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

PREPARATORY SURVEY REPORT ON THE PROJECT FOR REHABILITATION OF SUBSTATION AND TRANSMISSION LINE IN KILIMANJARO REGION IN THE UNITED REPUBLIC OF TANZANIA

JANUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the project for Rehabilitation of Substation and Transmission Line in Kilimanjaro Region in the United Republic of Tanzania, and organized a survey team headed by Mr. Kyoji FUJII of Yachiyo Engineering Co., Ltd. between March 2010 and January 2011.

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

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

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

January 2011

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

SUMMARY

SUMMARY

① Overview of the Country

The United Republic of Tanzania (hereinafter referred to as "Tanzania") is situated in the eastern part of the African continent; it has a total land area of approximately 945,000 km^2 (roughly 2.5 times bigger than Japan) and a population of some 42.48 million (2008, according to the World Bank). It is a unitary republic that was formed by the amalgamation of Tanganyika on the mainland and the island of Zanzibar in 1964.

Regarding the economy, Tanzania promoted a socialist economic policy after it gained independence in 1961. However, due to the effects of the subsequent oil crises, a war against Uganda and drought, Tanzania fell into economic crisis in the 1980s, and from 1986 it promoted market-oriented economic reforms under support from the World Bank and IMF. Since the latter part of the 1990s, Tanzania has conducted solid macroeconomic management, and it experienced an economic growth rate of around 7 percent between 2002 and 2008.

Meanwhile, GNI per capita is low at US$400 (2009, according to the World Bank), and the major challenge facing the Government of Tanzania concerns how to translate high economic growth into reduction of poverty.

The major industries of Tanzania are agriculture (rice, maize and coffee, etc.), mining (gold and diamonds, etc.), manufacturing (sisal hemp and tobacco, etc.) and tourism. In terms of sector-separate GDP, agriculture accounts for the largest share with approximately 27 percent in 2008. However, the GDP ratio of agriculture is declining every year, while the shares of mining, manufacturing and construction are increasing.

In terms of fiscal management, Tanzania has a perennial fiscal deficit whereby expenditure exceeds revenue. It is striving to cover the deficit with the help of assistance, however, it cannot fully compensate for its excess in expenditure in this way. Accordingly, it is unable to independently finance the construction and upgrading of large-scale public facilities and has no choice but to depend on assistance from donors.

② Background of the Project

The Government of Tanzania embarked on structural reform of the electric power sector including the breakup and privatization of TANESCO (Tanzania Electric Supply Company Limited) in 1993, however, this led to a stagnation of public assistance including aid from donors in the sector. Until it was decided to suspend the privatization of TANESCO in 2006, Tanzania was unable to conduct plant investment or adequate maintenance of existing facilities in line with the growing demand for electricity, leading to the serious deterioration of power supply facilities in the country. In response to this situation, the

Government of Tanzania compiled the Electric Power System Master Plan (revised in 2009), geared to long-term development of the power sector for 25 years up to 2033, and is promoting the development of power sources and extension of transmission and transformation facilities on the national level based on this plan.

Regarding power transmission and distribution networks in cities, JICA implemented the Study for Rehabilitation of Distribution Facilities in Major Cities in Tanzania in 2002, and this resulted in formulation of a 10-year master plan for improvement and expansion of transmission and distribution facilities in the three cities of Dar es Salaam, Moshi (the capital of Kilimanjaro Region) and Arusha. The Government of Tanzania is advancing improvement and expansion of the urban transmission and distribution network based on this plan, however, progress has fallen far behind schedule due to the lack of funds.

Kilimanjaro Region is the foremost tourist destination in Tanzania and constitutes an economic center having a population of 1.57 million (2008). However, due to the low level of plant investment and maintenance caused by the abovementioned failure of reform in the power sector, power supply is frequently interrupted by rationing and equipment failures.

It was against such a background that the Government of Tanzania issued the request to the Government of Japan for the upgrading and construction of transforming facilities and installation of 66 kV transmission lines geared to achieving stable power supply in Kilimanjaro Region.

③ Outline of the study findings and Project contents

In response to the request, JICA dispatched the Study Team to Tanzania from April 13 to May 7, 2010 (first field survey) and from June 6 to July 3, 2010 (second field survey) in order to reconfirm the contents of the request and discuss the contents for implementation with related agencies on the Tanzanian side (responsible government agency: Ministry of Energy and Minerals (MEM), and implementing agency: TANESCO), survey the Project sites and gather related materials and data.

On returning to Japan, the Study Team examined the necessity, social and economic impacts and validity of the Project based on the field survey materials and compiled the findings into the draft preparatory study report. Furthermore, JICA dispatched the Study Team to Tanzania for the third field survey (outline explanations) from November 20 to December 1, 2010 in order to explain and discuss the draft preparatory study report and reach a basic agreement with the Tanzanian counterparts.

The Project plan compiled based on the survey findings targets the upgrading of overloaded 33/11kV substations and construction of new transmission and distribution lines and substations in areas experiencing extreme voltage losses in Kilimanjaro Region.

Outline of the Basic Plan

Category	Outline of Facilities	
Equipment and Materials Procurement and Installation Works Plan	1. Procurement and installation of 33kV and 11kV distribution equipment and materials for upgrading of YMCA S/S	
	(1) 33/11kV transformer (17MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	2. Procurement and installation of 33kV and 11kV distribution equipment and materials for upgrading of Lawate S/S	
	(1) 33/11kV transformer (10MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	3. Procurement and installation of 33kV and 11kV distribution equipment and materials for construction of KCMC S/S	
	(1) 33/11kV transformer (10MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	4. Procurement and installation of 33kV distribution equipment and materials for expansion of Trade School S/S	
	(1) 33kV switchgear cubicle with circuit breaker	1 set
	(2) 33kV metering cubicle	1 cubicle
	(3) 33kV dead end pole	1 set
	(4) 33kV cables	1 lot
	(5) Earthing equipment	1 lot
	(6) Equipment foundations etc.	1 lot
	5. Procurement and installation of 66kV receiving and 33kV distribution equipment and materials for construction of Makuyuni S/S	
	(1) 66kV switching equipment with frame	1 set
	(2) 66/33kV transformer (10MVA)	2 sets
	(3) 33kV switchgear cubicle with circuit breaker	6 cubicles
	(4) 33kV station transformer cubicle	1 cubicle
	(5) Low voltage panel	1 cubicle
	(6) Battery charger and battery	1 set
	(7) 66kV control and protection panels	1 lot
	(8) 33kV control and protection panels	1 lot
	(9) 33kV dead end pole	4 sets

Category	Outline of Facilities	
Equipment and Materials Procurement and Installation Works Plan	(10) 33kV cables	1 lot
	(11) Earthing equipment (including overhead earth wire)	1 lot
	(12) Outdoor lights	1 lot
	(13) Control building construction (300m^2, 1F)	1 set
	(14) Equipment foundations etc.	1 lot
	6. Procurement and installation of 132kV receiving and 66kV transmission equipment and materials for expansion of Kiyungi S/S	
	(1) 132kV switching equipment with frame	1 set
	(2) 66kV switching equipment with frame	1 set
	(3) 132/66kV transformer (20MVA)	1 set
	(4) Low voltage panel	1 cubicle
	(5) Battery charger and battery	1 set
	(6) 132kV control and protection panels	1 set
	(7) 66kV control and protection panels	1 set
	(8) 66kV cables	1 lot
	(9) Earthing equipment	1 lot
	(10) Control building construction (100m^2, 1F)	1 set
	(11) Equipment foundations etc.	1 lot
	7. Construction of 66kV transmission line between Kiyungi~Makuyuni (approximately 34 km)	
	(1) 66kV transmission line supports (steel towers)	1 lot
	(2) Transmission line equipment and materials (conductors, insulators, earthing equipment)	1 lot
	8. Construction of 33kV transmission line between Trade School~KCMC (approximately 5 km)	
	(1) 33kV distribution line supports (wooden poles/steel poles)	1 lot
	(2) Distribution line equipment and materials (conductors, insulators)	1 lot
Equipment and Materials Procurement Plan	Procurement of the following equipment and materials	
	(1) Spare parts for the procured equipment and materials	1 set
	(2) Maintenance tools	1 set

④ Project implementation schedule and cost estimation

In the event where the Project is implemented based on the Japan's Grant Aid scheme, the total cost of the Project will be (*confidential*). The contents and costs to be borne by the Tanzanian side will primarily be provision of temporary road for construction of the 66kV transmission line (approximately 92 million yen) and construction of 33kV distribution line (from Makuyuni S/S) (approximately 123 million yen). The implementation schedule for the Project including the detailed design will be approximately 19 months.

(1) Relevance

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

(2) Efficiency

1) Quantitative effects

Indicator	Current value (2010)	Planned value (2013)
Restricted supply time	159 hours/month	32 hours/month
Time of power interruptions due to failures	272 hours/month	190 hours/month
Voltage drop	11kV system (KCMC Hospital): 18% drop (11→9 kV) 0.4 kV system (Lombo): 16% drop (0.4→0.338k V)	11kV system (KCMC Hospital): No drop (11→11 kV) 0.4 kV system (Lombo): 5% drop (0.4→0.380 kV)

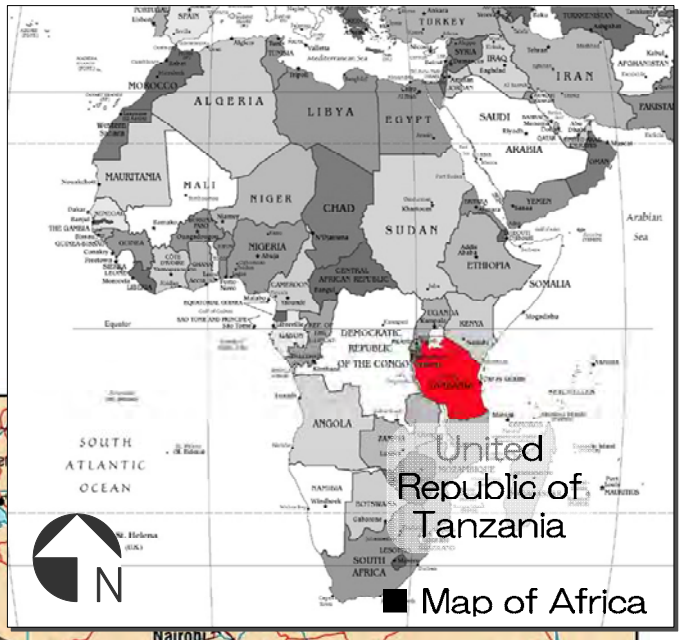
2) Qualitative effects

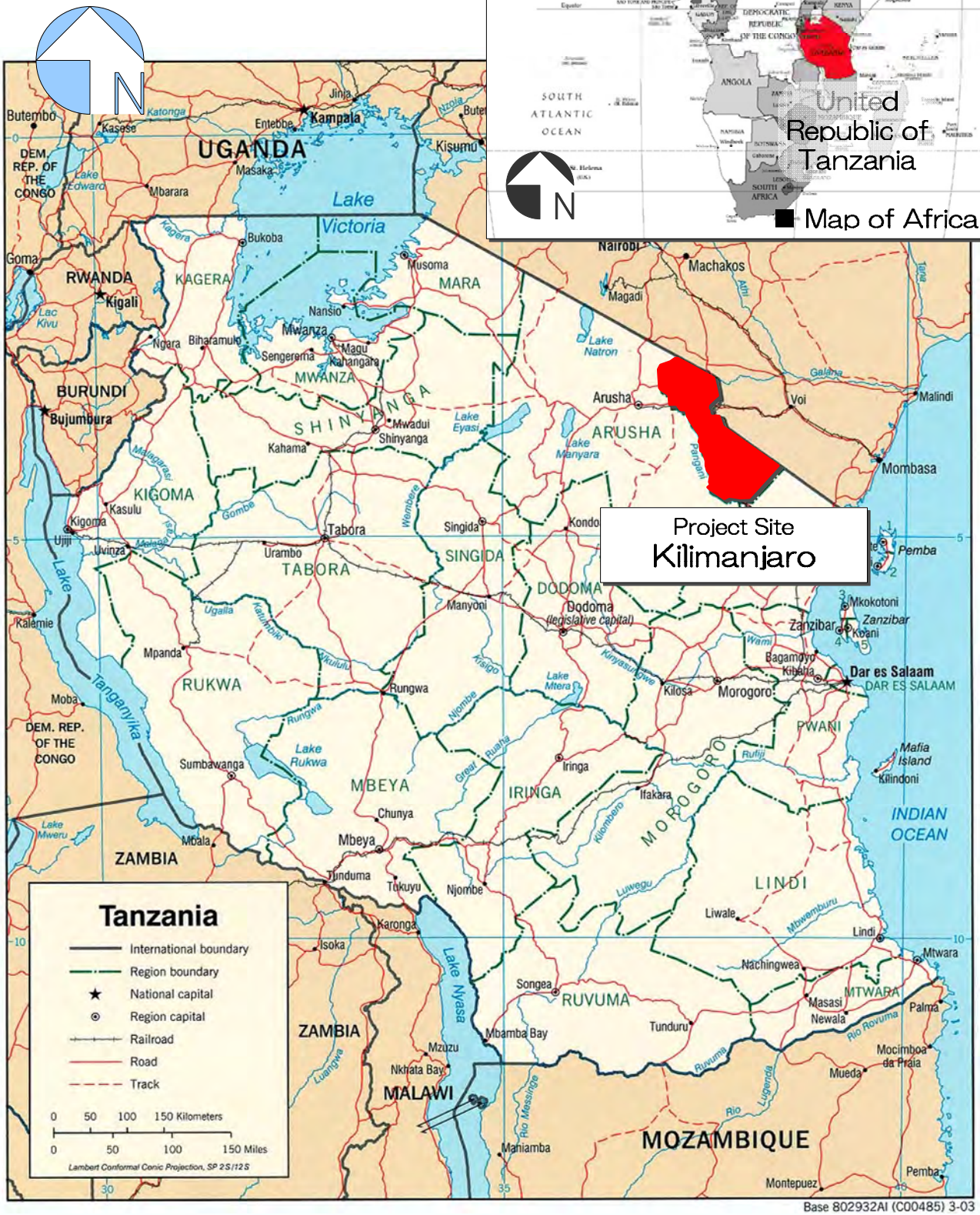
Indirect effects of the Project will be that it will contribute to the stable operation of hospitals and schools, help improve the living environment for residents in the Project target area and help boost production in factories and farms.

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

Contents

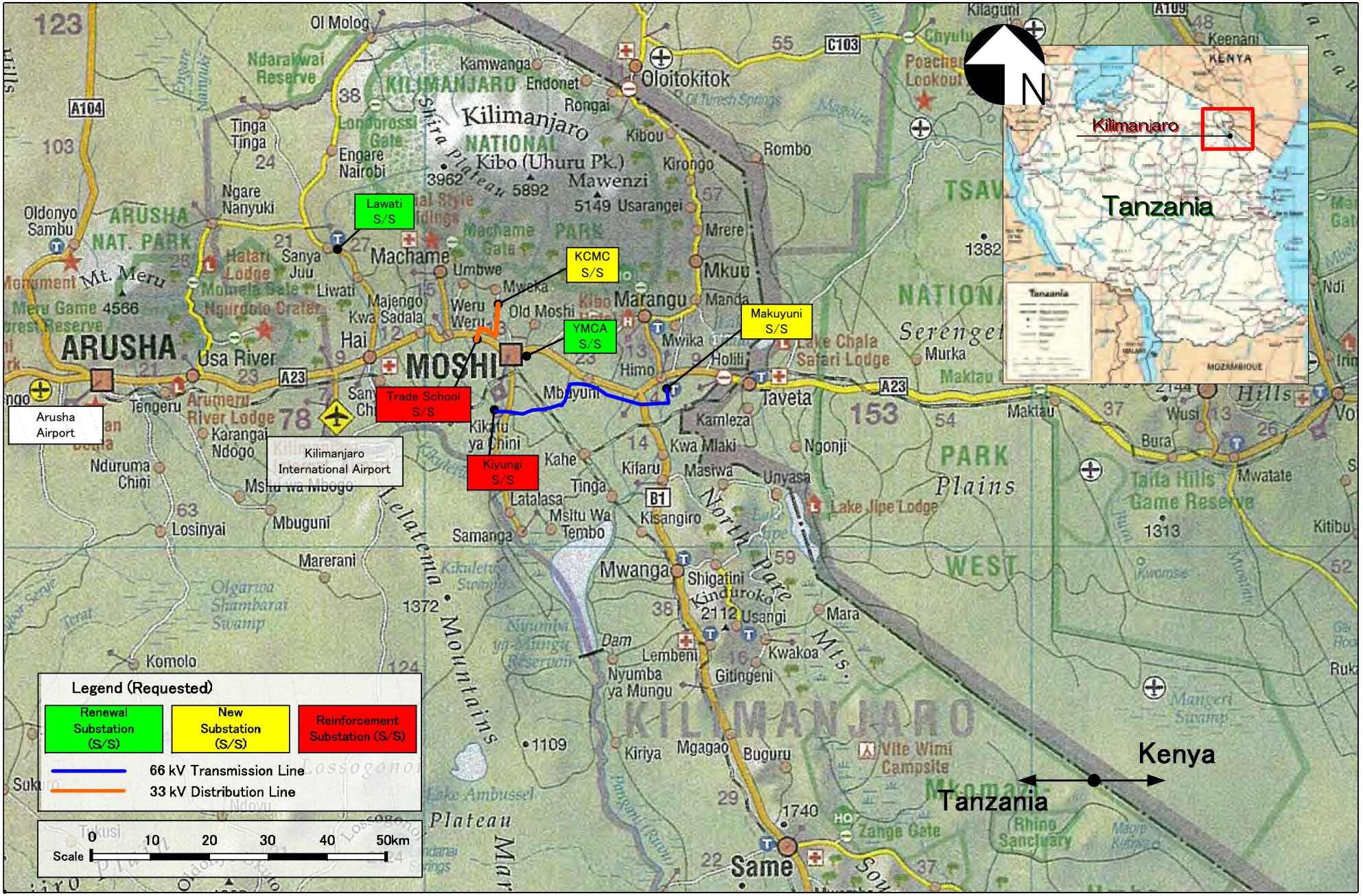
[Appendices]





■ Map of United Republic of Tanzania

Location of the Project Site



Project Site for Upgrading and Construction of Substations

The Project for Rehabilitation of Substation and Transmission Line in Kilimanjaro Region in the United Republic of Tanzania

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Abbreviations

AC	Alternate Current
ACSR	Alminium Conductor Steel Reinforced
DAC	Development Assistance Committee
DC	Direct Current
DoE	Department of Environment
E/N	Exchange of Notes
EDCF	Economic Development Cooperation Fund
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EWURA	Energy and Water Utility Regulatory Authority
G/A	Grant Agreement
GCB	Gas Circuit Breaker
GDP	Gross Domestic Product
GNI	Gross National Income
IEC	International Electrotechnical Commission
IMF	International Monetary Fund
IPP	Independent Power Producer
ISO	International Organization for Standardization
JCS	Japanese Electrical Wire and Cable Maker's Association Standards
JEC	Japanese Electrotechnical Committee
JEM	Standards of Japan Electrical Manufacturer’s Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
KCMC	Kilimanjaro Christian Medical Centre
KIA	Kilimanjaro International Airport
MEM	Ministry of Energy and Minerals
NEAC	National Environmental Advisory Committee
NEMC	National Environmental Management Council
NPES	National Poverty Eradication Strategy
NSGRP	National Strategy for Growth and Reduction of Poverty
O&M	Operation and Maintenance
OJT	On the Job Training
ONAN	Oil Natural Air Natural
OPGW	Optical Grounding Wire
PCB	Polychlorinated Biphenyl
PRS	Poverty Reduction Strategy
ROW	Right of Way
SCADA	Supervisory Control and Data Acquisition System
TANESCO	Tanzania Electric Supply Company Ltd.

TEDAP	Tanzania Energy Development and Access Expansion Project
TOR	Terms of Reference
TTS	Telegraphic Transfer Selling rate
VCB	Vacuum Circuit Breaker
YMCA	Young Men's Christian Association
XLPE	Cross-linked polyethylene

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

The United Republic of Tanzania has abundant natural resources such as gold and diamonds, etc. as well as tourism resources such as Mount Kilimanjaro – the highest peak in Africa. Thanks to sound macroeconomic management, it has achieved an economic growth rate of around 7 percent in recent years. However, GNI per capita remains low at US$400 (2009, according to the World Bank), and the majority of the population depends on agriculture, which accounts for roughly half of GDP. Infrastructure development is essential in order to improve the living standard of citizens and promote industry, however, Tanzania has particularly low rates of road dissemination and electrification among East African countries, and this situation places a major constraint on social and economic development and investment.

The Government of Tanzania embarked on structural reform of the electric power sector in 1993, however, because this included the breakup and privatization of TANESCO (Tanzania Electric Supply Company Limited), it led to a stagnation of public assistance including aid from donors in the sector. Until it was decided to suspend the privatization of TANESCO in 2006, Tanzania was unable to conduct plant investment or adequate maintenance of existing facilities in line with the growing demand for electricity, leading to the serious deterioration of power supply facilities in the country. In response to this situation, the Government of Tanzania compiled the Electric Power System Master Plan (revised in 2009), geared to long-term development of the power sector for 25 years up to 2033, and is promoting the development of power sources and extension of transmission and transformation facilities on the national level based on this plan.

Regarding power transmission and distribution networks in cities, JICA implemented the Study for Rehabilitation of Distribution Facilities in Major Cities in Tanzania in 2002, and this resulted in formulation of a 10-year master plan for improvement and expansion of transmission and distribution facilities in the three cities of Dar es Salaam, Moshi (the capital of Kilimanjaro Region) and Arusha. The Government of Tanzania is advancing improvement and expansion of the urban transmission and distribution network based on this plan, however, progress has fallen far behind schedule due to the lack of funds.

Kilimanjaro Region is the foremost tourist destination in Tanzania and constitutes an economic center having a population of 1.57 million (2008). However, due to the low level of plant investment and maintenance caused by the abovementioned failure of reform in the power sector, power supply is frequently interrupted by rationing and equipment failures. It was against such a background that the Government of Tanzania issued the request to the Government of Japan for the upgrading and construction of transforming facilities and installation of 66 kV transmission lines geared to achieving stable power supply in Kilimanjaro Region.

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

and analysis in Japan confirmed in the first field survey.

Table 1-1.1 Contents of the Final Request and Results of Evaluation

Contents of the final request (at time of first field survey)		Results of evaluation
Requested item	Component details	
Upgrading of YMCA Substation (S/S)	• Upgrading of 33/11kV transformer (5MVA×1→17MVA×1) • Upgrading of 33kV and 11kV circuit breakers • 33kV and 11kV cables, etc.	Target in the Project
Upgrading of Lawate S/S	• Upgrading of 33/11kV transformer (2.5MVA×1→10MVA×1) • Upgrading of 33kV and 11kV circuit breakers • 33kV and 11kV cables, etc.	
Construction of KCMC S/S	• Installation of 33/11kV transformer (5MVA×1) • Installation of 33kV and 11kV circuit breakers • 33kV and 11kV cables, etc.	
Installation of circuit breaker at Trade School S/S	• Installation of 33kV lead-out circuit breaker	
Construction of 33kV transmission line between Trade School ~ KCMC S/S	Construction of 33kV distribution line over the following section: • Trade School S/S ～KCMC S/S (3.7km)	
Construction of Makuyuni S/S	• Installation of 66/33kV transformer (10MVA×2) • Installation of 66kV and 33kV circuit breakers • 66kV and 33kV cables, etc.	
Construction of 66kV transmission line between Kiyungi S/S~Makuyuni S/S	• 66kV transmission line: 34km • 66kV circuit breaker (for transmission line lead-out)	
Installation of transformer at Kiyungi S/S	• Installation of 132/66kV transformer (20MVA×1) • Installation of 132kV and 66kV circuit breakers	
Construction of 33kV transmission line between KCMC and Gomberi	Construction of 33kV distribution line over the following section: • KCMC S/S ～Gomberi S/S (4.9km)	Out of scope of the Project (not adopted)
Upgrading of Machame S/S	• Upgrading of 33/11kV transformer (2.5MVA×1→10MVA×1) • Upgrading of 33kV and 11kV circuit breakers • 33kV and 11kV cables, etc.	
Construction of Gomberi S/S	• Installation of transformer (10MVA×1) • Installation of 33kV and 11kV circuit breakers • 33kV and 11kV cables, etc.	
Installation of circuit breaker at Same S/S	• Installation of 132kV lead-in and lead-out circuit breakers	
Construction of 33kV transmission line from Makuyuni S/S	Construction of 33kV distribution line over the following section (49km): • Makuyuni～Mkuu Rombo • Makuyuni～Kilema • Makuyuni～Marangu • Makuyuni～Himo town	
Construction of Mkuu Rombo switching station	• Installation of 33kV circuit breaker	

1-2 Environmental and Social Consideration

1-2-1 Systems and Procedures concerning Environmental Impact Assessment

(1) Environmental Impact Assessment System

1) Environmental Law

The first environmental legislation to be introduced in Tanzania main land was the National Environmental Management Act, No.19 of 1983, which marked the start of environmental management controls in the country. In 1997, the National Environmental Policy was adopted and the Draft EIA Guidelines and Procedure were formulated. This draft underwent revision in 2003, however, Tanzania still didn't have a consistent legal system for enabling effective environmental management. Accordingly, the Environmental Management Act, No.20 of 2004 was promulgated in 2004, and the Environmental Impact Assessment and Audit Regulations were announced as the official document stance in 2005, thereby creating the current legal system for environmental management. Features of this system are that it requires a registered environmental expert to conduct environmental impact assessment, and it clearly stipulates that stakeholder discussions should be held in the scoping stage so that opinions can be reflected in projects. Moreover, the National Environmental Management Act (No. 19 of 1983) was superseded by the Environmental Management Act (No.20 of 2004).

2) Environmental Management Implementing Agencies

The implementation setup for environmental management administration is prescribed in the Environmental Management Act, according to which the Ministry of Environment under the jurisdiction of the Office of the Vice President is responsible for environmental management and conservation on the national level. The Ministry of Environment, which includes the National Environmental Advisory Committee (NEAC), the Directorate of Environment (DoE) and the National Environmental Management Council (NEMC), compiles and implements policies related to environmental management and conservation.

① National Environmental Advisory Committee (NEAC):

This is the consultative body for the environment minister. It is composed of key figures in specialist fields of environmental management in the public and private sectors and gives recommendations and advice on all aspects of environmental administration.

② Directorate of Environment (DoE):

The DoE promotes the implementation of strategic environmental assessment in development policy, projects and large-scale developments, gives advice to the government on legal systems concerning compliance with international agreements on the environment, and coordinates environmental items in sector-separate policies.

③ National Environmental Management Council (NEMC):

The NEMC conducts environmental impact assessment, ensures compliance and implements review and monitoring of assessment; in addition it promotes public participation in decisions that affect the environment.

These three agencies are responsible for environmental administration on the central government level including coordination with other ministries and agencies. Concerning environmental administration on the regional level, regional environmental Experts or environmental management officers are appointed to each level of government. Figure 1-2-1.1 shows an outline of environmental administration organizations in Tanzania.

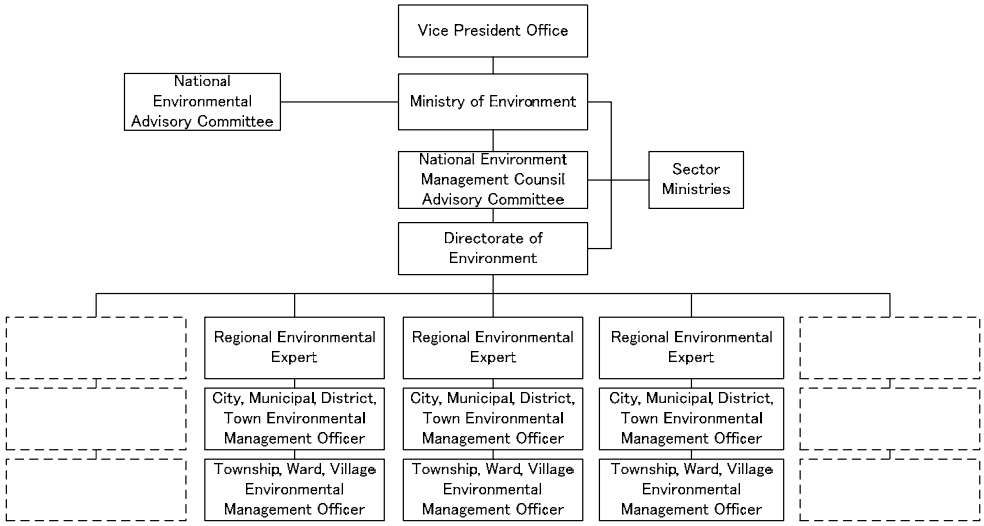


Figure 1-2-1.1 Outline of Environmental Administration Organization in Tanzania

3) Activities Targeted for Environmental Impact Assessment

The activities targeted for environmental impact assessment, as prescribed in the Environmental Impact Assessment and Audit Regulations, are divided into 22 sectors such as agriculture, livestock farming, forestry and fisheries, etc. Projects that require environmental impact assessment in the energy sector are as indicated below. The Project is thus eligible for environmental impact assessment.

① Power generation, transmission and distribution, production and supply of gas, steam and geothermal energy

② Storage of natural gas

③ Thermal power development (coal and nuclear power, etc.)

④ Hydropower generation

⑤ Development of other large-scale renewable and non-renewable energy resources

(2) Environmental Impact Assessment Implementation Procedure

The implementation procedure for environmental impact assessment, as prescribed in the Environmental Impact Assessment and Audit Regulations, entails the steps of screening, impact assessment, review, environmental permit decision, monitoring, environmental audit and abolition. Operators who hope to acquire environmental permit first need to compile a project brief describing the project on the designated format. This project brief has to be prepared by an environmental expert who is registered with the National Environmental Management Council (NEMC); the operator submits it to the NEMC, and the project is registered and then moved on to the screening process.

The results of screening by the NEMC are notified to the project operator within 45 days from the day of registration, and the operator moves on to the next stage of the procedure based on this notification (screening report). Incidentally, the result of screening can be one of four outcomes, i.e. implementation of preliminary assessment, implementation of environmental impact assessment (EIA), no need for EIA, or refusal of proposal.

Figure 1-2-1.2 shows the conceptual view of the environmental impact assessment procedure. As is shown here, the environment minister has authority concerning decisions about environmental permits.

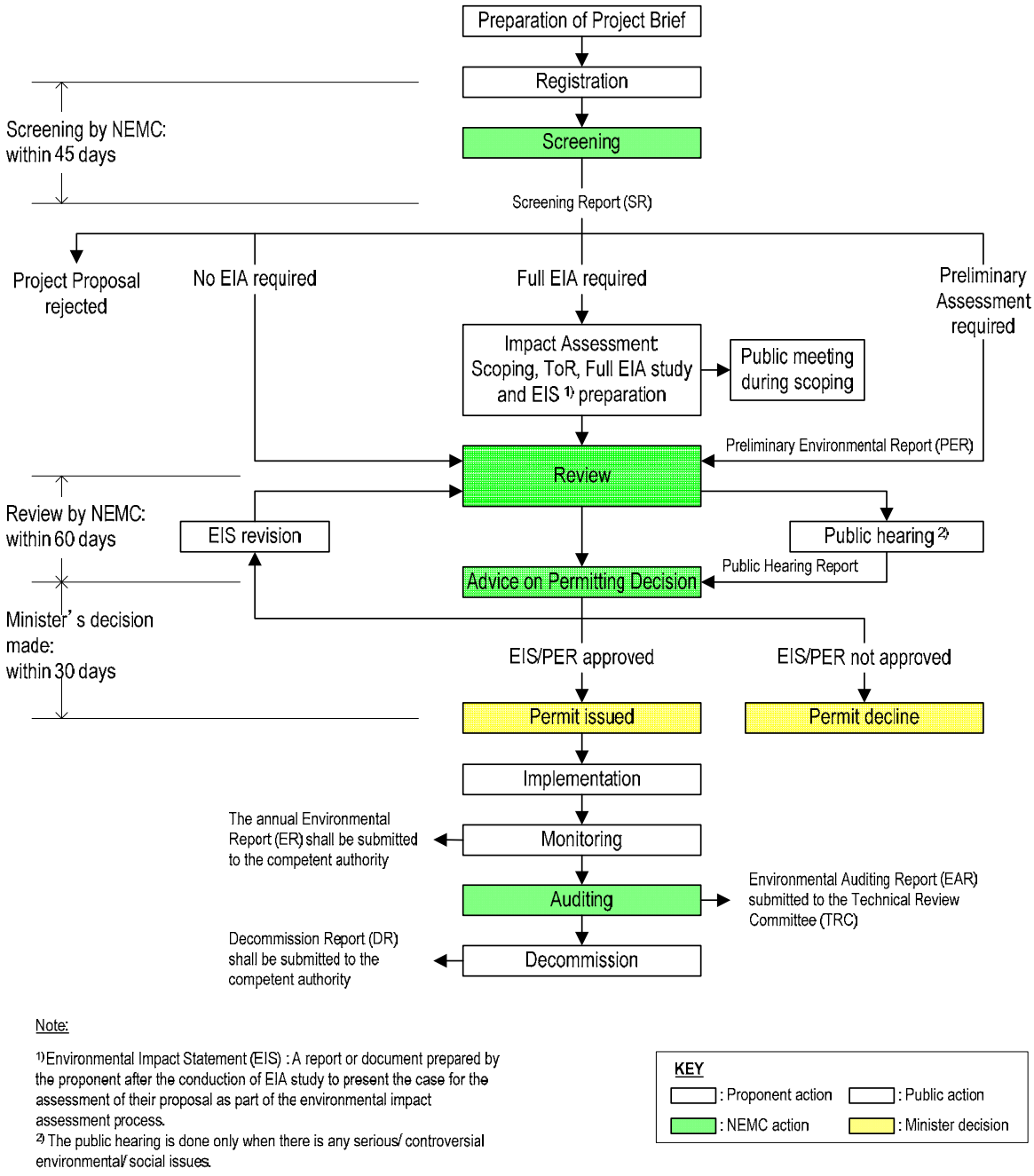


Figure 1-2-1.2 Conceptual View of Environmental Impact Assessment Procedure

(3) Environmental Impact Assessment Procedure in the Project

Concerning the environmental impact assessment procedure in the Project, TANESCO submitted the EIA registration application with the project brief to the NEMC on June 4, 2010 (see the attached EIA Registration Form). Based on this, the NEMC implemented the project screening and notified the results to TANESCO on July 6 (see the attached Screening Report). The Screening Report required TANESCO to implement an EIA, preceded by submission of a scoping report and draft TOR concerning EIA implementation. In response, TANESCO implemented a field survey, compiled a scoping report based on the findings and presented this to NEMC on August 31. The NEMC gave its approval for the Scoping Report and attached the draft TOR on September 9 (see the attached NEMC notification concerning the Scoping Report).

On receiving NEMC approval for the scoping and draft TOR, TANESCO embarked on the EIA in September and completed field surveys for this by the end of November. TANESCO compiled the results of the field surveys into the Environmental Impact Statement (EIS) and submitted this to the NEMC on January 19, 2011 (see the attached document concerning submission of the Environmental Impact Statement).

The results of review by the NEMC will be informed to TANESCO within 60 days of submission. Since recommendations are usually appended to the notification of results, TANESCO will amend the EIS according to the recommendations. Then the NEMC will conduct another review of the EIS and refer it with its opinions to the environment minister with a view to receiving environmental permission. The environment minister must make a decision within 30 days after receiving the results of review from the NEMC.

1-2-2 Staging of Stakeholder Discussions

Prior to registration of the Project with the NEMC, TANESCO conducted preliminary stakeholder discussions targeting some of the residents of communities on the 66kV transmission line route in May 2010, and it incorporated the results of these discussions into the project brief. In the scoping work that was implemented following the return of the screening findings by the NEMC, TANESCO identified the major stakeholders and conducted stakeholder discussions with the Executive Director of Moshi District Authority, the five villages on the transmission line route and the Tanganyika Plantation Company. Furthermore, TANESCO has conducted discussions with all the stakeholders during the EIA process and has strived to reflect as many opinions from residents and stakeholders as possible into the Project.

The following table summarizes the main opinions that have been expressed in the stakeholder discussions.

	Opinion	Response from the Implementing Agency
Executive Director of Moshi District Authority	- Since there is a shortage of land in Kilimanjaro region and it is very difficult to find alternative sites, particular caution will be required concerning the relocation and compensation of residents.	- There will be no relocation of residents. Concerning the acquisition of land for way-leave under the 66 kV transmission line, the District Authority Assessor, who is well-versed in the local land situation, will assess the contents and amount of compensation.
	- Since rice paddies are important to the farmers of southern Moshi, the transmission line should be kept away from them as much as possible.	- Rice paddies will be avoided as much as possible.
	- In order to stop people expecting too much compensation, the legal system should be clearly explained to local residents.	- Explanations will be given in stakeholder meetings with the target residents.
	- In order to prevent trespassing on the transmission line right of way, compensation and construction should be implemented at the same time. Also, signs should be out up to warn trespassers.	- It is planned to start construction immediately after the payment of compensation. Moreover, boundary poles and signs will be established to indicate that way-leave is managed by TANESCO.
	- In order to avoid future disputes over compensation, the district office or village offices should keep records of discussions with citizens and consensus reached over compensation.	- The District Office or Village Office will archive records of discussions with citizens and consensus reached over compensation. The EIA report will also be archived in the same way.
	- In order to avoid unexpected and large compensation claims, TANESCO should bind agreements with village offices confirming that it will not expropriate land beyond the transmission line way leave.	- It shall be confirmed with village offices that land outside of way-leaves will not be expropriated in future, and agreements will be concluded regarding this.
Five affected villages	- The villages want the transmission line to avoid farmland.	- The transmission line route has been planned to avoid farmland and avert resident relocation as much as possible.
	- It is desirable for TANESCO to maintain its relationship with residents throughout the entire Project period.	- TANESCO is striving to maintain good relations with residents and is also aware of the importance of good relations in the maintenance of facilities following Project completion.
	- When constructing the substations and transmission line, employment opportunities should be offered to local farmers.	- The contractor will be encouraged to employ local farmers for jobs they can perform.
	- Regarding compensation, money should be paid out fairly and promptly, and consideration should be given to the fact that it is difficult to secure alternative sites in Kilimanjaro region.	- The law requires the proper, fair and prompt payment of compensation. Moreover, the Assessor for Moshi District Authority has a thorough understanding of the land situation in Moshi District.
	- Cultivation under the transmission line should be permitted as much as possible provided there are no problems.	- Although the law doesn't recognize cultivation under transmission lines, it doesn't oppose cultivation performed by people under their own responsibility. However, no compensation at all is provided for crops that need to be removed for maintenance work, etc.

	Opinion	Response from the Implementing Agency
	- Since it is usually difficult to acquire land equivalent to that expropriated with the compensation provided, the project operators should prepare alternative land nearby. - In southern Moshi, since many farmers cultivate crops on leased land, compensation should be paid to both the lease holding farmers and landowners in order to avoid controversy. - Residents who are affected by the Project should be involved in all processes concerning land expropriation and compensation.	- Since compensation amounts are calculated in reference to actual land transactions, it is not difficult to purchase alternative land. Moreover, TANESCO will help secure alternative land if requested. - Compensation is paid to leaseholders for their crops, and to landowners for their land. - TANESCO is striving to maintain good relations with residents both during the Project and after its completion.
Plantation Company	- When setting the interval between steel towers, take care to ensure that the transmission line doesn't interfere with farm machinery. - Give the transmission line ample clearance off the ground and permit cultivation of sugar cane in the transmission line way leave. - Decide the layout of steel towers inside the plantation upon conducting ample discussions with the plantation company.	- The location of transmission lines and steel towers will be decided in discussions with plantation owners. Since land under transmission lines will be owned by TANESCO as way-leave, farm machinery will not be operated there. - Ditto - Although the law doesn't recognize cultivation under transmission lines, it doesn't oppose cultivation performed by people under their own responsibility. However, no compensation at all is provided for crops that need to be removed for maintenance work, etc.

1-2-3 Examination of Alternative Plans

With a view to optimizing the environmental and social impacts of the Project, examination was conducted on the following options including the zero option.

Alternative 0: No Project implementation

Alternative 1: The transmission line route that was originally requested by TANESCO (August 2009)

Alternative 2: The transmission line route that was revised in the field survey that was jointly implemented by TANESCO and the Study Team (route around villages)

As is indicated in Figure 1-2-3.1, the transmission line in Alternative 1 passes through a number of villages and it is possible that residents will need to be relocated. For this reason, Alternative 2 was drawn up with the goal of minimizing the impact on residents, and this entails no relocations.

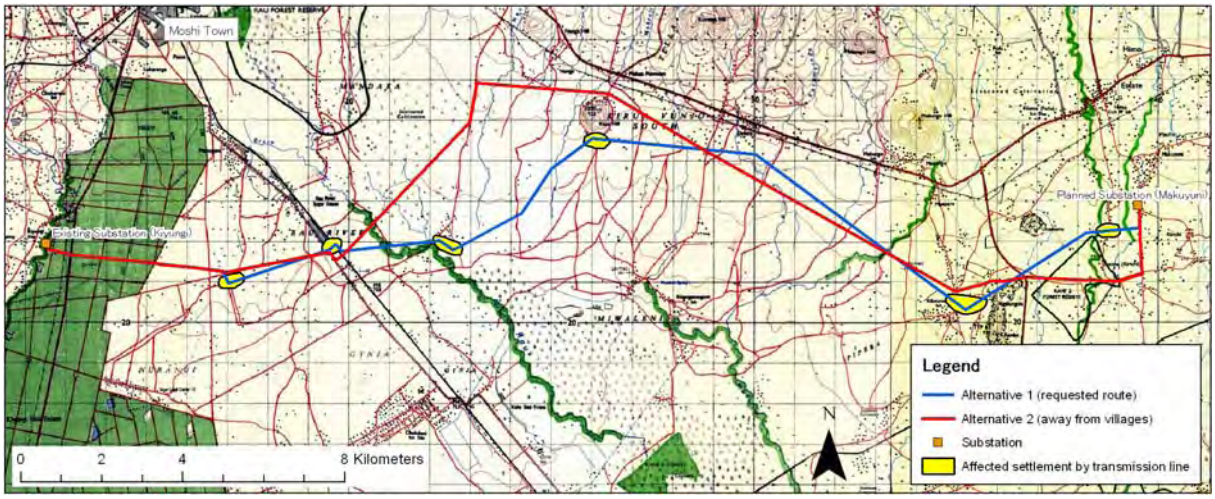


Figure 1-2-3.1 66kV Transmission Line Route

Table 1-2-3.1 gives an outline of the alternative plans. Alternative 2 was deemed to be the most feasible of the plans and was adopted as the Project route because it doesn't entail the relocation of residents.

Table 1-2-3.1 Outline of Alternative Routes for the 66kV Transmission Line

	Alternative 0	Alternative 1	Alternative 2
Explanation	No project implementation	Originally requested route	Route avoiding villages
Total length	-	32.6 km	32.7 km
Benefits	None	Realization of stable power supply, resulting improvement in public services and creation of employment, etc.	Same as in Alternative 1
Social and environmental impacts	None	- A certain level of decrease in farm production (limited) - Promotion of the local community through improvement in public services and creation of employment	Same as in Alternative 1
Impacts on the natural environment	None	Possibility of minor impacts such as limited soil runoff, etc.	Same as in Alternative 1
Risk of pollution	None	Minor possibility of limited air pollution due to operation of construction machinery	Same as in Alternative 1
Scale of land expropriation	None	Required land: 652,000 m^2	Required land: 654,000 m^2
Relocation of residents	None	Possibility that around 10 households will need to be relocated	None

1-2-4 Land Acquisition Situation

(1) TANESCO Land Acquisition Policy

In TEDAP, which is being implemented based on assistance from the World Bank, a resettlement action plan in line with 132kV transmission lines has been compiled, and the following policies, which meet the required criteria of the World Bank and Government of Tanzania, are indicated regarding compensation for residents who are affected by the Project.

- Spreading information about the rights and choices of residents concerning relocation
- Presentation of relocation alternatives and consultation based on technical and economic examination of feasibility
- Prompt implementation of compensation based on total substitution of losses

In the Project too, TANESCO is acquiring land based on this relocation and compensation policy inherited from TEDAP. Specifically, out of the alternative routes for the 66 kV transmission line, it has adopted the route proposed in Alternative 2, which doesn't entail relocation of residents. As a rule, land is acquired in return for cash compensation, although alternative land is sometimes offered at the request of residents. When calculating the amount of compensation, the following contents are taken into consideration (see the attached Matrix of Entitlement).

- Market price of real estate
- Loss of one's living environment/cost of acquiring the target land
- Loss of profits or accommodation
- Disturbance allowance (4~6 percent of the real estate compensation amount)
- Transport allowance/capital expenditure incurred to the development of the subject land

The above-mentioned "Market price of real estate" refers to the market price for reacquiring alternative real estate. In the case of buildings, this naturally includes the construction cost. Moreover, the market price of real estate will be decided after the Authority Assessor conducts hearing interviews with the Village Leaders in reference to the latest real estate transaction records in the target area (see the attached sample land sale agreement) and past assessment prices, while considering conditions of land use, soil, irrigation facilities and infrastructure in the target area, distance from main roads, grade of adjoining roads, inflation and other factors.

If landowners are unhappy with the compensation amount proposed by the Authority Assessor, they can lodge a complaint with the district authority Land Office. When this is received, the Assessor is obliged to assess the target land once again. If the landowners are still unhappy with the assessment, they can take the Assessor to court.

(2) Transmission Line Wayleave

Based on the Land Act (No. 4/1999), Village Land Act (No. 5/1999) and Electricity Act (2008), land underneath transmission lines is expropriated by TANESCO as Wayleave (synonym for ROW). Moreover, since the width of the way leave is not prescribed by law, it is decided according to technical criteria of TANESCO. In the Project, the way leave for the 66kV transmission line is prescribed as 20 m across and that for the 33kV distribution line is 10 m.

The transmission department of TANESCO normally has jurisdiction over the wayleave of transmission lines, and it periodically patrols way leave in order to check for illegal occupation and the amount of clearance. It sometimes consigns wayleave monitoring to village offices, which look out for destructive activities and so on. Moreover, in stakeholder discussions residents have requested that crop cultivation be allowed inside the wayleave, and while TANESCO has responded by explaining that such cultivation is not allowed under the law, at the same time it has indicated that field cultivation except for growing of tall fruit trees, etc. will be allowed providing that farmers bear all risk (including that compensation will not be provided even if crops need to be removed for maintenance and so on). It has maybe adopted this course because, in the past, when all cultivation activities were prohibited in the way-leave, this led to sabotage of the transmission lines by residents. Residents have responded favorably and given their full understanding to this stance by TANESCO. Regarding the cultivation of crops inside the wayleave, the practical solutions proposed above by TANESCO are thought to be appropriate.

① So far TANESCO has not experienced any accidents resulting from cultivation inside the wayleave.

② Since the minimum height of 66 kV transmission lines is 6.7 m above ground and the main crops grown under lines are sugar cane and sweet corn, etc., there is no risk of crops growing high enough to impede the transmission lines.

(3) Railway Lines

The 66kV transmission line in the Project will cross over a rail line (non-electrified) owned by Tanzania Railway Limited. Passenger services on this line, which links Moshi and Tanga, were abolished in 1992 and, although one freight train service ran back and forth over the line around once a week after that, there are currently no train services at all after part of the line was washed away by flooding in 2008. According to Tanzania Railway Limited, there are no plans to improve this line or rehabilitate the parts damaged in the flooding. Even so, TANESCO has held design discussions with Tanzania Railway Limited concerning the railway line crossing point and secure permission for transmission line construction before the start of works. Tanzania Railway Limited has orally given permission for the transmission line to cross the railway line, and it is currently implementing procedures geared to the issue of an official document. TANESCO has announced that it will obtain this written authorization to cross the railway line before the start of work on the Project.

(4) Land Acquisition Situation regarding the Project

Apart from the land that has been newly acquired for the new substation at Mayukuni, there is no need to acquire land for the upgrading and newly constructions of substations. Concerning the new transmission line, work is currently being advanced on acquiring land for the way leave and access roads (to be used as Temporary roads during construction). As for the 33kV distribution line, since this will be constructed inside the ROWs of public roads, it will not be necessary to acquire new land. Moreover, the Project will not entail relocation of residents or demolition of buildings, and it won't cause any replacement land and housing.

The following table shows the situation regarding land acquisition for each of the Project components.

Table 1-2-4.1 Land Acquisition Situation for Each Project Component (as of the end of Jan. 2011)

Item	Current land use / need for land acquisition	Landowner	Contents of compensation (Tsh)		Status
			Site	Access road	
YMCA S/S	Existing S/S / Unnecessary	TANESCO	Unnecessary	Unnecessary	—
Lawate S/S	Existing S/S / Unnecessary	TANESCO	Unnecessary	Unnecessary	—
KCMC S/S	Farmland / Unnecessary	KCMC	Unnecessary (given by KCMC)	Unnecessary	—
Trade School S/S	Existing S/S / Unnecessary	TANESCO	Unnecessary	Unnecessary	—
Makuyuni S/S	Farmland / Necessary (11,398 m^2)	TANESCO (land has already been acquired)	Land price: 10,300,000 Disturbance allowance: 465,000 Crops compensation: 1,329,000 Total: 12,094,000	Unnecessary	Completed
Kiyungi S/S	Existing S/S / Unnecessary	TANESCO	Unnecessary	Unnecessary	—
66kV transmission line	Farmland / Necessary (654,000 m^2)	Private	Negotiations in progress (Compensation is expected to be finished by April 2011)	Negotiations in progress (Ditto)	Negotiations in progress (Ditto)
33kV transmission line	Road / Unnecessary	TANROAD	Unnecessary	Unnecessary	—

Moreover, the temporary storage yard for use during the construction works will be located on land at

Kiyungi substation. It will thus not be necessary to acquire new land for this.

The Moshi District Land Office has informed landowners that land underneath the 66 kV transmission line will be expropriated, and assessment is currently being implemented with a view to determining the scope of the target land and the contents of compensation (there will be no removal of buildings or relocation of residents in the Project). The District Authority Assessor who is affiliated to the Land Office is currently assessing the value of land and crops based on applicable market prices and is preparing a Valuation Report indicating the contents of compensation to each landowner.

The Valuation Report will be submitted for approval to the Assessor General of the Ministry of Lands, Housing & Human Settlement Development. Once approval is given, the Authority Assessor will prepare the Compensation Schedule indicating the contents of compensation for each plot of land and notify this to TANESCO. Based on this, TANESCO will take budgetary steps and send funds covering the total compensation amount to the District Land Office. The Land Office will show the Compensation Schedule to the landowners, obtain their signatures and then make payments by check. Once payments of compensation are finished, the Land Office will send copies of the signed Compensation Schedule to TANESCO, legally paving the way for the transmission line works to be started. TANESCO expects to complete payments of compensation arising from the 66 kV line by the end of April 2011.

1-2-5 Projected Impacts and Mitigation Measures

Based on the JICA environmental and social consideration guidelines, scoping was carried out on the feasible option (Alternative 2) in joint work with the TANESCO staff (including personnel in charge of environmental matters) and JICA Survey Team (see the attached Scoping Summary).

In the Project, land will be newly acquired for the Mayukuni substation and the 66kV transmission line, while site leveling will be implemented for the construction and upgrading of substation facilities and transmission and distribution facilities, however, there are not expected to be any major environmental or social impacts. The Project will not entail any major land reclamation or construction works close to residential areas. The site leveling for construction of substations and transmission and distribution lines will also be limited.

Table 1-2-5.1 shows the results of the scoping and the mitigation measures. Any negative impacts from the Project can be minimized or avoided through implementing usual mitigation measures.

Table 1-2-5.1 Scoping Results and Mitigation Measures

Environmental Item	Rating	Explanation	Projected Mitigation Measures
Involuntary relocation of residents	D	There will be no relocation of residents.	
Local economy linked to employment and livelihood, etc.	B	Expropriation of land for Mayukuni S/S and construction of the transmission line is expected to cause reduction of agricultural production. However, the affected area will be small and limited.	Survey of land use conditions and provision of appropriate and ample compensation
Land use and utilization of local resources	B	The land used for constructing new S/S (Makuyuni and KCMC) will be converted from farmland.	Survey of land use conditions and provision of appropriate and ample compensation
Social capital and local decision making organizations, etc.	D	No negative impacts are anticipated on social organizations.	
Existing social infrastructure and social services	D	No negative impacts are anticipated on social infrastructure and social services	
Impoverished people, indigenous races and minorities	D	Not applicable	
Imbalance of damage and benefits	D	Not applicable	
Cultural heritage	D	Not applicable	
Local conflicts of interest	D	Not applicable	
Coordination of water rights and fishing rights, etc.	D	Not applicable	
Public hygiene	D	Not applicable	
Risk of infections such as HIV /AIDS, etc.	B	A certain degree of risk of sexual infections caused by influx of workers during construction is forecast. However, since public education activities geared to preventing infection are frequently conducted in the target area, construction workers will be recruited from the local population, and the works are not large enough to require worker camps, the impacts will be limited.	Guidance on infection countermeasures to construction workers as required
Topography and geology	D	Not applicable	
Soil runoff	B	There is risk of soil runoff occurring on the new S/S construction sites (Mayukuni and KCMC) during construction.	Implementation of soil runoff prevention measures such as covering by waterproof sheet, etc.
Groundwater changes	D	There are no construction works that will impact groundwater.	
Water utilization	D	No negative impacts are anticipated on water use.	

Environmental Item	Rating	Explanation	Projected Mitigation Measures
Coastal water bodies	D	Not applicable	
Biology and ecosystems	D	Not applicable	
Climate	D	Not applicable	
Landscape changes	D	Since the transmission line is planned on the south side of the main road running from east to west, it will not detract from the view of Mount Kilimanjaro as a tourist resource on the north side of the road. Moreover, since there are no tourism resources at all on the south side of the road, there will be no damage to the local landscape.	
Global warming	B	There is possibility that insulating material (SF6 gas) will leak from the circuit breakers to be installed at the new Mayukuni S/S. However, the possibility of this occurring will be very low.	Monitoring by gas leak detectors
Air pollution	B	Construction machinery will discharge exhaust gases during the construction period, however, because the scale of works will be limited, the quantities will be limited.	Appropriate maintenance of construction machines in order to secure total combustion of fuel
Water pollution	B	In the event of unexpected accidents, there is possibility that insulating oil will leak from transformers.	Thorough guidance to employees on how to deal with leaked insulating oil
Soil pollution	B	In the event of sudden accidents, there is a possibility that insulation oil used in transformers will leak.	Make sure that employees dispose of spilled insulation oil in the appropriate manner.
Solid waste	B	The transformer at YMCA S/S will be replaced, however, it is unclear whether or not PCB is used in this.	Inspection of old transformers. In cases where hazardous wastes such as PCB, etc. are generated, strictly collect, store and dispose according to the TANESCO guidelines.
Noise and vibration	B	There is concern over noise and vibration caused by construction machinery during the construction period.	Prohibition of nighttime works in residential areas
Ground subsidence	D	Not applicable	
Odor	D	Not applicable	
Bottom sediment	B	In the event of unexpected accidents, there is possibility that insulating oil will leak from transformers.	Thorough guidance to employees on how to deal with leaked insulating oil
Accidents	B	There is risk of construction laborers falling from high places or being electrocuted during the works.	Installation of warning signs, compulsory wearing of safety gear

[Note] A: Critical impacts are foreseen.
B: Some impacts are foreseen.
C: Degree of impact is unknown.
D: Hardly any impact is expected

1-2-6 Environmental Check List and Environmental Monitoring Plan

TANESCO has compiled an environmental checklist (see the attached Environmental Checklist for Power Transmission and Distribution Lines) and implements EIA and prepares monitoring plans based on this.

The monitoring plan is contained in the Environmental Impact Explanation that was presented by TANESCO to the NEMC (see the attached Environmental Monitoring Plan (extract from the Environmental Impact Explanation)). The monitoring items, implementation setup and budget indicated in this are deemed to be feasible contents because they are based on the experience of similar projects, etc. previously implemented by TANESCO. Moreover, the budget for environmental monitoring during the construction period is estimated to be approximately US$50,000.

This monitoring plan will be finalized upon undergoing review by the NEMC and following amendment in response to indicated points.

Concerning the particularly important environmental impacts covered in the monitoring plan, the results of monitoring will be regularly reported from TANESCO to JICA (see the attached Monitoring Form). The important environmental impacts for which reporting to JICA is obligatory are leakage of hydrocarbons (petroleum) and noise.

1-2-7 Concerning Natural Environment

The Project sites (substations and transmission line) are located inside farmland and plantations, and they do not include or are located close to any part of national parks of protected areas. This point has been confirmed by the responsible officer of the Kilimanjaro Regional Office of the Ministry of Natural Resources & Tourism. Moreover, the Office has also confirmed that there are no rare species of wildlife such as ICUN Red List registered fauna in and around the Project area.

CHAPTER 2 CONTENTS OF THE PROJECT

2. Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Superior Objective and Project Targets

In the National Strategy for Growth and Reduction of Poverty (NSGRP) that was compiled in July 2005, the following three-pronged basic strategy was prescribed in order to achieve growth and poverty reduction: Strategy 1: Growth of the economy and reduction in income poverty, Strategy 2: Improvement of quality of life and social well-being, and Strategy 3: Governance and accountability. As a separate policy for realizing Strategy 1, 'Provision of reliable and affordable energy to consumers' has been raised as a target.

Bearing in mind the said concept, the Project adopts the following superior objective: 'To vitalize social and economic activities in Kilimanjaro Region through providing stable power supply and improving power supply reliability,' and it has the following target: 'To resolve power outages and voltage drop problems in Kilimanjaro Region with a view to realizing stable power supply.'

2-1-2 Outline of the Project

In order to achieve the said objective and target, the Project intends to install and upgrade transmission, distribution and transforming equipment and thereby stabilize power supply and improve the quality of power in Kilimanjaro Region.

The assistance targets the upgrading of overloaded 33/11kV substations and construction of new transmission and distribution lines and substations in areas experiencing extreme voltage losses.

2-2 Out line Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

Based on the request to strengthen transmission and distribution facilities over almost the entire area of Kilimanjaro Region in Tanzania, the Project aims to verify the necessity, appropriateness and urgency of the request and satisfy the target power demand in Kilimanjaro Region in 2023 while taking into account the assistance plans of other donors.

2-2-1-2 Policy regarding Social Conditions

(1) Temperature

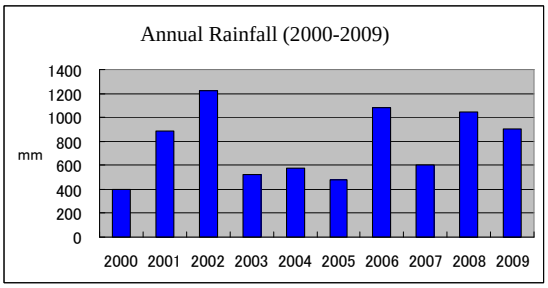
The annual peak temperature in the target area over the past nine years (2000~2008) has been 33.6℃ on average, while the annual minimum temperature has been 16.2℃ on average.

According to figures for relative humidity in the 10-year period between 2000~2009, maximum humidity has on average been 84.0 percent at six o'clock in the morning and 59.0 percent at twelve o'clock noon. Thus, even though the target area is situated close to the Equator, the year-round climate on average is warm and pleasant, reflecting the unique characteristics of being located in the shadow of Mount Kilimanjaro at an altitude of approximately 890 m.

Bearing in mind the above temperature and relative humidity conditions, the transmission and distribution facilities adopted in the Project shall be selected so that they operate normally and incur no maintenance problems with respect to temporary temperature increases caused by the outside air temperature and direct sunlight and high humidity.

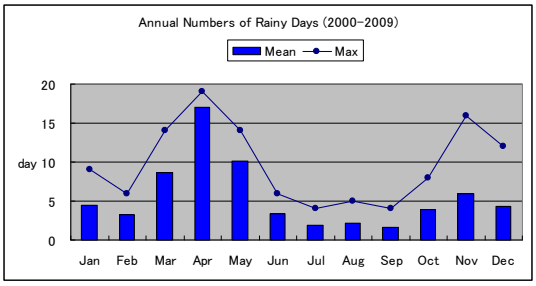
(2) Rainfall and lightning

In the Project target area, as is shown in the figures for annual rainfall shown in Figure 2-2-1-2.1, the annual average rainfall over the past 10 years has been 771.8 mm, although there have been fluctuations from year to year. Moreover, as is shown in the number of rainy days per year in the target area in the same figure, heavy rainfall is concentrated in the period between March and May (the long rains) while there is lighter rainfall between November and January (the short rains). In the Project, when designing the implementation plan, it will be necessary to pay ample attention to the schedule of outside works, for example civil and building works accompanying the installation of equipment.



Source: Tanzania Meteorological Agency

Figure 2-2-1-2.1 Annual Rainfall in the Project Target Area



Source: Tanzania Meteorological Agency

Figure 2-2-1-2.2 Annual Number of Rainy Days in the Project Target Area

There are no data concerning lightning strikes in the target area, however, local hearings found that lightening does strike during the rainy seasons. Since there is risk of lightning striking steel towers during construction of transmission lines, etc., it will be necessary to show ample attention to the schedule of works that entail work in high places; moreover, it will be necessary to install adequate protective equipment to guard against lightening infiltration on transmission and distribution lines and in substations.

(3) Wind

The average wind velocity in the Project area over the past 10 years (2000~2009) has been 10 knots (5 m/sec) on average, while a peak velocity of 16 knots (8 m/sec) has been measured. Peak wind velocity of 23 knots (11.5 m/sec) has been measured in Same approximately 100 km away from the target area. Therefore, although the target area is not impacted by the strong gusts experienced by Dar es Salaam in the coastal region (maximum velocity 45 knots or 23.15 m/sec), ample consideration shall be taken when designing transmission lines to ensure that they are strong enough to withstand sudden gusts, etc.

(4) Salt damage

In the Project area, which is situated roughly 200 km from the nearest coastal point (Tanga), there is no need to incorporate special salt damage steps in the equipment procurement and installation.

2-2-1-3 Policy regarding Social and Economic Conditions

In the Project substation facility works, since power will need to be cut when switching between new and existing facilities, it will be necessary to compile schedules that minimize impacts on consumers and shorten the length of power outages.

When constructing the transmission and distribution lines, since this will entail cutting trees and removing crops along routes and constructing access roads for works vehicles, it will be necessary to select routes and compile schedules in a way that minimizes impacts. Moreover, when installing poles and conducting excavation works, care will be needed to avoid impacts on telephone, water supply and sewerage lines; and when conducting overhead line works, it will be necessary to certainly secure safe clearance with existing distribution lines, telephone lines, rail lines and roads and strive for design and execution activities that avert interference with existing infrastructure.

2-2-1-4 Policy regarding Execution Conditions

In Tanzania, medium and large-scale construction works for commercial facilities and office buildings, etc. are routinely conducted and there are numerous general contractors and electrical works companies that handle such works mainly in Dar es Salaam. Therefore, execution conditions are relatively good.

2-2-1-5 Policy regarding Utilization of Local Contractors, Equipment and Materials

Interviews were conducted and materials were collected at a number of local companies concerning the target scope of works and past works performance, etc. As a result, it was found to be relatively easy to locally procure laborers, works vehicles and construction equipment and materials, etc. in

Tanzania. Moreover, judging from past jobs undertaken, since it is deemed possible to order general work for substation construction, civil engineering works, building works and transmission and distribution line construction works to local operators, the implementation plan shall be compiled assuming utilization of local operators.

Moreover, in Tanzania it is possible to procure the wooden poles used in distribution line works and the aggregate, cement and reinforcing bars, etc. used in civil engineering and building works. Considering the nurturing of local industry, locally procurable equipment and materials shall be adopted as much as possible, however, since equipment and materials for the scale of substations and transmission and distribution facilities required in the Project are not manufactured in Tanzania, these items shall be procured from Japan or third countries while considering the record of existing facilities and maintenance capacity in Tanzania.

2-2-1-6 Policy regarding Maintenance Capacity of the Implementing Agency

Tanzania has experienced numerous power development projects of similar scale to the Project here under Japanese Grant Aid and by other donors including the project to strengthen transmission and distribution facilities in Dar es Salaam (completed in September 2010). Moreover, since the Tanzanian side has operated and maintained the substation, transmission and distribution facilities supplied under past Grant Aid, TANESCO, which will be in charge of Project facilities, will have the capability to operate and maintain the substation, transmission and distribution facilities scheduled for procurement and installation in the Project.

However, due to financial difficulties, TANESCO is unable to quickly renew existing deteriorated substation, transmission and distribution facilities or procure expensive replacement parts and spare parts that are in short supply, and this situation leads to overloading, electrical failures and power outages. Moreover, since TANESCO does not conduct much training for engineers and operators, it lacks engineers who possess know-how and technology concerning recent substation, transmission and distribution facilities. As a result, in the Project, it will be necessary for Japanese engineers to conduct OJT on operating and maintaining substation, transmission and distribution facilities during the works period, to provide operation and maintenance manuals and to strive for the appropriate transfer of operation and maintenance technology. Furthermore, the minimum required spare parts, testing instruments and maintenance tools shall be supplied in order to facilitate the more effective and efficient operation and maintenance of facilities.

Since 2009 JICA has been implementing a five-year technical cooperation project, namely the Capacity Building Project for Efficient Transmission and Distribution Network (hereafter referred to as the technical cooperation project). Since this aims to conduct technical training for TANESCO engineers, electricians and technicians involved in transmission and distribution networks, prepare training materials and nurture training instructors, and it also targets training of engineers from regional branches, this will help enhance the capacity of TANESCO engineers to operate and maintain the transmission and distribution facilities following completion of the Project.

2-2-1-7 Policy regarding the Scope and Grading of Facilities and Equipment, etc.

Considering the above conditions, the equipment and materials procured in the Project, the scope of installation and the technical level of such equipment and materials shall be compiled based on the following basic concept.

(1) Policy regarding the scope of facilities and equipment

In the Project, facilities for providing stable power to residents and public facilities in the target area to meet the projected power demand in the target year of 2023 (10 years after the completion of the Project) which is shown in Table 2-2-1-7.1 shall be constructed. The Japanese side shall implement procurement and installation for the minimum required facilities, while the Tanzanian side shall be responsible for the items that can be procured and installed by the Tanzanian side. In this way care shall be taken to encourage the sustainable operation and maintenance of power facilities on the Tanzanian side. Transformer capacity at KCMC is planned so as to cover power demand at Gomberi substation which was initially requested but finally became out of scope of the Project.

Table 2-2-1-7.1 Power demand forecast in Kilimanjaro region by each substation

Unit: MW

	Actual				Estimate	Forecast														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
YMCA	4.0	4.0	5.6	5.6	4.9	5.3	5.8	6.4	5.6	6.1	6.7	7.4	8.1	8.8	9.7	10.6	11.6	12.7	14.0	15.3
Lawati	2.0	2.2	2.2	2.2	1.9	2.1	2.3	2.5	2.7	3.0	3.3	3.6	4.0	4.3	4.8	5.2	5.7	6.3	6.9	7.5
Machame	1.5	1.7	1.9	2.1	1.8	2.0	2.2	2.4	2.6	2.9	3.1	3.5	3.8	4.1	4.5	5.0	5.4	6.0	6.5	7.2
Boma Mbuzi	7.0	7.3	8.0	8.0	6.9	7.6	8.3	9.1	2.4	2.6	2.8	3.1	3.4	3.7	4.1	4.5	4.9	5.4	5.9	6.5
Trade School	4.9	5.5	6.6	7.0	6.1	6.6	7.3	8.0	7.3	8.0	8.8	9.7	10.6	11.6	12.7	13.9	15.3	16.7	18.3	20.1
Kiyungi	27.9	30.5	31.5	34.5	29.9	32.8	35.9	39.3	43.1	47.2	51.7	56.7	62.1	68.1	74.6	81.7	89.5	98.1	107.5	117.7
Mwanga	1.2	1.3	1.8	1.8	1.6	1.7	1.9	2.1	2.2	2.5	2.7	3.0	3.2	3.6	3.9	4.3	4.7	5.1	5.6	6.1
Same	1.5	1.6	1.6	2.0	1.7	1.9	2.1	2.3	2.5	2.7	3.0	3.3	3.6	3.9	4.3	4.7	5.2	5.7	6.2	6.8
KCMC									1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.7	2.9	3.2	3.5	3.8
Gomberi									1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.7	2.9	3.2	3.5	3.8
Makuyuni									7.6	8.4	9.2	10.0	11.0	12.0	13.2	14.5	15.8	17.4	19.0	20.8
K'njro Total	30.6	33.4	34.9	38.3	33.2	36.4	39.9	43.7	47.8	52.4	57.4	62.9	69.0	75.6	82.8	90.7	99.4	108.9	119.3	130.7

[Remarks] Substations to be upgraded or constructed under the Project

Growth rate 9.567% /year (Master Plan 2009 update)

Target Year

Furthermore, in order to realize economical design, standard items of equipment and materials that comply with international specifications shall be adopted as far as possible; moreover, the minimum required composition and specifications shall be adopted while seeking compatibility with existing equipment and instruments.

(2) Policy regarding grades

When designing the substation, transmission and distribution facilities for procurement and installation in the Project, care shall be taken to comply with existing system composition and TANESCO technical standards and works manuals and ensure that contents do not deviate from the technical level of TANESCO, which will be in charge of operation and maintenance following supply.

2-2-1-8 Policy regarding Works Methods, Procurement Methods and Works Schedule

In the Project, since numerous target sites are dispersed (substations) and construction of approximately 5 km of distribution line and 34 km of transmission line shall be implemented simultaneously, processes shall be planned so that work groups can be appropriately organized to efficiently implement the works; moreover, it will be necessary to adopt works methods with which the local operators and engineers are familiar and establish a works management setup to ensure that the work progresses safely and quickly.

Since equipment and materials from Japan or third countries will be landed at Dar es Salaam Port and then transported approximately 650 km overland, it will be necessary to give the utmost care to curing and packing and take ample steps to ensure that items can be procured safely and certainly without interfering with the surrounding traffic.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

(1) Design Conditions

Design conditions to be applied to the Project are described as follows.

1) Climatic Conditions

Table 2-2-2-1.1 shows the climatic conditions that will be applied to the design of substations, transmission and distribution facilities, buildings and foundations.

Table 2-2-2-1.1 Climatic Conditions

Region		Kilimanjaro
Altitude		Not more than 1,000m
Ambient Temperature	Maximum	40 degree C
	Minimum	10 degree C
	Mean	20 degree C
Maximum Humidity		85%
Max. Wind Velocity		32 knots (16m/s) (See Note 1)
Rainfall (Monthly Maximum)		500mm
Seismic Force		Horizontal 0.1G
Soil Bearing Capacity		5 ton/m^2

(Note)

1. Meteorological stations in Kilimanjaro region have meteorological data for the past 10 years (2000~2009). The highest mean wind velocity in Moshi which was recorded for the past 10 years (from 2000 to 2009) was 16 knots (8 m/s). Therefore, the maximum wind velocity is estimated to be 32 knots (16m/s), twice as high as the highest mean wind velocity.

2) Basic Electrical Design Conditions

Table 2-2-2-1.2 shows the basic conditions for design applicable to the substation, transmission and distribution line facilities.

Table 2-2-2-1.2 Electrical Design Conditions

Item	Transmission System		Distribution System		Station Service Power	
Nominal Voltage	132kV	66kV	33kV	11kV	400-230V AC	110V DC
Maximum Voltage	145 kV	72kV	36kV	12kV	440-253V AC	125V DC
Frequency	50Hz					N/A
Maximum Short Circuit Capacity	25kA (1sec.)	25kA (1sec.)	16.5kA (1sec.)	16.5kA (1sec.)	N/A	
Lightning Impulse Withstand Voltage (LIWV)	650 kV	325kV	170kV	75kV	N/A	
Earthing System	Effective Earthing System				N/A	
Minimum Creepage Distance of Insulator	25mm/kV (See Note 1)				N/A	
Minimum Clearance of Conductor	(See Note 2)				N/A	
Phase to Ground (mm)	1,700	1,000	500	300	N/A	
Phase to Phase (mm)	2,800	1,800	900	600	N/A	
Clearance and Way Leave	(See Note 3)					
Protection Class (IP)	(See Note 4)					
SCADA and Communication Systems	(See Note 5)					

(Notes)

1. Since the Project sites are located about 200 km away from the coast, salt damage is negligible. However, the Project sites are located in dusty area. Therefore, minimum creepage distance of insulator for outdoor use is 25 mm/kV. Minimum creepage distance of insulator inside of switchgear cubicles is 16 mm/kV.

2. The minimum clearance of conductor for transmission and distribution line conductors and supports shall be determined in accordance with relevant standards and regulations. The minimum clearance of conductor for 33kV and 11kV switchgear cubicles shall be determined by manufacturer's standards.

3. The height and clearance of transmission and distribution line conductors shall be determined in accordance with the requirements of TANESCO, TANZANIA National Roads Agency and Moshi Rural District Office, etc. as indicated in Table 2-2-2-1.3. However, in cases where special arrangement is required, TANESCO shall consult with relevant parties to obtain necessary permission.

4. Protection classes (IP) for 33kV switchgear cubicles, 11kV switchgear cubicles, low voltage panels, control panels and protection relay panels are as follows.
   Outdoor: IP43, Indoor: IP20

5. SCADA (Supervisory Control and Data Acquisition) and communication systems (power line carrier and/or other systems) for substations shall be designed and provided by TANESCO.

Table 2-2-2-1.3 Clearance of Transmission and Distribution Line Conductors and Supports

Item	66kV transmission line	33kV distribution line	11kV distribution line
Height of Conductor			
General Area (m)	6.7	6	6
Road (m)	8	6	6
Railway (m)	8	8	8
Waterway, Fairway (m)	8	6	6
Width of Way Leave (m)	20	10	5
Clearance between conductor and house (m)	4	3	3
Clearance between supporting structure and road center			
Trunk Road (m)	30	30	30
Feeder Road (m)	25	25	25
Collector Road (m)	20	20	20
Community Road (m)	12.5	12.5	12.5
Clearance between supporting structure and railway (m)	30	30	30

3) Applicable Codes/Standards and Units

With regard to the Project design, relevant international standards such as IEC and ISO and Japanese standards are applied to the major functions of equipment and facilities in conformity with the existing electrical equipment and facilities in Tanzania.

- 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
- 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

(2) Facilities Layout Plan

1) Substation Facilities

The layout plans for the six substations to be upgraded, expanded or constructed in the Project are described below.

The two substations targeted for upgrading (YMCA, Lawate) shall be constructed on land owned by TANESCO adjacent to the existing substations.

Transforming equipment (33/11kV transformer, 33kV outdoor switchgear cubicle, 11kV switchgear cubicle) shall be installed outdoors.

At the two substations targeted for expansion (Trade School and Kiyungi), equipment shall be installed inside the existing substation and on adjacent land.

Concerning expansion of the Trade School substation, the 33kV outgoing feeder to the KCMC substation to be constructed in the Project shall be branched off from the existing 33kV line, and a 33kV switchgear cubicle shall be installed outdoors to send power to the 33kV distribution line.

Concerning expansion of Kiyungi substation, transforming equipment (132/66kV 20MVA transformer, 132 kV switchgear and 66kV switchgear) for transmitting 66kV to Makuyuni substation to be constructed in the Project shall be additionally installed inside the substation. A control building (approximately 100 m^2) for housing the 132 kV switchgear and 66kV switchgear control and protection panels shall be constructed.

Concerning the two substations (KCMC, Makuyuni) to be newly constructed, TANESCO shall purchase the necessary construction sites from the landowners.

Concerning KCMC substation, transforming equipment (33/11kV transformer, 33kV outdoor switchgear cubicle, 11kV switchgear cubicle) shall be installed outdoors.

Concerning Makuyuni substation, the transforming equipment (66/33kV 20MVA transformer, 66kV switchgear and 33kV outdoor switchgear cubicle) shall be installed outdoors. A control building (approximately 300 m^2) for housing the 66kV switchgear and 33kV switchgear cubicle control and protection panels shall be constructed.

2) Transmission and distribution facilities

The layout plan for 66kV transmission lines and 33kV distribution lines to be constructed in the Project shall be as described below.

Concerning the 66kV transmission line, a single line of approximately 34 km shall be constructed from the 66kV transmission bay inside the existing Kiyungi substation to Makuyuni substation, which will be constructed in the Project. The 66kV line shall generally pass through flat land.

As for the 33kV distribution line, a single line of approximately 5 km shall be constructed from the 33kV outdoor switchgear cubicle that will be installed inside the Trade School substation in the Project to the KCMC substation, which will also be constructed in the Project. The 33kV distribution line shall pass along roads in the suburban area.

2-2-2-2 Outline of the Basic Plan

Table 2-2-2-2.1 shows an outline of the basic plan of assistance compiled based on the findings of the field surveys and results of discussions with the Tanzanian side.

Table 2-2-2-2.1 Outline of the Basic Plan

Category	Outline of Facilities	
Equipment and Materials Procurement and Installation Works Plan	1. Procurement and installation of 33kV and 11kV distribution equipment and materials for upgrading of YMCA S/S	
	(1) 33/11kV transformer (17MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	2. Procurement and installation of 33kV and 11kV distribution equipment and materials for upgrading of Lawate S/S	
	(1) 33/11kV transformer (10MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	3. Procurement and installation of 33kV and 11kV distribution equipment and materials for construction of KCMC S/S	
	(1) 33/11kV transformer (10MVA)	1 set
	(2) 33kV switchgear cubicle with circuit breaker	1 cubicle
	(3) 33kV metering cubicle	1 cubicle
	(4) 11kV switchgear cubicle	6 cubicles
	(5) 33kV dead end pole	1 set
	(6) 11kV dead end pole	3 sets
	(7) 33kV and 11kV cables	1 lot
	(8) Earthing equipment	1 lot
	(9) Outdoor lights	1 lot
	(10) Equipment foundations etc.	1 lot
	4. Procurement and installation of 33kV distribution equipment and materials for expansion of Trade School S/S	
	(1) 33kV switchgear cubicle with circuit breaker	1 set
	(2) 33kV metering cubicle	1 cubicle
	(3) 33kV dead end pole	1 set
	(4) 33kV cables	1 lot
	(5) Earthing equipment	1 lot
	(6) Equipment foundations etc.	1 lot
	5. Procurement and installation of 66kV receiving and 33kV distribution equipment and materials for construction of Makuyuni S/S	
	(1) 66kV switching equipment with frame	1 set
	(2) 66/33kV transformer (10MVA)	2 sets
	(3) 33kV switchgear cubicle with circuit breaker	6 cubicles
	(4) 33kV station transformer cubicle	1 cubicle
	(5) Low voltage panel	1 cubicle

Category	Outline of Facilities	
Equipment and Materials Procurement and Installation Works Plan	(6) Battery charger and battery	1 set
	(7) 66kV control and protection panels	1 lot
	(8) 33kV control and protection panels	1 lot
	(9) 33kV dead end pole	4 sets
	(10) 33kV cables	1 lot
	(11) Earthing equipment (including overhead earth wire)	1 lot
	(12) Outdoor lights	1 lot
	(13) Control building construction (300m^2, 1F)	1 set
	(14) Equipment foundations etc.	1 lot
	6. Procurement and installation of 132kV receiving and 66kV transmission equipment and materials for expansion of Kiyungi S/S	
	(1) 132kV switching equipment with frame	1 set
	(2) 66kV switching equipment with frame	1 set
	(3) 132/66kV transformer (20MVA)	1 set
	(4) Low voltage panel	1 cubicle
	(5) Battery charger and battery	1 set
	(6) 132kV control and protection panels	1 set
	(7) 66kV control and protection panels	1 set
	(8) 66kV cables	1 lot
	(9) Earthing equipment	1 lot
	(10) Control building construction (100m^2, 1F)	1 set
	(11) Auxiliary civil engineering facilities (equipment foundations)	1 lot
	7. Construction of 66kV transmission line between Kiyungi~Makuyuni (approximately 34 km)	
	(1) 66kV transmission line supports (steel towers)	1 lot
	(2) Transmission line equipment and materials (conductors, insulators, earthing equipment)	1 lot
	8. Construction of 33kV distribution line between Trade School~KCMC (approximately 5 km)	
	(1) 33kV distribution line supports (wooden poles/steel poles)	1 lot
	(2) Distribution line equipment and materials (conductors, insulators)	1 lot
Equipment and Materials Procurement Plan	Procurement of the following equipment and materials	
	(1) Spare parts for the procured equipment and materials	1 set
	(2) Maintenance tools	1 set

2-2-2-3 Construction Plan and Equipment Plan

(1) Upgrading of YMCA S/S

1) Basic Items

In order to upgrade the existing YMCA substation capacity (current transformer capacity is 5MVA) and the deteriorated 33kV switchgear equipment and 11kV switchgear cubicles, a new YMCA substation (approximately 25 x 15 m) shall be constructed on land adjacent to the existing substation.

One (1) new step down transformer (33/11kV, 17MVA), outdoor type 33kV/11kV switchgear cubicles, one (1) set of 33kV dead end poles (33kV incoming) and three (3) sets of 11kV dead end poles (11kV outgoing) shall be installed.

TANESCO shall execute the connection works from the 33kV receiving dead end poles to the existing 33kV distribution line and from the 11kV dead end poles to the existing 11kV distribution lines (3 lines).

Three feeders shall be used for drawing in the 11kV overhead distribution lines, and the circuit breakers and cable sizes shall be designed upon considering peak current capacity per feeder of 5MVA.

33kV and 11kV cables of armored type shall be directly buried under the ground about 1.0 m deep.

Low voltage and control cables shall be installed inside cable conduits.

The existing one (1) set of 33kV dead end poles (33kV incoming) and two (2) sets of 11kV dead end poles (11kV outgoing), which will obstruct the works, shall be demolished by TANESCO.

To ensure that the existing YMCA substation does not experience power outage during the works, the Japanese side shall procure temporary 33kV cables (approximately 90 m from the electric pole outside of the substation to the gantry tower inside the substation), and the TANESCO side shall install them.

2) Contents of the Plan

Table 2-2-2-3.1 shows the contents of transforming and distribution equipment and materials at YMCA substation.

Table 2-2-2-3.1 Contents of Transforming and Distribution Equipment and Materials for Upgrading of YMCA S/S

No.	Equipment	Contents
1	33/11kV transformer	Concerning the capacity and quantity of transformers, 17MVA x 1 set shall be adopted based on the results of the power demand projection in 2023. Transformer equipped with on-load tap changer and having the same tap voltage as the existing transformer shall be adopted.
2	33kV switchgear cubicle with circuit breaker	In order to receive power from the 33kV overhead distribution line and feed it to the 33kV side, a receiving cubicle (1) equipped with 33kV circuit breaker (1 set) shall be installed outside. Considering the transformer capacity (17MVA), the rated current of the circuit breaker shall be 600A.
3	33kV metering cubicle	If it isn't possible to house the metering transformer (current transformer, voltage transformer), measuring instruments and protective relays inside the 33kV switchgear cubicle with circuit breaker, the 33kV metering cubicle shall be installed outdoors.
4	11kV switchgear cubicle	Since the 11kV overhead distribution line has 3 outgoing lines, 3 feeders shall be adopted. Considering that the peak current capacity per feeder is 5MVA, the circuit breaker shall have a rated current of 600A. The 11kV switchgear cubicle shall comprise 6 cubicles, specifically 1 incoming feeder cubicle with circuit breaker, 3 outgoing feeder cubicles with circuit breakers, 1 station transformer and fuse cubicle and 1 battery/charger and distribution breaker cubicle, and these shall be installed outdoors.
5	33kV dead end pole	Dead end poles (1 set) for receiving power from the 33kV overhead line shall be installed inside the YMCA S/S and shall be equipped with 33kV lightening arresters and line switch.
6	11kV dead end pole	Dead end poles (3 sets) for distributing power from YMCA S/S to the 11kV overhead lines (3 lines) shall be installed and equipped with 11kV lightening arresters and line switch.
7	33kV and 11kV cables	The 33kV cables shall be connected from the 33kV dead end poles to the transformers (33kV side) via the 33kV switchgear cubicle. The 11kV cables shall be connected from the transformers (11kV side) to the 11kV dead end pole (3 sets) via the 11kV switchgear cubicle. Also, the Japanese side shall procure approximately 90 m of temporary cable for connecting the electric pole outside of the S/S to the steel tower inside the S/S during the works period.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.2 Outline Specifications of Major Equipment and Materials for YMCA S/S

No.	Item / Equipment	Specifications	Quantity
1	33/11kV Transformer		1 set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	33kV	
	3) Rated secondary voltage	11kV	
	4) Rated Capacity	17MVA	
	5) Cooling type	ONAN	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	33kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary：Star (neutral lead out) Secondary：Star (neutral lead out) Third：Delta	
	12) Impedance	About 7%	

No.	Item / Equipment	Specifications	Quantity
2	33kV Switchgear Cubicle with Circuit Breaker 1) Type 2) Number of cubicles 3) Type of circuit breaker 4) Rated current 5) Rated short-time withstand current	 Outdoor cubicle Incoming feeder: 1 cubicle VCB or GCB (1 set) 600A 16.5kA (1 sec.)	1 cubicle
3	33kV Metering Cubicle 1) Type 2) Number of cubicles 3) Metering and protection relays	 Outdoor cubicle 1 cubicle Inside of metering cubicle (Remarks: This cubicle is required in case the metering equipment and protective relays cannot be housed in the switchgear cubicle (fitted with circuit breaker)).	1 cubicle
4	11kV Switchgear Cubicle 1) Type 2) Number of cubicles 3) Type of circuit breaker 4) Rated current 5) Rated short-time withstand current 6) Metering and protection relays	 Outdoor cubicle Incoming feeder: 1 cubicle (with circuit breaker) Outgoing feeder: 3 cubicles (with circuit breaker) Station transformer: 1 cubicle (with fuse) Battery and charger: 1 cubicle (with mold case circuit breaker) VCB or GCB (Incoming feeder: 1 set, Outgoing feeder: 3 sets) Incoming feeder: 1,200A, Outgoing feeder: 600A 16.5kA (1 sec.) Inside of cubicles	6 cubicles
5	33kV Dead End Pole 1) Type 2) Equipment mounted on pole	 Gantry type 33kV Lightning Arresters and Line Switch	1 set
6	11kV Dead End Pole 1) Type 2) Equipment mounted on pole	 Gantry type 11kV Lightning Arresters and Line Switches	3 sets
7	33kV and 11kV Cables 1) Type 2) Conductor and insulation	 Armored type cables directly buried under the ground Copper conductor and XLPE insulation	1 set

(2) Upgrading of Lawate S/S

1) Basic Items

In order to upgrade the existing Lawate substation capacity (current transformer capacity is 2.5MVA) and the deteriorated 33kV switchgear equipment and 11kV switchgear cubicles, a new Lawate substation (approximately 30 x 18 m) shall be constructed on land adjacent to the existing substation.

One (1) new step down transformer (33/11kV, 10MVA), outdoor type 33kV/11kV switchgear cubicles, one (1) set of 33kV dead end poles (33kV incoming) and three (3) sets of 11kV dead end poles (11kV outgoing) shall be installed.

TANESCO shall execute the connection works from the 33kV receiving dead end poles to the existing 33kV distribution line and from the 11kV dead end poles to the existing 11kV distribution lines (3 lines).

Three feeders shall be used for drawing in the 11kV overhead distribution lines, and the circuit breakers and cable sizes shall be designed upon considering peak current capacity per feeder of 5MVA.

33kV and 11kV cables of armored type shall be directly buried under the ground about 1.0 m deep.

Low voltage and control cables shall be installed inside cable conduits.

The earthing resistance of the substation site shall be designed as no more than 10 ohm.

2) Contents of the Plan

Table 2-2-2-3.3 shows the contents of transforming and distribution equipment and materials at Lawate substation.

Table 2-2-2-3.3 Contents of Transforming and Distribution Equipment and Materials for Upgrading of Lawate S/S

No.	Equipment	Contents
1	33/11kV transformer	Concerning the capacity and quantity of transformers, 10MVA x 1 set shall be adopted based on the results of the power demand projection in 2023. Transformer equipped with on-load tap changer and having the same tap voltage as the existing transformer shall be adopted.
2	33kV switchgear cubicle with circuit breaker	In order to receive power from the 33kV overhead distribution line and feed it to the 33kV side, a receiving cubicle (1) equipped with 33kV circuit breaker (1 set) shall be installed outside. Considering the transformer capacity (10MVA), the rated current of the circuit breaker shall be 600A.
3	33kV metering cubicle	If it isn't possible to house the metering transformer (current transformer, voltage transformer), measuring instruments and protective relays inside the 33kV switchgear cubicle with circuit breaker, the 33kV metering cubicle shall be installed outdoors.
4	11kV switchgear cubicle	Since the 11kV overhead distribution line has 3 outgoing lines, 3 feeders shall be adopted. Considering that the peak current capacity per feeder is 5MVA, the circuit breaker shall have a rated current of 600A. The 11kV switchgear cubicle shall comprise 6 cubicles, specifically 1 incoming feeder cubicle with circuit breaker, 3 outgoing feeder cubicles with circuit breakers, 1 station transformer and fuse cubicle and 1 battery/charger and distribution breaker cubicle, and these shall be installed outdoors.
5	33kV dead end pole	Dead end poles (1 set) for receiving power from the 33kV overhead line shall be installed inside the Lawate S/S and shall be equipped with 33kV lightening arrester and line switch.
6	11kV dead end pole	Dead end poles (3 sets) for distributing power from the Lawate S/S to the 11kV overhead lines (3 lines) shall be installed and equipped with 11kV lightening arresters and line switch.
7	33kV and 11kV cables	The 33kV cables shall be connected from the 33kV dead end poles to the transformers (33kV side) via the 33kV switchgear cubicle. The 11kV cables shall be connected from the transformers (11kV side) to the 11kV dead end pole (3 sets) via the 11kV switchgear cubicle.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.4 Outline Specifications of Major Equipment and Materials for Lawate S/S

No.	Item / Equipment	Specifications	Quantity
1	33/11kV Transformer		1 set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	33kV	
	3) Rated secondary voltage	11kV	
	4) Rated Capacity	10MVA	
	5) Cooling type	ONAN	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	33kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary: Star (neutral lead out) Secondary: Star (neutral lead out) Third: Delta	
	12) Impedance	About 7%	
2	33kV Switchgear Cubicle with Circuit Breaker		1 cubicle
	1) Type	Outdoor cubicle	
	2) Number of cubicles	Incoming feeder: 1 cubicle	
	3) Type of circuit breaker	VCB or GCB (1 set)	
	4) Rated current	600A	
	5) Rated short-time withstand current	16.5kA (1 sec.)	
3	33kV Metering Cubicle		1 cubicle
	1) Type	Outdoor cubicle	
	2) Number of cubicles	1 cubicle	
	3) Metering and protection relays	Inside of metering cubicle (Remarks: This cubicle is required in case the metering equipment and protective relays cannot be housed in the switchgear cubicle (fitted with circuit breaker)).	
4	11kV Switchgear Cubicle		6 cubicles
	1) Type	Outdoor cubicle	
	2) Number of cubicles	Incoming feeder: 1 cubicle (with circuit breaker) Outgoing feeder: 3 cubicles (with circuit breaker) Station transformer: 1 cubicle (with fuse) Battery and charger: 1 cubicle (with mold case circuit breaker)	
	3) Type of circuit breaker	VCB or GCB (Incoming feeder: 1 set, Outgoing feeder: 3 sets)	
	4) Rated current	Incoming feeder: 1,200A, Outgoing feeder: 600A	
	5) Rated short-time withstand current	16.5kA (1 sec.)	
	6) Metering and protection relays	Inside of cubicles	
5	33kV Dead End Pole		1 set
	1) Type	Gantry type	
	2) Equipment mounted on pole	33kV Lightning Arresters and Line Switch	
6	11kV Dead End Pole		3 sets
	1) Type	Gantry type	
	2) Equipment mounted on pole	11kV Lightning Arresters and Line Switches	
7	33kV and 11kV Cables		1 set
	1) Type	Armored type cables directly buried under the ground	
	2) Conductor and insulation	Copper conductor and XLPE insulation	

(3) Construction of KCMC S/S

1) Basic Items

Part of the land currently owned by KCMC Hospital shall be obtained, and KCMC substation shall be constructed on a plot of this measuring approximately 30 x 30 m.

One (1) new step down transformer (33/11kV, 10MVA), outdoor type 33kV/11kV switchgear cubicles, one (1) set of 33kV dead end poles (33kV incoming) and three (3) sets of 11kV dead end poles (11kV outgoing) shall be installed.

The Japanese side shall install the 33kV distribution line from the Trade School substation to the 33kV incoming dead end pole, while the TANESCO side shall connect the 11kV dead end pole to the existing 11kV distribution lines (3 lines).

Three feeders shall be used for drawing in the 11kV overhead distribution lines, and the circuit breakers and cable sizes shall be designed upon considering peak current capacity per feeder of 5MVA.

33kV and 11kV cables of armored type shall be directly buried under the ground about 1.0 m deep.

Low voltage and control cables shall be installed inside cable conduits.

The earthing resistance of the substation site shall be designed as no more than 10 ohm.

2) Contents of the Plan

Table 2-2-2-3.7 shows the contents of transforming and distribution equipment and materials at KCMC substation.

Table 2-2-2-3.7 Contents of Transforming and Distribution Equipment and Materials for Upgrading of KCMC S/S

No.	Equipment	Contents
1	33/11kV transformer	Concerning the capacity and quantity of transformers, 10MVA x 1 set shall be adopted based on the results of the power demand projection in 2023. Transformer equipped with on-load tap changer and having the same tap voltage as the existing transformer shall be adopted.
2	33kV switchgear cubicle with circuit breaker	In order to receive power from the 33kV overhead distribution line and feed it to the 33kV side, a receiving cubicle (1) equipped with 33kV circuit breaker (1 set) shall be installed outside. Considering the transformer capacity (10MVA), the rated current of the circuit breaker shall be 600A.
3	33kV metering cubicle	If it isn't possible to house the metering transformer (current transformer, voltage transformer), measuring instruments and protective relays inside the 33kV switchgear cubicle with circuit breaker, the 33kV metering cubicle shall be installed outdoors.
4	11kV switchgear cubicle	Since the 11kV overhead distribution line has 3 outgoing lines, 3 feeders shall be adopted. Considering that the peak current capacity per feeder is 5MVA, the circuit breaker shall have a rated current of 600A. The 11kV switchgear cubicle shall comprise 6 cubicles, specifically 1 incoming feeder cubicle with circuit breaker, 3 outgoing feeder cubicles with circuit breakers, 1 station transformer and fuse cubicle and 1 battery/charger and distribution breaker cubicle, and these shall be installed outdoors.

No.	Equipment	Contents
5	33kV dead end pole	Dead end poles (1 set) for receiving power from the 33kV overhead line shall be installed inside the KCMC S/S and shall be equipped with 33kV lightening arresters and line switch.
6	11kV dead end pole	Dead end poles (3 sets) for distributing power from the KCMC S/S to the 11kV overhead lines (3 lines) shall be installed and equipped with 11kV lightening arresters and line switch.
7	33kV and 11kV cables	The 33kV cables shall be connected from the 33kV dead end poles to the transformers (33kV side) via the 33kV switchgear cubicle. The 11kV cables shall be connected from the transformers (11kV side) to the 11kV dead end pole (3 sets) via the 11kV switchgear cubicle.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.8 Outline Specifications of Major Equipment and Materials for KCMC S/S

No.	Item / Equipment	Specifications	Quantity
1	33/11kV Transformer		1 set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	33kV	
	3) Rated secondary voltage	11kV	
	4) Rated Capacity	10MVA	
	5) Cooling type	ONAN	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	33kV +10% to -10%	
	9) Number of taps	17 taps	
	10) Step voltage	1.25%	
	11) Winding connection	Primary: Star (neutral lead out) Secondary: Star (neutral lead out) Third: Delta	
	12) Impedance	About 7%	
2	33kV Switchgear Cubicle with Circuit Breaker		1 cubicle
	1) Type	Outdoor cubicle	
	2) Number of cubicles	Incoming feeder: 1 cubicle	
	3) Type of circuit breaker	VCB or GCB (1 set)	
	4) Rated current	600A	
	5) Rated short-time withstand current	16.5kA (1 sec.)	
3	33kV Metering Cubicle		1 cubicle
	1) Type	Outdoor cubicle	
	2) Number of cubicles	1 cubicle	
	3) Metering and protection relays	Inside of metering cubicle (Remarks: This cubicle is required in case the metering equipment and protective relays cannot be housed in the switchgear cubicle (fitted with circuit breaker)).	
4	11kV Switchgear Cubicle		6 cubicles
	1) Type	Outdoor cubicle	
	2) Number of cubicles	Incoming feeder: 1 cubicle (with circuit breaker) Outgoing feeder: 3 cubicles (with circuit breaker) Station transformer: 1 cubicle (with fuse) Battery and charger: 1 cubicle (with mold case circuit breaker)	
	3) Type of circuit breaker	VCB or GCB (Incoming feeder: 1 set, Outgoing feeder: 3 sets)	
	4) Rated current	Incoming feeder: 1,200A, Outgoing feeder: 600A	
	5) Rated short-time withstand current	16.5kA (1 sec.)	
	6) Metering and protection relays	Inside of cubicles	

No.	Item / Equipment	Specifications	Quantity
5	33kV Dead End Pole 1) Type 2) Equipment mounted on pole	 Gantry type 33kV Lightning Arresters and Line Switch	1 set
6	11kV Dead End Pole 1) Type 2) Equipment mounted on pole	 Gantry type 11kV Lightning Arresters and Line Switches	3 sets
7	33kV and 11kV Cables 1) Type 2) Conductor and insulation	 Armored type cables directly buried under the ground Copper conductor and XLPE insulation	1 set

(4) Expansion of Trade School S/S

1) Basic Items

New outdoor type 33kV switchgear cubicles and one (1) set of 33kV dead end poles (33kV outgoing feeder to KCMC substation) shall be installed at an area adjacent to the existing Trade School, on a plot of land (approximately 9 x 8 m) that won't interfere with the substation upgrading plans compiled by TEDAP.

33kV underground cable shall connect the existing 33kV electric pole to the 33kV dead end poles for outgoing feeder to KCMC S/S via the outdoor 33kV switchgear cubicle so that the TEDAP plans for substation upgrading are not hindered. 33kV cables of armored type shall be directly buried under the ground about 1.0 meter deep.

Earthing wire for new 33kV switchgear cubicle shall be connected to the existing earthing wires of Trade School substation.

2) Contents of the Plan

Table 2-2-2-3.9 shows the contents of transforming and distribution equipment and materials at Trade School substation.

Table 2-2-2-3.9 Contents of Transforming and Distribution Equipment and Materials for Upgrading of Trade School S/S

No.	Equipment	Contents
1	33kV switchgear cubicle with circuit breaker	In order to receive power from the 33kV overhead distribution line and feed it to the KCMC S/S, a receiving cubicle (1) equipped with 33kV circuit breaker (1 set) shall be installed outside. Considering the transformer capacity (10MVA) at KCMC S/S, the rated current of the circuit breaker shall be 600A.
2	33kV metering cubicle	If it isn't possible to house the metering transformer (current transformer, voltage transformer), measuring instruments and protective relays inside the 33kV switchgear cubicle with circuit breaker, the 33kV metering cubicle shall be installed outdoors.
3	33kV dead end pole	Dead end poles (1 set) for feeding the 33kV overhead line to KCMC S/S shall be installed inside the Trade School S/S and shall be equipped with 33kV lightening arresters and line switch.
4	33kV cables	The 33kV cables shall be connected from the existing electric pole to the 33kV dead end poles via the 33kV switchgear cubicle.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.10 Outline Specifications of Major Equipment and Materials for Trade School S/S

No.	Item / Equipment	Specifications	Quantity
1	33kV Switchgear Cubicle with Circuit Breaker 1) Type 2) Number of cubicle 3) Type of Circuit Breaker 4) Rated current 5) Rated short-time withstand current	 Outdoor cubicle Incoming feeder: 1 cubicle VCB or GCB (1 set) 600A 16.5kA (1 sec.)	1 cubicle
2	33kV Metering Cubicle 1) Type 2) Number of cubicles 3) Metering and protection relays	 Outdoor cubicle 1 cubicle Inside of metering cubicle (Remarks: This cubicle is required in case the metering equipment and protective relays cannot be housed in the switchgear cubicle (fitted with circuit breaker)).	1 cubicle
3	33kV dead end pole 1) Type 2) Equipment mounted on pole	 Gantry type 33kV Lightning Arresters and Line Switch	1 set
4	33kV cables 1) Type 2) Conductor and insulation	 Armored type cables directly buried under the ground Copper conductor and XLPE insulation	1 set

(5) Construction of Makuyuni S/S

1) Basic Items

Land that used to be privately owned was purchased by TANESCO, and Makuyuni substation shall be constructed on a plot of this measuring approximately 85 x 50 m.

Two (2) outdoor type step down transformers (66/33kV, 10MVA each), 66kV outdoor type switching equipment (circuit breakers, line switches, etc.), outdoor type 33kV switchgear cubicles, and four (4) sets of 33kV dead end poles shall be installed at the substation site. 66kV/33kV control/protection panels shall be installed inside the control building (approximately 20 x 15 m), while batteries shall be installed inside the battery room of the control building.

Four outgoing 33kV feeders shall be installed and the size of circuit breakers and 33kV feeder cables shall be designed based on the feeder capacity of 10MVA current capacity per feeder.

33kV and 11kV cables of armored type shall be directly buried under the ground about 1.0 m deep.

Low voltage and control cables shall be installed inside cable conduits.

The earthing resistance of the substation site shall be designed as no more than 10 ohm.

SCADA (Supervisory Control and Data Acquisition) and communication systems (power line carrier and/or another system) for the substation shall be designed and procured by TANESCO.

2) Contents of the Plan

Table 2-2-2-3.11 shows the contents of transforming and distribution equipment and materials at Makuyuni substation.

Table 2-2-2-3.11 Contents of Transforming and Distribution Equipment and Materials for Upgrading of Makuyuni S/S

No.	Equipment	Contents
1	66kV circuit breakers	One (1) 66kV, SF6 gas circuit breaker shall be installed at the incoming point from the 66kV overhead transmission line, and two sets shall be installed outdoors at the 66/33kV transformer (2 transformers) feeders.
2	66kV line switch	One (1) 66kV, manually operated line switch shall be installed at the incoming point from the 66kV overhead transmission line, and two sets shall be installed outdoors at the 66/33kV transformer (2 transformers) feeders.
3	66kV current transformers	Three (3) sets of 66kV current transformers shall be installed outdoors for the metering and protective relays.
4	66kV voltage transformers	One (1) set of 66kV voltage transformer shall be installed outdoors for the metering and protective relays.
5	66/33kV transformers	Concerning the capacity and quantity of transformers, 10MVA x 2 sets shall be adopted based on the results of the power demand projection in 2023. Transformers equipped with on-load tap changer and having the same tap voltage as transformers at other S/S shall be adopted.
6	33kV switchgear cubicle with circuit breaker	Two (2) receiving cubicles from the 66/33kV transformer to the secondary (33kV) side and four (4) feeder cubicles to the 33kV overhead distribution line shall be installed outside. Considering the peak current capacity per feeder (5MVA), the rated current of the circuit breaker shall be 600A.
7	33kV station transformer cubicle	A 33kV station transformer cubicle (1 cubicle) containing the station transformer (33kV/415-240V, 50kVA, 1 set) shall be installed adjacent to the 33kV switchgear cubicle with circuit breaker.
8	Low voltage panel	A low voltage panel (1 cubicle) shall be installed inside the control building as a low voltage power supply for the transforming equipment and control building.
9	Battery charger and battery	A battery charger and battery (1 set) shall be installed inside the control building as a DC power supply for transforming equipment.
10	66kV control and protection panels	66kV control and protection panels equipped with the measuring instruments and protective relays needed to monitor and control the 66kV switchgear shall be installed inside the control building.
11	33kV control and protection panels	33kV control and protection panels equipped with the measuring instruments and protective relays needed to monitor and control the 33kV switchgear shall be installed inside the control building.
12	33kV dead end pole	Dead end poles (4 sets) for transmitting power from the 33kV overhead lines inside Makuyuni S/S shall be installed and equipped with 33kV lightening arresters and line switch.
13	33kV cables	The 33kV cables shall be connected from the secondary (33kV) side of the 66/33kV transformer to the 33kV dead end poles (4 sets) via the 33kV switchgear cubicle.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.12 Outline Specifications of Major Equipment and Materials forMakuyuni S/S

No.	Item / Equipment	Specifications	Quantity
1	66kV Circuit Breaker 1) Type 2) Rated voltage 3) Rated current 4) Rated short-time withstand current 5) Rated break time 6) Controlled source	 Outdoor type, SF6 gas, 3-phase 66kV 1,250A 25kA, 1 second 3-cycle DC110V	3 sets

No.	Item / Equipment	Specifications	Quantity
2	66kV Line Switch 1) Type 2) Rated voltage 3) Rated current 4) Rated short-time withstand current	 Outdoor type, Manual operation, 3-phase, Horizontal or Vertical break type, with earthing switch 66kV 1,250A 25kA, 1 second	3 sets
3	66kV Current Transformers 1) Type 2) Rated voltage 3) Rated primary current 4) Rated secondary current 5) Accuracy class 6) Rated secondary burden 7) Rated short-time withstand current	 Outdoor, single phase 66kV 600-300A, 400-200A 1A Metering: Class 0.5, Protection: Class 5P 20VA 25kA, 1 second	3 sets
4	66kV Voltage Transformers 1) Type 2) Rated primary voltage 3) Rated secondary voltage 4) Accuracy class 5) Rated secondary burden	 Outdoor, single phase $66/\sqrt{3}$ kV $110\sqrt{3}$ V Metering: Class 1.0, Protection: Class 3P 100VA	1 set
5	66/33kV Transformer 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) Winding connection 12) Impedance	 Outdoor, oil immersed, with on-load tap changer 66kV 33kV 10MVA ONAN 3 50Hz 66kV +10% to -10% 17 taps 1.25% Primary: Star (neutral lead out) Secondary: Star (neutral lead out) Third: Delta About 7%	2 sets
6	33kV Switchgear Cubicle with Circuit Breaker 1) Type 2) Number of cubicle 3) Circuit Breaker 4) Rated current 5) Rated short-time withstand current	 Outdoor cubicle Incoming feeder: 2 cubicle Outgoing feeder: 4 cubicle VCB or GCB (Incoming feeder: 2 sets, Outgoing feeder: 4 sets) Incoming feeder: 600A, Outgoing feeder: 600A 16.5kA (1 sec.)	6 cubicles
7	33kV Station Transformer Cubicle 1) Type 2) Number of cubicle 3) Equipment inside cubicle	 Outdoor cubicle 1 cubicle One station transformer (33kV/415-240V, 100kVA) with fuse and mold case circuit breakers	1 cubicle
8	Low Voltage Panel 1) Type 2) Voltage 3) Type of Circuit Breaker	 Indoor type 3 phase 4 wires, 415/240V Mold case circuit breakers	1 cubicle

No.	Item / Equipment	Specifications	Quantity
9	Battery Charger and Battery 1) Battery charger type 2) Battery charger rating 3) Battery model 4) Battery rating	 Indoor, thyristor type DC110V, 50A Lead-acid battery 250AH/10HR	1 set
10	66kV Control & Protection Panels 1) Type	 Indoor	1 set
11	33kV Control & Protection Panels 1) Type	 Indoor	1 set
12	33kV Dead End Pole 1) Type 2) Equipment mounted on pole	 Gantry type 33kV Lightning Arresters and Line Switch	4 sets
13	33kV Cables 1) Type 2) Conductor and insulation	 Armored type cables directly buried under the ground Copper conductor and XLPE insulation	1 set

4) Outline Specifications of the Substation Building

A reinforced concrete frame and block masonry, single story control building (approximately 20 x 15 m) shall be constructed for monitoring the operation of Makuyuni substation. The outline specifications of the control building shall be as follows.

① Control room

This room, having area of 180m^2, shall be equipped with the 66kV control and protection panels, 33kV control and protection panels, low voltage panel and battery charger.

② Battery room

This room, having an area of approximately 15 m^2, shall house the batteries (lead, 250AH/10HR).

③ Office

The substation office shall be permanently manned by the station manager (1) and operation and monitoring staff (2). It shall have an area of approximately 37.5 m^2.

④ Storeroom

The storeroom for storing spare parts and tools shall have an area of approximately 20m^2.

⑤ Sanitary equipment

Flush toilets and infiltration septic tanks shall be installed. A water tank (PVC, 2m^3) shall be installed outdoors.

(6) Expansion of Kiyungi S/S

1) Basic Items

One (1) 132/66kV, 20MVA transformer, 132kV switching equipment and 66kV switching equipment shall be installed at existing Kiyungi substation (trunk substation) serving Makuyuni

substation (66/33kV, 20MVA), which shall be constructed in the Project.

The existing 66kV bus bar shall be extended to install new 66kV outgoing bay (circuit breaker, line switch, etc) for the new Makuyuni substation.

The secondary (66kV) side of the new 132/66kV transformer and the existing 66kV bus bars shall be connected with 66kV armored cables directly buried under the ground about 1.0 meter deep.

A 66kV line switch to separate the extended 66kV bus bar from the existing one shall be installed so as not to allow parallel operation of old and new 132/66kV transformers.

The 132kV/66kV control/protection panels, battery/charger and low voltage panel shall be installed at a new control building (10 x 10 m).

A new low voltage panel and the existing station transformer (33kV/400-230V, 50kVA) shall be connected with low voltage cables.

Low voltage and control cables shall be installed inside new and/or existing cable trench and conduit.

The earthing wire of new equipment shall be connected to the existing earthing wires at Kiyungi substation.

SCADA (Supervisory Control and Data Acquisition) and communication systems (power line carrier and/or other system) for the substation shall be designed and provided by TANESCO.

Steel towers for the overhead grounding wires of new 66kV outgoing bay for Makuyuni substation shall be designed and procured by TANESCO.

2) Contents of the Plan

Table 2-2-2-3.13 shows the contents of transforming and distribution equipment and materials at Kiyungi substation.

Table 2-2-2-3.13 Contents of Transforming equipment and Materials for Expansion of Kiyungi S/S

No.	Equipment	Contents
1	132kV circuit breaker	One (1) 132kV, SF6 gas circuit breaker shall be installed outdoors between the existing 132kV bus line and the new 132/66kV transformer.
2	132kV line switch	One (1) 132kV motor-driven line switch shall be installed outdoors between the existing 132kV bus line and the new 132/66kV transformer.
3	132kV current transformer	One (1) 132kV current transformer shall be installed outdoors for the metering and protective relays.
4	66kV circuit breakers	One (1) 66kV, SF6 gas circuit breaker shall be installed on the secondary (66kV) side of the 132/66kV transformer, and one (1) shall be installed outdoors for transmitting power to Makuyuni S/S.
5	66kV line switch	One (1) manually operated 66kV line switch shall be installed on the secondary (66kV) side of the 132/66kV transformer, and two (2) shall be installed outdoors for transmitting power to Makuyuni S/S.
6	66kV bushing current transformer (equipped in the 66kV circuit breaker)	Four (4) 66kV bushing current transformers shall be installed in the two (2) 66kV circuit breakers for metering and protective relay.
7	66kV voltage transformers	One (1) 66kV voltage transformer shall be installed outdoors for the metering and protective relays.
8	132/66kV transformer	Concerning the capacity and quantity of transformers, 20MVA x 1 set shall be adopted in line with Makuyuni S/S. Transformer equipped with on-load tap changer and having the same tap voltage as the existing transformer (T1) shall be adopted.
9	Low voltage panel	A low voltage panel (1 cubicle) shall be installed inside the control building as a low voltage power supply for the transforming equipment and control building.
10	Battery charger and battery	A battery charger and battery (1 set) shall be installed inside the control building as a DC power supply for transforming equipment.
11	132kV control and protection panels	132kV control and protection panels equipped with the measuring instruments and protective relays needed to monitor and control the 132kV switchgear shall be installed inside the control building.
12	66kV control and protection panels	66kV control and protection panels equipped with the measuring instruments and protective relays needed to monitor and control the 66kV switchgear shall be installed inside the control building.
13	66kV cables	The 66kV cables shall be connected from the secondary (66kV) side of the 132/66kV transformer to the 66kV existing bus line.

3) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.14 Outline Specifications of Major Equipment and Materials for Kiyungi S/S

No.	Item / Equipment	Specifications	Quantity
1	132kV Circuit Breaker		1 set
	1) Type	Outdoor type, SF6 gas, 3-phase	
	2) Rated voltage	132kV	
	3) Rated current	1,250A	
	4) Rated short-time withstand current	25kA, 1 second	
	5) Rated break time	3-cycle	
	6) Controlled source	DC110V	
2	132kV Line Switch		1 set
	1) Type	Outdoor type, Motor-driven, 3-phase, Horizontal or Vertical break type	
	2) Rated voltage	132kV	
	3) Rated current	1,250A	
	4) Rated short-time withstand current	25kA, 1 second	
	5) Controlled source	DC110V	
	6) Motor power source voltage	DC 110V	

No.	Item / Equipment	Specifications	Quantity
3	132kV Current Transformers 1) Type 2) Rated voltage 3) Rated primary current 4) Rated secondary current 5) Accuracy class 6) Rated secondary burden 7) Rated short-time withstand current	 Outdoor, single phase 132kV 400-200A 1A Metering: Class 0.5, Protection: Class 5P 20VA 25kA, 1 second	1 set
4	66kV Circuit Breaker 1) Type 2) Rated voltage 3) Rated current 4) Rated short-time withstand current 5) Rated break time 6) Controlled source	 Outdoor type, SF6 gas, 3-phase 66kV 1,250A 25kA, 1 second 3-cycle DC110V	2 sets
5	66kV Line Switch 1) Type 2) Rated voltage 3) Rated current 4) Rated short-time withstand current	 Outdoor type, Manual operation, 3-phase, Horizontal or vertical break type, with earthing switch 66kV 1,250A 25kA, 1 second	3 sets
6	66kV Bushing Current Transformer (equipped in 66kV circuit breaker) 1) Type 2) Rated voltage 3) Rated primary current 4) Rated secondary current 5) Accuracy class 6) Rated secondary burden 7) Rated short-time withstand current	 Outdoor type, single phase, bushing type (equipped in 66kV circuit breaker) 66kV 800-400A 1A Metering: class 0.5, Protection: class 5P 20VA 25kA, 1 second	4 sets
7	66kV Voltage Transformers 1) Type 2) Rated primary voltage 3) Rated secondary voltage 4) Accuracy class 5) Rated secondary burden	 Outdoor, single phase $66/\sqrt{3}$ kV $110/\sqrt{3}$ V Metering: class 1.0, Protection: class 3P 100VA	1 set

No.	Item / Equipment	Specifications	Quantity
8	132/66kV Transformer		1 set
	1) Type	Outdoor, oil immersed, with on-load tap changer	
	2) Rated primary voltage	132kV	
	3) Rated secondary voltage	66kV	
	4) Rated Capacity	20MVA	
	5) Cooling type	ONAN	
	6) Number of phases	3	
	7) Frequency	50Hz	
	8) Tap voltage	132kV+5% to -15%	
	9) Number of taps	17 taps	
	10) Winding connection	Primary：Star (neutral lead out) Secondary：Star (neutral lead out) Third：Delta	
	11) Impedance	About 11%	
9	Low Voltage Panel		1 set
	1) Type	Indoor type	
	2) Voltage	3 phase 4 wires, 415/240V	
	3) Circuit Breakers	Mold case circuit breakers	
10	Battery Charger and Battery		1 set
	1) Battery charger type	Indoor, thyristor type	
	2) Battery charger rating	DC110V, 30A	
	3) Battery model	Lead-acid battery	
	4) Battery rating	150AH/10HR	
11	132kV Control & Protection Panels		1 set
	1) Type	Indoor	
12	66kV Control & Protection Panels		1 set
	1) Type	Indoor	
13	66kV Cables		1 set
	1) Type	Armored type cables directly buried under the ground	
	2) Conductor and insulation	Copper conductor and XLPE insulation	

4) Outline Specifications of the Substation Building

A reinforced concrete frame and block masonry, single story control building (approximately 10 x 10 m) shall be constructed for monitoring the operation of the 132kV and 66kV transforming equipment to be expanded in the Project. The outline specifications of the control building shall be as follows.

① Control room

This room, having area of 85m^2, shall be equipped with the 132kV control and protection panels, 66kV control and protection panels, low voltage panel and battery charger.

② Battery room

This room, having an area of approximately 15 m^2, shall house the batteries (lead, 150AH/10HR).

(7) Construction of 66kV Transmission Line between Kiyungi and Makuyuni

1) Basic Items and Contents of Plan

A 66kV transmission line of single circuit and approximately 34 km long shall be constructed between the Makuyuni substation 66kV outgoing bay newly constructed in the Project inside the

key existing substation at Kiyungi and the new Makuyuni substation constructed in the Project. The line shall pass through mostly flat land.

Standard span length of support shall be 200~250 m and the sag shall be around 3 percent. The material and size of conductors shall be ACSR 150 mm^2 .

When designing the strength of the steel towers, consideration shall be given to the load of overhead optical grounding wire (OPGW) procured and installed by TANESCO. The shield angle between OPGW and conductor shall be no more than 60 degrees.

2) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.15 shows the outline specifications of major equipment and materials for the 66kV transmission line between Kiyungi substation and Makuyuni substation.

Table 2-2-2-3.15 Outline Specifications of Major Equipment and Materials for 66kV Transmission Line between Kiyungi S/S and Makuyuni S/S

No.	Item / Equipment	Specifications	Quantity
1	Type of support	Steel structure lattice type	
		Type A	123 sets
		Type A+3m	12 sets
		Type B	20 sets
		Type B+3m	3 sets
		Type C	6 sets
		Type D	2 sets
		Type R	6 sets
		Type R+3m	1 set
2	Type and size of conductor	ACSR 150mm^2 (Wolf)	115,566m
3	Type and number of suspension insulator	Disc type (approx. 250mm), 6 pieces per unit	1 lot

(8) Construction of 33kV Distribution Line between Trade School S/S and KCMC S/S

1) Basic Items and Contents of Plan

A 33V distribution line of single circuit, about 5 km long shall be constructed between the 33kV outdoor switchgear cubicle newly installed at the Trade School substation in the Project and KCMC substation, which shall be constructed in the Project. The line passes along roads in the urban area.

As for the design of 33kV distribution line, TANESCO's standards shall be applied basically.

The standard span of poles shall be 100 m and ACSR100 mm^2 shall be adopted for conductors.

Wooden poles (12 m and 14 m) shall be used in general but steel poles (15 m) shall be adopted in locations where the line crosses over roads and/or existing 33kV/11kV/LV distribution lines.

Stay blocks (stay anchors) will not be required because the line passes through an area of favorable soil conditions.

2) Outline Specifications of Major Equipment and Materials

Table 2-2-2-3.16 shows the outline specifications of major equipment and materials for the 33kV distribution line between the Trade School substation and KCMC substation.

Table 2-2-2-3.16 Outline Specifications of Major Equipment and Materials for 33kV Distribution Line between Trade School S/S and KCMC S/S

No.	Item / Materials	Specifications	Quantity
1	Type of support and length	Wooden pole: 12 m	
		Type A	29 sets
		Type B	4 sets
		Type C	1 set
		Type E	2 sets
		Type F	2 sets
		Wooden pole: 14 m	
		Type D	5 sets
		Steel pole: 15 m (crosses over a road and/or existing distribution lines)	
		Type G	14 sets
2	Type and size of conductor	ACSR 100 mm^2 (Dog)	16,995 m
3	Type and number of suspension insulator	Disc type (aprox. 250 mm), 3 pieces per unit	1 lot

(9) Spare Parts and Maintenance Tools

1) Basic Items and Contents of Plan

The spare parts to be procured in the Project shall be categorized according to purpose of use as follows.

① Consumables: Parts that become worn and deteriorated in regular use and require regular replacement. The quantity shall be 100 percent of the quantity deemed to be necessary per year.

② Replacement parts: Repair parts that have little wear and deterioration in regular use but are at risk of parts breakage, etc. The quantity shall be 100 percent of the quantity deemed to be necessary per year.

Moreover, maintenance tools shall also be procured in the Project in order to enable the appropriate maintenance of transforming equipment.

2) Outline Specifications

Table 2-2-21 shows the outline specifications of spare parts and maintenance tools to be procured in the Project.

2-2-2-3.17 Spare Parts and Maintenance Tools to be Procured in the Project

Name	Unit	Quantity	Remarks
1. Consumable			
1.1 Transformer			YMCA, Lawate, KCMC, Makuyuni and Kiyungi substations
(1) Silica gel	kg	2	Each substation
2. Replacement parts			
2.1 Transformer			YMCA, Lawate, KCMC, Makuyuni and Kiyungi substations
(1) Lamp (each type)	pc	1	Each substation
(2) Fuse (each type)	pc	1	Each substation
(3) Space heater (each type)	pc	1	Each substation
(4) Packing (each type)	lot	1	Each substation
2.2 132kV Circuit Breaker			Kiyungi substation
(1) Closing coil	pc	1	
(2) Tripping coil	pc	1	
(3) Gasket	pc	1	
2.3 66kV Circuit Breaker			Makuyuni and Kiyungi substations
(1) Closing coil	pc	1	Each substation
(2) Tripping coil	pc	1	Each substation
(3) Gasket	pc	1	Each substation
2.4 33kV Switchgear Cubicle			YMCA, Lawate, KCMC, Trade School and Makuyuni substations
(1) Lamp (each type)	pc	1	Each substation
(2) Fuse (each type)	pc	1	Each substation
(3) Space heater (each type)	pc	1	Each substation
2.5 11kV Switchgear Cubicle			YMCA, Lawate, and KCMC substations
(1) Lamp (each type)	pc	1	Each substation
(2) Fuse (each type)	pc	1	Each substation
(3) Space heater (each type)	pc	1	Each substation
2.6 132kV Control & Protection Panels			Kiyungi substation
(1) Lamp (each type)	pc	1	
(2) Fuse (each type)	pc	1	
(3) Space heater (each type)	pc	1	
2.7 66kV Control & Protection Panels			Makuyuni and Kiyungi substations
(1) Lamp (each type)	pc	1	Each substation
(2) Fuse (each type)	pc	1	Each substation
(3) Space heater (each type)	pc	1	Each substation
2.8 33kV Control & Protection Panels			Makuyuni substation
(1) Lamp (each type)	pc	1	

Name	Unit	Quantity	Remarks
(2) Fuse (each type)	pc	1	
(3) Space heater (each type)	pc	1	
2.9 Outdoor Lighting			YMCA, Lawate, KCMC and Makuyuni substations
(1) Lamp	pc	1	Each substation
(2) Ballast	pc	1	Each substation
(3) Photo-cell	pc	1	Each substation
(4) Lamp cover	pc	1	Each substation
3. Maintenance Tools			
3.1 Testing Instruments			
(1) DC dielectric tester	set	1	
(2) Analogue type tester	set	1	
(3) Phase rotation meter	set	1	
(4) Voltage detector (High voltage)	set	1	
(5) Voltage detector (Low voltage)	set	1	
(6) DC voltage detector	set	1	
(7) Relay testing kit	set	1	
(8) Relay maintenance tool	set	1	
(9) AC power meter	set	1	
(10) Portable AC volt/amp meter	set	1	
(11) Portable DC volt/amp meter	set	1	
(12) WH meter maintenance tool	set	1	
(13) Insulation resistance tester (Low voltage)	set	1	500 V class
(14) Insulation resistance tester (High voltage)	set	1	1,000 V class
(15) Portable earth resistance tester	set	1	
(16) Digital type multimeter	set	1	
(17) Clip-on meter	set	1	
3.2 General Tools			
(1) Hydraulic compression tool	set	2	
(2) Hydraulic termination pliers	set	2	
(3) Cable cutter	set	2	
(4) Wire stripper	set	2	
(5) Portable earthing device	set	2	
(6) Operation rod for fused cut-out switch	set	2	

2-2-3 Outline Design Drawing

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

Single Line Diagrams

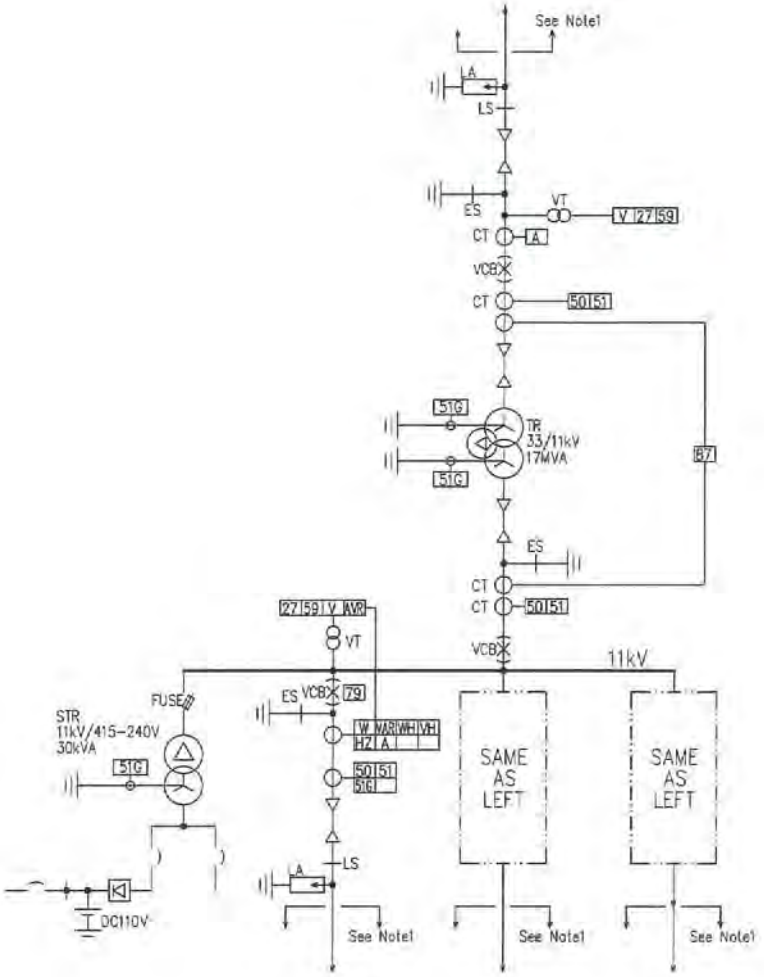
Drawing No.	Drawing Title
AE-01	YMCA S/S Single Line Diagram
BE-01	Lawate S/S Single Line Diagram
DE-01	KCMC S/S Single Line Diagram
EE-01	Trade School S/S Single Line Diagram
FE-01	Makuyuni S/S Single Line Diagram
GE-01	Kiyungi S/S Single Line Diagram
GE-02	Kiyungi S/S Single Line Diagram (Detail)

Layout Plans

Drawing No.	Drawing Title	Scale
AL-01	YMCA S/S Layout Plan	1 / 200
BL-01	Lawate S/S Layout Plan	1 / 200
DL-01	KCMC S/S Layout Plan	1 / 200
EL-01	Trade School S/S Layout Plan	1 / 200
FL-01	Makuyuni S/S Layout Plan	1 / 200
FS-01	Makuyuni S/S Layout Plan (Cross Section)	1 / 150
FA-01	Makuyuni S/S Control Building (Floor Plan)	1 / 150
FA-02	Makuyuni S/S Control Building (Elevation)	1 / 150
GL-01	Kiyungi S/S Layout Plan	1 / 500
GS-01	Kiyungi S/S Layout Plan (Cross Section)	1 / 300
GA-01	Kiyungi S/S Control Building (Floor Plan)	1 / 100
GA-02	Kiyungi S/S Control Building (Elevation)	1 / 100

Transmission and Distribution Line Drawings

Drawing No.	Drawing Title
HR-01～19	66kV Transmission Line Route Map
HT-01～08	Steel Tower Type
HF-01～03	Steel Tower Foundations
IR-01～03	33kV Distribution Line Route Map
IT-01～08	Assembling Drawing



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
CT: Current Transformer
ES: Earthing Switch
HZ: Herz
LA: Lightning Arrester
LS: Line Switch
STR: Station Transformer
TR: Transformer
V: Voltmeter
VAR: Var Meter
VCB: Vacuum Circuit Breaker
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

PROTECTION RELAYS

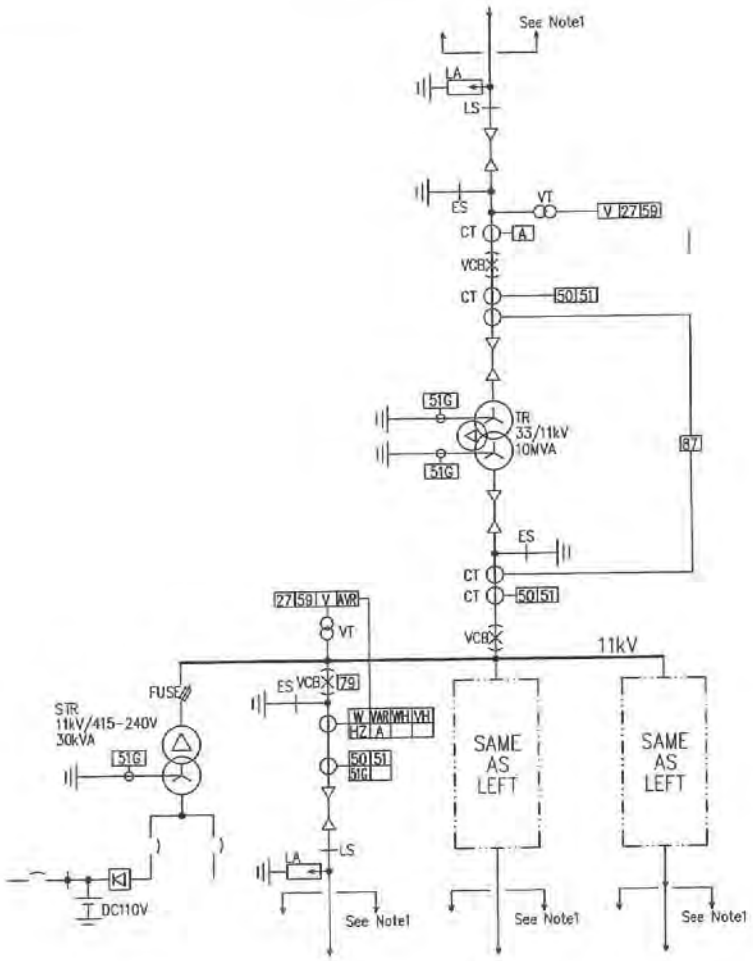
27: Under Voltage Relay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
59: Over Voltage Relay
79: Auto Re-closing Relay
87: Differential Relay

Note

1: Procurement and installation work by TANESCO

DWG. No.AE-01
SINGLE LINE DIAGRAM FOR YMCA S/S

DWG. No.AE-01
YMCA変電所 単線結線図



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
CT: Current Transformer
ES: Earthing Switch
HZ: Herz
LA: Lightning Arrester
LS: Line Switch
STR: Station Transformer
TR: Transformer
V: Voltmeter
VAR: Var Meter
VCB: Vacuum Circuit Breaker
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

PROTECTION RELAYS

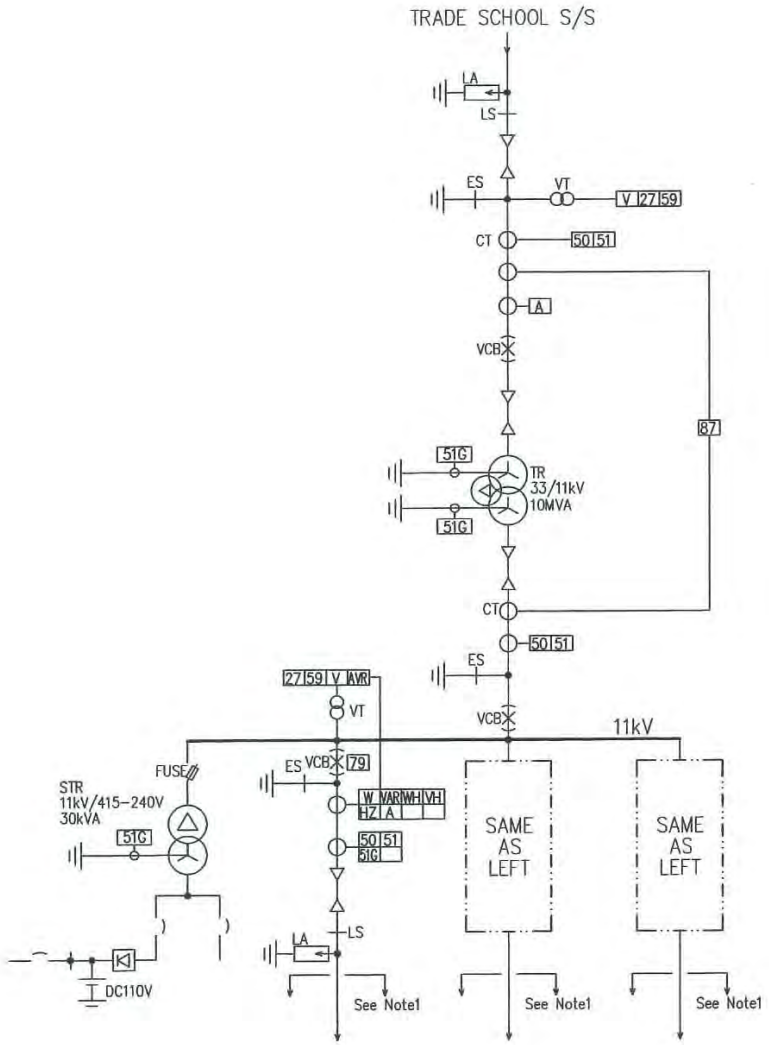
27: Under Voltage Relay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
59: Over Voltage Relay
79: Auto Re-closing Relay
87: Differential Relay

Note

1: Procurement and installation work by TANESCO

DWG. No.BE-01
SINGLE LINE DIAGRAM FOR LAWATE S/S

DWG. No.BE-01
ラワティ変電所　単線結線図



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
CT: Current Transformer
ES: Earthing Switch
HZ: Herz
LA: Lightning Arrester
LS: Line Switch
STR: Station Transformer
TR: Transformer
V: Voltmeter
VAR: Var Meter
VCB: Vacuum Circuit Breaker
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

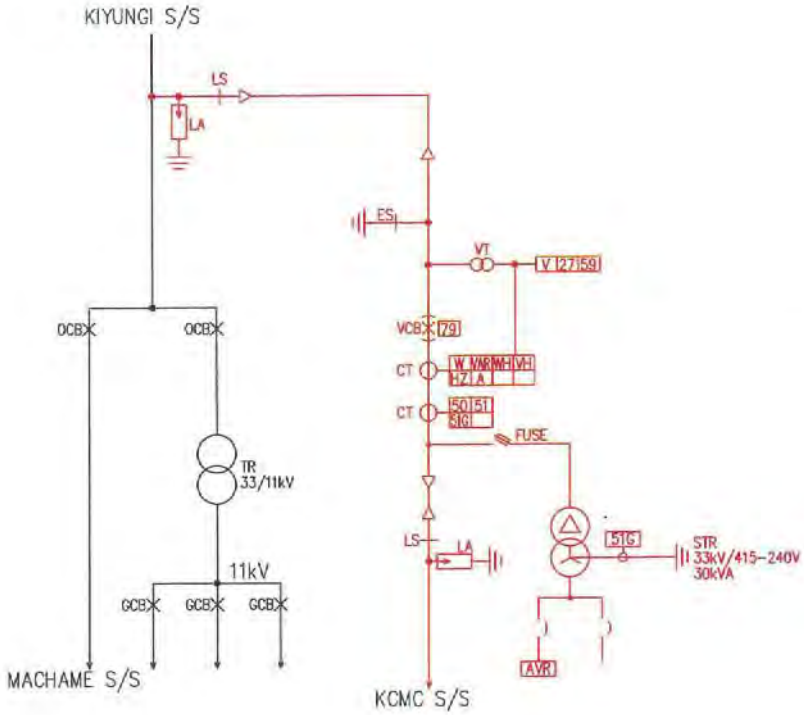
PROTECTION RELAYS

27: Under Voltage Relay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
59: Over Voltage Relay
79: Auto Re-closing Relay
87: Differential Relay

Note

1: Procurement and installation work by TANESCO

DWG. No.DE-01
SINGLE LINE DIAGRAM FOR KCMC S/S
DWG. No.DE-01
KCMC変電所　単線結線図



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
CT: Current Transformer
ES: Earthing Switch
OCB: Oil Circuit Breaker
HZ: Herz
LA: Lightning Arrester
LS: Line Switch
STR: Station Transformer
TR: Transformer
V: Voltmeter
VAR: Var Meter
VCB: Vacuum Circuit Breaker
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

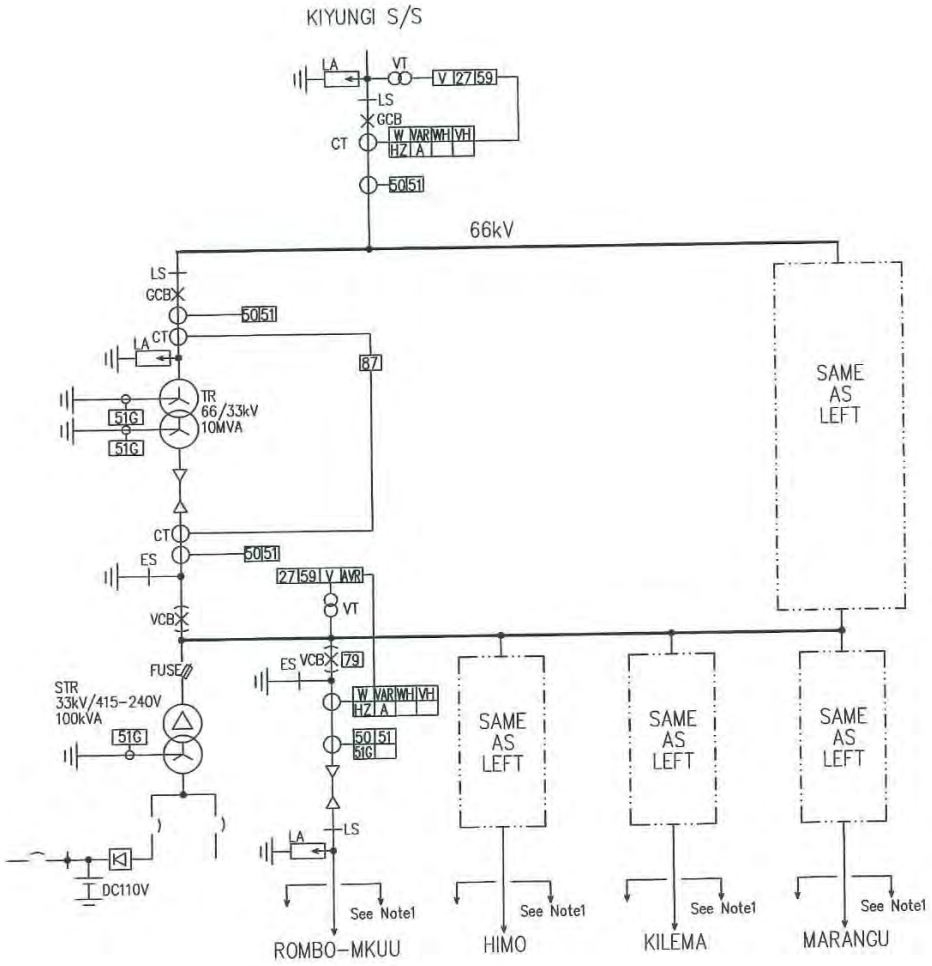
PROTECTION RELAYS

27: Under Voltage Relay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
59: Over Voltage Relay
79: Auto Re-closing Relay

LEGEND

—— :Existing
—— :New

DWG. No.EE-01
SINGLE LINE DIAGRAM FOR TRADE SCHOOL S/S
DWG. No.EE-01
トレード・スクール変電所　単線結線図



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
CT: Current Transformer
ES: Earthing Switch
GCB: Gas (SF6) Circuit Breaker
HZ: Herz
LA: Lightning Arrester
LS: Line Switch
STR: Station Transformer
TR: Transformer
V: Voltmeter
VAR: Var Meter
VCB: Vacuum Circuit Breaker
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

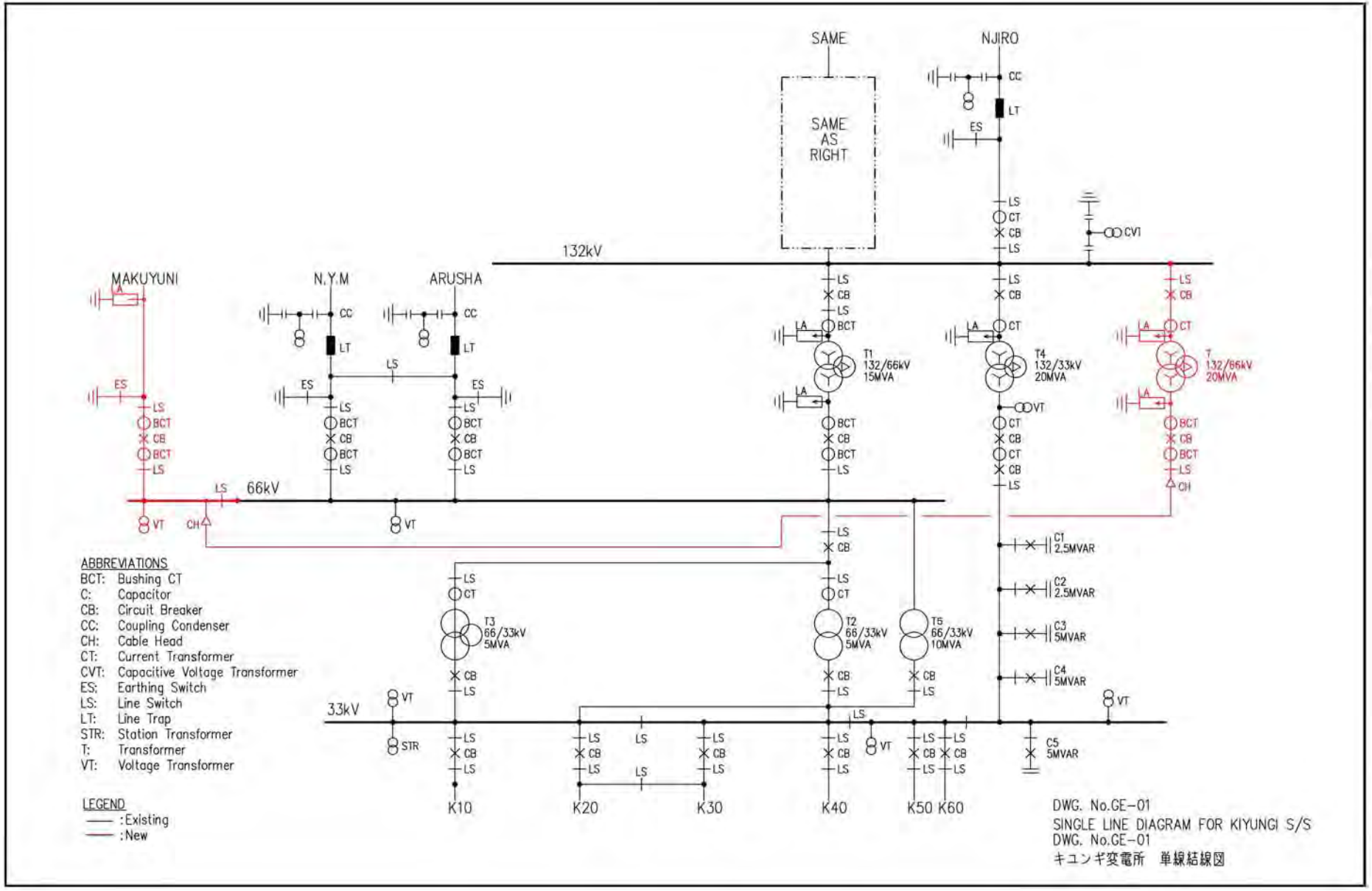
PROTECTION RELAYS

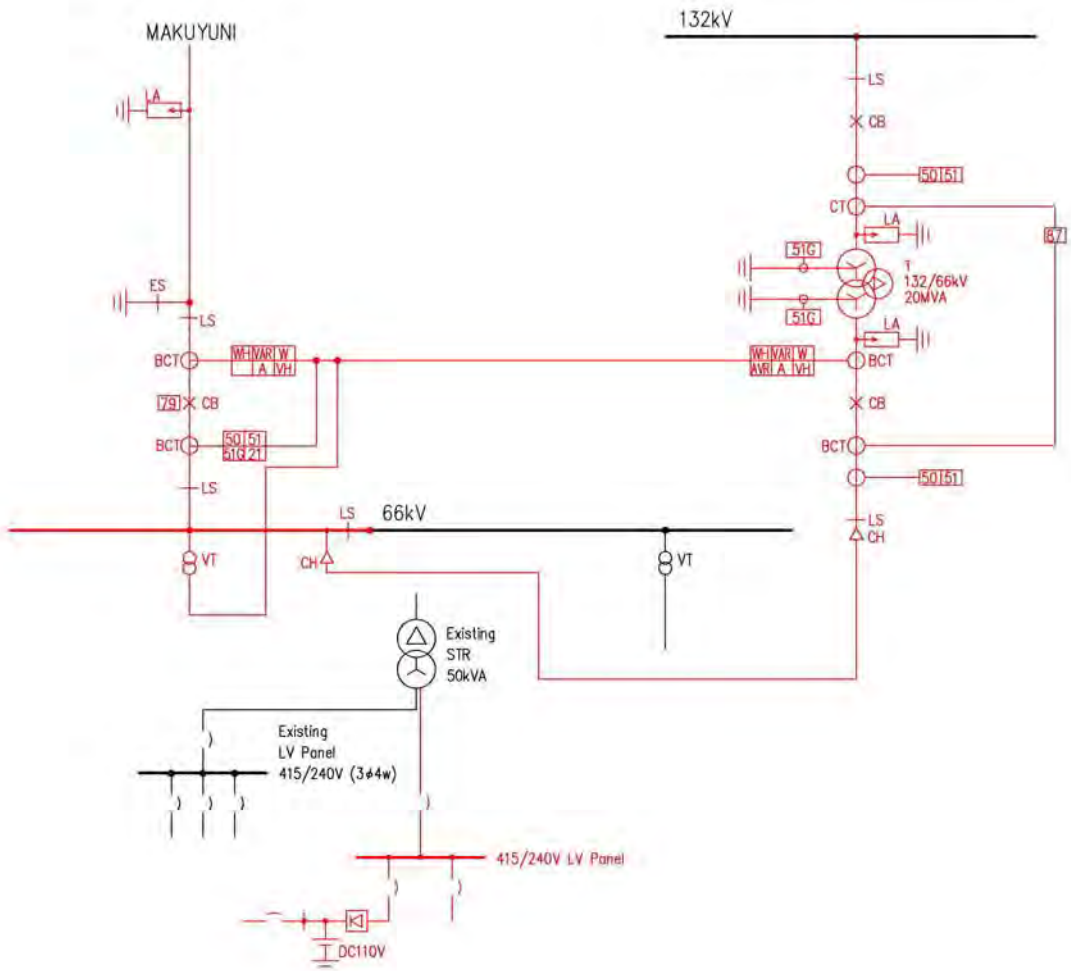
27: Under Voltage Relay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
59: Over Voltage Relay
79: Auto Re-closing Relay
87: Differential Relay

Note

1: Procurement and installation work by TANESCO

DWG. No.FE-01
SINGLE LINE DIAGRAM FOR MAKUYUNI S/S
DWG. No.FE-01
マクユニ変電所　単線結線図


SAME
NJIRO
SAME AS RIGHT
132kV
MAKUYUNI
N.Y.M
ARUSHA
66kV
33kV
T1 132/66kV 15MVA
T2 66/33kV 5MVA
T3 66/33kV 5MVA
T4 132/33kV 20MVA
T5 66/33kV 10MVA
T 132/66kV 20MVA
C1 2.5MVAR
C2 2.5MVAR
C3 5MVAR
C4 5MVAR
C5 5MVAR
K10
K20
K30
K40
K50 K60
ABBREVIATIONS
BCT: Bushing CT
C: Capacitor
CB: Circuit Breaker
CC: Coupling Condenser
CH: Cable Head
CT: Current Transformer
CVT: Capacitive Voltage Transformer
ES: Earthing Switch
LS: Line Switch
LT: Line Trap
STR: Station Transformer
T: Transformer
VT: Voltage Transformer
LEGEND
:Existing
:New
DWG. No.GE-01
SINGLE LINE DIAGRAM FOR KIYUNGI S/S
DWG. No.GE-01
キユンギ変電所 単線結線図



ABBREVIATIONS

A: Ammeter
AVR: Automatic Voltage Regulator
BCT: Bushing CT
CB: Circuit Breaker
CH: Cable Head
CT: Current Transformer
CVT: Capacitive Voltage Transformer
ES: Earthing Switch
LS: Line Switch
STR: Station Transformer
T: Transformer
VAR: Var Meter
VH: Var-hour Meter
VT: Voltage Transformer
W: Watt Meter
WH: Watt-hour Meter

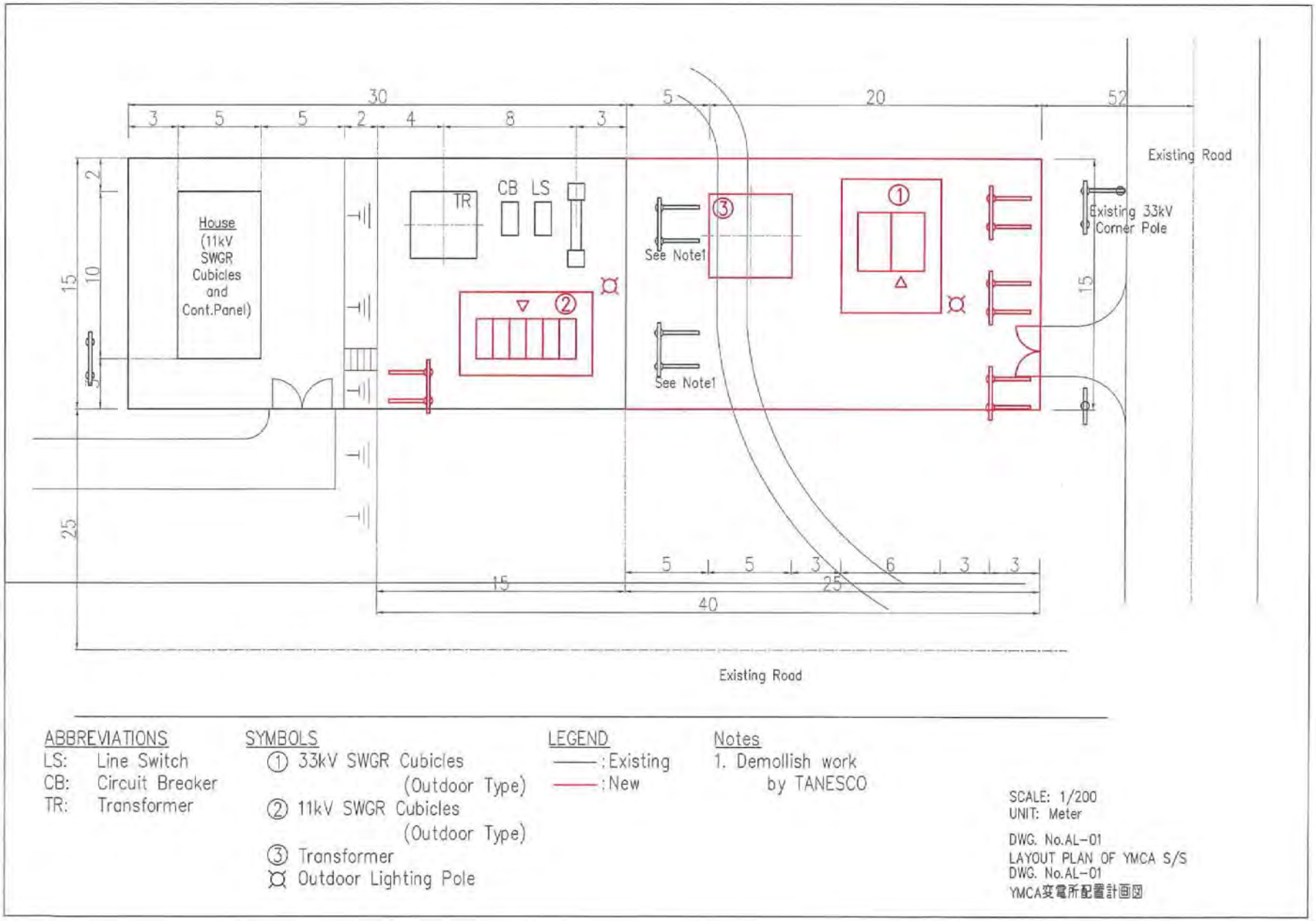
PROTECTION RELAYS

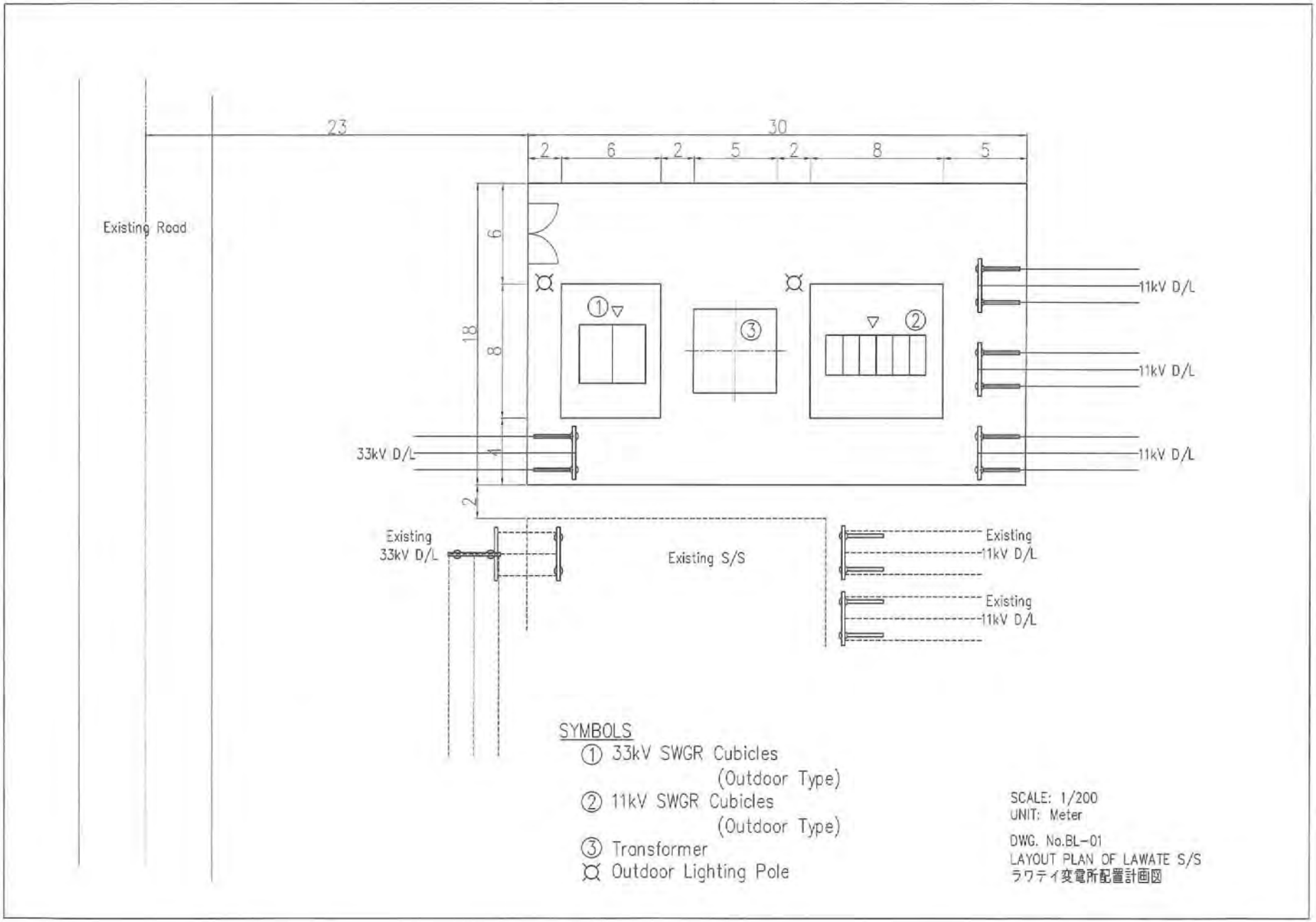
21: Distance Replay
50: Over Current Relay(Instantaneous)
51: Over Current Relay
51G: Over Current Ground Relay
79: Auto Re-closing Relay
87: Differential Relay

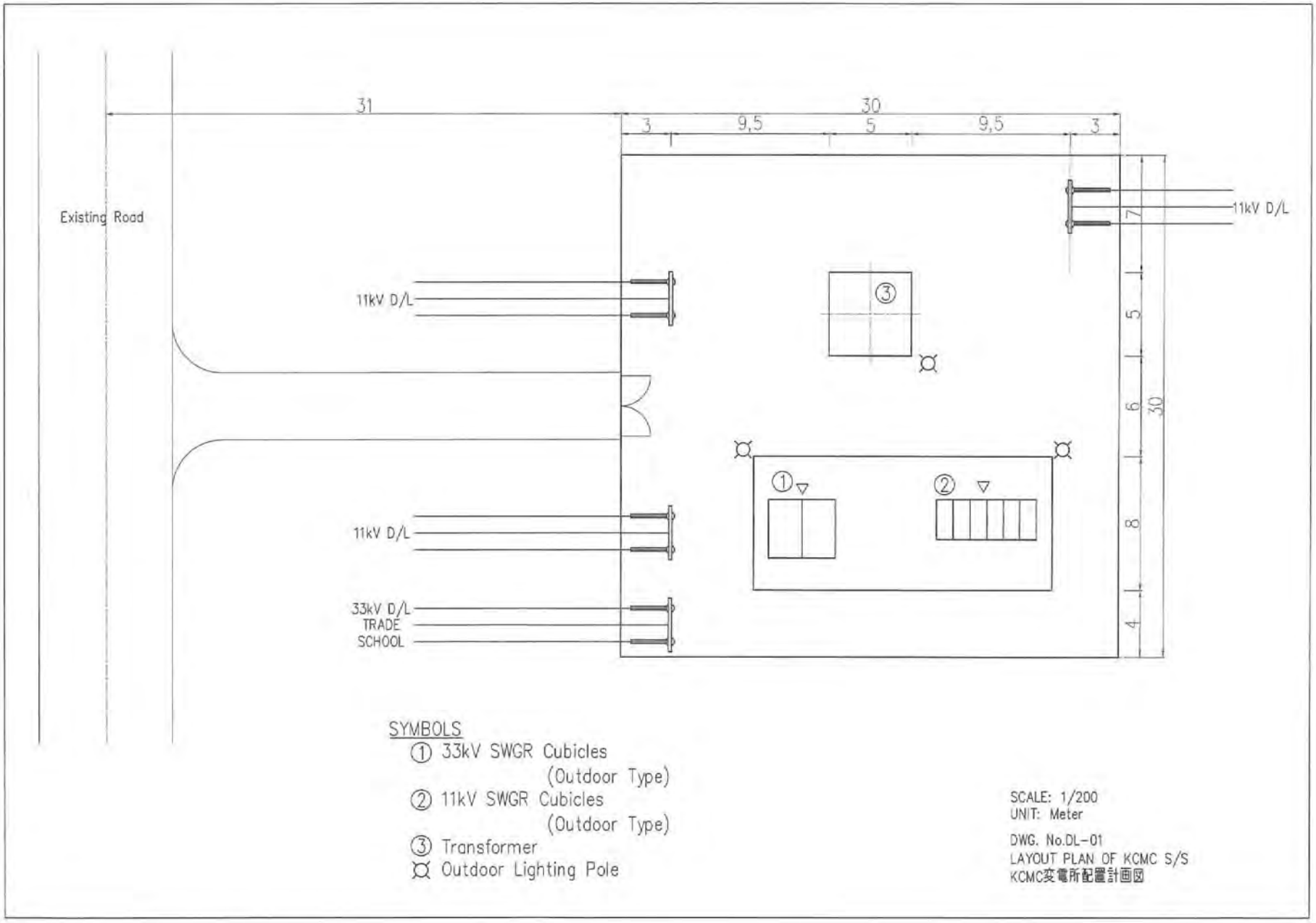
LEGEND

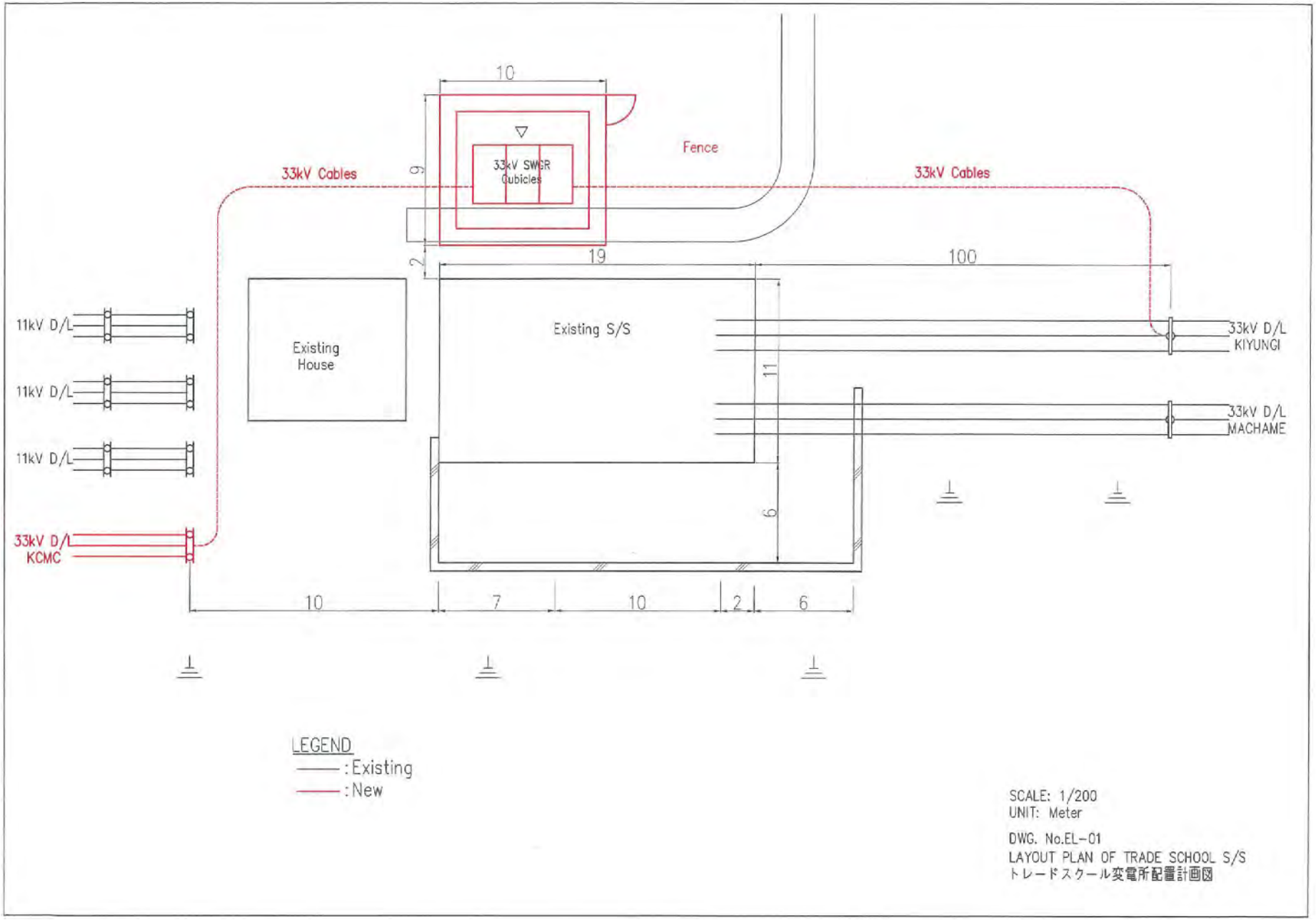
——— :Existing
——— :New

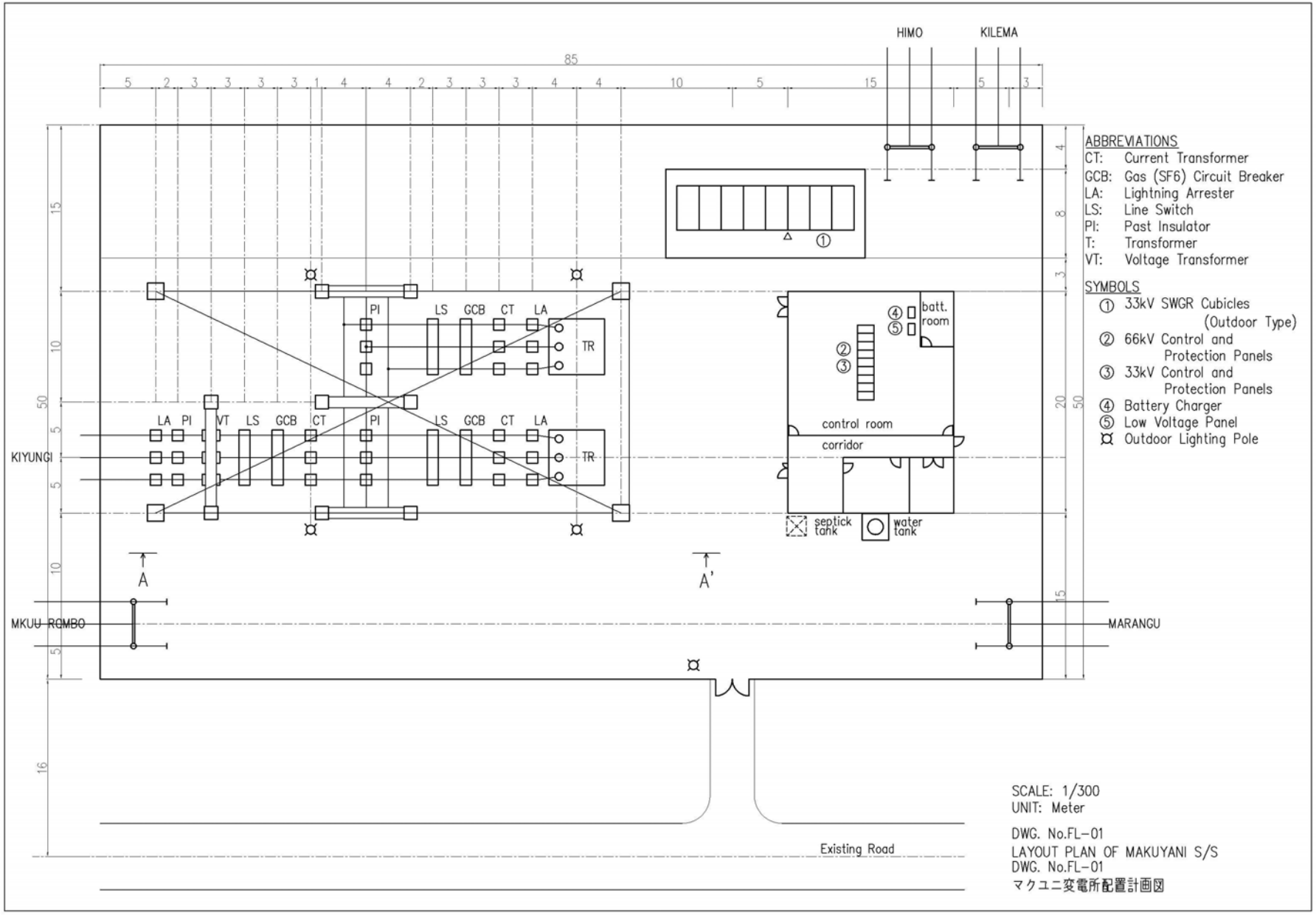
DWG. No.GE-02
SINGLE LINE DIAGRAM FOR KIYUNGI S/S(Detail)
DWG. No.GE-02
キユンギ変電所 単線結線図(詳細)


30
3
5
5
2
4
8
3
5
20
52
Existing Road
House
(11kV
SWGR
Cubicles
and
Cont.Panel)
TR
CB
LS
See Note1
See Note1
Existing 33kV
Corner Pole
2
10
15
15
25
5
5
3
6
3
3
15
25
40
Existing Road
ABBREVIATIONS
LS: Line Switch
CB: Circuit Breaker
TR: Transformer
SYMBOLS
① 33kV SWGR Cubicles (Outdoor Type)
② 11kV SWGR Cubicles (Outdoor Type)
③ Transformer
Outdoor Lighting Pole
LEGEND
: Existing
: New
Notes
1. Demollish work by TANESCO
SCALE: 1/200
UNIT: Meter
DWG. No.AL-01
LAYOUT PLAN OF YMCA S/S
DWG. No.AL-01
YMCA変電所配置計画図

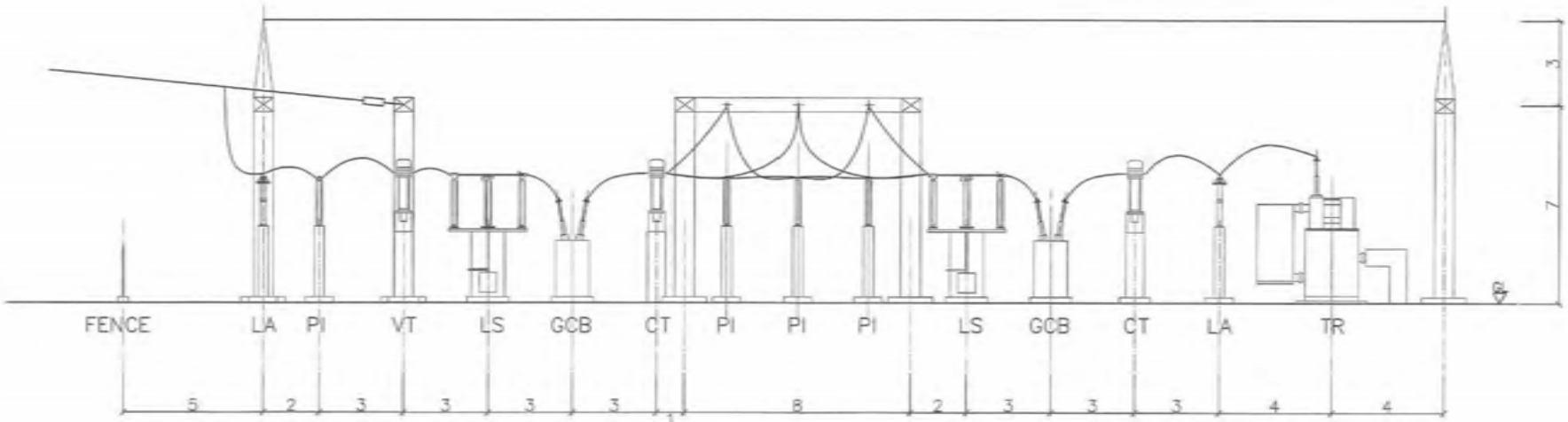

23
30
2
6
2
5
2
8
5
Existing Road
6
18
8
1
2
11kV D/L
11kV D/L
11kV D/L
33kV D/L
Existing
33kV D/L
Existing S/L
Existing
11kV D/L
Existing
11kV D/L
SYMBOLS
① 33kV SWGR Cubicles
(Outdoor Type)
② 11kV SWGR Cubicles
(Outdoor Type)
③ Transformer
Outdoor Lighting Pole
SCALE: 1/200
UNIT: Meter
DWG. No.BL-01
LAYOUT PLAN OF LAWATE S/S
ラワティ変電所配置計画図


31
30
3
9.5
5
9.5
3
Existing Road
11kV D/L
11kV D/L
11kV D/L
33kV D/L
TRADE
SCHOOL
①
②
③
7
5
6
30
8
4
SYMBOLS
① 33kV SWGR Cubicles (Outdoor Type)
② 11kV SWGR Cubicles (Outdoor Type)
③ Transformer
Outdoor Lighting Pole
SCALE: 1/200
UNIT: Meter
DWG. No.DL-01
LAYOUT PLAN OF KCMC S/S
KCMC変電所配置計画図


10
9
33kV SWGR
Cubicles
Fence
33kV Cables
33kV Cables
2
19
100
11kV D/L
11kV D/L
11kV D/L
Existing
House
Existing S/S
11
33kV D/L
KIYUNGI
33kV D/L
MACHAME
6
33kV D/L
KCMC
10
7
10
2
6
LEGEND
: Existing
: New
SCALE: 1/200
UNIT: Meter
DWG. No.EL-01
LAYOUT PLAN OF TRADE SCHOOL S/S
トレードスクール変電所配置計画図


HIMO
KILEMA
85
5 2 3 3 3 3 1 4 4 2 3 3 3 4 4 10 5 15 5 3
ABBREVIATIONS
CT: Current Transformer
GCB: Gas (SF6) Circuit Breaker
LA: Lightning Arrester
LS: Line Switch
PI: Past Insulator
T: Transformer
VT: Voltage Transformer
SYMBOLS
① 33kV SWGR Cubicles (Outdoor Type)
② 66kV Control and Protection Panels
③ 33kV Control and Protection Panels
④ Battery Charger
⑤ Low Voltage Panel
Outdoor Lighting Pole
PI LS GCB CT LA
TR
LA PI VT LS GCB CT PI LS GCB CT LA
TR
KIYUNGI
batt. room
control room
corridor
septick tank
water tank
A
A'
MKUU ROMBO
MARANGU
Existing Road
SCALE: 1/300
UNIT: Meter
DWG. No.FL-01
LAYOUT PLAN OF MAKUYANI S/S
DWG. No.FL-01
マクユニ変電所配置計画図

ABBREVIATIONS
CT: Current Transformer
GCB: Gas (SF6) Circuit Breaker
LA: Lightning Arrester
LS: Line Switch
PI: Station Post Insulator
TR: Transformer
VT: Voltage Transformer



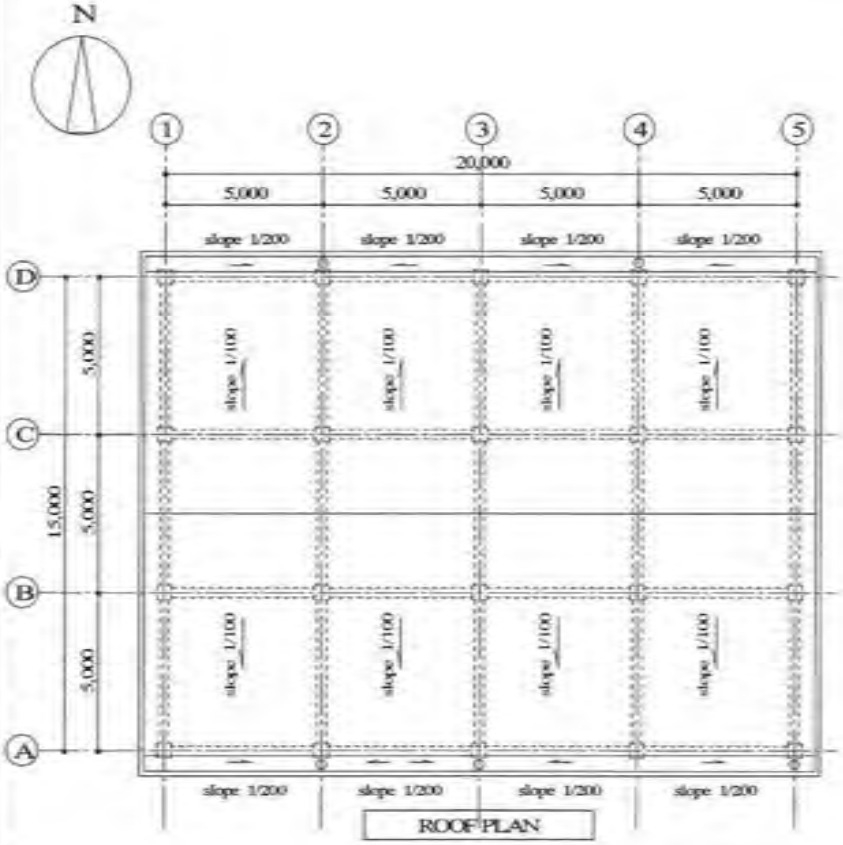
Section A–A'

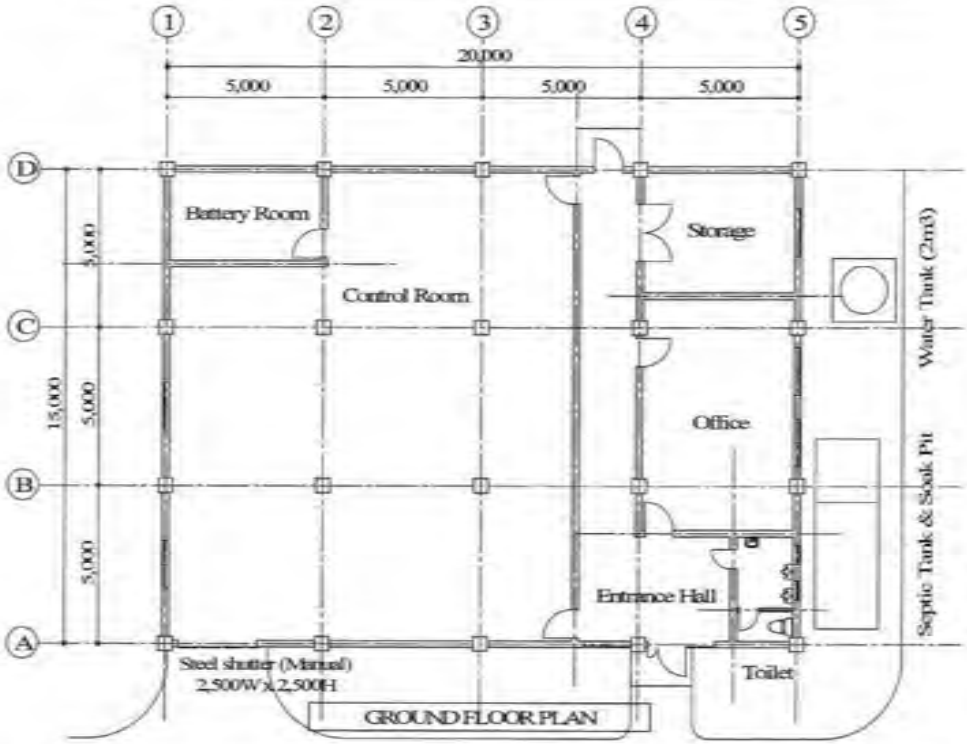
SCALE: 1/150 (in case of A3)
UNIT: Meter

DWG. No.FS-01
LAYOUT FOR MAKUYANI S/S (SECTION)
DWG. No.FS-01
マクユニ変電所配置計画図(断面図)

1. EXTERIOR FINISHING	
TOP ROOF	SLOPE CONCRETE T=90(AVERAGE), with meshed wire(6mm Dia. 150x150) WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK, t=200, MORTAL TROWEL PAINTING-FINISH (EP FOR EXTERNAL) ON MORTAR

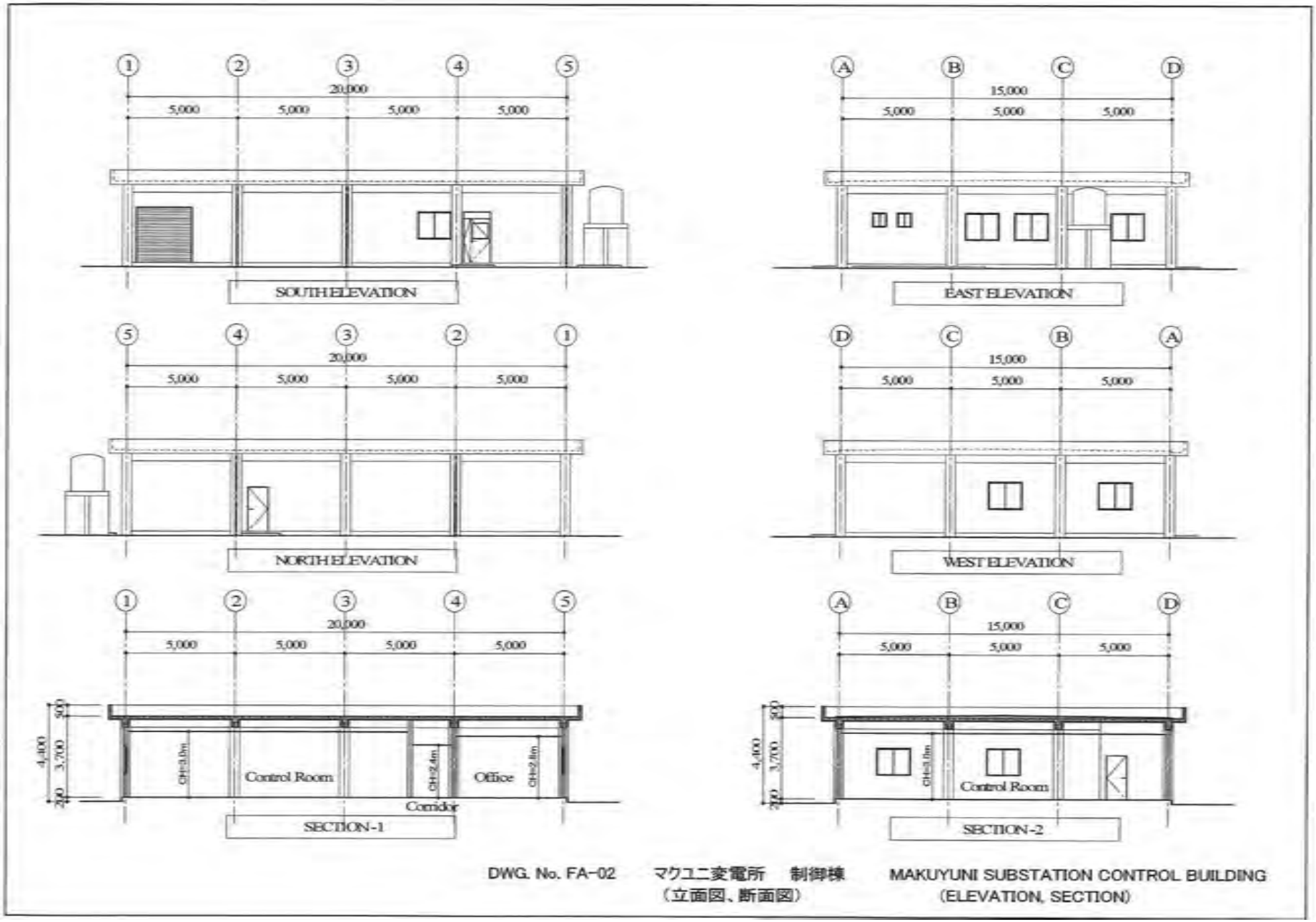
2. INTERIOR FINISHING		
ROOM NAME	FINISHING / SPECIFICATION	
ENTRANCE HALL CORRIDOR OFFICE	FLOOR	PORCELAIN TILE 300 x 300 (NON-SLIP TYPE)
	WALL	EP PAINTING FINISH ON MORTAR
	CEILING	DECORATED PLASTER BOARD WITH INSULATION
CONTROL ROOM	FLOOR	NONSLIP PAINTING FINISH ON MORTAR
	WALL	EP PAINTING FINISH ON MORTAR
	CEILING	DECORATED PLASTER BOARD WITH INSULATION
BATTERY ROOM STORAGE	FLOOR	BATTERY ROOM: ACID RESISTING PAINT FINISH ON MORTAR STORAGE : MORTAR FINISH
	WALL	EP PAINTING FINISH ON MORTAR
	CEILING	EP PAINTING FINISH
TOILET	FLOOR	PORCELAIN TILE 300 x 300 (NON-SLIP TYPE)
	WALL	PORCELAIN TILE 300 x 300
	CEILING	DECORATED PLASTER BOARD WITH INSULATION



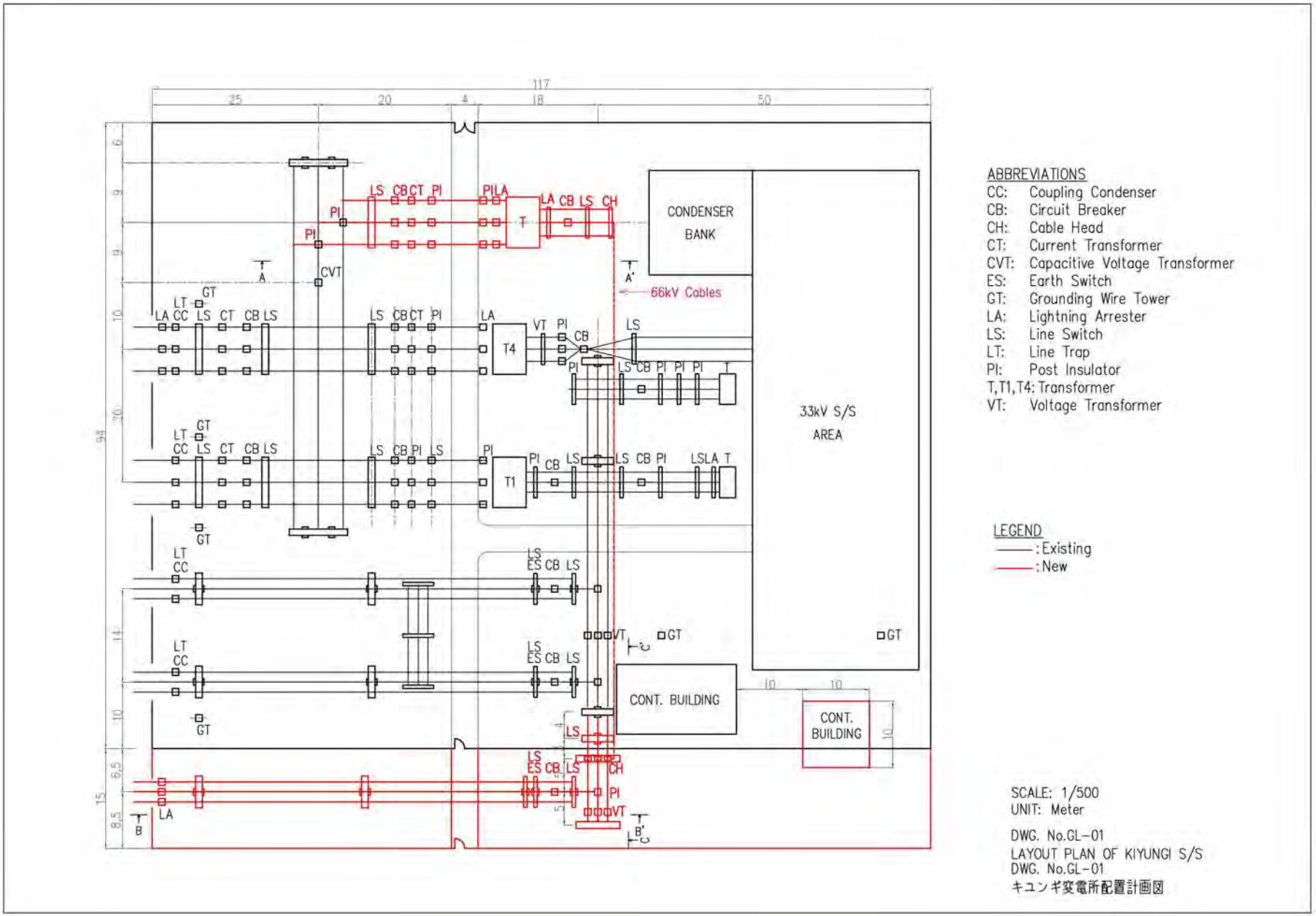


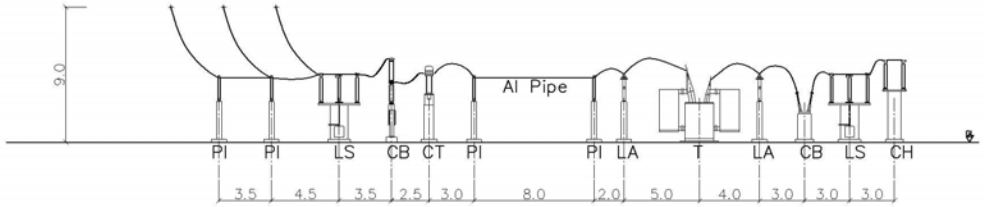
DWG. No. FA-01　マクユニ変電所　制御棟
（平面図）

MAKUYUNI SUBSTATION CONTROL BUILDING
(PLAN)

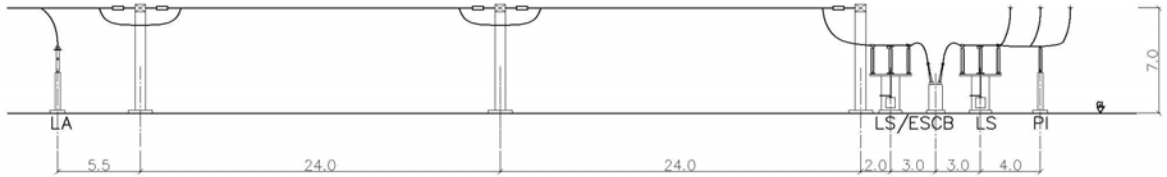


DWG. No. FA-02　マクユニ変電所　制御棟（立面図、断面図）　MAKUYUNI SUBSTATION CONTROL BUILDING (ELEVATION, SECTION)

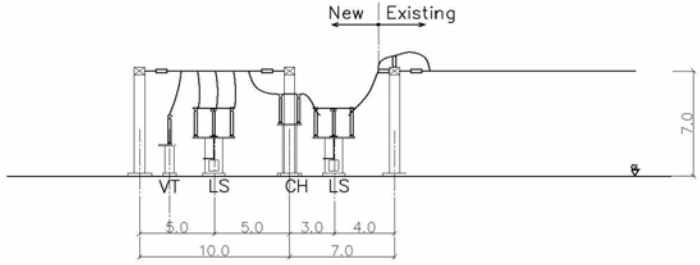

117
25
20
4
18
50
CONDENSER BANK
66kV Cables
33kV S/S AREA
CONT. BUILDING
CONT. BUILDING
T4
T1
T
CVT
GT
LT
CC
LS
CT
CB
LA
VT
PI
CH
ES
ABBREVIATIONS
CC: Coupling Condenser
CB: Circuit Breaker
CH: Cable Head
CT: Current Transformer
CVT: Capacitive Voltage Transformer
ES: Earth Switch
GT: Grounding Wire Tower
LA: Lightning Arrester
LS: Line Switch
LT: Line Trap
PI: Post Insulator
T,T1,T4: Transformer
VT: Voltage Transformer
LEGEND
: Existing
: New
SCALE: 1/500
UNIT: Meter
DWG. No.GL-01
LAYOUT PLAN OF KIYUNGI S/S
DWG. No.GL-01
キユンギ変電所配置計画図



Section A–A'



Section B–B'



Section C–C'

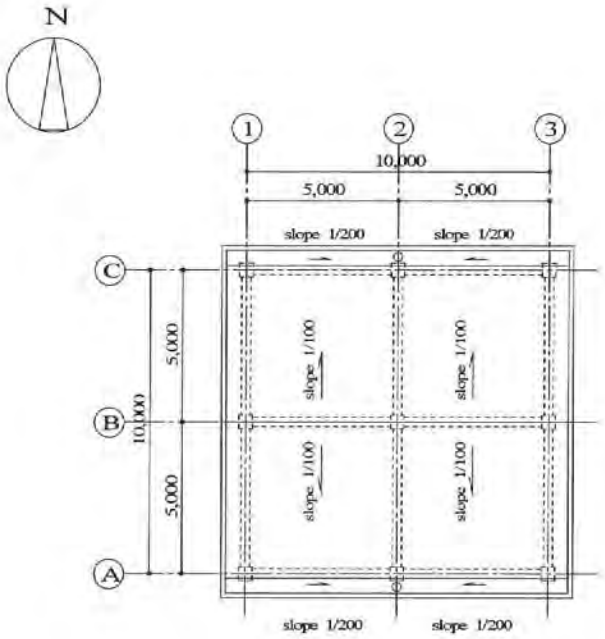
ABBREVIATIONS
CB: Circuit Breaker
CH: Cable Head
CT: Current Transformer
ES: Earth Switch
LA: Lightning Arrester
LS: Line Switch
PI: Post Insulator
T: Transformer
VT: Voltage Transformer

SCALE: 1/300 (in case of A3)
UNIT: Meter

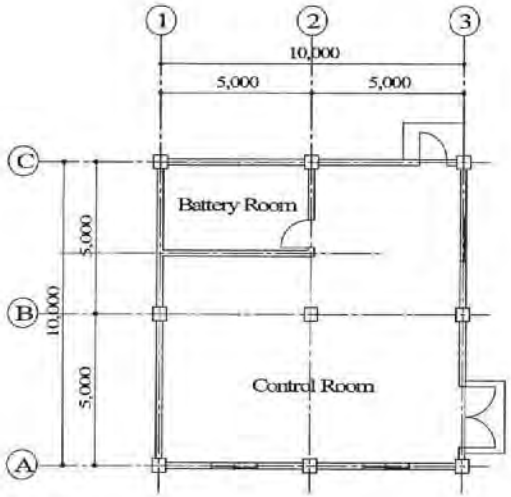
DWG. No.GS-01
LAYOUT FOR KIYUNGII S/S (SECTION)
DWG. No.GS-01
キユンギ変電所配置計画図(断面図)

1. EXTERIOR FINISHING	
TOP ROOF	SLOPE CONCRETE T=80(AVERAGE), with meshed wire(6mm Dia 150x150) WATER-PROOF COATING
EXTERIOR WALL	CONCRETE BLOCK t=200, MORTAL TROWEL PAINTING FINISH (EP FOR EXTERNAL) ON MORTAR

2. INTERIOR FINISHING		
ROOM NAME	FINISHING / SPECIFICATION	
CONTROL ROOM TANESCO's SCADA SPACE	FLOOR	NON-SLIP PAINTING FINISH ON MORTAR
	WALL	EP PAINTING FINISH ON MORTAR
	CEILING	DECORATED PLASTER BOARD WITH INSULATION
BATTERY ROOM	FLOOR	ACID RESISTING PAINT FINISH ON MORTAR
	WALL	EP PAINTING FINISH ON MORTAR
	CEILING	EP PAINTING FINISH



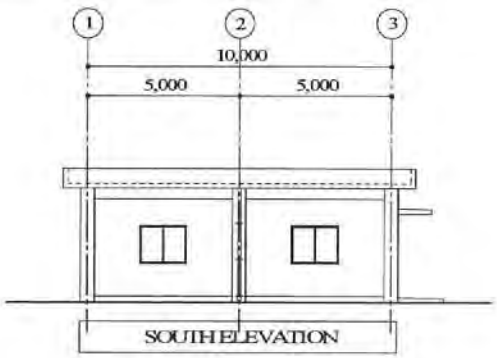
ROOF PLAN

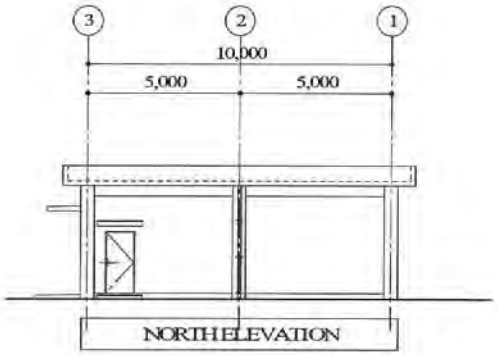


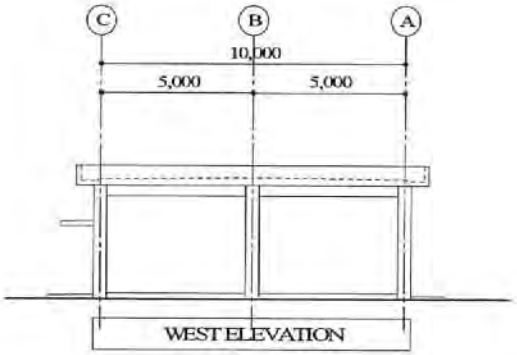
GROUND FLOOR PLAN

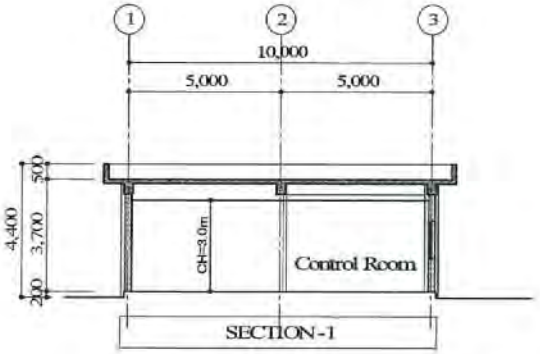
DWG. No. GA-01　キユンギ変電所　制御棟
（平面図）

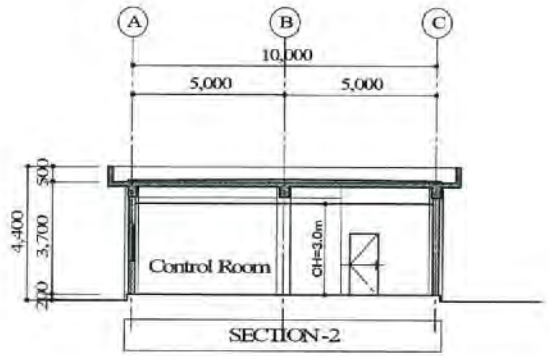
KIYUNGI SUBSTATION CONTROL BUILDING
(PLAN)





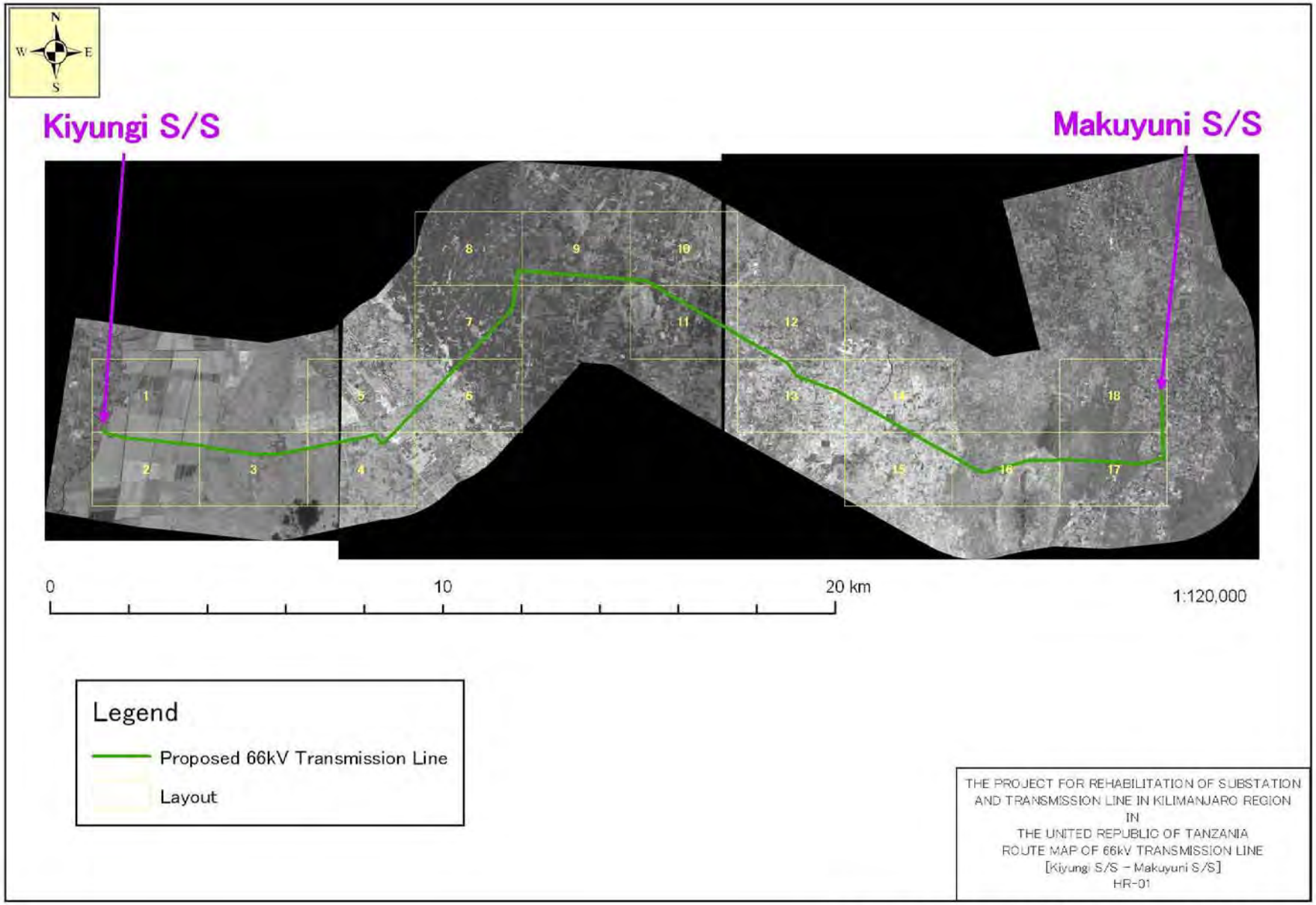






DWG. No. GA-02　キユンギ変電所　制御棟
（立面図、断面図）

KIYUNGI SUBSTATION CONTROL BUILDING
(ELEVATION, SECTION)



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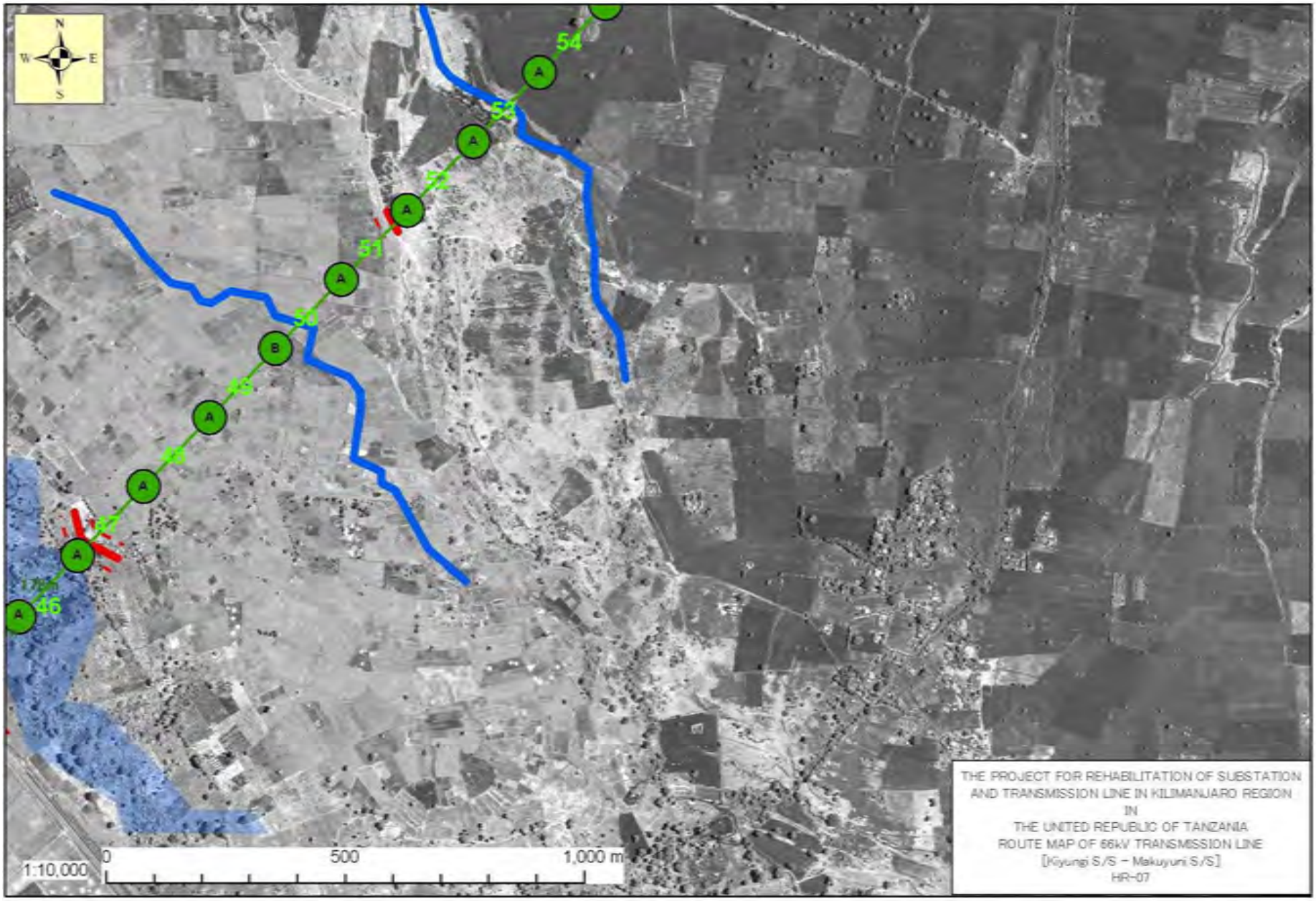

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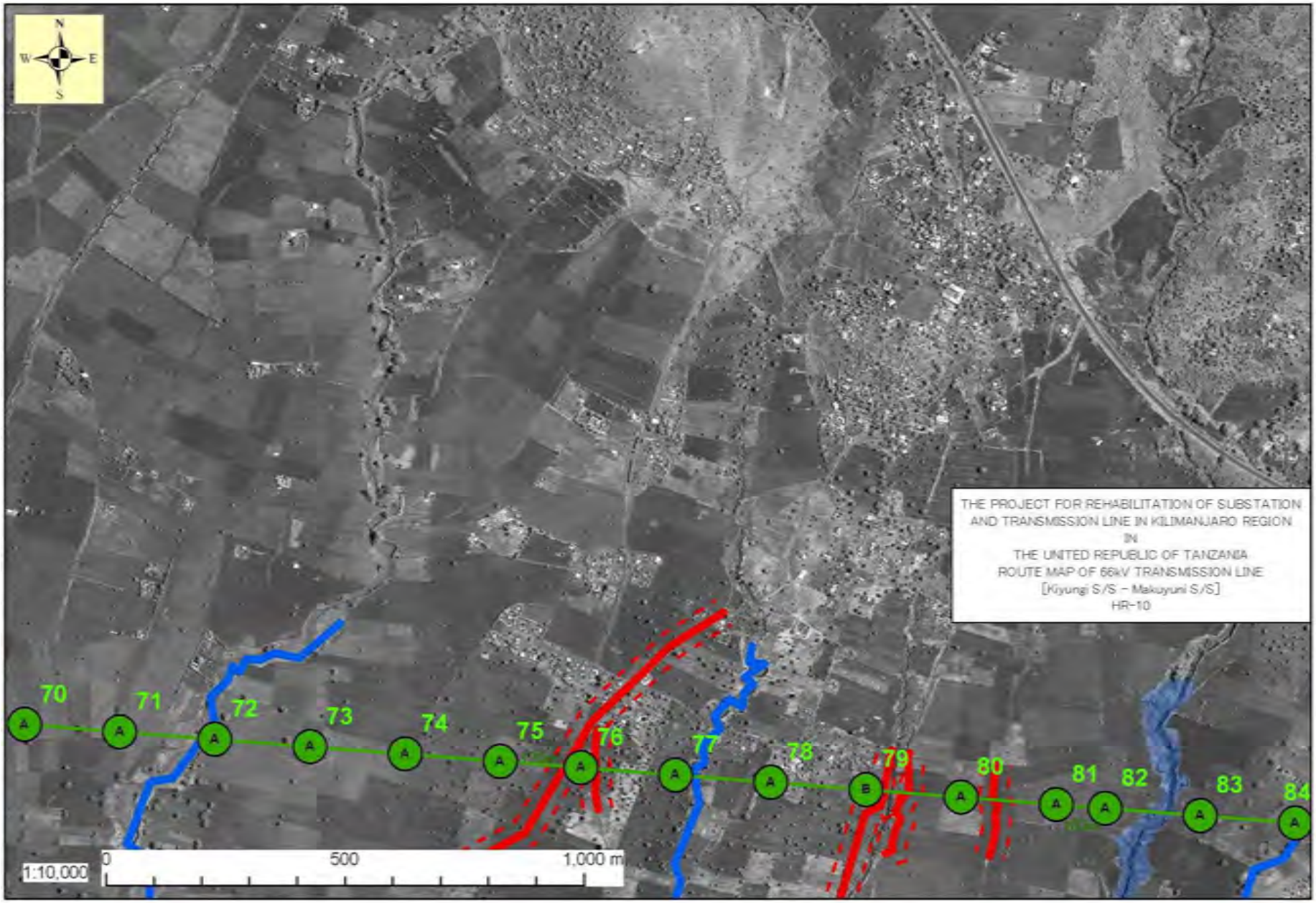

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