	1	17	1	28							2	2									1	13	2	6	157	8	165
	B	Steel pole 15m with Pole Cap	pc	本													1		1		2				4	4	1		1		1						4	0	4
2	A	Disc Insulator	pc	個							18	18	18	306	18	504	18		18		18		9	9	12	12			18		18				6	18	867	43	910
	B	Anchor Shackle	pc	個							6	6	6	102	6	168	6		6		6		3	3	6	6			6		6				3	9	294	15	309
	C	Ball Eye	pc	個							6	6	6	102	6	168	6		6		6		3	3	6	6			6		6				3	9	294	15	309
	D	Socket Eye	pc	個							6	6	6	102	6	168	6		6		6		3	3	6	6			6		6				3	9	294	15	309
	F	Dead End Clamp for 33kV(ACSR150)	pc	個							6	6	6	102	6	168	6		6		6		3	3	6	6			6		6						285	14	299
	G	Dead End Clamp for 11kV(ACSR150)	pc	個																					6	6									3	9	15	1	16
	J	Twist Strap	set	セット							6	6	6	102	6	168	6		6		6		3	3	6	6			6		6				3	9	294	15	309
	K	33kV Post Insulator	pc	個	3		3	270	3		3	3	3	51	3	84	3		3		3		3	3	18	18	3		3		3						429	21	450
	M	11kV Pin Insulator	pc	個																					18	18									3	9	27	1	28
	N	Performed Top Tie for ACSR150	pc	個	3		3	270			3	3	3	51	3	84					3						3		3		3						408	20	428
	L	Performed Side Tie for ACSR150	pc	個					3								3		3																				
	Q	Aluminum Bind Wire 4.0mm	m	m																			9	9											9	27	36	2	38
3	A	Crossarm 75x75x3.2x3000	pc	個	1				1		2	2					4		2		2		2	2			1		3		3				2	6	10	1	11
	B	Crossarm 45x75x3.2x3000	pc	個	1				1		1	1					1		1																		1	0	1
	C	Crossarm 45x75x3.2x1500	pc	個			1	90					1	17	1	28					2		2	2	2	2	1		1		1						139	7	146
	D	Crossarm 75x75x3.2x3000 for Terminal	pc	個																			5	5	2	2									5	15	22	1	23
	E	Crossarm 75x75x3.2x3400	pc	個																					20	20											20	1	21
	F	Crossarm 75x75x3.2x2400	pc	個																					4	4											4	0	4
	K	Crossarm Brace Pipe type	pc	個	2				2		4	4					8		4		4		4	4	4	4	1				2				4	12	24	1	25
	L	Crossarm Support	pc	個	2		2	180	2		2	2	2	34	2	56	2		2		4		2	2	4	4	2		2		2						278	14	292
	M	Insulator Support	pc	個			3	270																			3		3		3						270	14	284
4	A	Stay Band (Double)	pc	個															2		1		1	1									1	13			14	1	15
	E	Stay Band (Single)	pc	個					1		1	1			1	28									2	2	1				1		1	13	2	6	50	3	53
	F	Stay Wire	m	m					15		30	30			30	840			40		60		30	30	60	60	30				30		50	650	30	90	1700	85	1785
	H	Dead End Grip for Insulator	pc	個					2		4	4			2	56			4		8		8	8	4	4	2				2		2	26	4	12	110	6	116
	J	Dead End Grip for Thimble	pc	個					4		8	8			4	112			8		16		16	16	8	8	4				4		6	78	8	24	246	12	258
	K	Stay Insulator 33kV	pc	個					1		4	4			1	28			2		4		4	4	2	2	1				1		1	13			51	3	54
	L	Stay Insulator 11kV	pc	個																															2	6	6	0	6
	M	Turnbuckle	pc	個					1		2	2			1	28			2		4		4	4	2	2	1				1		1	13	2	6	55	3	58
	N	Stay Rod	pc	個					1		2	2			1	28			2		4		4	4	2	2	1				1		1	13	2	6	55	3	58
	P	Stay Plate	pc	個					1		2	2			1	28			2		4		4	4	2	2	1				1		1	13	2	6	55	3	58
	R	Stay Pole	pc	本									1	17			1												1				1	13			30	2	32
	T	Stay Pole Bracket	pc	個									1	17			1												1								17	1	18
5	A	PVC Protection Pipe L=4.0m	pc	本																			2	2											1	3	5	0	5
	B	Stainless Band	set	セット															3				16	16											6	18	34	2	36
	D	Ground Rod 14x1500	pc	個	1		1	90	1		1	1	1	17	1	28	1		1		1		3	3	1	1	1		1		1				2	6	146	7	153
	E	Lead Wire Terminal	pc	個	1		1	90	1		1	1	1	17	1	28	1		1		1		3	3	1	1	1		1		1				2	6	146	7	153
	F	Compression Connector (38-22)	pc	個	1		1	90	1		1	1	1	17	1	28	1		1		1		3	3	1	1	1		1		1				2	6	146	7	153
	J	Grounding Wire (IV38sq.mm)	m	m	18		18	1620	18		18	18	18	306	18	504	18		18		18		40	40	40	40	18		18		18				20	60	2588	129	2717
6	A	Protection Pipe for Cable(PVC150)	m	m																			4	4	8	8									4	12	24	1	25
	B	Pipe Saddle	pc	個																			2	2	2	2									2	6	10	1	11
7	A	Bolt&Nut M16x400 (Pole/Crossarm)	pc	個	1				1														10	10			1								12	36	46	2	48
	B	Double Arming Bolt M16x400 (Pole/W-Crossarm)	pc	個							3	3					4		2		2		2	2					3		2				2	6	11	1	12
	C	Bolt&Nut M16x350 (Pole/Crossarm)	pc	個	2		2	180	2		2	2	2	34	2	56	2		2		2		12	12	18	18			2		2						302	15	317
	E	Square Washer	pc	個	8		5	450	9		19	19	20	340	20	560	18		11		19		45	45			6		20		20				38	114	1528	76	1604
	G	Bolt&Nut M16x120 (Crossarm/Brace)	set	個	2				2		2	2					8		4		4		4	4			1		2		2				4	12	18	1	19
	I	Bolt&Nut M16x300 (Pole/Brace)	set	個							–																								2	6	6	0	6
	J	Bolt&Nut M16x350 (Pole/Brace)	set	個	1				1		1	1					2		1		2		2	2													3	0	3
	K	Bolt type Connector for 33kV(ACSR150/ACSR150)	pc	個							6	6	6	102	6	168	6		2		6		6	6					12		12				6	18	300	15	315
9	A	33kV Lightning Arrester	pc	個																			3	3	3	3											6	0	
	B	33kV Line Switch	set	セット																			1	1	1	1											2	0	2
	C	11kV Line Switch	set	セット																					1	1									1	3	4	0	4
	D	11kV Lightning Arrester	pc	個																					3	3									3	9	12	1	
	G	Bolt type Connector(ACSR150/Cu 38)	pc	個																			3	3											3	9	12	1	13
10	A	Pole Number Plate	pc	枚	1		1	90	1		1	1	1	17	1	28	1		1		1		1	1	1	1	1		1		1				1	3	141	7	148
	B	Danger Plate	pc	枚	1		1	90	1		1	1	1	17	1	28	1		1		1		1	1	1	1	1		1		1		1	13	1	3	154	8	162
	D	Japanese national Flag Plate	pc	枚	1		1	90	1		1	1	1	17	1	28	1		1		1		1	1	1	1	1		1		1		1	13	1	3	154	8	162
	E	Barbed Wire for anti-climbing	m	m	5		5	450	5		5	5	5	85	5	140	5		5		10		10	10	20	20	5		5		5		5	65	10	30	805	40	845

Table 2-2-2-4.26 Material List for 33kV Distribution line
(New City Center substation ~ Muhimbili substation)

Part List on Each Pole Type for 11/33kV Distribution Line / 各ポールタイプ 資機材数量表(Muhimbili)

Part No.		Description	unit	単位	Pole Type																																設計数量	補給数量	調達数量
					A-1		A-2		B		C-1		C-2 (Stay Pole)		C-2 (Stay Wire)		D		E		F		G		H		I-1		I-2 (Stay Pole)		I-2 (Stay Wire)		J		K				
					0		0		0		0		0		0		0		0		0		2		0		22		2		8		3		3				
			unit	式	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	合計	5%	合計
1	A	Steel pole 12m with Pole Cap	pc	本	1		1		1		1		1		1								2	4									1	3	2	6	13	1	14
	B	Steel pole 15m with Pole Cap	pc	本													1		1		2				4		1	22	1	2	1	8					32	2	34
2	A	Disc Insulator	pc	個							18		18		18		18		18		18		9	18	12				18	36	18	144			6	18	216	11	227
	B	Anchor Shackle	pc	個							6		6		6		6		6		6		3	6	6				6	12	6	48			3	9	75	4	79
	C	Ball Eye	pc	個							6		6		6		6		6		6		3	6	6				6	12	6	48			3	9	75	4	79
	D	Socket Eye	pc	個							6		6		6		6		6		6		3	6	6				6	12	6	48			3	9	75	4	79
	F	Dead End Clamp for 33kV(ACSR150)	pc	個							6		6		6		6		6		6		3	6	6				6	12	6	48					66	3	69
	G	Dead End Clamp for 11kV(ACSR150)	pc	個																					6										3	9	9	0	9
	J	Twist Strap	set	セット							6		6		6		6		6		6		3	6	6				6	12	6	48			3	9	75	4	79
	K	33kV Post Insulator	pc	個	3		3		3		3		3		3		3		3		3		3	6	18		3	66	3	6	3	24					102	5	107
	M	11kV Pin Insulator	pc	個																					18										3	9	9	0	9
	N	Performed Top Tie for ACSR150	pc	個	3		3				3		3		3						3						3	66	3	6	3	24					96	5	101
	L	Performed Side Tie for ACSR150	pc	個					3								3		3																				
	Q	Aluminum Bind Wire 4.0mm	m	m																			9	18											9	27	45	2	47
3	A	Crossarm 75x75x3.2x3000	pc	個	1				1		2						4		2		2		2	4			1	22	3	6	3	24			2	6	62	3	65
	B	Crossarm 45x75x3.2x3000	pc	個	1				1		1						1		1																				
	C	Crossarm 45x75x3.2x1500	pc	個			1						1		1						2		2	4	2		1	22	1	2	1	8					36	2	38
	D	Crossarm 75x75x3.2x3000 for Terminal	pc	個																			5	10	2										5	15	25	1	26
	E	Crossarm 75x75x3.2x3400	pc	個																					20														
	F	Crossarm 75x75x3.2x2400	pc	個																					4														
	K	Crossarm Brace Pipe type	pc	個	2				2		4						8		4		4		4	8	4		1	22			2	16			4	12	58	3	61
	L	Crossarm Support	pc	個	2		2		2		2		2		2		2		2		4		2	4	4		2	44	2	4	2	16					68	3	71
	M	Insulator Support	pc	個			3																				3	66	3	6	3	24					96	5	101
4	A	Stay Band (Double)	pc	個															2		1		1	2									1	3			5	0	5
	E	Stay Band (Single)	pc	個					1		1				1										2		1	22			1	8	1	3	2	6	39	2	41
	F	Stay Wire	m	m					15		30				30				40		60		30	60	60		30	660			30	240	50	150	30	90	1200	60	1260
	H	Dead End Grip for Insulator	pc	個					2		4				2				4		8		8	16	4		2	44			2	16	2	6	4	12	94	5	99
	J	Dead End Grip for Thimble	pc	個					4		8				4				8		16		16	32	8		4	88			4	32	6	18	8	24	194	10	204
	K	Stay Insulator 33kV	pc	個					1		4				1				2		4		4	8	2		1	22			1	8	1	3			41	2	43
	L	Stay Insulator 11kV	pc	個																															2	6	6	0	6
	M	Turnbuckle	pc	個					1		2				1				2		4		4	8	2		1	22			1	8	1	3	2	6	47	2	49
	N	Stay Rod	pc	個					1		2				1				2		4		4	8	2		1	22			1	8	1	3	2	6	47	2	49
	P	Stay Plate	pc	個					1		2				1				2		4		4	8	2		1	22			1	8	1	3	2	6	47	2	49
	R	Stay Pole	pc	本									1				1												1	2			1	3			5	0	5
	T	Stay Pole Bracket	pc	個									1				1												1	2							2	0	2
5	A	PVC Protection Pipe L=4.0m	pc	本																			2	4											1	3	7	0	7
	B	Stainless Band	set	セット															3				16	32											6	18	50	3	53
	D	Ground Rod 14x1500	pc	個	1		1		1		1		1		1		1		1		1		3	6	1		1	22	1	2	1	8			2	6	44	2	46
	E	Lead Wire Terminal	pc	個	1		1		1		1		1		1		1		1		1		3	6	1		1	22	1	2	1	8			2	6	44	2	46
	F	Compression Connector (38-22)	pc	個	1		1		1		1		1		1		1		1		1		3	6	1		1	22	1	2	1	8			2	6	44	2	46
	J	Grounding Wire (IV38sq.mm)	m	m	18		18		18		18		18		18		18		18		18		40	80	40		18	396	18	36	18	144			20	60	716	36	752
6	A	Protection Pipe for Cable(PVC150)	m	m																			4	8	8										4	12	20	1	21
	B	Pipe Saddle	pc	個																			2	4	2										2	6	10	1	11
7	A	Bolt&Nut M16x400 (Pole/Crossarm)	pc	個	1				1														10	20			1	22							12	36	78	4	82
	B	Double Arming Bolt M16x400 (Pole/W-Crossarm)	pc	個							3						4		2		2		2	4					3	6	2	16			2	6	32	2	34
	C	Bolt&Nut M16x350 (Pole/Crossarm)	pc	個	2		2		2		2		2		2		2		2		2		12	24	18				2	4	2	16					44	2	46
	E	Square Washer	pc	個	8		5		9		19		20		20		18		11		19		45	90			6	132	20	40	20	160			38	114	536	27	563
	G	Bolt&Nut M16x120 (Crossarm/Brace)	set	個	2				2		2						8		4		4		4	8			1	22	2	4	2	16			4	12	62	3	65
	I	Bolt&Nut M16x300 (Pole/Brace)	set	個																															2	6	6	0	6
	J	Bolt&Nut M16x350 (Pole/Brace)	set	個	1				1		1						2		1		2		2	4													4	0	4
	K	Bolt type Connector for 33kV(ACSR150/ACSR150)	pc	個							6		6		6		6		2		6		6	12					12	24	12	96			6	18	150	8	158
9	A	33kV Lightning Arrester	pc	個																			3	6	3												6	0	
	B	33kV Line Switch	set	セット																			1	2	1												2	0	2
	C	11kV Line Switch	set	セット																					1										1	3	3	0	3
	D	11kV Lightning Arrester	pc	個																					3										3	9	9	0	
	G	Bolt type Connector(ACSR150/Cu 38)	pc	個																			3	6											3	9	15	1	16
10	A	Pole Number Plate	pc	枚	1		1		1		1		1		1		1		1		1		1	2	1		1	22	1	2	1	8			1	3	37	2	39
	B	Danger Plate	pc	枚	1		1		1		1		1		1		1		1		1		1	2	1		1	22	1	2	1	8	1	3	1	3	40	2	42
	D	Japanese national Flag Plate	pc	枚	1		1		1		1		1		1		1		1		1		1	2	1		1	22	1	2	1	8	1	3	1	3	40	2	42
	E	Barbed Wire for anti-climbing	m	m	5		5		5		5		5		5		5		5		10		10	20	20		5	110	5	10	5	40	5	15	10	30	225	11	236

Part List on Each Pole Type for 11/33kV Distribution Line / 各ポールタイプ 資機材数量表(Jangwani Beach)

Part No.		Description	unit	単位	Pole Type																																設計数量	補給数量	調達数量
					A-1		A-2		B		C-1		C-2 (Stay Pole)		C-2 (Stay Wire)		D		E		F		G		H		I-1		I-2 (Stay Pole)		I-2 (Stay Wire)		J		K				
					49		0		16		6		0		0		4		19		7		2		0		0		0		0		10		3				
			unit	式	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	合計	5%	合計
1	A	Steel pole 12m with Pole Cap	pc	本	1	49	1		1	16	1	6	1		1								2	4									1	10	2	6	91	5	96
	B	Steel pole 15m with Pole Cap	pc	本													1	4	1	19	2	14			4		1		1		1						37	2	39
2	A	Disc Insulator	pc	個							18	108	18		18		18	72	18	342	18	126	9	18	12				18		18				6	18	684	34	718
	B	Anchor Shackle	pc	個							6	36	6		6		6	24	6	114	6	42	3	6	6				6		6				3	9	231	12	243
	C	Ball Eye	pc	個							6	36	6		6		6	24	6	114	6	42	3	6	6				6		6				3	9	231	12	243
	D	Socket Eye	pc	個							6	36	6		6		6	24	6	114	6	42	3	6	6				6		6				3	9	231	12	243
	F	Dead End Clamp for 33kV(ACSR150)	pc	個							6	36	6		6		6	24	6	114	6	42	3	6	6				6		6						222	11	233
	G	Dead End Clamp for 11kV(ACSR150)	pc	個																					6										3	9	9	0	9
	J	Twist Strap	set	セット							6	36	6		6		6	24	6	114	6	42	3	6	6				6		6				3	9	231	12	243
	K	33kV Post Insulator	pc	個	3	147	3		3	48	3	18	3		3		3	12	3	57	3	21	3	6	18		3		3		3						309	15	324
	M	11kV Pin Insulator	pc	個																					18										3	9	9	0	9
	N	Performed Top Tie for ACSR150	pc	個	3	147	3				3	18	3		3						3	21					3		3		3						186	9	195
	L	Performed Side Tie for ACSR150	pc	個					3	48							3	12	3	57																	117	6	123
	Q	Aluminum Bind Wire 4.0mm	m	m																			9	18											9	27	45	2	47
3	A	Crossarm 75x75x3.2x3000	pc	個	1	49			1	16	2	12					4	16	2	38	2	14	2	4			1		3		3				2	6	155	8	163
	B	Crossarm 45x75x3.2x3000	pc	個	1	49			1	16	1	6					1	4	1	19																	94	5	99
	C	Crossarm 45x75x3.2x1500	pc	個			1						1		1						2	14	2	4	2		1		1		1						18	1	19
	D	Crossarm 75x75x3.2x3000 for Terminal	pc	個																			5	10	2										5	15	25	1	26
	E	Crossarm 75x75x3.2x3400	pc	個																					20														
	F	Crossarm 75x75x3.2x2400	pc	個																					4														
	K	Crossarm Brace Pipe type	pc	個	2	98			2	32	4	24					8	32	4	76	4	28	4	8	4		1				2				4	12	310	16	326
	L	Crossarm Support	pc	個	2	98	2		2	32	2	12	2		2		2	8	2	38	4	28	2	4	4		2		2		2						220	11	231
	M	Insulator Support	pc	個			3																				3		3		3								
4	A	Stay Band (Double)	pc	個															2	38	1	7	1	2									1	10			57	3	60
	E	Stay Band (Single)	pc	個					1	16	1	6			1										2		1				1		1	10	2	6	38	2	40
	F	Stay Wire	m	m					15	240	30	180			30				40	760	60	420	30	60	60		30				30		50	500	30	90	2250	113	2363
	H	Dead End Grip for Insulator	pc	個					2	32	4	24			2				4	76	8	56	8	16	4		2				2		2	20	4	12	236	12	248
	J	Dead End Grip for Thimble	pc	個					4	64	8	48			4				8	152	16	112	16	32	8		4				4		6	60	8	24	492	25	517
	K	Stay Insulator 33kV	pc	個					1	16	4	24			1				2	38	4	28	4	8	2		1				1		1	10			124	6	130
	L	Stay Insulator 11kV	pc	個																															2	6	6	0	6
	M	Turnbuckle	pc	個					1	16	2	12			1				2	38	4	28	4	8	2		1				1		1	10	2	6	118	6	124
	N	Stay Rod	pc	個					1	16	2	12			1				2	38	4	28	4	8	2		1				1		1	10	2	6	118	6	124
	P	Stay Plate	pc	個					1	16	2	12			1				2	38	4	28	4	8	2		1				1		1	10	2	6	118	6	124
	R	Stay Pole	pc	本									1				1	4											1				1	10			14	1	15
	T	Stay Pole Bracket	pc	個									1				1	4											1								4	0	4
5	A	PVC Protection Pipe L=4.0m	pc	本																			2	4											1	3	7	0	7
	B	Stainless Band	set	セット															3	57			16	32											6	18	107	5	112
	D	Ground Rod 14x1500	pc	個	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	3	6	1		1		1		1				2	6	113	6	119
	E	Lead Wire Terminal	pc	個	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	3	6	1		1		1		1				2	6	113	6	119
	F	Compression Connector (38-22)	pc	個	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	3	6	1		1		1		1				2	6	113	6	119
	J	Grounding Wire (IV38sq.mm)	m	m	18	882	18		18	288	18	108	18		18		18	72	18	342	18	126	40	80	40		18		18		18				20	60	1958	98	2056
6	A	Protection Pipe for Cable(PVC150)	m	m																			4	8	8										4	12	20	1	21
	B	Pipe Saddle	pc	個																			2	4	2										2	6	10	1	11
7	A	Bolt&Nut M16x400 (Pole/Crossarm)	pc	個	1	49			1	16													10	20			1								12	36	121	6	127
	B	Double Arming Bolt M16x400 (Pole/W-Crossarm)	pc	個							3	18					4	16	2	38	2	14	2	4					3		2				2	6	96	5	101
	C	Bolt&Nut M16x350 (Pole/Crossarm)	pc	個	2	98	2		2	32	2	12	2		2		2	8	2	38	2	14	12	24	18				2		2						226	11	237
	E	Square Washer	pc	個	8	392	5		9	144	19	114	20		20		18	72	11	209	19	133	45	90			6		20		20				38	114	1268	63	1331
	G	Bolt&Nut M16x120 (Crossarm/Brace)	set	個	2	98			2	32	2	12					8	32	4	76	4	28	4	8			1		2		2				4	12	298	15	313
	I	Bolt&Nut M16x300 (Pole/Brace)	set	個							–																								2	6	6	0	6
	J	Bolt&Nut M16x350 (Pole/Brace)	set	個	1	49			1	16	1	6					2	8	1	19	2	14	2	4													116	6	122
	K	Bolt type Connector for 33kV(ACSR150/ACSR150)	pc	個							6	36	6		6		6	24	2	38	6	42	6	12					12		12				6	18	170	9	179
9	A	33kV Lightning Arrester	pc	個																			3	6	3												6	0	
	B	33kV Line Switch	set	セット																			1	2	1												2	0	2
	C	11kV Line Switch	set	セット																					1										1	3	3	0	3
	D	11kV Lightning Arrester	pc	個																					3										3	9	9	0	
	G	Bolt type Connector(ACSR150/Cu 38)	pc	個																			3	6											3	9	15	1	16
10	A	Pole Number Plate	pc	枚	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	1	2	1		1		1		1				1	3	106	5	111
	B	Danger Plate	pc	枚	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	1	2	1		1		1		1		1	10	1	3	116	6	122
	D	Japanese national Flag Plate	pc	枚	1	49	1		1	16	1	6	1		1		1	4	1	19	1	7	1	2	1		1		1		1		1	10	1	3	116	6	122
	E	Barbed Wire for anti-climbing	m	m	5	245	5		5	80	5	30	5		5		5	20	5	95	10	70	10	20	20		5		5		5		5	50	10	30	640	32	672

Table 2-2-2-4.27 Material List for 33kV Distribution line
(Tegeta substation ~ Jangwani Beach substation)

Table 2-2-2-4.28 Material List for 33kV Distribution line (Makumbusho substation ~ Mwananyamala substation)

Part List on Each Pole Type for 11/33kV Distribution Line / 各ポールタイプ 資機材数量表(Mwananyamala)

Part No.		Description	unit	単位	Pole Type																												設計数量	補給数量	調達数量
					A-1		A-2		B		C-1		C-2 (Stay Pole)		C-2 (Stay Wire)		D		E		F		G		H		I-1		I-2 (Stay Pole)		I-2 (Stay Wire)		J		K				
					0		5		0		0		1		1		1		0		0		2		0		3		3		1		1		3				
			unit	式	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	1セット当たり	小計	合計	5%	合計
1	A	Steel pole 12m with Pole Cap	pc	本	1		1	5	1		1		1	1	1	1							2	4							1	1	2	6	18	1	19
	B	Steel pole 15m with Pole Cap	pc	本													1	1	1		2				4		1	3	1	3	1	1			8	0	8
2	A	Disc Insulator	pc	個							18		18	18	18	18	18	18	18		18		9	18	12				18	54	18	18			6	18	162	8	170
	B	Anchor Shackle	pc	個							6		6	6	6	6	6	6	6		6		3	6	6				6	18	6	6			3	9	57	3	60
	C	Ball Eye	pc	個							6		6	6	6	6	6	6	6		6		3	6	6				6	18	6	6			3	9	57	3	60
	D	Socket Eye	pc	個							6		6	6	6	6	6	6	6		6		3	6	6				6	18	6	6			3	9	57	3	60
	F	Dead End Clamp for 33kV(ACSR150)	pc	個							6		6	6	6	6	6	6	6		6		3	6	6				6	18	6	6					48	2	50
	G	Dead End Clamp for 11kV(ACSR150)	pc	個																					6										3	9	9	0	9
	J	Twist Strap	set	セット							6		6	6	6	6	6	6	6		6		3	6	6				6	18	6	6			3	9	57	3	60
	K	33kV Post Insulator	pc	個	3		3	15	3		3		3	3	3	3	3	3	3		3		3	6	18		3	9	3	9	3	3					51	3	54
	M	11kV Pin Insulator	pc	個																					18										3	9	9	0	9
	N	Performed Top Tie for ACSR150	pc	個	3		3	15			3		3	3	3	3					3						3	9	3	9	3	3					42	2	44
	L	Performed Side Tie for ACSR150	pc	個					3								3	3	3																		3	0	3
	Q	Aluminum Bind Wire 4.0mm	m	m																			9	18											9	27	45	2	47
3	A	Crossarm 75x75x3.2x3000	pc	個	1				1		2						4	4	2		2		2	4			1	3	3	9	3	3			2	6	29	1	30
	B	Crossarm 45x75x3.2x3000	pc	個	1				1		1						1	1	1																		1	0	1
	C	Crossarm 45x75x3.2x1500	pc	個			1	5					1	1	1	1					2		2	4	2		1	3	1	3	1	1					18	1	19
	D	Crossarm 75x75x3.2x3000 for Terminal	pc	個																			5	10	2										5	15	25	1	26
	E	Crossarm 75x75x3.2x3400	pc	個																					20														
	F	Crossarm 75x75x3.2x2400	pc	個																					4														
	K	Crossarm Brace Pipe type	pc	個	2				2		4						8	8	4		4		4	8	4		1	3			2	2			4	12	33	2	35
	L	Crossarm Support	pc	個	2		2	10	2		2		2	2	2	2	2	2	2		4		2	4	4		2	6	2	6	2	2					34	2	36
	M	Insulator Support	pc	個			3	15																			3	9	3	9	3	3					36	2	38
4	A	Stay Band (Double)	pc	個															2		1		1	2									1	2			4	0	4
	E	Stay Band (Single)	pc	個					1		1				1	1									2		1	3			1	1	1	2	2	6	13	1	14
	F	Stay Wire	m	m					15		30				30	30			40		60		30	60	60		30	90			30	30	50	50	30	90	350	18	368
	H	Dead End Grip for Insulator	pc	個					2		4				2	2			4		8		8	16	4		2	6			2	2	2	6	4	12	44	2	46
	J	Dead End Grip for Thimble	pc	個					4		8				4	4			8		16		16	32	8		4	12			4	4	6	6	8	24	82	4	86
	K	Stay Insulator 33kV	pc	個					1		4				1	1			2		4		4	8	2		1	3			1	1	1	3			16	1	17
	L	Stay Insulator 11kV	pc	個																															2	6	6	0	6
	M	Turnbuckle	pc	個					1		2				1	1			2		4		4	8	2		1	3			1	1	1	1	2	6	20	1	21
	N	Stay Rod	pc	個					1		2				1	1			2		4		4	8	2		1	3			1	1	1	1	2	6	20	1	21
	P	Stay Plate	pc	個					1		2				1	1			2		4		4	8	2		1	3			1	1	1	1	2	6	20	1	21
	R	Stay Pole	pc	本									1	1			1	1											1	3			1	1			6	0	6
	T	Stay Pole Bracket	pc	個									1	1			1	1											1	3				1			6	0	6
5	A	PVC Protection Pipe L=4.0m	pc	本																			2	4											1	3	7	0	7
	B	Stainless Band	set	セット															3				16	32											6	18	50	3	53
	D	Ground Rod 14x1500	pc	個	1		1	5	1		1		1	1	1	1	1	1	1		1		3	6	1		1	3	1	3	1	1			2	6	27	1	28
	E	Lead Wire Terminal	pc	個	1		1	5	1		1		1	1	1	1	1	1	1		1		3	6	1		1	3	1	3	1	1			2	6	27	1	28
	F	Compression Connector (38-22)	pc	個	1		1	5	1		1		1	1	1	1	1	1	1		1		3	6	1		1	3	1	3	1	1			2	6	27	1	28
	J	Grounding Wire (IV38sq.mm)	m	m	18		18	90	18		18		18	18	18	18	18	18	18		18		40	80	40		18	54	18	54	18	18			20	60	410	21	431
6	A	Protection Pipe for Cable(PVC150)	m	m																			4	8	8										4	12	20	1	21
	B	Pipe Saddle	pc	個																			2	4	2										2	6	10	1	11
7	A	Bolt&Nut M16x400 (Pole/Crossarm)	pc	個	1				1														10	20			1	3							12	36	59	3	62
	B	Double Arming Bolt M16x400 (Pole/W-Crossarm)	pc	個							3						4	4	2		2		2	4					3	9	2	2			2	6	25	1	26
	C	Bolt&Nut M16x350 (Pole/Crossarm)	pc	個	2		2	10	2		2		2	2	2	2	2	2	2		2		12	24	18				2	6	2	2					48	2	50
	E	Square Washer	pc	個	8		5	25	9		19		20	20	20	20	18	18	11		19		45	90			6	18	20	60	20	20			38	114	385	19	404
	G	Bolt&Nut M16x120 (Crossarm/Brace)	set	個	2				2		2						8	8	4		4		4	8			1	3	2	6	2	2			4	12	39	2	41
	I	Bolt&Nut M16x300 (Pole/Brace)	set	個																															2	6	6	0	6
	J	Bolt&Nut M16x350 (Pole/Brace)	set	個	1				1		1						2	2	1		2		2	4													6	0	6
	K	Bolt type Connector for 33kV(ACSR150/ACSR150)	pc	個							6		6	6	6	6	6	6	2		6		6	12					12	36	12	12			6	18	96	5	101
9	A	33kV Lightning Arrester	pc	個																			3	6	3												6	0	
	B	33kV Line Switch	set	セット																			1	2	1												2	0	2
	C	11kV Line Switch	set	セット																					1										1	3	3	0	3
	D	11kV Lightning Arrester	pc	個																					3										3	9	9	0	
	G	Bolt type Connector(ACSR150/Cu 38)	pc	個																			3	6											3	9	15	1	16
10	A	Pole Number Plate	pc	枚	1		1	5	1		1		1	1	1	1	1	1	1		1		1	2	1		1	3	1	3	1	1			1	3	20	1	21
	B	Danger Plate	pc	枚	1		1	5	1		1		1	1	1	1	1	1	1		1		1	2	1		1	3	1	3	1	1	1	1	1	3	21	1	22
	D	Japanese national Flag Plate	pc	枚	1		1	5	1		1		1	1	1	1	1	1	1		1		1	2	1		1	3	1	3	1	1	1	1	1	3	21	1	22
	E	Barbed Wire for anti-climbing	m	m	5		5	25	5		5		5	5	5	5	5	5	5		10		10	20	20		5	15	5	15	5	5	5	5	10	30	130	7	137

④ Technical Specifications of Major Equipment and Materials

A summary of the major equipment related to 33kV Distribution line is shown in Table 2-2-2-4.29.

Table 2-2-2-4.29 Summary of Major Equipment (33kV Distribution Line)

No.	Equipment and Materials	Quantity	Unit	Specification
1-A	Steel pole 12m with Pole Cap	1	Unit	Material: Steel Coating: Hot dip galvanizing with Anti-corrosive coat 50cm from the bottom Type: Slip joint type Slip:2 slips Length:12m Design load: Minimum 3.90kN (500kg) Accessary: Top cap, Base plate
1-B	Steel pole 15m with Pole Cap	1	Unit	Material: Steel Coating: Hot dip galvanizing with Anti-corrosive coat 50cm from the bottom Type: Slip joint type Slip:3 slips Length:15m Design load: Minimum 3.90kN (500kg) Accessary: Top cap, Base plate
2-A	Disc insulator	1	Unit	Applicable standard: IEC or equivalent Type: Porcelain galvanized disk type Minimum creepage distance：300mm Minimum Electrical-Mechanical failing load：120kN Dry lightning impulse withstand voltage：110kV Wet power frequency withstand test voltage：40kV Power frequency puncture voltage：110kV
2-B	Anchor Shackle	1	Unit	Type: Bolt type Material: Steel with hot dip galvanizing for body, Stainless for pin
2-C	Ball Eye	1	Unit	Material: Mild steel, Hot dip galvanizing
2-D	Socket Eye	1	Unit	Material: Cast iron or Mild steel for body, Stainless for pin
2-F	Dead End Clamp for 33kV (ACSR150)	1	Unit	Material: Aluminum alloy iron casting
2-G	Dead End Clamp for 11kV (ACSR150)	1	Unit	Material: Aluminum alloy iron casting
2-J	Twist Strap	1	Unit	Hot dip galvanizing
2-K	33kV Post Insulator	1	Unit	Applicable standard: IEC or equivalent Type: Porcelain single solid core type Nominal system voltage:33kV Minimum creepage distance：25mm/kV Minimum Electrical-Mechanical failing

No.	Equipment and Materials	Quantity	Unit	Specification
				load：12.5kN Dry lightning impulse withstand voltage：170kV Wet power frequency withstand test voltage：70kV
2-M	11kV Post Insulator	1	Unit	Applicable standard: IEC or equivalent Type: Porcelain single solid core type Nominal system voltage:11kV Minimum creepage distance：25mm/kV Minimum Electrical-Mechanical failing load：12.5kN Dry lightning impulse withstand voltage：75kV Wet power frequency withstand test voltage：28kV
2-N	Performed Top Tie for ACSR150	1	Unit	ACSR150mm^2, Aluminum-clad steel wire
2-L	Performed Side Tie for ACSR150	1	Unit	ACSR150mm^2, Aluminum-clad steel wire
2-Q	Aluminum Bind Wire 4.0mm	1	Unit	4.0mm Aluminum-clad steel wire
3-A	Crossarm 75x75x3.2x3000	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-B	Crossarm 45x75x3.2x3000	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-C	Crossarm 45x75x3.2x1500	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-D	Crossarm 75x75x3.2x3000 for Terminal	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-E	Crossarm 75x75x3.2x3400	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-F	Crossarm 75x75x3.2x2400	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Section shape: Square shape
3-K	Crossarm Brace Pipe type	1	Unit	Material: Mild Steel Coating: Hot dip galvanizing
3-L	Crossarm Support	1	Unit	Material: Mild Steel Coating: Hot dip galvanizing
3-M	Insulator Support	1	Unit	Material: Mild Steel Coating: Hot dip galvanizing
4-A	Stay Band (Double)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
4-E	Stay Band (Single)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
4-F	Stay Wire	1	Unit	Material: Mild steel

No.	Equipment and Materials	Quantity	Unit	Specification
				Type: Strand wire Size:45mm^2 (2.9mm×7) or equivalent Coating: Hot dip galvanizing
4-H	Dead End Grip for Insulator	1	Unit	Material: Zinc-coated steel wire Size:45mm^2
4-J	Dead End Grip for Thimble	1	Unit	Material: Zinc-coated steel wire Size:45mm^2
4-K	Stay Insulator 33kV	1	Unit	Type: Porcelain type Nominal system voltage:33kV
4-L	Stay Insulator 11kV	1	Unit	Type: Porcelain type Nominal system voltage:11kV
4-M	Turnbuckle	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
4-N	Stay Rod	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size: 13mmφ×2,100mm
4-P	Stay Plate	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
4-R	Stay Pole	1	Unit	Material: Steel Coating: Hot dip galvanizing with Anti-corrosive coat 50cm from the bottom Type: Slip joint type Slip:2 slips Length:12m Design load: Minimum 3.90kN (500kg) Accessary: Top cap, Base plate
4-T	Stay Pole Bracket	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
5-A	PVC Protection Pipe L=4.0m	1	Unit	Material: Polyvinyl chloride Size:26mmφx4m
5-B	Stainless Band	1	Unit	Material: Stainless Length:1,200mm Attachment: Fastener
5-D	Ground Rod 14x1500	1	Unit	Material: Copper-clad steel Type: Rod type Size:14mmφx1,500mm
5-E	Lead Wire Terminal	1	Unit	Material: Copper alloy Size:22mm^2
5-F	Compression Connector (38-22)	1	Unit	Material: Copper alloy Size:38-22mm^2
5-J	Grounding Wire (IV38sq.mm)	1	Unit	Material:600 V PVC insulated Copper conductor Size:38mm^2
6-A	Protection Pipe for Cable (PVC150)	1	Unit	Material: PVC (with sealing materials) Size:150mmφx4m
6-B	Pipe Saddle	1	Unit	Material: Stainless
7-A	Bolt&Nut M16x400 (Pole/Crossarm)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing

No.	Equipment and Materials	Quantity	Unit	Specification
				Size:M16x400 (Steel pole/Cross arm)
7-B	Double Arming Bolt M16x400 (Pole/W-Crossarm)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size:M16x400 (Pole/W-Crossarm)
7-C	Bolt&Nut M16x350 (Pole/Crossarm)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size:M16x350 (Pole/W-Crossarm)
7-E	Square Washer	1	Unit	Material: Mild steel Coating: Hot dip galvanizing
7-G	Bolt&Nut M16x120 (Crossarm/Brace)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size:M16x120 (Crossarm/Brace)
7-I	Bolt&Nut M16x300 (Pole/Brace)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size:M16x300 (Pole/Brace)
7-J	Bolt&Nut M16x350 (Pole/Brace)	1	Unit	Material: Mild steel Coating: Hot dip galvanizing Size:M16x350 (Pole/Brace)
7-K	Bolt type Connector for 33kV (ACSR150/ACSR150)	1	Unit	Material: Aluminum alloy Coating: Galvanizing
9-A	33kV Lightning Arrester	1	Unit	Specified in substation part
9-B	33kV Line Switch	1	Unit	Applicable standard: IEC or equivalent, Type: Outdoor pole mount vertical type Operation method: Manual operation Nominal voltage:33kV Rated voltage:36kV Rated current:600A Rated withstand short circuit current:16.5kA (1sec.) Insulator: Porcelain or polymer insulator Accessary: Hot-dipped galvanized steel support with fixing material
9-C	11kV Line Switch	1	Unit	Applicable standard: IEC or equivalent, Type: Outdoor pole mount vertical type Operation method: Manual operation Nominal voltage:11kV Rated voltage:12kV Rated current:600A Rated withstand short circuit current:16.5kA (1sec.)
9-D	11kV Lightning Arrester	1	Unit	Specified in substation part
9-G	Bolt type Connector (ACSR150/Cu 38)	1	Unit	Material: Aluminum alloy Coating: Galvanizing Size:ACSR150/Cu38
10-A	Pole Number Plate	1	Unit	Material: Aluminum or stainless Size: 210mm×150mm×t0.5mm Accessary: Stainless band
10-B	Danger Plate	1	Unit	Material: Aluminum or stainless

No.	Equipment and Materials	Quantity	Unit	Specification
				Size: 210mm×150mm×t0.5mm Accessary: Stainless band
10-D	Japanese national Flag Plate	1	Unit	Material: Aluminum or stainless Size: 210mm×150mm×t0.5mm Accessary: Stainless band
10-E	Barbed Wire for anti-climbing	1	Unit	Material: Steel Length:5m
11-A	Conductor (ACSR150 mm^2)	1	Unit	Applicable standard: BS or equivalent or equivalent Type: ACSR (Aluminum alloy conductor steel reinforced) Size:150mm^2 (Dingo)
11-B	Grounding wire (ACS30 mm^2)	1	Unit	Applicable standard: IEC or equivalent or equivalent Type: ACS (Aluminum alloy conductor steel reinforce) Size:30mm^2
11-C	Straight joint for conductor (ACSR150 mm^2)	1	Unit	Applicable standard: IEC or equivalent Type: Straight compression joint Size: for ACSR150mm^2 (Dingo)
11-D	Straight joint for grounding wire (ACS30 mm^2)	1	Unit	Applicable standard: IEC or equivalent Type: Straight compression joint Size: for ACS30mm^2

2-2-3 Outline Design Drawing

The outline design drawings for the Project are as indicated below.

Single Line Diagrams

DWG No.	Title
DWG No. SS-E-01	Single Line Diagram for Ilala Substation
DWG No. SS-E-02	Single Line Diagram for Msasani Substation
DWG No. SS-E-03	Single Line Diagram for Muhimbili Substation
DWG No. SS-E-04	Single Line Diagram for Jangwani Beach Substation
DWG No. SS-E-05	Single Line Diagram for Mwananyamala Substation
DWG No. SS-E-06	Single Line Diagram for Existing Msasani Substation

Layout Plan

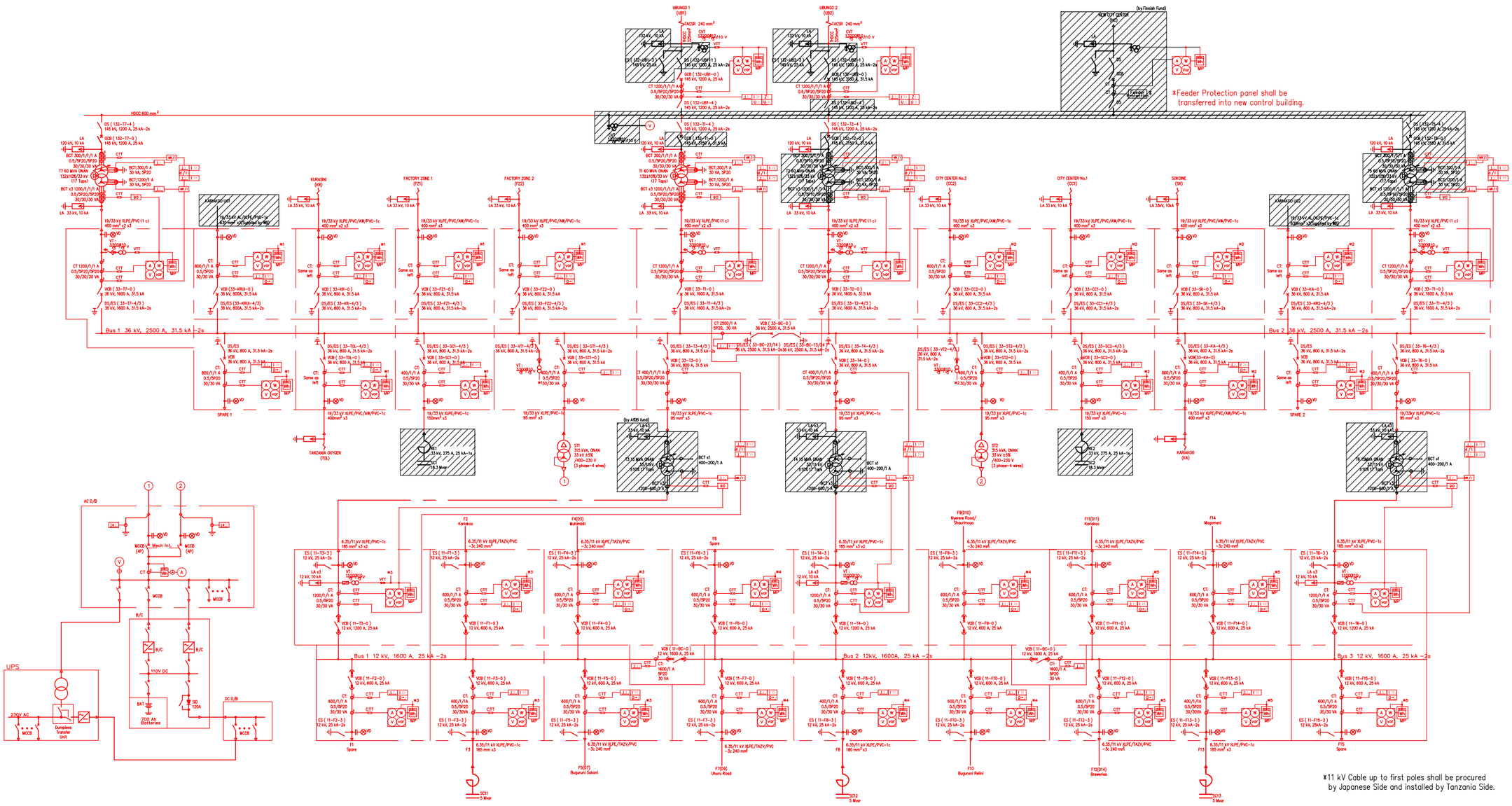
DWG No.	Title
DWG No. SS-L-001	Layout Plan for Ilala Substation
DWG No. SS-L-002	Sectional Plan for Ilala Substation
DWG No. SS-L-003	Layout Plan for Msasani Substation
DWG No. SS-L-004	Layout Plan for Muhimbili Substation
DWG No. SS-L-005	Layout Plan for Jangwani Beach Substation
DWG No. SS-L-006	Layout Plan for Mwananyamala Substation
DWG No. SS-A-01	Finishing Schedule for Ilala Substation
DWG No. SS-A-02	Ground Floor Plan for Ilala Substation
DWG No. SS-A-03	Roof Plan for Ilala Substation
DWG No. SS-A-04	Elevation Plan for Ilala Substation (1)
DWG No. SS-A-05	Elevation Plan for Ilala Substation (2)
DWG No. SS-A-06	Sectional Plan for Ilala Substation
DWG No. SS-A-07	Finishing Schedule for 33/11kV Substation
DWG No. SS-A-08	Ground Floor Plan and Roof Plan for 33/11kV Substation
DWG No. SS-A-09	Elevation Plan for 33/11kV Substation
DWG No. SS-A-10	Sectional Plan for 33/11kV Substation

Transmission Line Drawings

DWG No.	Title
DWG No. TL-01	Route Map of Transmission Line (Key Plan)
DWG No. TL-01-01~05	Route Map of Transmission Line
DWG No. TL-E-01	Elevation Diagram of Gantry (Expansion)
DWG No. TL-S-01~04	Elevation Diagram of Steel Tower

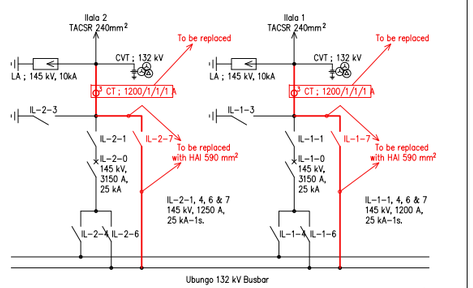
Distribution Line Drawings

DWG No.	Title
DWG No. DL-R-01	Route Map of Distribution Line (Jangwani Beach) Key Plan
DWG No. DL-R-01-01～04	Route Map of Distribution Line (Jangwani Beach)
DWG No. DL-R-02	Route Map of Distribution Line (Muhimbili) Key Plan
DWG No. DL-R-02-01～02	Route Map of Distribution Line (Muhimbili)
DWG No. DL-R-03	Route Map of Distribution Line (Mwananyamala) Key Plan
DWG No. DL-R-03-01	Route Map of Distribution Line (Mwananyamala)
DWG No. DL-R-04	Route Map of Distribution Line (Msasani) Key Plan
DWG No. DL-R-04-01～05	Route Map of Distribution Line (Msasani)
DWG No. DL-E-01~14	Pole Type of Distribution Line



Single Line Diagram at Ubungo 132 kV Ilala Lines

1. CT on Ilala 1 & 2 shall be replaced with 1200/1/1/1 A
2. Bypass lines shall be replaced with 590 mm^2 , as shown below.



UBUNGO SUBSTATION

LEGEND :

ABBREVIATIONS

SYMBOL	DESCRIPTION
Tr	POWER TRANSFORMER
DS	DISCONNECTING SWITCH
ES	EARTHING SWITCH
VCB	VACUUM CIRCUIT BREAKER
LA	LIGHTNING ARRESTER
VT	VOLTAGE TRANSFORMER
CT	CURRENT TRANSFORMER
PF	POWER FUSE
AC D/B	AC DISTRIBUTION BOARD
DC D/B	DC DISTRIBUTION BOARD
STR	STATION SERVICE TRANSFORMER
B/C	BATTERY CHARGER
BAT	BATTERY
UPS	UNINTERRUPTIBLE POWER SUPPLY
MP	METER PANEL
BCT	BUSHING TYPE CURRENT TRANSFORMER
VTT	VOLTAGE TEST TERMINAL
CTT	CURRENT TEST TERMINAL
VD	VOLTAGE DETECTOR
MCCB	MOLDED CASE CIRCUIT BREAKER
F	FUSE
SH	SHUNT
SID	SILICON DROPPER

PROTECTIVE DEVICES AND FUNCTIONS

SYMBOL	NAME OF PROTECTIVE DEVICE
I >t	INVERCE TIME OVER CURRENT PROTECTION
I >>	INSTANTANEOUS OVER CURRENT PROTECTION
Ie >t	EARTH FAULT OVER CURRENT PROTECTION
Ie >>	INSTANTANEOUS EARTH FAULT OVER CURRENT PROTECTION
Id/I>	DIFFERENTIAL PROTECTION
IdN/I>	RESTRICTED EARTH FAULT PROTECTION
Z<	DISTANCE PROTECTION
U<	UNDER VOLTAGE PROTECTION
U>	OVER VOLTAGE PROTECTION
90	AUTOMATIC VOLTAGE CONTROL
O→I	AUTO RECLOSER
A	AMPERE
V	VOLTAGE
W	WATT(ACTIVE ENERGY)
var	VAR (REACTIVE ENERGY)
Wh	WATT HOUR (TOTAL ACTIVE ENERGY)
varh	VAR HOUR (TOTAL REACTIVE ENERGY)
Hz	FREQUENCY
Amax	MAXIMUM AMPERE

:Existing (Out of Scope)

:Scope of the Project

Note

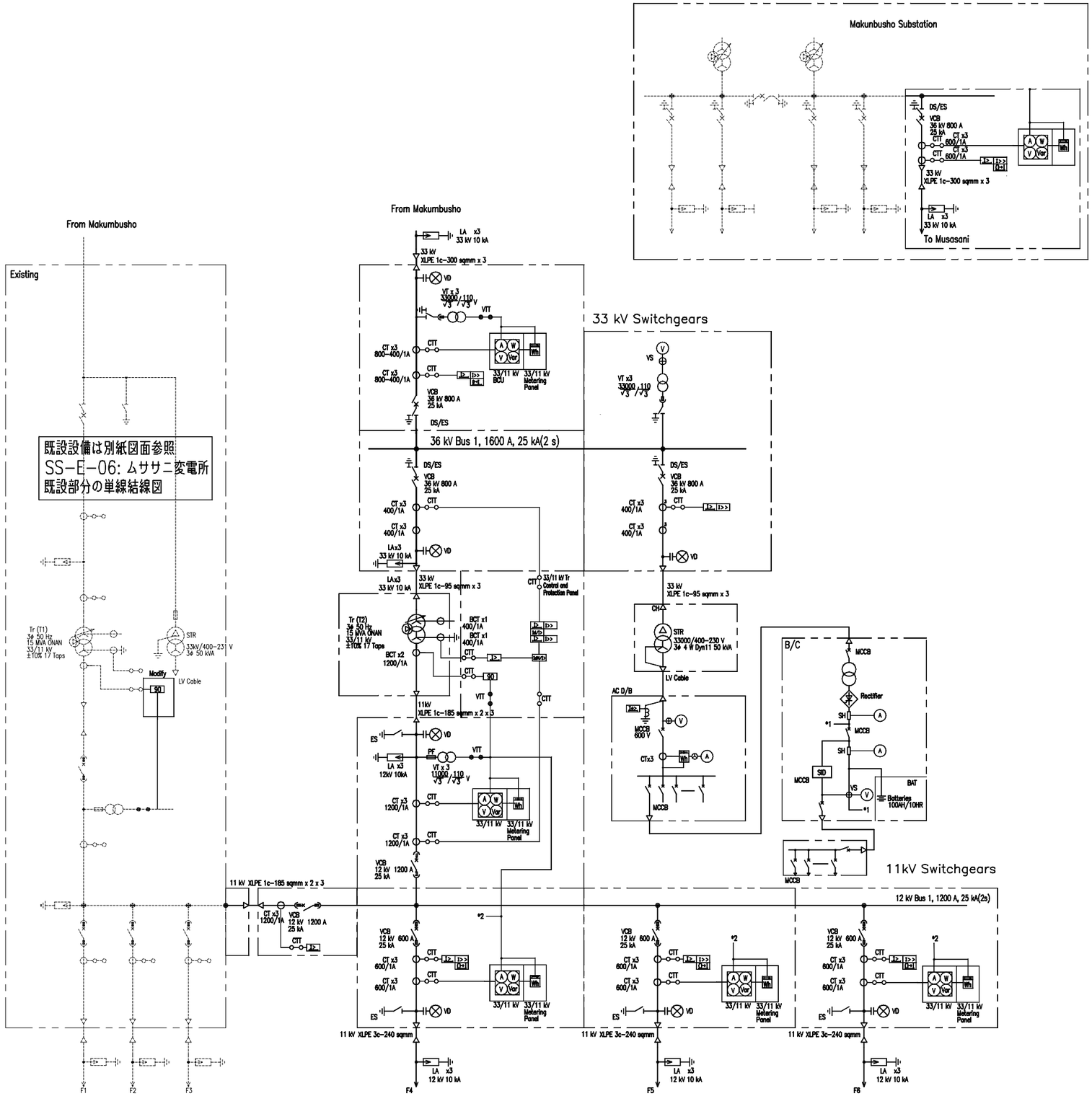
1. The modification for " Remote Control " should be made on 132 kV DS (including ES) as below ; –
   –132–UB1–1 & –3
   –132–UB2–1 & –3
   –132–UB2–4
   –132–T5–4

*11 kV Cable up to first poles shall be procured by Japanese Side and installed by Tanzania Side.

DWG No. SS-E-01

Single Line Diagram for Ilala Substation

イララ変電所　単線結線図



LEGEND :

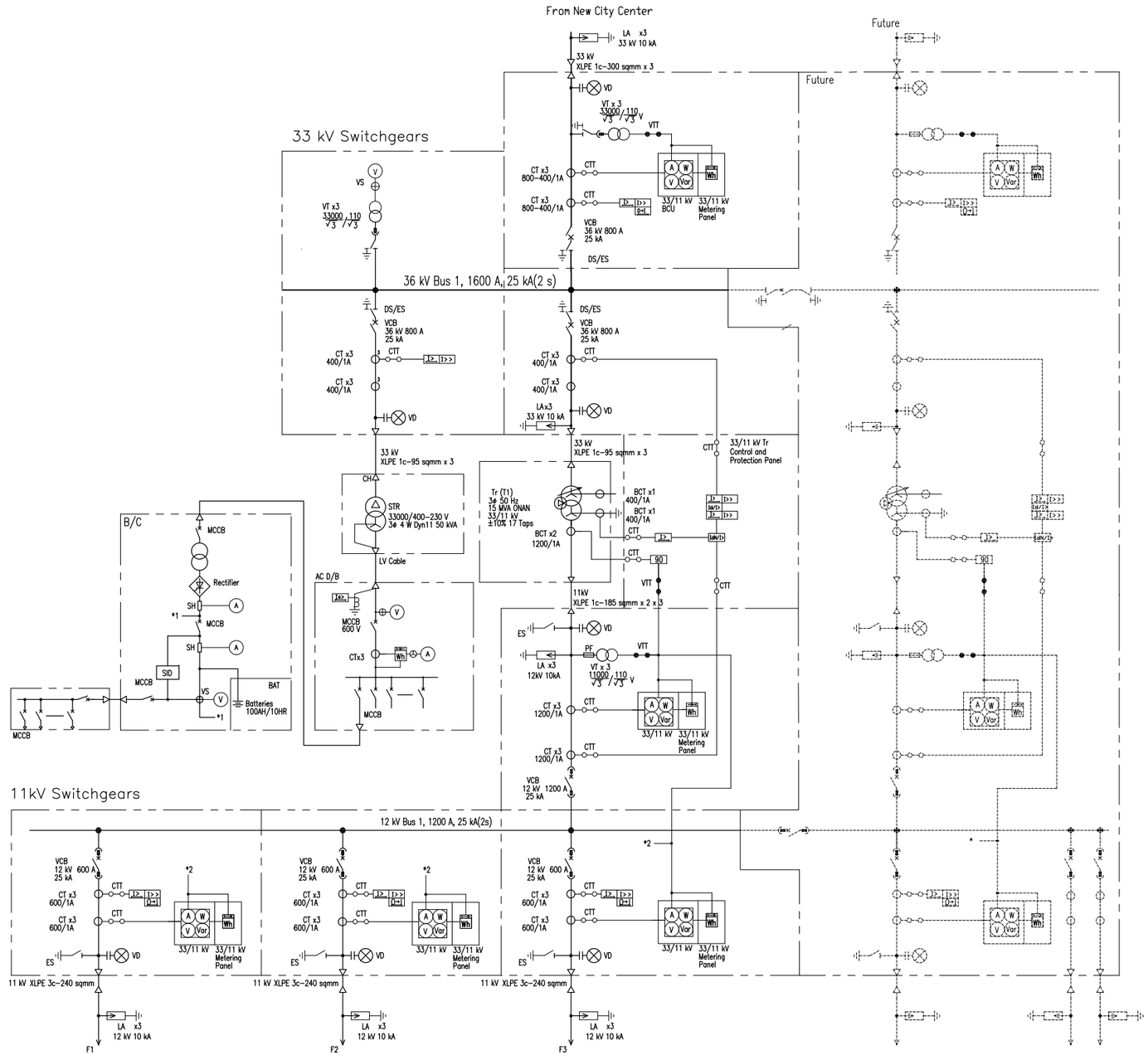
ABBREVIATIONS

SYMBOL	DESCRIPTION
Tr	POWER TRANSFORMER
DS	DISCONNECTING SWITCH
ES	EARTHING SWITCH
VCB	VACUUM CIRCUIT BREAKER
LA	LIGHTNING ARRESTER
VT	VOLTAGE TRANSFORMER
CT	CURRENT TRANSFORMER
LBS	LOAD BREAK SWITCH
PF	POWER FUSE
AC D/B	AC DISTRIBUTION BOARD
DC D/B	DC DISTRIBUTION BOARD
STR	STATION SERVICE TRANSFORMER
B/C	BATTERY CHARGER
BAT	BATTERY
BCT	BUSHING TYPE CURRENT TRANSFORMER
VTT	VOLTAGE TEST TERMINAL
CTT	CURRENT TEST TERMINAL
VD	VOLTAGE DETECTOR
CH	CABLE HEAD
MCCB	MOLDED CASE CIRCUIT BREAKER
F	FUSE
SID	SILICONE DROPPER
SH	SHUNT

PROTECTIVE DEVICES AND FUNCTIONS

SYMBOL	NAME OF PROTECTIVE DEVICE
I>	INVERCE TIME OVER CURRENT PROTECTION
I>>	INSTANTANEOUS OVER CURRENT PROTECTION
Ie>	EARTH FAULT OVER CURRENT PROTECTION
Ie>>	INSTANTANEOUS EARTH FAULT OVER CURRENT PROTECTION
Id/I>	DIFFERENTIAL PROTECTION
IdN/I>	RESTRICTED EARTH FAULT PROTECTION
U<	OVER VOLTAGE PROTECTION
U>	UNDER VOLTAGE PROTECTION
25	SYNCHROCHECK
90	AUTOMATIC VOLTAGE CONTROL
0→1	AUTO RECLOSER
A	AMPERE
V	VOLTAGE
W	WATT(ACTIVE ENERGY)
Var	VAR (REACTIVE ENERGY)
Wh	WATT HOUR (TOTAL ACTIVE ENERGY)
Varh	VAR HOUR (TOTAL REACTIVE ENERGY)
Hz	FREQUENCY
Amax	MAXIMUM AMPERE

DWG No. SS-E-02
Single Line Diagram for Msasani Substation
ムササニ変電所　単線結線図



LEGEND :

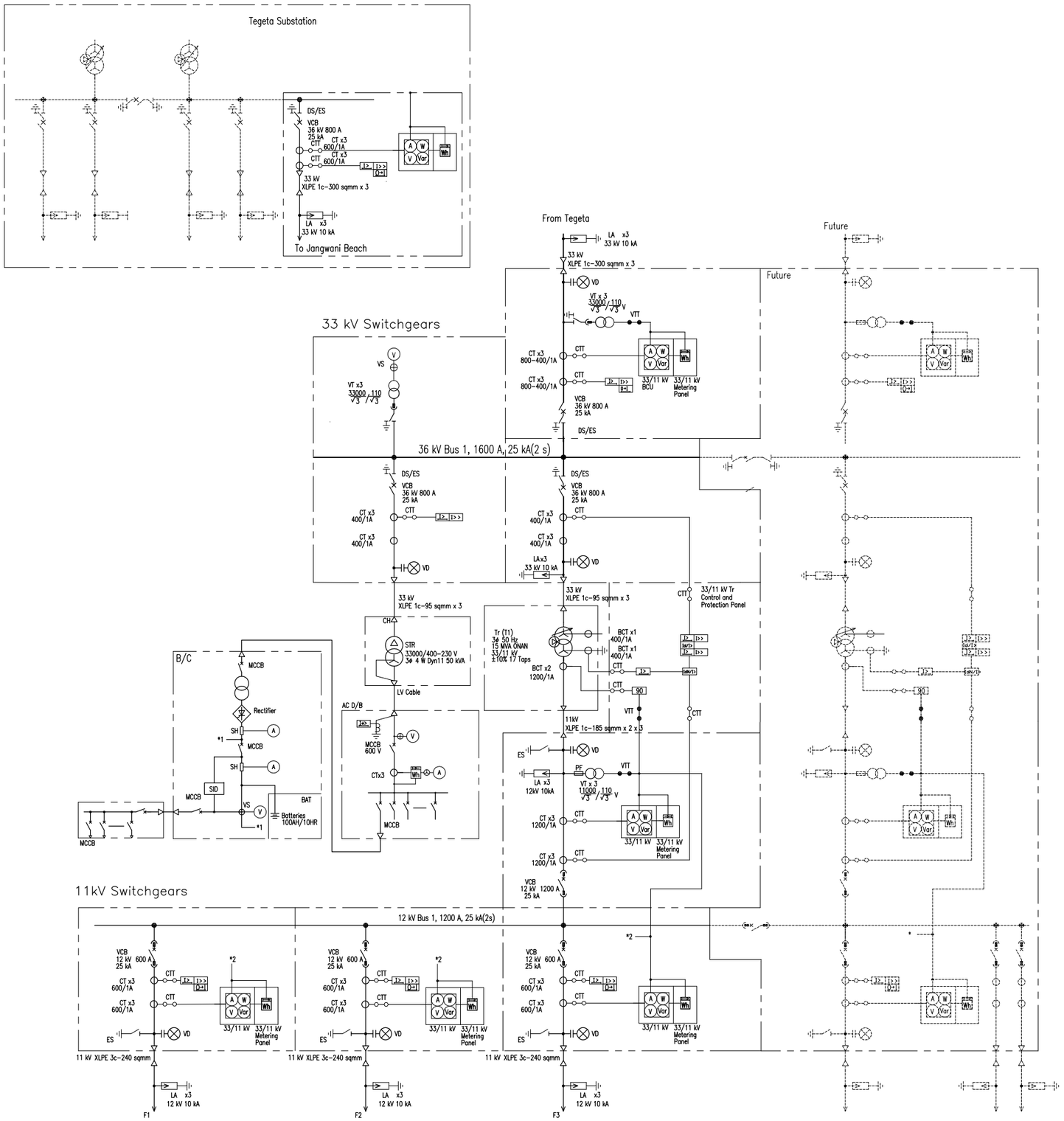
ABBREVIATIONS

SYMBOL	DESCRIPTION
Tr	POWER TRANSFORMER
DS	DISCONNECTING SWITCH
ES	EARTHING SWITCH
VCB	VACUUM CIRCUIT BREAKER
LA	LIGHTNING ARRESTER
VT	VOLTAGE TRANSFORMER
CT	CURRENT TRANSFORMER
LBS	LOAD BREAK SWITCH
PF	POWER FUSE
AC D/B	AC DISTRIBUTION BOARD
DC D/B	DC DISTRIBUTION BOARD
STR	STATION SERVICE TRANSFORMER
B/C	BATTERY CHARGER
BAT	BATTERY
BCT	BUSHING TYPE CURRENT TRANSFORMER
VTT	VOLTAGE TEST TERMINAL
CTT	CURRENT TEST TERMINAL
VD	VOLTAGE DETECTOR
CH	CABLE HEAD
MCCB	MOLDED CASE CIRCUIT BREAKER
F	FUSE
SID	SILICONE DROPPER
SH	SHUNT

PROTECTIVE DEVICES AND FUNCTIONS

SYMBOL	NAME OF PROTECTIVE DEVICE
I>	INVERCE TIME OVER CURRENT PROTECTION
I>>	INSTANTANEOUS OVER CURRENT PROTECTION
I◆>	EARTH FAULT OVER CURRENT PROTECTION
I◆>>	INSTANTANEOUS EARTH FAULT OVER CURRENT PROTECTION
Id/I>	DIFFERENTIAL PROTECTION
IdN/I>	RESTRICTED EARTH FAULT PROTECTION
U<	OVER VOLTAGE PROTECTION
U>	UNDER VOLTAGE PROTECTION
25	SYNCHROCHECK
90	AUTOMATIC VOLTAGE CONTROL
0→1	AUTO RECLOSER
A	AMPERE
V	VOLTAGE
W	WATT(ACTIVE ENERGY)
Var	VAR (REACTIVE ENERGY)
Wh	WATT HOUR (TOTAL ACTIVE ENERGY)
Varh	VAR HOUR (TOTAL REACTIVE ENERGY)
Hz	FREQUENCY
Amax	MAXIMUM AMPERE

DWG No. SS-E-03
Single Line Diagram for Muhimbili Substation
ムヒンビリ変電所　単線結線図



LEGEND :

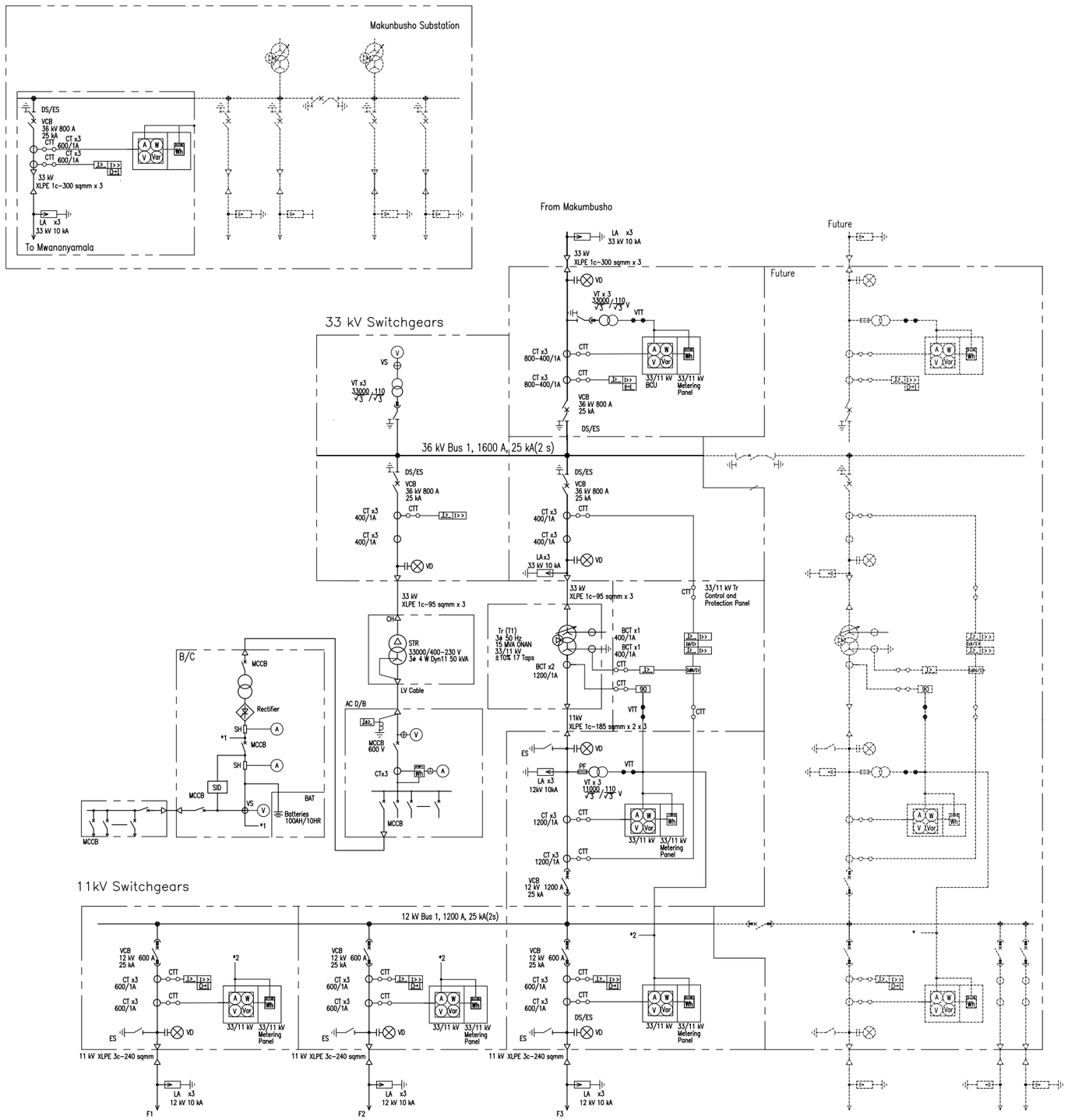
ABBREVIATIONS

SYMBOL	DESCRIPTION
Tr	POWER TRANSFORMER
DS	DISCONNECTING SWITCH
ES	EARTHING SWITCH
VCB	VACUUM CIRCUIT BREAKER
LA	LIGHTNING ARRESTER
VT	VOLTAGE TRANSFORMER
CT	CURRENT TRANSFORMER
LBS	LOAD BREAK SWITCH
PF	POWER FUSE
AC D/B	AC DISTRIBUTION BOARD
DC D/B	DC DISTRIBUTION BOARD
STR	STATION SERVICE TRANSFORMER
B/C	BATTERY CHARGER
BAT	BATTERY
BCT	BUSHING TYPE CURRENT TRANSFORMER
VTT	VOLTAGE TEST TERMINAL
CTT	CURRENT TEST TERMINAL
VD	VOLTAGE DETECTOR
CH	CABLE HEAD
MCCB	MOLDED CASE CIRCUIT BREAKER
F	FUSE
SID	SILICONE DROPPER
SH	SHUNT

PROTECTIVE DEVICES AND FUNCTIONS

SYMBOL	NAME OF PROTECTIVE DEVICE
I>	INVERCE TIME OVER CURRENT PROTECTION
I>>	INSTANTANEOUS OVER CURRENT PROTECTION
Ie>	EARTH FAULT OVER CURRENT PROTECTION
Ie>>	INSTANTANEOUS EARTH FAULT OVER CURRENT PROTECTION
Id/I>	DIFFERENTIAL PROTECTION
IdN/I>	RESTRICTED EARTH FAULT PROTECTION
U<	OVER VOLTAGE PROTECTION
U>	UNDER VOLTAGE PROTECTION
25	SYNCHROCHECK
90	AUTOMATIC VOLTAGE CONTROL
0→1	AUTO RECLOSER
A	AMPERE
V	VOLTAGE
W	WATT(ACTIVE ENERGY)
Var	VAR (REACTIVE ENERGY)
Wh	WATT HOUR (TOTAL ACTIVE ENERGY)
Varh	VAR HOUR (TOTAL REACTIVE ENERGY)
Hz	FREQUENCY
Amax	MAXIMUM AMPERE

DWG No. SS-E-04
Single Line Diagram for Jangwani Beach Substation
ジャングワニビーチ変電所　単線結線図



LEGEND :

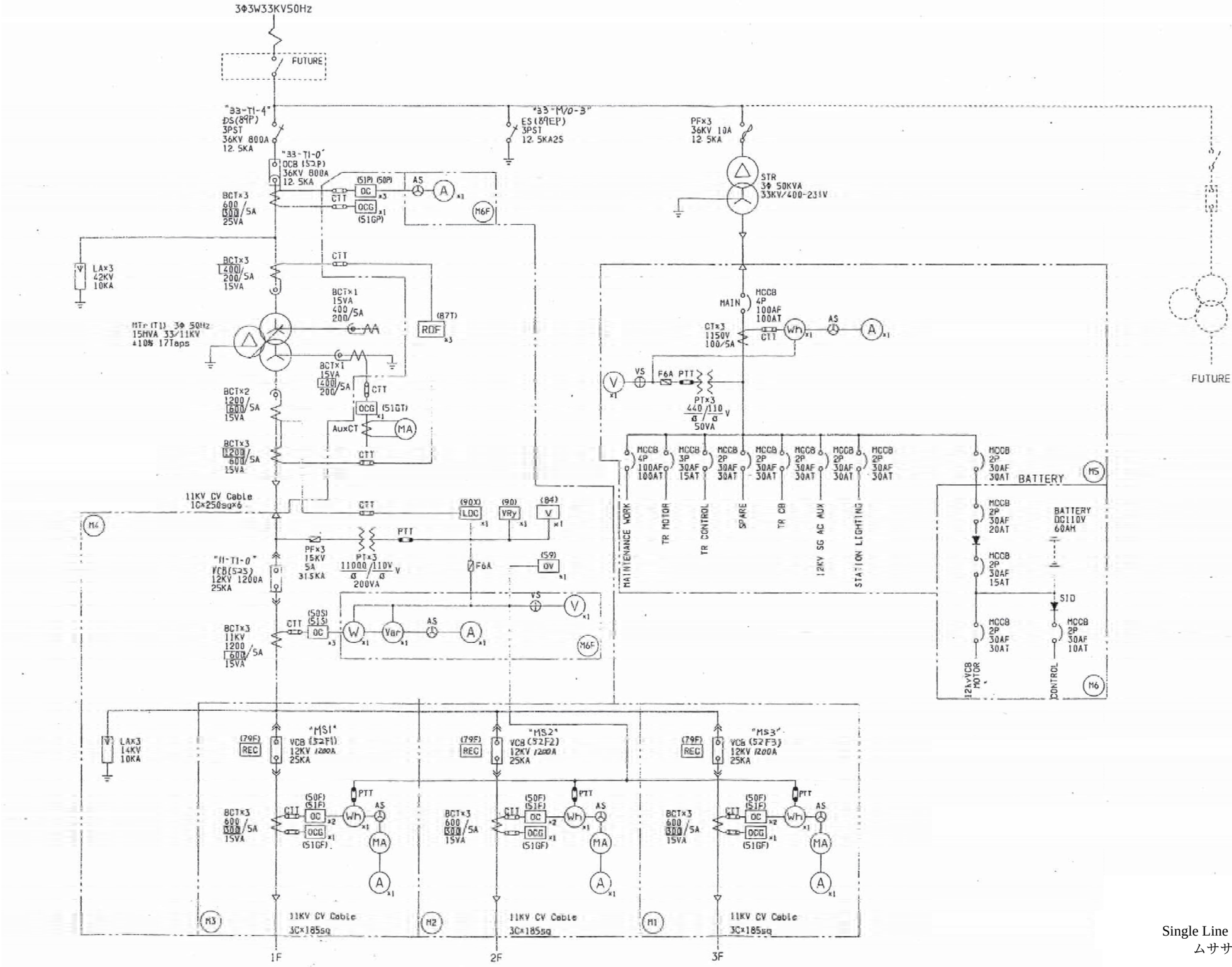
ABBREVIATIONS

SYMBOL	DESCRIPTION
Tr	POWER TRANSFORMER
DS	DISCONNECTING SWITCH
ES	EARTHING SWITCH
VCB	VACUUM CIRCUIT BREAKER
LA	LIGHTNING ARRESTER
VT	VOLTAGE TRANSFORMER
CT	CURRENT TRANSFORMER
LBS	LOAD BREAK SWITCH
PF	POWER FUSE
AC D/B	AC DISTRIBUTION BOARD
DC D/B	DC DISTRIBUTION BOARD
STR	STATION SERVICE TRANSFORMER
B/C	BATTERY CHARGER
BAT	BATTERY
BCT	BUSHING TYPE CURRENT TRANSFORMER
VTT	VOLTAGE TEST TERMINAL
CTT	CURRENT TEST TERMINAL
VD	VOLTAGE DETECTOR
CH	CABLE HEAD
MCCB	MOLDED CASE CIRCUIT BREAKER
F	FUSE
SID	SILICONE DROPPER
SH	SHUNT

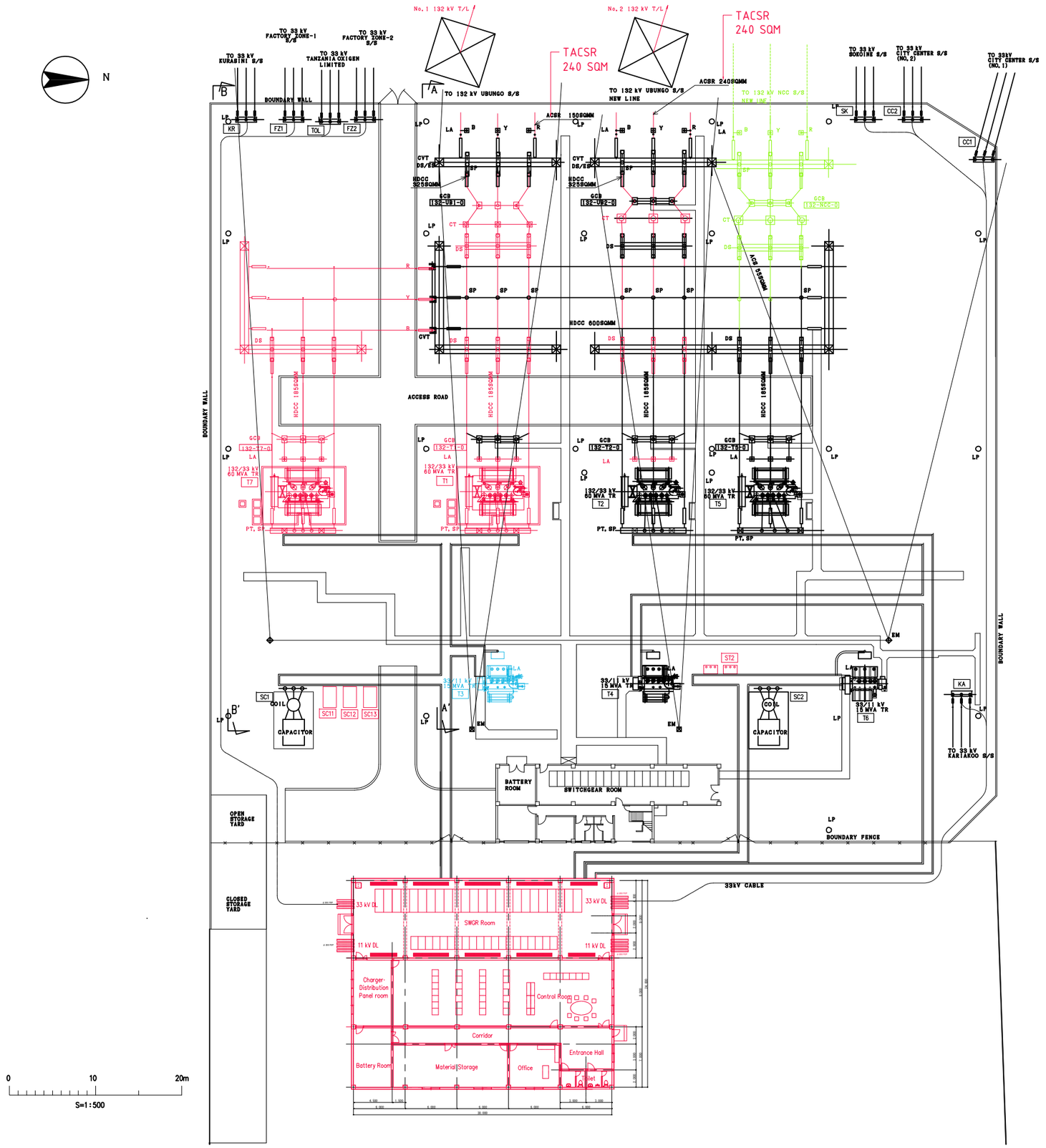
PROTECTIVE DEVICES AND FUNCTIONS

SYMBOL	NAME OF PROTECTIVE DEVICE
I>	INVERCE TIME OVER CURRENT PROTECTION
I>>	INSTANTANEOUS OVER CURRENT PROTECTION
Ie>	EARTH FAULT OVER CURRENT PROTECTION
Ie>>	INSTANTANEOUS EARTH FAULT OVER CURRENT PROTECTION
Id/I>	DIFFERENTIAL PROTECTION
IdN/I>	RESTRICTED EARTH FAULT PROTECTION
U<	OVER VOLTAGE PROTECTION
U>	UNDER VOLTAGE PROTECTION
25	SYNCHROCHECK
90	AUTOMATIC VOLTAGE CONTROL
0→1	AUTO RECLOSER
A	AMPERE
V	VOLTAGE
W	WATT(ACTIVE ENERGY)
Var	VAR (REACTIVE ENERGY)
Wh	WATT HOUR (TOTAL ACTIVE ENERGY)
Varh	VAR HOUR (TOTAL REACTIVE ENERGY)
Hz	FREQUENCY
Amax	MAXIMUM AMPERE

DWG No. SS-E-05
Single Line Diagram for Mwananyamala Substation
ムワナニャマラ変電所　単線結線図

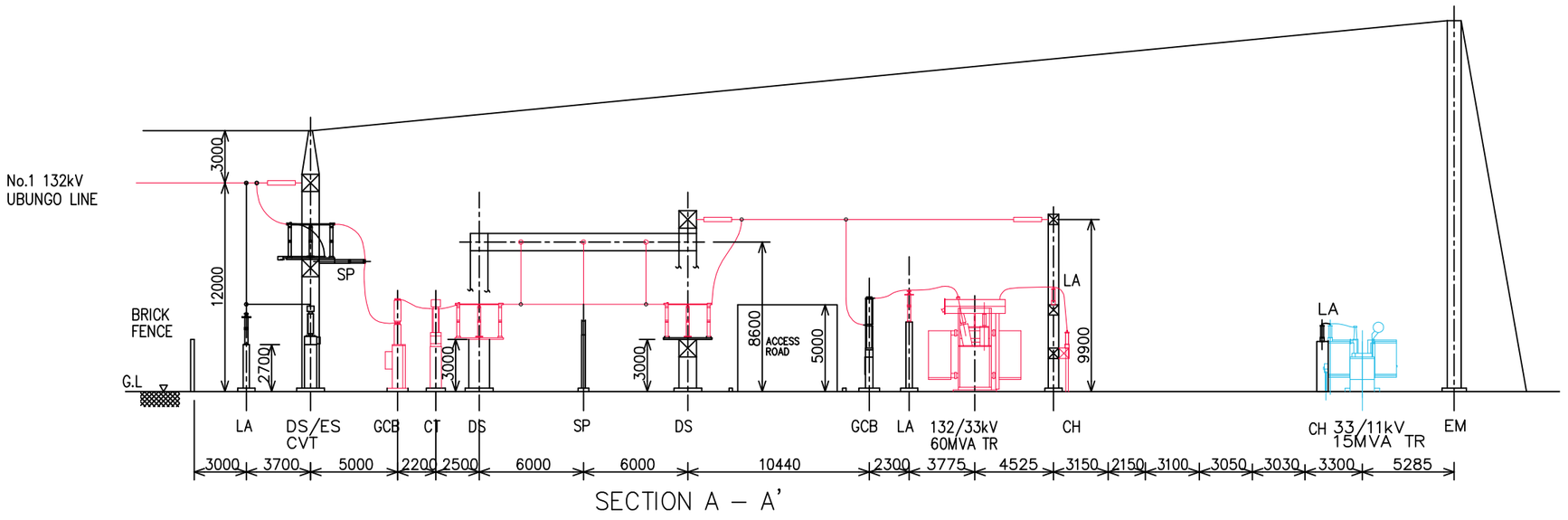


DWG No. SS-E-06
Single Line Diagram for Existing Msasani Substation
ムササニ変電所　既設部分の単線結線図

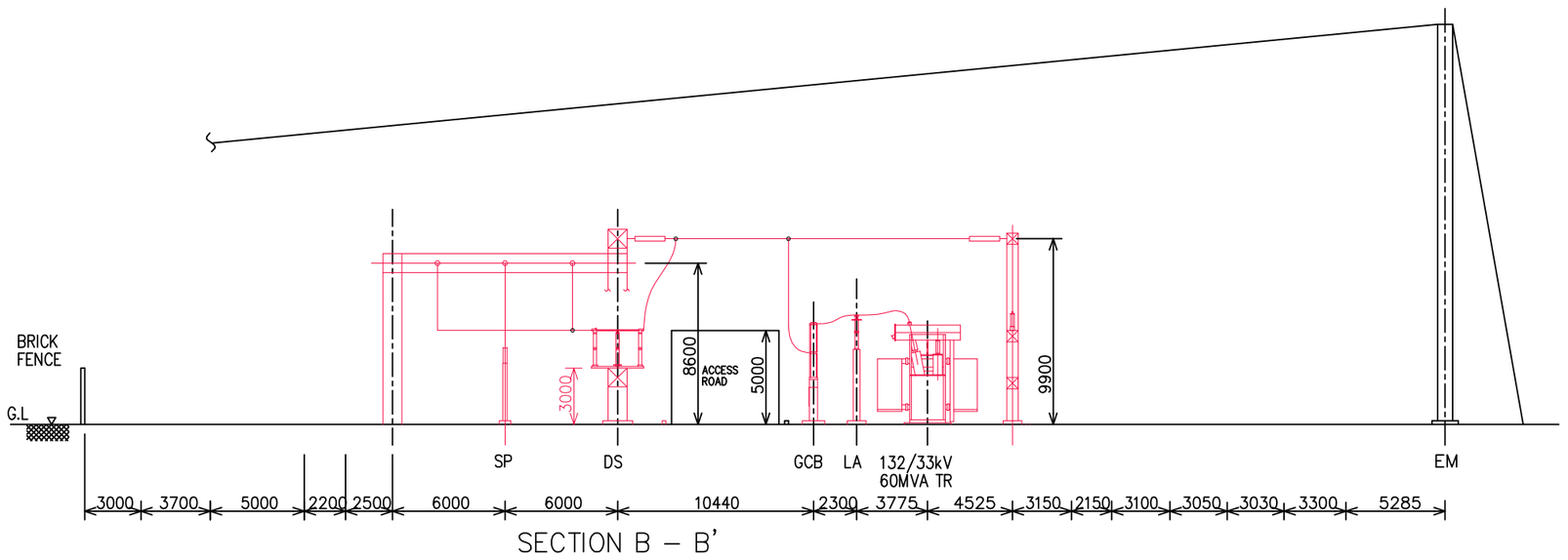


Red : JICA
Green : MFA Finland
Blue : AFDB
Black : Existing

DWG No. SS-L-001
Layout Plan for Ilala Substation
イララ変電所　概略配置図



SECTION A – A'



SECTION B – B'

Red : JICA
Blue : AFDB
Black : Existing

ABBREVIATION

GCB	:	GAS CIRCUIT BREAKER
OCB	:	OIL CIRCUIT BREAKER
DS	:	DISCONNECTING SWITCH
ES	:	EARTHING SWITCH
CT	:	CURRENT TRANSFORMER
CVT	:	CAPACITOR VOLTAGE TRANSFORMER
VT	:	VOLTAGE TRANSFORMER
LA	:	LIGHTNING ARRESTER
TR	:	POWER TRANSFORMER
SHR	:	SHUNT REACTOR
SP	:	STATION POST INSULATOR
LP	:	LIGHTING POLE
EM	:	EARTH MAST
CH	:	CABLE HEAD

DWG No. SS-L-002
Sectional Plan for Ilala Substation
イララ変電所　概略配置図（断面図）

N

Existing Building

Existing Building

Net Fence
Construction for Tanzania Side

Net Fence
Construction for Tanzania Side

TR

STR

Hand holl

Charger, Distribution Panel Room

Control Room

Battery Room

FRP

Existing Substation

Existing TR

Existing 11kV Cubicles

SWG Room

CABLE PIT

Hand holl

18, 000

9, 000

: Scope of the Project

0 5 10m

S=1:150

DWG No. SS-L-003
Layout Plan for Msasani Substation
ムササニ変電所　概略配置図

N

TR

Existing Fence

STR

Charger,
Distribution
Panel
Room

Battery Room

CABLE PIT
SWG Room

Control Room

9,000

18,000

Hand holl

Hand holl

Existing Fence

TR

Concrete Block wall H=4,000

Net Fence
Construction for Tanzania Side

Existing Fence

Net Fence
Construction for Tanzania Side

0 5 10m

S=1:150

DWG No. SS-L-004
Layout Plan for Muhimbili Substation
ムヒンビリ変電所　概略配置図

N

Net Fence
Construction for Tanzania Side

Outdoor Lighting

Concrete Block wall H=4,000

TR

Hand holl

Hand holl

Net Fence
Construction for Tanzania Side

STR

Net Fence
Construction for Tanzania Side

Control Room

SWG Room

CABLE PIT

Battery Room

Charger,
Distribution
Panel
Room

9,000

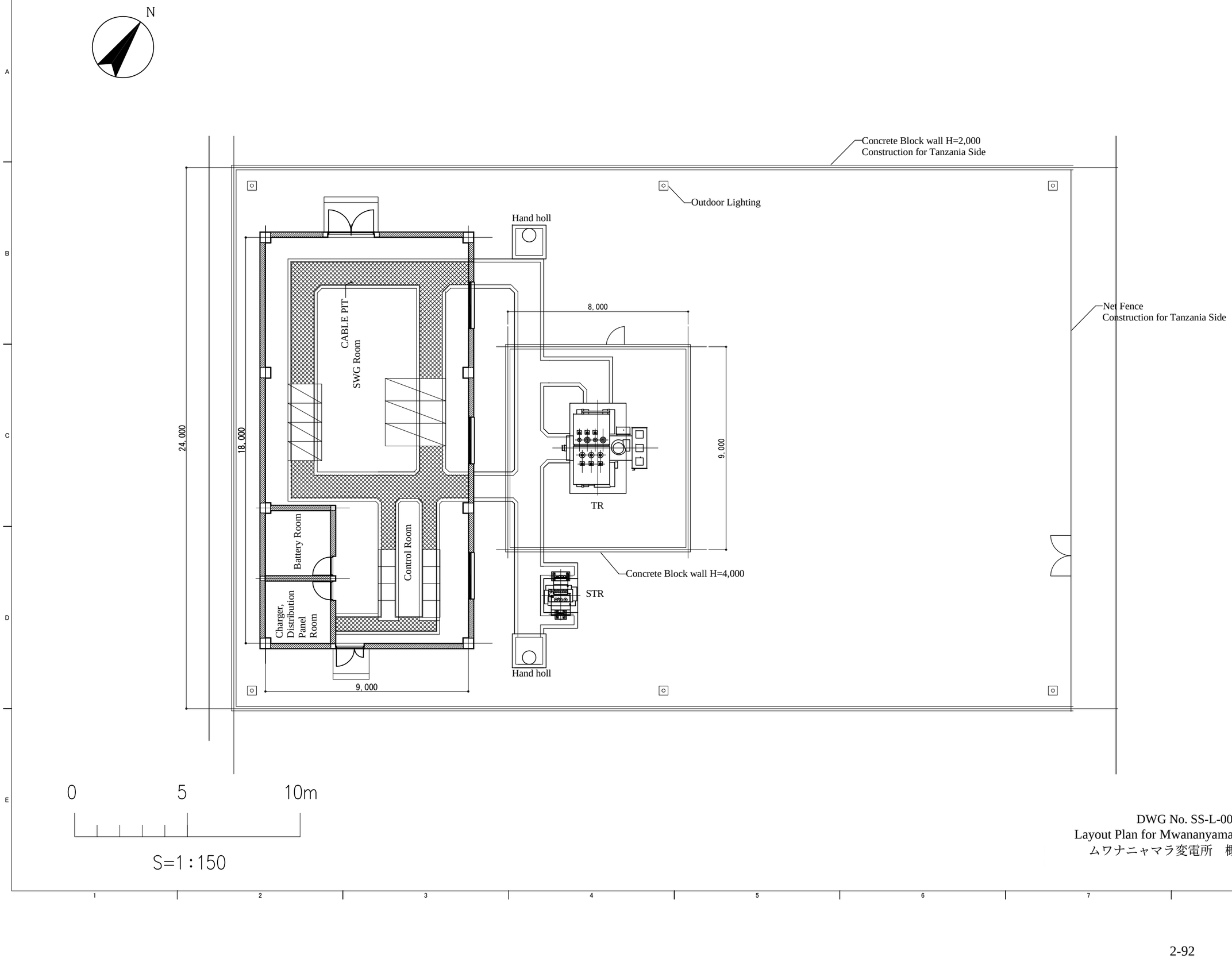
18,000

Existing Fence

0 5 10m

S=1:150

DWG No. SS-L-005
Layout Plan for Jangwani Beach Substation
ジャングワニビーチ変電所　概略配置図



DWG No. SS-L-006
Layout Plan for Mwananyamala Substation
ムワナニャマラ変電所　概略配置図