No.

United Republic of Tanzania
Ministry of Energy and Minerals

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR
REINFORCEMENT OF TRANSMISSION AND DISTRIBUTION FACILITIES IN OYSTER BAY SUBSTATION
IN
THE UNITED REPUBLIC OF TANZANIA

MARCH 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a basic design study on the Project for Reinforcement of Transmission and Distribution Facilities in Oyster Bay Substation and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team from September 17 to October 14, 2006.

The team held discussions with the officials concerned of the Government of Tanzania, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Tanzania in order to discuss a draft basic design, and as this result, 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.

I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the teams.

March 2007

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

March 2007

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Reinforcement of Transmission and Distribution Facilities in Oyster Bay Substation in the United Republic of Tanzania.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from September, 2006 to March, 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Tanzania and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Masatsugu Komiya
Project manager,
Basic design study team on
the Project for Reinforcement of
Transmission and Distribution Facilities in
Oyster Bay Substation
Yachiyo Engineering Co., Ltd.

SUMMARY

SUMMARY

<Country Profile>

The United Republic of Tanzania (hereinafter referred to as "Tanzania") has the total area of 945,037 km^2 (approximately 2.5 time of Japan) and approximately 37.6 million population (estimated by the World Bank in 2004), which is the largest country in East Africa. As Tanzania is a united nation inaugurated through the Tanganyika and Zanzibar were combined together in 1964 immediately after its independence, the Government of Tanzania and the Zanzibar Government respectively supervise their area.

The Government of Tanzania is pushing forward for shift from the state-planned economy in the socialism at its independence to the market economy. As a result of efforts for new socio-economic development by the said government since 1995, the Tanzanian economy has shown a favorable expansion in the recent years, the gross domestic product (GDP) growth rate in 2004 (Tanzanian fiscal year between July 2004 to June 2005) recorded 6.3% (IMF source) and the gross national income (GNI) per capita has steadily increased from $210 in 1997 to $330 in 2005 annually. On the other hand, national finance is an excess of expenditure; however, the second Poverty Reduction Strategy was formulated in April 2005 and its implementation is on-going in cooperation of donors.

Although the capital of Tanzania is Dodoma (approximately 760,000 population estimated by the World Bank in 2006) located in the central part of the said country, the substantial capital is Dar es Salaam in the eastern part of Tanzania, which is the largest city facing the Indian Ocean where power demand has remarkably increased in line with the recent economic growth and an increase in population.

<Background, Details and Outline of the Requested Project>

The electric power industry in Tanzania has been managed by the Tanzania Electric Supply Company Limited (TANESCO) under the supervision of the Ministry of Energy and Minerals (MEM). TANESCO is an electric utility incorporated through the Tanganyika Electric Supply Company Limited established in 1931 and the District Electric Supply Limited were merged in 1964, which provide electric power across the Tanzanian land except for the Zanzibar Island. Although TANESCO monopolized generation, transmission, distribution and electricity sales until 1992, the participation of the private sector in the electric power business has been gradually permitted in line with a change in energy policies in the said government, at the present time, two (2) independent power producers (IPP) are permitted to have their business license. However, with respect to transmission and distribution, TANESCO is still the only the utility on the national land side in Tanzania, so monopolized business has been still carried out. The capacity of generation facilities in Tanzania was 561MW in hydraulic

power and 316 MW in thermal power (of those, 282 MW was generated by IPP) as of March 2006. The transmission facilities are the 220kV transmission lines (2,986km), the 132kV transmission lines (1,971km) and the 66kV transmission lines (554km).

The Government of Tanzania launched a public enterprise reform in 1993 by putting emphasis on the introduction of the principal of competition and adjustment of unprofitable sectors. Even in the power sector, a structural reform was scheduled for the purpose of business efficiency and the bill for the reform to divide TANESCO into three (3) generation companies and two (2) transmission and distribution companies was approved by the Government of Tanzania in 2002. In addition, until the completion of the structural reform, as it was decided that management of TANESCO would be entrusted to an external consultant, and the Netgroup Solutions, the consultant in South Africa, (hereinafter referred to as "Netgroup") was selected.

Although a bill for structural reform of the power sector was planned for business efficiency of public enterprises, since the unbundling and privatization of TANESCO was included in the plan, public assistance for the power sector including support by donors was stagnant after the formulation of the plan. Although the Netgroup has made efforts to improve the balance of revenue at TANESCO through reduction in unpaid bill or other measures, it was difficult to balance an expansion in facilities to meet demand increase with maintenance of the existing facilities, so the TANESCO business faced critical conditions coupled with reduction in power sales due to drought since 2003, rise in a power generation cost and continuance of cheap electric tariff that cannot cover the generation cost. Accordingly, the Government of Tanzania excluded TANESCO from a list of public enterprises to be privatized and decided to be actively involved in management of the power sector. Due to the decision of the said policy, assistance for the power sector by donors is expected to start again in the near future.

In the Country Assistance Plan (CAP) for Tanzania, Japan regards the electric power infrastructure development to be one of priority areas. In accordance with the said policy, Japan had positively supported the development of transmission and distribution facilities in Kilimanjaro district and Dar es Salaam city. With respect to an expansion in the transmission and distribution networks in Dar es Salaam, Japan had recommended to construct secondary substations and 132kV transmission lines in order to improve the reliability of power supply and to reduce power loss through the master plan study. However, the transmission and distribution network has hardly reinforced due to the stagnant assistance and investment for TANESCO by government and donors including Japan since 2002 through the privatization movement of the power sector. Consequently, the development for substation or distribution facilities cannot catch up with a rapid expansion of power demand in Dar es Salaam so that the existing facilities are compelled to operate over load, to make matters worse, interruptions

frequently occur due to breakdown of the facilities resulted the deterioration and this hinders people' s living and urban functions.

In due consideration of such the situations, the Government of Tanzania made a request for Japan' s Grand Aid scheme for the construction of a new substation and transmission lines that will connect between the said new substation and the existing substations. In response to this request, the Government of Japan dispatched a Preliminary Study Team in February 2006 and decided to implement a basic design study based on the results. After that, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team to Tanzania from September 17 to October 14, 2006 in order to re-confirm the components of the request and to make discussions with concerned authorities of the said country on the contents of the implementation were made, at the same time, a project site survey was conducted and related materials were collected. After returning to Japan, a basic design pertaining to the most suitable plans and a draft final report were compiled by examining the necessity, socio-economic effects and the relevance of the Project. Based on those, JICA dispatched the Basic Design Study Team to Tanzania again in order to explain the draft final report from February 25 to March 8, 2007.

Based on the “Master Plan Study on the Power Sector for Major Towns” conducted by JICA in 2002, as the improvement in electric power supply in Dar es Salaam and development of regional economy, that is deemed to be an overall goal, the Project is deigned for the purpose of improving the reliability for power supply for reducing interruptions, voltage fluctuation, over load and power loss in the northern area in Dar es Salaam. The basic concept of the Project is to carry out procurement and installation of the 132kV, 33kV and 11kV transmission and distribution equipment necessary for accomplishment of the above-mentioned goal.

<Overview of Findings of the Study and Contents of the Project>

A basic plan of the requested Japanese assistance compiled based on the field survey and discussion with the Tanzanian side is outlined in the following table.

Overview of the Basic Plan

Category	Reinforcement for 33kV Distribution Facilities	Reinforcement for 132kV Transmission Facilities
Equipment & Materials Procurement & Installation Plan	Procurement & Installation of Equipment & Materials for 33kV & 11kV Distribution at New Oyster Bay Substation (1) 33kV switchgears 1 set • Incoming/outgoing feeder: 5 feeders • Transformer feeder: 4 feeders • Bus tie panel: 1 feeder (2) 11kV switchgears 1 set • Incoming/outgoing feeder: 5 feeders • Transformer feeder: 2 feeders • Bus tie panel: 1 feeder (3) 33kV control & protection panel 4 units (4) 11kV control panel 1 unit (5) 132/33/11kV meter panel 2 units (6) 33/11kV distribution transformer (15MVA) 2 units (7) Station service facilities (DC・AC) 1 set (8) Station service transformer (33/0.4kV, 100kVA) 2 units (9) Dead end steel tower (gantry type) 1 set (10) Earthing system (including conductors) 1 set (11) Outdoor lighting system 1 set (12) Fire extinguisher (ABC, portable type) 1 set (13) 33kV XLPE cables 1 set (14) 11kV XLPE cables 1 set (15) Construction of central building ($363m^2$, one-story building) 1 set (16) Associated civil facilities (access road, oil separator & cable trench, etc.) 1 set	1. Procurement & Installation of Equipment & Materials for 132kV Transmission at New Oyster Bay Substation (1) 132kV feeder equipment (for main transformer including bus) 1 set (2) 132kV switchgear 1 set (3) 132/33kV main transformers (45MVA) 2 units (4) 132kV control & protection panels 1 set (5) Earthing equipment 1 set (6) Associated civil facilities (foundation & cable trench, etc.) 1 set 2. Procurement & Installation of 132kV Lead-out Equipment at Ubungo S/S (1) Dead end steel tower (gantry type) 1 unit (2) 132kV lead out equipment including bus 1 set (3) 132kV switchgear 1 set (4) Transfer of existing voltage measuring instrument (CVT) 1 set (5) Modification of existing control system 1 set (6) Earthing system 1 set (7) Associated civil facilities (foundation, etc.) 1 set 3. Construction of 132kVTransmission Lines (Ubungo S/S to New Oyster Bay S/S, about 7km) (1) 132kVtransmission pole foundation 1 set (2) 132kV transmission monopole 38 units (3) Materials for transmission line (conductors, insulators & earthing system, etc.) 1 set
Equipment & Materials Procurement Plan	Procurement of the following equipment & materials (1) 33kV lighting arresters 12 units (2) 11kV lighting arresters 12 units (3) Spare parts for equipment & materials, maintenance tools 1 set	

<Construction Period and Estimated Project Cost>

As for implementing the Project through the Japan's Grant Aid scheme, the total project cost is estimated to be approximately ¥1,854 billion (approximately ¥1,807 billion to be taken by the Japan side and approximately ¥47.32 million to be taken by the Tanzanian side). Of those, major undertakings to be taken by the Tanzanian side include site creation for the substation, site preparation for the power transmission route (removal of the existing infrastructure facilities, transfer of the 33kV distribution facilities and security of temporary construction lot) and installation work for the 33kV and 11kV distribution facilities. The implementation period of the Project is anticipated to be 3.5 months for implementation design, 3.0 months for tendering and selection of contractors, and 24 months for procurement of equipment and materials and construction period.

As same as previous projects, TANESCO is supposed to operate and maintain the facilities and equipment after the completion of the Project. Since TANESCO has maintained transmission and substation equipment up to the 220kV without any difficulties, moreover, specifications of each transmission, substation and distribution equipment to be procured and installed under the Project are assumed not to exceed the equipment procured in the past Japan's Grant Aid scheme, TANESCO seems to have the enough capacity to construct, operate and maintain equipment and facilities required under the Project. In addition, as the similar transmission, substation and distribution equipment procured in the past Japan's Grant Aid scheme have been favorably maintained, the equipment procured under the Project is assumed to be appropriately maintained even after the completion of the Project.

<Examination of Relevance of the Project>

Approximately 229,000 residents in the northern part of Dar es Salaam (Kinondoni District) are expected to benefit from the Reinforcement for 33kV Distribution Facilities at New Oyster Bay S/S and the over load conditions for the entire area in the said city (approximately 2.5 million people) will be mitigated by reinforcing the 132kV transmission system.
Reliable and stable electric power will be supplied through the implemented facilities in the Kinondoni District and as its result, the living standards of local people can be improved, public facilities can be operated in a stable manner and socio-economic activities can be stimulated. Therefore, the implementation of Japan's Grant Aid scheme for the requested Japanese assistance is judged to be appropriate. Furthermore, with respect to operation and maintenance of the implemented facilities, the Tanzanian side has sufficient human resources and financial capability, in due consideration of their experiences on the similar projects, any specific problems cannot be observed in the implementation of the Project.

Major undertakings to be implemented by the Tanzanian side are described as follows in order to produce the desired and feasible effects of the Project.

(1) The Tanzanian side should complete site creation for the New Oyster Bay Substation and access roads, etc. prior to the commencement of the construction work on the Japanese side.

(2) The Tanzanian side should complete the work to transfer the 33kV distribution lines built on the right side of the Sam Nujoma on the 132kV transmission route prior to the commencement of the construction work on the Japanese side.

(3) The underground infrastructure systems such as water supply pipes and telephone lines were confirmed on the 132kV transmission route. The Tanzanian side should complete the arrangement with the concerned authorities with respect to its transfer. Simultaneously TANESCO should secure the budget to transfer the existing infrastructures before the time of the construction work.

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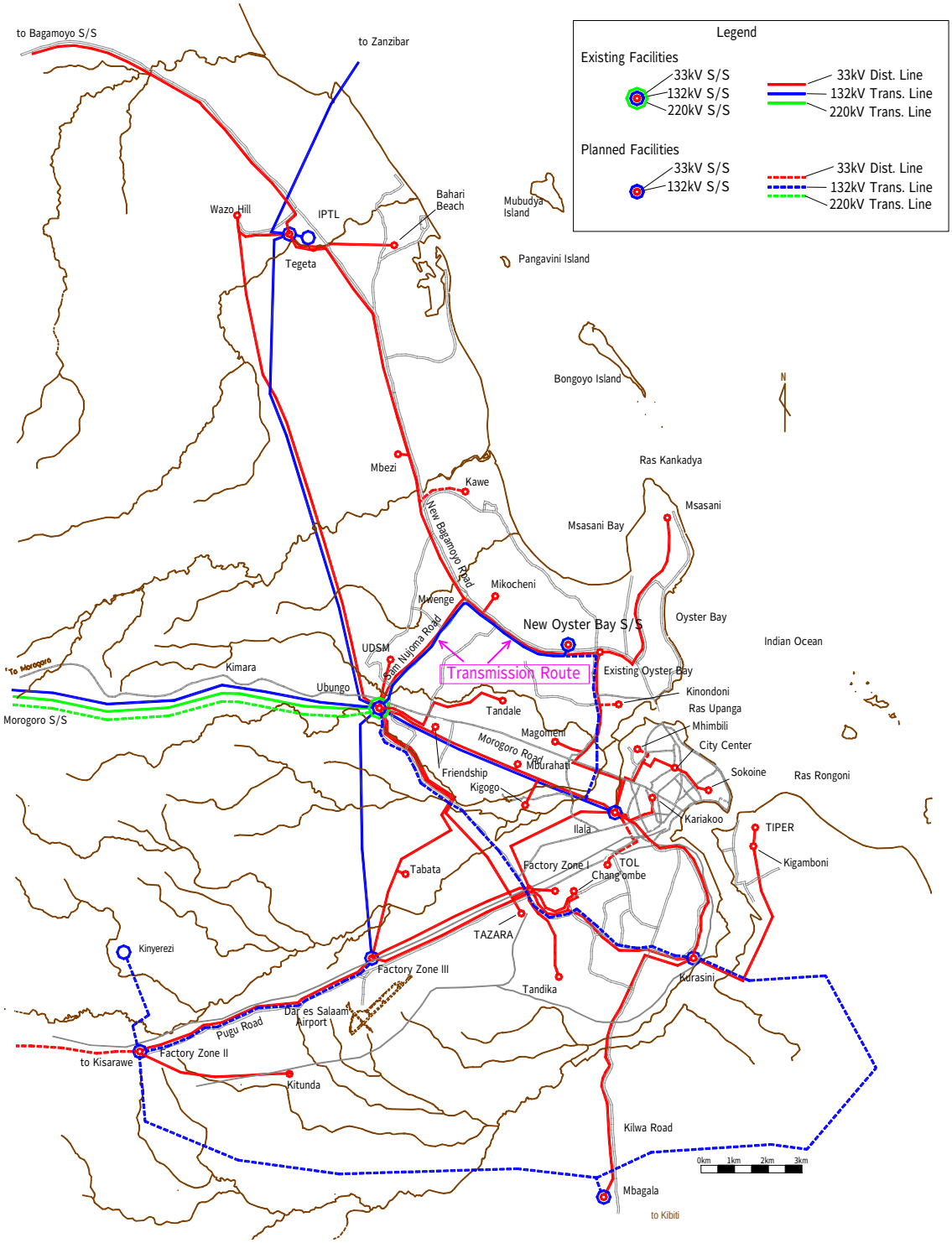
UNITED REPUBLIC OF TANZANIA AND PROJECT SITES



Transmission and Distribution Network in Dar es Salaam (220kV, 132kV, 33kV)

LIST OF FIGURES AND TABLES

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ABBREVIATIONS

ASCE	American Society of Civil Engineers
DAMP	The Dar-Es-Salaam Power Distribution and Maintenance Project
DANIDA	Danish International Development Agency
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
FINNIDA	Finnish Development Agency
IPTL	Independent Power Tanzania Ltd.
IEC	International Electrotechnical Commission
IKL	Isokeraunic Level
ISO	International Organization for Standardization
JCS	Japanese Cable Maker's Association Standard
JEAC	Japan Electric Association Code
JEC	Japanese Electrotechnical Committee
JEM	Standard of the Japan Electrical Manufacturers' Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
KfW	Kreditanstalt fur Wiederaufbau
MEM	Ministry of Energy and Minerals
NEMC	National Environmental Management Council
NSGRP	National Strategy for Growth and Reduction of Poverty
NORAD	Norwegian Agency for Development Cooperation
O&M	Operation and Maintenance
OJT	On the Job Training
PRS	Poverty Reduction Strategy
PRSP	Poverty Reduction Strategy Paper
RAP	Resettlement Action Plan
SADCC	Southern African Development Coordination Conference
SIDA	Swedish International Development Cooperation Agency
S/S	Substation
TANESCO	Tanzania Electric Supply Co., Ltd.
TICAD	Tokyo International Conference on African Development
Tsh	Tanzania Shilling (1 US$ = 1,280 Tsh, As of September, 2006)
USAID	US Agency for International Development
WB	World Bank
WPRP	Wetlands and Poverty Reduction Project

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1
BACKGROUND OF THE PROJECT

1-1 Background of the Study

The Tanzanian economy has shown a favorable expansion in the recent years so that the power demand in Dar es Salaam which is the Project site has been remarkably increased inline with the recent economic growth and an increase in population. In response to the request by Tanzania, the Government of Japan decided to conduct the study. Then JICA carried out development studies in 1994 and 2002 for the "1992/94 Master Plan Study and Pre-feasibility Study on Dar es Salaam Power Supply System Expansion" and the "2001/02 Master Plan Study on the Power Sector for Major Towns". The both study reports pointed out that the transmission and distribution network should be reinforced to improve the reliability for power supply in the northern part of Dar es Salaam (such as reduction in interruptions, voltage fluctuation, over load and power loss) by constructing the 132kV transmission network which is the upper transmission system and building a new secondary substations.

In spite of such recommendations, the transmission and distribution network has hardly been reinforced since 2002 due to the stagnant assistance and investment for TANESCO resulted from the movement of the privatization of the power sector. Consequently, as the development of substation or distribution facilities cannot catch up with a rapid expansion of power demand so that the existing facilities are compelled to be operated over load and are deteriorated. As the result, interruptions frequently happen in Dar es Salaam and that gives adverse effects to life of people and local economy. In due consideration of such the situations, the Government of Tanzania made a request for Japan's Grand Aid scheme for the construction of a new substation and transmission lines that will connect between the said new substation and the existing substations. Since the privatization of power sector was free from possibility through reassessing by the Tanzanian Government, in response to this request, the Government of Japan decided to conduct the study. Then JICA dispatched a Preliminary Study Team to Tanzania in February 2006 in order to confirm the components of the request and the relevance of the Project.

As shown below, the components of the request confirmed at the time of field survey in the Basic Design Study. Contents of request has been examined by the Basic Study Team and item D is deleted in the final result.

A. Construction of New Oyster Bay Substation

①	132/33kV main transformer 45MVA	2 units
②	33/11kV distribution transformer 15MVA	2 units
③	Related equipment for 132/33kV main transformer	1 set
④	Related equipment for 33/11kV distribution transformer	1 set
⑤	33kV distribution feeder	5 feeders

⑥ 11kV switchgears and equipment 1 set

B. Construction of 132kV Transmission Line (240mm^2)

• Between existing Ubungo Substation and New Oyster Bay Substation About 7km

C. Expansion of 132kV Lead-out Facilities at Ubungo Substation 1 set

D. Procurement of Equipment and Materials for 33kV Distribution Line (240mm^2)

(Laying work to be taken by the recipient side)

• Between new and existing Oyster Bay Substations About 1.6km

1-2 Natural Conditions

As Dar es Salaam, the former capital situated in the eastern part of Tanzania, is located in the tropical zone and is nearly 0m to 55m above the sea level, it is high temperature and humid. There is a long rainy period (between March and May) and a short rainy period (between November and December). A period between June and September is relatively cool, whereas, a period between December and February is extremely hot, so this is an area where the temperature exceeding 30℃ continues day after day. Its area is approximately 534km^2 and population is 2.5 million (2002 National Census).

(1) Location and Topography

From the geographical point of view, the Project site belongs to coastal zone situated in 6°52′ of the south altitude and 39°12′ of the east longitude and faces the Indian Ocean.

(2) Climatic Conditions (Temperature, Humidity, rainfall, Frequency of Lightning, Wind Velocity)

1) Temperature, Humidity and Rainfall

The conditions of temperature, humidity and rainfall in the Dar es Salaam area are shown in the following table.

Table 1-2.1 Temperature, Humidity and Rainfall in Dar es Salaam

Month	Mean Sunshine Duration	Temperature (°C)				Discomfort Index High Temperature & Humidity	Relative Humidity (%)		Mean Rainfall (mm)	Days of raining (0.25mm or more)
		Mean		Record						
		Min.	Max.	Min.	Max.		Morning	Afternoon		
Jan	8	25	31	21	35	High	81	74	66	8
Feb	7	25	31	20	35	High	81	74	66	6
Mar	7	24	31	21	36	High	85	76	130	12
Apr	5	23	30	19	35	High	88	77	290	19
May	7	22	29	18	33	High	87	72	188	15
Jun	7	20	29	16	32	Medium	84	64	33	6
Jul	7	19	28	16	32	Medium	85	62	31	6
Aug	9	19	28	15	32	Medium	84	64	25	7
Sep	9	19	28	16	33	Medium	81	67	31	7
Oct	9	21	29	17	33	High	78	70	41	7
Nov	8	25	31	19	34	High	79	73	74	9
Dec	8	25	31	21	35	High	80	75	91	11

Source: BBC Web site

2) Wind Conditions

According to the Tanzania Meteorological Agency, there are not many strong winds which have an impact on electric facilities in the Dar es Salaam area. However, the cyclone occurred in the Indian Ocean uncommonly approached to the coast in East Africa, so the approach of three (3) cyclones has been recorded since 1852. Of those, the latest cyclone was “Lily” approached in 1966 and 17 to 24 m/s wind velocity was recorded in Dar es Salaam. This was recorded as the maximum wind velocity in Dar es Salaam.

3) Lightning

Although lightnings are observed in the rainy season, annual statistics are not recorded.

1-3 Environmental and Social Considerations

(1) Environmental and Social Considerations on Substation Facilities

Due to the construction of new substation in the residential area, preventive measures for noise arisen from substation equipment should be taken. Since a transformer is oil immersed type, a preventive step for oil leakage at the time of an unexpected accident should be also taken. During a construction period, noise or vibration should be minimized, at the same time, safety for pedestrian, etc. should take into account when construction vehicles enter or leave the site.

(2) Environmental and Social Considerations on Transmission Facilities

Since the transmission line will pass through an area of the crowded population from the Ubungo Substation to the New Oyster Bay Substation, the minimum road clearance or offset distance should be set up in order to secure public safety. The following figure illustrates safety offset distance with the transmission line under the Project.

As the transmission line will be built on the spot adjacent to the private land, a construction method to minimize an negative impact (such as noise, vibration and traffic restriction during the construction work) should be examined. Accordingly, a cast-in-place pile will be applied to minimize the construction space and mitigate the negative impact during the construction. Cast-in-place piles will be drilled by machine for low noise and vibration.

After the commissioning of the transmission line, a preventive step for approaching should be taken by utilizing a danger plate, at the same time, the explanation to the local resident on the safety offset distance between general residences including TV antennas and power line should be carried out by Tanzanian side.

As the transmission lines will be constructed by the trunk roads, if a vehicle hit the pole, this will have a serious danger to both vehicle side and the transmission line. Consequently, an accident should be prevented before it happens by installing protective fences, anti-collision curbstones or reflectors for traffic obstacles.

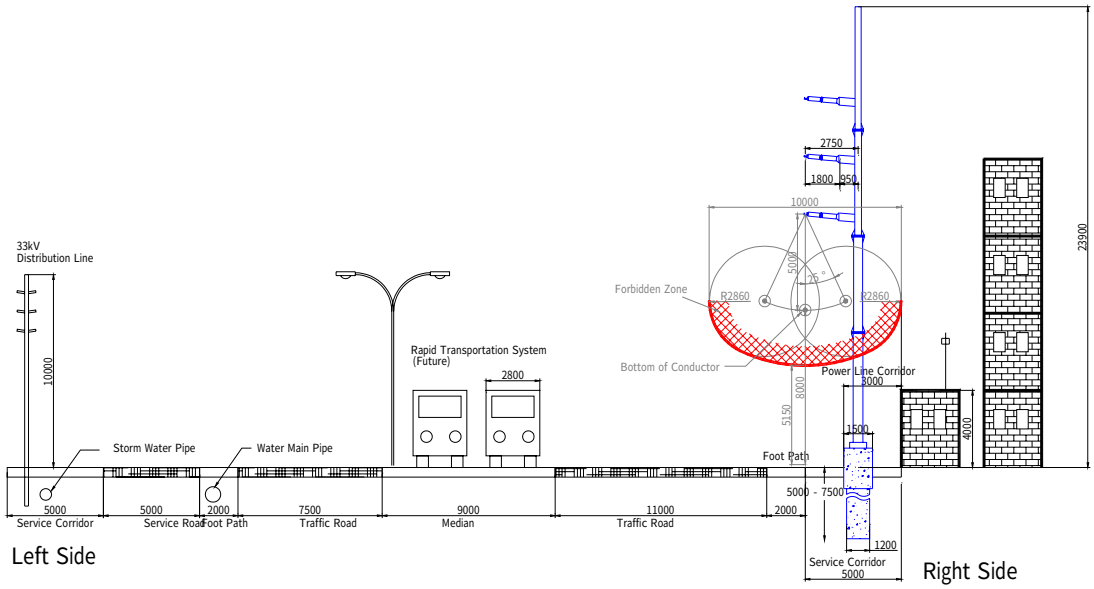

Figure 1-3.1 Examination of Transmission Line Layout

(3) Land Acquisition for New Oyster Bay Substation

The construction site for New Oyster Bay Substation covers two (2) parcels of land (approximately 64m x 90m) in Victoria area. In the relevant site, the access road (10m in width) to the official dwelling is planned to construct in addition to the New Oyster Bay Substation. Even its road space is taken into account, there is a sufficient space as the land for the substation. The land has not yet been transferred from private land owner to TANESCO. Transfer procedure is supposed to be completed by around September 2007.

(4) Change of Implementation Body of Expansion Work for New Bagamoyo Road

The 132kV transmission line from the Ubungo Substation to the New Oyster Bay Substation will be constructed along the said road, the right side of the road from the Mwenge Junction to the New Oyster Bay Substation will be the transmission line corridor. With respect to the expansion plan for the said road, the implementation body was changed from TANROADS to Dar es Salaam City. Consequently, the agreed components with respect to the land for the transmission lines that were confirmed between TANESCO and TANROADS should be discussed again

between TANESCO and Dar es Salaam City. The discussions will be also completed by around September 2007.

(5) Progress of EIA Procedures

In the procedure of environmental impact assessment (EIA), the National Environmental Management Council (NEMC) had completed the technical examination of the EIA report prepared by TANESCO.

In the EIA report, the left side of the Sam Nujoma Road is supposed to be utilized as the transmission line route. However, the 132kV transmission route was changed from the left side to the right of the Sam Nujoma Road after NEMC examination completed. Regarding the position of the 132kV transmission route, the side change from left to right does not have any impact on the environment, so it is not necessary to revise the existing EIA report. This was confirmed through a letter sent from NEMC to TANESCO.

Although the technical examination of the EIA report was completed, according to the NEMC, due to the recent revision on the procedures, it becomes necessary to submit an EIA report to be translated into Swahili. The said report was already submitted by TANESCO. The final approval notice for the EIA (environmental license) is scheduled to be issued by the Minister of Environment by around mid of May 2007.

CHAPTER 2

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2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

The power demand has increased tremendously in Dar es Salaam, Tanzania's largest city, associated with the recent economic growth and increase in population. The country implemented the Master Plan Study and the Feasibility Study on Dar es Salaam Power Supply System Expansion (1994) and Master Plan Study and the Feasibility Study on the Power Sector for Major Towns (2002) with the aim of reexamining the reinforcement of transmission and distribution system in order to meet future power demand by receiving technical assistance of the Government of Japan. Although the gas turbine generation system that uses natural gas produced with Songosongo was expanded, the reinforcement of transmission and distribution system has fallen well behind due to financial difficulty in power sector. As a result, problems frequently occur at facilities due to overloading and insufficient maintenance. Consequently, frequency and period of interruptions has been increased and these outages influences the people's living and urban functions seriously.

To boost the economic growth, the Government of Tanzania strongly emphasized the importance of infrastructure development in its national development strategies. In accordance with this national policy, the aim of the Project is to secure a stable power supply capability in the Kinondoni District in the north of Dar es Salaam where power demand has increased significantly.

2-1-2 Outline of the Project

The Project involves the construction of new 132/33kV substations in the city center where power demand is high and to connect with the trunk 132kV transmission network in order to accomplish the above-mentioned goal. Through the execution of the Project, a stable power supply and a reduction in power loss can be achieved in the Kinondoni District. The requested Japanese assistance will build a new 132/33kV Oyster Bay Substation in the northern part of Dar es Salaam and add the 132kV lead-out facilities at the existing Ubungo Substation as a power source. Moreover, 132kV transmission lines will be constructed to connect both substations.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Concept

The scope of the Project includes the procuring and installation of the 132/33kV substation and the 132kV transmission line necessary to distribute electric power to consumers in the northern district of Dar es Salaam, and the transformer capacity is determined as to satisfy forecasted demand in the commissioning year of the Project.

Since 132kV transmission lines will be constructed along major roads in the city center, adequate consideration should be taken to public safety as well as the local topography.

(2) Natural Conditions

1) Temperature

The annual mean temperature at the Project site is approximately 29℃ and the humidity is around 67% during the daytime despite being muggy and exceeding 95% in the morning.

As the substation facilities to be adopted under the Project are an outdoor type, except for the 33/11kV switchgears, special consideration should be given to higher temperatures due to ambient temperatures or direct sunlight and high humidity so it will not hinder the operation and maintenance of equipment after commissioning.

2) Rainfall and Thunderstorms

The annual rainfall at the Project site is approximately 1,000mm. There is a long rainy period (between March and May) and a short rainy period (between November and December). During the rainy season rain falls in a concentrated manner, a rainy water drainage system, etc. will be included at the substation lot so that heavy rain will not hinder the operation and maintenance of substation equipment. In addition, the period of rainy season should be noted in scheduling outdoor work such as foundation work during construction.

Thunderstorms do occur at the Project site during the rainy season and direct lightning strikes on the transmission steel poles are possible. Assembling of transmission pole and stringing work will be carried out at high places, so special care should be taken on considering the construction schedule.

3) Wind

The maximum wind velocity recorded over the past 100 years in Dar es Salaam is 45 knots (approximately 23.15m/s). Therefore, when designing the structure and configuration of monopole, the said wind velocity should be taken into account for safe operation of the transmission system.

4) Salt contamination

The Project site is located 2 to 4km apart from the coast, so appropriate countermeasures against salt contamination should be taken to establish reliable transmission system.

(3) Socio-economic Conditions

The Project site is the city center and 132kV transmission line runs along trunk roads with heavy traffic volume and close to residential areas. Moreover, other utilities' infrastructure such as telephone lines, water supply and drainage pipes are buried at the construction site for for 132kV transmission lines. Therefore, the utmost care should be taken so as not to inconvenience local residents and disrupt traffic during the construction work.

Consideration was given to ensure a safety distance from nearby residences and shops along the road boundaries when designing transmission lines.

(4) Procurement Conditions

According to the recent economic development, large-scale construction works including various commercial facilities or office buildings are underway in Dar es Salaam, several general contractors are involved in construction work, including electrical construction firms, so the construction climate is favorable. Consequently, as it is possible to utilize local companies for local procurement of workers, transportation vehicles, construction machinery, etc. as well as general workers necessary for foundation work for constructing the substations or the 132kV transmission lines in the Project, they will be effectively utilized.

Although engineers who have advanced technical skills are necessary at the time of installing and commissioning of the equipment, there is little similar installation work for high voltage substation equipment or construction work for monopoles for 132kV transmission lines in Tanzania. It will be therefore difficult to effectively utilize local companies aside from workmen, so Japanese engineers will be dispatched for the said facilities' construction.

As for construction materials, aggregates, cement and reinforcing bars, etc. utilized in the foundation work are locally available in Tanzania. Although locally available materials will be

adopted as much as possible, main equipment and some materials for substations and transmission line construction are not produced in Tanzania. Therefore, they will be procured from Japan or a third country with the consideration of the past experience and capability of operation and maintenance on the Tanzanian side.

(5) Effective Use of Local Construction Companies

Since local procurement of workers, transportation vehicles, construction machinery and materials is possible, local construction companies will be effectively utilized for foundation (civil engineering) work for substations and 132kV transmission lines under the Project.

(6) Operation and Maintenance Capability

TANESCO has experience with other similar scale power system expansion projects in Dar es Salaam through Japan's Grant Aid scheme. In addition, the specifications of the substation, transmission and distribution equipment are formulated not to exceed the scope of the equipment procured through previous grand aid. Accordingly, the TANESCO which will take charge of operation and maintenance of the Project is deemed to have the enough capability to operate and maintain the procured transmission and distribution equipment.

However, the existing facilities and equipment have deteriorated and there are insufficient spare parts due to financial difficulties at TANESCO, so there are many problems due to overload and insufficient maintenance. In addition, TANESCO's engineers and operators may not be completely familiar with the latest substation equipment technology. Japanese engineers will therefore provide on-the-job training (OJT) in operation and maintenance of the relevant facilities and equipment during the construction period in the Project. Simultaneously, special consideration should be given to effective and efficient operation of facilities to be constructed under the Project by providing necessary spare parts, testing instrument, maintenance tools, operation and maintenance manuals and recommendations on an operation and maintenance system after the commissioning of the Project.

(7) Scope of Facilities and Equipment, Grade Setting

The scope of procurement and installation of equipment and materials, and technical level is formulated based on the following basic principles in due consideration of the above-mentioned various conditions.

1) Principles for Scope of Facilities and Equipment

The minimum but necessary configuration and specifications of facilities are selected for 132/33kV substation and 132kV transmission line in order to provide stable electric power

to residents, social welfare facilities such as hospitals or school in the Project site by the year of commissioning, which is regarded to be the target year of the Project.

In addition, the equipment is designed in relation to international standards and adopt compatible parts by minimizing the number of type or manufactures as much as possible to achieve economical design and reduce maintenance cost.

2) Principles for Grade Setting

In designing 132/33kV substation and 132kV transmission line to be constructed and procured under the Project, special consideration should be given so that the design will be familiar to TANESCO who will take charge of operation and maintenance after the completion of construction.

(8) Construction and Procurement Method, Construction Schedule

In order to complete the Project within the prescribed construction period and to produce the expected effects, process planning should be formulated by coordinating work to be taken by the Japanese side and the Tanzanian side, inland transportation routes and methods, the term of construction and various other procedures, etc.

2-2-2 Basic Plan (Equipment Plan)

(1) Preconditions

1) Demand Forecast

Figure 2-2-2.1 illustrates the difference between the demand forecast in a study of the master plan conducted by JICA in 2002 (Master Plan Study of the Power Sector for Major Towns) to examine expansion plan of transmission and distribution facilities in Dar es Salaam City, Kilimanjaro and Arusha districts, and demand currently predicted by TANESCO. Although later forecast shows lower demand, growth in demand is expected to increase gradually.

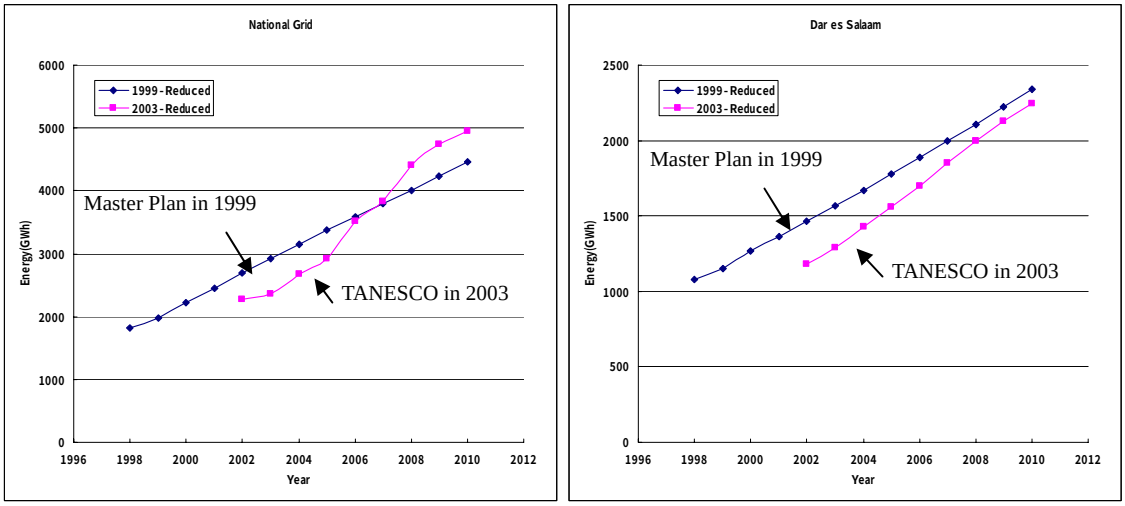


Figure 2-2-2.1 Difference in Demand Forecast

The construction schedule for the New Oyster Bay Substation based on the demand forecast examined at the time of the Master Plan Study of the Power Sector for Major Towns (2002) is shown in Table 2-2-2.1. As the New Oyster Bay Substation was deemed to be necessary in 2003, load at the time of 2010 was assumed to be 81.4MVA (Commissioning year of the New Oyster Bay Substation under feasibility study of the said report was set in 2004 in due consideration of construction period).

Table 2-2-2.1 Examination at the time of the Master Plan Study of the Power Sector for Major Towns

(Unit: MVA)

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Remark
New Oysterbay				15.8	16.2	16.6	17.0	17.4	17.8	18.3	18.7	
Expansion Plan	132/33 (2x45)			2x45								Commissioned in 2003
	33/11 (2x15)			2x15								
TR Capacity	132/33kV TR			90	90	90	90	90	90	90	90	
	33/11kV TR			30	30	30	30	30	30	30	30	
Oysterbay		loved from Ilala System		18.7	19.9	21.3	22.7	24.2	25.8	27.6	29.4	
Expansion Plan				1x15	2x5							
TR Capacity	33/11kV TR			30	30	30	30	30	30	30	30	
Msasani		loved from Ilala System		15.6	17.9	20.6	23.7	27.3	31.4	36.1	41.5	
Expansion Plan						1x15				1x15		
TR Capacity	33/11kV TR			15	15	30	30	30	30	45	45	
132/33kV Total Load				50.1	54.1	58.5	63.4	68.9	75.0	81.9	89.6	Summary of 33/11kV Load
132/33kV Total Load w/ Diversity Factor				45.5	49.1	53.2	57.6	62.6	68.2	74.5	81.4	=Summary of 33/11kV Load/1.1

With respect to the difference between the assumption at the time of the Master Plan Study of the Power Sector for Major Towns and operation method of the New Oyster Substation recently considered by TANESCO, the 132/33 kV main transformers at New Oyster Bay Substation would distribute power for load at the existing Oyster Bay and Msasani Substations in the former study; whereas, in addition to this, TANESCO plans to provide power for load at the Mikohceni and Magomeni Substations and industry feeder from the New Oyster Bay Substation. Demand forecast, considering that was conducted by the Preliminary Study Team, the load at the time of 2010 is assumed to be 71.4MVA.

Table 2-2-2.2 Demand Forecast by Preliminary Study Team

No	33/11kV Substation Name or District Name	Present Transformer Capacity (Unit × MVA)	Results (MVA)			Forecast (MVA)	
			1991	2000	2004	2006	2010
1	Mikocheni	1×15	7.9	14.2	15.6	20.3	25.0
2	Msasani	1×15	3.7	6.0	6.9	9.0	13.9
3	Existing Oyster Bay	1×15	7.3	12.3	14.0	17.5	20.3
4	Magomeni	1×15	Nil	Nil	5.0	10.0	15.0
5	Industrial Feeder	33kV supply	Nil	2.0	3.0	5.0	15.0
	Total		18.9	34.5	44.5	61.8	89.2
	Diversity Factor Considered (Total × 0.8)				35.6	44.9	71.4
	Required Number of 132/33kV Transformers×Capacity					1×45	2×45

Source: Preliminary Study Report

With respect to the capacity and the number of 132/33kV main transformers to be installed at New Oyster Bay Substation, both of the above-mentioned demand forecasts recommend that it is necessary to install 2 units of 45MVA transformers from the beginning of the commercial operation to meet the rapid demand growth in Kinondoni District.

From the viewpoint of local power demand growth, large-scale commercial facilities such as the Mlimani Shopping Center are being developed one after another along the perimeter of the Project site in accordance with the expansion of trunk road such as Sam Nujoma and the New Bagamoyo Roads. Amount of energy consumption is rapidly growing in relevant area where the electric power is fed through 33kV distribution system. 132/33kV transformer capacity in Dar es Salaam is not enough in compare with transmission and distribution capacity of 132kV and 33kV system, therefore, 132/33kV transformer is the bottleneck of power system at present. To solve this bottleneck, 2 units should be installed.

In addition, if 2 units will be installed at New Oyster Bay from the start of operation, TANESCO can do maintenance work by taking the either transformer outage without total outage of substation and power will be continuously supplied even in maintenance period. Considering above-mentioned conditions, 2 units of 132/33 transformer should be installed from the start of operation.

2) Operation Conditions at New Oyster Bay Substation

Future expansion is also considered in designing of switchyard of New Oyster Bay Substation because the planned 132kV transmission line is the part of 132kV ring network surrounding Dar es Salaam area. 3 plans were considered in the study as shown in Table

2-2-2.3 and Figure 2-2-2.2. As the result of examination, one additional 132kV feeder space is provided in 132kV switchyard of New Oyster Bay Substation

Table 2-2-2.3 Possible 132kV Transmission Line to be drawn into New Oyster Bay Substation in Future

Plan	Expansion Plan	Purpose
Plan A	Lead-out of 2nd line from Ubungo S/S	Alternating outage of transmission line is enabled.
Plan B	Lead-out of 1 line from Tegeta S/S	Alternating outage of transmission line is enabled.
Plan C	Lead-out of 1 line from Ilala S/S or City Center S/S	Alternating outage of transmission line is enabled. Reliability of 132kV system is improved by establishment of 132kV loop system configuration

If Plan B will be taken, New Oyster Bay Substation will be fed by two different power source, that is Ubungo system and Tegeta system. However, asynchronous operation by two different power source will not taken into account due to the small capacity of the New Oyster Substation and the complexity in operation (Refer to No. 1 “132kV Interconnection Plan that cannot be adopted” indicated in Figure 2-2-2.2).

In a similar manner, the plan to transmit power to from Tegeta to Ilala Substation via the New Oyster Bay Substation was examined. As the result of examination, this plan is judged not to be taken under the Project (Refer to No. 2 “132kV Interconnection Plan that cannot be adopted” indicated in Figure 2-2-2.2) since 3 feeders of the 132kV lead-out equipment will be required at the New Oyster Bay Substation and the capacity of power source at the Tegata Substation is supposed not enough to supply power to city center.

3) Power Flow

The power flow diagram at the completion of the Project is shown in Figure 2-2-2.3 Although the assumed demand by 2010 in the Master Plan Study of the Power Sector for Major Towns is applied to the load at substations, the assumed demand of the Preliminary Study Team is applied to the demand in the distribution substation fed from the New Oyster Bay Substation. In addition, a total of 40% of the load at the Mikocheni Substation and 30% of the existing Oyster Bay Substation is assumed to be shifted to 33kV load at the New Oyster Bay Station in the power flow analysis.

Although the load of 132/33kV transformer at the New Oyster Bay Substation is overload (96.2MVA) in the calculation, since the load of 33kV distribution lines to be connected to the 132/33kV transformer are simply combined, it will actually be around 80MVA taking the diversity factor into account. Due to the heavy power flow of the 132kV transmission line from the Ubungo Substation, the voltage on the New Oyster Bay Substation will drop to

some extent, but the said voltage drop can be compensated by on-load tap changer equipped on the transformer; so no problems will arise during operation.

The power flow diagram shows a peak power flow of between 2010 and 2015, and the result indicates the 132/33kV transformers at the Ilala Substation will be overloaded. Other appropriate countermeasure should be taken to solve overload problem at 132/33kV transformers of Ilala Substation.

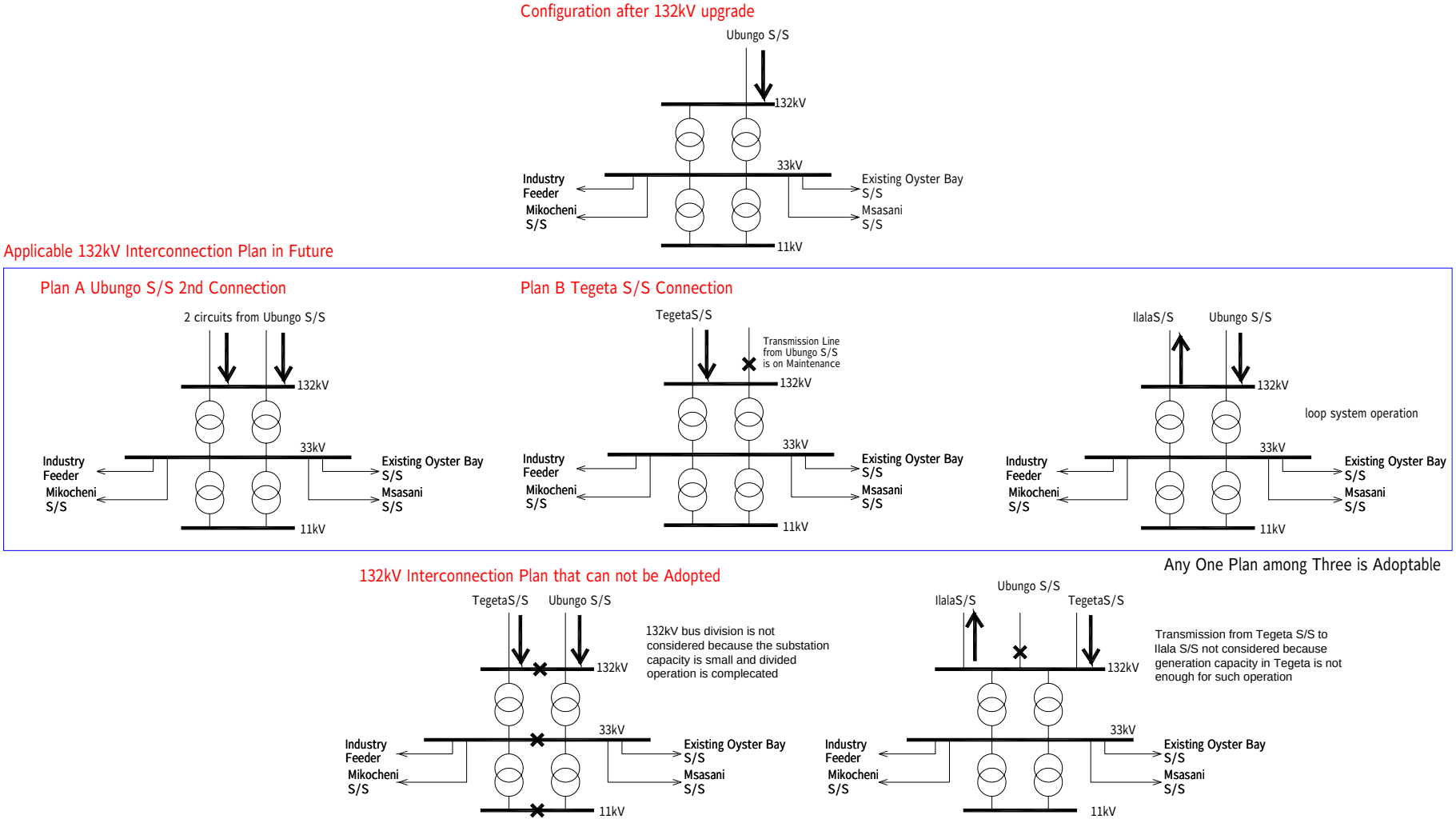


Figure 2-2-2.2 Future New Oyster Bay Substation Operation System

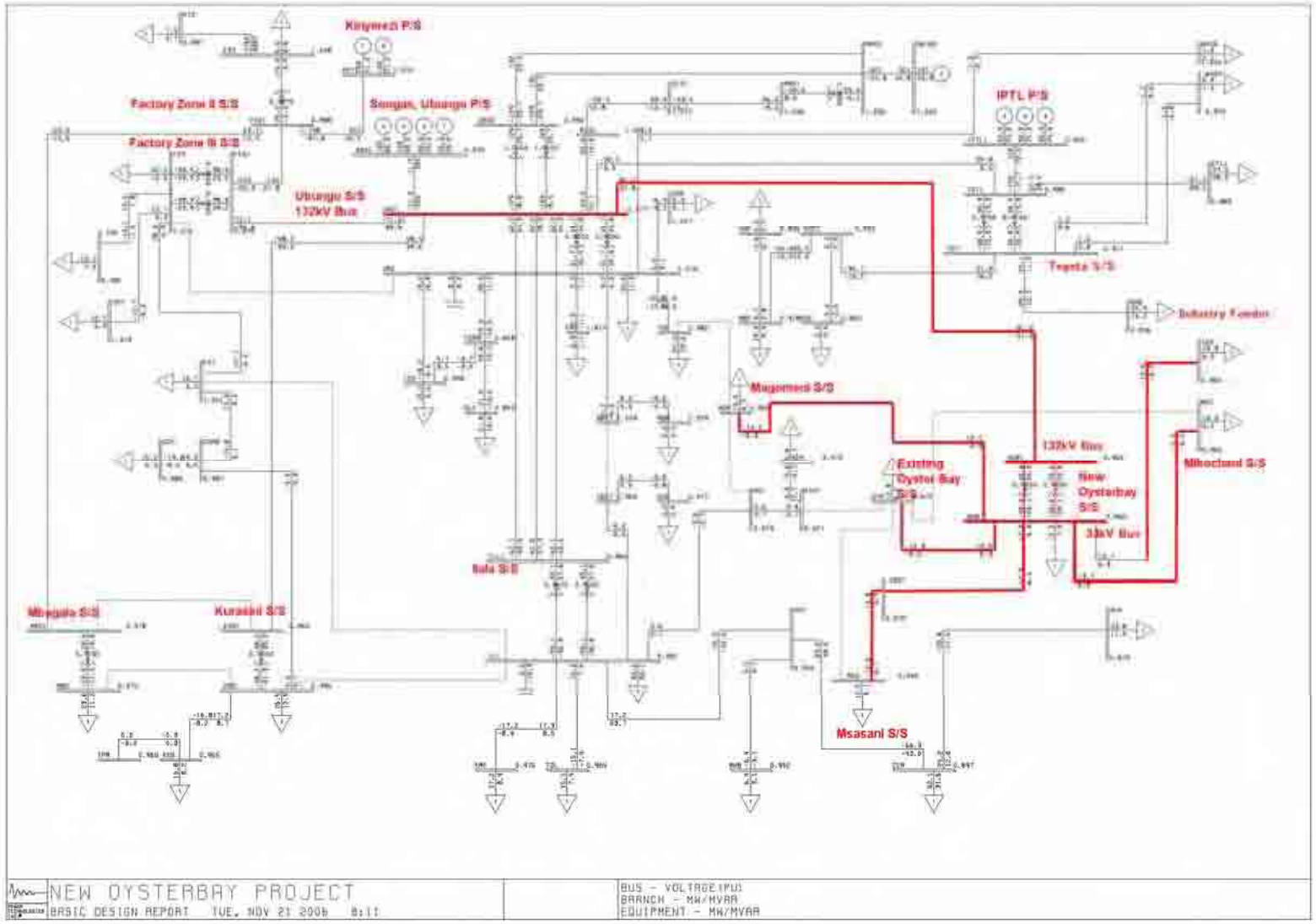


Figure 2-2-2.3 Schematic Diagram after Starting Operation at New Oyster Bay Substation

(2) General Plan

1) Design Conditions

Design conditions under the Project are described as follows.

(i) Climatic Conditions

Natural conditions at designing are shown in Table 2-2-2.4

Table 2-2-2.4 Natural Conditions in Designing

District		Dar es Salaam
Altitude		Not more than 1,000m
Ambient Temperature	Maximum	40℃
	Minimum	10℃
	Mean	20℃
Maximum Humidity		Not less than 95%
Wind Velocity		25.8m/s (Conductor Swing) 35m/s (Supports, Structure Wires)
Rainfall (Monthly Maximum)		300mm
Seismic Force		Horizontal 0.1G
Soil Bearing Capacity		10 ton/m^2

Since transmission lines will be constructed adjacent to private land under the Project, wind velocity should be examined for swing of conductor and structural strength separately. Approach of conductor to private land becomes a problem only if such conditions occur simultaneously as heavy current flown in conductor, high ambient temperature, right-angled strong wind. so design wind velocity is decided based on past results in order to avoid excessive design. In other word, the proposed maximum wind velocity is 25.8m/s in the consideration of conductor swing taking the some margin in maximum wind velocity recorded over the past 100 years.

On the other hand the different wind velocity is taken in structural design of transmission line. 40m/s is usually applied in Japan as the maximum wind velocity in structural design of transmission line structures. In similar projects in Tanzania, 38.3m/s was adopted based on the design conditions of the 220kV transmission line from Kidatu to Morogoro that passes through a mountainous area. However, since transmission lines under the Project will be constructed in the city center, it is assumed that strong winds like those found in mountainous areas will not pose a problem, based on past records. Consequently, the proposed wind velocity adopted by TANESCO in the Pangani Falls 132kV Transmission Line Construction Project (1995, SIDA), where transmission lines were constructed near the east coast of Tanzania in similar

topography as Dar es Salaam is applied. Accordingly, the maximum wind velocity is estimated to be 35m/s.

(ii) Electrical Mode Conditions

Basic condition for designing electrical equipment is described in Table 2-2-2.5.

Table 2-2-2.5 Basic Electrical Condition

Item	Transmission System	Distribution System		Station Service Power	
Nominal Voltage	132kV	33kV	11kV	400-230VAC	110DC
Maximum Voltage	145kV	36kV	12kV	440-253VAC	125VDC
Frequency	50Hz				No Adapted
Maximum Short Circuit Capacity	31.5kA（2s）	25kA（2s）		No Adapted	
Lightning Impulse Withstand Voltage (LIWV)	650kV	200kV (Indoor 170kV)	90kV (Indoor 75kV)	2kV	No Adapted
Earthing System	Effectively Earthed System			No Adapted	
Minimum Leakage Distance	3500mm	25mm/kV		No Adapted	

(iii) New Oyster Bay Substation Construction Plan

(a) Bus Bar Configuration

The single bus design meets Tanzanian standards. In conformity with TANESCO standards, a bus tie circuit breaker will be installed to a bus with 5 feeders or more of the 33kV and the 11kV systems for flexible operation.

(b) Insulation Coordination

For the substation equipment, appropriate insulation coordination is taken in accordance with IEC so that the equipment will be protected from abnormal over voltages occurred by lightning or switching operation.

In conformity with the nominal voltage mentioned in Table 2-2-2.5, a lightning impulse withstand voltage (LIWV) are adopted to coordinate with the protective level and to secure a withstand voltage level for equipment.

Lightning Arrester Rating

Rated voltage, reference voltage and residual voltage of lightning arresters that protect equipment are set up for the above-mentioned protective level as shown in Table 2-2-2.6. As for the type of lighting arresters, zinc oxide type arrester is

adopted due to their excellent discharge characteristic against steep surges in current.

Table 2-2-2.6 Lightning Arrester Rating

Nominal Voltage (kV)	Rated Voltage (kV)	Reference Voltage (kV)	Residual Voltage (kV)
11	12	19.8	Not more than 50
33	36	59.4	Not more than 145
132	120	178	Not more than 403

Minimum Clearance

Minimum Clearance are set for the distance between outdoor bus conductors and earth and the distance among conductors as shown in Table 2-2-2-7.

Table 2-2-2.7 Minimum Clearance

Nominal Voltage (kV)	Phase to Ground Clearance (mm)		Phase to Phase Clearance (mm)	
	Minimum	Standard	Minimum	Standard
11	150	300 (180)	190	600 (300)
33	350	500 (420)	480	900 (580)
132	1300	1700	1700	2800

Note: ( ) indicates a indoor designed value.

(c) Substation Earthing

A meshed banding system (buried copper wire) is applied to the earthing system on the substation.

Earthing resistance will be no more than 0.2 ohm to control any rise in electric potential of the substation during an injection of fault current.

Earthing resistance (ohm)＝2000V/10kA＝0.2 ohm

(d) Switch Panel Specifications

The standard specifications for switch panels at substation equipment is as follows.

Protection level (lowest): Outdoor: IP43
Indoor: IP20

(iv) Ubungo Substation Expansion Plan

(a) Expanded Components

The existing 132kV switchyard at the Ubungo Substation will be expanded and 132kV transmission lead-out equipment will be installed to introduce 132kV transmission line for the New Oyster Bay Substation. The expansion will be carried out by adding 1-bay steel structure on the north side of the existing 132k switchyard. Consequently, CVT for 132kV bus A2 and B2 will be transferred and both buses will be extended 10.5m to the north. The 132kV transmission line will be drawn into the expanded bay from the TW-01 monopole; at the same time, circuit breakers, disconnecting switches, current transformers, transformers for instruments and lightning arresters will be installed in expanded feeder bay. In addition, a control and protection function for the expanded equipment will be added to the existing 132kV control and protection panels, and the SCADA system will be modified in order to operate and monitor the new equipment from integrated control system in the Ubungo Substation

(b) Insulation Coordination

As the Ubungo Substation is located 6km inland from the coast, the impact of salt contamination is relatively smaller than the New Oyster Bay Substation (approximately 2km from the coast). Although the number of discs in insulating string at the existing 132kV switchyard is 11 pieces and the leakage distance is 292mm/piece x 11 pieces = 3,212mm, no trouble due to salt contamination has occurred. Consequently, the minimum leakage distance of the substation equipment at the Ubungo Substation is determined as 3,212mm or more in coordination with the existing equipment at the 132kV switchyard. The designed values of the New Oyster Bay Substation are applied to values other than the minimum leakage distance.

(v) 132kV Transmission Line Plan

(a) Type of Transmission Line

An overhead transmission system is applied to the 132kV transmission lines in due consideration of maintainability, workability and material cost, etc. The height shown in Table 2-2-2.8 is applied to the transmission line minimum height based on TANESCO's standard.

Table 2-2-2.8 132kV Transmission Line Minimum Height

Item	Minimum Ground Height (m)
General Areas	6.7
Roads	8.0
Railways	9.0
Waterways・Fairways	10.0

(b) Steel Monopoles

Since the transmission line route is situated in an urban area, a compact monopole is adopted from the viewpoint of acquiring land. Major specifications are described as follows.

Configuration : Round cross-section, steel pole
Number of partitions : 4-partition by considering transportation (length of 1 pole piece should be within 8m)
Finish : Hot zinc galvanizing finish from a maintenance point of view

The purpose and equipment components of the compact monopoles are described in Table 2-2-2.9.

Table 2-2-2.9 Overview of Various Monopoles

Steel Pole Type (Horizontal deviation Angle)	Major Equipment	Purpose & Major Materials	Quantity Procured
Type A (Suspension Type) (0 to 3 degrees)	•Monopole • Post insulator • Overhead earthing wire	Type A is adopted at the place the horizontal deviation angle is 0 to 3 degrees. The pole height is 22.9m & will be installed on the foundation at 1m height. It has a 4-partition structure with an overhead earthing wire. It has no cross arm but 3 post insulators.	19 units
Type B (Tension Type) (3 to 15 degrees)	• Monopole • Tension insulator strings • Jumper support insulator • Overhead earthing wire	Type B is adopted at the place the horizontal deviation angle is 3 to 15 degrees. The pole height is 25.2m & will be installed on the foundation at 1m height. It has a 4-partition structure with an overhead earthing wire. By applying cross arm, it has 6 sets of tension insulator strings & 3 jumper support insulators.	13 units
Type C (Tension Type) (15 to 35 degrees)	• Monopole • Tension insulator strings • Jumper support insulator • Overhead earthing wire	Type C is adopted at the place the horizontal deviation angle is 15 to 35 degrees. Pole height is 25.2m & will be installed on the foundation at 1m height. It has a 4-partition structure with an overhead earthing wire. By applying cross arm, it has 6 sets of tension insulator strings & 3 jumper support insulators.	3 units
Type D (Dead End Type) (0 to 90 degrees)	• Monopole • Tension insulator strings • Jumper support insulator • Overhead earthing wire	Type D is adopted at 132kV transmission line end (for lead-out to Ubungo S/S & New Oyster Bay S/S). Pole height is 25.2m & has a 4-partition structure with an overhead earthing wire. By applying a cross arm, it has tension insulator strings (3 sets at Ubungo S/S, 6 sets at New Oyster Bay S/S) & 3 jumper support insulators (3 sets only for Ubungo S/S).	2 units
Type DR (Dead End Type) (0 to 90 degrees)	• Monopole • Tension insulator strings • Jumper support insulator • Overhead earthing wire	Type DR is adopted for the tower at Mwenge Junction with 90 degrees of horizontal deviation angle. The pole height is 24.0m & has a 4-partition structure with an overhead earthing wire. By applying a cross arm, it has 6 sets of tension insulator strings. The tower is designed to be capable to connect another 132kV transmission line from Tegeta that is planned as future expansion.	1 unit

(c) Monopole Span and Electric Line Sag

In due consideration of the high-voltage transmission lines in the city center and workability in construction, the standard span is determined as 200m and sag is around 3% according to Table 2.2.2.8. The maximum working tension of conductor is approximately 27,500N for conductor.

(d) Transmission Line Configuration and Assembling

A vertical 3- configuration is applied to meet the condition of narrow transmission lines corridor since transmission line will be installed in the city center close to private land.

(e) Conductor

Aluminum conductor aluminum-clad steel reinforced (ACSR/AC) type of wire is adopted for transmission line conductor, which is TANESCO's

standard. The conductor size is 240mm^2 (code name: Hawk). The detailed designed quantity and the quantity to be procured are outlined in Table 2-2-2.10.

Table 2-2-2.10 Quantity of Conductor for 132kV Transmission Lines

Conductor Classification	Quantity
① 132kV Transmission Line Distance	6,869m
② Sag (3%) ①x 0.03	206m
③ Designed Quantity (①+②) x 3 phases	21,225m
④ Conductor for jumper lines on monopole	Included in quantity of construction margin
⑤ Construction Margin (5%)	1,061m
⑥ Total Quantity to be procured ③+⑤	22.2km (22,286m)

(f) Overhead Earthing Wire

Aluminum-clad steel stranded wire (AC) that TANESCO deems standard is adopted and its size is 55mm^2. By setting the tension of overhead earthing wire as around 80% of conductor, the maximum working tension is 12,300N. The designed quantity and quantity to be procured are described in detail in the Table 2-2-2.11.

Table 2-2-2.11 Quantity of Overhead Earthing Wire for 132kV Transmission Lines

Steel Wire Classification	Quantity
① 132k Transmission Line Distance + Second wire from gantry to 1st tower	6,997m
② Sag (3%) ① x 0.03	210m
③ Designed Quantity (①+②) x 1 phase	7,207m
④ Construction Margin (5%)	360m
⑤ Total Quantity to be procured ③+④	7,500m(7,567m)

(g) Insulators

The transmission lines route are situated 2 to 4km away from the coast and the maximum equivalent salt deposit density is assumed to be 0.35mg/cm^2. Since the pollution withstand voltage per standard 250mm insulator is 7.2kV, the number of insulators to meet the desired value of withstand

voltage at 83.8kV (132kVx1.1/$\sqrt{3}$) is calculated as 12 pieces (11.7 pieces). The leakage distance per 250mm suspension insulator (insulator disc) is 292mm, so 3,417mm (292mm x 11.7 pieces) is necessary for the leakage distance of 132kV insulator strings. Accordingly, the minimum leakage distance of 132kV insulator strings (per 12 pieces) is 3,500mm. The tension insulator is composed of 13 discs, including one additional insulator for stable operating in case breakage of an insulator.

(h) Foundation

Due to narrow width of the land for transmission lines, a cast-in-place pile method for exclusive narrow land and a small excavation amount will be adopted for monopole foundation design and construction. In addition, as the construction work is supposed to be carried out during the rainy season and there will be many restrictions in scheduling, 1.2m-diameter and 1.5m-diameter pile foundations will be constructed by mechanical drilling. Pier foundations will be applied for the large-diameter pile foundation.

(i) Pole Location

Under the Project, the 132kV transmission line will be built on a 3m-wide space common to the infrastructure on the side of a trunk road. Since the foundation diameter of monopoles for the straight line type (Type A) or those for the light deviation angle type (Type B) is small, if the length of the cross arm is slightly extended, a monopole can be built within the 3m-wide common space including the foundation while maintaining a safe distance from private land. However, monopoles for the heavy deviation angle type (Type C) or those for the dead end type (Type D and Type DR) cannot be accommodated within the 3m land because the foundation diameter is large and wider working space will also be necessary during pole construction. Consequently, the locations for monopole construction are designed in coordination with TANROADS, the administrator of trunk roads, as shown in the Table 2-2-2.12 (Refer to Appendix 8).

Table 2-2-2.12 Results of Discussions with TANROADS on Monopole Construction Locations

No.	Pole Type	Pole Location	Policy
TW-01	Type D	Ubungo S/S property	No problem since pole construction is on the property of Ubungo S/S
TW-02	Type C	TANESCO property	No problem since pole construction is on TANESCO property
TW-03	Type C	Near Morogoro Road Junction	Pole construction within 4.25m from property boundary
TW-05	Type C	Near University Road Junction	Pole construction within 4.25m from property boundary
TW-24	Type DR	Mwenge Junction	Pole construction within 4.5m from property boundary
TW-38	Type D	Near New Oyster Bay S/S	Pole construction within 4m from property boundary

2) Applicable Codes/Standards and Units

With regard to the Project design, as shown below, in due consideration of conformity with existing equipment in Tanzania, relevant international standards such as IEC and ISO and Japanese standards are applied to the major functions of equipment and facilities. JEC or JIS are applied to compact monopoles. In addition, the International System of Units (SI) is utilized.

- International Electrotechnical Commission (IEC): Applied to major functions of electrical products in general
- International Standardization Organization (ISO): Applied to performance evaluation of industrial products in general
- Japanese Industrial Standard (JIS): Applied to industrial products in general
- Japanese Electrotechnical Commission (JEC): Applied to electrical products in general
- Standards for Japan Electrical Manufacturer's Association (JEM): Same as above
- Japan Electric Association Guide (JEAG): Same as above
- Japanese Electrical Wire and Cable Maker's Association (JCS): Applied to electric wire and cables
- Relevant Technical Standards on Electrical Installation: Applied to electrical work in general

(3) Overview of the Basic Plan

The Basic Plan of the Project is based on the basic design policy mentioned above (Refer to 2-1) as outlined in Table 2-2-2.13.

Table 2-2-2.13 Overview of the Basic Plan

Category	Reinforcement for 33kV Distribution Facilities	Reinforcement for 132kV Transmission Facilities
Equipment & Materials Procurement & Installation Plan	Procurement & Installation of Equipment & Materials for 33kV & 11kV Distribution at New Oyster Bay Substation (1) 33kV switchgears 1 set • Incoming/outgoing feeder: 5 feeders • Transformer feeder: 4 feeders • Bus tie panel: 1 feeder (2) 11kV switchgears 1 set • Incoming/outgoing feeder: 5 feeders • Transformer feeder: 2 feeders • Bus tie panel: 1 feeder (3) 33kV control & protection panel 4 units (4) 11kV control panel 1 unit (5) 132/33/11kV meter panel 2 units (6) 33/11kV distribution transformer (15MVA) 2 units (7) Station service facilities (DC・AC) 1 set (8) Station service transformer (33/0.4kV, 100kVA) 2 units (9) Dead end steel tower (gantry type) 1 set (10) Earthing system (including conductors) 1 set (11) Outdoor lighting system 1 set (12) Fire extinguisher (ABC, portable type) 1 set (13) 33kV XLPE cables 1 set (14) 11kV XLPE cables 1 set (15) Construction of central building ($363m^2$, one-story building) 1 set (16) Associated civil facilities (access road, oil separator & cable trench, etc.) 1 set	1. Procurement & Installation of Equipment & Materials for 132kV Transmission at New Oyster Bay Substation (1) 132kV feeder equipment (for main transformer including bus) 1 set (2) 132kV switchgear 1 set (3) 132/33kV main transformers (45MVA) 2 units (4) 132kV control & protection panels 1 set (5) Earthing equipment 1 set (6) Associated civil facilities (foundation & cable trench, etc.) 1 set 2. Procurement & Installation of 132kV Lead-out Equipment at Ubungo S/S (1) Dead end steel tower (gantry type) 1 unit (2) 132kV lead out equipment including bus 1 set (3) 132kV switchgear 1 set (4) Transfer of existing voltage measuring instrument (CVT) 1 set (5) Modification of existing control system 1 set (6) Earthing system 1 set (7) Associated civil facilities (foundation, etc.) 1 set 3. Construction of 132kVTransmission Lines (Ubungo S/S to New Oyster Bay S/S, about 7km) (1) 132kVtransmission pole foundation 1 set (2) 132kV transmission monopole 38 units (3) Materials for transmission line (conductors, insulators & earthing system, etc.) 1 set
Equipment & Materials Procurement Plan	Procurement of the following equipment & materials (1) 33kV lighting arresters 12 units (2) 11kV lighting arresters 12 units (3) Spare parts for equipment & materials, maintenance tools 1 set	

(4) Equipment and Materials Plan

1) Reinforcement Plan for 33kV Substation Facilities at New Oyster Substation 33kV

(i) Fundamentals

The 33/11kV distribution transformers will be installed on Plot N. 457 and No. 458 along the New Bagamoyo Road and a 33kV distribution line from Ubungo or the existing Oyster Bay Substation will be used as the power source. By installing 2 units of 33/11kV 15MVA transformers and related equipment, electric power will be supplied to consumers around the New Oyster Bay Substation through 11kV distribution feeders.

(ii) Components of Substation Equipment

The components of substation equipment to be installed at the New Oyster Bay Substation under the Reinforcement Plan for 33kV Distribution Equipment at the New Oyster Bay Substation are shown in Table 2-2-2.14.

Table 2-2-2.14 Components of Substation Equipment to be installed at New Oyster Bay Substation

Equipment Name	Description
(1) 33kV Switchgears	The number of lead-out feeders is 5 lines. The current capacity per feeder is 600A by taking the maximum 2 units of 15MVA transformers. In conformity with TANESCO standards, an OC/OCG relay is applied to the protection device for 33kV switchgears. A low speed re-closing system is also adopted to reduce the period of outages caused by accidents.
(2) 11kV Switchgears	The number of lead-out feeders is 5 lines. The current capacity per feeder is 600A by taking the maximum 10MVA transformers. In a similar manner as the 33kV switchgear, an OC/OCG relay is applied to the protection device for 33kV switchgears. A low speed re-closing system is also adopted to reduce the period of outages caused by accidents.
(3) 33kV Control & Protection Panel	A function to control and to display conditions necessary to supervisory control of 33kV switchgears will be installed. Tap operation and a protective function for the 33/11kV transformer is included for this equipment.
(4) 11kV Control Panel	A function to control and to display conditions necessary to supervisory control of 11kV switchgears will be installed.
(5) Meter Panel	A energy meter will be installed in each 11kV feeder. A bidirectional (import/export) type energy meter will be installed in the 33kV feeder. Space to accommodate 132kV equipment to be installed in the future will be also secured.
(6) 33/11kV Transformer	Vacuum valve type tap changer is applied to minimize maintenance work load. Charged section is covered by cable duct to avoid unfavorable touch of metallic objects or maintenance worker. Other specifications is the same level as transformers installed in previous similar projects.
(7) Station Service Transformer	These are 33/0.4kV transformers for providing electric power to the station. Each transformer unit will be connected to each bus in consideration with 33kV bus bars outage for maintenance.
(8) Station Service Facilities	A switching unit will be installed for incoming feeder of auxiliary circuit so that power from either station service transformer can be fed. The battery capacity is 150AH taking into account an approximate 5-hour interruption. Auxiliary circuit voltage is 400 to 230V on the AC side which is standard Tanzanian voltage and 110V on the DC side.
(9) 33kV Lightning Arresters	A zinc oxide type lighting arrester rated at 36kV is applied. The discharge current is 10kA for the substation arrester and 5kA for the feeder arrester because the site is in an area rarely affected by violent thunderstorms. IEC Class 3 and Class 1 discharge current is applied to the substation and the feeder arrester respectively.
(10) 11kV Lightning Arresters	A zinc oxide type lighting arrester rated at 12kV is applied. The discharge current is determined in the same manner as 33kV arrester.

(iii) Overview of the Control House

A one-story, reinforced concrete frame and block masonry control house will be constructed for the supervision of operations of the New Oyster Bay Substation. The control house is outlined as follows.

(a) Lot Planning

The lot for the control house is located at the back on the east side of the New Oyster Bay Substation and its size is approximately 33m (south to north) x 11m (east to west). Since the house will be constructed in a space on the east side facing private land and since the transformer will be a source of noise, preventing noise from entering private land can be expected.

(b) Major Functions and Architectural Planning

The following rooms are scheduled for the control house.

① Switchgear Room

This is a room for the installation of 33kV and 11kV switchgears and adequate space should be arranged for appropriate maintenance. A door is located on the north side for carrying equipment in and out, so space for maintenance is provided near the door. As countermeasures for heat radiation from switchgears, an ventilation fan will be installed in the switchgear room. The area of the room is approximately 235.5m^2.

② Control Room

33kV control and protection panels, and a 11kV control panel and meter panel will be installed in this room, so substation operations will normally be monitored here. To supervise the substation facilities, windows are located on the west and south sides. An air conditioning system is adopted because full-time operators will be posted here. Free-access floor is adopted taking easy expansion work TANESCO plans in future into account. Its area is approximately 60m^2.

③ Battery Room

2V 150Ah battery cells will be installed in this room. Due to the discharging of hydrogen gas emitted from batteries, an ventilation fan will be installed. The area of the room is approximately 8.8m^2.

④ Service Room

Station service facilities (charger panels, AC distribution boards and DC distribution boards) will be installed in this room. An ventilating fan will be installed as a countermeasure against heat discharged from various panels to be installed. The area of the room is approximately 8.8m^2.

⑤ Office

This is a substation office where the manager of the substation will normally stay. The area of the room is approximately 17.5m^2. Since normally someone will be in this room at all times, an air conditioning system is adopted.

⑥ Sanitation

A lavatory and a hot-water supply room will be installed in the control house. Toilets is flush type with a penetration type septic tank. Although water will be drawn from the public water supply system, a water tank (500-L polyvinyl chloride product) will be installed due to low water pressure. The total area of the lavatory, hand washing and hot-water supply rooms is 13.6m^2.

(c) Structural Design

① Major Building Structure

The main structure is a one story, reinforced concrete frame and block masonry structure which is the standard adopted by secondary substations in Tanzania.

② Foundation Structure

From the results of a soil investment conducted at the proposed construction site for the substation, lot ground is composed mainly of sand, so soil on the ground surface is soft. Because the proposed construction site inclines, the southern part of plot have to be cut and northern part have to be land filled to prepare the flat land for substation. Control house is located on the landfill part. Local surplus soil will be utilized for the material of landfill and if adequate surface compaction is taken, sufficient bearing capacity can be expected for supporting soil due to the high quality of sandy soil with low

viscosity. Consequently, a spread foundation is applied for the control house foundation for reinforced concrete construction.

③ Exterior Finish

Locally available outdoor paint with weather resistant materials will be used after finishing with metal mortar trowels on block-masonry walls or exposed concrete finished pillars and beams. The roof will be tiled and gabled utilizing locally available roofing tiles and will be supported by steel trusses.

④ Interior Finish

Interior finish in each part of the building is described in Table 2-2-2.15.

Table 2-2-2.15 Control House Finish

Room Name	Item	Finish
Control Room	Floor	Free access system floor (aluminum-die casting product)
	Base Boards	Polyvinyl chloride-coated soft base board
	Walls	Coated by indoor paint after finishing mortar metal trowel
	Ceiling	Light-weight steel substrate, incombustible decorated gypsum board
Switchgear Room	Floor	Cast-in-place terrazzo finish
	Base Boards	Cast-in-place terrazzo finish
	Walls	Coated by indoor paint after finishing mortar metal trowel
	Ceiling	Light-weight steel substrate, incombustible decorated gypsum board
Battery Room	Floor	Mortar metal trowel
	Base Boards	Mortar metal trowel
	Walls	Coated by indoor paint after finishing mortar metal trowel
	Ceiling	Light-weight steel substrate, incombustible decorated gypsum board
Office Hot Water-supply Room Service Room Hallway	Floor	Cast-in-place terrazzo finish
	Base Boards	Cast-in-place terrazzo finish
	Walls	Coated by indoor paint after finishing mortar metal trowel
	Ceiling	Light-weight steel substrate, incombustible decorated gypsum board
Lavatory	Floor	Mortar substrate tiling
	Base Boards	None
	Walls	Partially coated by indoor paint after finishing mortar metal trowel
	Ceiling	Light-weight steel substrate, incombustible decorated gypsum board

(d) Building Utilities

Building utilities in each room are described as follows.

① Outlets for lighting system

By applying the JIS to the illumination level for indoor lighting, fluorescent lamps are generally adopted for lighting equipment. The illumination level is shown in the following table.

Table 2-2-2.16 Recommended Illumination Level

Location	Luminance (lx)
Control Room, Office	Not less than 500
Switchgear Room, Battery Room, Service Room, Hot-water Supply Room	Not less than 200
Hallway, lavatory	Not less than 100

② Air conditioning system

The air conditioning system shown in the following table will be installed for room temperature adjustment, temperature rising and ventilation. Steps to prevent birds from entering will be also taken for ventilation openings and hoods will be installed if necessary.

Table 2-2-2.17 Applicable Locations for Air Conditioning System

Location	Air Conditioning	Ventilating Fan
Control Room	○	
Switchgear Room		○
Battery Room		○
Office	○	
Service Room		○
Lavatory		○

③ Fire Extinguishing System

For first-aid and fire fighting, an ABC-type fire extinguisher are arranged as shown in the following table. The following should be taken into account in order to prevent fire from spreading.

- Measures for pipes connecting each room and breakthrough sections
- Measures for cable service entrance in each room
- Measures for high-voltage cables

Table 2-2-2.18 Applicable Place for Fire Extinguishing System

Location	Small Extinguisher	Large Extinguisher
Control Room	○	
Switchgear Room		○
Battery Room	○	
Service Room	○	

(iv) 33kV Distribution Lines

Since the two (2) 33kV distribution lines connecting with the existing Oyster Bay Substation were built along the New Bagamoyo Road from the Ubungo Substation via the branch to Mikocheni Substation, the lines pass the front of the New Oyster Bay Substation. The existing distribution line diagram is shown in Figure 2-2-2.4.

As the scope of the construction work in Step 1 (Reinforcement of 33kV Distribution Facilities) will include the following contents, the 33kV distribution line diagram is shown in Figure 2-2-2.5.

- Divide the existing 33kV distribution lines into 4 routes (for the Ubungo and Mikocheni Substations, for industry zone, for the existing Oyster Bay Substation and for the Msasani Substation), connect between the 33kV switchgear to the dividing point (3 electric poles) with the 33kV underground cable (dividing points of 33kV distribution lines and the 33kV cable route are shown in Basic Design Drawing DL-G01).
- The procurement and installation work for the 33kV cables, the procurement of lightning arresters for protecting the said cables will be taken by the Japanese side; whereas, the installation work of lightning arresters will be taken by TANESCO.
- Jumper lines at the existing Oyster Bay Substation to the 33kV Msasani line will be removed (by TANESCO).
- The 33kV industry feeder currently drawn out from the bus bar at the Mikocheni Substation will be connected to the existing 33kV distribution line and the feeder for the Mikocheni Substation will be utilized as incoming 33kV feeder from Ubungo Substation (wiring work to be taken by TANESCO, 33kV circuit breaker for industry feeder at Mikocheni Substation has deteriorated seriously, therefore, industry feeder will be drawn out from 33kV bus at New Oyster Bay Substation)

As the scope of the construction work in Step 2 (Reinforcement of 132kV Transmission Facilities) will include the following contents, the 33kV distribution line diagram is shown in Figure 2-2-2.6.

- After constructing the 132kV transmission lines, a power source at the New Oyster Bay Substation will be 132kV transmission line. All 33kV distribution lines will therefore supply electric power to each distribution substation.
- Since the 33kV distribution line from the existing Ubungo Substation to Mikocheni Substation will be unnecessary, removal is possible.

(v) 11kV Distribution Lines

Among the 11kV distribution consumers in Kinondoni District, those who reside around the New Oyster Bay Substation will be fed from new substation (planned 11kV distribution area of the New Oyster Bay Substation is shown in Figure DL-02). The construction work for new 11kV overhead distribution line from the tap out point of existing 11kV distribution system to the 11kV line terminal from New Oyster Bay Substation will be taken by TANESCO. The new 11kV switchgears will be connected through the 11kV underground cable with the 11kV line terminal. The location of 11kV line terminal and the 11kV cable route are shown in Basic Design Drawing DL-G02. Procurement and installation work for the 11kV cables will be taken by the Japanese side. Regarding 11kV lightning arresters for protecting the 11kV cables, procurement will be taken by the Japanese side; whereas, the installation work will be taken by TANESCO.

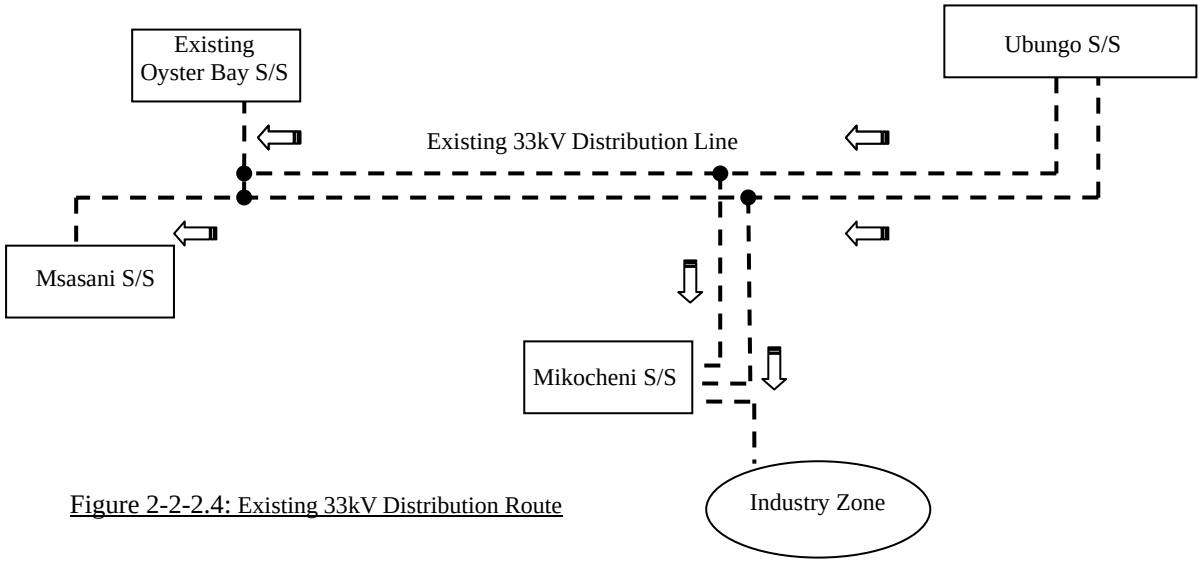


Figure 2-2-2.4: Existing 33kV Distribution Route

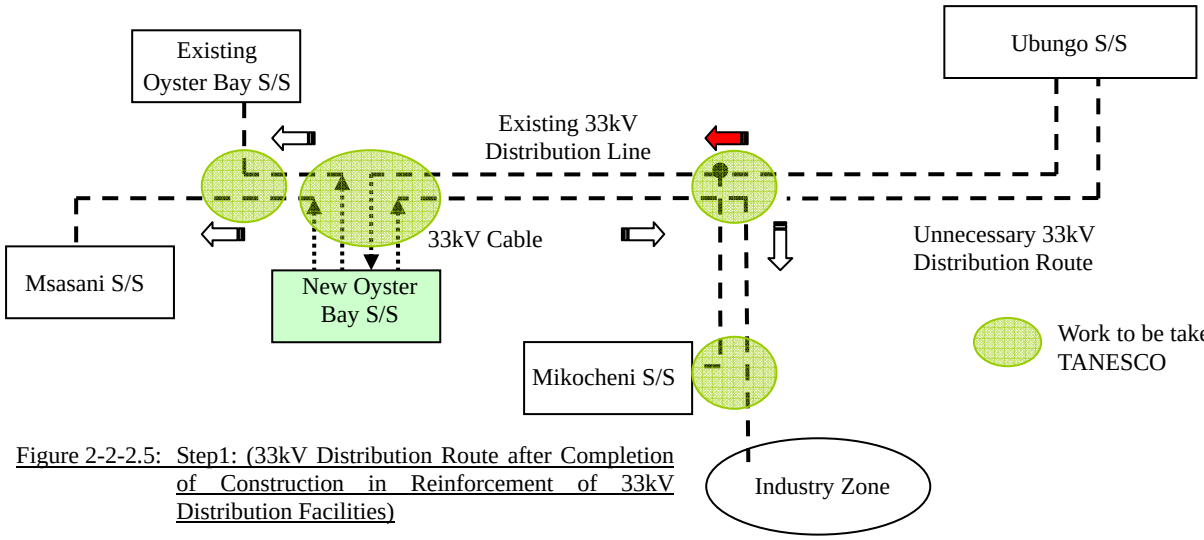


Figure 2-2-2.5: Step1: (33kV Distribution Route after Completion of Construction in Reinforcement of 33kV Distribution Facilities)

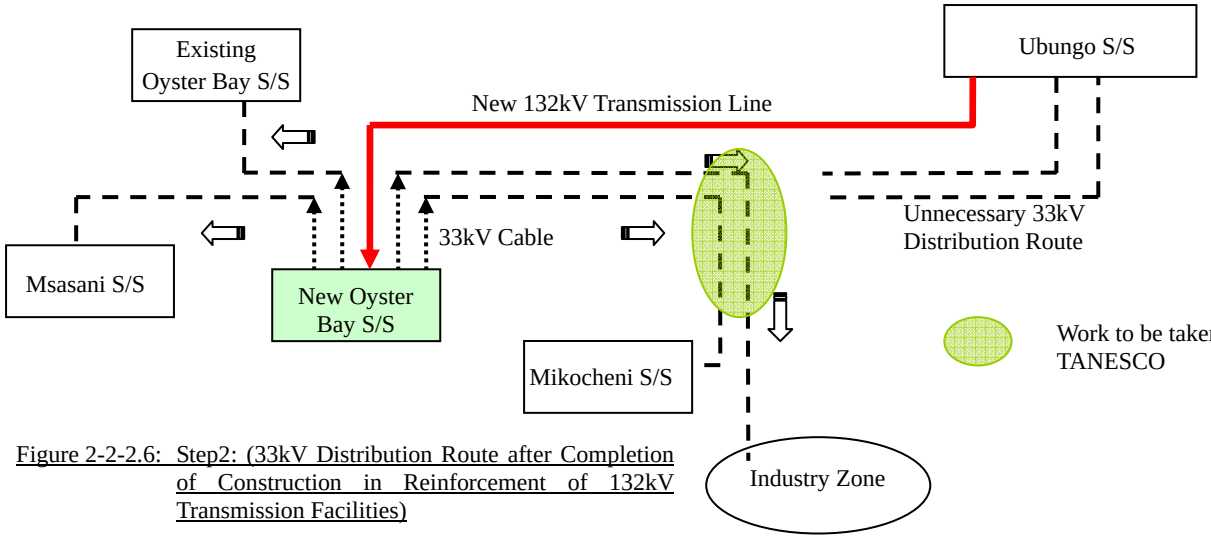


Figure 2-2-2.6: Step2: (33kV Distribution Route after Completion of Construction in Reinforcement of 132kV Transmission Facilities)

2) Reinforcement Plan for 132kV Transmission Facilities at New Oyster Bay Substation

(i) Fundamentals

The 132kV transmission lines from the Ubungo Substation will be drawn into the New Oyster Bay Substation committed as a distributing substation in Phase 1. Moreover, 132/33kV main transformers (45MVA x 2 units) will be installed to upgrade it to a secondary substation. Transmitted power from Ubungo will be stepped-down from 132kV to 33kV via the 132/33kV main transformers at the New Oyster Bay Substation and fed the power to the existing Oyster Bay Substation, the Msasani Substation and the Mikocheni Substation. Other than this, electric power will be fed to large-scale consumers through the 33kV industry feeder.

(ii) Components of 132kV Substation Equipment

The components of the 132kV substation equipment to be installed at the New Oyster Bay Substation under the Reinforcement Plan for 132kV Transmission Facilities at New Oyster Bay Substation are shown in Table 2-2-2.19.

Table 2-2-2.19 Components of 132kV Substation Equipment to be Installed at New Oyster Bay Substation

Equipment Name	Description
(1) 132kV Circuit Breakers (GCB)	Porcelain type gas circuit breaker is adopted. Rated voltage is not less than 145kV & rated current is 1,250A which is the most available for the applicable 132kV circuit breakers. Breaking current is 31.5kA which is the required short circuit capacity & favorable availability.
(2) 132kV Disconnecting Switch (DS)	General double break type disconnecting switch is adopted. The same rated voltage & current as the 132kV circuit breakers are adopted.
(3) 132kV Current Transformer	General winding type transformer is adopted. The ratio is 800 to 400/1A. The accuracy class is IEC 0.5 for measurement and IEC 5P for protection. Burden is not less than 10VA for measurement & not less than 30VA for protection.
(4) 132kV Capacitor Voltage Transformer (CVT)	General capacitor type voltage transformer is adopted. The ratio is $132/\sqrt{3}$ kV: $110/\sqrt{3}$ V: 110V for primary: secondary: third. The accuracy class is IEC 1.0 for measurement & IEC 3P for protection. Burden is 30VA for measurement, 60VA for protection & 60VA.
(5) 132kV Lightning Arrester (LA)	A zinc oxide type lightning arrester with the rated 120kV is applied. 10kA of discharge current and Class 3 operating duty are adopted.
(6) 132/33kV Main Transformers (MTR)	Two (2) 45MVA transformers which are the standard capacity of TANESCO will be installed. Likewise with 33/11kV distribution transformer, vacuum valve type tap changer is applied and secondary lead out terminal and conductor is covered by duct.
(7) 132kV Control & Protection Panel	Functions to control & to display conditions necessary for supervising & controlling the 132kV switchgears will be installed. In addition, a function to protect the 132kV transmission lines & 132/33kV transformers will be installed for this device. The protection method for the 132kV transmission lines is main protection DZ relays, and backup protection OC + OCG relays which is the TANESCO's standard. By taking flexible operation into account, UV relays & OV relays will be installed.
(8) Marshalling Kiosk	Terminal boards for the 132kV incoming feeders & terminals for the 132/33kV transformer feeders is respectively installed in each terminal block box.

3) Expansion Plan for Ubungo Substation in Reinforcement Plan for 132kV Transmission Facilities at New Oyster Bay Substation

(i) Fundamentals

The 132kV transmission line bay will be added in the 132kV switchyard at the Ubungo Substation, and the transmission lines for the New Oyster Substation will be led out. Existing control system will be modified to cover the new lead out equipment.

(ii) Overview of 132kV Substation Equipment

In the Reinforcement Plan for 132kV Transmission Facilities at New Oyster Bay Substation, the components of the132kV substation equipment to be installed at Ubungo Substation are shown in Table 2-2-2.20.

Table 2-2-2.20 Components of Substation Equipment to be Installed at Ubungo Substation

Equipment Name	Description
(1) 132kV Circuit Breakers (GCB)	Same as the New Oyster Bay Station
(2) 132kV Disconnecting Switches (DS)	By conforming to the bus bar layout, pantograph type disconnecting switches with diagonal configuration is adopted as disconnecting switches for the bus bars. Due to narrow lot, pantograph type disconnecting switches with perpendicular configuration is adopted for the bypass circuits. General double break type disconnecting switches is adopted for lines. The same rated voltage & current as the 132kV circuit breakers are adopted.
(3) 132kV Current Transformer (CT)	Same as the New Oyster Bay Station
(4) 132kV Capacitor Voltage Transformer (CVT)	Same as the New Oyster Bay Station
(5) 132kV Lighting Arresters (LA)	Same as the New Oyster Bay Station
(6) Marshalling Kiosk	Terminal boards for 132kV incoming feeders will be installed in terminal block box.

4) Construction Plan for 132kV Transmission Lines in Reinforcement Plan for 132kV Transmission Facilities at New Oyster Bay Substation

(i) Fundamentals

One (1) 132kV transmission line will be built from the Ubungo Substation to the New Oyster Bay Substation. As the transmission route, the line is passed through on the right side of the Sam Nujoma Road from the Ubungo Substation to the Mwenge Junction and is passed through on the right side of the New Bagamoyo Road from the Mwenge Junction to the New Oyster Bay Substation. The ACSR/AC 240mm^2 (Hawk) and AC 55mm^2 are respectively applied for conductor and ground wire. A leakage distance of more than 3,500mm is adopted for insulators.

(ii) Sag

The maximum sag of conductor is 5m, considering the rise in conductor temperature when sending the current equivalent to rated capacity of a transformer on the assumption of the maximum planned span at 208m and maximum working tension of 27,500N.

(iii) Overview of 132kV Monopoles

A compact type vertical 3-phase configuration is adopted due to the 3m width of transmission line lot from the road end. By conforming to the TANSCO standards, the lowest ground clearance is determined to be 8m, and then the height for the lowest phase on the pole is set as 13m from ground level taking into consideration of maximum sag of 5m. After that considering required mutual distance between phases, shielding angle of ground wire, etc, and then a monopole is designed and the height of pole is determined. Monopoles are roughly classified into suspension type (Type A), tension type and dead-end type. Moreover, the tension type is categorized into Type B (5° to 15°) and Type C (15° to 25°). As for the dead-end type, Type D will be installed in the anchoring (dead-end) section at the Ubungo Substation and the New Oyster Bay Substation. With regard to the DR type monopole to be installed at the Mwenge Junction, it should have the option to lead one (1) transmission line in from the Tegeta side in the future.

Various compact type monopoles are outlined in Table 2-2-2.9.

Out of 38 units to be procured under the Project, 19 units adopt Type A (0° to 3°) which has a smaller horizontal deviation angle because the transmission route is almost a straight line for the main part. Taking into consideration the following matters, post insulators are adopted for Type A.

- Number of insulators and cost : Material cost can be reduced because 3 post insulators are applied to Type A instead of combination of 3 sets of cross-arm and suspension insulator strings.
- Reduction of monopole height : Application of post insulator can save material cost of monopole and its foundation because the height can be lowered approximately 2.3m compared with other types (B/C/D types).

(iv) Overview of Foundations for Monopoles

Due to narrow width of the transmission line lot, a cast-in-place pile is adopted. The pile diameter is 1.2m for Type A and 1.5m for Type B due to relatively small overturning moment for support. The drilling work will be conducted by machine for the foundation of Type A and B. The pile diameter is larger for Type C(2.5m) Type DR(3.0m) and Type D(2.5m) due to the large overturning moment. It is difficult to drill the pile shaft with the diameter more than 2m with machine, therefore hand-drilling method will be used to pier foundations of diameter more than 2.5m. Since the pier foundation cannot constructed by hand-drilling due to bad ground conditions for No. 38 pole foundation, 2 piles of diameter 1.5m will be drilled by machine and then the footing will be constructed on the top of 2 piles. As the pile length, the depth to obtain the required soil bearing capacity is determined by examining the findings of soil investigation.

Table 2-2-2.21 Contents of Procurement and Installation of Equipment and Materials for 33kV and 11kV Distribution Facilities at New Oyster Bay Substation

No.	Item / Equipment	Specifications	Quantity
A- 1	Procurement & Installation of 33kV Switchgears	(Refer to Drawing OB-E01)	12 Panels
	1) Type	Indoor, enclosed type	
	2) Number of feeders	132/33kV transformer secondary feeder: 2 feeders 33/11kV transformer primary feeder: 2 feeders Incoming/outgoing feeder: 5 feeders Bus tie feeder: 1 feeder	
	3) Circuit Breakers	VCB or GCB	
A-2	Procurement & Installation of 11kV Switchgears	(Refer to Drawing OB-E01)	8 Panels
	1) Type	Indoor, enclosed type	
	2) Number of feeders	33/11kV transformer secondary feeder: 2 feeders Outgoing feeder: 5 feeders Bus tie feeder: 1 feeder	
	3) Circuit Breakers	VCB	
A-3	Procurement & Installation of 33kV Control & Protection Panels	(Refer to Drawing OB-E01)	4 Panels
	1) Type	Indoor type	
A-4	Procurement & Installation of 11kV Control & Protection Panels	(Refer to Drawing OB-E01)	1 Panel
	1) Type	Indoor type	
A-5	Meter Panels	(Refer to Drawing OB-E01)	
	1) Type	Indoor type	
	2) Application	For 132/33kV meter	1 Panel
		For 11kV meter	1 Panel
	3) Accuracy	Class 1.0	

No.	Item / Equipment	Specifications	Quantity
A-6	Procurement & Installation of 33/11kV Distribution Transformers 1) Type 2) Rated primary voltage 3) Rated secondary voltage 4) Rated Capacity 5) Cooling type 6) Number of phases 7) Frequency 8) Tap voltage 9) Number of taps 10) Step voltage 11) Wire connection 12) Impedance	(Refer to Drawing OB-E01) Outdoor, oil immersed self-cooling type, with vacuum valve type on-load tap changer 33kV 11kV 15MVA ONAN 3 50Hz 33kV +10% to -10% 17 taps 1.25% Primary: Star (neutral lead out) Secondary: Star (neutral lead out) Third: Delta About 7.5%	2 Units
A-7	Procurement & Installation of Station Service Transformers 1) Type 2) Rated primary voltage 3) Rated secondary voltage 4) Rated Capacity 5) Cooling type 6) Number of phases 7) Frequency 8) Tap voltage 9) Wire connection	(Refer to Drawing OB-E01) Outdoor, oil immersed self-cooling type, with no-load tap changer 33kV 400-230V 100kVA ONAN 3 50Hz 33kV ±2.5%、±5% Primary: Delta Secondary: Star (neutral lead out)	2 Units
A-8	Procurement & Installation of Station Service Facilities Procurement & Installation of Battery Chargers 1) Battery charger type 2) Battery charger rating 3) Battery model 4) Battery rating 5) AC distribution board type 6) AC distribution board rating 7) DC distribution type 8) DC distribution rating	 Indoor, thirstier type DC110V,30A Valve regulated lead acid battery 150AH/10HR Indoor type 400-230V Indoor type DC 110V	1 Set
A-9	Procurement of 33kV Lightning Arrester 1) Type 2) Rating	(Refer to Drawing OB-E01) Outdoor, zinc oxide type 36kV, 5kA	12 Units
A-10	Procurement of 11kV Lightning Arrester 1) Type 2) Rating	(Refer to Drawing OB-E01) Outdoor, zinc oxide type 12kV, 5kA	12 Units
A-11	Procurement & Installation of Power Cables 1) Type	 XLPE	1 Set
A-12	Procurement & Installation of Electric Facilities 1) Gantry & support structures 2) Wiring materials (cables) 3) Grounding system, overhead earth wires, earthing system, etc. 4) In-plant lightning system		1 Set

No.	Item / Equipment	Specifications	Quantity
A-13	Procurement & Installation of Associated Civil and Architectural Facilities		1 Set
	1) Foundation	Including safety fence in switchyard, cable trench, spill prevention dike, oil separator	
	2) Control house	363m^2, one-storied construction, SWGR room: fireproofing wall (bridge wall) Including indoor lighting, sanitation, fire extinguisher, water tank	
	3) Access road	Including gravel, stone masonry	

Table 2-2-2.22 Contents of Procurement and Installation of Equipment and Materials for 132kV Transmission Facilities at New Oyster Bay Substation

No.	Item / Equipment	Specifications	Quantity
B-1	Procurement & Installation of 132kV Circuit Breakers	(Refer to Drawing OB-E01)	3 Units
	1) Type	Outdoor type, SF6 gas, 3-phase	
	2) Rated voltage	145kV (minimum)	
	3) Rated current	1,250A	
	4) Rated short-time withstand current	31.5kA, 2 seconds	
	5) Rated operating sequence	O-3min-CO-3min-CO	
	6) Rated break time	3-cycle	
	7) Controlled source	DC110V	
B-2	Procurement & Installation of 132kV Disconnecting Switches	(Refer to Drawing OB-E01)	
	1) Type	Outdoor type, Motor-driven, 3-phase	3 Units
	2) Structure	Horizontal double break type	1 Unit
		Horizontal double break type, with grounding switch	
	3) Rated voltage	145kV (minimum)	
	4) Rated current	1250A	
	5) Rated short-time withstand current	31.5kA, 2 seconds	
	6) Controlled source	DC110V	
	7) Motor power source voltage	DC110V	
B-3	Procurement & Installation of 132kV Current Transformers	(Refer to Drawing OB-E01)	3 Units
	1) Type	Outdoor, oil immersed winding type, single phase	
		145kV (minimum)	
	2) Rated voltage	800 to 400A	
	3) Rated primary current	1A	
	4) Rated secondary current	Class 0.5 for measurement, Class 5P for protection	
	5) Accuracy class	10VA for measurement, 30VA for protection	
	6) Rated secondary burden	31.5kA, 2 seconds	
	7) Rated short-time withstand current		
B-4	Procurement & Installation of 132kV Capacitor Voltage Transformers	(Refer to Drawing OB-E01)	3 Units
	1) Type	Outdoor, oil immersed capacitor type, single phase	
		$132/\sqrt{3}$ kV	
	2) Rated primary voltage	$110\sqrt{3}$ V	
	3) Rated secondary voltage	110V	
	4) Rated third voltage	Class 1.0 for measurement, Class 3P for protection	
	5) Accuracy class	30VA for measurement, 60VA for protection	
	6) Rated secondary burden	60VA	
	7) Rated third burden		

No.	Item / Equipment	Specifications	Quantity
B-5	Procurement & Installation of 132kV Lightning Arresters 1) Type 2) Rated voltage 3) Rated discharge current 4) Line discharge class (IEC)	(Refer to Drawing OB-E01) Outdoor type, single phase 120kV 10kA 3	9 Units
B-6	Procurement & Installation of 132/33kVMain Transformers 1) Type 2) Rated primary voltage 3) Rated secondary voltage 4) Rated Capacity 5) Cooling type 6) Number of phases 7) Frequency 8) Tap voltage 9) Number of taps 10) Step voltage 11) Wire connection 12) Impedance	 Outdoor, oil immersed self-cooling type, with vacuum valve type on-load tap changer 132kV 33kV 45MVA ONAN 3 50Hz 132kV +10% to -10% 17 taps 1.25% Primary：Star (neutral lead out) Secondary：Star (neutral lead out) Third：Delta About 11.5%	2 Units
B-7	Procurement & Installation of 132kV Control & Protection Panels 1) Type	(Refer to Drawing OB-E01) Indoor type	2 Panels
B-8	Procurement & Installation of Marshalling Kiosk 1) Type	(Refer to Drawing OB-E01) Outdoor type	3 Panels
B-9	Procurement & Installation of Power Cables 1) Type	 XLPE	1 Set
B-10	Procurement & Installation of Electric Facilities 1) Support Structures 2) Wiring materials (cables) 3) Bus bars, support insulators, conductors	(Refer to Drawing OB-G01)	1 Set
B-11	Procurement & Installation of Associated Civil Facilities 1) Foundation	(Refer to Drawing OB-G01)	1 Set

Table 2-2-2.23 Contents of Procurement and Installation of 132kV Lead-out Facilities at Ubungo Substation

No.	Item / Equipment	Specifications	Quantity
C-1	Procurement & Installation of 132kV Circuit Breakers	(Refer to Drawing UB-E01)	1 Set
	1) Type	Outdoor type, SF6 gas, 3-phase	
	2) Rated voltage	145kV (minimum)	
	3) Rated current	1,250A	
	4) Rated short-time withstand current	31.5kA, 2 seconds	
	5) Rated operating sequence	O-3min-CO-3min-CO	
	6) Rated break time	3-cycle	
	7) Controlled source	DC110V	
C-2	Procurement & Installation of 132kV Disconnecting Switches	(Refer to Drawing UB-E01)	
	1) Type	Outdoor type, Motor-driven, 3-phase	
	2) Structure	Pantograph type with diagonal configuration	2 Units
		Pantograph type with perpendicular configuration	1 Unit
		Horizontal double break type, with grounding switch	1 Unit
	3) Rated voltage	145kV (minimum)	
	4) Rated current	1250A	
	5) Rated short-time withstand current	31.5kA, 2 seconds	
	6) Controlled source	DC110V	
	7) Motor power source voltage	DC110V	
C-3	Procurement & Installation of 132kV Current Transformers	(Refer to Drawing UB-E01)	3 Units
	1) Type	Outdoor, oil immersed winding type, single phase	
		145kV (minimum)	
	2) Rated voltage	800 to 400A	
	3) Rated primary current	1A	
	4) Rated secondary current	Class 0.5 for measurement, Class 5P for protection,	
	5) Accuracy class	10VA for measurement, 30VA for protection	
	6) Rated secondary burden	31.5kA, 2 seconds	
	7) Rated short-time withstand current		
C-4	Procurement & Installation of 132kV Capacitor Voltage Transformers	(Refer to Drawing UB-E01)	3 Units
	1) Type	Outdoor, oil immersed capacitor type, single phase	
	2) Rated primary voltage	$132/\sqrt{3}$ kV	
	3) Rated secondary voltage	$110\sqrt{3}$ V	
	4) Rated third voltage	110V	
	5) Accuracy class	Class 1.0 for measurement, Class 3P for protection	
	6) Rated secondary burden	30VA for measurement, 60VA for protection	
	7) Rated third burden	60VA	
C-5	Procurement & Installation of 132kV Lightning Arresters	(Refer to Drawing UB-E01)	3 Units
	1) Type	Outdoor type, single phase	
	2) Rated voltage	120kV	
	3) Rated discharge current	10kA	
	4) Line discharge class (IEC)	3	
C-6	Procurement & Installation of Marshalling Kiosk	(Refer to Drawing UB-E01)	1 Unit
	1) Type	Outdoor type	
C-7	Procurement & Installation of Electric Facilities	(Refer to Drawing UB-E01)	1 Set
	1) Gantry & support structures		
	2) Wiring materials (cables)		
	3) Grounding system, overhead earth wires, earthing system, etc.		
	4) In-plant lightning system		

No.	Item / Equipment	Specifications	Quantity
C-8	Procurement & Installation of Associated Civil Facilities 1) Foundation	(Refer to Drawing UB-G01)	1 Set

Table 2-2-2.24 Components of 132kV Transmission Line Construction (Ubungo Substation to New Oyster Bay Substation)

No.	Item / Equipment	Specifications	Quantity
D-1	Procurement & Installation of Type A 132kV Monopole (Suspension Type, 0 to 3 degree) 1) Type 2) Height 3) Cross arm 4) Accessories	(Refer to Drawing TL-G09) Steel compact type pole 22.9m None Anti climbing equipment, step bolt, anchor frame	19 Units
D-2	Procurement & Installation of Type B 132kV Monopole (Tension Type, 3 to 15 degree) 1) Type 2) Height 3) Cross arm 4) Accessories	(Refer to Drawing TL-G09) Steel compact type pole 25.2m 2.8m, 2.8m, 2.8m Anti climbing equipment, step bolt, anchor frame	13 Units
D-3	Procurement & Installation of Type C 132kV Monopole (Tension Type, 15 to 35 degree) 1) Type 2) Height 3) Cross arm 4) Accessories	(Refer to Drawing TL-G10) Steel compact type pole 25.2m 2.8m, 2.8m, 2.8m Anti climbing equipment, step bolt, anchor frame	3 Units
D-4	Procurement & Installation of Type DR (Dead-end Type, 0 to 90 degree) 1) Type 2) Height 3) Cross arm 4) Accessories	(Refer to Drawing TL-G10) Steel compact type pole 24.0m 1.5m, 1.5m, 1.5m Anti climbing equipment, step bolt, anchor frame	1 Unit
D-5	Procurement & Installation of Type D (Dead-end Type, 0 to 90 degree) 1) Type 2) Height 3) Cross arm 4) Accessories	(Refer to Drawing TL-G11) Steel compact type pole 25.2m 2.8m 3.5m 4.2m Anti climbing equipment, step bolt, anchor frame	2 Units
D-6	Post Insulators 1) Type 2) Leakage distance 3) Low frequency withstand voltage (wet) 4) LIWV 5) Cantilever strength 6) Tensile strength 7) Other	 Porcelain type Not less than 3500mm 385kV 700kV Not less than 12,400N (1,270kgf) Not less than 22,200N (2,270kgf) Including bases & fittings	57 Units
D-7	Jumper Support Insulators 1) Type 2) Leakage distance 3) Low frequency withstand voltage (wet) 4) LIWV 5) Total length 6) Other	 Porcelain type Not less than 3,500mm 290kV 800kV 1660mm Including bases & fittings	51 Units

No.	Item / Equipment	Specifications	Quantity
D-8	Tension Insulator Strings		
	1) Type	Porcelain ball & socket type	114 Units
	2) Mechanical failing load	120kN/piece	
	3) Disc diameter	254mm	
	4) Number of discs	13 pieces	
	5) Low frequency withstand voltage (wet)	40kV/ piece	
	6) LIWV	105kV/ piece	
	7) Other	Including bases & fittings	
D-9	Conductors		
	1) Type	ACSR/AC 240mm^2	22.2km
	2) Stranded wire configuration	26 aluminum wires 7 steel wires	
D-10	Overhead Ground Wires		
	1) Type	AC 55mm^2	7.5km
	2) Stranded wire configuration	7 steel wires	
D-11	Other Accessories		
	Damper	No. 12 conductor	222 Pieces
	Damper	No. 3 for ground wire	74 Pieces
	Armor rod	For conductor	57 Pieces
	Armor rod	For ground wire	19 Pieces
	Suspension clamp	For ground wire	57 Pieces
	Suspension clamp	For ground wire	19 Pieces
	Compression clamp	For ground wire	44 Pieces
	GW jumper clamp	For ground wire	23 Pieces
	GW suspension fitting		19 Sets
	GW tension fitting		44 Sets
D-12	Number plate (large) (Aero plate)	Aluminum 700 x 400 x 2	38 Pieces
	Number plate (small) (Ground plate)	Aluminum 150 x 230 x 2	38 Pieces
	Danger plate	Aluminum 380 x 380 x 2	38 Pieces
	Phase plate	Aluminum 150 x 230 x 2	114 Pieces

2-2-3 Basic Design Drawings

The basic design drawings for the Project are listed as follows.

(1) New Oyster Bay Substation Plan Drawings

Drawing No.	Drawing Name	Reduced Scale
OB-G01	Layout for New Oyster Bay Substation (Plan)	1/600
OB-G02	Layout for New Oyster Bay Substation (Section)	1/300
OB-G03	Plan & Section of Control Building for New Oyster Bay Substation	1/250
OB-G04	Elevation of Control Building for New Oyster Bay Substation	1/250
OB-E01	Single Line Diagram for New Oyster Bay Substation	—
OB-E02	Substation Control System Diagram for New Oyster Bay Substation	—

(2) Ubungo Substation 132kV Lead-out Facilities Expansion Plan Drawings

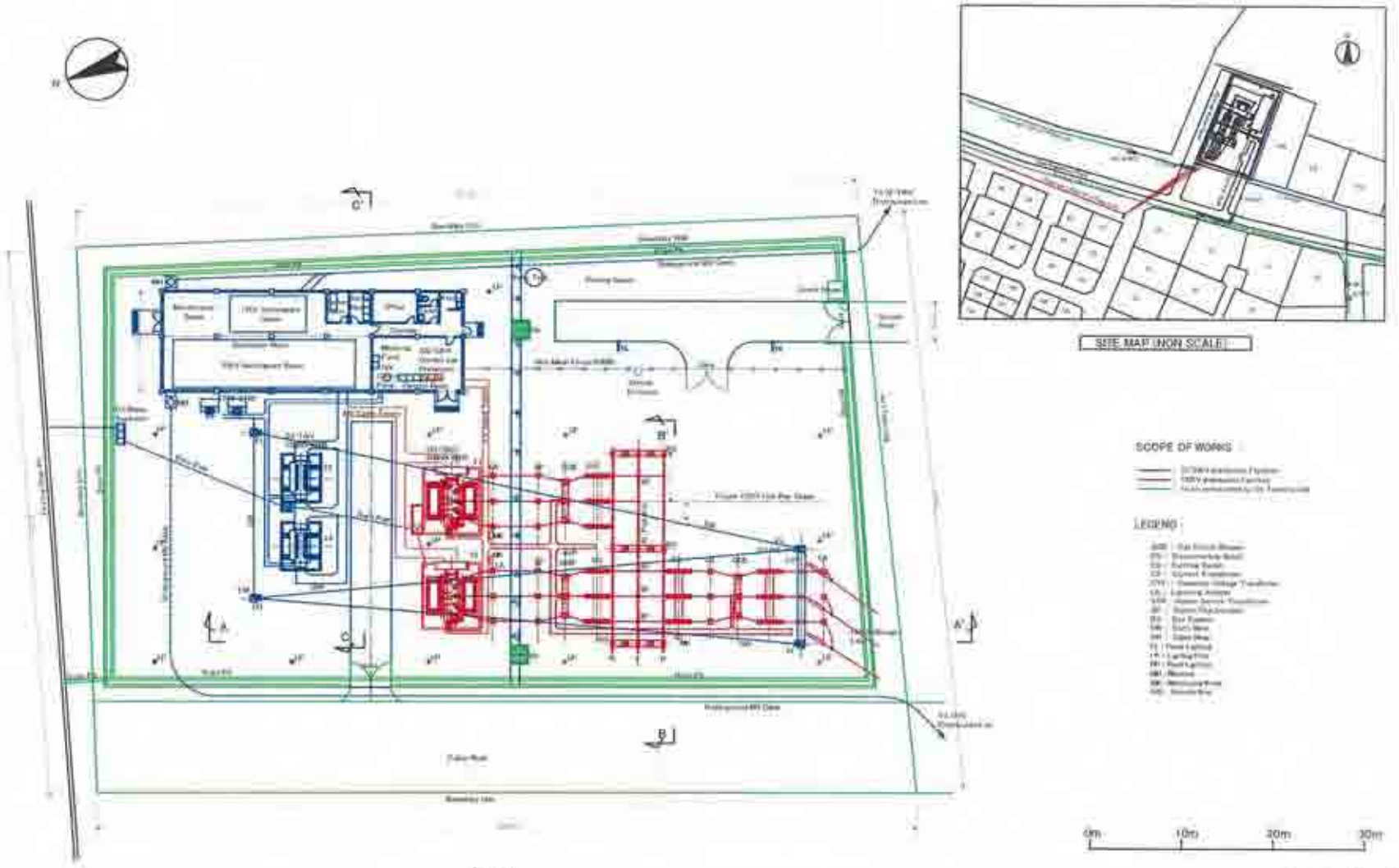
Drawing No.	Drawing Name	Reduced Scale
UB-G01	Location of Ubungo Substation	1/3000
UB-G02	Layout for Ubungo Substation 132kV Switch Yard (Plan)	1/800
UB-G03	Layout for Ubungo Substation 132kV Switch Yard (Section)	1/300
UB-G04	Layout for Ubungo Substation Control Building (Plan)	1/150
UB-E01	Single Line Diagram of Ubungo Substation	—

(3) 132kV Transmission Line Plan Drawings

Drawing No.	Drawing Name	Reduced Scale
TL-G01	General View on 132 kV Transmission Route	As indicated in drawing
TL-G02	Location Map on 132kV Transmission Monopole (1/6)	As indicated in drawing
TL-G03	Location Map on 132kV Transmission Monopole (2/6)	As indicated in drawing
TL-G04	Location Map on 132kV Transmission Monopole (3/6)	As indicated in drawing
TL-G05	Location Map on 132kV Transmission Monopole (4/6)	As indicated in drawing
TL-G06	Location Map on 132kV Transmission Monopole (5/6)	As indicated in drawing
TL-G07	Location Map on 132kV Transmission Monopole (6/6)	As indicated in drawing
TL-G08	132kV Transmission Route Profile	As indicated in drawing
TL-G09	132kV Compact Monopole (Type A & B)	1/200
TL-G10	132kV Compact Monopole (Type C & DR)	1/200
TL-G11	132kV Compact Monopole (Type D)	1/200
TL-G12	Foundation Of Compact Monopole	1/200

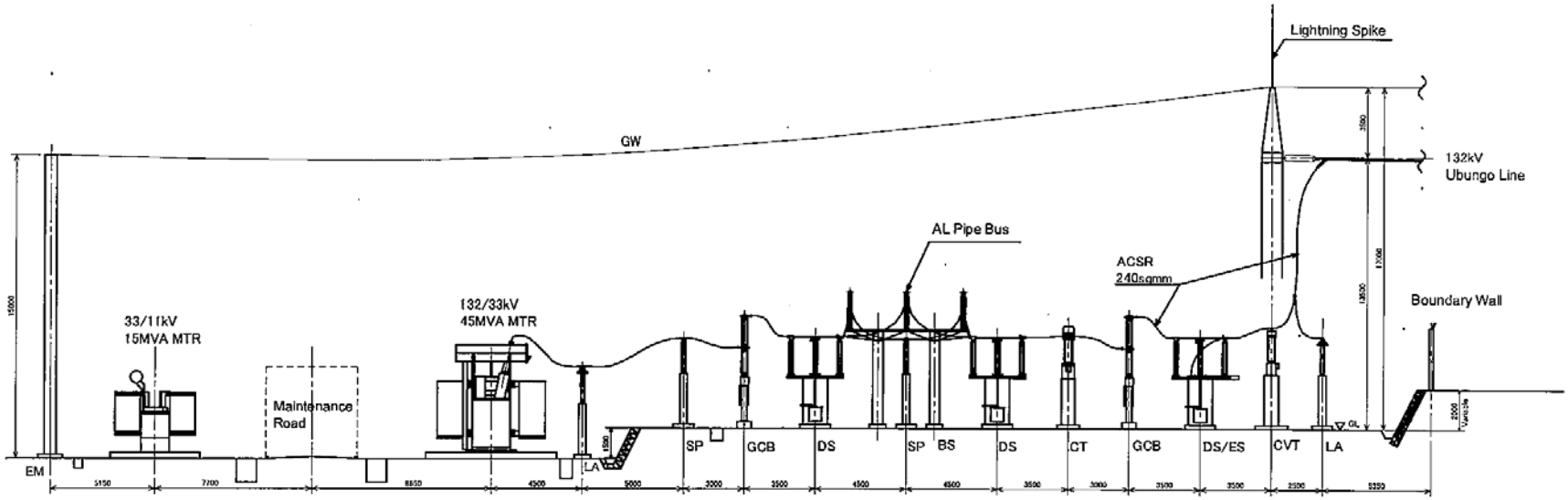
(4) 33kVand 11kV Distribution Lines Connection Plan Drawings

Drawing No.	Drawing Name	Reduced Scale
DL-G01	33/11kV Distribution Route Diagram	As indicated in drawing
DL-G02	Proposed 11kV Distribution Network Diagram for New Oyster Bay S/S	As indicated in drawing

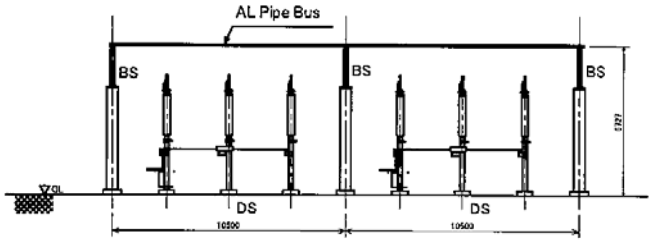


Scale 1:600

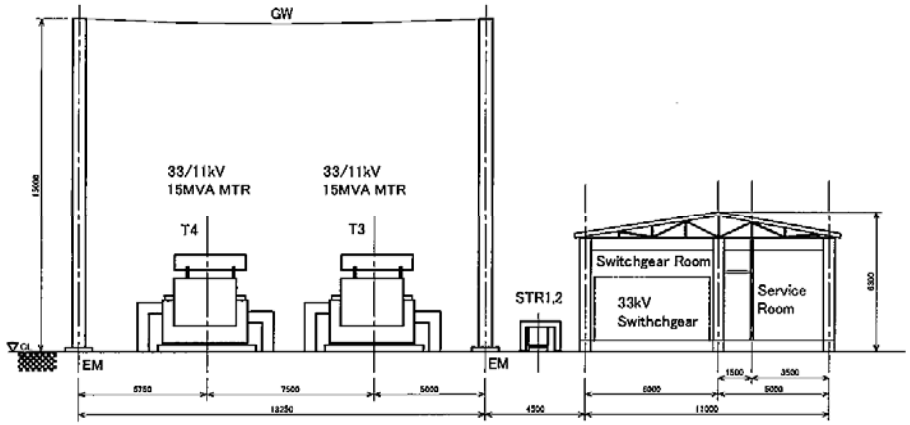
OB-G-01 Layout for New Oyster Bay Substation (Plan)



Section A – A'



Section B – B'

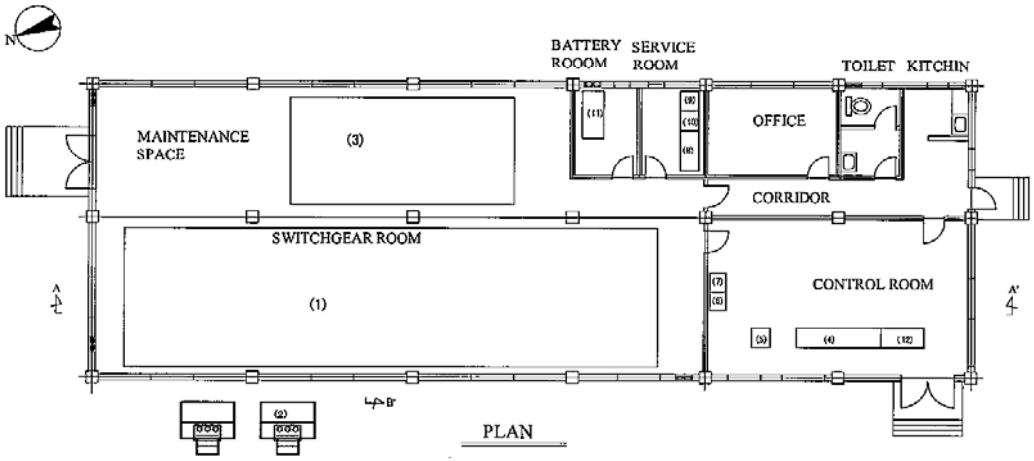


Section C – C'

0m 5m 10m

Scale 1:300

OB-G02 Layout for New Oyster Bay Substation (Section)

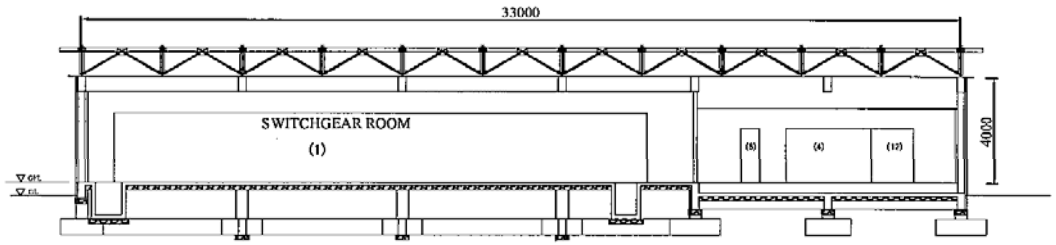


PLAN

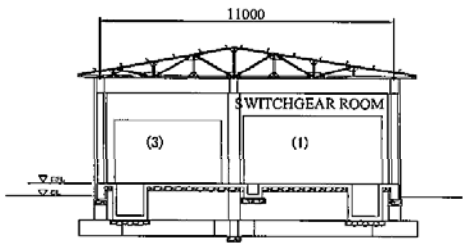
LEGEND

(1) 33kV SWITCHGEAR
(2) STATION TRANSFORMER
(3) 11kV SWITCHGEAR
(4) 33kV CONTROL AND PROTECTION PANEL
(5) 11kV CONTROL PANEL
(6) 132/33kV METER PANEL
(7) 11kV METER PANEL
(8) DC DISTRIBUTION BOARD
(9) AC DISTRIBUTION BOARD
(10) BATTERY CHARGER PANEL
(11) STORAGE BATTERY
(12) 132kv CONTROL AND PROTECTION PANEL

0 1 2 3 4 5 (m)



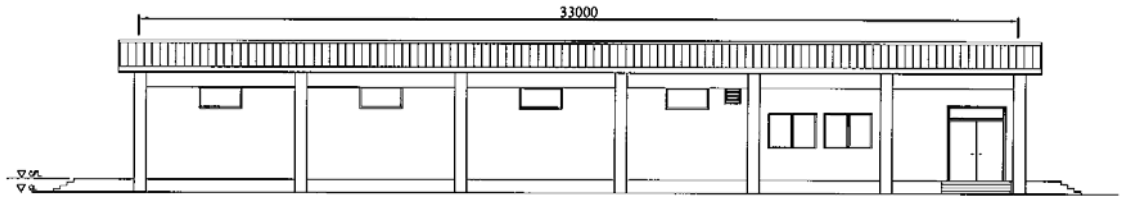
A-A' SECTION



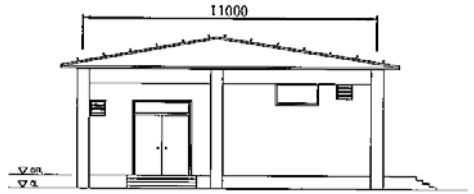
B-B' SECTION

Scale 1:250

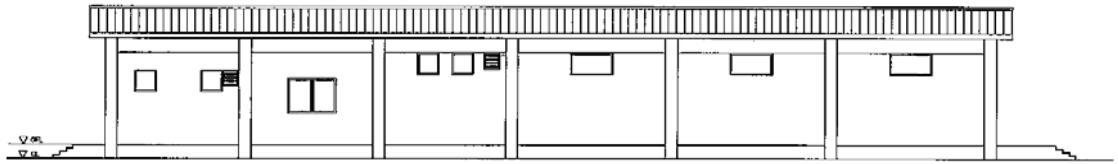
OB-G03 Plan & Section of Control Building for New Oyster Bay Substation



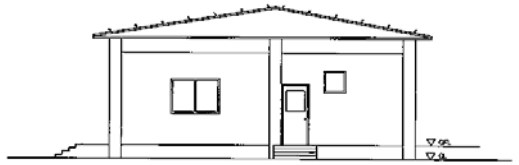
WEST ELEVATION



NORTH ELEVATION



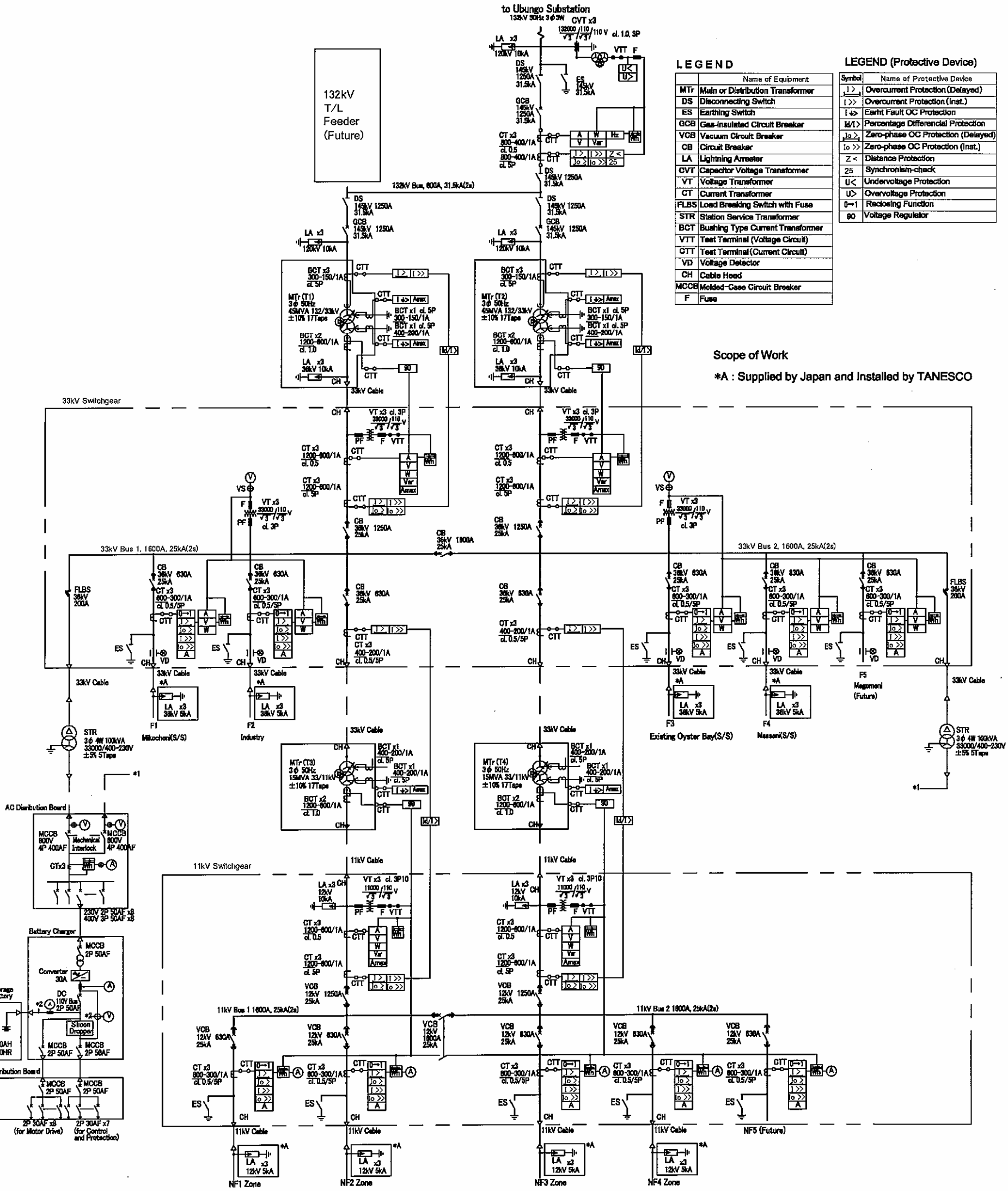
EAST ELEVATION



SOUTH ELEVATION

Scale 1:250

OB-G04 Elevation of Control Building for New Oyster Bay Substation



LEGEND

	Name of Equipment
MTr	Main or Distribution Transformer
DS	Disconnecting Switch
ES	Earthing Switch
GCB	Gas-Insulated Circuit Breaker
VCB	Vacuum Circuit Breaker
CB	Circuit Breaker
LA	Lightning Arrester
CVT	Capacitor Voltage Transformer
VT	Voltage Transformer
CT	Current Transformer
FLBS	Load Breaking Switch with Fuse
STR	Station Service Transformer
BCT	Bushing Type Current Transformer
VTT	Test Terminal (Voltage Circuit)
CTT	Test Terminal (Current Circuit)
VD	Voltage Detector
CH	Cable Head
MCCB	Molded-Case Circuit Breaker
F	Fuse

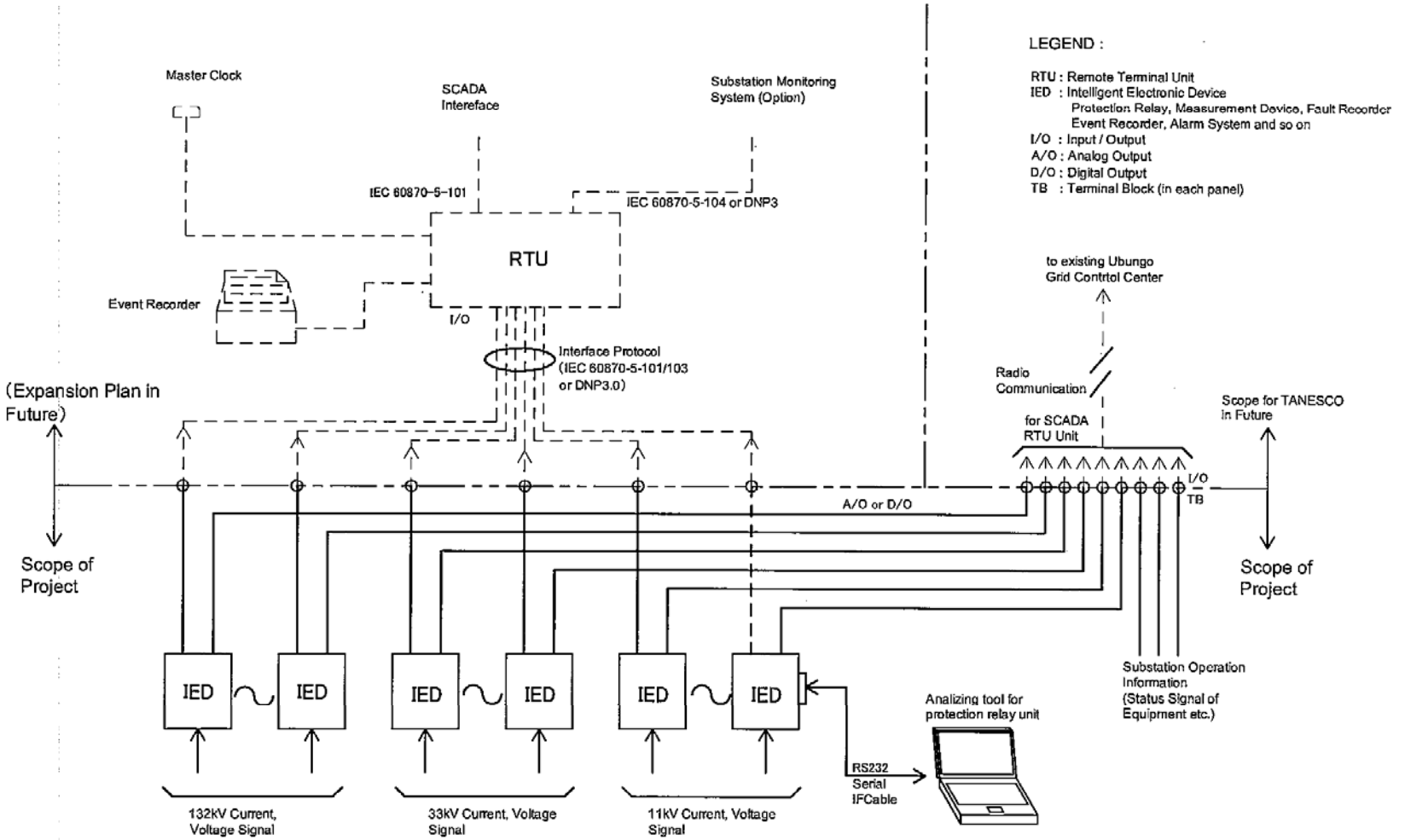
LEGEND (Protective Device)

Symbol	Name of Protective Device
I>	Overcurrent Protection (Delayed)
I>>	Overcurrent Protection (Inst.)
I↓>	Earht Fault OC Protection
Id/I>	Percentage Differencial Protection
Io>	Zero-phase OC Protection (Delayed)
Io>>	Zero-phase OC Protection (Inst.)
Z<	Distance Protection
25	Synchronism-check
U<	Undervoltage Protection
U>	Overvoltage Protection
0→1	Reclosing Function
90	Voltage Regulator

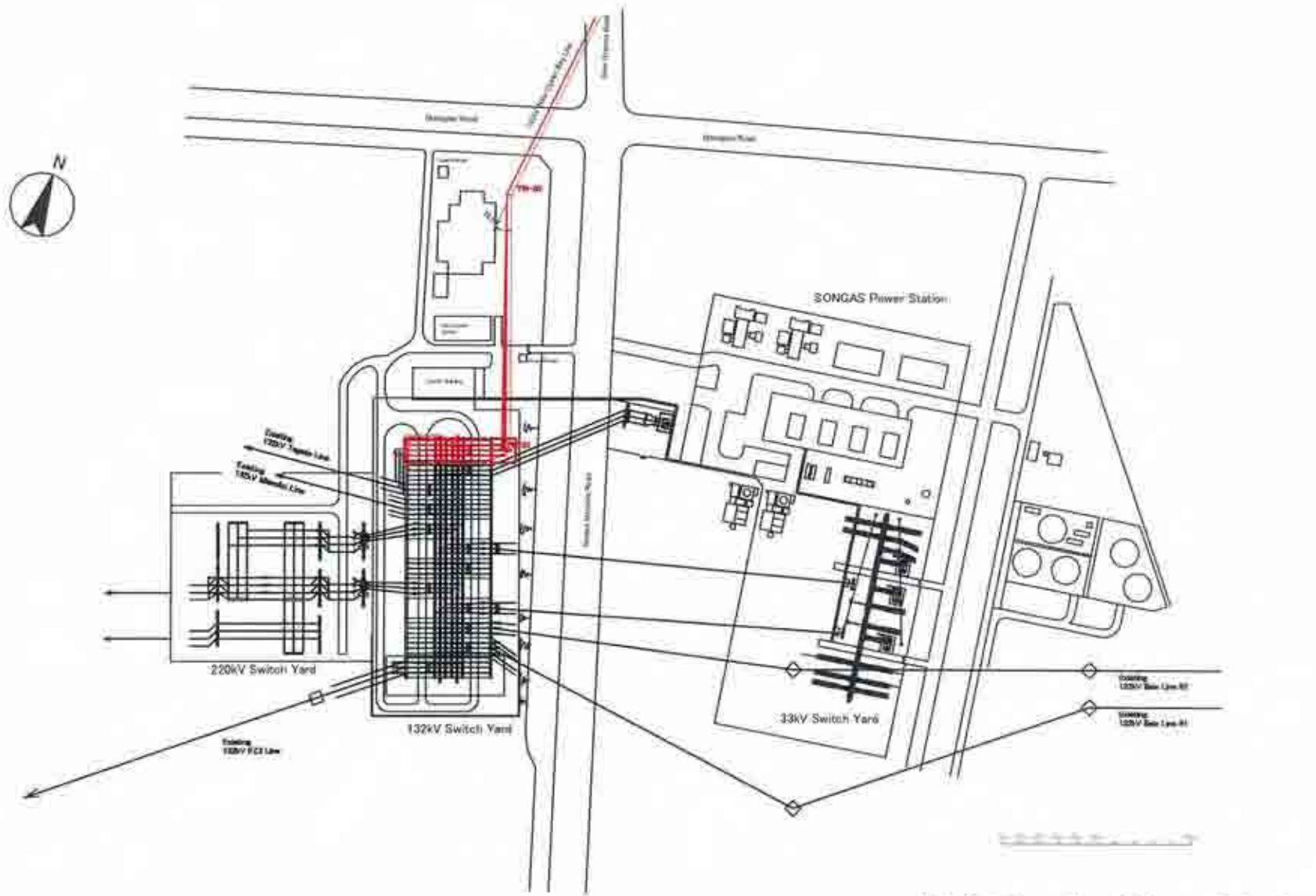
Scope of Work

*A : Supplied by Japan and Installed by TANESCO

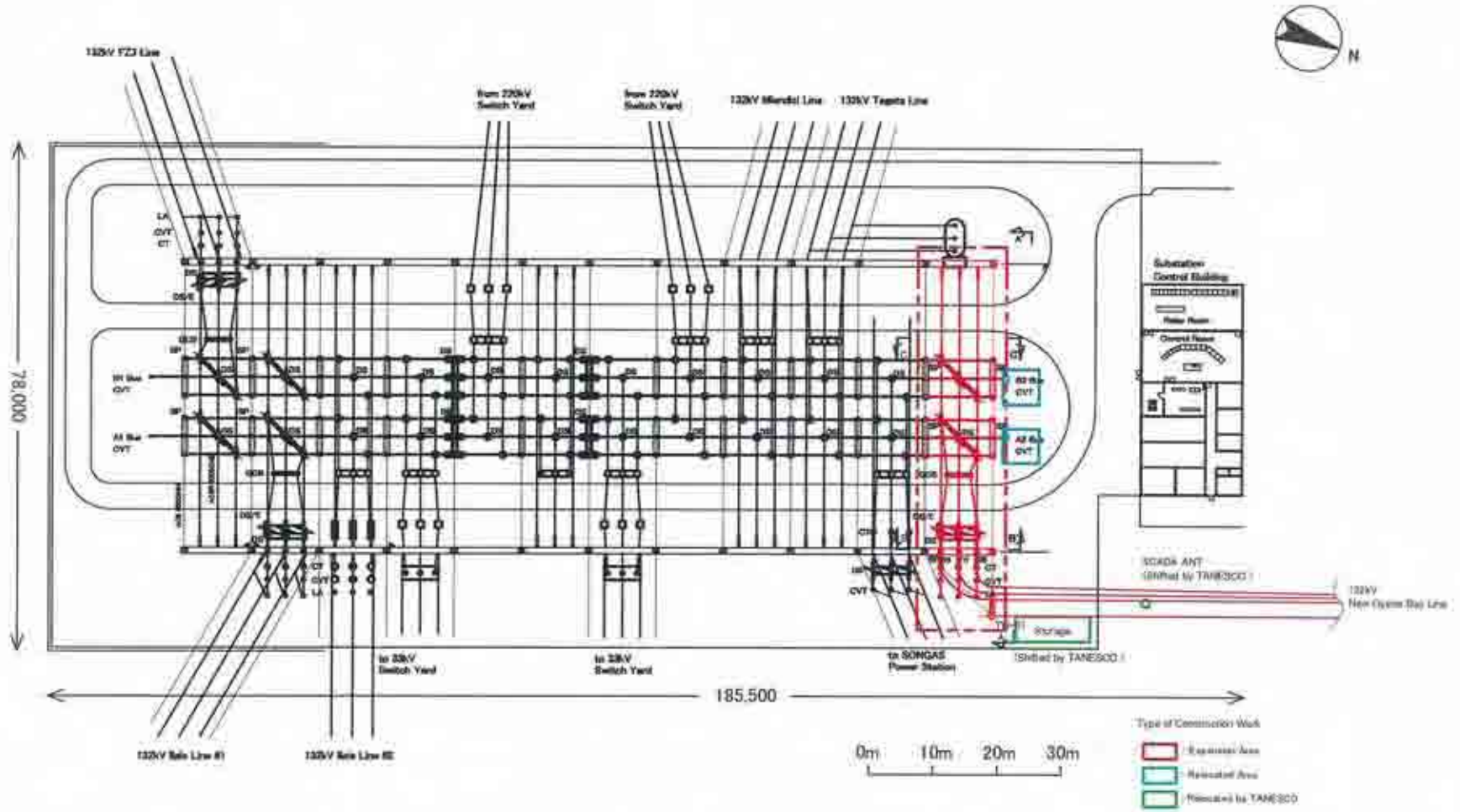
OB-E01 SINGLE LINE DIAGRAM FOR NEW OYSTER BAY SUBSTATION



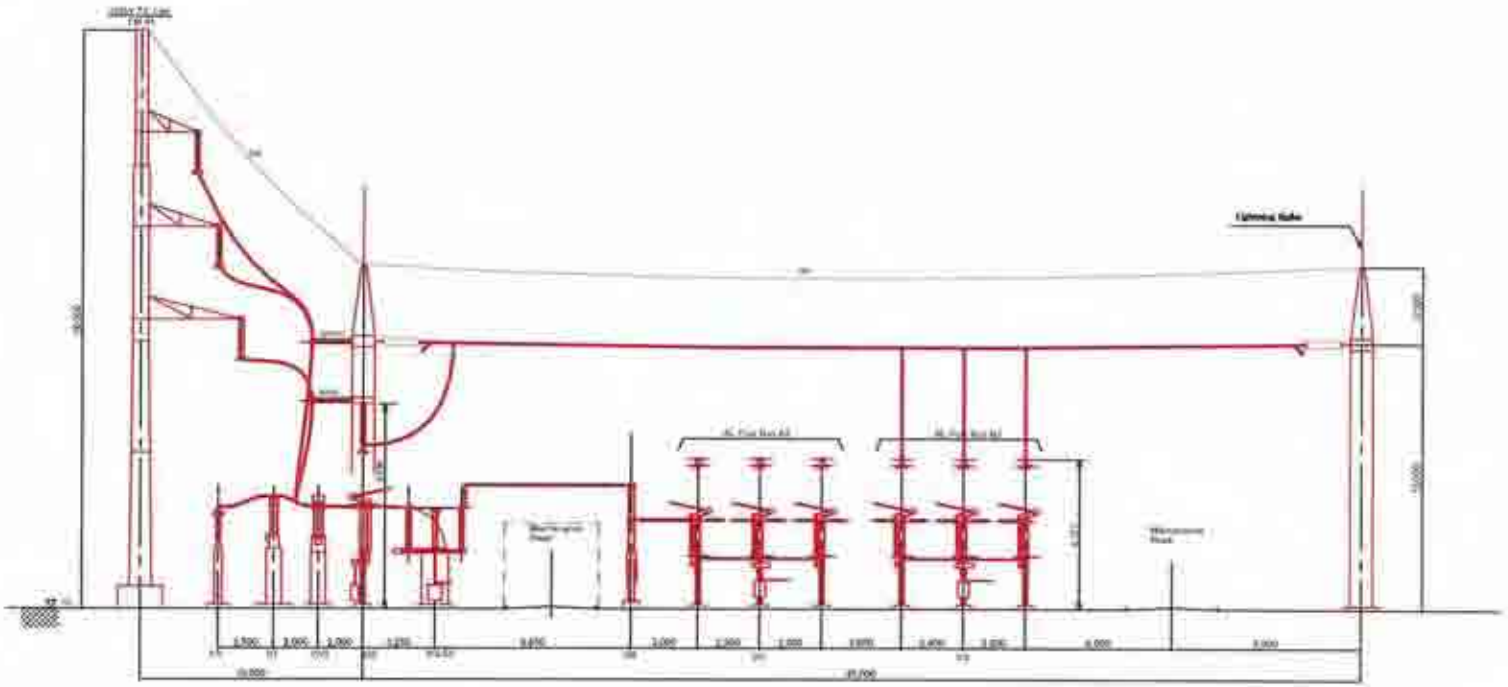
OB-E02 Substation Control System Diagram for New Oyster Bay Substation



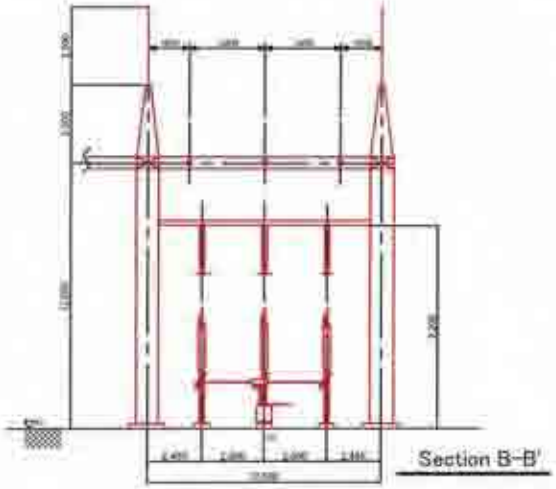
UB-G-01 Location of Ubungo Substation



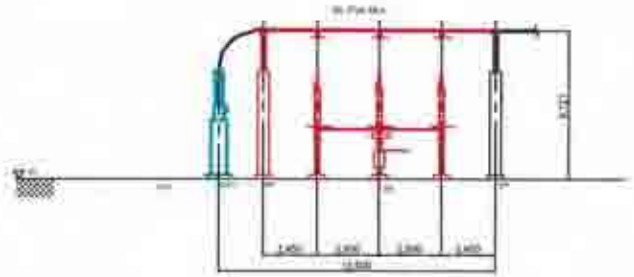
UB-G02 LAYOUT FOR UBUNGO SUBSTAION 132kV SWITCH YARD (PLAN)



Section A–A'



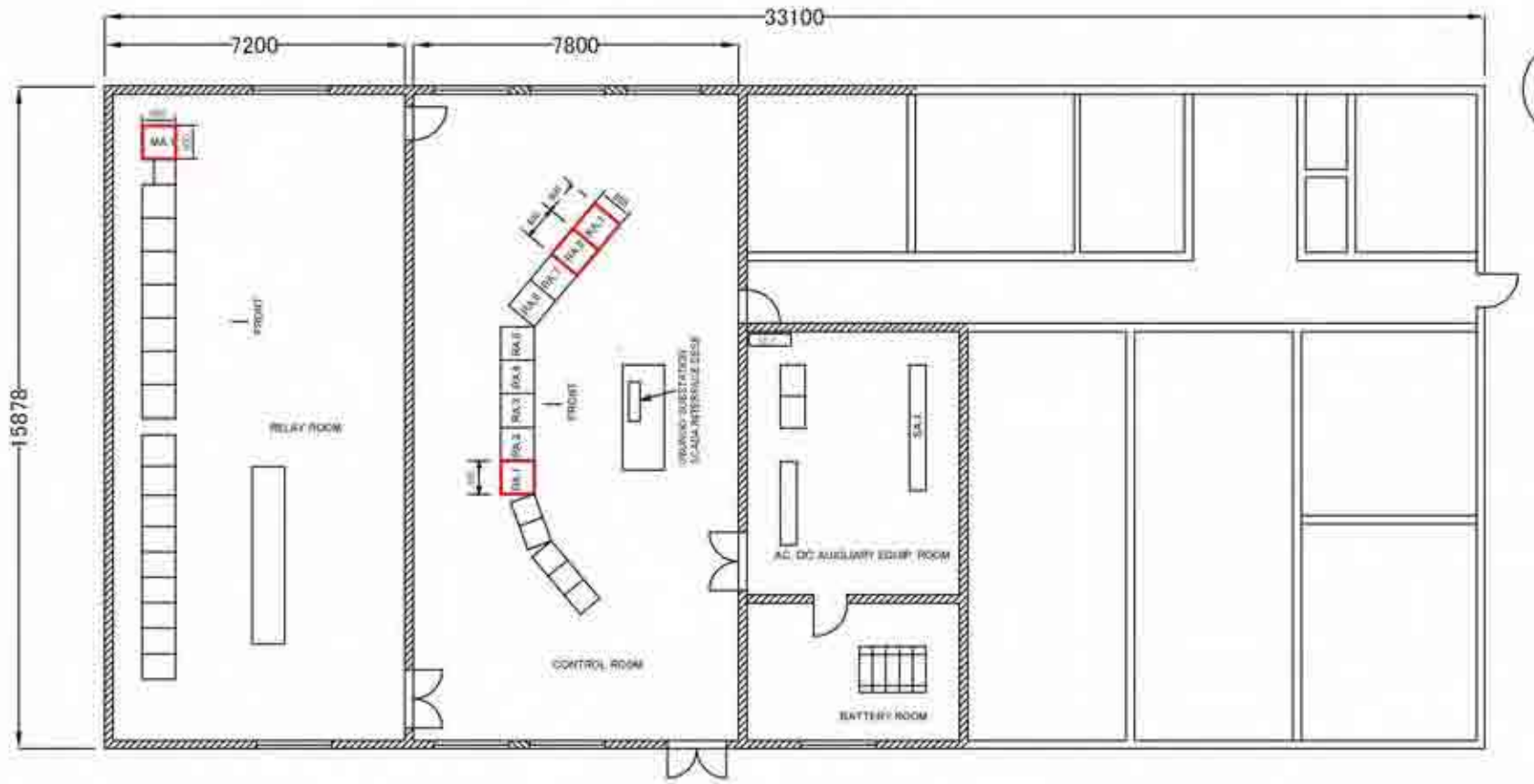
Section B–B'



Section C–C'

Scale 1:300

UB-G03 LAYOUT FOR UBUNGO SUBSTATION 132kV SWITCH YARD (SECTION)



LEGEND

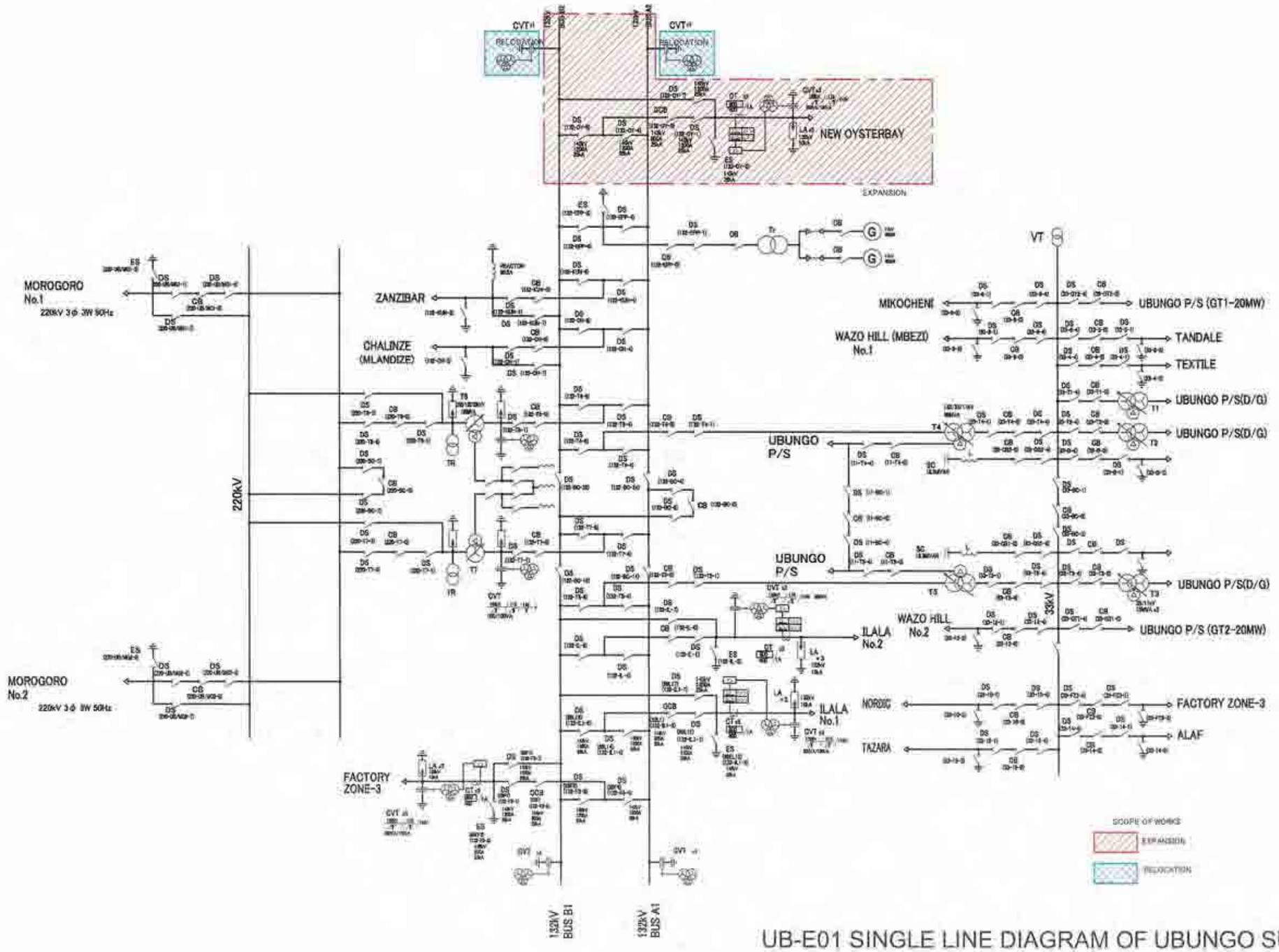
Item No	Type of Panel
MA I	SUBSTATION CONTROL PANEL
RA#	#3 TRANSFORMER AND NEW OYSTER BAY FEEDER PROTECTION PANEL
MA I	METER PANEL
RA I	ANNUNCIATER PANEL

NOTE:
MODIFIED PANEL

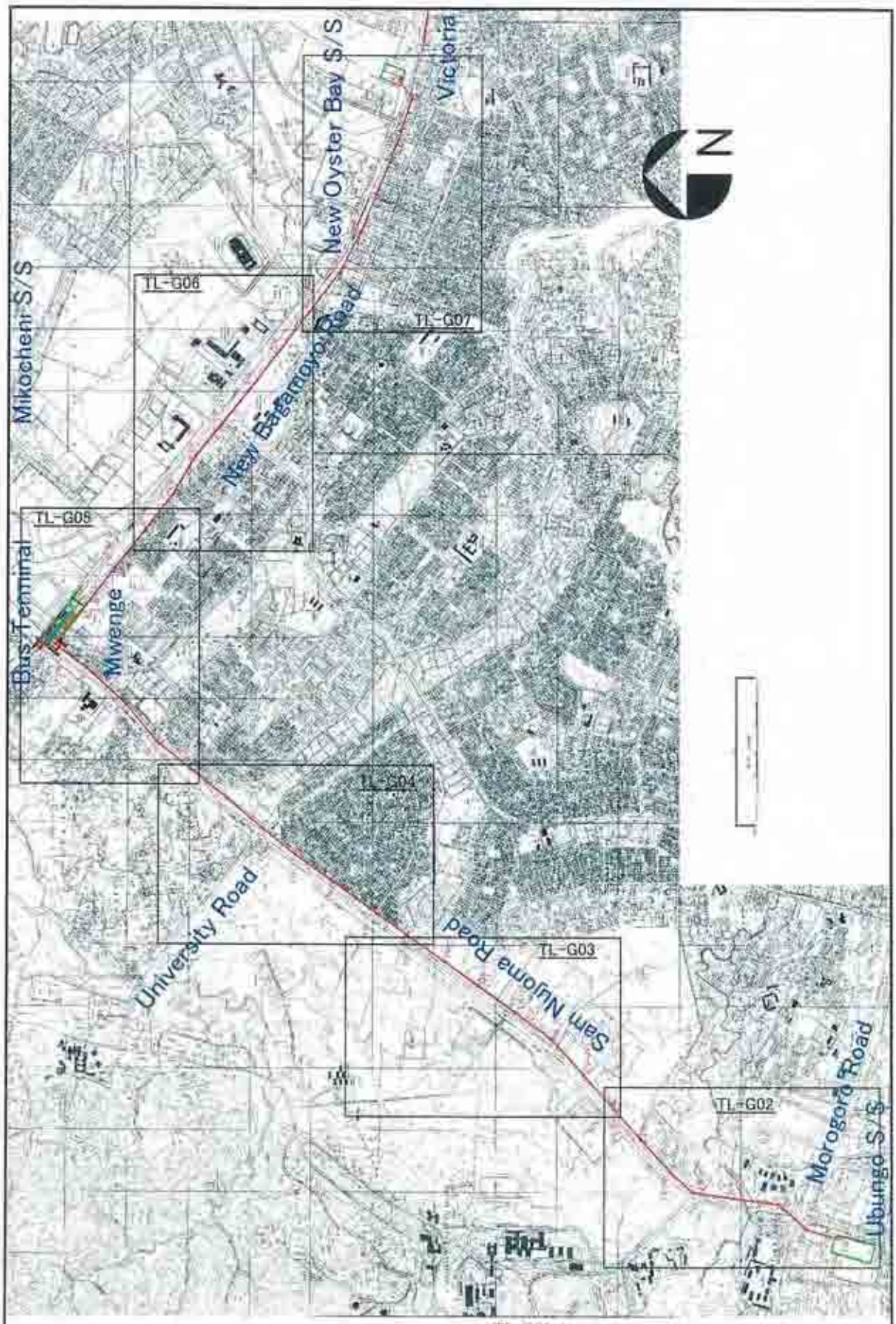
UBUNGO SUBSTATION
CONTROL BUILDING LAYOUT (PLAN)

Scale 1:150

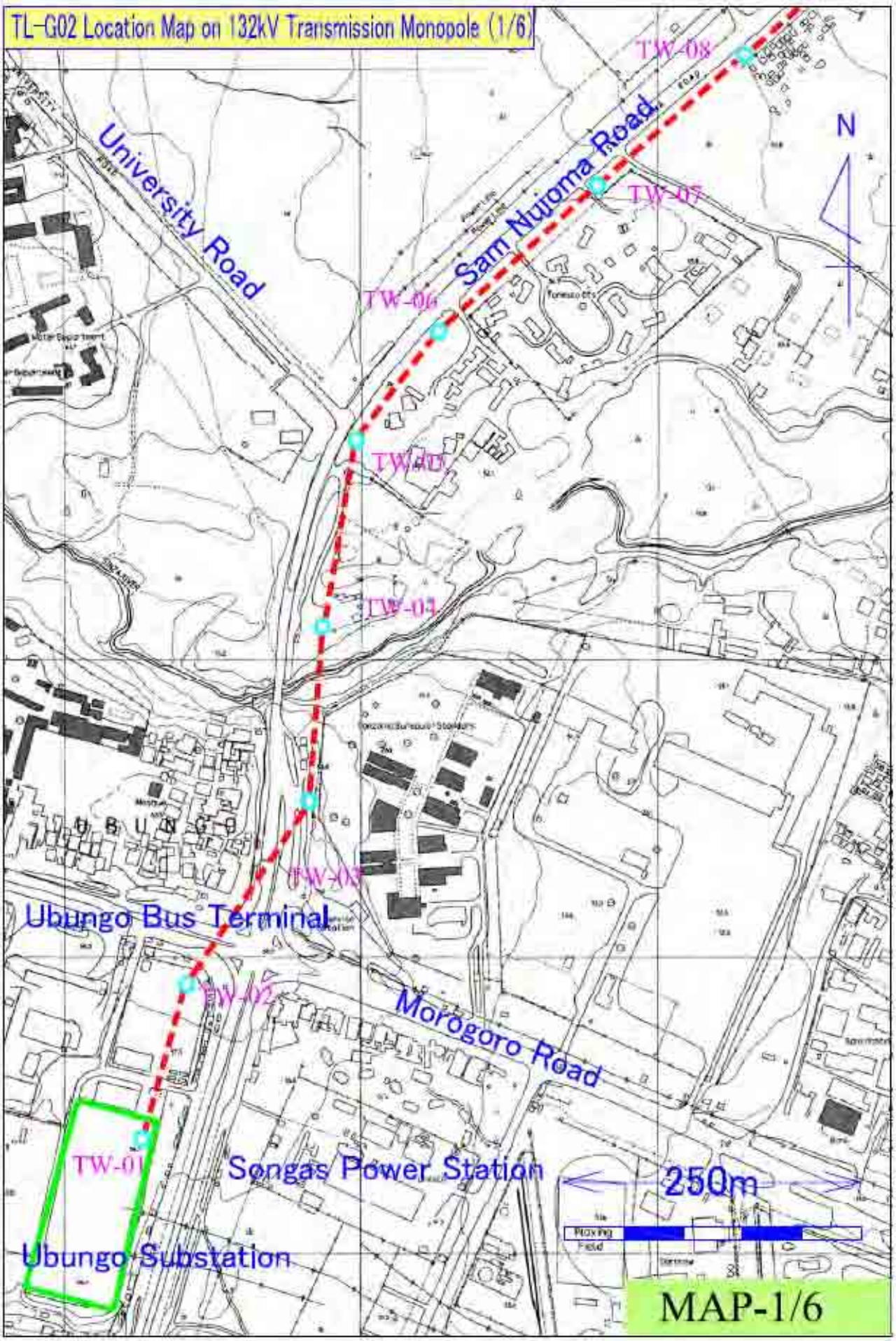
UB-G04 LAYOUT FOR UBUNGO SUBSTATION CONTROL BUILDING (PLAN)

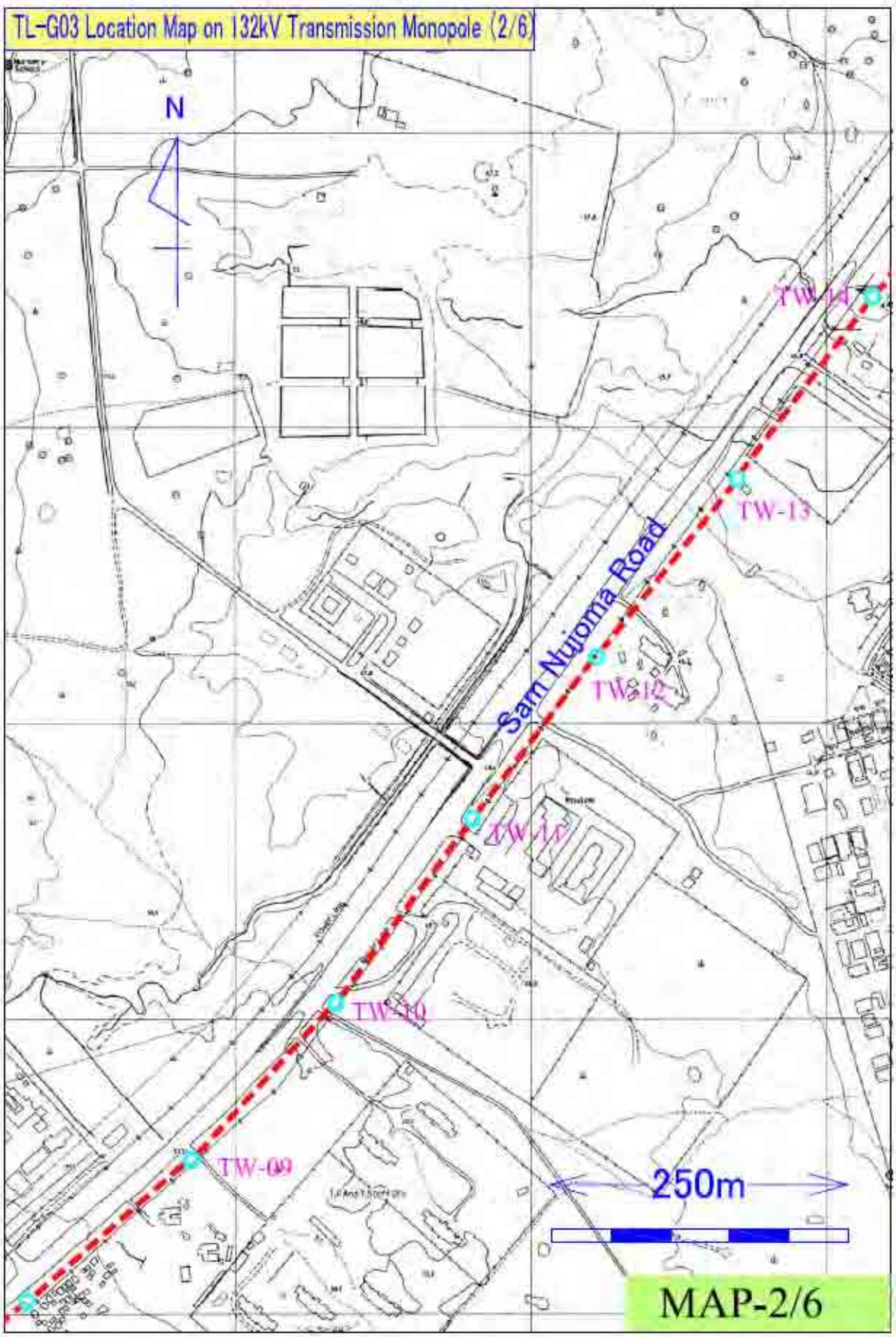


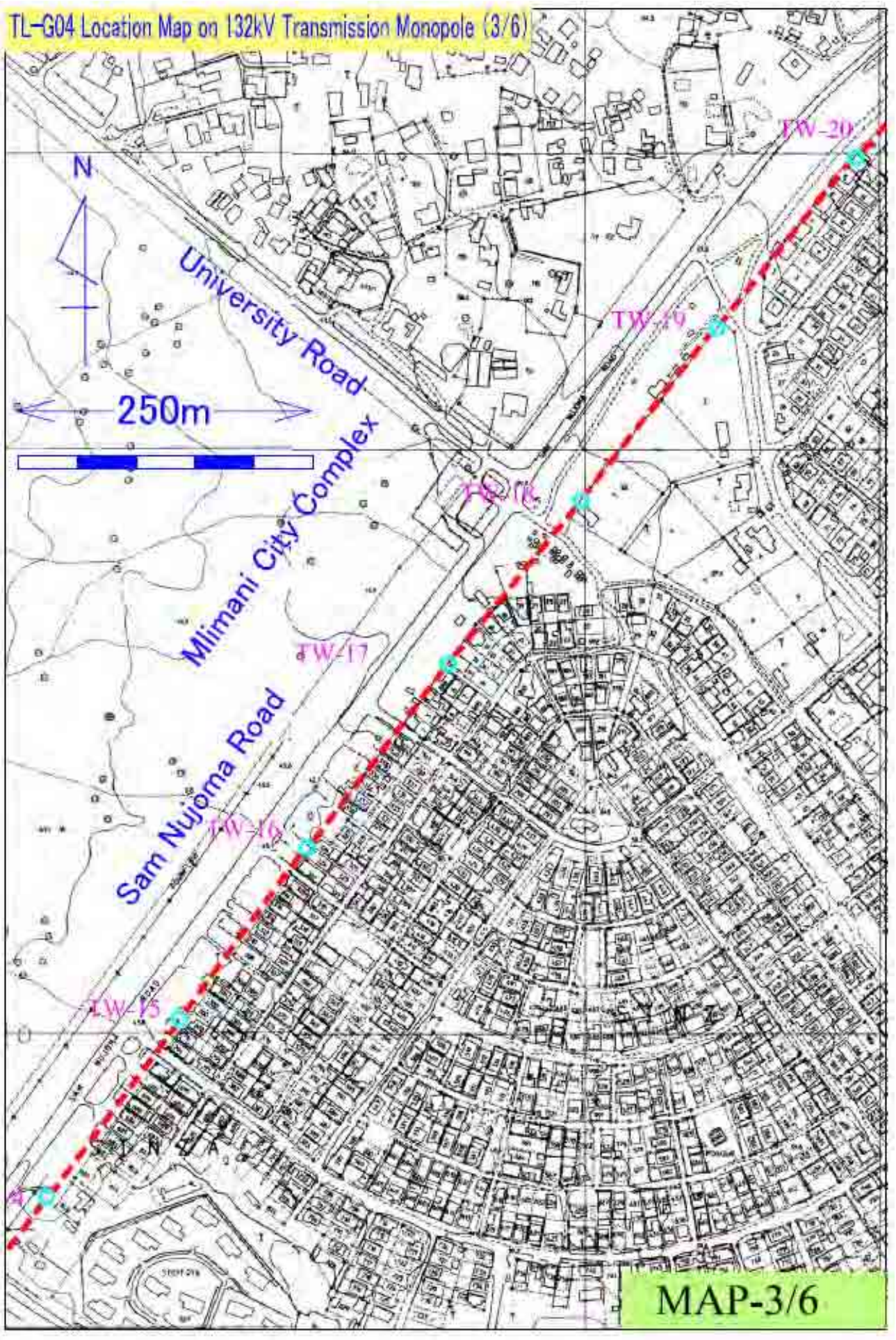
UB-E01 SINGLE LINE DIAGRAM OF UBUNGO SUBSTATION

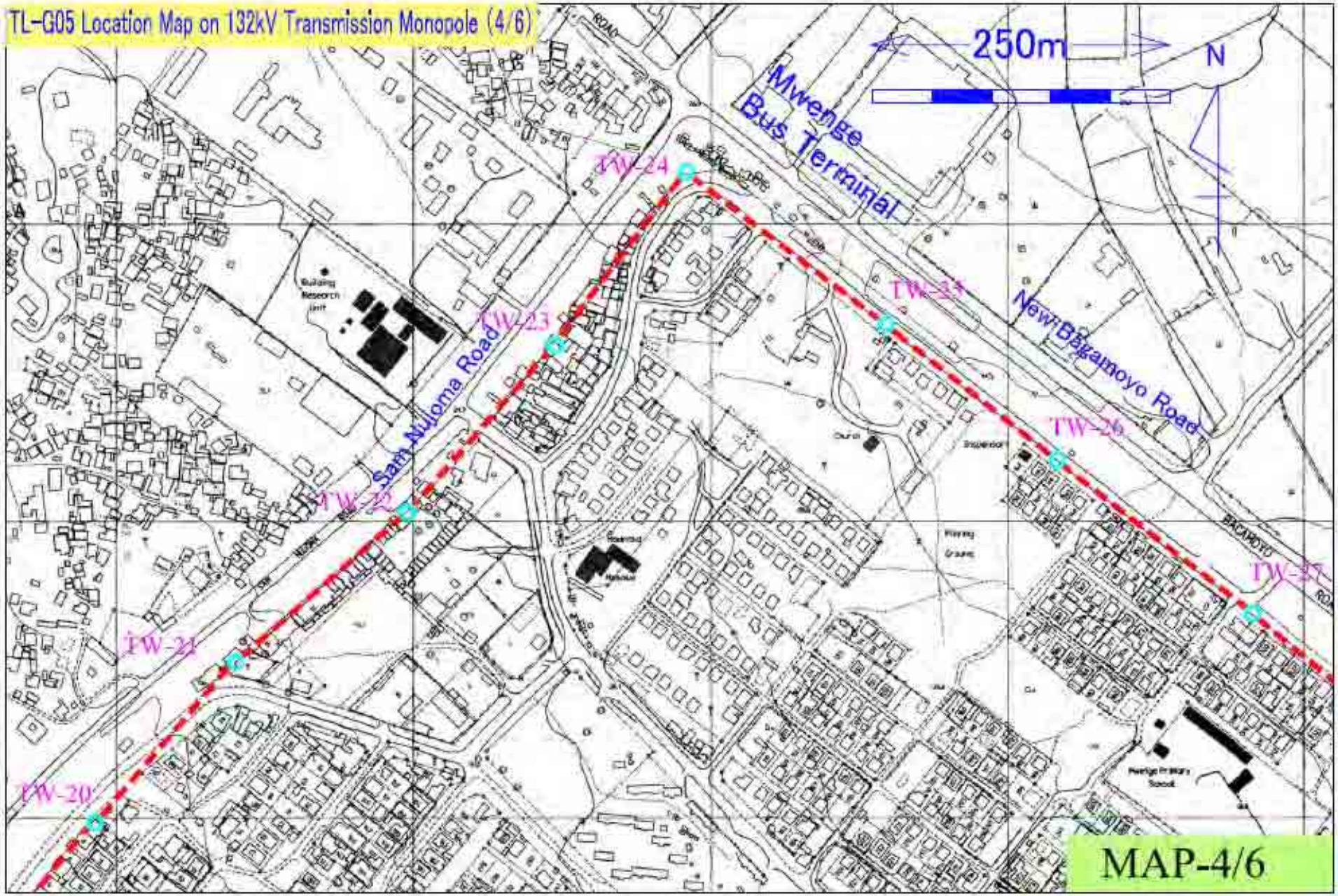


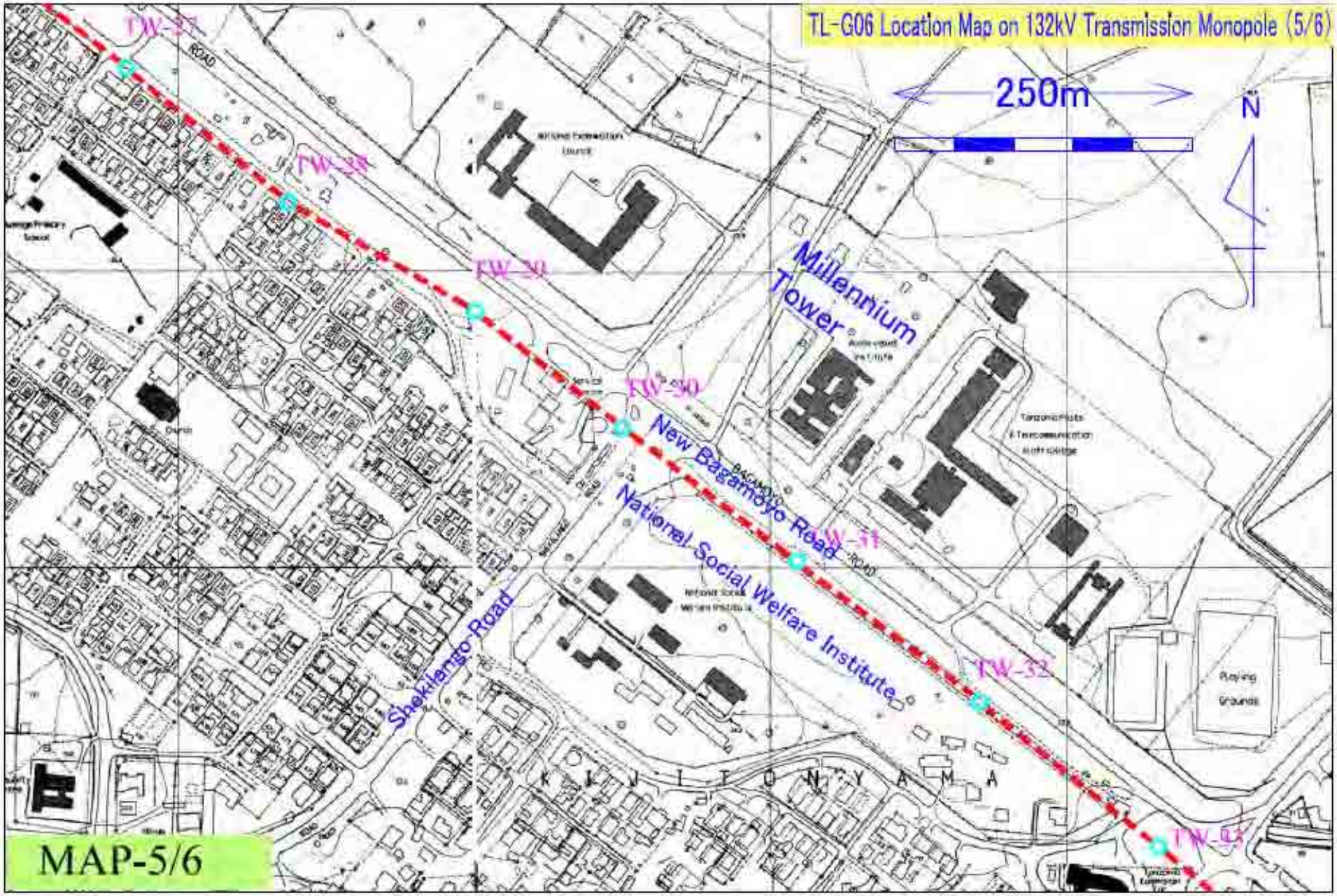
TL-G01 General View on 132kV Transmission Route
TL-G01 132kV送電線ルート全体図

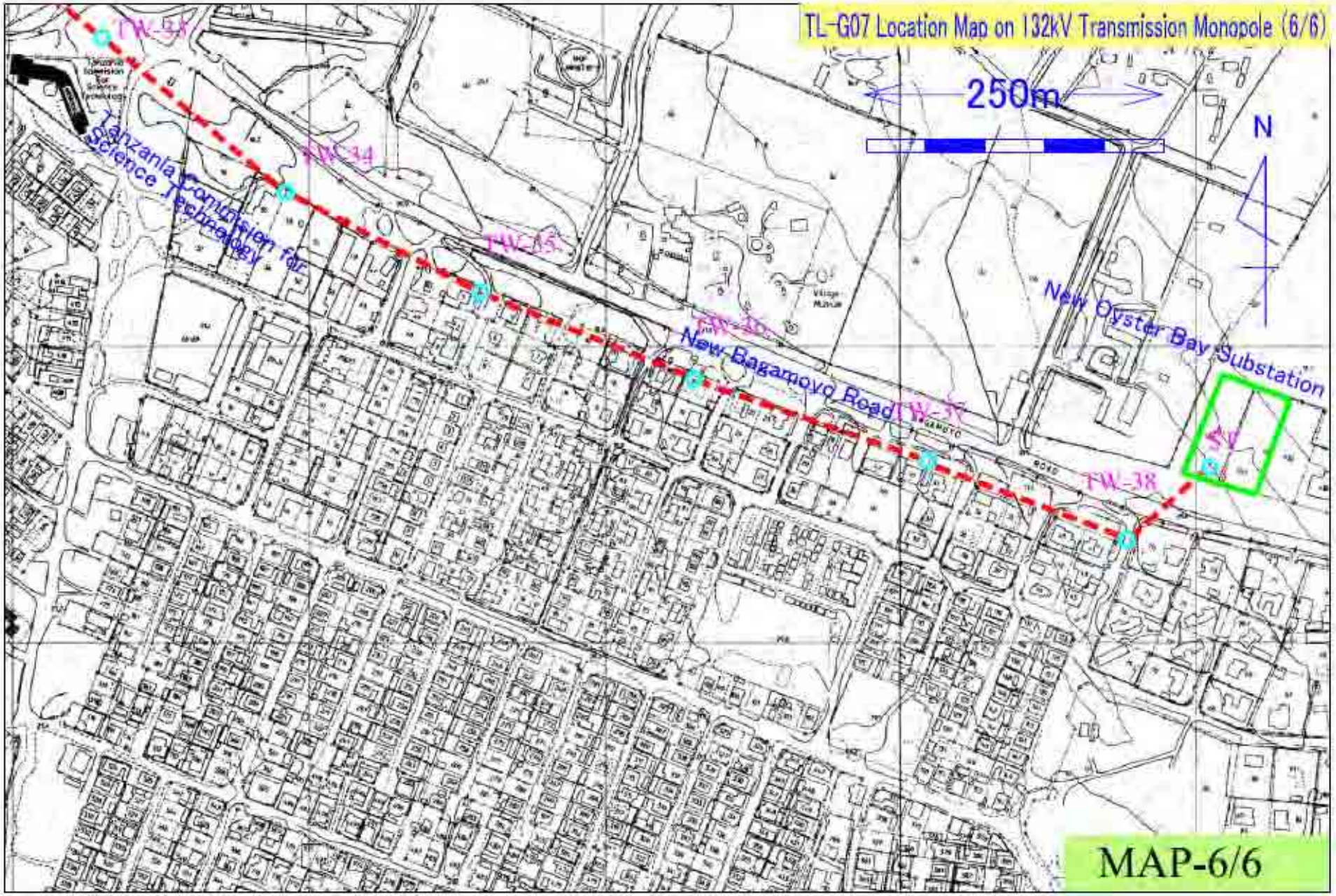

TL-G02 Location Map on 132kV Transmission Monopole (1/6)
TW-08
TW-07
TW-06
TW-05
TW-04
TW-03
TW-02
TW-01
University Road
Sam Nujoma Road
Morogoro Road
Ubungo Bus Terminal
Songas Power Station
Ubungo Substation
N
250m
MAP-1/6

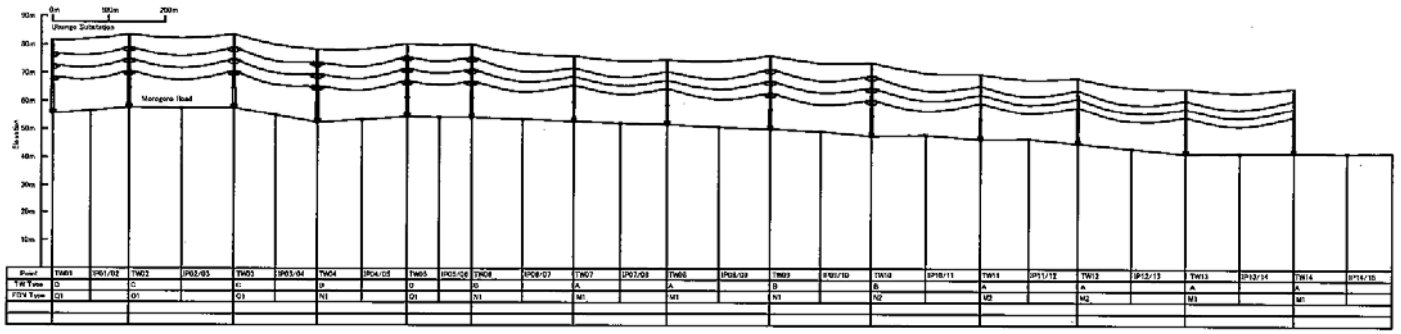

TL-G03 Location Map on 132kV Transmission Monopole (2/6)
N
TW-14
TW-13
Sam Nujoma Road
TW-12
TW-11
TW-10
TW-09
250m
MAP-2/6


TL-G04 Location Map on 132kV Transmission Monopole (3/6)
N
250m
University Road
Mlimani City Complex
Sam Nujoma Road
TW-15
TW-16
TW-17
TW-18
TW-19
TW-20
MAP-3/6

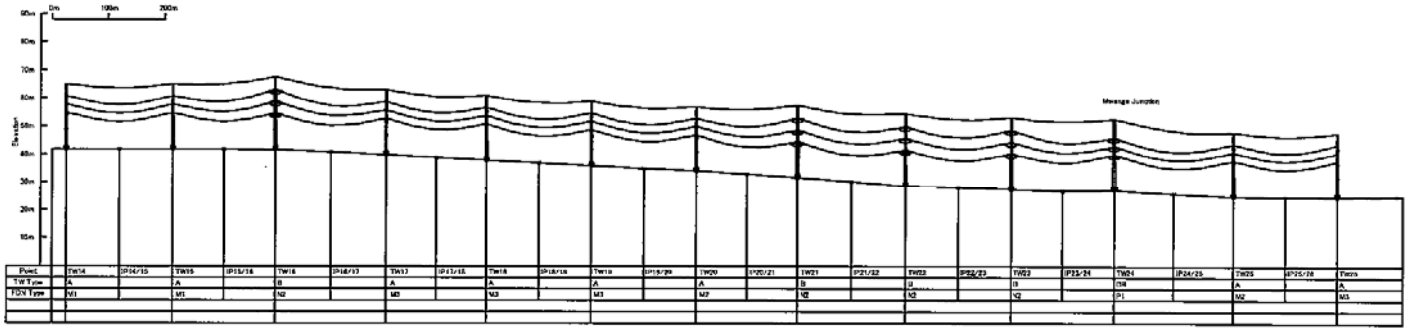

TL-G05 Location Map on 132kV Transmission Monopole (4/6)
250m
N
Mwenge Bus Terminal
New Bagamoyo Road
Sam Nujoma Road
TW-20
TW-21
TW-22
TW-23
TW-24
TW-25
TW-26
TW-27
MAP-4/6


TL-G06 Location Map on 132kV Transmission Monopole (5/6)
250m
N
TW-27
TW-28
TW-29
TW-30
TW-31
TW-32
TW-33
Millennium Tower
New Bagamoyo Road
National Social Welfare Institute
Shekilango Road
Playing Grounds
MAP-5/6

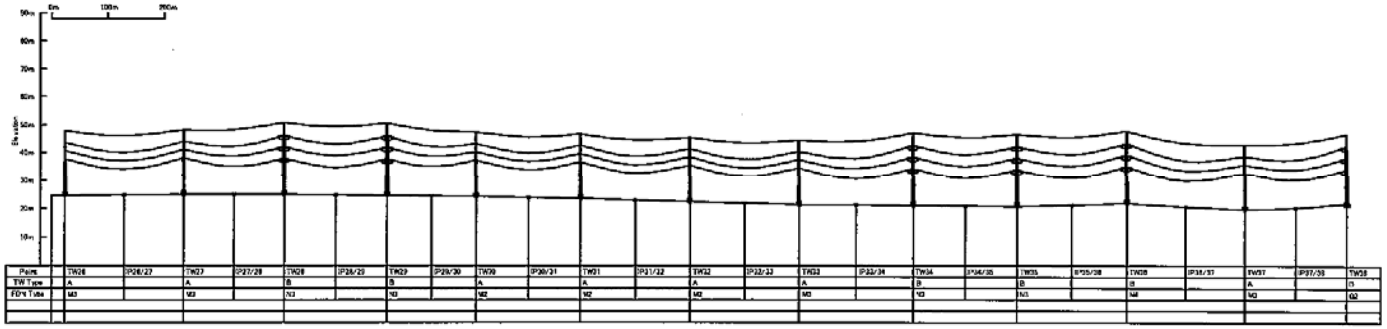

TL-G07 Location Map on 132kV Transmission Monopole (6/6)
250m
N
TW-34
TW-35
TW-36
TW-37
TW-38
Tanzania Commission for Science Technology
New Bagamoyo Road
New Oyster Bay Substation
MAP-6/6



TW01 - TW14



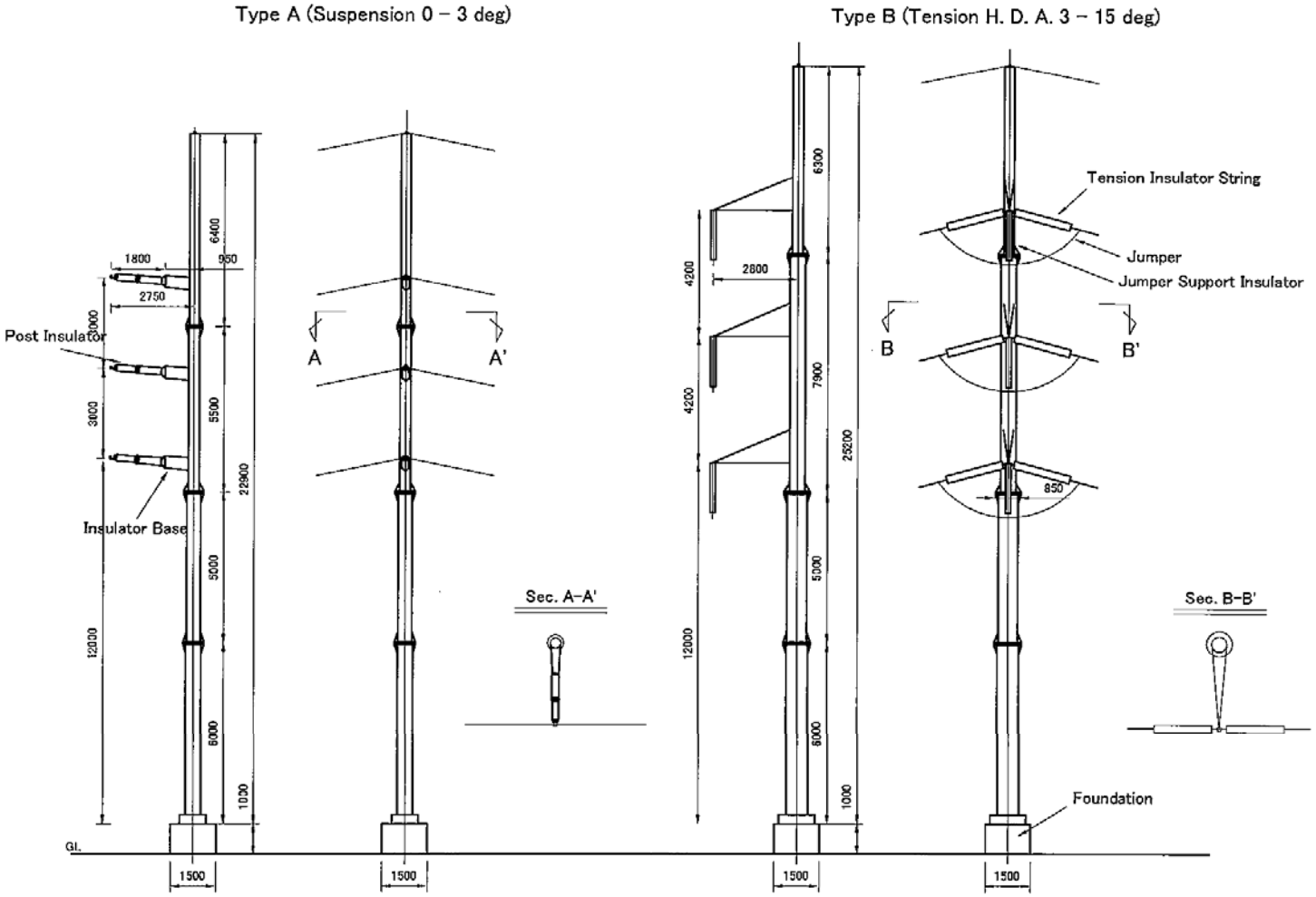
TW14 - TW26



TW26 - TW38

TL-G08: 132kV Transmission Route Profile

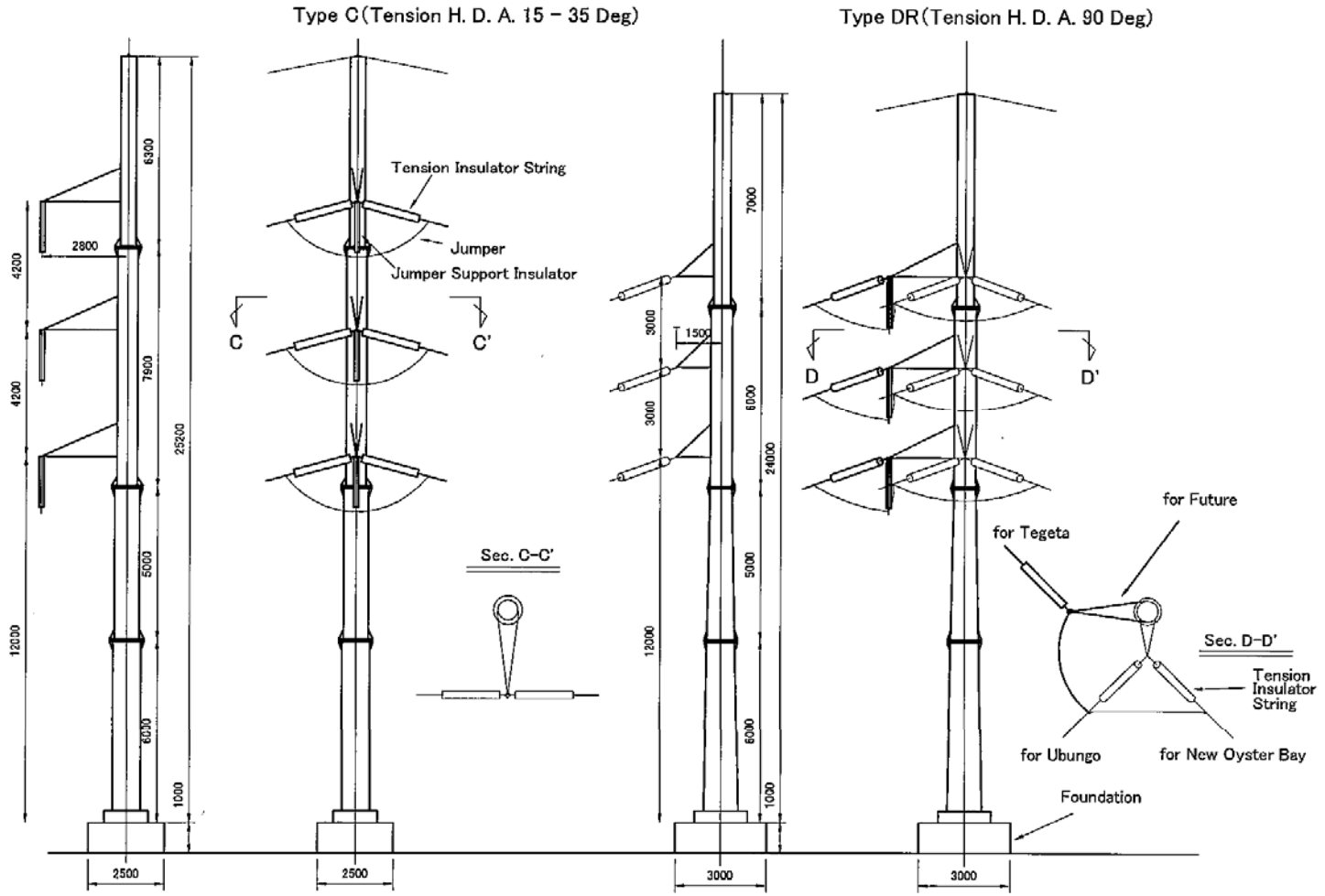
Material Monopole: Carbon steel, Cross arm: Rolled steel
Surface finishing Hot dip galvanized



Scale 1:200

TL-G09 132kV COMPACT MONOPOLE (TYPE A &B)

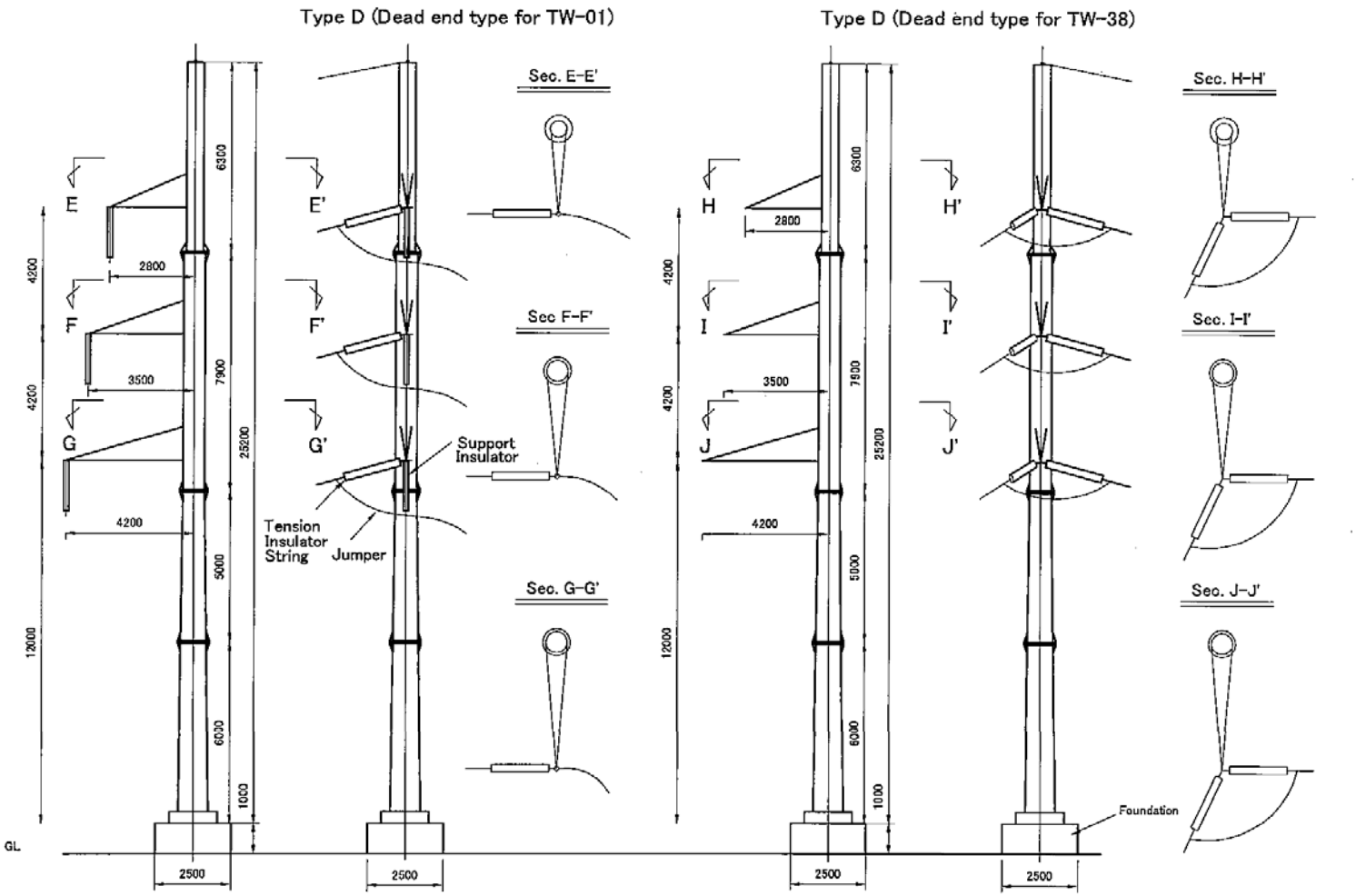
Material Monopole: Carbon steel, Cross arm: Rolled steel
Surface finishing Hot dip galvanized



Scale 1:200

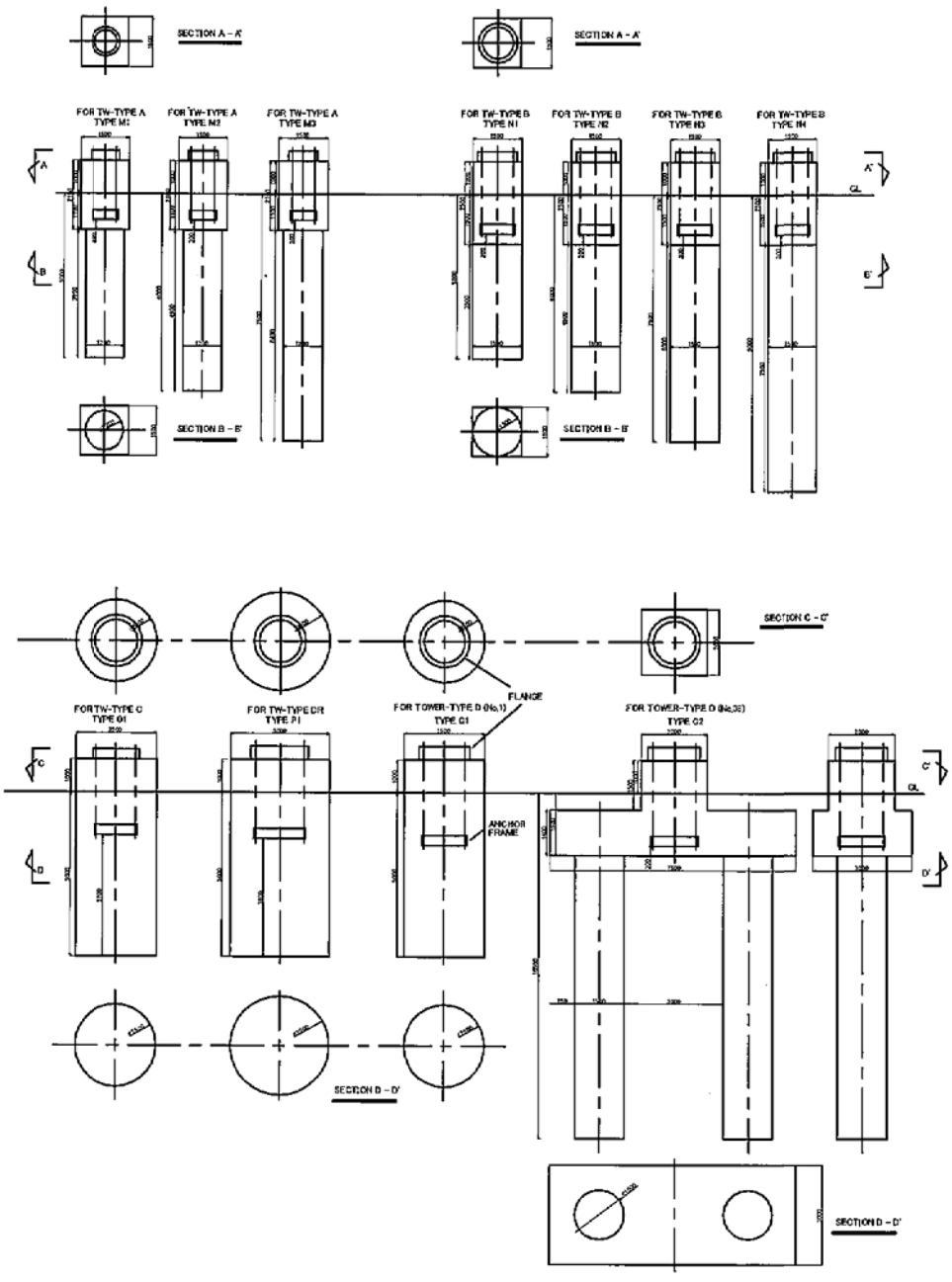
TL-G10 132kVCOMPACT MONOPOLE (TYPE C & DR)

Material Monopole: Carbon steel, Cross arm: Rolled steel
Surface finishing Hot dip galvanized



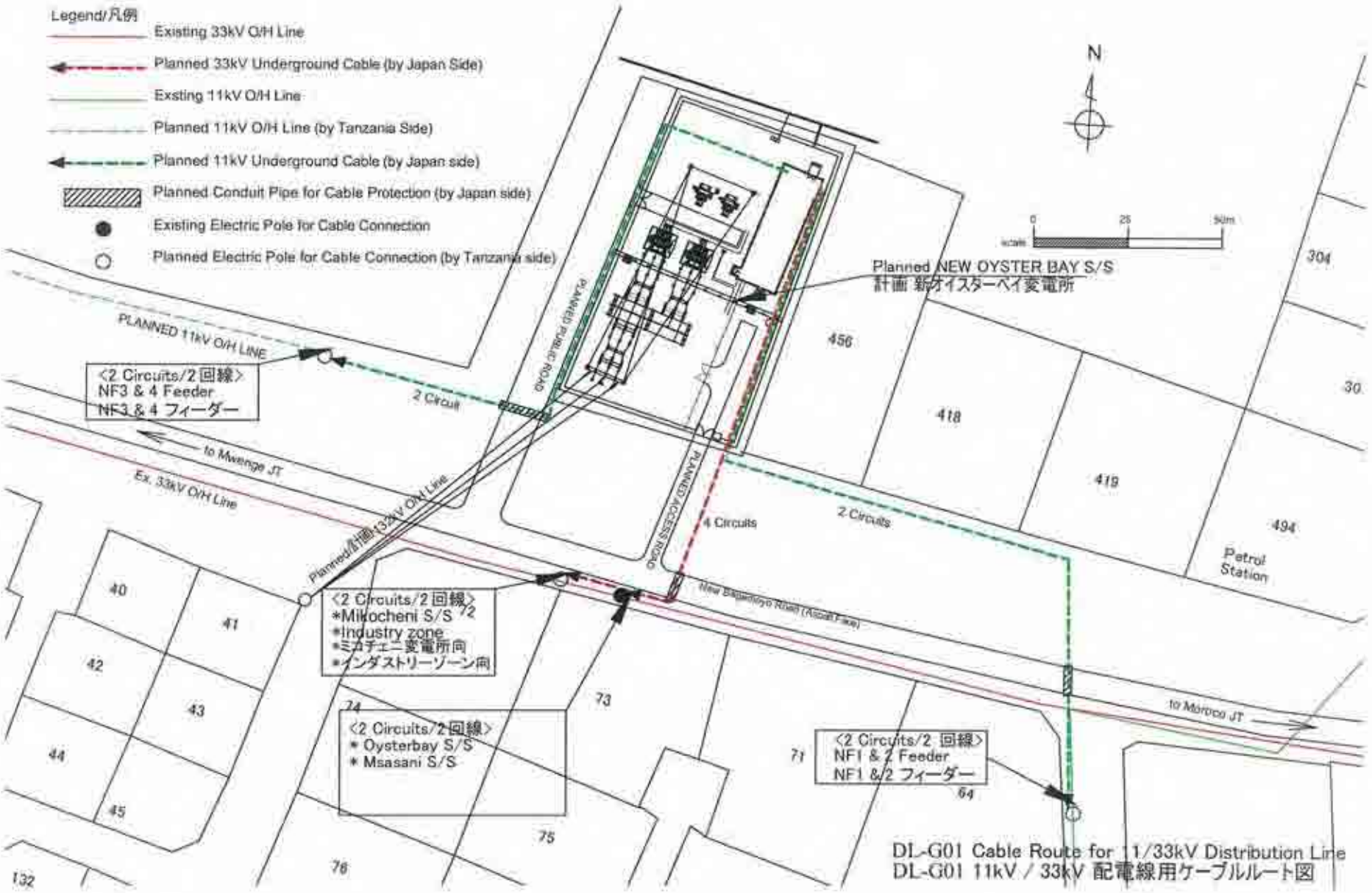
Scale 1:200

TL-G11 132kV COMPACT MONOPOLE (TYPE D)

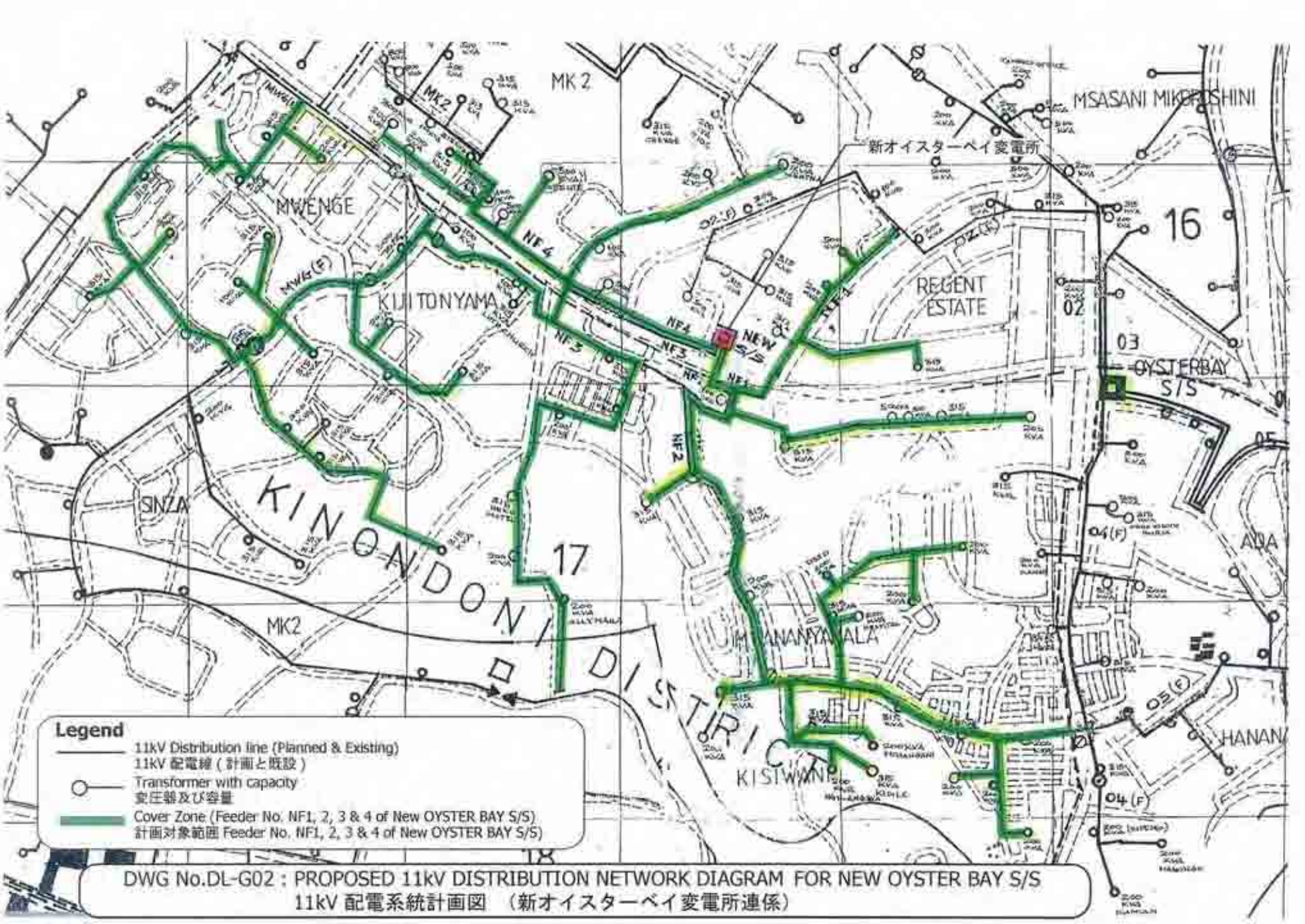


Scale 1:200

TL-G12 132kV FOUNDATION OF COMPACT MONOPOLE



DL-G01 Cable Route for 11/33kV Distribution Line
DL-G01 11kV / 33kV 配電線用ケーブルルート図



DWG No.DL-G02 : PROPOSED 11kV DISTRIBUTION NETWORK DIAGRAM FOR NEW OYSTER BAY S/S
11kV 配電系統計画図 （新オイスターベイ変電所連係）

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project will be implemented in accordance with Japan's Grant Aid Scheme. Accordingly, its implementation will only take place after Project approval by the Government of Japan and the Exchange of Notes (E/N) between both governments. The basic issues and points to note in the process of implementing the Project are described as follows.

(1) Project Implementation Body

The organization responsible for the implementation of the Project on the Tanzanian side is the Ministry of Energy and Minerals (MEM). Although the Energy and Petroleum Division in MEM will be directly responsible for the Project, the Tanzania Electric Supply Company Limited (TANESCO), the Project implementation body, is scheduled to take charge of operation and maintenance of the relevant facilities after the commissioning. It will, therefore, be necessary for TANESCO to assign the capable person responsible for the Project to ensure its smooth progress by maintaining close contact and consult with Japanese consultants and equipment suppliers.

The appointed person responsible for the Project at TANESCO will be required to explain fully the contents of the Project to staff concerned of MEM, TANESCO and local residents at the Project sites in order to facilitate their understanding of the Project and to encourage their cooperation in its implementation.

(2) Consultant

A Japanese consultant will conclude a consulting services agreement with TANESCO and will provide detailed design and work supervision for the Project to realize the planned procurement and installation of equipment and materials. The consultant will also prepare tender documents and provide necessary assistance for TANESCO, the Project implementation body, and to conduct tenders.

(3) Equipment Supplier

In accordance with the framework of the Japan’s Grant Aid Scheme, a Japanese equipment supplier selected by the Tanzanian side will carry out the procurement and installation of equipment and materials through competitive tendering.

If it is deemed necessary that the contract provide aftercare service including continuous supply of spare parts and an appropriate response to breakdowns even after completing the Project, the

equipment supplier should provide adequate liaison and adjustment after handing over relevant equipment and materials.

(4) Necessity for Dispatching Japanese Engineers

The Project is to be implemented in a short period of time and will require the combined works involving the civil and architectural work, electrical equipment installation work, transmission line construction work, commissioning work and so on. Each components should be co-coordinated well, otherwise, problems of schedule, quality, safety etc. will occur during Project period. Therefore, it is essential that a site manager capable of controlling and guiding all work in an integral manner will be dispatched from Japan to ensure execution of work smoothly.

Other than capable site manager, highly skilled engineers will also be required for construction and commissioning work, however, it will be difficult to utilize local companies. Accordingly, engineers should be dispatched from Japan to ensure quality, technical guidance and schedule control.

2-4-4-2 Implementation Conditions

(1) Construction Industry Conditions in Tanzania and Technology Transfer

As described earlier (Refer to 2-2-1-4), there are a few general contractors and electric firms in Dar es Salaam, so it is possible to place orders at local companies for onsite recruitment and procurement of workers, transportation vehicles, construction work equipment and materials within Tanzania for foundation work for substation construction under the Project or construction work for 132kV transmission lines. However, the dispatch of Japanese engineers is vital for schedule management, quality and safety control in due consideration of the severe delivery schedule under the Project which is the Japan's Grant Aid Scheme and the construction work requiring special attention for 132kV transmission lines at the end of roads closed to private households and with heavy traffic.

On the other hand, it will be difficult to utilize local companies other than workers since there is little similar installation work for substation equipment or construction work for 132kV transmission monopoles and construction and commissioning of these electrical facilities require the advanced and integrated technical skill. Accordingly, Japanese equipment suppliers should dispatch engineers from Japan and procure workers and machinery from local companies in the case of installation work under the Project. In addition, Japanese engineers should provide on-the-job training (OJT) to Tanzanian engineers during the relevant installation period in order to promote technology transfer.

(2) Effective Use of Local Equipment and Materials

Construction materials such as aggregates, cement and reinforcing bars, etc. to be utilized for foundation work are locally available in Tanzania and have been frequently adopted in similar projects. Consequently, in the formulation of a work plan, locally available materials will be utilized whenever possible as a means of promoting local industry. However, the most of high voltage transmission materials depends upon import in Tanzania, accordingly, it is difficult to utilize local products. Therefore transmission and substation materials and equipment will be procured from Japan or a third country under the Project.

(3) Safety Measures

Although Tanzania has relatively few problems with public peace and order compared with other surrounding nations, pick-pocketing, theft, trespassing on private property and robbery do occur The number of general crimes tends to increase immediately after the Ramadan or before and after religious holidays such as Christmas. There is also concern over the increasing number of appalling crimes mainly occurring in urban areas in recent years due to firearms from Kenya and Rwanda. As the Project site is located in the center of Dar es Salaam, accessibility is favorable so easy monitoring is possible during the implementation of the Project. However, due to the fear of worsening public peace and order, special attention should be paid to preventing theft of equipment and materials and ensuring the safety of related-construction personnel. Although it has been confirmed that the recipient government will take necessary measures to ensure safety, the Japanese side also should also take the following steps.

1) A temporary stockyard should be established at the Kinondoni North branch office of TANESCO, and equipment and materials should be stored in a place out of reach of the general public.
2) A liaison system for related-construction personnel should be created.

(4) Tax Exemption

The procedures for tax exemption (including value added taxes) for equipment and materials to be procured under the Project by the Tanzanian side are as follows. After a equipment supplier submits an application for tax exemption to TANESCO, TANESCO submits a request for a letter for tax exemption from the Ministry of Finance via the MEM, which is sent to Customs (copies are issued simultaneously to the MEM and the equipment supplier). When equipment and materials arrive at port or at an airport in Tanzania, the equipment supplier presents the prescribed shipment documents with an attached copy of the above-mentioned tax exemption letter to Customs. Tax is then exempted. Consequently, it is important to pay special attention to

the process of acquiring tax exemption in order to prevent any delays which could have a negative impact on the progress of the Project.

2-2-4-3 Scope of Work

Of the undertakings between the Japanese side and the Tanzanian side, the Japanese side will carry out procurement and installation work, commissioning for equipment at the New Oyster Bay Substation, 132kV lead-out facilities at the existing Ubungo Substation and 132kV transmission lines to be constructed and necessary civil engineering work. The Tanzanian side will take care of land preparation. The detailed work demarcation between the Japanese side and the Tanzanian side is shown in Table 2-2-4.1.

Table 2-2-4.1 Scope of Work between Japan and Tanzania

Work Item	Procurement		Installation		Remarks
	Japan	Tanzania	Japan	Tanzania	
【33kV Distribution Facilities Construction】					
1. Common Requirement					
(1) Providing Stockyard for Equipment & Materials		○		○	To be completed prior to commencement of Japanese work
(2) Assuring worker security at the site during construction period		○		○	
(3) Counter plan & compensation to consumers at necessary interruptions during construction period		○		○	Especially at the time of connecting 33kV & 11kV distribution lines
(4) Informing interruptions plan to consumers during construction period (at need)		○		○	
(5) Road traffic restriction (at need)		○		○	
(6) Providing disposal pit for surplus soil & waste water		○		○	
2. Construction Work for 33kV & 11kV Distribution Facilities at New Oyster Bay S/S					
【Site Preparation】					
(1) Site preparation (including removal of existing structures)		○		○	To be completed prior to commencement of Japanese work
(2) Site creation (including 2-story creation, steps)		○		○	Same as above
(3) Access roads (main roads & secondary roads)		○		○	Same as above
(4) Drainage system in the site & access roads		○		○	Same as above
(5) Fences & gates		○		○	Same as above
(6) Building utility (such as leading in water supply, waste water drainage, telephone system & procurement of furniture & furnishings)		○		○	To lead public pipes of water supply & sewer systems into the site
【33kV& 11kV Distribution Equipment】					
(1) Control house	○		○		
(2) Building utility (indoor lighting, water & drainage systems)	○		○		
(3) Access roads	○		○		
(4) 33kV switchgears	○		○		
(5) 11kV switchgears	○		○		
(6) 33/11kVcontrol & protection panels	○		○		
(7) 33/11kV distribution transformers	○		○		
(8) Station service facilities	○		○		
(9) Dead-end towers (gantry)	○		○		
(10) Earthing system (including overhead grounding wires)	○		○		
(11) Outdoor lighting system	○		○		
(12) Fire extinguishers	○		○		

Work Item	Procurement		Installation		Remarks
	Japan	Tanzania	Japan	Tanzania	
(13) Equipment & materials necessary for installing the above-mentioned (2) to (11) (such as cables)	○		○		
(14) Civil engineering work necessary for the above-mentioned (2) to (11) (such as foundation, cable trenches & gavel laying at the site)	○		○		
(15) Oil separator for transformers	○		○		
(16) Equipment & materials for connecting between existing 33kV distribution lines & 33kV switchgears	○		○		To install 33kV lightning arresters to existing poles by Tanzania
(17) Equipment & materials for connecting between existing 11kV distribution lines & 11kV switchgears	○		○		To install 11kV lightning arresters to existing poles by Tanzania
【Other】					
(1) Spare parts, maintenance tools (including testing devices)	○			○ (Storage)	Maintenance tools to be utilized at installation work by Japan
(2) Commissioning Test			○		
(3) OJT			○ (Guidance)		
【132kV Transmission Facilities Construction】					
1. Common Requirement					
(1) Providing stockyard for equipment & materials		○		○	To be completed prior to commencement of Japanese work
(2) Assuring worker security at the site during construction period		○		○	
(3) Counter plan & compensation to consumers at necessary interruptions during construction period		○		○	Especially at the time of connecting 132kV transmission liens
(4) Informing consumers of interruptions plan or safety measures during construction period (at need)		○		○	
(5) Road traffic restriction (at need)		○		○	
(6) Providing disposal pit for surplus soil & waste water		○		○	
(7) Measures for accidents due to vehicle collisions with 132kV transmission monopoles		○		○	
(8) Explanation on safety isolating distance of 132kV transmission lines & compensation for building restriction to local residents (at need)		○		○	
2. Construction Work for 132kV Transmission Facilities at New Oyster Bay S/S		○		○	
【132kV Transmission Equipment】					
(1) 132kV feeders, main transformer feeders, bus bars	○		○		
(2) 132kV switchgears	○		○		
(3) 132/33kV main transformers	○		○		
(4) 132kV control & protection panels	○		○		
(5) Earthing system	○		○		
(6) Equipment & materials necessary for installing the above-mentioned (1) to (5) (such as cables)	○		○		
(7) Civil engineering work necessary for the above-mentioned (1) to (5) (such as foundation, cable trench & gavel laying at the site)	○		○		
【Other】					
(1) Spare parts, maintenance tools (including testing devices)	○			○ (Storage)	Maintenance tools to be utilized at installation work by Japan
(2) Commissioning Test			○		
(3) OJT			○ (Guidance)		

Work Item	Procurement		Installation		Remarks
	Japan	Tanzania	Japan	Tanzania	
3. Expansion Work for 132kV Lead-out Facilities at Existing Ubungo S/S					
【Site Preparation】					
(1) Transferring existing structures on the proposed routes (such as warehouses, antenna towers & water tanks)		○		○	To be completed prior to commencement of Japanese work
【132kV Transmission Equipment】					
(1) 132kV feeder dead-end tower (gantry)	○		○		
(2) 132kV lead-out bus system	○		○		
(3) 132kV switchgears	○		○		
(4) Transferring existing CVT	○		○		Existing cables to be recycled under the Project
(5) Modification of existing control panels	○		○		Control systems & protection relays to be installed in the existing control panels under the Project
(6) Earthing system (including overhead grounding wires)	○		○		
(7) Equipment & materials necessary for installing the above-mentioned (2) to (7) (such as cables)	○		○		
(8) Civil engineering work necessary for the above-mentioned (1) to (5) (such as foundation & cable trench)	○		○		
【Other 】					
(1) Spare parts, maintenance tools (including testing devices)	○			○ (Storage)	Maintenance tools to be utilized during installation work by Japan
(2) Commissioning Test			○		
(3) OJT			○ (Guidance)		
3. 132kV Transmission Lines Construction (Ubungo S/S to New Oyster Bay S/S)					
【Site Preparation】					
(1) Transferring existing 33kV distribution lines at Sam Nujoma Road (from the right to the left side of the road directed to the Mwenge Junction)		○		○	To be completed prior to commencement of Japanese work
(2) Felling trees on proposed transmission route		○		○	Same as above
(3) Removing illegal buildings on proposed transmission route		○		○	Same as above
(4) Removing existing underground infrastructure systems at construction sites for transmission monopoles (such as water supply pipes, telephone lines, sewerage systems & power cables)		○		○	Cost of transferring compensations to be taken by Tanzania
(5) Temporary construction land for construction work draw transmission lines in (about 10m x 20m)		○		○	In front of Ubungo Junction, Mwenge Junction & New Oyster Bay S/S
【132kV Transmission Lines】					
(1) Foundation for transmission monopoles	○		○		
(2) 132kV transmission monopoles	○		○		
(3) Equipment & materials for transmission lines (such as conductors, insulators, cross arms & earthing equipment)	○		○		
(4) Spare parts, maintenance tools (including testing devices)	○			○ (Storage)	Maintenance tools to be utilized at installation work by Japan
(5) Commissioning Test	○		○		

(Note) ○ denotes the side responsible for the work.

2-2-4-4 Consultant Supervision

In due consideration of the objectives of the basic design in accordance with Japan's Grant Aid scheme, the consultant is responsible for smooth implementation of the detailed design and work supervision after creating a reliable project team. Since the Project site will be an urban area where the general public is active and the Project will be combined work including the substation construction and 132kV transmission line construction, the consultant will dispatch at least one full-time engineer to the project site to carry out appropriate management of schedule, quality and safety control during the construction period. The consultant will also dispatch other engineers in line with the work progress of equipment installation and commissioning and supervise construction work to be conducted by equipment suppliers. Moreover, as the occasion arises, the consultant will make necessary arrangement to send the engineers to the shop test conducted by manufactures and pre-shipment inspections of equipment in Japan in order to prevent any problems after the materials and equipment are delivered to the project site.

(1) Basic Principles of Work Supervision

The consultant will supervise the work progress to ensure the completion of the construction work within the predetermined period and will supervise and guide equipment supplier to ensure quality described in an agreement and safe implementation of the construction work in principle.

Major points to be noted in the case of work supervisor are described as follows.

1) Schedule Control

The implementation schedule planned at the conclusion of the contract and actual state of progress will be compared monthly or weekly to ensure the handing over date specified in the contact. If any delay in work is anticipated, the consultant will issue a warning to the equipment supplier and will request that the equipment supplier take steps to improve the situation so that the work is completed within the contract period. The above-mentioned comparison is mainly conducted by confirming the following items.

① Confirmation of quantity of work completed (Quantity of equipment manufactured at the factory and equipment for completed civil engineering work onsite)

② Confirmation of quantity of equipment and materials delivered (substation, transmission and distribution equipment and materials for civil engineering work)

③ Confirmation of conditions of temporary work and preparation of construction machinery

④ Confirmation of actual number of engineers, skilled workers and laborers and their ratio compared with the original plan

2) Safety Control

The consultant will provide supervision in order to prevent any industrial injuries and accidents at the site during the construction period before they happen though consultations with representatives of equipment suppliers. The key points for onsite safety control are described as follows.

① Preparation of safety control rules and appointment of a safety manager

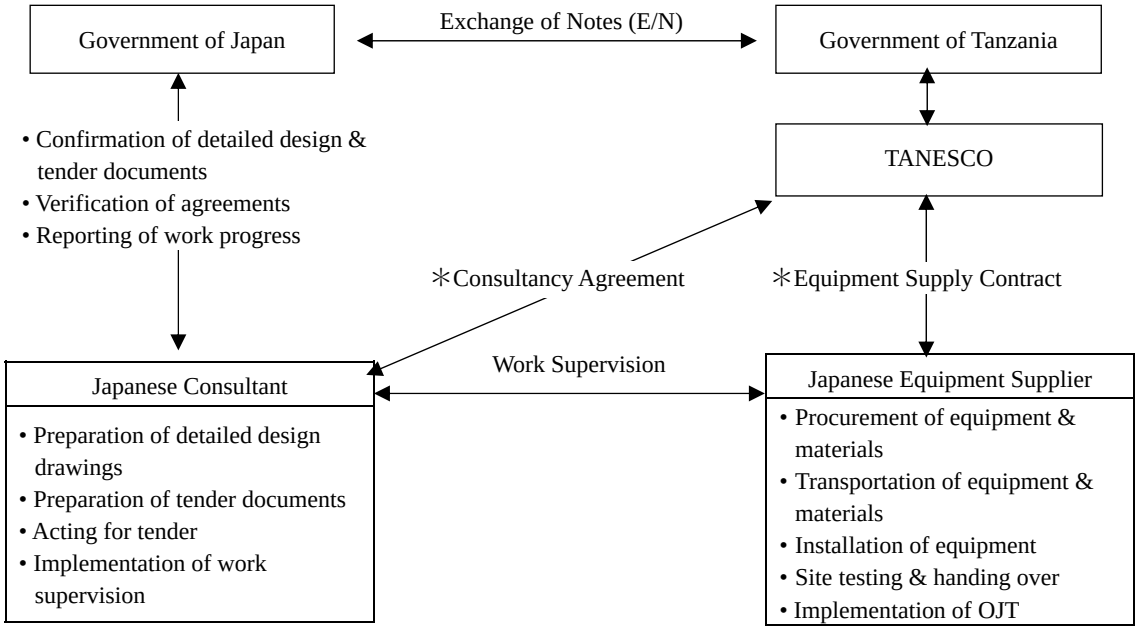
② Prevention of accidents by carrying out periodical inspections of construction machinery

③ Formulation of operational routes for construction vehicles and machinery, etc. and strict enforcement of careful and safe driving

④ Adherence to welfare measures and holidays for workers

(2) Project Implementation System

The interrelationship between participants in the implementation of the Project including the work supervision period is shown in Figure 2-2-4.1.



＊Note: The consultancy agreement and the equipment supply contract must be approved by the Government of Japan.

Figure 2-2-4.1 Project Implementation System

(3) Work Supervisors (Supervising Engineers)

The equipment supplier will carry out substation construction, the 132kV transmission line construction and necessary civil engineering work. The equipment supplier will also employ local construction companies in Tanzania in accordance with the contract agreements. Since it will be necessary for the equipment supplier to fully understand the contents of the subcontract regarding the work schedule, work quality and compliance with specifications and safety measures, the equipment supplier will dispatch Japanese engineers with overseas experience similar to the Project to provide guidance and training for local companies.

Given the scale and contents of the planned construction work under the Project, it is desirable to dispatch at least full-time engineers listed in Table 2-2-4.2.

Table 2-2-4.2 Engineers Dispatched by Equipment Supplier

Type of Engineer	No.	Assign Work	Assignment Period
Site Manager	1	Overall construction work management, consultation & coordination with related organizations, obtaining of necessary permits, director to implement OJT, equipment procurement control, customs clearance, personnel management, accounting business	Equipment instillation period (except building and civil work)
Inspection Engineer 1 (Substation Equipment)	1	Confirmation & checking of substation equipment shop drawings in general (work in Japan)	Drawing approval period
	1	Witnessing of substation equipment testing in general (work in Japan)	Equipment testing period
Inspection Engineer 2 (Transmission Equipment)	1	Confirmation & checking of transmission monopoles shop drawings in general (work in Japan)	Drawing approval period
	1	Witnessing of inspection of transmission facilities (work in Japan)	Equipment & materials testing period
Assistant Procurement Control 1 (locally employed)	1	Testing & adjustment of equipment installation in general, assisting for site manager	Equipment instillation period (except building and civil work)
Assistant Procurement Control 2 (locally employed)	1	Assisting of transmission lines construction in general(such as underground objects disposal)	Transmission line construction period
Assistant Procurement Control 3 (locally employed)	1	Joint inspection, assistant to implement OJT	Equipment testing period

2-2-4-5 Quality Control Plan

Quality control will be conducted in an integrated manner with the consultant supervision as mentioned above (Refer to 2-2-4-4).

It produces it according to specifications.

In a quality control plan, the consultant will check whether or not the equipment and materials to be manufactured, delivered and installed according to predetermined plan in the contract documents, the quality of the facilities and quality of finished work based on the following items. If any doubt in quality or specifications exists, the consultant will immediately ask the equipment supplier to rectify, alter or improve the situation.

① Checking of shop drawings and specifications of equipment and materials

② Witnessing of shop test of equipment and materials or checking of shop test results

③ Checking of packing, transporting and temporary on-site storage methods

④ Checking of equipment shop drawings and installation manuals

⑤ Checking of manuals on commissioning test and inspection manuals of equipment

⑥ Supervision of equipment onsite installation work and witnessing of commissioning test and inspection

⑦ Checking of civil work drawings, factory fabrication drawings, and checking of drawing specifications and quality of finished work against original drawings

2-2-4-6 Procurement Plan

Although some European substation equipment manufacturers have agents in Tanzania, few manufacturers provide a local aftercare services system necessary for responding to accidents or repair or procuring spare parts, etc. On the other hand, TANESCO, which will take responsible for operation and maintenance of the facilities and equipment after the completion of the Project, is accustomed to operation and maintenance Japanese equipment procured in the past Japanese Grant Aid projects and places its trust in aftercare service. Accordingly, they strongly request that Japanese products be used as major equipment and materials for the Project under the Grant Aid project of the Government of Japan.

In the selection of origin countries of substation equipment and materials for the Project, it should be decided by taking the local conditions into account in due consideration of ease of operation and maintenance of the relevant equipment and facilities by Tanzanian engineers and the availability of aftercare service.

Although the 132kV system is the standard voltage class in Europe, the same voltage class does not exist and 154kV system is equivalent to this in Japan. It is therefore anticipated that Japanese 132kV feeder equipment circuit breakers or disconnecting switches may be less competitive due to the difference in electrical insulation. Besides, Tanzania generally utilizes European-type 33kV indoor

switchgears so TANESCO is familiar with their operation and maintenance. Consequently, DAC nations in addition to Japan are determined as the possible origin countries of substation equipment for 132kV and 33/11kV equipment to secure competition in tender.

As described above, the supply sources for the equipment and materials to be utilized under the Project are as follows.

(1) Equipment and Materials to be locally procured

- Construction materials and machinery: cement, sand, aggregates for concrete, concrete blocks, bricks, reinforcing bars, timber, gasoline, diesel oil, construction-related vehicles, cranes, trailers and other equipment and materials for temporary work

(2) Equipment and Materials to be Procured from Japan

- Equipment and materials for substations: 132kV transmission monopoles, 132/33kV main transformers and 33/11kV distribution transformers, etc.
- Equipment and materials for transmission lines: conductors, insulators, cross arms and earthing systems, etc.

(3) Equipment and Materials to be Procured from Japan or a Third Country (DAC Nations)

- Equipment and materials for substations: 132kV feeder equipment, 33kV and 11kV switchgears

In addition, with regard to the transportation of products to be procured from Japan, a packaging method which can sufficiently withstand long marine transportation, unloading at port, inland transportation to the Project site and storage should be adopted.

The port of Dar es Salaam the most convenient port for landing of imported equipment as the large scale wharf machinery suited for heavy equipment to be procured under the Project is equipped and transportation condition is favorable (short distance to the Project site). Road conditions from Dar es Salaam Port to the Project sites are favorable too.

2-2-4-7 Operational Guidance Plan

Before the completion of construction work, guidance on operation and maintenance for the equipment to be procured under the Project will be carried out. The said guidance will be provided by instructors from equipment supplier in accordance with an operation and maintenance supervision manual through OJT at the site. In addition, guidance on insulating oil control will be provided at the

time of installation. Eligible persons for taking guidance on insulating oil control are assumed to be foremen of workshops and electrical engineers at each branch (approximately 40 persons).

It will, therefore, be necessary for TANESCO to appoint engineers who will participate in OJT to ensure smooth progress of OJT with maintaining close contact with Japanese consultants and equipment suppliers. The appointed engineer at TANESCO will be required to train other personnel who cannot participate in OJT and spread maintenance skills horizontally in order to improve the maintenance capability at TANESCO.

2-2-4-8 Soft Component (Technical Assistance Plan)

Necessary guidance on operation and maintenance of procured equipment and related OJT mentioned above in 2-2-4-7 will be provided under the construction plan by equipment supplier, it is, therefore, unnecessary to introduce other Soft Component (technical assistance) under the Project.

2-2-4-9 Implementation Schedule

The recommended project implementation schedule prepared in accordance with Japan's Grand Aid scheme is as follows.

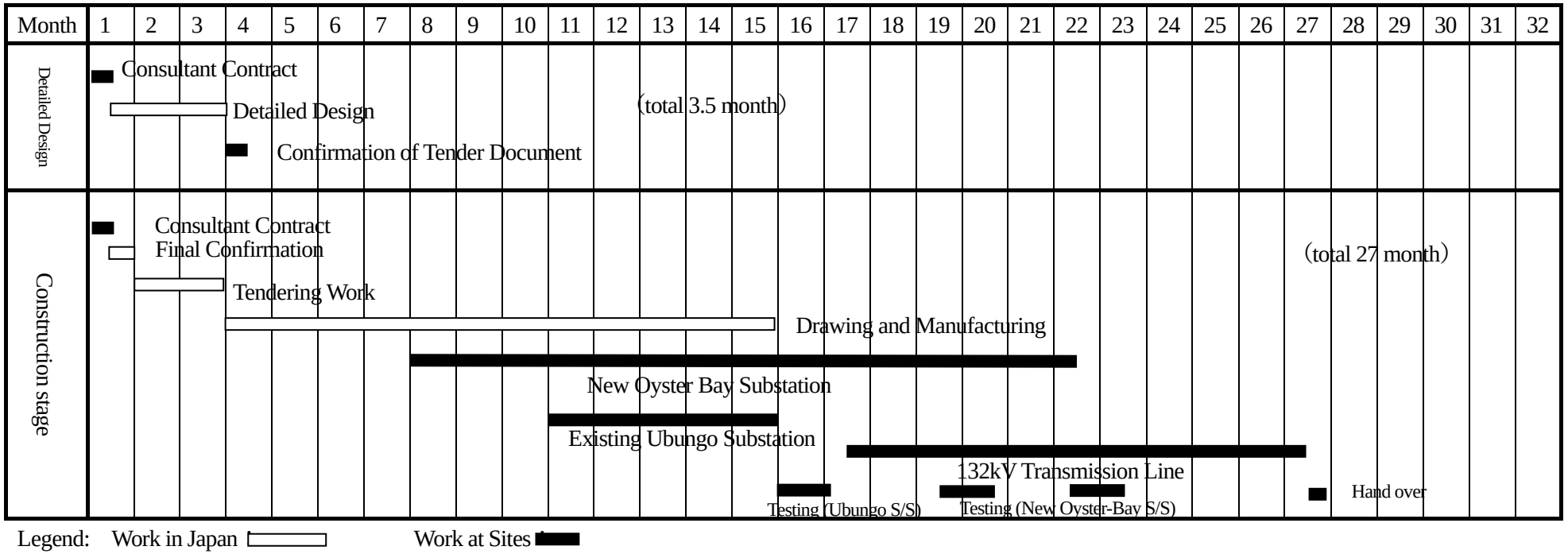


Figure 2-2-4.2 Project Implementation Schedule

2-3 Obligations of Recipient Country

In the implementation of the Project, apart from the work responsibilities as outlined in 2-2-4-3 (Scope of Work), work items will be implemented and undertaken by the Tanzanian side are described as follows.

(1) To provide necessary data and information for the Project.

(2) To ensure speedy unloading custom clearance and tax exemption of goods for the Project at ports and airports in Tanzania.

(3) To accord dispatched Japanese nationals whose services may be required in connection with the supply of products and services in accordance with verified contracts for necessary entry and stay in Tanzanian therein in the performance of work.

(4) To exempt Japanese nationals from custom duties, local taxes and other fiscal levies that may be imposed in Tanzania with respect to the supply of products and services in accordance with verified contracts.

(5) To bear expenses for opening a bank account and service charges of a Japanese bank authorized in a foreign exchange bank banking arrangement.

(6) To bear all expenses other than those borne by Japan's Grant Aid scheme necessary in the implementation of the Project.

(7) To appoint engineers and skilled workers as the counterpart (C/P) in order to witness inspections of equipment and materials and to transfer operation and maintenance skills under the Project.

(8) To use and maintain properly and effectively all equipment and materials to be provided through Japan's Grant Aid scheme.

(9) To provide the stockyard for equipment and materials, temporary work land and proper disposal sites for excavated soil, waste water during a construction period.

(10) To assure safety for construction-related personnel during the construction period and to contact the consumers at the time of traffic restrictions, planned outages or implementation of safety measures.

(11) To implement necessary planned outages during the construction period and to deal with and to compensate for consumers, etc.

(12) To clear and create construction land for the New Oyster Bay Substation and to construct access roads and fences, etc.

(13) To transfer storage and antennas, etc. within the existing 132kV switchyard at the Ubungo Substation.

(14) To transfer the existing 33kV distribution lines on the 132kV transmission route of the Sam Nujoma Road.

(15) To fell trees on the 132kV transmission route, to remove illegal buildings and to ensure a working space for transmission line stringing work.

(16) To transfer the existing underground infrastructure objects on the foundation site of transmission monopoles for 132kV transmission lines.

(17) To take measures to prevent vehicle accidents involving the 132kV transmission monopoles (such as guard fences, anti-collision curbstones and road sign light reflectors).

(18) To explain to local residents the safety distance for 132kV transmission lines and to compensate for building restrictions (at need).

2-4 Project Operation Plan

2-4-1 Basic Concept

In order to improve the reliability of electric power supply to consumers around the Project site, it is important to carry out appropriate operation and maintenance (O&M) of transmission, substation and distribution facilities and equipment as well as to preserve the surrounding environment. Consequently, steady execution of proper maintenance (including preventive maintenance) is strongly recommended for the purpose of reducing failure rate for each equipment and improving the safety and efficiency of system operation.

Figure 2-4-1.1 describes the basic concept of maintenance of transmission, distribution and substation facilities and equipment. Not breakdown maintenance but preventive maintenance should be taken as the primary maintenance for equipment to be procured a under the Project to secure the soundness of facilities over the long duration.

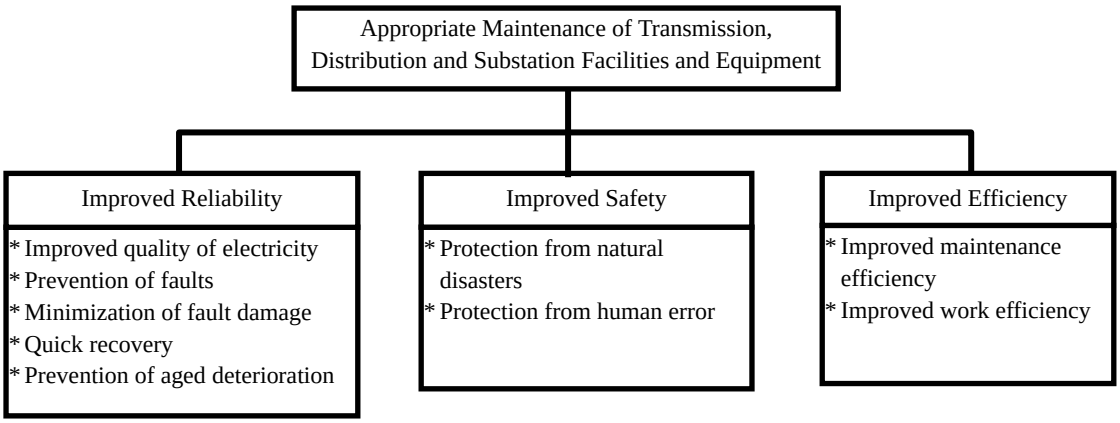


Figure 2-4-1.1 Basic Concept for Maintenance of Transmission, Distribution and Substation Facilities and Equipment

Engineers are scheduled to be dispatched from a Japanese equipment supplier to conduct OJT on operation and maintenance of the relevant substation equipment during installation work and commissioning under the Project. On the top of this, the Japanese side will provide necessary spare parts, testing instruments and maintenance tools, operation and maintenance manuals considering for the execution of appropriate maintenance by TANESCO after commissioning. By taking above mentioned measures, the Project is expected to demonstrate the effects for a long term.

In addition, TANESCO has their project implementation plan by utilizing human resources from organizations listed below under the supervision of headquarter. Therefore, appropriate maintenance staff is expected be organized for the maintenance of procured facilities.

• Ubungo Workshop
• Transmission Line Maintenance Office : Kinondoni South Branch of TANESCO
• Distribution lines in Kinondoni District： Kinondoni North Branch and KAUDA of TANESCO

2-4-2 Maintenance Plan

(1) Periodical Inspections of Substation Equipment

The standard items for periodical inspections of the 132kV, 33kV and 11kV transmission, distribution and substation equipment to be procured and installed under the Project are shown in Table 2-4-2.1.

As shown in the said table, inspections for the above-mentioned equipment can be classified into “patrol inspections” which are daily checks using the human senses to detect abnormal sounds in equipment, etc., ② “ordinary inspections” to check charging parts which cannot be checked by daily patrol inspections such as the temperature rise of parts, fixing conditions of bolts and nuts and damage on the surface of insulators, and ③ “detailed inspections” to check interlock functions, etc. and to carry out accurate maintenance of instruments.

In general, ordinary inspections and detailed inspections are conducted once every 1 to 2 years and once every 4 years respectively. It is also recommended to replace parts that have deteriorated in operating performance, insulation, worn out of contacts etc. according to the duration of operation. Such parts are fuses, meters, relays and so on in the switchgears or panels and if deterioration will be confirmed at the ordinary or detailed inspections, damaged parts should be replaced before serious problem will occur.

Table 2-4-2.1 Periodical Inspection Items of Standard Equipment

Item	Description (Method)	Patrolling Inspection	Ordinary Inspection	Detailed Inspection
Appearance	Indicating conditions of switch indicators, indicating lamps	○	○	
	Presence of abnormal noise, abnormal odors	○	○	
	Presence of discoloration from heat on terminals	○	○	
	Presence of cracks or & damage to bushings & porcelain tubes, damage	○	○	
	Rust on installed cases & footstools	○	○	
	Presence of abnormal temperature (heat gage)	○	○	
	Clamping conditions of bushing terminal (mechanical check)	○	○	
Operating Unit & Control Panel	Indicating conditions of various instruments	○	○	○
	Indication of operation counter		○	○
	Presence of moisture in operation boxes & panels, rust, damage		○	○
	Refueling, cleaning conditions		○	○
	Clamping conditions of terminals on distribution lines	○	○	○
	Confirmation of switch indication		○	○
	Presence air, gas or oil leakage		○	○
	Confirmation of pressure before & after operation (such as air pressure)		○	○
	Confirmation of actuating of operating units		○	○
	Presence of rust, deformities or damage of springs (care)	○	○	○
	Presence of abnormality of all clamping pins		○	○
	Inspection (care) of auxiliary switches & relays		○	○
	Inspection of DC control power source	○		
Measuring & Testing	Measurement of insulation resistance		○	○
	Measurement of contact resistance			○
	Presence of heater disconnection		○	○
	Performance test for relays		○	○

(2) Periodical Inspection of Transmission Lines

① Presence of electric line damage and uneven sag, etc.
② Present of insulator damage
③ Presence of contact of electric wires with trees, etc.
④ Presence of flaws on steel poles (steel towers), bolt looseness and inclination
⑤ Presence of damage to pole foundation

(3) Periodical Inspection of Distribution Lines

The most important service to consumers is to detect accidents, damage or breakdowns through daily patrol inspections and to immediately carry out repair work. In addition, if an outbreak of ground faults is anticipated due to the contact of distribution lines with trees, etc., preventive

measures such as felling trees in advance should be taken. Inspection items for daily patrolling inspection are listed as follows.

① Presence of electric line cuts
② Presence of insulator damage
③ Presence of contact of distribution lines with trees, etc.
④ Presence of electric pole damage
⑤ Presence of electric pole inclination
⑥ Installing conditions and oil leakage from distribution transformers
⑦ Condition of various types of switching equipment

2-4-3 Spare Parts Procurement Plan

(1) Classification of Spare Parts

Spare parts subject to the project can be classified into the following.

① Consumables
② Replacement parts

(2) Selection Conditions by Classification of Spare Parts

1) Consumables

Consumables are parts necessary for periodical replacement due to exhaustion and deterioration during daily operations. The required number of consumables will be 100% of the annual expected amount.

2) Replacement Parts

Replacement parts are parts for repair when there is partial damage despite periodical exhaustion or deterioration during daily operations. The required number of replacement parts will be 100% of the annual expected amount.

(3) Maintenance Tools

Testing instrument and tools necessary for appropriate maintenance will be procured under the Project. As existing testing instruments and maintenance tools at Ubungo Substation will be utilized for equipment installed in the said substation, they will be procured only for the New Oyster Bay Substation.

(4) Budgetary Steps for Spare Parts and Maintenance Tools

Spare parts for substation equipment, transmission and distribution equipment include parts to be replaced according to deterioration and replacement parts urgently necessary by an accident. TANESCO should purchase necessary parts following an investigation during periodical inspections as mentioned in the preceding paragraph.

Under the Project, the minimum but necessary one-year portion of spare parts and maintenance tools is scheduled to be procured. The major items are shown in Table 2-4-3.1, and TANESCO should prepare the necessary budget for purchasing additional spare parts by the next year after the completion of the Project.

Table 2-4-3.1 Spare Parts and Maintenance Tools to be Procured under the Project

Equipment Name	Unit	Quantity	
		For Distribution Facilities	For Transmission Facilities
1. Consumables			
1.1 33/11kV 15MVA Distribution Transformer (concurrently utilized as 45MVA main transformer)			
(1) Silica gel (20kg/can)	can	1	
2. Spare Parts			
2.1 132kV System			
2.1-1 132kV circuit breaker (GCB)			
(1) Close coil	piece		1
(2) Trip coil	piece		1
2.1-2 132kV disconnecting switch (DS)			
(1) Fixed & running part contact ((DS 3-phase set)	set		1 each
(2) Fixed & running part contact (ES 3-phase set)	set		1 each
2.1-3 132/33kV 45MVA main transformer			
(1) Gasket	set		1
(2) Buchholtz relay	piece		1
(3) Oil temperature gauges (various)	piece		1 each
(4) Oil level gauges (various)	piece		1 each
2.1-4 132kV control & protection panels			
(1) Protective relays (various)	piece		1 each
(2) Lamps (various)	%		100
(3) Fuses (various)	%		100
(4) Meters (various)	piece		1 each
(5) Auxiliary relays (various)	piece		1 each
(6) Control & selecting switches (various)	piece		1 each
2.2 33kV System			
2.2-1 33/11kV 15MVA distribution transformer			
(1) Gasket	set	1	
(2) Buchholtz relay	piece	1	
(3) Oil temperature gauges (various)	piece	1 each	
(4) Oil level gauge s(various)	piece	1 each	
2.2-2 33kV switchgears			
(1) Close coil	piece	1	
(2) Trip coil	piece	1	
(3) Vacuum valves (various)	set	1 each	
(4) Main insulation terminal	set	1 each	
(5) Lamps (various)	piece	1 each	
(6) Electric power fuses (various)	piece	1 each	
(7) Fuses (various)	%	100	
(8) Meters (various)	piece	1 each	
(9) Protective relays (various)	piece	1 each	
(10) Auxiliary relays (various)	piece	1 each	
2.2-3 33kV control & protection panels			
(1) Protective relays (various)	piece	1 each	
(2) Meters (various)	piece	1 each	
(3) Lamps (various)	piece	1 each	
(4) Annunciator unit	set	1	
(5) Fuses (various)	%	100	
(6) Control & selecting switches (various)	piece	1 each	
2.2-4 33kVcable terminal materials	set	1	
2.3. 11kV System			
2.3-1 11kV switchgear			
(1) Close coil	piece	1	
(2) Trip coil	piece	1	
(3) Vacuum valves (various)	set	1 each	
(4) Main insulation terminal	set	1 each	
(5) Lamps (various)	%	100	

Equipment Name	Unit	Quantity	
		For Distribution Facilities	For Transmission Facilities
(6) Electric power fuses (various)	piece	1 each	
(7) Fuses (various)	%	100	
(8) Meters (various)	piece	1 each	
(9) Protective relays (various)	piece	1 each	
(10) Auxiliary relays (various)	piece	1 each	
2.3-2 11kV control & protection panels			
(1) Meters (various)	%	100	
(2) Lamps (various)	piece	1 each	
(3) Fuses (various)	%	100	
(4) Control & selecting switches (various)	piece	1 each	
2.4 Station Service Facilities			
2.4-1 Station Service AC switch boards			
(1) MCCB (various)	piece	1 each	
(2) Lamps (various)	%	100	
(3) Fuses (various)	%	100	
2.4-2 Station Service DC switch boards			
(1) MCCB (various)	piece	1 each	
(2) Lamps (various)	%	100	
(3) Fuses (various)	%	100	
2.4-3 Rechargeable battery charger panel & battery			
(1) Control board & diode unit	piece	1	
(2) Lamps (various)	%	100	
(3) Fuses (various)	%	100	
2.4-4 Outdoor lighting			
(1) Lamp	piece	1	
(2) Ballast	piece	1	
2.4-5 132kV Transmission Lines			
(1) Post insulator	set		3
(2) Jumper support insulators	set		3
(3) Tension insulators	set		6
3. Maintenance Tools			
3.1 Testing Instruments for Substations			
3.1-1 Transformer oil depurator (following configuration) (1) Oil depurator (4,000L/hour, outdoor, portable type) (2) Vacuum pump (3,040 L/minute, outdoor, portable type) (3) Oil filter (200 L/minute, outdoor, tank type)	set	1	
3.1-2 Oil insulating testing device (0 to 60kV)	unit	1	
3.1-3 Single-phase protective relay testing device (1) Single-phase protective relay testing device (2) Precision AC voltmeter & ammeter (13 taps, portable type) (3) Precision DC voltmeter & ammeter (17 taps, portable type)	set	1	
3.1-4 3-phase protective relay testing device	unit	1	
3.1-5 Universal tester (DCV, DCA, ACV & resistance)	piece	1	
3.1-6 Phase indicator (10V to 480V)	piece	1	
3.1-7 Protective relay fault analyzer	unit	1	
3.1-8 Voltage detector (AC 195kV)	piece		1
3.1-9 Voltage detector (AC 3 to 34.5kV)	piece	1	
3.1-10 Voltage detector (AC 600V)	piece	1	
3.1-11 Megger (DC 500V/100M-ohm)	piece	1	
3.1-12 Megger (DC 1000V/2000M- ohm)	piece	1	
3.1-13 Earthing resistance tester (2-point earthing system, portable type)	piece	1	
3.1-14 Digital multi-meter (DCV, DCA, ACV, ACA & resistance)	piece	1	
3.1-15 Clamp meter (ACV, ACA & resistance)	piece	1	
3.1-16 SF6 gas injector	piece		1
3.1-17 DC withstand voltage testing device (DC 100kV)	unit	1	
3.2 Maintenance Tools for Substations			
3.2-1 Compressed terminal unit (14mm^2 to 250mm^2, including dice)	set	1	
3.2-2 Earthing system (3-phase, 4.5m rod, universal type)	set	1	

Equipment Name		Unit	Quantity	
			For Distribution Facilities	For Transmission Facilities
3.2-3	Shimelar (1.5 ton)	piece		3
3.2-4	Tension meter (1 ton)	piece		3
3.2-5	Tension hoist (2.5 ton)	piece		3
3.2-6	Oil jack (15 ton)	piece		1
3.2-7	Drum stand (for cable drum, jack type)	set		1
3.2-8	Wire cutter (size: 100 to 240mm^2)	piece	1	1
3.2-9	Electrical work tools	set	2	3

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The total cost for implementing the requested Japanese assistance will be ¥1.854 billion. Based on the scope of work between the Japanese and Tanzanian sides as described earlier, the breakdown of expenses for both sides can be calculated by the estimated conditions shown in the following (3). However, the estimated project cost does not reflect limited assistance in accordance with the Exchange of Notes (E/N).

(1) Expenses to be taken by the Japanese side

Estimated Project Cost (Subtotal) **Approximately ¥ 1,807million**

Item		Estimated Project Cost (¥million)	
New Oyster Bay Substation	Equipment Cost	825	1,041
	Installation Cost	216	
Existing Ubungo Substation	Equipment Cost	100	150
	Installation Cost	50	
132kV Transmission Line	Equipment Cost	241	516
	Construction Cost	275	
Detailed Design and Supervision Work			100

(2) Expenses to be taken by the Tanzanian side Approx. 521 million Tsh (Approx. ¥47.32 million)

1) Land creation cost, etc. for new substations (such as land reclamation, boundary fences and rainwater gutter) : Approx. 291 million Tsh (Approx. ¥26.4 million)
2) Construction cost for removing underground infrastructure on 132kV transmission route : Approx. 175 million Tsh (Approx. ¥15.9 million)

3) Construction cost for removing 33kV distribution lines on Sam Nujoma Road 33kV : Approx. 55 million Tsh (Approx. ¥5.02 million)

(3) Estimated Conditions

① Date of estimation: October 2006

② Exchange rate: $1.00 = ¥116.37
€1.00 = ¥147.51
1,100.41Tsh = ¥100

③ Construction and procurement period: National Treasury Defrayment Scheme will be applied for the Project over Japan's three fiscal years.

④ Other: The Project will be carried out in accordance with the Grant Aid scheme of the Government of Japan.

2-5-2 Operation and Maintenance Cost

The existing transmission and substation department of TANESCO will be responsible for operation and maintenance of the new Oyster Bay Substation and the new 132kV transmission lines to be constructed under the Project. Since the said department has maintained all equipment and facilities within their jurisdiction in a cross-sectional manner, it will not be necessary to hire new maintenance personnel in line with the implementation of the Project. On the other hand, the new Oyster Bay Substation will require 4 groups of 2 operators each since it requires 24-hour manned supervision. According to TANESCO's preliminary plan, operators are scheduled to be selected from each branch (4 branches 1,152 employees) in Dar es Salaam, so new operators do not need to be employed.

Essentially the relevant substation equipment is designed as maintenance-free, so periodical replacement except for some spare parts (such as silica gel for transformers) will not be required. However, spare parts shown in Table 2-4-3.1 should be kept on hand in preparation for abnormal faults, so TANESCO should prepare the budget (2.2 million Tsh/annual). The total 2006 budget for TANESCO including payroll (personnel), repairs, administrative cost and indirect expenses was 79,713 million Tsh. Therefore, TANESCO seems to be able to secure budget for spare parts necessary for maintenance of facilities to be constructed under the Project within their budget.

2-6 Other Relevant Issues

The following items are assumed to have a direct influence on the smooth implementation of the requested Japanese assistance.

(1) The Project will be an urban-type transmission lines construction plan and will include work contents such as the 132kV monopole construction and cast-in-place pile by machine drilling, etc. that TANESCO has not yet experienced. In addition, with transmission line construction in highly populated areas, special attention should be given to public safety such as prevention of falling conductor, etc. Accordingly, in the implementation of the Project, TANESCO should work closely with the consultant on the Japanese side as well as keep the public in construction site fully informed of the construction planning.

(2) Since it was confirmed that other underground public infrastructure were built on the construction site for transmission lines, well organized coordination with TANROAD, the municipal authorities, water department and telephone department, etc. should be made to proceed the construction of 132kV transmission line. Coordination will be taken by TANESCO by cooperating with the consultant on the Japanese side for the purpose of smooth execution of arrangement.

(3) In line with the construction process for substation facilities to be procured and installed under the Project, the TANESCO should form a construction team in order to carry out equipment procurement and installation of 11kV distribution lines to be taken by the TANESCO and formulate a process plan, personnel plan, equipment and materials purchase plan, etc. for smooth progress of construction work.

(4) TANESCO promptly appoints engineers who will participate in OJT to be implemented under the Project. Appointed engineers will attend OJT, and after that their acquired skills should be passed on horizontally to other engineers who will not participate in the training.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3
PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effects

The expected effects through the implementation of the Project are described as follows.

Current Situation and Problems	Remedial Measures under the Project	Direct Effects and Degree of Improvement	Indirect Effects and Degree of Improvement
① Since the investment for reinforce of power system falls behind due to financial shortage, etc. and the distribution capacity Dar es Salaam becomes insufficient. The 132/33kV Ilala S/S that is the primary substation in the city is in over load conditions for long time so that problems frequently occur. Other than that, the power supply in the city is compelled to operate planned outage for 12 hours a day due to the long-term load shedding, so people' living and urban functions are hindered. ② Because the 33kV distribution lines are utilized in areas with large load but no 132kV line is installed, power losses become great. (A power loss from the Ubungo S/S to the New Oyster Bay S/S is assumed to be about 21 %.) (The Japanese power loss is 2 to 3 % in general.) ③ As the 132kV transmission lines do not form redundant network. The interruptions resulted from accidents are therefore prolonged.	① The 33/11kV distribution transformers will be installed at the New Oyster Bay S/S surrounded by highly developed area in the northern part of Dar es Salaam (Oyster Bay and Msasani area) ② 132/33kV main transformers will be installed at the New Oyster Bay S/S. ③ The 132kV lead-out facilities will be installed at the existing Ubungo S/S and the 132kV transmission lines will be constructed to connect Ubungo and New Oyster Bay S/S .	① Through an increase in the distribution capacity by installation of the 33/11kV distribution transformers at the New Oyster Bay S/S, the capability of power supply to consumers in the said substation area (about 229,000) will be upgraded. ② Since the New Oyster Bay S/S will take a part of load (about 25MVA) at the Ilala S/S which faces over load problem due to breakdowns of transformers, the over load at the Ilala S/S can be relieved at about 19% (about 25MVA). ③ As the New Oyster Bay S/S and the Ubungo S/S will be connected by the 132kV transmission line, the capacity of power supply at the New Oyster Bay S/S can be secured, so a stable power supply can be possible. ④ The power loss from the Ubungo S/S to the New Oyster Bay S/S will be improved up to 7.2% (about 13.8% of the improvement)	① As stable operations of public facilities and shops in the Project site can be possible, urban functions and living standards of residents will be stimulated. ② Operations of engine generator due to interruptions will be reduced, so energy expenditure of public facilities or private citizen can be mitigated. ③ As over load conditions at the Ubungo S/S and the Ilala S/S which are primary substations for the 132kV system will be relieved, the capacity of power supply in the entire Dar es Salaam will be expanded so interruptions can be reduced. ④ As the Project will become a part of the 132kV ring power transmission line program, this will contribute to the promotion of the said program.

3-2 Recommendations

3-2-1 Recommendations to be Taken by Recipient Country

The following tasks should be taken by the Tanzanian side in order for the effects of the Projects to be demonstrated and be sustainable.

(1) The Tanzanian side should carry out periodical on-site patrolling inspections and enforce preventive maintenance by felling trees along the distribution route in order to reduce faults on the transmission and distribution routes and to ensure a stable power supply system.

(2) As a preventive step for vehicle collision accident against the 132kV monopole, the Tanzanian side should prevent an accident before it happens by installing protective fences around the transmission poles, anti-collision curbstones and reflectors for traffic obstacles. In addition, it should be implement public information activities on safety knowledge and necessary building regulations such as safety distance with the transmission lines to local residents.

(3) The Tanzanian side should obtain the understanding of local residents on the 132kV transmission route by explaining a safety distance with the transmission route at need.

(4) Although the 2 units of 132/33kV main transformers and 2 units of 33/11kV distribution transformers those are urgently necessary will be procured under the Project, however 132/33kV main transformers are supposed to carry full load at the commissioned year and there will be no room to meet demand escalation. Therefore the Tanzanian side should review power demand as much as is desired and formulate a plan for an increase in transformers after the completion of the Project, at the same time, a budget to procure increased equipment should be prepared.

(5) The Tanzanian side should establish a highly reliable and stable power supply system by effectively utilizing the facilities to be procured under the Project and by promoting the 132kV ring power transmission program in Dar es Salaam recommended in the “Master Plan Study and Pre-feasibility Study on Dar es Salaam Power Supply System Expansion” and the “Master Plan Study on the Power Sector for Major Towns”.

(6) In order to prevent an accident before it happens due to over-load operation of the existing transformers and to effectively utilize the facilities, the Tanzanian side should carry out safe operation of the system by reviewing protective equipment such as protective relays at substations.

(7) The Tanzanian side should review the existing power development plan and secure the generation capacity corresponds to the demand growth. Cooperating operation among generation, transmission and distribution is indispensable to establish reliable power supply.

3-2-2 Technical Cooperation and Coordination with Other Donors

Other donors related to the Project in Dar es Salaam in terms of the power sector include the World Bank and the Swedish International Development Cooperation Agency (SIDA). Although World Bank has supported the 132kV transmission line construction program in Dar es Salaam and the SIDA plans to a program to support management funds (assisting for consultant personnel expenses) of TANESCO, either of programs does not directly relate to the Project. Besides, there is no technical cooperation as a precondition for the implementation of the Project.