TANZANIA ELECTRIC SUPPLY CO.,LTD.
THE UNITED REPUBLIC OF TANZANIA

No. 1

BASIC DESIGN STUDY REPORT ON THE KILIMANJARO ELECTRIFICATION PROJECT IN THE UNITED REPUBLIC OF TANZANIA

MARCH, 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
EPDC INTERNATIONAL LTD.

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PREFACE

In response to a request from the Government of the United Republic of Tanzania the Government of Japan decided to conduct a basic design study on the Kilimanjaro Electrification Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team from October 14 to November 12, 1995.

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

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

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

March, 1996

Kimio Fujita

Kimio Fujita
President
Japan International Cooperation Agency

March, 1996

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Kilimanjaro Electrification Project in the United Republic of Tanzania.

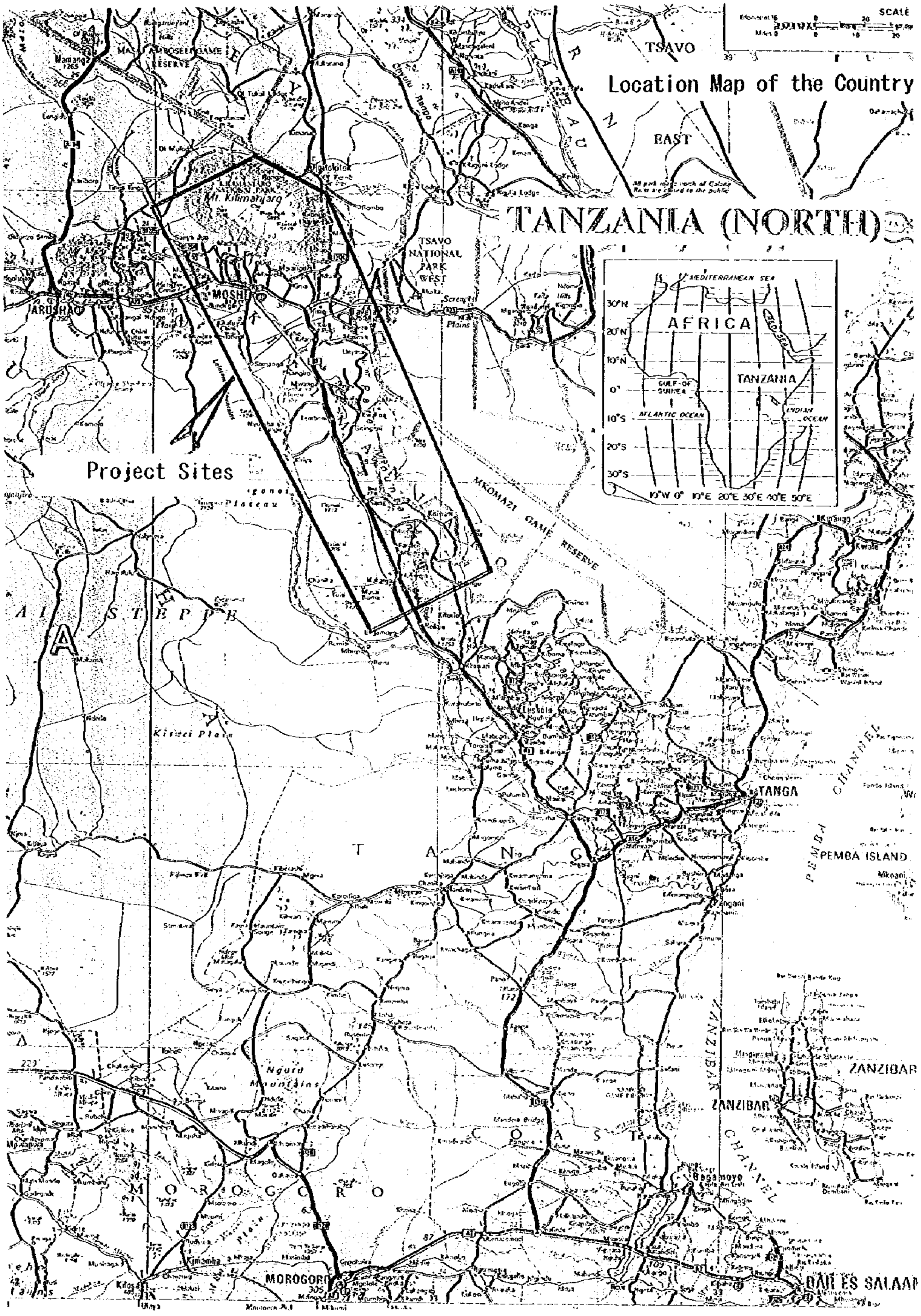
This study was conducted by EPDC International Ltd., under a contract to JICA, during the period from October 9, 1995 to March 29, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Tanzania and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

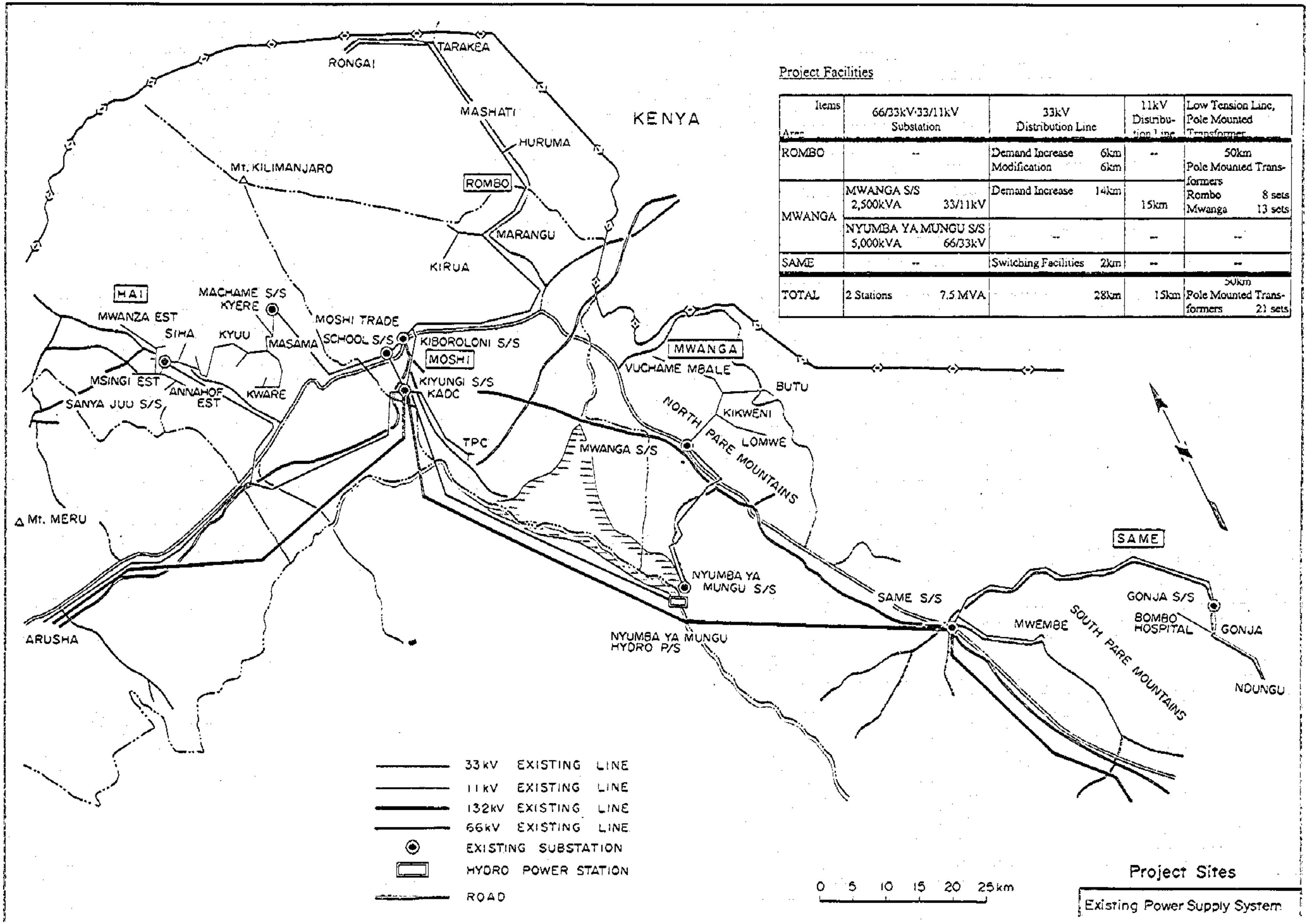
Very truly yours,

T. Tomabechi

Tatsuo Tomabechi
Project Manager,
Basic Design Study Team on
The Kilimanjaro Electrification Project
EPDC International Ltd.


Location Map of the Country
TANZANIA (NORTH)
Project Sites
TSAVO
EAST
TSAVO NATIONAL PARK WEST
Mt. Kilimanjaro
MOSHI
ARUSHA
MKOMAZI GAME RESERVE
AFRICA
TANZANIA
MEDITERRANEAN SEA
GULF OF GUINEA
ATLANTIC OCEAN
INDIAN OCEAN
30°N
20°N
10°N
0°
10°S
20°S
30°S
10°W 0° 10°E 20°E 30°E 40°E 50°E
TANGA
PEMBA ISLAND
PEMBA CHANNEL
ZANZIBAR
ZANZIBAR CHANNEL
Bagamoyo
MOROGORO
DAR ES SALAAM
Nguru Mountains
M O R O G O R O
C O A S T
T A N G A
SCALE

Location Map of the Sites



Project Facilities

Items / Area	66/33kV·33/11kV Substation	33kV Distribution Line	11kV Distribution Line	Low Tension Line, Pole Mounted Transformer
ROMBO	--	Demand Increase 6km Modification 6km	--	50km Pole Mounted Transformers Rombo 8 sets Mwanga 13 sets
MWANGA	MWANGA S/S 2,500kVA 33/11kV	Demand Increase 14km	15km	
	NYUMBA YA MUNGU S/S 5,000kVA 66/33kV	--	--	--
SAME	--	Switching Facilities 2km	--	--
TOTAL	2 Stations 7.5 MVA	28km	15km	50km Pole Mounted Transformers 21 sets

Project Sites

Existing Power Supply System

Abbreviations

Agencies

MEM	: Ministry of Energy and Minerals
MOF	: Ministry of Finance
TANESCO	: Tanzania Electricity Supply Company Limited
EMB	: Embassy
JICA	: Japan International Cooperation Agency
IMF	: International Monetary Fund
OECF	: The Overseas Economic Cooperation Fund
NYM	: Nymba ya Mungu

Term

BHN	: Basic Human Needs
E/N	: Exchange of Notes
GDP	: Gross Domestic Products
GNP	: Gross National Products
G/T	: Gas Turbine
VHF	: Very High Frequency

Unit

US$	: United States dollar	
T.sh	: Tanzania Shillings	
W	: Watt	
kW	: Kilowatt	$= 10^3$ W
kWh	: Kilowatt hour	$= 10^3$ Wh
MW	: Megatwatt	$= 10^3$ kW
MWh	: Megawatt hour	$= 10^3$ kWh
GWh	: Gigawatt hour	$= 10^6$ kWh
Pf	: Power factor	
Hz	: Hertz (cycles per second)	
EL	: Elevation	
H.W.L	: High Water Level	
L.W.L	: Low Water Level	
kVA	: Kilovolt Ampere	
MVA	: Megavolt Ampere	
kV	: Kilovolt	

Table of Contents

Chpater 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

After independence in 1961, the United Republic of Tanzania adopted the Arusha Declaration in 1967 and promoted socialist policies such as community firming and nationalizing its major industries, this toward establishing an African-type socialist country. In the early 1980's, however, Tanzania experienced an economical crisis. From 1986 and supported by the IMF and World Bank, in response to the crisis and to re-construct her economy, Tanzania has carried out an economic restructure program. Although this program has shown partial success, a significant national financial deficit still presents a large and pressing problem. Tanzania's financial balance is somehow supported by aid from foreign countries.

Concerning Tanzania's development, the Tanzanian Government's policy is focused on the development of local villages in which more than 80% of her total population reside. As part of the fundamental infrastructure in response to this policy, therefore, the expansion and reinforcement of electric power supply facilities is a matter of high priority. Development such as this would provide a solution for the increasing power demand in the local villages, as would serve to control on-going deforestation for firewood in the yet unelectrified villages. The problem of supply assurance of energy is also an important subject for the current development plan of the RPFB (Rolling Plan and Forward Budget; 1993/94 - 1995/96).

Tanzania's power supply system mainly rely on hydro power generation. Tanzania presently has a power generation capacity of approx. 520MW, in all together from hydro and thermal power generation. A nation-wide interconnection system is formed by 220kV extra-high voltage transmission lines which provide electricity to the nation's major cities. On the other hand, the Tanzanian Government is developing a new large hydro power station at Kihansi (200MW) to cater for the sharp demand increase predicted in near future. In response to a recent supply shortage caused by continuous drought for past some years, a gas turbine thermal power station has been constructed last year which will be relied on a natural gas field reserve confirmed on the nation's southeast coast. (at present, wholly depend on imported fuel.) A total of 110MW was operated until last year.

Regarding Kilimanjaro Region, the capital city Moshi was electrified in the early 1970's. Electrification was expanded throughout the Region in accord with the Transmission and Distribution Network Project in Kilimanjaro Region (hereinafter referred to as the 'Previous Plan') cooperated by Japan (OECF loan) and carried out from 1981 through 1984. (The following item provides an outline of this content) Consequently, 4 country office seats, 11 district centers and 128 villages in the Region were electrified. This rural electrification plan provided significant contribution to economic development within the Region. On the other hand, the following problems are now faced due to a sharp local demand increase after 12 years since the construction.

* Inadequate transformer capacity at some substations
* Voltage drop at end of distribution lines

Of its national plans, the Tanzanian Government gives high priority to those which would contribute to economic and social development in Kilimanjaro Region because the agricultural production in this Region is high. Since power supply facilities are essential for such development, the previously described problems are matters of concern. To reinforce the facilities, therefore, the Tanzanian Government has requested for grants-in-aid from the Japanese Government which aided in developing the facilities in the Previous Plan.

1-2 Request Content

Items requested by the Government of Tanzania:

1)	Voltage compensator (3 MVA)	1 unit
2)	Transformer (2.5 MVA)	1 unit
3)	33 kV line materials for construction of line	55 km
4)	11 kV line materials for repairing and expansion of existing system	20 km
5)	LT line materials for repairing of LT lines including pole mounting transformers with accessories	1 lot
6)	Radio telecommunication system	1 set
7)	Vehicles and tools for construction and installation work	
	Truck with crane	1
	Pick-up truck	2
	4WD Station Wagon	1
	Tools	1 lot

1-3 Purposes of the Project

The Previous Project were developed as part of the Kilimanjaro Integrated Development Plan (described in the following Item) and contributed to the economic and social prosperity of the farming areas in the Region. Over a decade has passed since its development, however, and as described previously, problems of inadequate power transformation capacity and voltage drop are now presented.

Since these power supply facilities are fundamental and essential factors for the maintenance of local economy and social life, these problems must be solved as quickly as possible to maintain and enhance the region's future prosperity. The main purpose of this project reinforcing the trunk facilities is, therefore, to recover a reliable performance contributive to heightened prosperity and improved living standards in the Region's villages.

Another purpose is to convert the present trend of consuming large volumes of timber energy across to the alternative of consuming electricity, this because deforestation is now a major problem in Tanzania and one which seriously and adversely affects the nation's forestry resources.

1-4 Outline of Previous Plan: Transmission and Distribution Network Project in Kilimanjaro Region

Based on its policy of decentralization, the Tanzanian Government requested all the Regions to formulate comprehensive region development plans in cooperation with the advanced countries for the 3rd 5-year Plan (1976 - 1981). In 1977 and in cooperation with Japan, Kilimanjaro Region produced its Kilimanjaro Integrated Development Plan (KIDP). The focal point of this Plan was how to convert the development pattern of the Region, the problems of which were a decreasing arable land area, limited productivity of traditional agriculture, a high population density, and also how to promote continuous growth.

In this program, improvement in agricultural productivity and the development of arable land was promoted as retaining an economic structure based on agriculture. Also, the economic growth in the coming decade of 1975 to 1985 through the promotion of small to medium agro-industries was expected at 5.1% for agriculture and 12% - 14% for manufacturing, being 6.4% - 7% overall.

Regarding the electrification in this Plan, to improve the quality of public services, the first priority was given to public facilities including police stations, governmental district offices and hospitals. To improve the living standards and promote agriculture and agro-industries, electrification priority was also planned for the core of each district where the public facilities were concentrated, and to 15 other local centers by 1985. Thereafter it was to be gradually expanded to the highly populated agricultural zones in the Mt. Kilimanjaro area and the Pare Highlands. The areas to be electrified were selected based on the previously described in 'Kilimanjaro Integrated Development Plan' and according to the standards of 1. Core of each district and ward, 2. Highly populated area, and 3. High industrial development potential area.

Facility content:

214km of 33kV distribution lines, 183km of 11kV distribution lines, five 33kV/11kV substations for a total of 7.5MVA, 140km of low tension lines, 136 pole mounted transformers, and 27 vehicles.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Objectives of the Project

The Tanzanian government planed and promoted the development of each region, according to a decentralizing policy, in making the 3rd 5 year plan, for a comprehensive development program. With cooperation from Japanese government, Kilimanjaro Region formulated the Kilimanjaro Integrated Development Plan (KIDP) as a comprehensive development program including an electrification plan for this Region in 1977 and is now carrying out its progress in accordance with the program. The region is endeavoring to complete its infrastructures, improve agricultural productivity and develop arable land, while also promoting smaller industries centering on agro-industry.

The major factors are shown below.

- Improvement and expansion of the highlands area which is an existing high density farming area.

- Arable land is developed in the lowlands which extend high potential for water resource utilization.

- The population reception plan is established to expand the arable land in the lowland of Mt. Kilimanjaro and the pare range for absorption of population residing in mountainous area which show very high density in population.

This electrification program is required for the agro-industy of farm villages in the highland region and for the completion of the infrastructures for the development of arable land in the upper lowlands and other areas.

One objective of the rural electrification in the 5 year plan is to enhance social development as electricity is the basic indispensable service at this time. Therefore, electric power supply facilities are improved to complete the electric power field which forms the basis of economic and social growth in Kilimanjaro region and promotes development of farm villages.

Completed in 1983 on a Yen credit, the Kilimanjaro region electrification program covers 33 kV/11 kV, total 7.5 MW substations, 214.5 km of 33 kV distribution line and 183.5 km of 11 V distribution line. Up to 1995, 22,000 households had received the benefits of electrification.

After a lapse of 12 years, however, demand has increased and a service level decline is now apparent, this due to a shortage of transformer capacity and voltage drop in some districts. In 1995, some 4,000 households had been on the wait list for power supply for many years.

The objectives of this project are to build up power supply facilities to meet increased demand including those areas not electrified in Kilimanjaro region 12 years prior, and to improve the service level and establish good quality infrastructure.

The goals are:

1) To improve the present inadequate condition of equipment capacity actualized due to increased demand.
2) To take measures to prevent voltage drop indicated in some districts.
3) To expand the distribution line over a proper range for non-electrified prospective customers who have already applied for power.
4) To promote improvement and higher efficiency in facility maintenance and operation.

To carry out the above, this program improves the electric power supply situation by establishing new substations and distribution lines, by replacing low tension lines and by purchasing radio systems and vehicles for work.

2-2 Basic Concept of the Project

Items requested are as follows.

1)	Voltage Compensator	3 MVA	1 unit
2)	Transformer	2.5 MVA	1 unit
3)	33 kV line materials for construction of line	55 km	
4)	11 kV line materials for repairing and expansion of existing system	20 km	
5)	Low tension materials for repairing of low tension lines including pole mounted transformers with accessories	1 lot	
6)	Radio telecommunication system	1 set	
7)	Vehicles and tools for construction and installation work		
	Truck with crane	1	
	Pick-up truck	2	
	4WD station wagon	1	
	Tools	1 lot	

It is clarified by the results of on-site studies and investigations that some of the above requested items should be modified or changed to the alternative. In order of item number of the request, finally adopted items (measures) and the reasons are described below.

(1) Voltage Compensator (3 MVA) 1 unit

In response to numerous claims of voltage drop in the Rombo District, the Request Letter proposes that a voltage booster be newly installed at the intermediate point of the Rombo distribution line. It was believed that this voltage drop must be caused by the long 33 kV Rombo distribution line.

On-site studies, however, showed that no large voltage drops were discovered in the Rombo distribution line, per se (high tension side). It is believed that the reason is the good performance of a capacitor newly installed in 1994 to improve the system voltage at the Kyungi Substation where Rombo distribution line starts. Another reason is that the newly installed tap changer for the new 20,000 kVA transformer in the 132 kV system is operating well.

Also, the reinforcement of the upper systems including the Rombo area (introduction of a 66 kV transmission line to Marangu) is being planned. Considering this plan, it is unnecessary to install a booster in the middle of the Rombo distribution line, even for the future.

It is believed that consumer claims of voltage drop are born from the weakness of the low tension circuit. In some villages, the power is distributed by an extremely long (2 km) low tension circuit from the main trunk line established in the last Project. The dimensions of the power line are also small. Consequently, the voltage drops at peak time, thereby resulting in claims such as fluorescent lamps not operating.

A more preferable measure would be that instead of installing a booster, to change the small sized wires to bigger ones (50 km not only for Rombo including other areas), and to increasing some pole mounted transformers (8 units).
For the expansion of 33 kV distribution branch line 6 km shall be applied for corresponding the growth of demand. (See Fig. 2-2. Distribution system A. Table 2-14 Desired line expansion, Rombo, Fig. 2-6, ~ 7 Pole configulation.)

(2) Transformer (2.5 MVA) 1 unit

Through substation in the previous Project covered to establishing Mwanga as the capital of town the former North Pare District. However, as such a sharp demand increase was not expected that time, only one 500kVA transformer was planned.

Since then, Mwanga Town has developed further as the district capital. Especially, the construction of an aggregate plant funded by Norway for road repair, a motor pool for construction equipment and repair plants has resulted in a large population increase, including their employees in the neighborhood. It was impossible to predict such a high power demand when planning the former Projects.

In response to the demand increase, Tanesco installed a 500kVA transformer to this substation in 1992 at their own expense. However, 20% overload still occurs at peak time. This Project requests a 2,500 kVA transformer which is seen as the appropriate capacity as explained in the attached Demand Estimation Study Sheets. (See Appendices 6. 6-1 Load Forecast in Mwanga.)

This capacity is equivalent to that of the Machame and San Ya Juu substations in the Hai District installed in the former Project and does, therefore, extend adequate compatibility. Currently, the lot adjoining the Mwanga Substation is owned by Tanesco. Therefore, a substation with the previously described 2,500 kVA transformer and its switch gears shall be installed on this lot.

The proposal to replace the transformer only is unrealistic as that would require the shutting down of the currently operated transformer for a long period. Instead, the system should be switched to the new system after all the new components are installed next to the existing substation, thereby minimizing power outage time. Those existing components which can be applied to the other substation shall be utilized.

The current 500kVA transformer will no longer be necessary after the completion of new substation. Although it can be removed, it shall be retained 'as is' until its application destination is determined. The cost for its removal is excluded from this Project.

In addition above, 33 kV 14 km new distribution line and 4 unit pole mounted transformers shall be installed for the measure of demand increase in Mwanga area.

(See Fig. 2-2, Distribution system, B. Table 2-14 Desired Line Expansion, 1/2 Mwanga Fig. 2-8 Pole Configulation, Fig. 2-9 Pole Configulation with Transformer.)

(3) 33 kV line materials for construction of line 55 km

According to the capacity increase of the Mwanga Substation, it is also necessary that the power receiving system be reinforced. Currently, power is supplied by a 33 kV distribution line via a 1,000 kVA transformer which is connected to the 11 kV bus in the NYM Power Station. This system, however, would be unavailable once the capacity at Mwanga Substation is increased to 2,500 kVA.

Therefore, a method was proposed in the Request Letter to receive the power from the Same Substation located 55 km south of Mwanga. This proposal includes that a 55 km long 33 kV distribution line is installed newly to Mwanga, with the power received from the existing 132/33 kV 5,000 kVA transformer of the Same Substation and transmitted to Mwanga through this new line.

A substitute plan was assumed after on-site studies. A 66/33 kV 5,000 kVA transformer is newly installed and connected to the 66 kV bus on the high tension side of the NYM Power Station. The power is supplied to Mwanga through the existing 27 km long 33 kV distribution line. (See system diagram in Fig. 2-1.)

In comparison to the proposal in the Request Letter, this substitute plan provides various features as described below.

Reasons to accept the substitute plan:

* Minimal power loss (See attached calculation papers in Appendices 6, References: 6-2 comparison study on power receiving system for Mwanga)
* A 33 km long 33 kV distribution line has already been extended by Tanesco toward Himo in the north. The distribution distance from Same is excessively long, thereby resulting in problems of high power loss and voltage drop.
* The transformer of the existing Same Substation is old and its facility conditions are not preferable. It is doubtful that its facilities can be relied upon.
* Despite the site at the NYM Power Station being somewhat small for an outdoor switching station, it is possible to install a transformer and its accessories including the switches on it.
* There are no villages requiring electrification between Same and Mwanga.
* It is less costly than receiving power from the Same Substation via a new 33 kV distribution line.

(4) 11 kV line materials for repairing and expansion of existing system

The demand in this district has been restricted due to a small transformer capacity at the Mwanga Substation. The number of consumers on the 'wait list' is the highest of all the districts. In the Request letter, the quantity is also specified for a 20 km expansion of the 11 kV distribution line.

The 11 kV distribution network expansion in the Distribution Line Map Fig. 2-2, B was requested during the on-site study and it shall be carried out. The content is a new installation of 15 km long 11 kV distribution lines. Table 2-14 (Mwanga) shows the detail. Fig. 2-8, 2-9 shows 11 kV pole configuration. Alonging this new line, 9 unit pole mounted transformers shall be installed.

(5) Low tension line materials for repairing of low tension line including pole mounted transformers with accessories 1 lot

Low tension circuit is using 400 V and 230 V, from pole mounted transformer to final electric consumers.

To change the wire of this circuits larger size and to strengthen the number of pole mounted transformer are very effective for preventing the voltage drop.

The total length of the low tension circuits are 50 km including Rombo and Mwanga area.

(6) Radio communication system 1 set

It is necessary that a total communication system be established for the effective operation of the electricity business. Especially, communications for both power supply operation (command for switch on/off) and security is essential. Its reinforcement is, therefore, highly important.

The current conditions are, however, extremely poor and require far-reaching improvements. As, due to the power line carrier (PLC), communications between the Regional Office in Moshi and the Head Office in Dar es Salaam are good, it is unnecessary to improve this system.

It is necessary, however, to develop a business communication system between the Regional Office and its five area offices, and between the area offices and their sub-area offices.
It is also necessary to develop a communication system between the construction vehicles, supervisors, offices and substations for equipment operation and repair work at all locations. It is appropriate to set up a communication system using VHF radio as presently incorporated.

The base shall be equipped with a desk-top system. The vehicles shall be equipped with a mobile radio system. Supervisors shall be provided with portable radios.

Most present radio systems were supplied during the last construction and are now old. A communication system is an effective device for efficient maintenance and management. Also, as they are inexpensive, it would be appropriate that they be completely renewed for this Project.

Naturally, this equipment shall be used during the construction.

Fig. 2-3 shows the Tanesco Communication System Diagram after completion.

(7) Vehicles and tools for construction and installation work

1) Vehicles

The following vehicles will be provided for construction works.

Type	Quantity	Purpose
Truck 5t	1	Load/unload equipment and materials at warehouse and site. To install transformer. Workers, power poles, cables, etc. are transported by their own or leased trucks.
Pick-up truck 2t	3	Transport small equipment and materials.

This quantity may not be enough in comparison with the range of the Project. But it is difficult to provide ample number of vehicles in case the Japanese Grant. Tanesco should prepare some more vehicles in order to proceed the works smoothly by itself.

After completion of the construction, these vehicles will be employed in facility maintenance and management purpose, it is, therefore, necessary to take good care of use during the construction period.

2) Tools

The small tools in the attached table (Appendices 6. References, 6-3 provisional tool lists) shall be provided for Tanesco to carry out a smooth construction.
These tools shall be used for facility maintenance after construction completion.

(8) System rationalization measures

1) Improvement of Rombo System

The extremely long distribution line in the Rombo District (126 km from Kyungi to Rongai) provides a few problems including voltage drop (not significant for the time being) and power loss. It also brings some demerits in maintenance work. For instance, if a tree contact fault should occur (in the fact, such kind of fault occur frequently in this system), it is very difficult to identify the fault location because of a broad spread system, so, it takes long time to repair it.

In the present system, a line with load in the Kilema and Kirua direction enters to Marangu from just before Himo. It then enters the Rombo District. The line to Marangu is thin, being $50mm^2$ as constructed before the last Project. This area also suffers frequent incidents due to tree falls.

When, in this Project, a new 6 km line is extended and connected to the Marangu Secondary School along the road from Himo to most of Marangu, the power is transmitted to Rombo directly, thus separating the Marangu load. This is a very effective measure against voltage drop and power loss as well as for maintenance.

A new line installation for this measure requires only 6 km and 2 load break section switches.
See Fig. 2-5 System Configuration Diagram. (1)

2) Improvement of Mwanga System

A long 33 kV distribution line was extended just before the Mwanga Substation to the north. Currently, it is extended directly at a T branch from the NYM Line.

In this Project, considering facility operation, it is recommended that this north distribution line should be led to the reinforced Mwanga Substation so that the power is directly transmitted from the substation bus.
The required facilities are the out going facility including a 33 kV circuit breaker unit, wire and support structure for distribution line change.
See Fig. 2-5 System Configuration Diagram. (2)

3) Improvement of Same System

The 33 kV distribution line from the Same Substation is a single circuit to the Gonja Substation. A 33 kV distribution line to Mwembe is branched at its half-way.

The Mwembe Line has been extended significantly by Tanesco, and is now approx. 40 km long. Consequently, the entire system including the 65 km Gonja distribution line is shut down by an incident, regardless of any location of that incident. In every incident, the load break switch (LBS) at the branch point must be shut off manually to search for the incident location. Therefore, T-branching at half-way would make demerits in both operation and maintenance.

It is necessary to lead the Mwembe Line into the Same Substation directly.
This measure requires 2 km to 3 km of 33 kV line, 1 circuit breaker unit, meters, and protective devices.
See Fig. 2-5 System configuration Diagram. (3)

4) Expansion of 11 kV out going feeders at Mwanga Substation

At present, only one 11 kV feeder outlet was provided at the Mwanga Sub-station. This feeder should be divided in response to significant system expansion. In this Project, therefore, 3 cubicles (1 circuit for towns and 2 circuits for the mountainous area) shall be installed to rationalize distribution.

5) Installation of 33 kV 3 LBS (Load Breaker Switches)

When fault has occured in the long complex distribution line, these LBS make easy search of fault point. 2 unit of LBS are used for Rombo, and 1 unit for Same.

(9) Summary of basic concept of the project

The above examination resulted in the basic concept in the Table 2-2.

Table 2-2 List of Project Component (Requested and Conclusion)

Requested Items (Minutes on 23/10/95)	Conclusion	Proposed Measures
1. Voltage Compensator (Rombo) 3 MVA x 1	Not necessary	o Reinforcement of low voltage system • Replace to larger LT conductor: 50 km including Rombo and Mwanga area • Increasing pole mounted transformers: 8 units o Reinforcement of increasing demand: 33 kV distribution line: 6 km
2. Transformer (Mwanga): 2.5 MVA x 1	Necessary	o 2.5 MVA x 1 transformer and switch gears are provided. o Reinforcement of increasing demand: • 33 kV distribution line: 14 km • Pole mounted transformers: 4 units
3. 33 kV line materials from Same to Mwangu 55 km (The method of receiving power for new Mwanga SS)	Alternative	• 66/33 kV 5 MVA x 1 transformer and switch gears are provided to transmit power from NYM PS to Mwanga SS. • Existing 33 kV line (from NYM to Mwanga) will be used.
4. 11 kV line materials 20 km	Necessary	• 11 kV distribution line materials : 15 km • Pole mounted transformers : 9 units
5. Low tension line materials for repair including pole mounted transformers 1 lot	Necessary	• LT line materials including Rombo and Mwanga Total 50 km • Pole mounted transformers 33 kV Total 12 units 11 kV Total 9 units
6. Radio telecommunication 1 system	Necessary	Shown in the drawing Fig. 2-3.
7. Vehicles and tools Truck with crane 1 Pick-up truck 2 4WD wagon 1 Tools 1 lot	4 WD wagan 1 unit should be changed to Vehicle for work	Vehicles Truck 5 ton 1 Vehicles for work 3 Tools including measurement equipment 1 lot
Additional		Distribution System Retationalization • Improvement of Rombo System 33 kV 6 km • Improvement of Mwanga System 33 kV 1 circuit • Improvement of Same System 33 kV 2 km • Mwanga Substation 11 kV feeder 3 circuits • Installation of Load Breaker Switches 3 sets

2-3 Basic Design

2-3-1 Design Concept

(1) Natural conditions

1) Foundation work and the installation of substation equipment is adversely affected in the rainy season. March to June is the heavy rain season. November and December is the season of light rain. As this project's engineering works start in September and the substation installation works start in January it is, therefore, not overly influenced by rainfall.

2) The monthly mean maximum and minimum temperatures are 30°C and 18°C respectively. Equipment design for temperature change is ordinary.

3) As Tanzania experiences no earthquakes, monsoons and the like, equipment design has no limitations. The substation and power distribution route present no geographical features which may cause flooding.

(2) Construction situation and local constructors

The following may be accepted from the experience of works done 12 years ago.

1) The expertise and experience of the local contractors is adequate for the general construction work.

2) The labor standards are satisfactory in both quality and quantity.

3) Cement and other general work materials can be procured locally.

4) The work of this project requires no permission from the Tanzanian government and infringes upon no laws.

(3) Utilization of local materials

Wooden poles and bare aluminum wires are procured from Zambia and South Africa.

(4) Maintenance and management capacity of executive organ

1) TANESCO has maintained and managed as many power supply substations and power supply lines as in this project for many years and its capacity presents no problem.

2) TANESCO staff are well able to carry out the maintenance and management of the power supply substations and lines with no increase, even after completion of this project. (The number of substations remains unchanged. The power supply lines show only a 10% increase.)

(5) Grade of facilities, equipment, etc.

Consistency with existing substations is important in this project. The grade of facilities, equipment, etc. is set to the existing grade as far as possible. Existing facilities are to be used as much as possible. Some standards are not yet popular in Tanzania, in that case, Japanese or international standards will be applied for this project.

(Applicable standards)

- Japanese Industrial Standards (JIS)
- Japanese Electrotechnical Committee Standards (JEC)
- Japanese Electric Machinary (JEM)

- Japan Cable Manufacturer Association Standards (JCS)
- International Electrotechnical Commission (IEC)
- American National Standards Institute (ANSI)
- National Electrical Manufacturers Association (NEMA)

(6) Policy for term of works

The construction of the substations and other principal parts and material procurement will be completed in March, 1997. Works for the power supply lines and low voltage lines to be executed by TANESCO are kept on and will be completed by December, 1997.

(7) Design conditions

1) Natural conditions

Elevation	:	800 m - 1,500 m
Atmospheric temperature	:	Highest; 40°C
		Lowest; 10°C
		Average; 32°C

2) Safety factor

The following values are applied according to Tanesco Standards.

Support structure	:	4
Support structure base	:	2.5
Electric cable	:	3
Insulator	:	3.5
Cross arm	:	2.5
Branch wire	:	2.5

3) Conductor temperature

Average operating temperature: 32°C

Permissible temperature : 90°C

4) Wind pressure

Assuming a max. wind velocity of 33m/sec, the wind pressure on the overhead cable shall be 50 kg/m^2 and the wind pressure on the structure shall be 75 kg/m^2.

5) Height above ground of transmission/distribution line

The following height shall be applied to the overhead cables according to Tanesco Standards.

Table 2-3 Height above ground of transmission/distribution line

Item	33 kV	11 kV	L/T
Cable crossing roads carrying vehicular traffic;	6.0 m	5.7 m	5.0 m
Others;	6.0	5.4	4.0
Cable crossing roads with no vehicular traffic;	6.0	4.8	4.0
Others;	6.0	4.8	4.0
Above telephone lines;	1.8	1.8	1.2
Above railway tracks;	9.0	9.0	9.0

(8) Basic design concept

The distribution facilities shall be designed based on the following items. Harmony and coordination with the existing facilities have been thoroughly considered.

1) Improvement in supply reliability

* An on-load tap changer shall be attached to the main transformer of the substation to constantly retain the correct rated voltage.
* All distribution transformers shall be equipped with a lightening arrester.
* Regarding the feeder from the substation, an automatic reclosure system shall be installed to the breaker at the distribution line outlet to shorten outage time caused by temporary transient incidents.
* Load break section switches shall be installed at appropriate locations along the distribution lines to restrict the outage area for work during incidents.
* Insulated wiring shall be used for low tension cables to reduce the number of unnecessary incidental shutdowns caused by the temporary contact of foreign objects.

2) Coordination with existing power facilities

* In principle, the capacity of all distribution transformers shall be 50 kVA as it is for the existing facilities.
* Breakers exceeding 33 kV shall be the oil circuit breaker (OCB) type due to their familiarity for effective maintenance.
* 11 kV circuit breakers shall be set in the cubicle type as same as existing model. Vacuum circuit breakers (VCB) shall be used.
* Considering the use of existing tools, the electric conductor dimensions shall be determined according to the existing ones in principle.
* Same as the former design, the distribution line shall not be equipped with an overhead ground wire. (No problems have occurred thus far.)

(9) Insulation design

The insulation for equipment shall be designed to withstand against abnormal voltages appeared in the system whole range from AC transient high voltage up to very high lightning surges.

But it is impossible to protect equipment against such a high voltage of lightning impulse by their own insulation. Accordingly, following principle is usually adopted:

a. Against internal abnormal voltages (subsequent abnormal voltage rise in case one line fault and switching surge in case open operation of isolator etc.), equipment must withstand by own insulation strength.

b. Against external abnormal voltages (lightning surge), equipment will be protected by surge arrester by means of reduction of lightning surge voltage value to suppress it below a limited value (residual voltage of arrester).

In this project, we specify equipment insulation in accordance with this principle.

1) Determination of kind and number of insulators

Insulation strength shall be born the internal abnormal voltage. As neutral point earthing of transformer, the direct earthing system is adopted for all 66 kV, 33 kV and 11 kV power system here.

Accordingly, coefficient of abnormal voltage value is as follows:

a. Multiple coefficient for AC lasting abnormal voltage:

0.8 Um (Um is the maximum system voltage)

b. Multiple coefficient for switching surge:

2.8 Um

Table 2-4 Required insulation strength deduced by switching surge

Nominal voltage (kV)	66	33	11
Max. system voltage Um (kV)	72	36	12
Crest voltage to earth (kV) √2/√3Um (kV)	58.8	29.4	9.8
Multiple coefficient for switching surge n	2.8	2.8	2.8
Switching surge voltage (kV)	164.6	82.3	27.4
Deterioration factor	1.2	1.2	1.2
Required insulation strength (kV)	197	99	33

Table 2-5 Required insulation strength deduced by AC lasting abnormal voltage

Nominal voltage (kV)	66	33	11
Max. system voltage Um (kV)	72	36	12
Multiple coefficient for switching surge n	2.8	2.8	2.8
Lasting abnormal voltage (kV)	57.6	28.8	9.6
Deterioration factor	1.2	1.2	1.2
Required insulation strength (kV)	69	35	12

Table 2-6 Characteristics of insulators

Strain insulator number of strings	Standard surge	Switching surge		Power frequency	
	50% flash over voltage (kV)	50% flash over (kV)	Withstand (kV)	Flash over (kV)	Withstand (kV)
1	150	85	75	45	40
2	240	155	140	80	70
3	330	225	205	115	105
4	410	295	265	150	135
5	495	360	325	190	170
33 kV Post insulator	200			80	
11 kV Post insulator	105			35	

Comparing to insulator characteristics and required insulation strength, insulator type and number of insulators to be used were decided as following Table: (According to the maintenance practice, one disc is added against the necessary number theoretically calculated.)

Table 2-7 Selection of insulator type and number of insulators

Nominal Voltage	Place	Strain insulator number	33 kV post insulator	11 kV post insulator
66 kV	Straight Tension	5 discs with arcing horn		
33 kV	Straight Tension	3 discs	o	
11 kV	Straight Tension	2 discs		o

2) Insulation clearance

a. Standard clearance against earth

Standard clearance is assumed as same as rod gap that will flash over by the 50% flush over voltage of insulator string in case standard impulses (positive) are applied.

Table 2-8 Insulation clearance

Nominal voltage (kV)	66	33	11
Number of strain insulator (real)	5	3	2
Number of strain insulator (net)	4	2	1
50% FOV of insulator chain (kV)	495	330	240
Equivalent rod gap (cm)	80	52	36
Standard insulation clearance (cm)	85	55	40

b. Minimum insulation clearance

Minimum clearance shall be born against both switching surge and lasting AC abnormal voltage. Actually, clearance value may be determined by the switching surge voltage. Clearance of arcing horn should be set beyond this value.

Table 2-9 Minimum insulation clearance

Nominal voltage (kV)	66	33	11
Max. system voltage Um (kV)	72	36	12
Crest AC value against earth (kV)	58.8	29.4	9.8
Multiple for switching surge n	2.8	2.8	2.8
Crest value of switching surge (kV)	164.6	82.3	27.4
Required withstand voltage (kV)	197	99	33
Required clearance (cm)	35	19	7
Minimum insulation clearance (cm)	40	25	10

It is necessary that the clearance which may become abnormally small when maximum wind should be checked by values shown in the following table:

Table 2-10 Insulation clearance in abnormal case

Nominal voltage (kV)	66	33	11
Max. system voltage Um (kV)	72	36	12
Crest AC value against earth (kV)	41.6	20.7	6.9
Required withstand voltage (kV)	197	22.8	7.6
Required clearance (cm)	14.3	6.5	2.2
Safety clearnace (cm)	17	8	3

Table 2-11 Minimum clearance between lines

Nominal voltage (kV)	66	33	11
Max. system voltage Um (kV)	72	36	12
Crest voltage against earth (kV)	58.8	29.4	9.8
Multiple switching surge between lines	5.3	6.4	6.4
Surge voltage between line (kV)	311.6	188.1	62.7
Withstand voltage between lines (kV)	343	207	69
Min. clearance between lines (cm)	65	37	12
Actual clearance between lines (cm)	150	135	100

3) Determination of BIL and selection of arrester

Considering the residual voltage of arrester BIL (Basic Impulse Level) will be adopted as follows:

Table 2-12 BIL and arrester

Nominal voltage (kV)	66	33	11
Um (kV)	69	36	12
Rated voltage of arrester (kV)	72	36	12
MCOV * (kV)	56.1	28	9.3
MCOV x √3 (kV)	97.2	48.5	16.1
Tolerance between MCOV & Um	1.35	1.35	1.34
BIL (kV)	325	170	90
Tolerance between Residu. V & BIL	1.6	1.8	2.5

Note. * MCOV: Maximum Continuous Operating Voltage

4) Protection against lightning attack

Statistical data on IKL (Isokeraunic Level) cannot be got. But since former equipment have never been damaged by lightning attack, same design will be adopted that over head ground wires will be set for substations while no over head ground wires are set for distribution lines.

2-3-2 Basic Design

(1) General Plan

1) Conditions, configuration and environment of land planned for the substation

Mwanga substation to be established is near a consuming area on flat land and within the premises of the existing Mwanga substation. It is a good site with no neighboring residences. (Plottage approximately 23 m x 15 m).

To ensure no water stays in the substation after rainfall it is necessary that the ground be leveled by about 50 cm bringing it flush with the existing substation ground. This is executed by TANESCO.

New NYM substation to be established is adjacent to the switchyard of NYM power station and is in the premises of that power station. The ground near the dam is solid. There are no private residences in the neighborhood. (Plottage approximately 36 m x 12 m).

Most distribution branch lines run along village roads which provides easy pole erection and maintenance.

2) Conditions of existing infrastructure

There are roads used for the construction of the existing power station and there is, therefore, no problem concerning the sending in of heavy goods for the construction of NYM substation. Mwanga substation is by a public road near a national highway and the access road offers no problem.

A paved, well-maintained national highway runs from the port of Dar es Salaam to Kilimanjaro covering approximately 500 km enabling the smooth transportation of heavy goods.

3) Suitability as installation location

The site of new Mwanga substation to be established is adjacent to the existing substation and requires the least labor and cost. Being close to the demand area behind, the change-over work between the new and old facilities after establishment is easy and maintenance and operation after completion makes this the most suitable site.

New NYM substation to be established is to transmit electricity to Mwanga substation. According to the original plan, electricity is to be received from Same, 35 km away. The plan is changed to receive it from NYM substation thereby providing many advantages. Close examination of TANESCO transmission system shows that nowhere other than NYM substation is close to Mwanga substation to obtain power source. It also provides the advantage of using the existing distribution line.

(2) Materials Plan

1) Outlined specifications of principal equipment are shown below.

Name of Equipment	Principal Specification	Quantity	Purpose
Main Transformer	63/33 kV 5 MVA	1 set	NYM Substation
Main Transformer	33/11 kV 2.5 MVA	1 set	Mwanga Substation
33 kV Line Materials	ACSR 100 sq, 28 km	1 set	Expansion for Rombo area and others
11 kV Line Materials	ACSR 100 sq, 15 km	1 set	Expansion for Mwanga area
Low Voltage Materials	HAL OW55, 50 km	1 set	Replace and expansion for Rombo area and others
Truck	5 ton	1 unit	Construction Work and Maintenance
Vehicles for work	2 ton	3 units	Construction Work and Maintenance
Tools and Measurements		1 set	Construction for distribution line
Wireless System	VHF/FM	1 system	Construction and Maintenance

2) Technical level and maintenance, operation know-how concerning principal equipment

The technical level of substation equipment generally becomes difficult in proportion to the operating voltage. 66 kV is the highest voltage in this project. As TANESCO owns a 220 kV substation and maintains and operates the substation, this level offers no problem. 33 kV class equipment also offers no problem because the equipment installed 12 years ago is controlled with no problem.

3) Spare parts and consumables

Concerning the substation equipment and distribution line, no special spare parts or consumables are required for this project.

These equipment is stationary and there are no special units because no equipment rotates regularly.
From past experience, about 10% of the main body prices are expected for vehicle spare parts.

4) Local procurement and procurement third country procurement

Nothing can be purchased in Tanzania.
Wooden poles and bare aluminum wiring will be purchased from the third countries. These materials are low in the processing degree and can be obtained at a lower cost in view of transportation expenses when obtainable from a nearby country.

(3) Specifications of Principal Equipment

The content and specifications of the project components shown in the basic concept shown below.

1) Mwanga substation

The Mwanga substation is a secondary substation which supplies power to Mwanga township where the district capital office is located and the surrounding area and the densely-populated mountainous area which contains many villages. Previously, one 500 kVA substation was available (an additional 500 kVA station was established by TANESCO in 1992.) Due to capacity shortage, a 2,500 kVA substation is to be established in an adjacent location.

The location of the substation, single-line wiring and equipment layout are shown in Figs. 2-10 through 2-12.

Facility outline

Power receiving system

Electricity is received by one 33 kV distribution line from the NYM power station.

a. Main Transformer

Standard based	JEC 204 Transformer
	JEC 186 On-load-tap-changer
	IEC Transformer
Capacity	2,500 kVA
Rating	Continuous
Number of phase	3
Frequency	50 Hz
Cooling system	Oil immersed self cooling
Rated voltage	33,000 V/11,000 V
Tap voltage	+5%, -15%, 17 taps
BIL	170/90 kV
Connection 1ry	Star
2ry	Star
3ry	Delta
Neutral point	Direct earthing
Impedance	5.5%
Phase angle deviation	0
Polarity	Decrease
Place used	Out door
Tap changer	On load tap changer
Altitude	Less than 1,000 m
Max. ambient temperature	40 degree C

b. Circuit Breaker

Standard applied	JEC 181 Circuit Breaker	
Rated Voltage	36 kV	12 kV
Type	Outdoor OCB	In door VCB
Rated current	600 A	600 A
BIL	200 kV	90 kV
Rated Frequency	50 Hz	50 Hz
Rated rupturing current	12.5 kA	12.5 kA
Rated rupturing time	5 cycles	5 cycles
Rated closing voltage	DC 125 V	DC 125 V
Rated tripping voltage	DC 125 V	DC 125 V
Operation duty	A	A
	0-(1 min)-CO	0-(0.3 sec)-CO
	-(3 min)-CO	-(1 min)-CO

c. Isolator

Applied standard	JEC 196 Disconnecting Switch	
Rated Voltage	36 kV	12 kV
Rated Current	600 A	600 A
Rated short time current	12.5 kA	12.5 kA
Type	Out door	Out door
Operation	Manually	Manually

d. Current transformer

Applied standard	IEC 185, JEC 193 Instrument Transformer	
Rated voltage	36 kV	12 kV
Rated current ratio	100/50/5 A	150/5 A
Rated burden	40 VA	40 VA
Accuracy class	1.0	1.0

e. Arrester

Applied standard	JEC 203 Arrester	
Rated voltage	36 kV	12 kV
Rated discharge current	10 kA	10 kA

2) Nyumba Ya Mungu (NYM) Substation

A new NYM substation is to be established adjacent to the outdoor switchyard of NYM hydraulic power station (4 MW x 2).
Electricity is received by a 66 kV branch line connected to the 66 kV bus bar of the outdoor switchyard of the above power station. One 5,000 kVA transformer is installed and the 33 kV service line is drawn out by using the existing 33 kV switchgear.

The location of the substation, single line diagram and equipment layout are shown in Figs. 2-13, 2-14.

Facility outline

Power receiving system

The 66 kV bus bar of the NYM power station is remodeled and a 66 kV branch line is constructed to receive electricity.

Specification of main equipment

a. Main Transformer

Applied standard	JEC 204 Transformer
	JEC 186 Tap Changer
	IEC Transformer
Capacity	5,000 kVA
Rating	Continuous

Number of phase	3
Frequency	50 Hz
Type of cooling	Oil immersed self cooling
Rated voltage	66,000 / 33,000 V
Tap voltage	±10%, 17 taps
BIL	350 kV / 200 kV
	1ry star
	2 ry star
	3 ry delta
Neutral point earthing	Direct earthing
Impedance	7.5%
Phase angle deviation	0
Polarity	Decrease
Place of use	Out door
Tap change mechanism	On-load tap-changer
Altitude	Less than 1,000 m
Maximum ambient Temperature	40 degree C

b. Circuit Breaker

Applied standard	JEC 181 Circuit Breaker
Rated voltage	72 kV
Type	Out door type OCB
Rated current	600 A
BIL	350 kV
Frequency	50 Hz
Rated rupturing current	25 kA
Rated rupturing time	5 cycles
Rated closing operation V.	DC 125 V
Rated trip operation voltage	DC 125 V

c. Isolator

Applied standard	JEC 196 Isolator
Rated voltage	72 kV
Rated current	600 A
Rated short time current	25 kA
Place of use	Out door
Operation method	Manually

d. Current transformer

Applied standard	IEC 185, JEC 193 Instrumental transformer
Rated voltage	66 kV
Rated current ratio	75 / 5 A
Rated burden	25 VA
Accuracy class	1P

e. Arrester

Applied standard	JEC 203 Arrester
Rated voltage	72 kV
Nominal discharge current	10 kA

3) Radio communication system

The type and required number are as follows.

VHF base stations (desk-top stationary unit): 8

Marangu, Mwanga, Same, Gonja, Hai, Machame, Rombo & Tarakea

Mobile stations (in-vehicle): 13

2 at Regional Office, 1 each at Marangu, Hai and Machame,

2 each at Mwanga, Same, Rombo and Gonja

Portable radios: 16

2 each at VHF base stations

Repeater station: 1

Near Himo

Antenna: 9 units (base stations and repeater station)

Fig. 2-3 shows the Tanesco Communication System Diagram after completion.

2-3-3 Tables and Figures

Fig. 2-1	Conceptional Power System Diagram in Kilimanjaro
Fig. 2-2	Distribution System A ~ G
Table 2-14	Desired Line Expansion 1/2, 2/2
Fig. 2-3	Tanesco Communication System in Kilimanjaro
Fig. 2-4	Power System Diagram in Kilimanjaro
Fig. 2-5	System Configuration Diagram (1) ~ (3)
Fig. 2-6	Pole Configuration, 33 kV Line
Fig. 2-7	Pole Configuration, 33 kV Line with Transformer
Fig. 2-8	Pole Configuration, 11 kV
Fig. 2-9	Pole Configuration, 11 kV Line with Transformer
Fig. 2-10	Mwanga Substation Site
Fig. 2-11	Mwanga Substation Single Line Diagram
Fig. 2-12	Mwanga Substation Arrangement
Fig. 2-13	New and Existed Mwanga Substation Arrangement
Fig. 2-14	NYM Substation Site
Fig. 2-15	NYM Substation Single Line Diagram
Fig. 2-16	NYM Substation Arrangement
Fig. 2-17	New and Existed NYM Substation

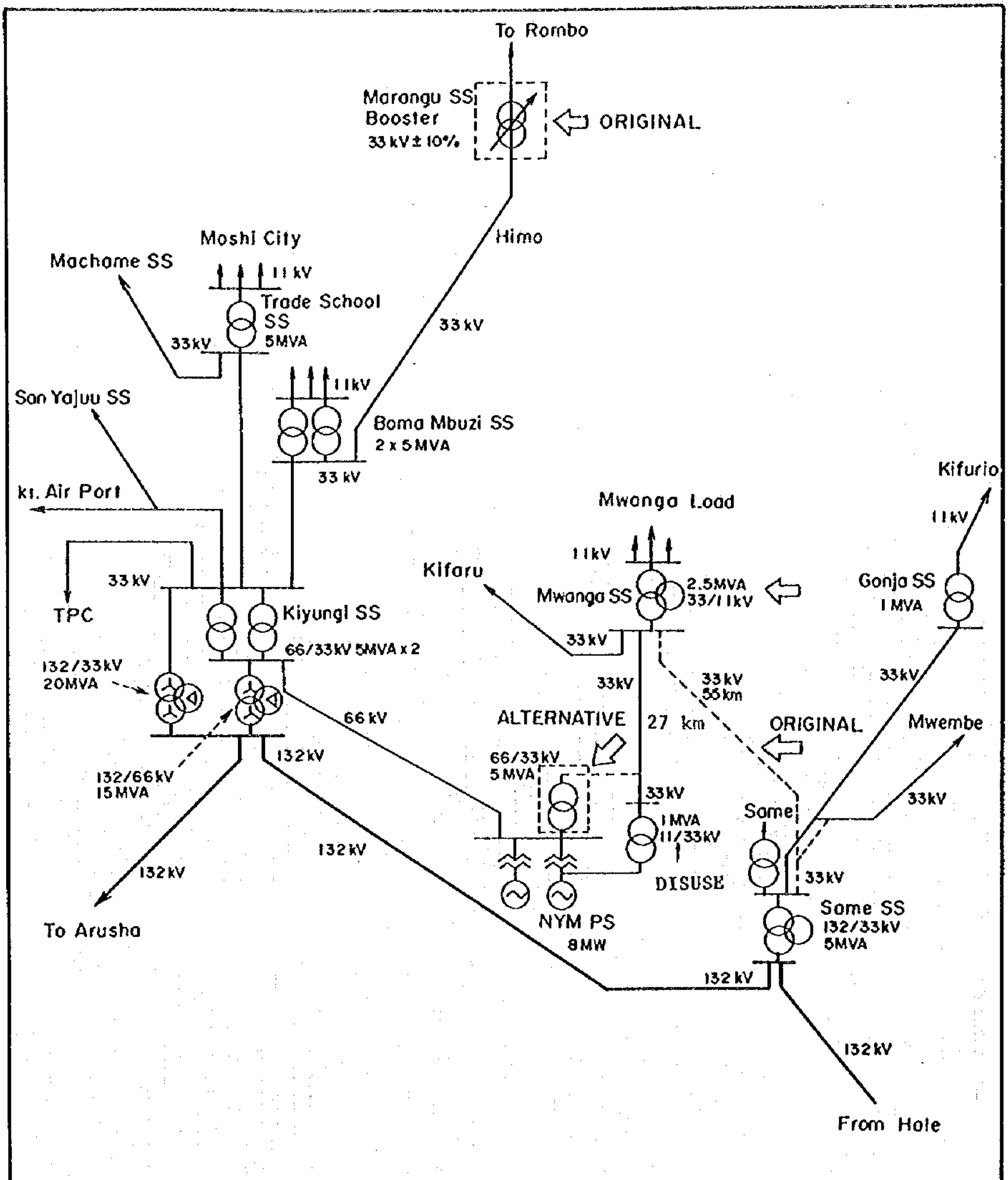


Fig. 2-1 Conceptional Power System Diagram in Kilimanjaro

ROMBO AREA 33kV DISTRIBUTION SYSTEM

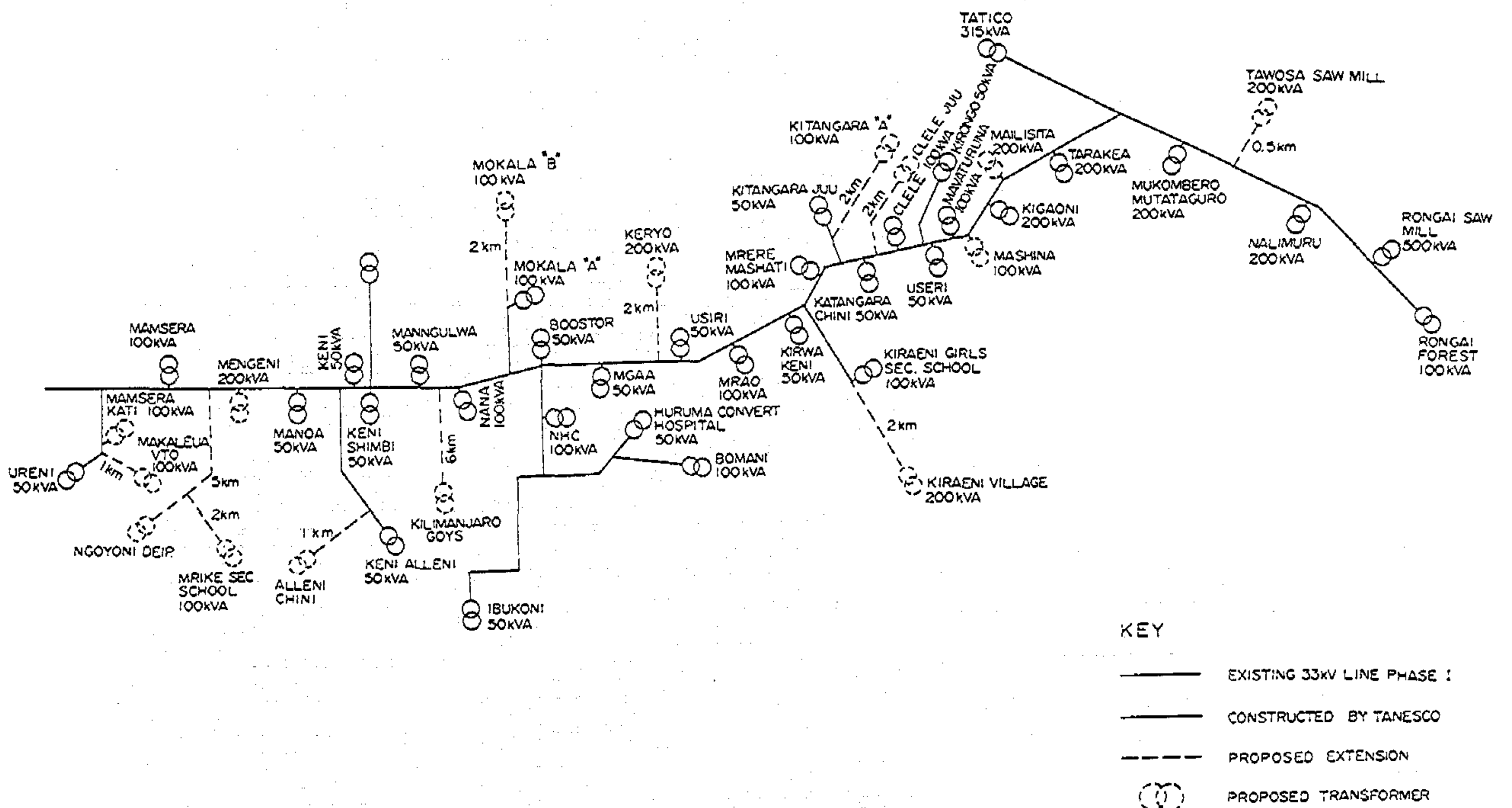


Fig. 2-2 Distribution System A

MWANGA 33kV & 11kV DISTRIBUTION SYSTEM & SYSTEM'S IMPROVEMENT PROPOSALS

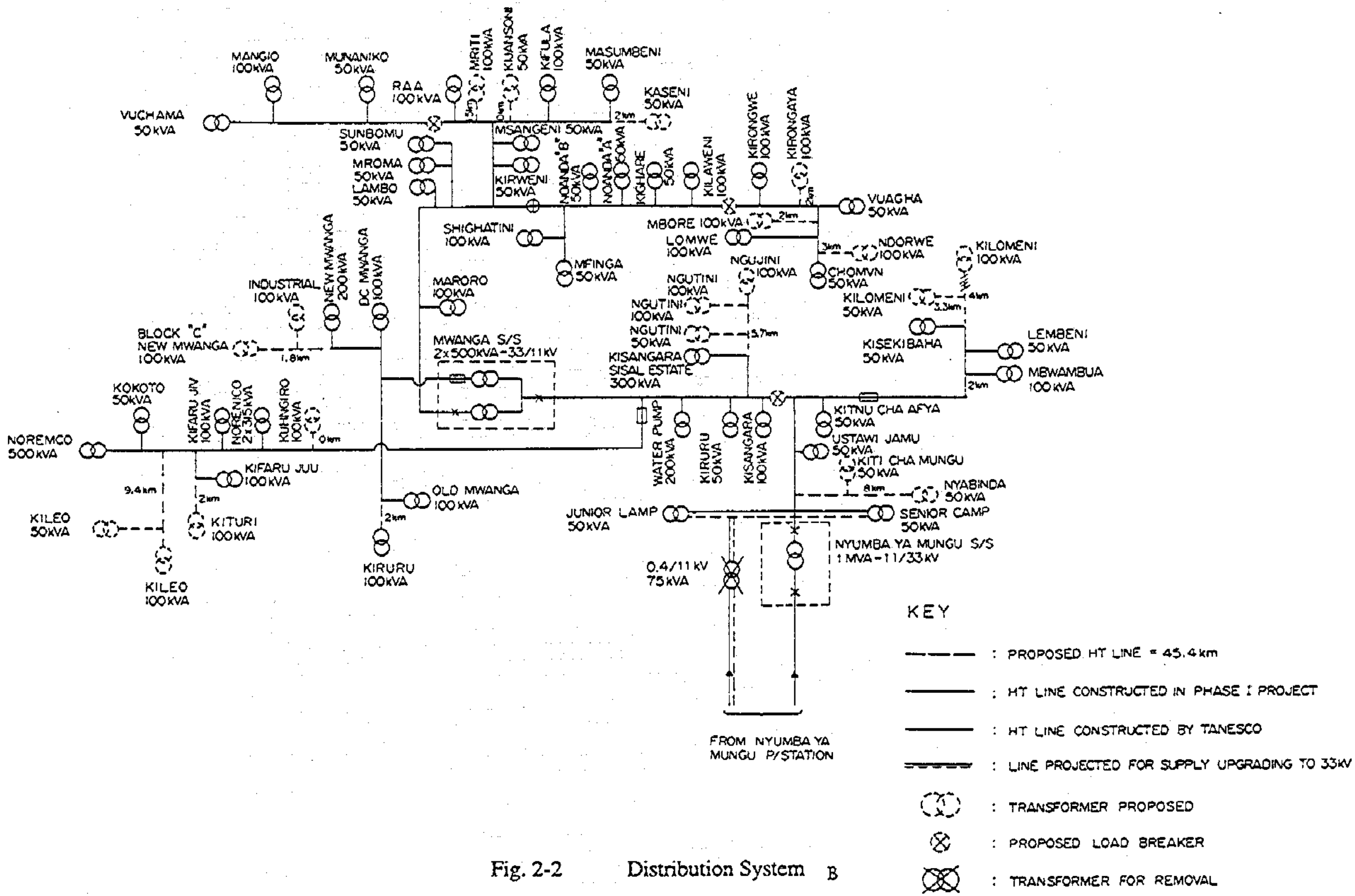


Fig. 2-2 Distribution System B

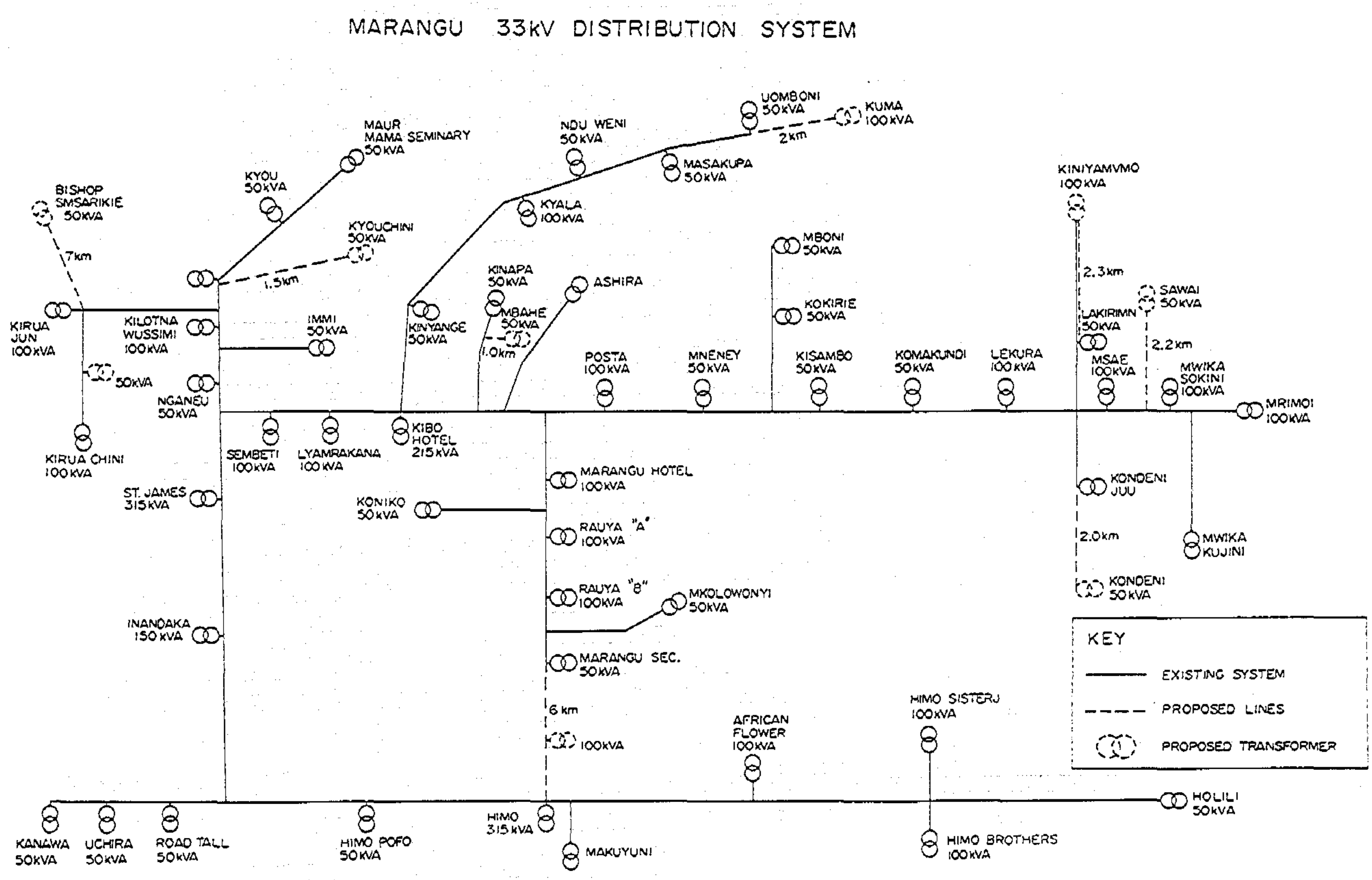


Fig. 2-2 Distribution System c

DISTRIBUTION SYSTEM SAME DISTRICT.

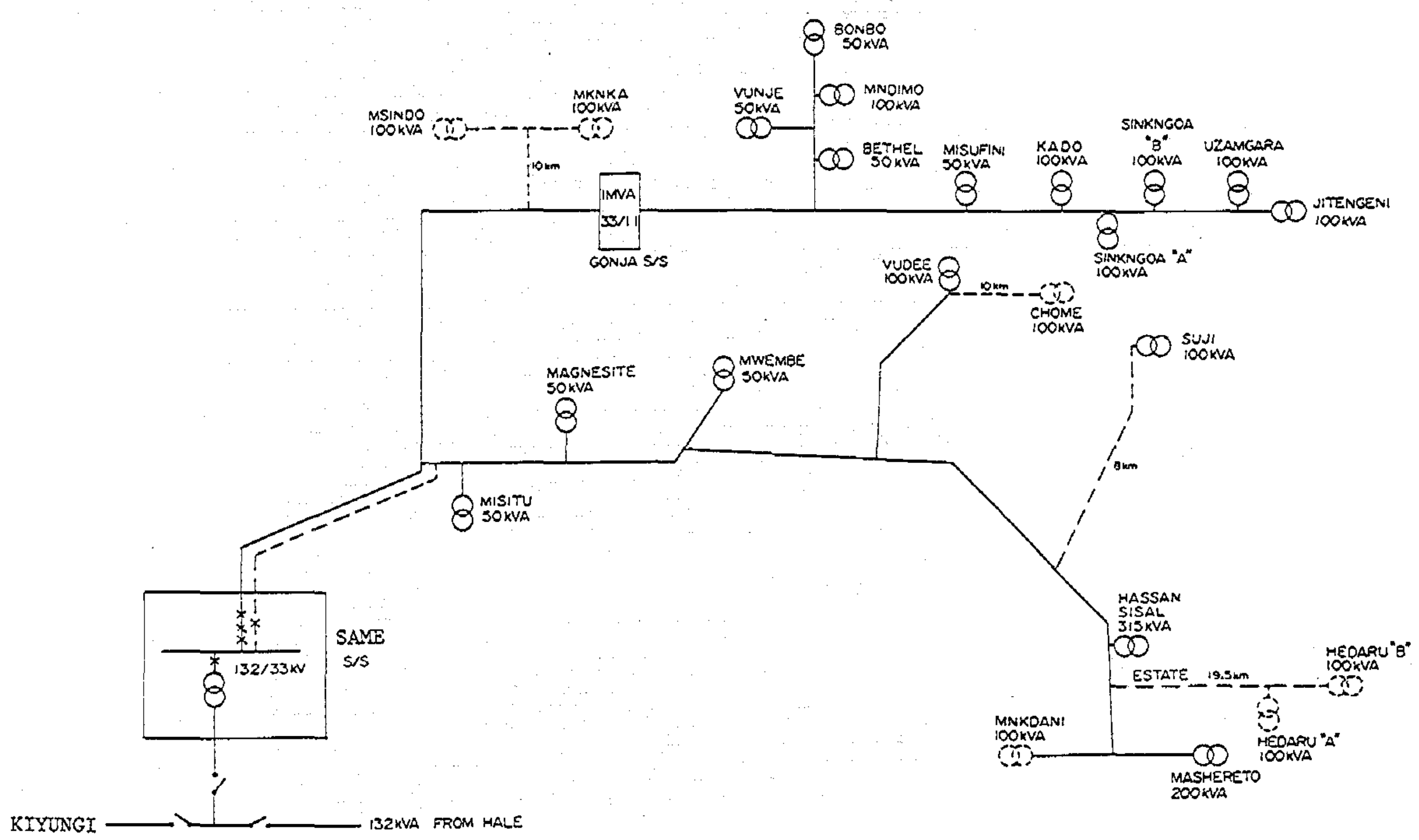


Fig. 2-2 Distribution System D

SAME TOWNSHIP 11 kV SYSTEM

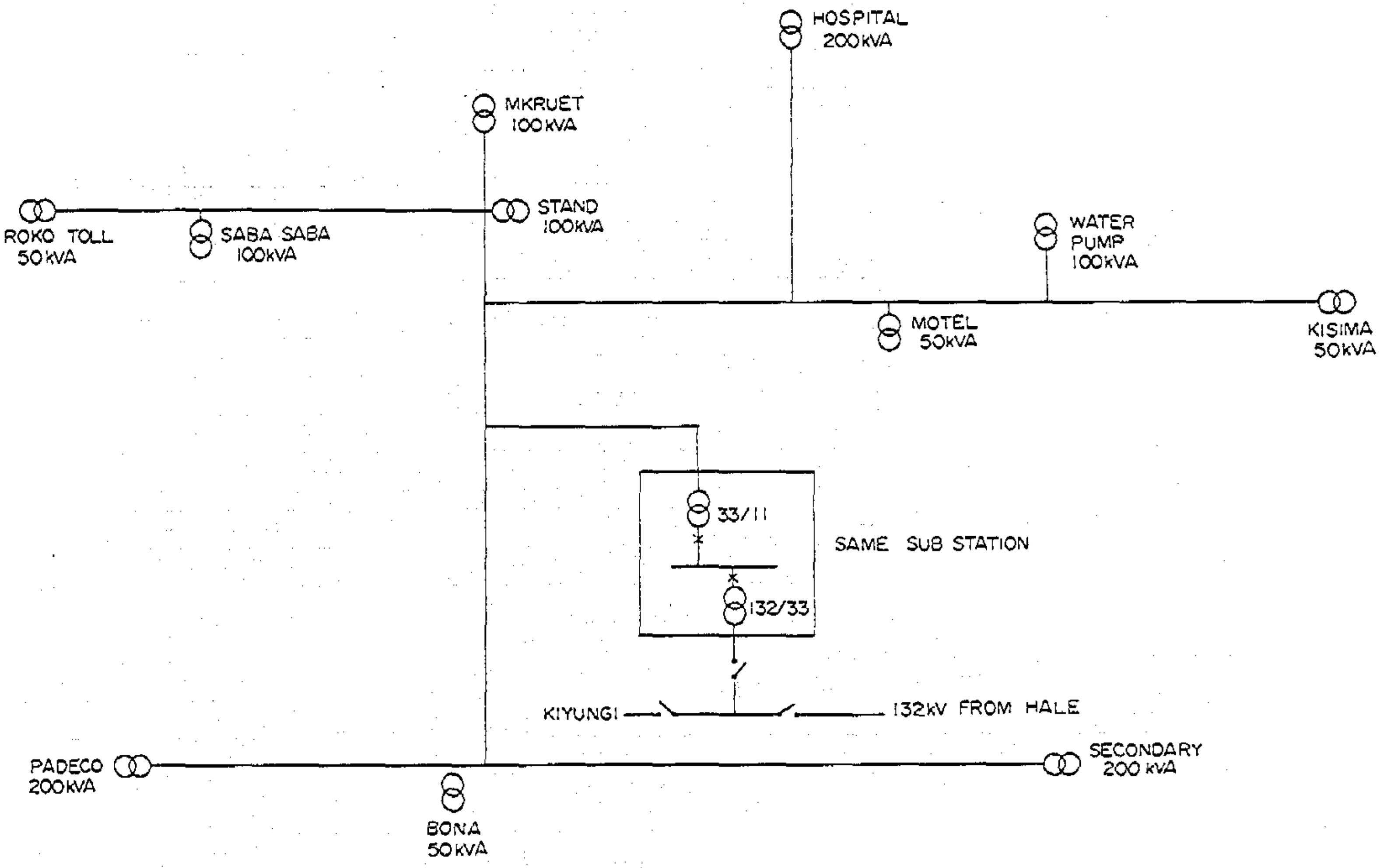


Fig. 2-2 Distribution System E

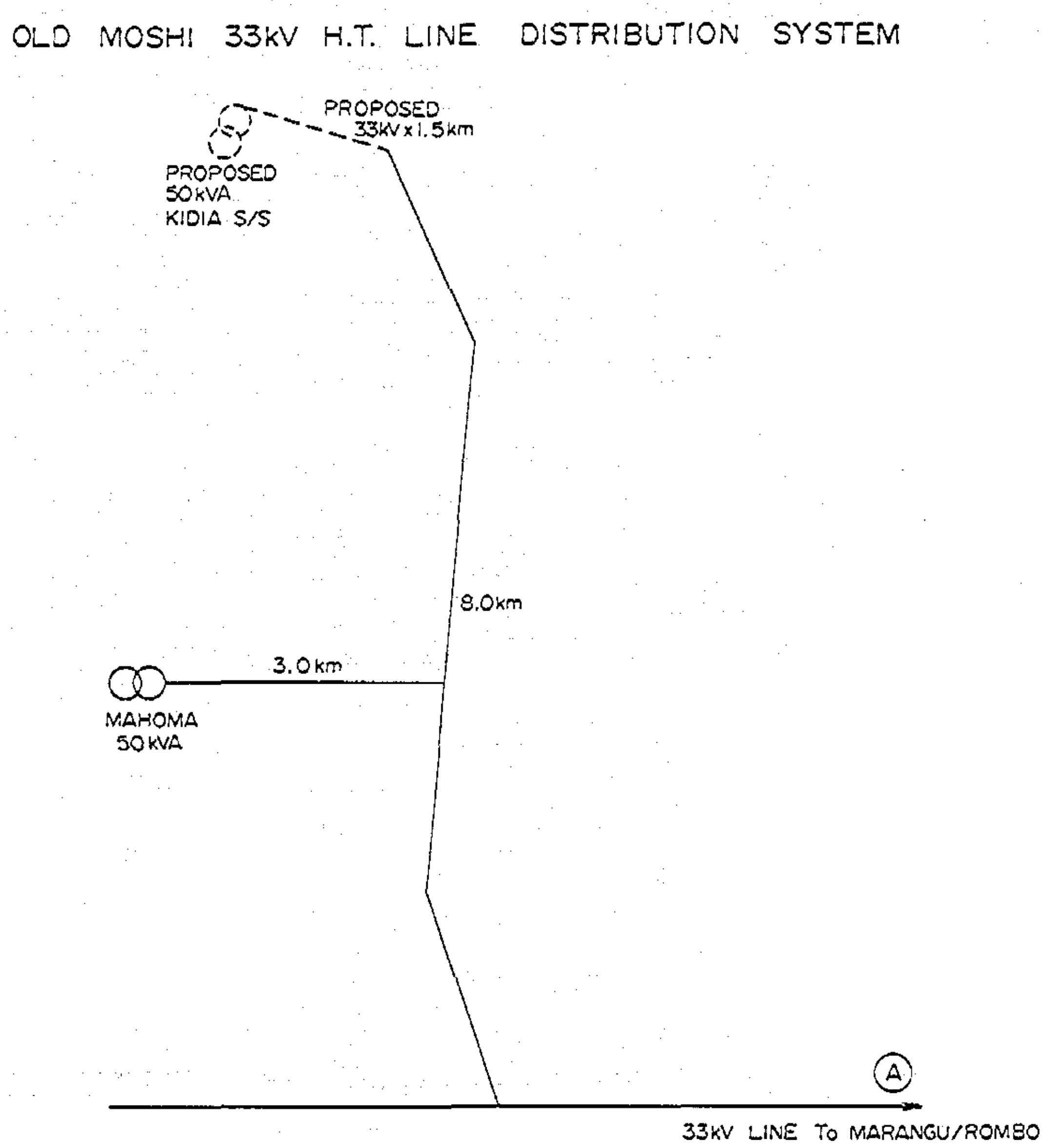


Fig. 2-2 Distribution System F

SINGLE LINE DIAGRAM FOR HAI DISTRICT UNDER KREP

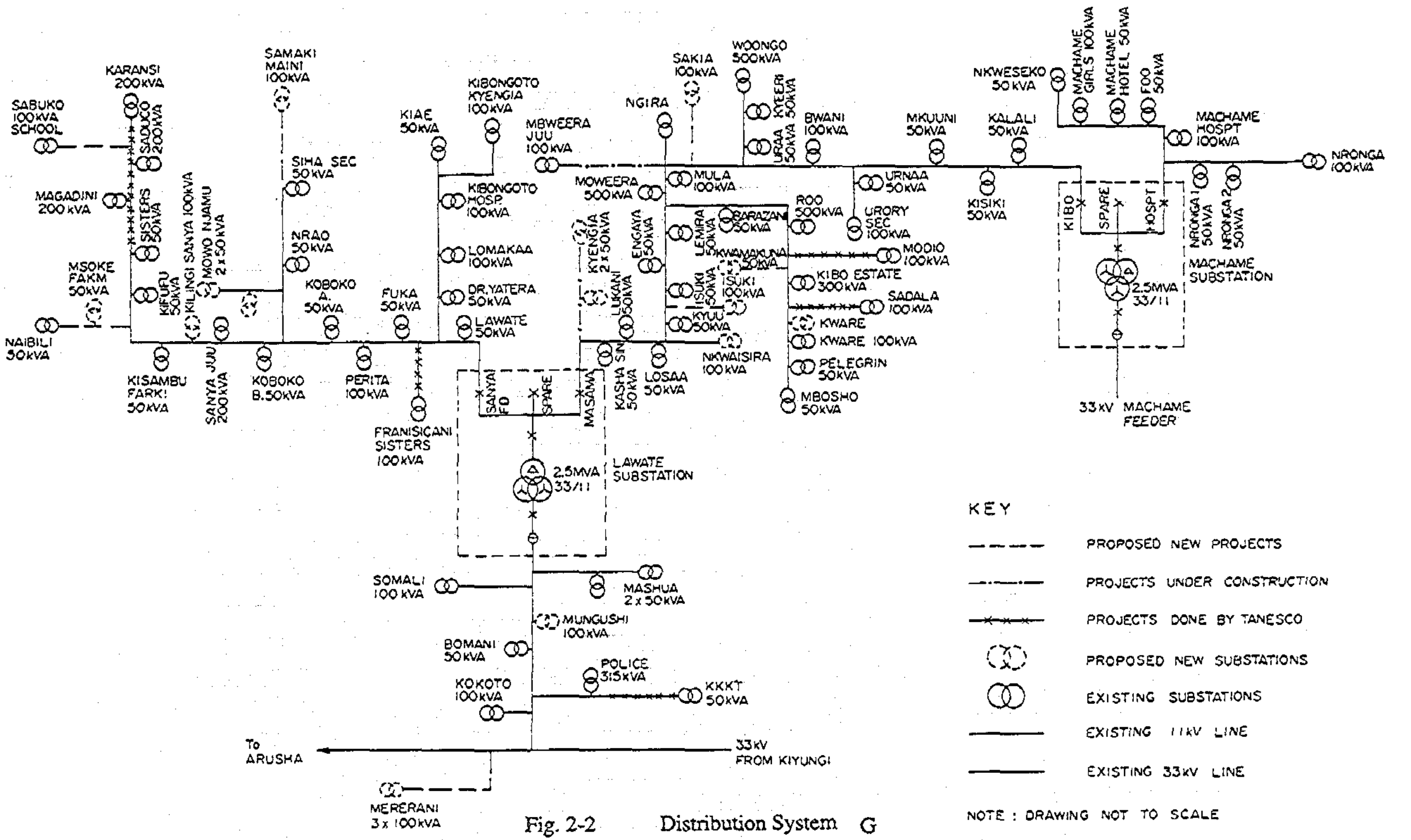


Fig. 2-2 Distribution System G

Table 2-14 Desired Line Expansion 1/2

Desired Line Expansion

Nov.,1995
[Expansion]

Rombo

Trf.No.	Location	kVA	Line(km)	Prio.A	Trf.
1	Mamsera Kati	100	0	0	1
2	Makaleua VTC	100	1	1	1
3	Ngoyoni	50	5		
4	Mrike 2nd Sch.	100	2		
4'	Mangeni	50	0		1
5	Alleni Chini	50	1	1	1
6	Kilimanjaro Boys	50	6		
7	Mokala B	100	2		
8	Keryo	200	2	2	1
9	Kiraeni Village	200	2	2	1
10	Kitangara A	100	2		
11	Olele Juu	50	2		
12	Mashina	100	0		1
13	Mailisita	200	0		
14	Tawosa Saw Mill	200	0.5		
	No. of Unit: 15	1650	25.5	6	7

Mwanga

33kv/LT

Trf.No.	Location	kVA	Line(km)	Prio.A	Trf.
1	Kileo	50	9.4		
2	Kileo	100	0		
3	Kituri	100	2		
4	Kuangiro	100	0		
5	Ngutini	50	5.7	5.7	1
6	Ngutini	100	0		1
7	Ngutini	100	0		
8	Mbwambua	100	2		
9	Kilomeni	50	4		
9'	Kilomeni	100	0		
10	Kiti Cha Mungu	50	8	8	1
11	Nyabinda	50	0		1
	No. of Unit: 12	950	31.1	13.7	4

11kv/LT

Trf.No.	Location	kVA	Line(km)	Prio.A	Trf.
1	Kiruru	100	2	2	1
2	Block C New Mwanga	100	1.8	1.8	1
3	Industrial	100	0	0	1
4	Mriti	100	1.5	1.5	1
5	Kisanjoni	50	0	0	1
6	Kaseni	50	2	2	1
7	Kirongaya	100	2	2	1
8	Mbore	100	2	2	1
9	Ndorwe	100	3	3	1
	No. of Unit: 9	800	14.3	14.3	9

Marangu

33kv/LT

Trf.No.	Location	kVA	Line(km)	Prio.A	Trf.
1	Conection	100	6	6	1
2	Bishop MMsarikie	50	7		
2'	Kirua'	50	0		
3	Kyou Chini	50	1.5		
4	Mbahe	50	1		
5	Kiima	100	2		
6	Kinyamvmo	100	2.3		
7	Sawai	50	2.2		
8	kKondeni	50	2		
	No. of Unit: 9	600	24	6	1

Same

33kv/LT

Trf.No.	Location	kVA	Line(km)	Prio.A	Trf.
1	Connection		2	2	
2	Chome	100	10		
3	Suji	100	8		
4	Hedaru A	100	19.5		
5	Hedaru B	100	0		
6	Gonja'	100	0		
	No. of Unit: 5	500	39.5	2	0

Hai

11kv/LT

Trf.No.	Location	kVA	Line(km)
1	Naibili	50	?
2	Msoke	50	0
3	Mowo Njamu	50	?
4	Samaki	100	?
5	Mae	50	
6	Isuki	100	
7	Nkwaisira	100	
8	Uroky Sec	100	
	No. of Unit: 8	600	0

33kv/LT

Trf.No.	Location	kVA	Line(km)
1	Somali	100	?
2	Mashua	50	
3	Mashua B	50	
	No. of Unit: 3	200	0

Total

	Equipment	Request	Realization	
33 kV	Line length	120 km	27.7 km	(23.1%)
	Trf. No. & Cap.	44 sets	50 kVA x 12 sets	(27.3%)
11 kV	Line length	14.3 km	14.3 km	(100%)
	Trf. No. & Cap.	9 sets	50 kVA x 9 sets	(100%)

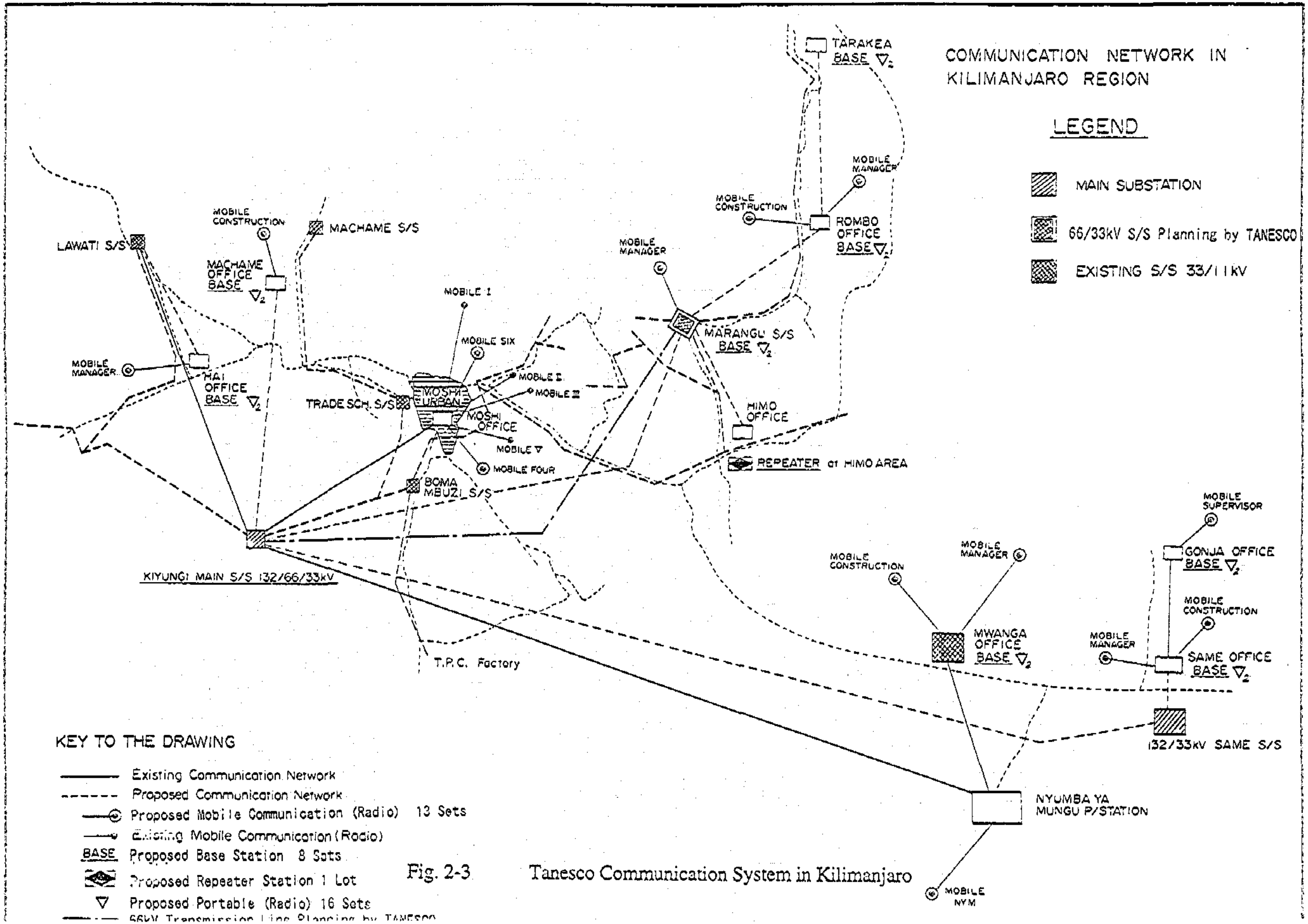
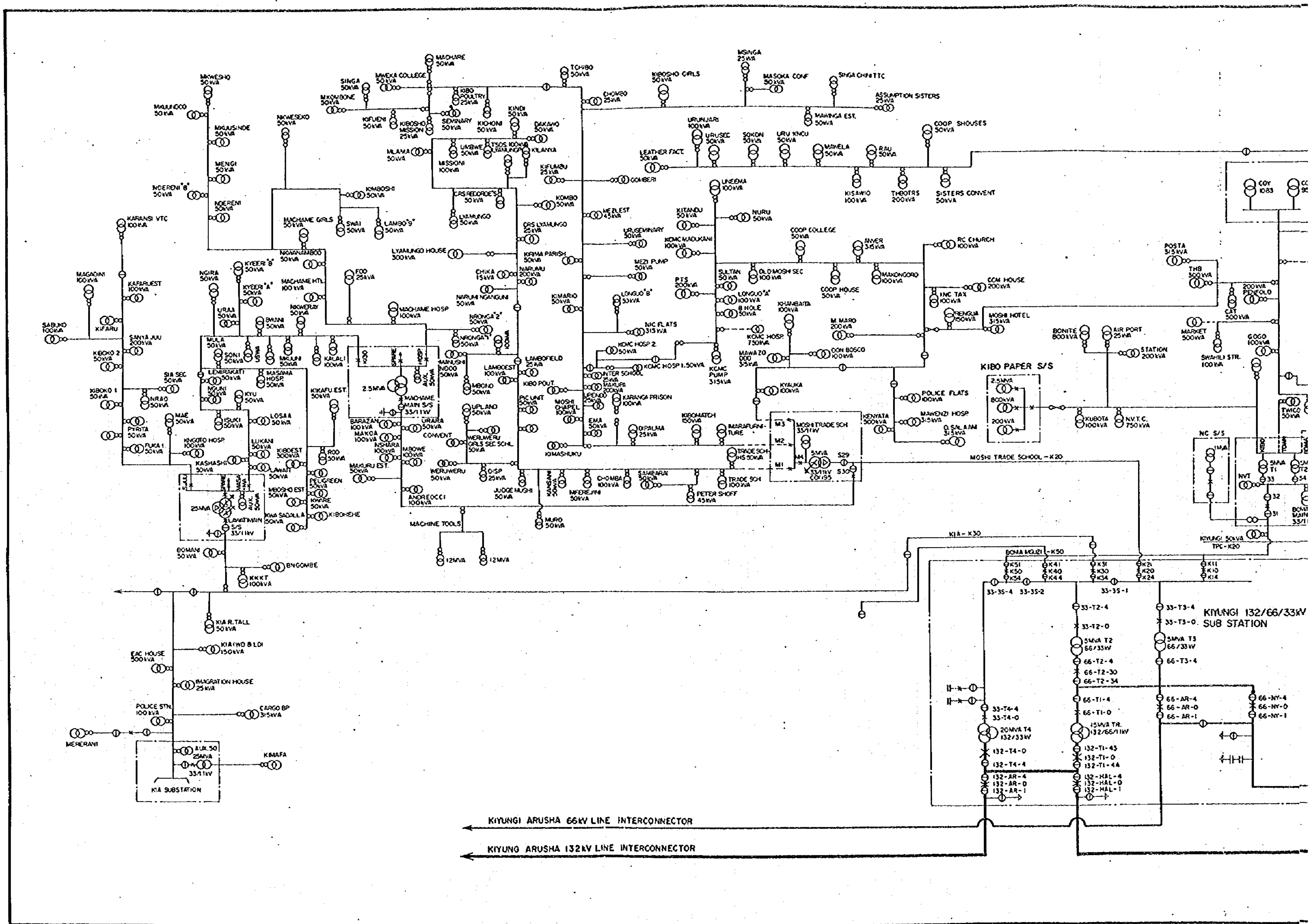
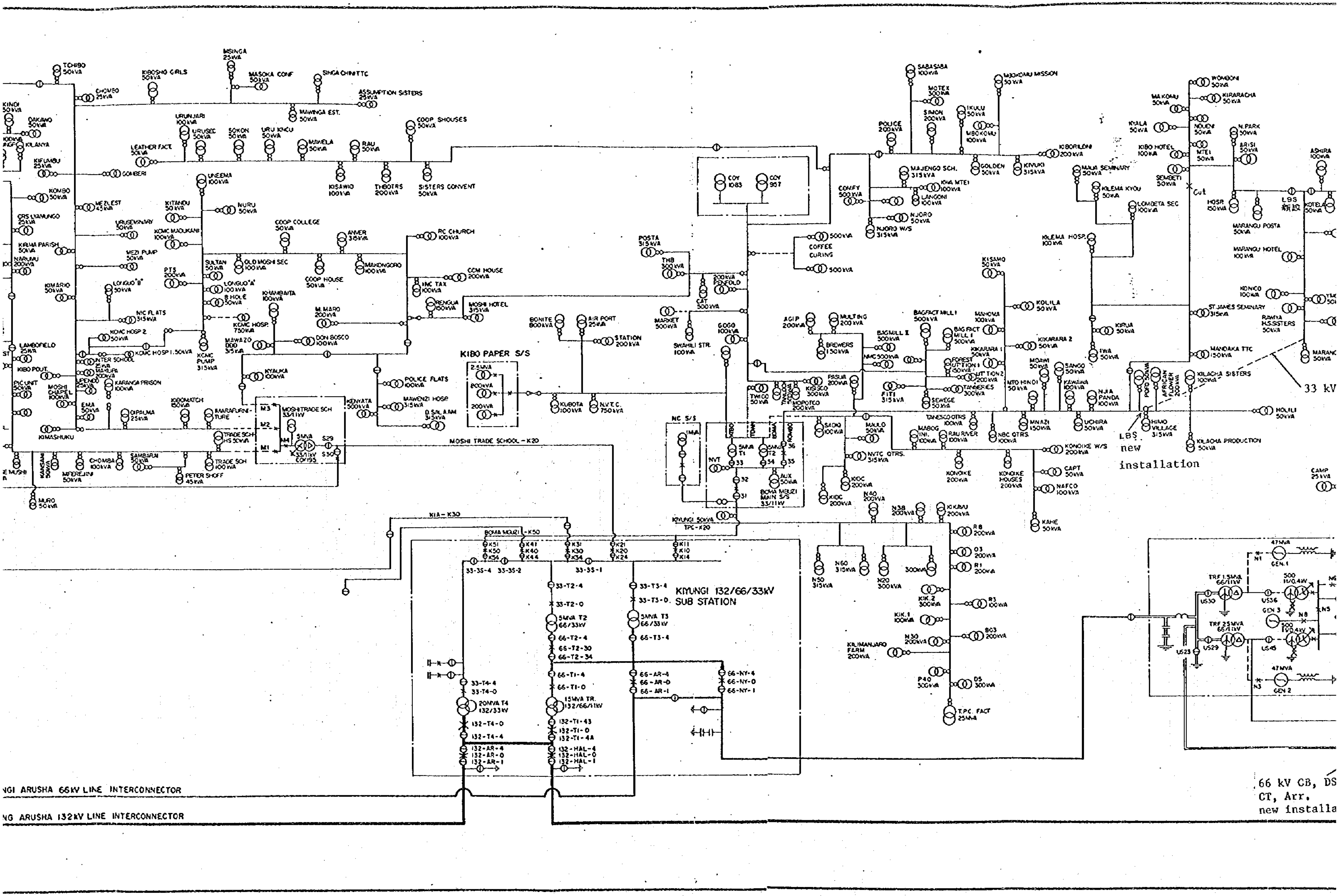


Fig. 2-3 Tanesco Communication System in Kilimanjaro


KIBO PAPER S/S
KIYUNGI 132/66/33kV
SUB STATION
KIYUNGI ARUSHA 66kV LINE INTERCONNECTOR
KIYUNG ARUSHA 132kV LINE INTERCONNECTOR
MOSHI TRADE SCHOOL - K20
KIA - X30
KIA SUBSTATION
MERERANI
KIMAFA
MACHINE TOOLS
NC S/S



KIYUNGI 132/66/33kV SUB STATION
KIBO PAPER S/S
NC S/S
BOMA MBUZI MAIN S/S 33/11kV
MOSHI TRADE SCH 33/11kV
MOSHI TRADE SCHOOL - K20
KIA - K30
BOMA MBUZI - K50
KIYUNGI 50kVA
TPC - K20
20MVA T4 132/33kV
15MVA TR. 132/66/11kV
5MVA T2 66/33kV
5MVA T3 66/33kV
33-T2-4
33-T2-0
66-T2-4
66-T2-30
66-T2-34
66-T1-4
66-T1-0
132-T1-43
132-T1-0
132-T1-4A
132-HAL-4
132-HAL-0
132-HAL-1
33-T4-4
33-T4-0
132-T4-0
132-T4-4
132-AR-4
132-AR-0
132-AR-1
33-T3-4
33-T3-0
65-T3-4
66-AR-4
66-AR-0
66-AR-1
66-NY-4
66-NY-0
66-NY-1
33-3S-4
33-3S-2
33-3S-1
K51 K50 K54
K41 K40 K44
K31 K30 K34
K21 K20 K24
K11 K10 K14
NGI ARUSHA 66kV LINE INTERCONNECTOR
NG ARUSHA 132kV LINE INTERCONNECTOR
TCHIBO 50kVA
KIBOSHO GIRLS 50kVA
MSINGA 25kVA
MASOKA CONF 50kVA
SINGA CHINI TTC
ASSUMPTION SISTERS 25kVA
MAWINGA EST. 50kVA
COOP SHOUSES 50kVA
LEATHER FACT. 50kVA
KISAWO 100kVA
THEOTRS 200kVA
SISTERS CONVENT 50kVA
COOP COLLEGE 50kVA
ANVER 315kVA
RC CHURCH 100kVA
CCM HOUSE 200kVA
MOSHI HOTEL 315kVA
BONITE 800kVA
AIR PORT 25kVA
STATION 200kVA
KUBOTA 100kVA
N.V.T.C. 750kVA
POLICE FLATS 100kVA
MAWENZI HOSP 315kVA
D.SALAAM 315kVA
KENYATA 500kVA
POSTA 315kVA
THB 500kVA
MARKET 500kVA
SWAHILI STR. 100kVA
COFFEE CURING
AGIP 200kVA
BREWERS 1.5kVA
MULTING 200kVA
SABASABA 100kVA
MWOKOMU MISSION 50kVA
POLICE 200kVA
SIMON 200kVA
MAJENGO SCH. 315kVA
COMFY 500kVA
NJORO 50kVA
KIBORILONI 200kVA
KISAMO 50kVA
KOLILA 50kVA
KIKARARA 2 50kVA
NBC QTRS 100kVA
KONOIKE W/S 200kVA
KONOIKE 200kVA
KONOIKE HOUSES 200kVA
CAPT 50kVA
NAFCO 100kVA
KAHE 50kVA
MNAZI 150kVA
UCHIRA 50kVA
HIMO VILLAGE 315kVA
HOLILI 50kVA
KILACHA SISTERS 100kVA
KILACHA PRODUCTION 50kVA
MANDAKA TTC 150kVA
ST JAMES SEMINARY 315kVA
KIBO HOTEL 100kVA
MARANGU POSTA 50kVA
MARANGU HOTEL 100kVA
WOMBONI 50kVA
KIRARACHA 50kVA
MAKOMU 50kVA
N.PARK 50kVA
ASHIRA 100kVA
LBS
Cut
33 kV
LBS
new
installation
N40 200kVA
N38 200kVA
KIKAVU 200kVA
N60 315kVA
N50 315kVA
N20 300kVA
KIK.2 300kVA
KIK.1 100kVA
N30 200kVA
KILIMANJARO FARM 200kVA
P40 300kVA
T.P.C. FACT 25MVA
R8 200kVA
O3 200kVA
R1 200kVA
R3 100kVA
803 200kVA
D5 300kVA
47MVA GEN.1
47MVA GEN 2
TRF 1.5MVA 66/11kV
TRF 2.5MVA 66/11kV
US30
US29
US23
US36
US45
66 kV CB, DS
CT, Arr.
new installa

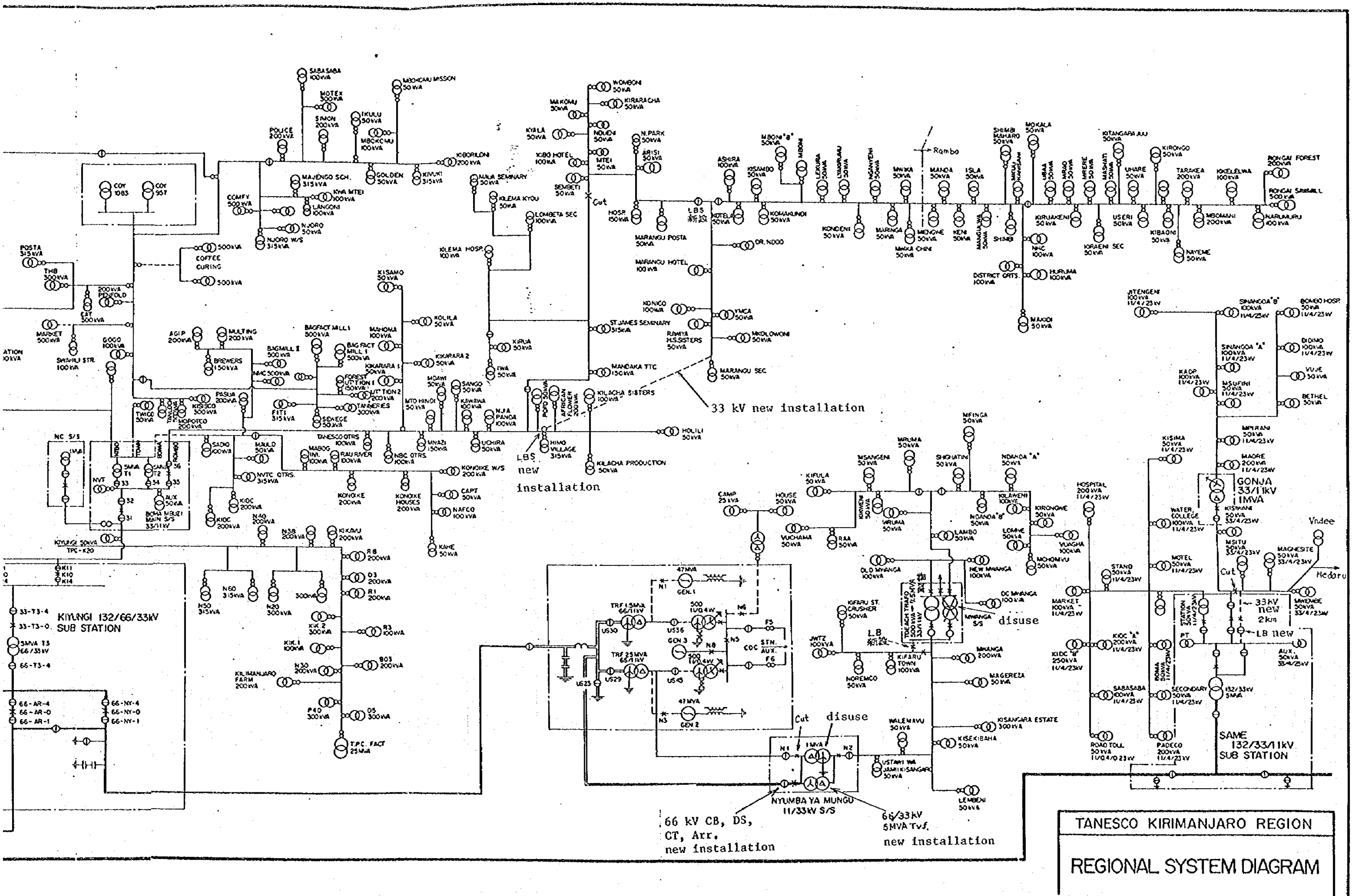
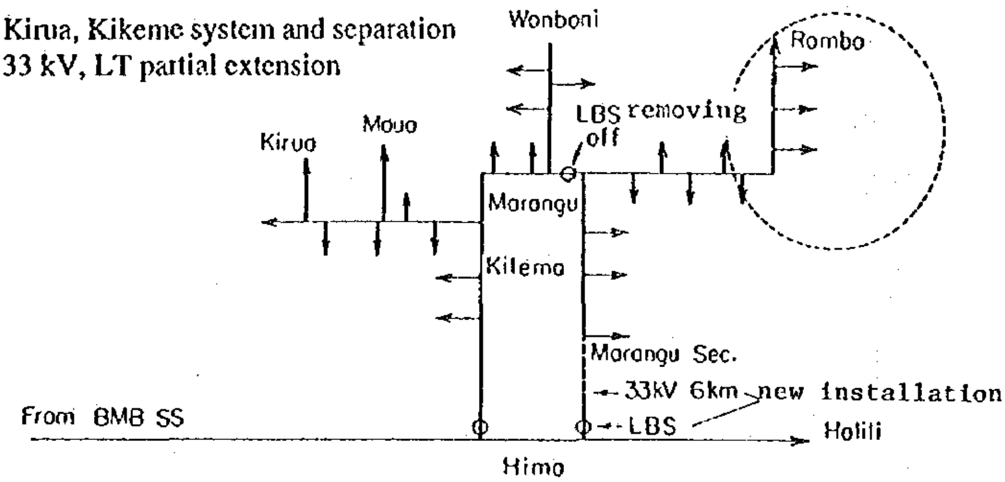


Fig. 2-4 Power System Diagram in Kilimanjaro

(1) Rombo power system strengthing measures

1. Kirua, Kikeme system and separation
2. 33 kV, LT partial extension



(2) Mwanga region, supply capability increment measures

1. Mwanga SS capacity reinforcement
   0.5 → 2.5 MVA
2. NVM SS newly established
   66/33 kV 5 MVA
3. 11 kV system extension
   15 km

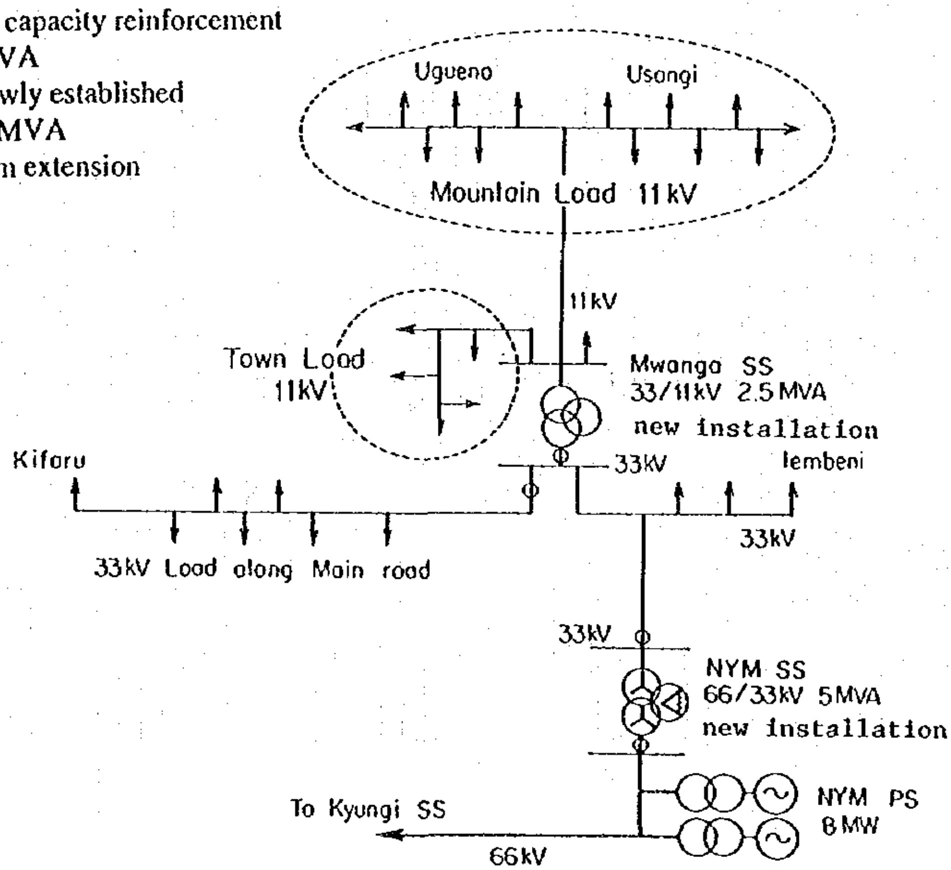
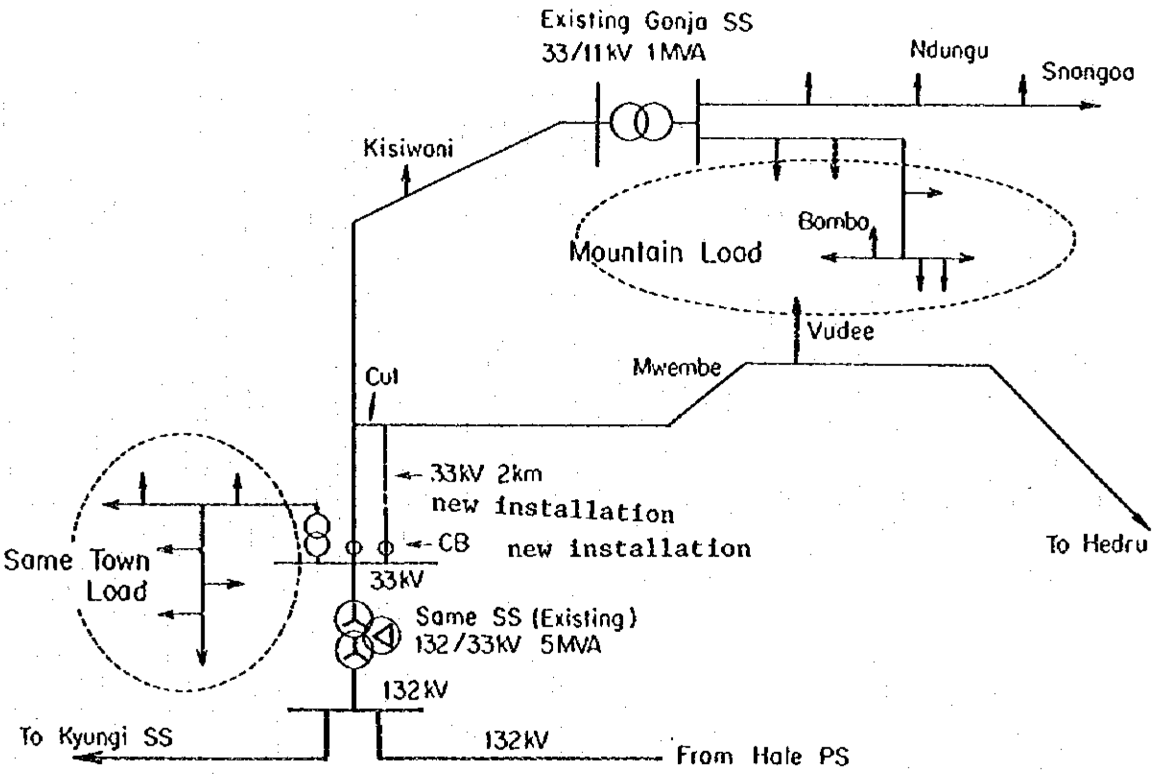


Fig. 2-5 System Configuration Diagram (1) ~ (3)

(3) Same region power system strengthing measures

1. Gonja Separation of Gonja system and Mwemba system
2. 11 kV line extension to mountain area and downtown load



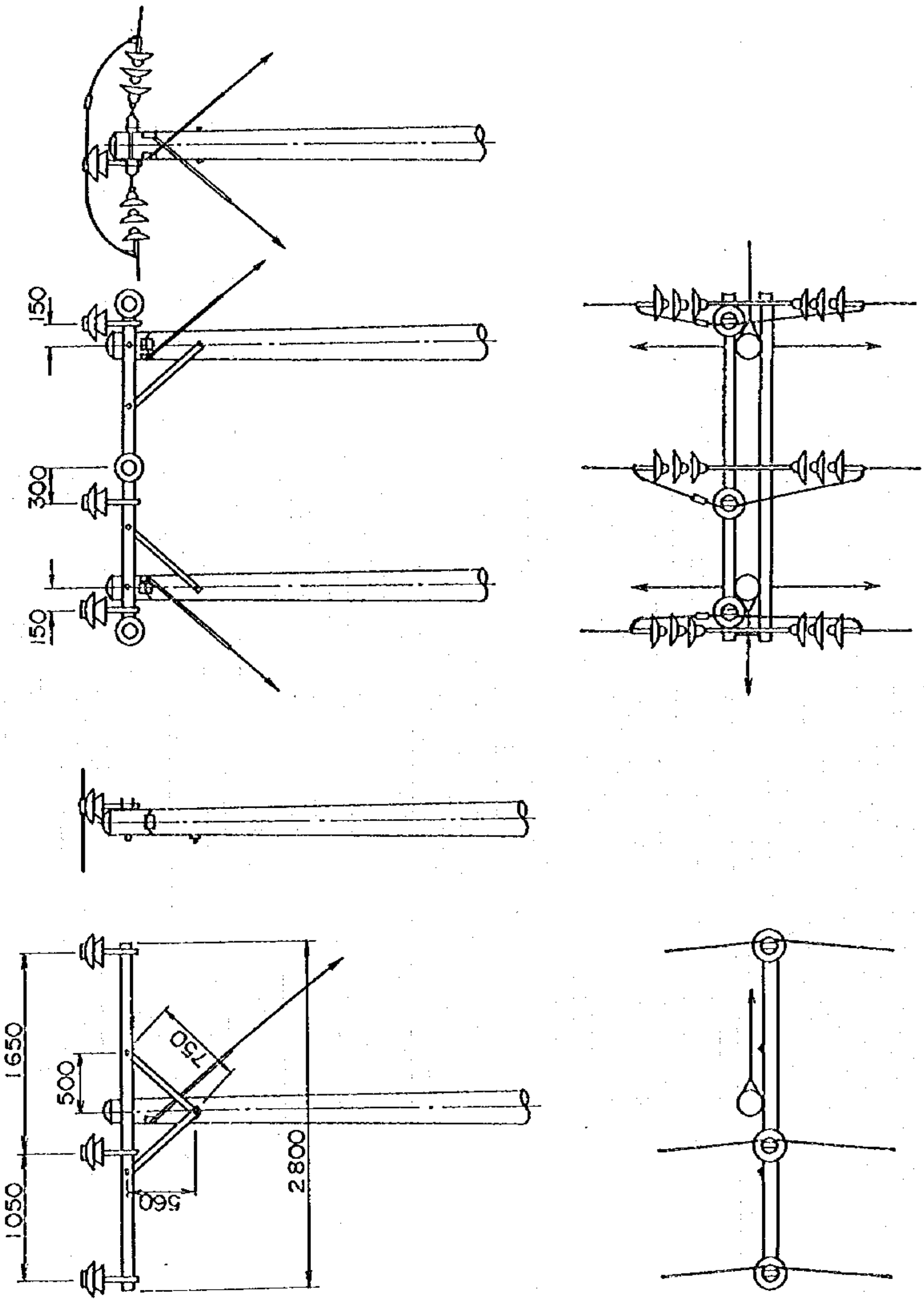


Fig. 2-6 Pole Configuration, 33 kV Line

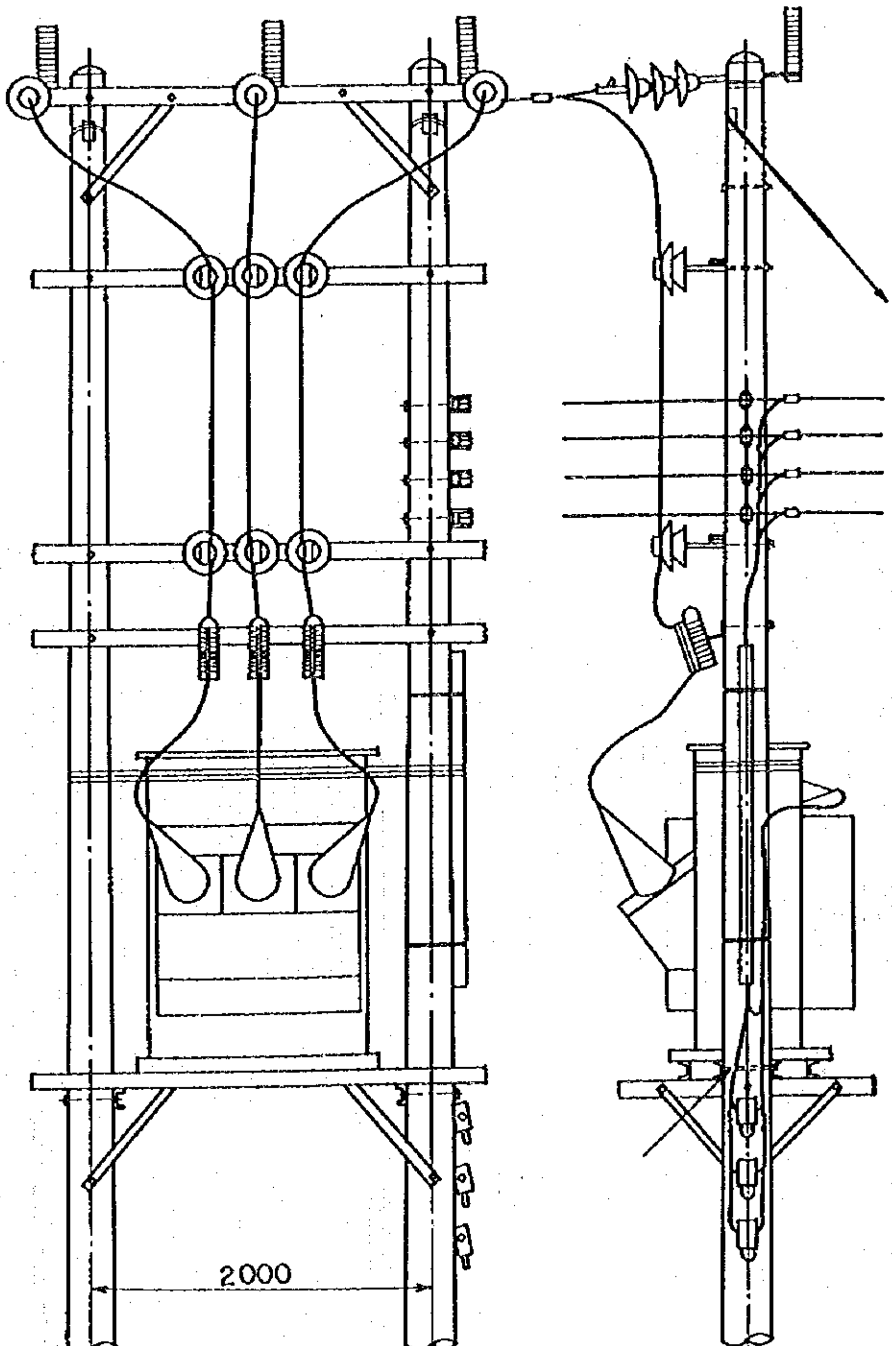


Fig. 2-7 Pole Configuration, 33 kV Line with Transformer

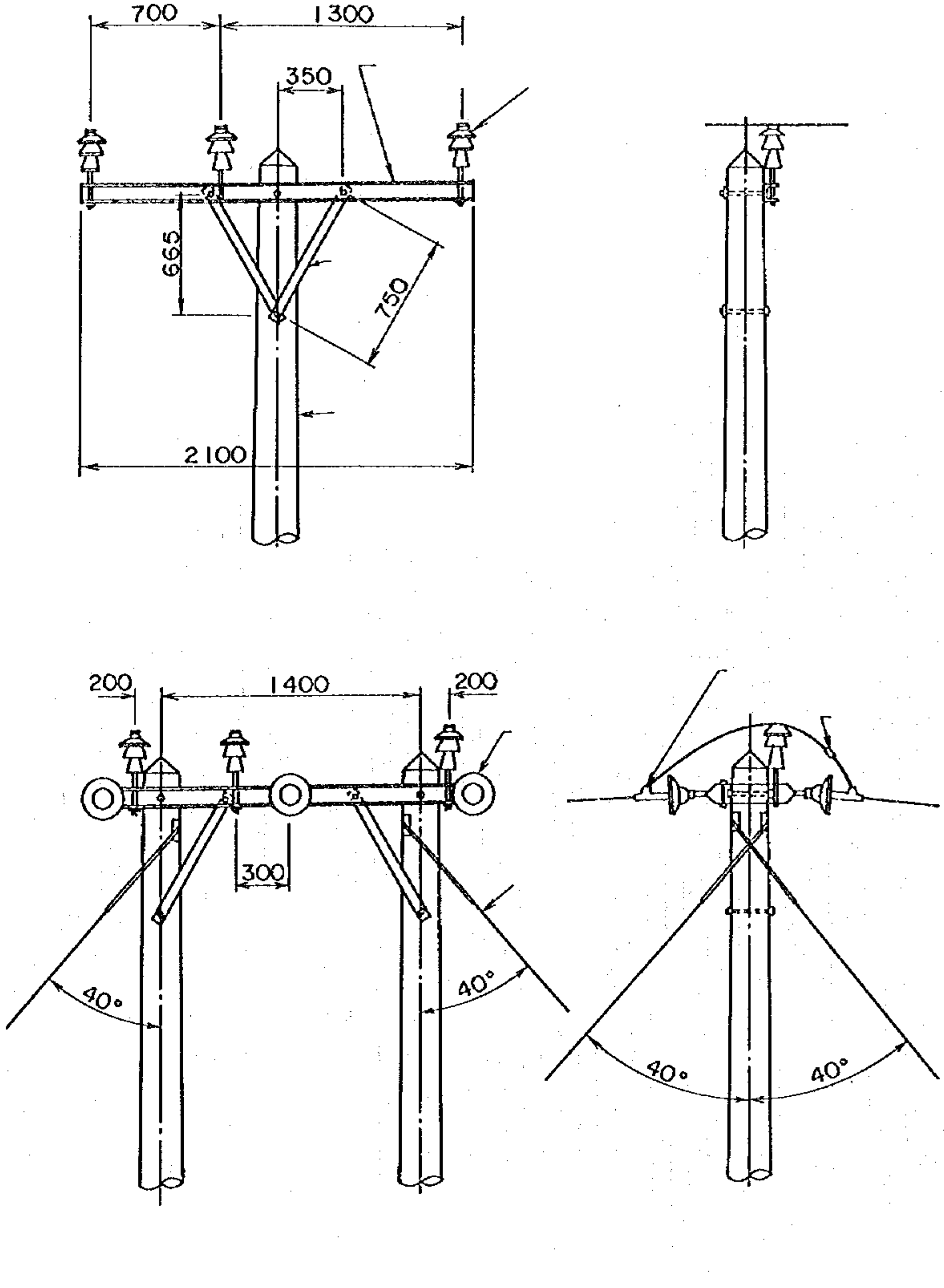


Fig. 2-8 Pole Configuration, 11 kV

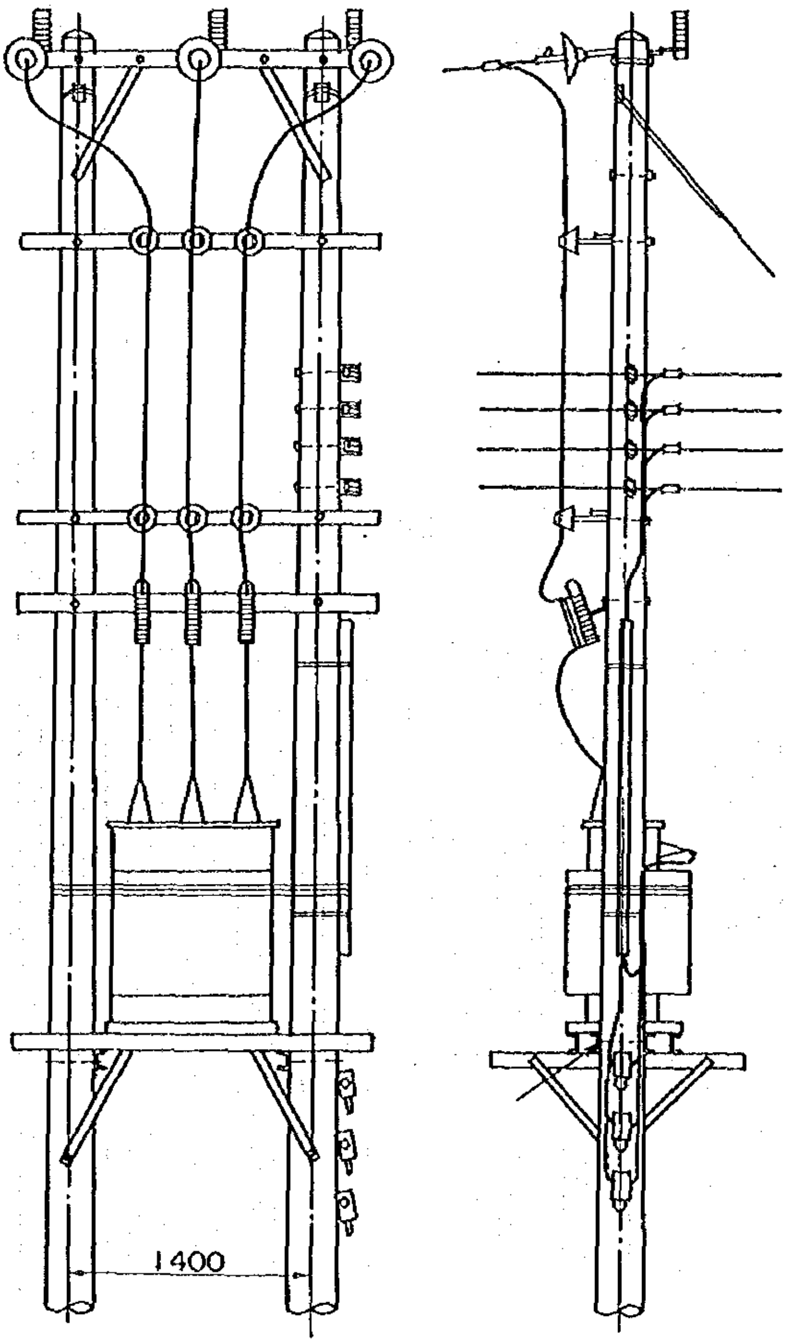


Fig. 2-9 Pole Configuration, 11 kV Line with Transformer

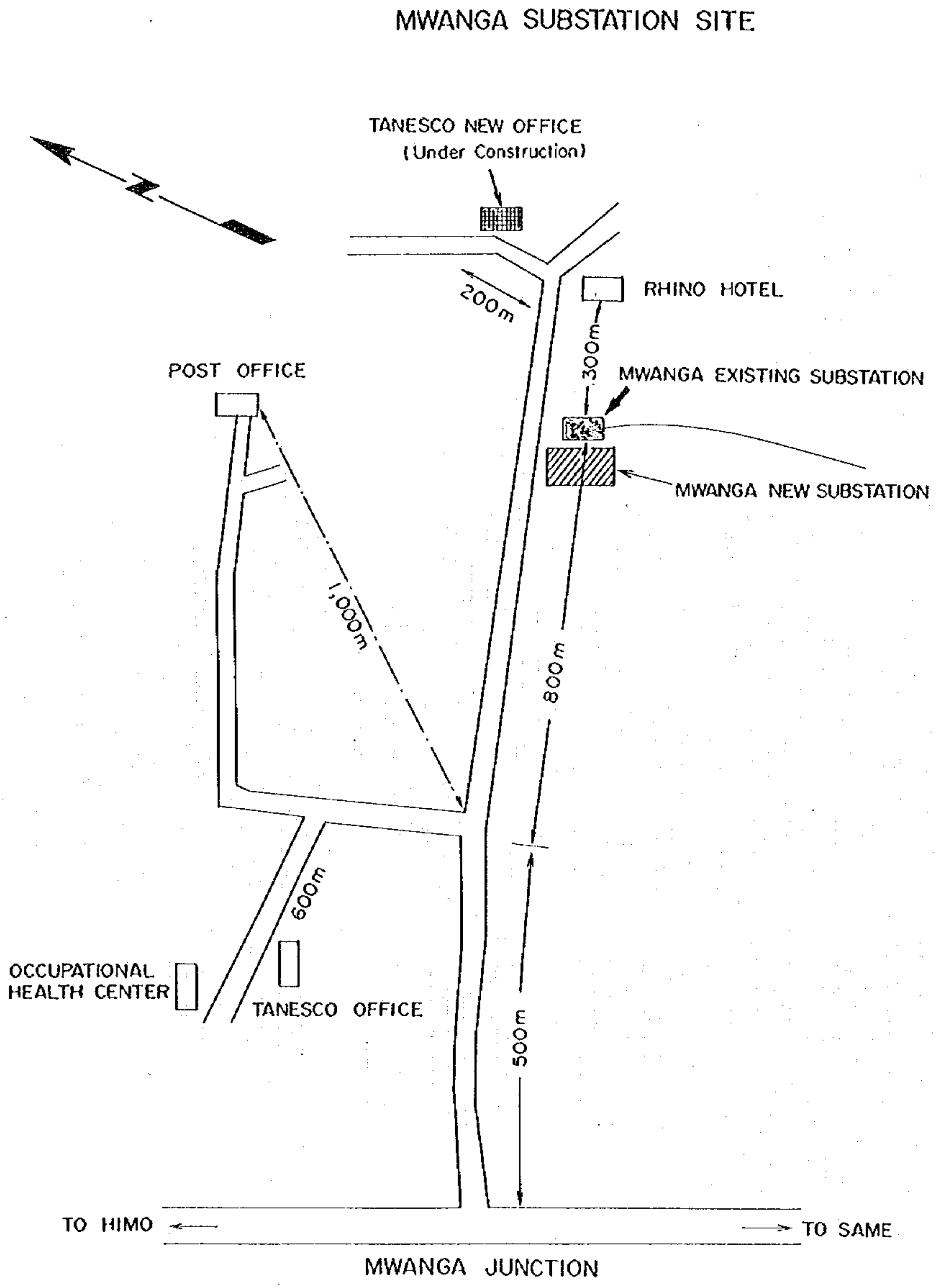


Fig. 2-10 Mwanga Substation Site

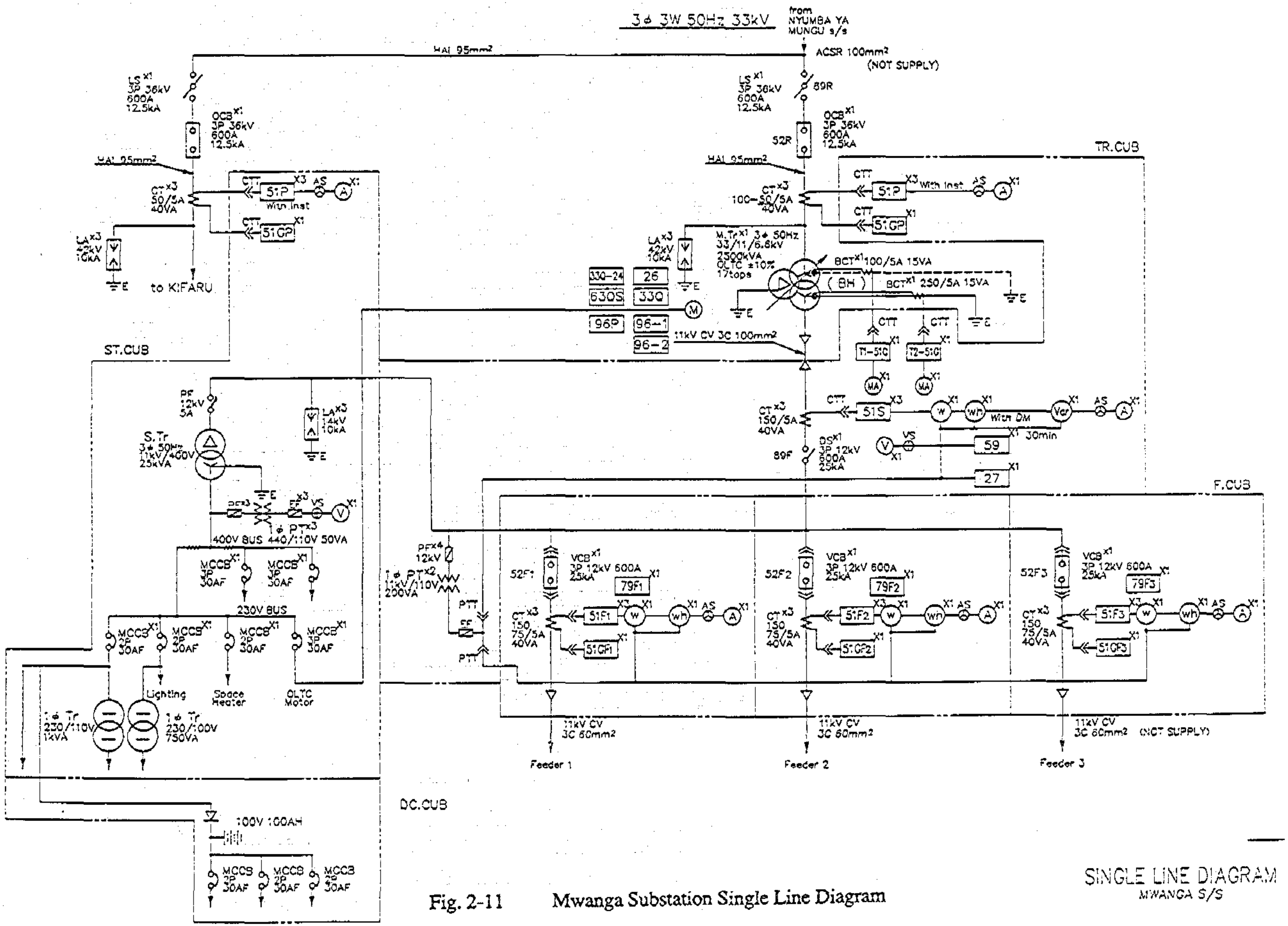


Fig. 2-11 Mwanga Substation Single Line Diagram

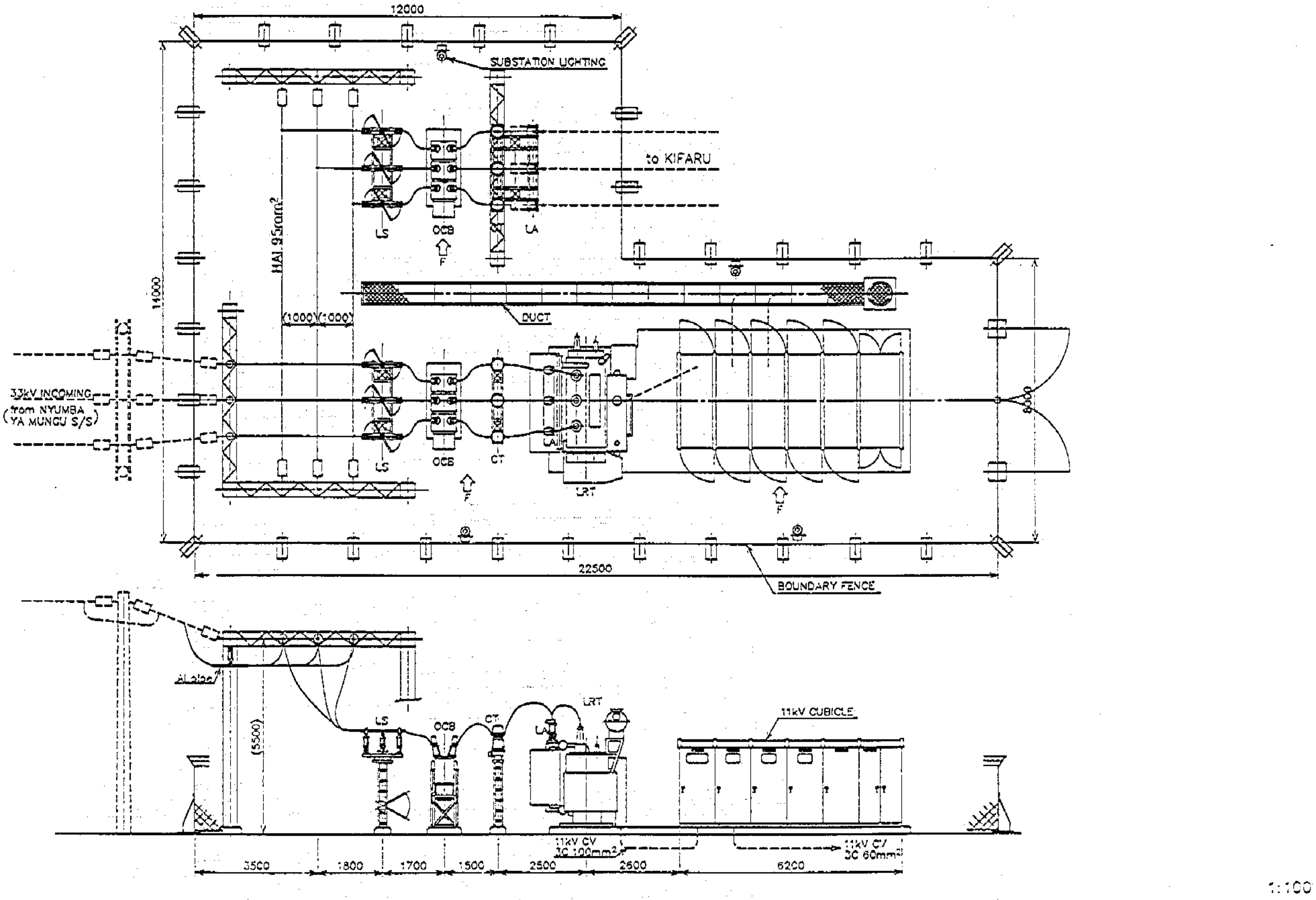


Fig. 2-12 Mwanga Substation Arrangement

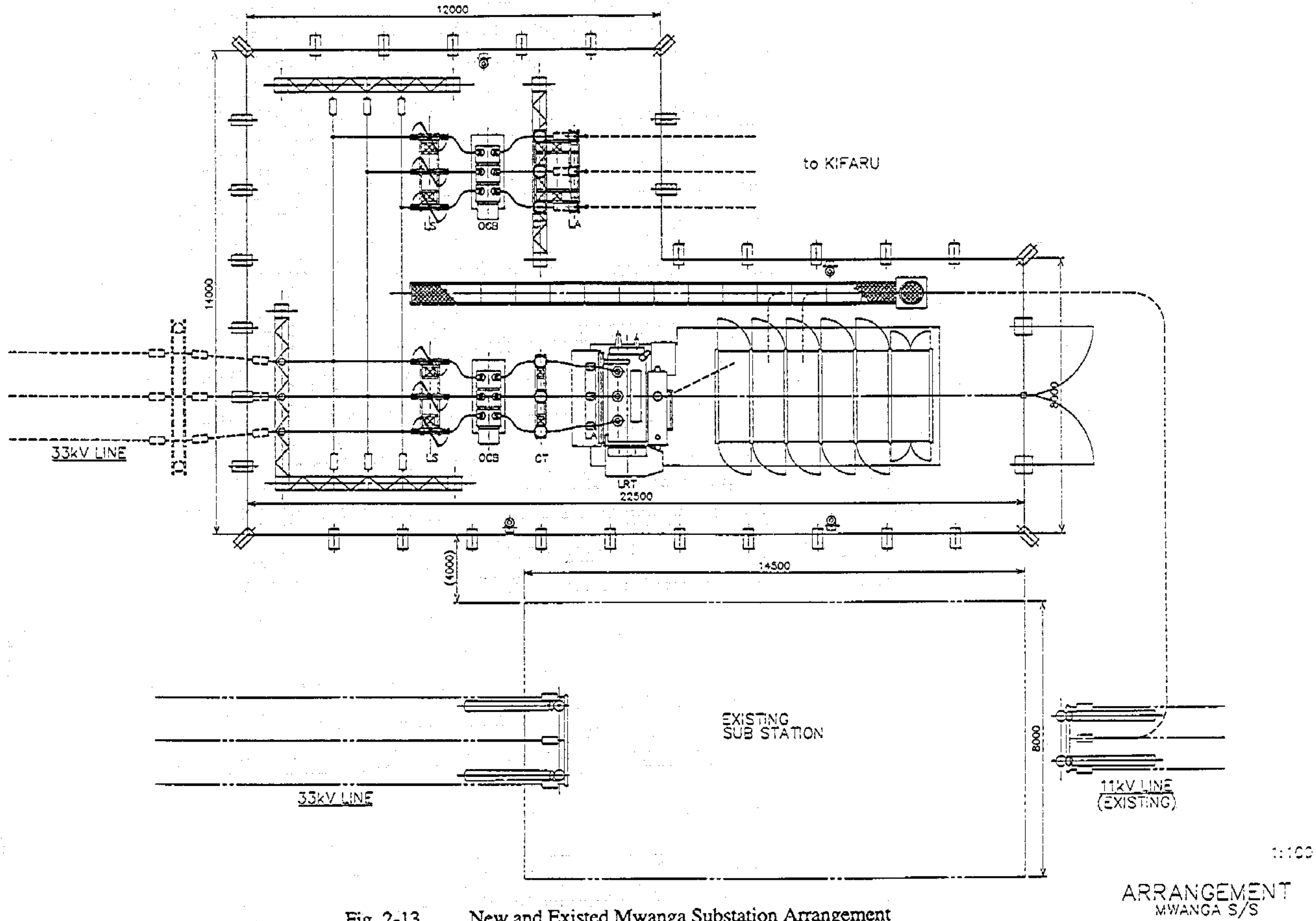


Fig. 2-13 New and Existed Mwanga Substation Arrangement

Fig. NYUMBA YA MUNGU SUBSTATION SITE

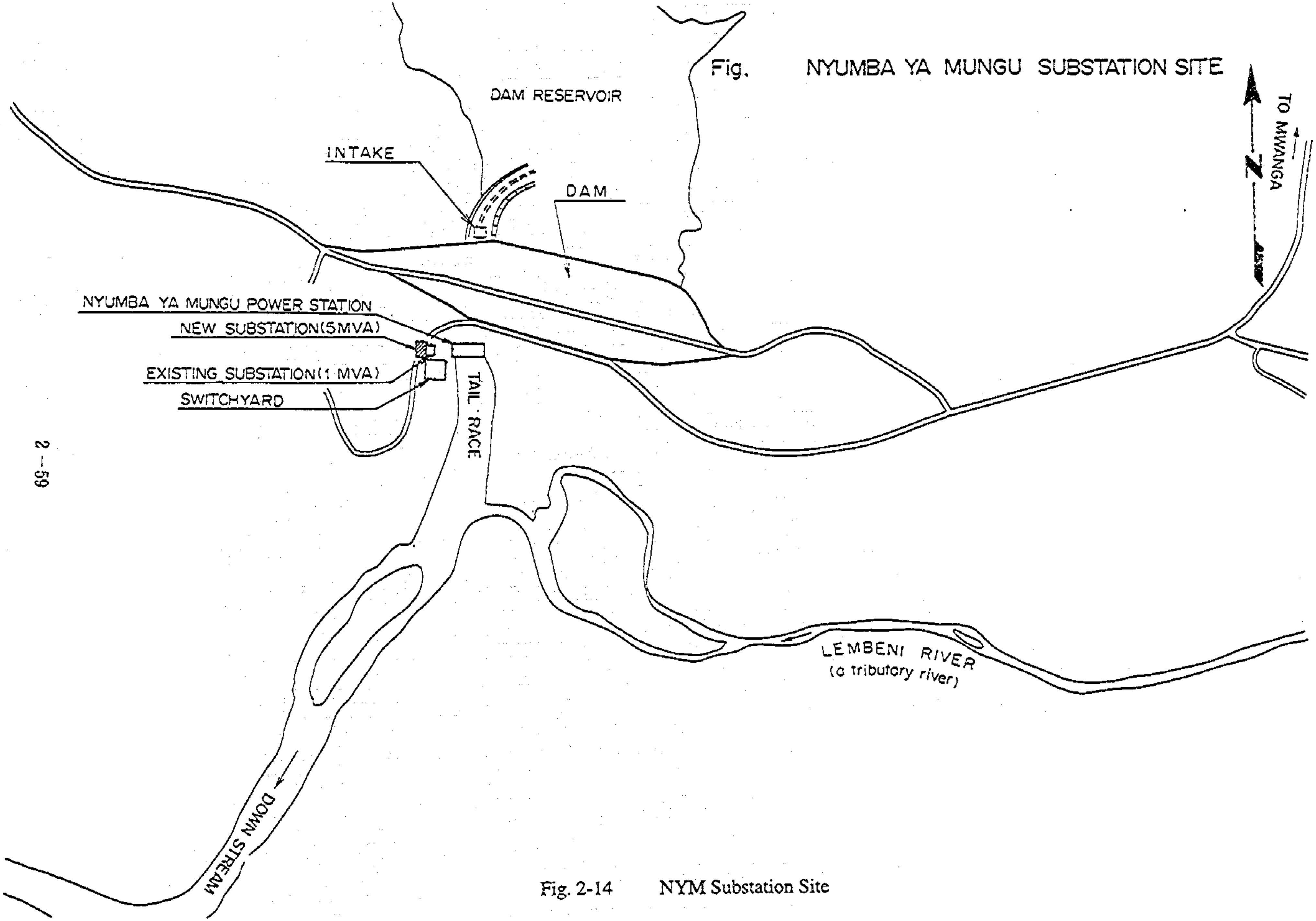


Fig. 2-14 NYM Substation Site

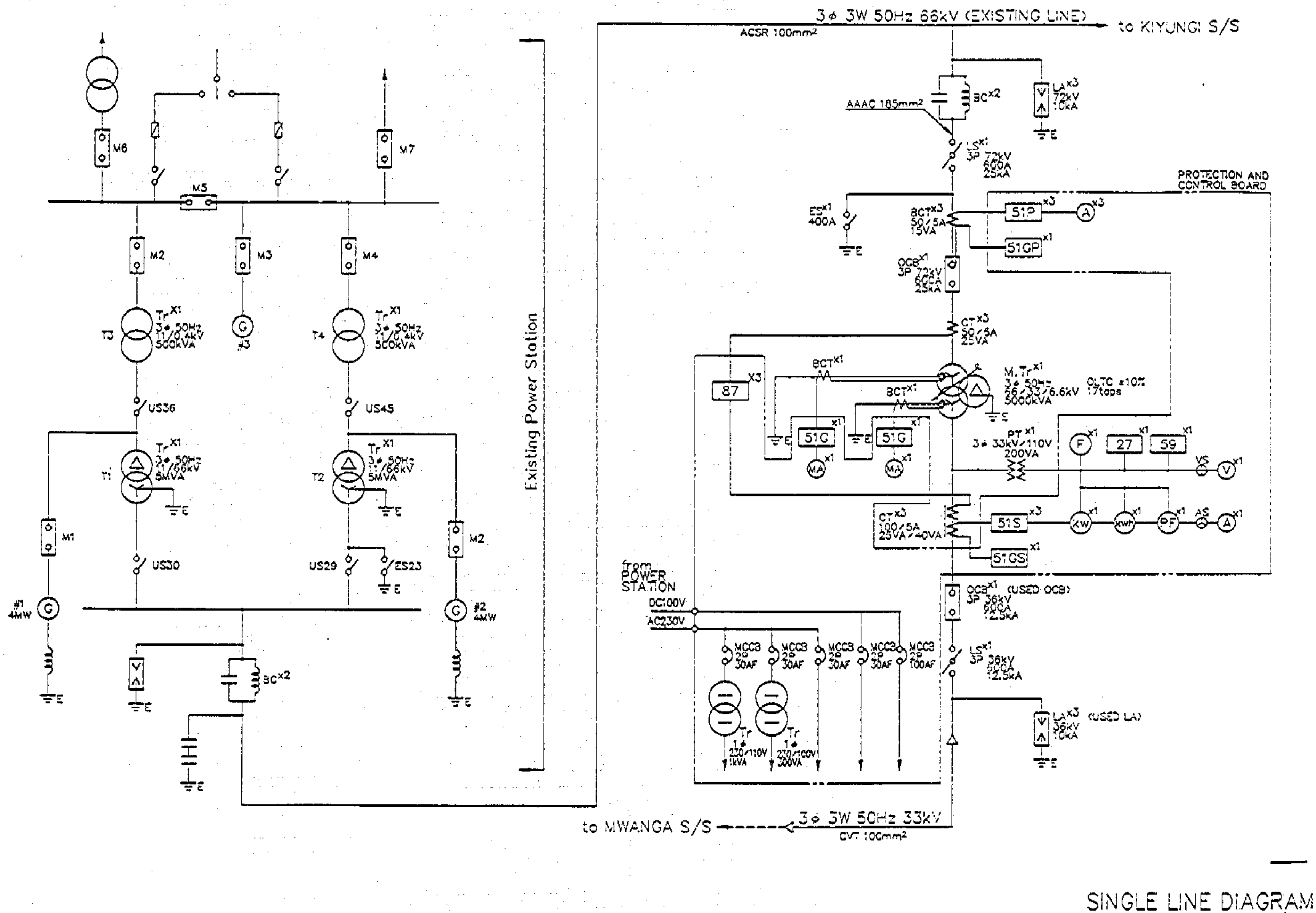


Fig. 2-15 NYM Substation Single Line Diagram

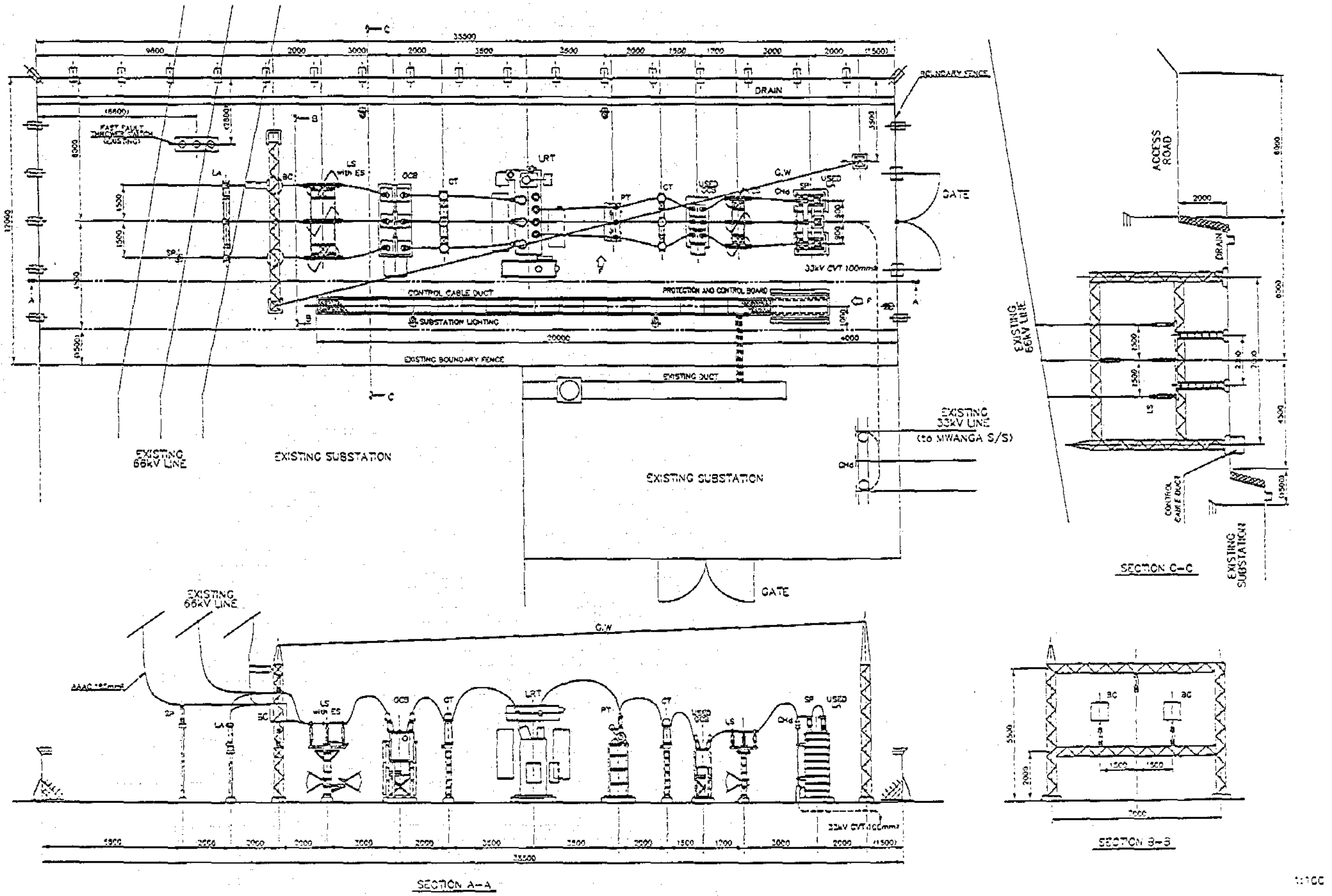
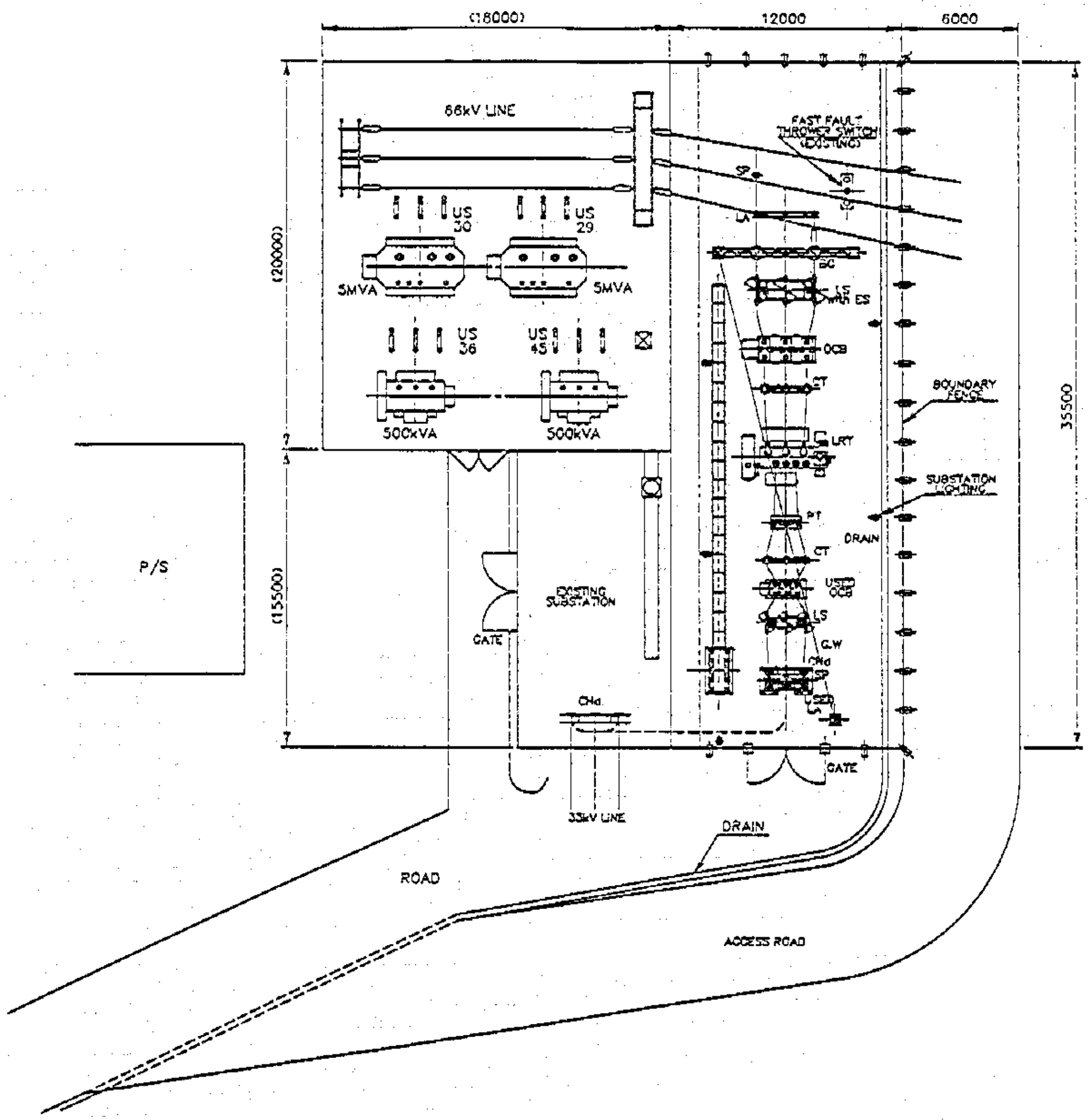


Fig. 2-16 NYM Substation Arrangement



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ARRANGEMENT
NYUMBA YA MUNGU S/S

Fig. 2-17 New and Existed NYM Substation

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Concept

This project is to be carried out in the Kilimanjaro Region of Tanzania based on the grant finance cooperation system of Japan. An appropriate implementation system and construction period shall, therefore, be carefully determined in response to the construction period allowed by the grant finance cooperation system.

As TANESCO is the project implementation body, the President of TANESCO is, therefore, the Project Head. The actual person in charge is the Manager of the Kilimanjaro Regional Office.

The total support and cooperation of TANESCO is a matter of vital importance for this Project to be completed economically and within the specified period at the level of technical perfection worthy of a project conducted by the Japanese grant finance cooperation system.

A Japanese Consultant for this Project shall be engaged in the production of the bidding documents, bidding management, procurement and supervision of materials and equipment, and the construction schedule supervision after the E/N between the two governments concerned.

Construction of a substation facility shall be conducted by a firm selected by bidding. This firm shall construct the transmission facility based on the agreement, construction specifications and diagrams under the supervision of and with the support of TANESCO and under the Consultant's supervision.

It is necessary that engineer(s) be dispatched from the manufacturer(s) throughout the construction period of the substations until their completion. Engineers for the major transformer, breakers, protective control system and comprehensive test shall be required at the two substations that are constructed in parallel.

The substations must be completed by the end of March, 1997. Due to a tight schedule, it is necessary to complete the site development and foundation works before the arrival of the components.

In Japan, also, it is necessary to minimize the period of implementation design, and component ordering as well as to shorten the period of component manufacture and installation. The Consultant shall monitor the schedule closely and shall supervise the implementation at each important stage.

3-1-2 *Implementation Conditions*

(1) Construction conditions

The scale of the site development and component foundation works for the two substations is small at 23 m x 14 m for the Mwanga Substation and 36 m x 12 m for the NYM substation. The Mwanga Substation site provides a plains topography. Only little excavation is required at the NYM site. Such works can be done by domestic civil engineering workers.

The distribution line and low tension cable works are to be carried out by TANESCO. This presents no problem as TANESCO constantly performs such works for branch line extension and outage recovery.

(2) Procurement of construction materials and equipment

The construction materials required for this Project including ordinary cement, aggregate (sand and gravel), and crushed rock and reinforced steel for the component foundations are available at the construction sites.

Cranes, concrete mixer, trucks, and power shovels can be leased.

Gasoline is available without restriction.

(3) Other conditions

1) Although the major part of road from Dar es Salaam Port to the site is a paved national highway, caution is nevertheless required in transportation due to the long distance (500 km) involved.

2) Construction is carried out near an existing electrical facility. Safety precautions are, therefore, necessary to ensure that this facility is not adversely affected.

3) Despite a tight schedule, caution is required in order to prevent accidents due to hasty work.

4) As the construction will be conducted outdoors during the hot season, caution is also required for safety and personal health and well-being.

3-1-3 Scope of Works

In this Project, the transmission components are installed by Japan, with the distribution line construction and civil engineering works for the substations conducted by Tanzania.

Table 3-1 describes the Scope of Works for Japan and Tanzania.

Table 3-1 Scope of Work

Item	Japan	Tanzania
Substation		
Land development		o
Foundation work		o
Equipment manufacture	o	
Transportation (to substation site)	o	
Storage		o
Installation & adjustment	o	
Test		o
Distribution line		
Equipment manufacture	o	
Transportation (to Mwanga warehouse)	o	
Storage		o
Transport to site		o
Construction		o
Test		o

Components such as the transformer are not manufactured in Tanzania. Also, the same models as the existing components enable easy maintenance for Tanzania. Consequently, the major components are manufactured in Japan and are also installed and adjusted by Japanese engineers.

3-1-4 Construction Supervision

(1) Job content of Consultant

The implementation design and implementation management of this Project is conducted by the Japanese Consultant as a grant finance cooperation project. The job content of the

Consultant is described in Table 3-2.

Table 3-2 Content of Supervision

Stage	Services
Before Construction	Detailed design investigation Preparation of bidding documents Vicarious execution of bidding for selection of the contractor Evaluation of bidding literature Assistance in contract business with contractor Study and approval of manufacturing drawings Witness shop test
During Construction	Implementation supervision at important point Report on business progress OJT for the TANESCO engineers Presence and approval of substation completion test Report making, etc.

Regarding the implementation design, the facility plan and equipment/material plan shall be determined according the site survey. Bidding documents shall be produced after the detailed design. The bidding date shall be determined through discussions between the relevant governmental offices. Regarding the bidding, the Consultant shall act for the implementation body, thus evaluating the bidding result. The Consultant shall also aid in formulating an agreement(s) between the implementation body and the contractor(s).

The Consultant shall inspect the facility and the equipment/materials upon completion of the substation as well as provide technical guidance to the operators for their operation and maintenance. The Consultant shall produce a Completion Report upon completion of the facility.

(2) Construction Supervision System

It is not necessary for the Consultant to supervise the entire construction throughout the construction period. Instead, supervision shall be provided at the important stages as described below.

1. When the substations and civil engineering works are completed by TANESCO
2. When the equipment and materials are delivered and accepted
3. At the meeting prior to the commencement of substation construction
4. For distribution line and low tension cable construction
5. For substation completion tests

The distribution line and low tension cables are constructed by TANESCO and to be completed in 1997.
Construction Supervision System is described in Table 3-3.

Table 3-3 Construction Supervision System

Supervisory Engineers	Duties	Term of Dispatch
Project Manager	Starting construction work	One month at start of construction
Electrical Engineer	ditto	ditto
ditto	Civil work on Substation	0.67 month at completion of civil work
ditto	Taking over of materials	0.5 month at completion of delivery
ditto	Substation construction	0.67 month before construction on substation
ditto	Distribution line Low voltage line	0.67 month during construction
ditto	Test of Substation	0.67 month at completion of construction

(3) Project Implementation System

The project implementation system is described in Figure 3-1.

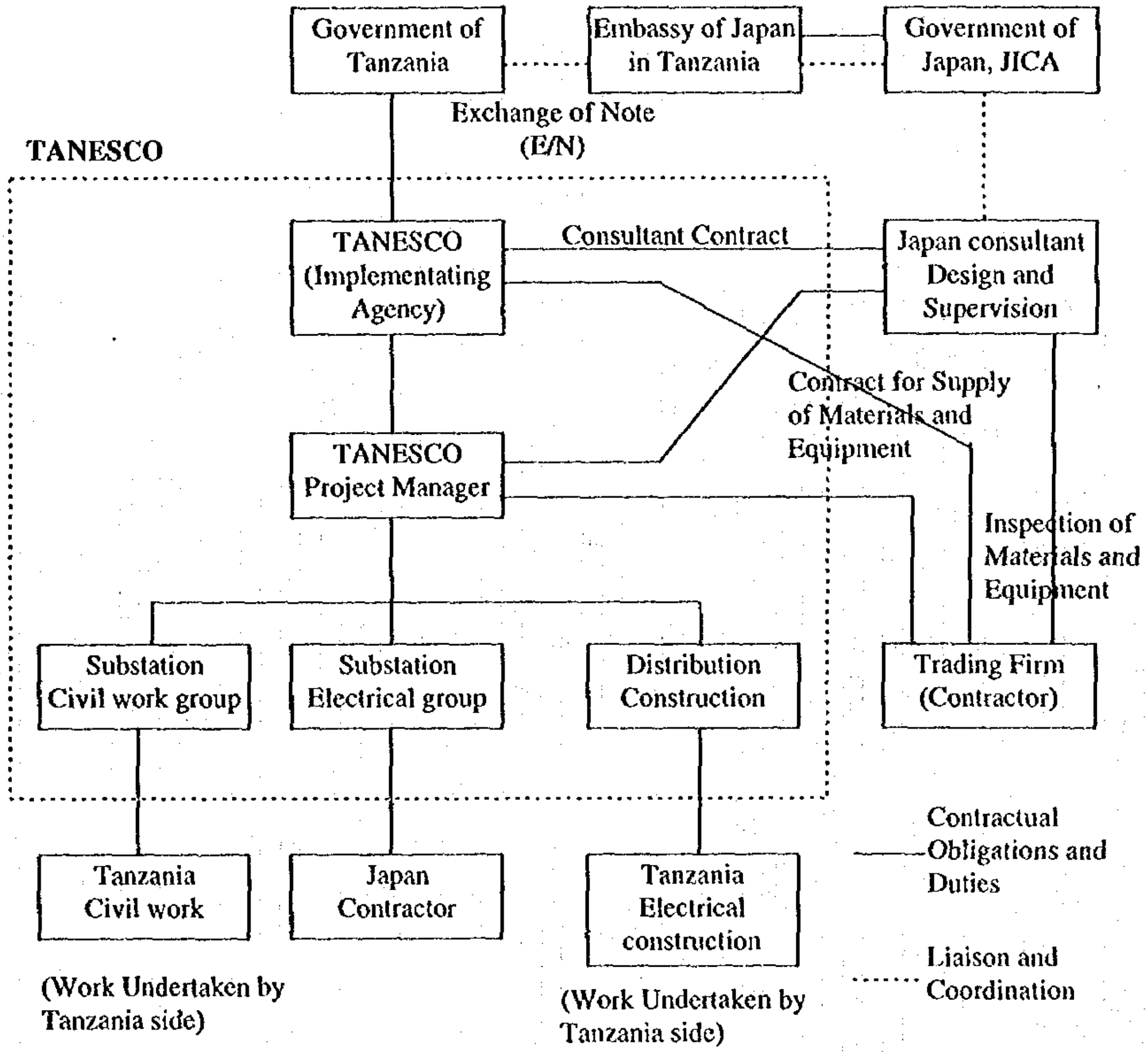


Fig. 3-1 Project Implementation System

3-1-5 Procurement Plan

In principle, the equipment and materials for this Project shall be manufactured in Japan. Procurement shall be conducted by Japanese firm(s) under the Consultant's design supervision in Japan.

However, distribution line materials such as wooden poles and bare electric conductors manufactured in other countries can be used as long as they meet with international standards. Generally, it is uneconomic to import those manufactured in a simple process such as wooden poles and bare electric conductors from a distant country.

1) Substation components shall be procured in Japan.
2) Cement, aggregate, etc. for substation site development and component foundation shall be procured in Tanzania.
3) Wooden poles and the bare aluminum conductors shall be procured from a third country near Tanzania.
4) Construction machinery shall be procured in Tanzania.

The distribution line and low tension materials shall be delivered to the warehouse prepared by TANESCO in Mwanga. The responsibility of the Japanese firm shall be deemed ended upon such delivery to the said warehouse.

The acceptance site for the substation components shall be the property of each substation. However, the Japanese firm shall be responsible for the installation, adjustment and test completion.

Procurement location of equipment, materials and construction machinery are described in Table 3-4.

Table 3-4 Supplying Countries of Materials/Equipment and Construction Machines

Items	Supplying Country		
	Tanzania	Japan	Third party country
Cement	O		
Aggregate	O		
Reinforcing steel bar	O		
Forms			
Transformer		O	
Circuit breaker		O	
Isolator		O	
Current transformer		O	
Other substation equipment		O	
Bare electric wire			O
Insulated electric wire		O	
Wood pole			O
Pole mounted transformer		O	
Radio telecommunication system		O	
Vehicles		O	
Tools		O	

Construction machine	Specification	Supplying Country		
		Tanzania	Japan	Third party country
Crane Vehicle	30 t	O		
Concrete Mixer	0.3 m^3	O		
Truck	4 t	O		

3-1-6 Implementation Schedule

The Implementation Schedule of this project are as follows.

(1) Exchange note between countries (E/N)

(2) Contract of Consultant

(3) Site Survey (distribution line route etc.)

(4) Detail Design, Specification

(5) Preparation of Tender Document

(6) Tender, Evaluation

(7) Manufacturing, Shoptest

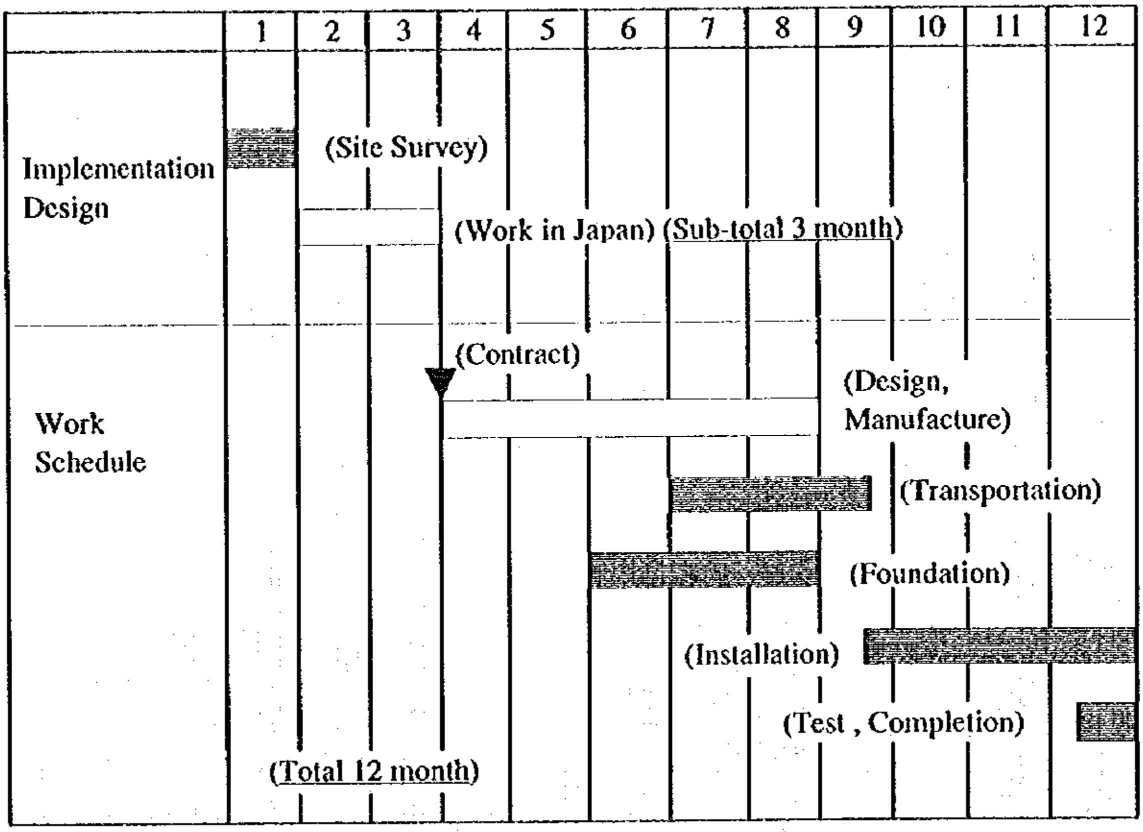
(8) Transportation

(9) Installation

(10) Taking over, Test, Completion

It takes about three and half month, for the definite design and tender document, five month for the manufacturing of equipment, two and half month for the transportation and three month for civil works of substations in Tanzania side, as a result, twelve month shall be needed for the total implementation schedule. Works of distribution line and low tension shall be completed within December, 1997 by Tanzania side. (See Table 3-5 Implementation Schedule.)

Table 3-5 Implementation Schedule



3-1-7 Obligations of Recipient Country

The minutes of the basic design was signed in Dar es Salaam on January 25, 1996. The obligations of the Tanzanian government in Annex III are shown below.

1. Securing of project site
2. Ground leveling at site prior commencement of project
3. Outdoor appurtenant work including fencing, gates, doors, lighting, etc. around the site
4. Preparation of bank account, including foreign exchange bank
5. Speedy material unloading and clearance at Tanzanian port and speedy transportation inland
6. Exemption of Japanese nationals from taxation on contracted products and services including customs, internal duties and other levies
7. Offering of convenience to Japanese nationals who enter or stay in Tanzania for business execution
8. Materials to be maintained and controlled properly and efficiently
9. Bearing of all transportation expenses except those to be borne by grant aid
10. Pay attention to safety when handling electric equipment and take all necessary steps and responsibilities during construction.
11. Prepare a place for material storage. Store existing equipment (including 500 kVA transformer) until they are used.
12. Foundation work for the substation must be completed before materials arrive from Japan.
13. Prepare the budget so that all works including low voltage circuit are completed in 1997.

3-2 Operation and Maintenance Plan

(1) Maintenance system

Daily inspection and periodical inspection are required to maintain the distribution substations and distribution lines. The former inspection is conducted during facility operation. The facility is, however, shut down for the latter inspection. Detailed inspection is conducted approximately once a year according to the inspection standards provided by the component manufacturer(s). This inspection is planned in advance and the power is shut down for the inspection.

Ordinary inspection does not require facility shutdown. The facility is inspected visually for abnormal noise or vibration. It is usually conducted once a week or so, or after heavy rainfall or gusty winds.

When such constant maintenance is provided, the life expectancy of the transformers and distribution lines is generally some 40 years or so.

The actual maintenance shall be carried out by 4 engineers under the supervision of the TANESCO Kilimanjaro Regional Manager, and approx. 100 members of the Substation Team and Line Protection Team.

(2) Operation and Maintenance Cost

Basically, the power distribution system consists of power supply substations and lines which are stationary. Their operation and maintenance is easy. Therefore, if regular inspection and maintenance are done, neither special spare parts nor repair expenses are required. The substation equipment installed 12 years ago are presently operated with no trouble.

The following maintenance expenses are required when this project is completed.

Personnel expenses	8 M¥ (48.00 M Tsh)
Repairing expenses	8 M¥ (48.00 M Tsh)
Miscellaneous and overhead expenses	6 M¥ (36.00 M Tsh)
Depreciation cost	11 M¥ (66.00 M Tsh)
Total	33 M¥ (198.00 M Tsh)

Maintenance expenses of facilities concerned with this project are shown above and are estimated on the basis of the execution budget. As generally practiced by Japanese power companies, each expense is obtained from the rate of expenses to construction expenses. Depreciation cost per year is estimated at ¥11 million on the assumption that this project (¥437.9 million) is depreciated in forty years and the remaining value in the last year is zero.

Thus, expenses necessary for this project can be satisfactorily maintained with 256 employees in the Kilimanjaro region and operating expenses planned by TANESCO (¥1.4 billion in 1993).

Chapter 4 Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

4-1 Project Effect

By the implementation of this Project the following specific benefits can be anticipated.

(1) Direct Effect

1) Elimination for Power Shortage at Mwanga District (Population 200,000)

At present, power supply is restricted in Mwanga District due to overload on the existing 1,000 kVA transformer. This project would eliminate this problem. An additional transformer (2,500 kVA) would enable to supply power to those areas presently on the "Waiting List", thus eliminating one of the barriers in the agricultural infrastructure. The largest consumer is the Posho Mill (31 kW maize threshing mill) and by the reinforcement of supply capability 43 threshing units may be installed at different locations in the future. Regarding residential consumers on the "Waiting List", there are 600 in Mwanga District and 640 in Rombo District. These problems will be overcome successively when power supply become available by increasing substation capacity and distribution equipment and materials are procured for this Project.

2) Improvement of Voltage Drop Particularly at Rombo District (Population 100,000)

Procurement of low voltage equipment and materials and transformers will improve the voltage drop problem existing at many locations (under 190 V against rated 230 V) thereby controlling voltage fluctuation within $\pm 10\%$ and thus improving the quality of power supply.

3) Reducing Power Interruption Time by Upgrading System Configuration and Communication System

The existing distribution lines in Rombo District passes through forest zone. By changing the route of distribution lines, providing multiple outgoing feeders from substations and installing breakers, power interruption by fault can be localized and by upgrading and reinforcing communications system, time to restore power supply can be shortened. By these measures it is thought that the present 20 times per year power interruption in Rombo District can be reduced by half.

(2) Indirect Effect

A study of the daily load pattern in this area reveals that a heavy peak demand is recorded at around 19:00 hours. This peak is caused by combined lighting and cooking demand. A small peak is also recorded at around 07:00 hours and again at around 12:00 hours (noon) probably by cooking demand. If there is no electricity service, cooking will be most likely by using inexpensive firewood, thereby accelerating deforestation. When calculating the power load for cooking in the zone toward the mountainous area in Mwanga District where the demand for cooking is clearly evident, electricity consumption is 600 MWh/year - equivalent to one third of the total power demand. This demand converted into timber equivalent is 280 m^3 or one thousand 15 m tall trees 15 cm in diameter. Up to this time, electricity has been supplied to this area by one 500 kVA transformer. When calculating the consumption in proportion to the total transformer capacity in the entire Kilimanjaro Region (20 MVA), or simply to the maximum demand, 40 times more trees or 30,000 trees would be conserved throughout the region annually.

From the viewpoint of forest protection, this indirect effect created by this Project cannot be overlooked.

[Justification of Grant-Aid]

The purpose of this Project is to reinforce the local electrification system. The beneficiaries of this Project are the inhabitants of the farming villages in Kilimanjaro Region. Generally speaking, rural electrification project generates a small revenue from electricity sales in relation to the size of supply facilities, and in the medium and short term return on investment is low. On the other hand a reliable power supply to the local villages serves to significantly improve the living standards of the villagers, and by the implementation of the Project, it will provide a foundation for the promotion of local economic development and the stabilization of the people which is the target of the government. It is, therefore, judged that the impact of providing grand-aid to this Project is significant.

4-2 Technical Cooperation and Relation with Other Donors

The implementing agency, TANESCO, owns, manages and operates a number of similar power facilities, and, therefore, there is no need of immediate technical assistance in these fields, but to reinforce maintenance and management systems in the future, it is thought technology transfer by Japan in those areas would be beneficial.

4-3 Conclusion and Recommendation

As stated earlier, various large benefits are expected from this Project, and in addition, this Project would contribute to the improvement of the BHN of the people. Therefore, it is recognized that this Project is eligible for grant-aid. Regarding management and operation of this Project, it is judged that the recipient country has adequate manpower and financial resources, and it is thought that no problem exists. In the past, TANESCO has successfully implemented several similar projects with grant-aid from Japan. In the implementation of this project, by remedying the following matters, it is thought that it can be executed smoothly and effectively.

(1) Upgrading TANESCO's Maintenance and Operation Standards

At some of the 132 kV substations, there are areas where technical level of maintenance and operation are evidently below standard. Compounded by the shortage of repair funds, the situation is that power outage may happen at any time.

(2) Establishment of Billing and Collecting System

In Kilimanjaro, the majority of consumers are scattered in mountainous districts. Because of the shortage of vehicles and motor bikes for meter reading, this work is not performed regularly. For this reason conflict with consumers arise and there are many delinquent electricity charge payers. Regular meter reading is an important issue for the sound business operation of TANESCO.

Appendices

Appendices

Appendices

1. Member List of the Survey Team

1-1 Site Survey

1) Leader, Mitsuru SUEMORI
   Director, First Basic Design Study Division,
   Grant Aid Study & Design Department, JICA

2) Coordinator, Akio KAGAWA
   Consultant Contract Division, Procurement Department, JICA

3) Chief Consultant/Operation and Maintenance, Tatsuo TOMABECHI
   EPDC International Ltd. (EPDCI)

4) Transportation and Distribution Planner, Masashi KOIKE
   EPDC International Ltd. (EPDCI)

5) Equipment Planner, Minoru NODA
   EPDC International Ltd. (EPDCI)

1-2 Member of the Explanation Team for the Draft Basic Design

1) Leader, Mitsuo NAKAMURA
Grant Aid Management Department, JICA

2) Chief Consultant/Operation and Maintenance, Tatsuo TOMABECHI
EPDC International Ltd. (EPDCI)

3) Transportation and Distribution Planner, Masashi KOIKE
EPDC International Ltd. (EPDCI)

2. Survey Schedule

2-1 Field Survey

No. of Day	Date	Week	Schedule	Stay
1	10/14	Sa	NRT 11:45 (JL 401) LHR 16:25	LON
2	15	Su	LHR 22:25 (BA 069)	Air
3	16	M	DAR 11:55 Courtesy call to EMB, JICA	DAR
4	17	Tu	Courtesy call to EMB, JICA, MEM, TANESCO, MOF Request for Site Survey	DAR
5	18	W	Meeting with TANESCO (Incep. Repo, Schedule, Questionnaire, Counterpart, etc.)	DAR
6	19	Th	Discussion with TANESCO (Confirm project contents)	DAR
7	20	F	Discussion with TANESCO	DAR
8	21	Sa	Preparation Minutes	DAR
9	22	Su	Inner Meeting	DAR
10	23	M	Signing Minutes	DAR
11	24	Tu	DAR 10:40 (TC 510) Meeting with TANESCO Regional Office	MOSHI
12	25	W	Data collection, Kyungi S.S., Moshi S.S. etc.	MARANGU
13	26	Th	Survey for Marangu Mkuu - Tarakia - Rongai and Rombo	MARANGU
14	27	F	Data collect for Mwanga S.S. and NYM P.S. Courtesy call to District Officer	MARANGU
15	28	Sa	Survey for Kikuletwa P.S.	MARANGU
16	29	Su	Inner Meeting	MARANGU
17	30	M	Site Survey for Mwang	MARANGU
18	31	Tu	Distribution Line route survey Discussion with TANESCO Regional Office	MARANGU
19	11/1	W	Kilimanjaro 16:50 (TC537) for DAR Zamzibar 17:40 Emergency Landing	ZANZIBAR

No. of Day	Date	Week	Schedule	Stay
20	2	Th	Zamzibar 9:20 DAR 9:35 Discussion with TANESCO	DAR
21	11/3	F	Collect Data, Reply to questionnaire Discussion with TANESCO Head Office	DAR
22	4	Sa	Collection of Data & Information	DAR
23	5	Su	Collection of Data & Information	DAR
24	6	M	Collection of Data & Information	DAR
25	7	Tu	Final Discussion for "Technical Notes"	DAR
26	8	W	Signing of the "Technical Notes"	DAR
27	9	Th	Investigation of Market Prices	DAR
28	10	F	Trouble of KLM Air Plain (20:30 KL 568)	Air Port
29	11	Sa	DAR 8:25 (BA 066) LHR 17:05 LHR 19:00 (JL 402)	Air
30	12	Su	NRT 15:20	

2-2 Member of the Explanation Team for the Draft Basic Design

No. of Day	Date	Week	Schedule	Stay
1	1/20	Sa	NRT 13:45 (BA 008) LHR 17:40	LON
2	21	Su	LHR 22:25 (BA 069)	Air
3	22	M	DAR 12:45 Courtesy call to EMB, JICA, TANESCO	DAR
4	23	Tu	Meeting with TANESCO for draft report	DAR
5	24	W	Preparation Minutes	DAR
6	25	Th	Signing Minutes Reporting to EMB, JICA	DAR
7	26	F	DAR 10:10 Kilimanjaro for Site Survey	MOSHI
8	27	Sa	Collection of data & Information Kilimanjaro DAR	DAR
9	28	Su	Data Arrangement	DAR
10	29	M	Discussion meeting at TANESCO DAR 20:05 (BA 068)	Air
11	30	Tu	LHR 5:00 LHR 19:45 (JL 402)	Air
12	31	W	NRT 15:25	

3. List of Party Concerned in the Recipient Country

3-1 Basic Design Study Survey Team

	Name	Belongings
(1)	**Tanzania Embassy of Japan**	
	Mr. Mitsuru Eguchi	Ambassador of Japan
	Mr. Shigeyuki Suzuki	Minister
	Mr. Yasushi Shigemasa	First Secretary
	Mr. Kazuhiko Kitagawa	Second Secretary
(2)	**Tanzania Office Japan International Cooperation Agency**	
	Mr. Takemasa Kawazoe	Superintendent
	Ms. Manami Tada	Assistant Resident Representative
	Mr. Jackson M. Biswaro	Assistant Director (Economic Affairs)
	Mr. Akira Sato	Team Leader (Kilimanjaro Village Forestry Phase II)
	Mr. Sugawara Seikichi	Agri-Machinery Expert (Kilimanjaro Agricultural Development Project)
(3)	**MEM (Ministry of Water, Energy and Minerals)**	
	Prof. J. Mbwiliza	Deputy Minister
	Mr. Raphael O.S. Mollel	Principal Secretary
	Ms. Esthet Masunzu	Assistant Commissioner Electricity
(4)	**MOF (Ministry of Finance)**	
	Mr. Paul A. Mwafongo	Finance Officer (External Finance)
	Mr. Prosper Mbena	Senior Finance Officer Aid Coordination
	Mr. Patrick Rutabanzibwa	Commissioner for Energy and petroleum Affairs
	Mr. Kassim A. Mtawa	Personal Asst. to Minister
(5)	**TANESCO (Tanzania Electricity Supply Company Limited)**	
	Mr. S. L. Mhaville	Managing Director
	Mr. Kyaro K. Iranga	Deputy Managing Director (Operations)
	Mr. S. J. Kimaryo	Deputy Managing Director (Technical Services)
	Mr. B.E.A.T. Luhanga	Deputy Managing Director (Corporate Planning and Research)
	Mr. S.M. Sikare	Director of Operations
	Mr. K.R. Abdulla	Director Corporate Planning and Research

Name	Belongings
Ms. Mercy Baregu	Manager Distribution Engineer & Commercial Services
Ms. Sophia Mgonja	Distribution Engineer
Mr. S.A. (Al) Warrington	Site Construction Manager (Ubungo)
Mr. Prem K. Sharma	Electrical Construction Manager (Ubungo)
Mr. Mfaume Kassanga	Distribution Engineer
Mr. Maclean Mbonile	Distribution Engineer
Mr. Maclean Mbonile	Distribution Engineer
Mr. Hilal S.A.	Regional Manager (Kilimanjaro Region)
Mr. A. Burhan	Area Manager (Same)
Mr. H.S. Mzirai	Control Superintendent (Kyungi)
Mrs. C. Lyimo	Area Manager (Mwanga)
Mr. Magoti. M	Personnel Officer (Kilimanjaro Region)
Mr. Kilimo Amir	Area Manager (Rombo Area)
Mr. R. King' ozo	Generation Superintendent (Kikuletwa P.S)
Mr. A.G. Kamanga	Generation Superintendent (N.Y. Mung P.S)
Mr. Jumanne Msofe	Acting Generation Superintendent (N.Y.M P.S)
Mr. Amoni Shittindi	System Operator (N.Y.M P.S)

(6) **Kilimanjaro Region**

Mr. Gallus Abeid	Regional Commissioner (Kilimanjaro Region)
Ms. Benne	Acting Regional Planning Officer
Mr. P.C. Kangwa	District Commissioner (Same District)
Mr. G.M. Msuya	District Executive Director (Rombo District)
Sister. Asela Chami	Sister Incharge (Huruma Hospital)

(7) **Government**

Mr. Cleopa David Msuya	Prime Minister (United Republic of Tanzania)
Mr. Albert Msangi	Prime Minister and First Vice President's Office (Private Secretary of Mwanga)

(8) **Others**

Mr. L. G. Mchomba	General Manager (TATICO Factory)
Mr. A. Kilutai	Power Switching Artisan (Kibo Hotel)