4.3 OUTLINE OF PROJECT

(1) Organization for Implementation of Project and Operating System

Tanzania Electric Supply Company (TANESCO) will be responsible for the implementation of Project in Tanzania. As described in Chapter 5, TANESCO will establish an organization with its Operation Department acting as the center to implement Project. The organization of TANESCO and the project organization are illustrated in Figure 4.3-1 and Figure 4.3-2.

(2) Project Plan

The Project, consisting of project items presented in Paragraph (4) below shall be implemented with the main objective of resolving the problems related to heavy loading of power distribution facilities occurring in two areas of Dar es Salaam City.

(3) Location and Condition of Project Site

The locations where construction, expansion and repair works are to be performed are illustrated in Figure 4.3-3. All project sites are at the locations or near the locations of existing facilities. It is expected that no particular difficulty will be encountered in construction works except for the difficulty of securing sufficient spaces.

(4) Outline of Facilities and Equipments

1) Construction of New Substations

a) Sokoine Substation
33/11 kV, 15 MVA, 4 circuits of 11 kV feeders, to be constructed on the back yard of TANESCO Head Office building.

b) Msasani Substation
3/11 kV, 15 MVA, 3 circuits of 11 kV feeders, to be constructed at the central part of Msasani Peninsula.

2) Grant of Materials/Equipment for Construction of New 33 kV Transmission Line and 11 kV Distribution Line

a) 33 kV Transmission Line for Sokoine Substation
1 km of underground line and 1 km of overhead line supported by steel pipe structure are newly constructed, and Ilala - City Center No. 1 Line is expanded to a double circuit line.

b) 33 kV Transmission Line for Msasani Substation
6 km of overhead line supported by wood structure is newly constructed, and Ilala - Oyster Bay Line is expanded to a double circuit line.

c) 11 kV Distribution Lines for New Substations
New feeder distribution lines and interconnection lines, with total length of 20 km, are newly constructed.

d) Interconnection Lines and Low Voltage Distribution Lines
Small amount of low voltage materials other than conductors and poles.

3) Grant of Two Transformers for Existing Substations
Main transformers, 33/11 kV, 15 MVA.

4) Replacement of 11 kV Switchgears in Existing Substations
Replacement of 9 transformer boards, 20 feeder boards and related cables.

5) Construction Vehicles/Tools/Measuring Instruments

a) Vehicles: The following type and numbers of vehicles will be granted.

7-ton crane	1
5-ton unit truck	2
Pick-up truck	3
Small type jeep	1
3-ton fork lift	1
Administration vehicle	1

b) Tools and Measuring Instruments: General construction tools and measuring instruments to outfit four construction teams will be granted.

(5) Operation and Maintenance System

Operation and maintenance tasks for the transmission/distribution facilities in Dar es Salaam City and its suburbs are in charge of Coastal Zonal Office inside the City, which is separate from the Head office of TANESCO, and routine works are being performed by Service office located in each Business Zone. After completion of this Project, the operation and maintenance of the facilities will be performed by each Service office under the supervision of Coastal Zonal Office. As the facilities to be constructed in this Project are practically expansion of existing facilities, there seems to be no need to increase the number of operating personnels and to establish a new management system. After this Project is completed, the operation and switching jobs at substation and transmission line level, which have been conducted so far to deal with overloading of facilities, will be eliminated, and the main tasks will be to deal with the customers on a long term basis. Therefore, the operation and maintenance of the facilities of this Project will be operated and maintained by the current operation/maintenance crews without any problem.

Fig. 4.3-1 ORGANIZATION OF TANESCO

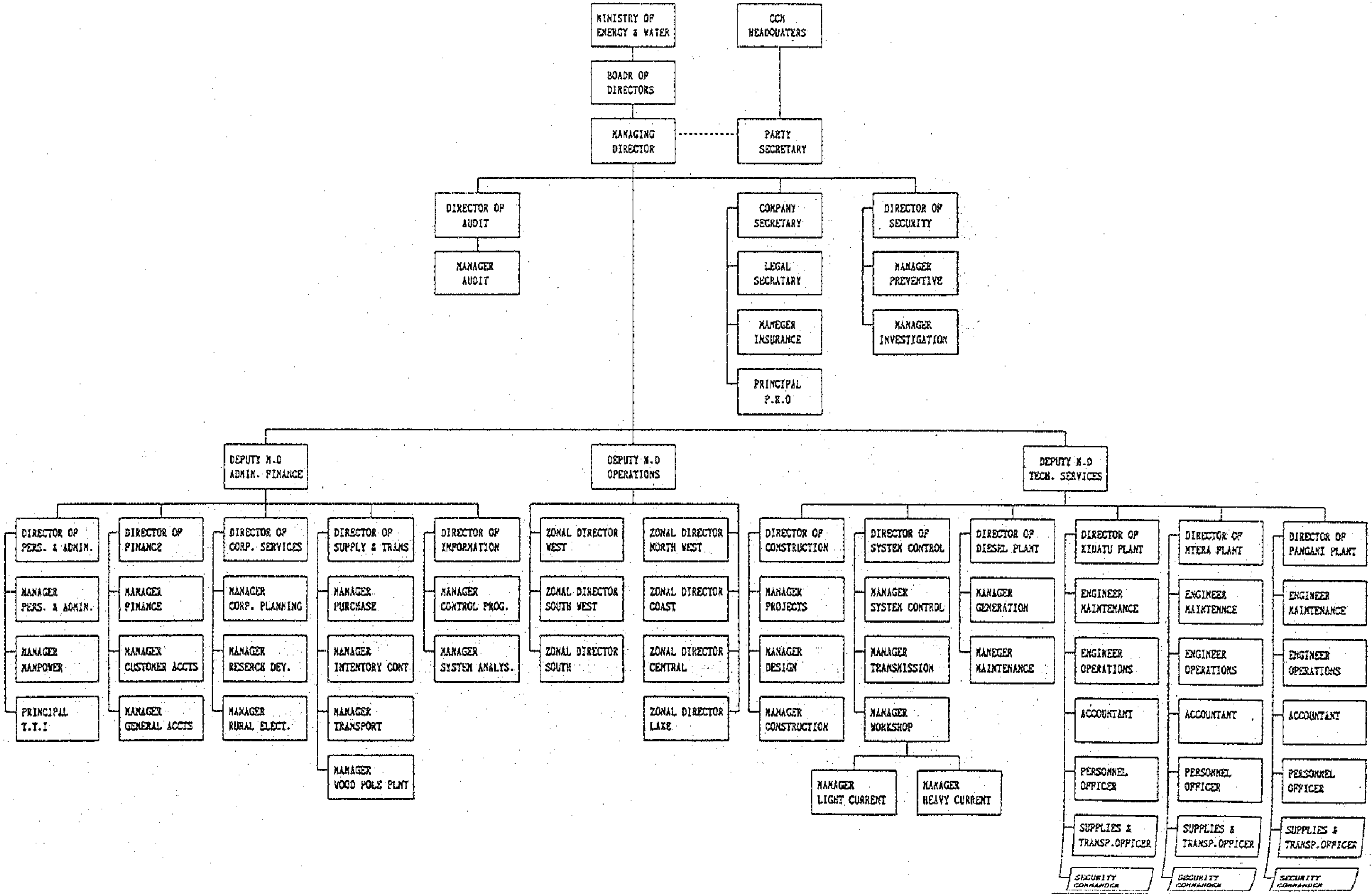


Fig. 4.3-2 PROJECT ORGANIZATION (TANESCO)

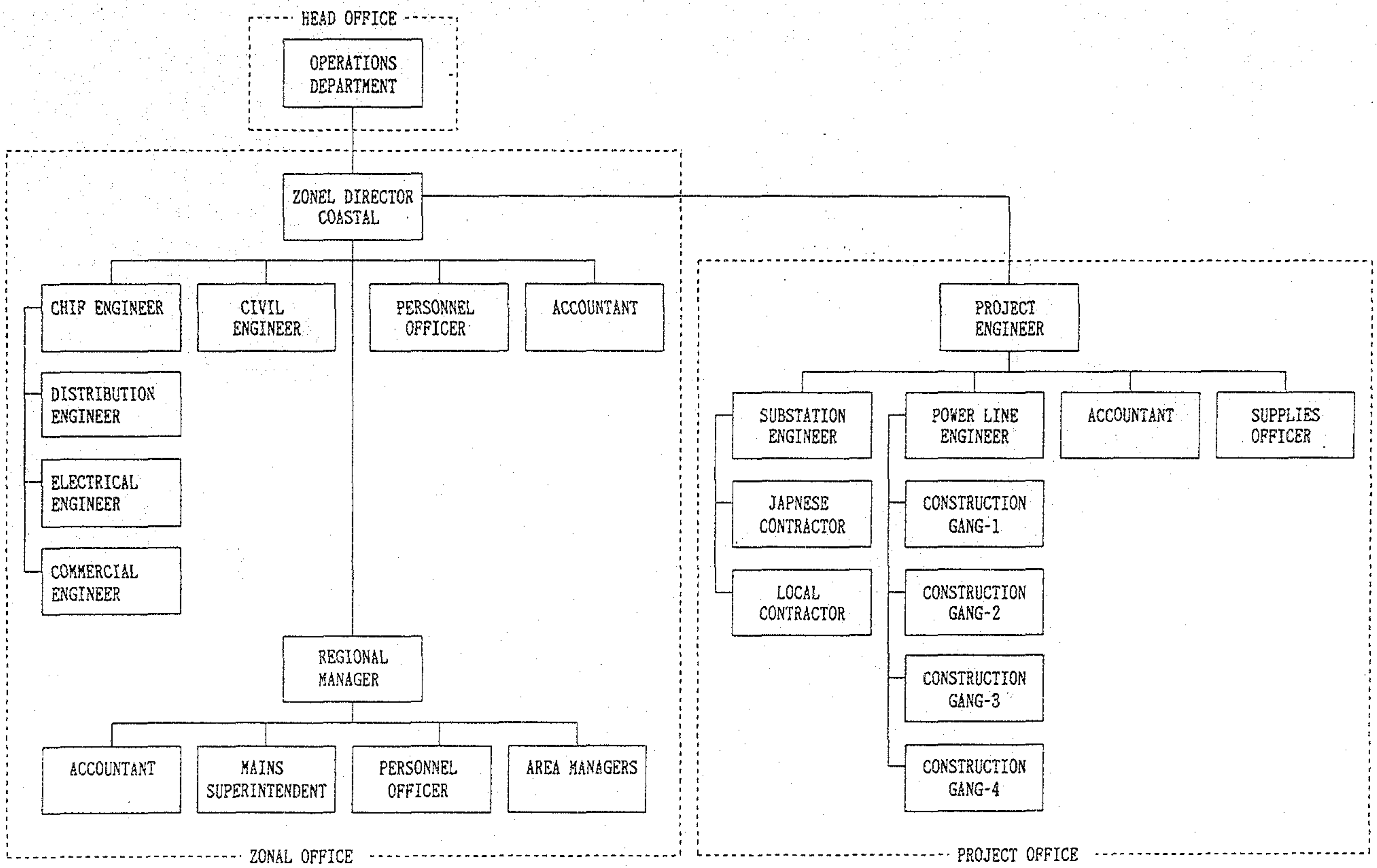
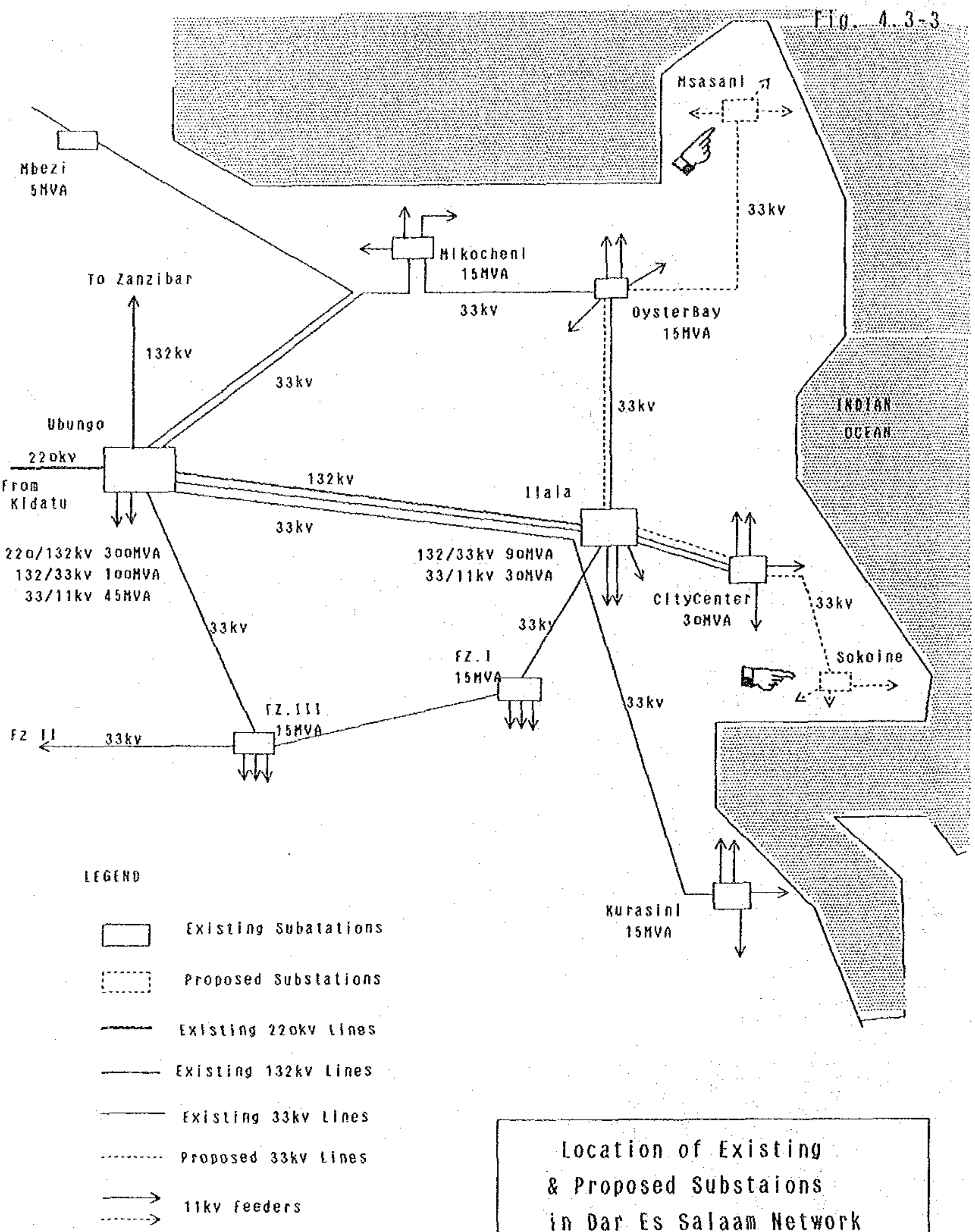


Fig. 4.3-3



Location of Existing & Proposed Substaions in Dar Es Salaam Network

EPDC International Jan.,1991

CHAPTER 5

BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5.1 DESIGN PRINCIPLE

Although this Project can be divided into construction and improvement works related to substations and those related to transmission and distribution lines, the Project can be classified into the following three groups of articles according to the objective of the work.

(1) Expansion of Facilities to Deal with Increase of Demand

1) Construction of new, 33/11 kV substations in order to relieve the loads on existing substations which are over-loaded.

2) Construction of new, 33 kV transmission lines to supply power to the above new substations.

(2) Repair of Aged Facilities and Replacement of Facilities

1) Replacement of 11 kV switchgears in existing substations.

2) Replacement of main transformers.

(3) Expansion of Facilities for Improvement of Reliability

1) One circuit is added to the 33 kV, double circuit designed transmission line supplying City Center Substation, so that power can be supplied even when one circuit fails.

2) Expansion of 33 kV transmission lines in order to secure power supply route under emergency conditions or when a line is shut down under maintenance schedule.

In designing these works, the designs and construction plans will be developed with due attention on the conditions of the sites, and with particular attention on the following matters.

(1) The economical design is set at the target, and facilities will be designed with emphasis on strong and simple structural designs.

(2) The codes and technical standards currently applied in Tanzania are duly taken into account, so that new facilities do not have adverse effect on the standardization efforts.

(3) Complicated and sensitive technologies are avoided as much as possible, and introduction of drastically innovative technology in reference to the existing facilities is avoided. By adopting designs which are coordinated to the existing facilities and current technical levels in Tanzania, it is intended to facilitate maintenance and operation of existing facilities.

(4) Efforts to Reduce Duration of Supply Interruption by Construction Work as Much as Possible

As this improvement and refurbishment plan is to be applied to urban areas where electric power supply has already been introduced, it is impossible to create power supply failure for a large area for a long period. For this reason, the implementation plan must be formulated in such a manner that power supply interruption is reduced as much as possible.

(5) Considerations on Surrounding Environment

As the newly constructed transmission lines will pass urban areas and residential areas, full attention is given to assure safety of the public. Although new feeders will be constructed to supply power from new substations, they will be so designed that it is not necessary to cut trees along street, so that the urban environment is protected.

(6) Transportation of Heavy Items and Easiness of Construction Work

As heavy items will have to be transported for the construction work, the construction plan will be formulated with due consideration on this problem.

5.2 STUDY OF DESIGN CONDITIONS

In designing substations and transmission/distribution lines on which the improvement and refurbishment will be applied under this plan, the current standards and codes in Tanzania and the standard practice in

Japan were followed. The standards applied the materials and equipments are mostly Japanese standards, and ANSI (U.S. Standard) and BS (British Standard) are used in some parts.

5.2.1 Design Condition

(1) Meteorological condition

1) Elevation: less than 1,000 m above the seal level

2) Temperature

Maximum	40°C
Minimum	10°C
Mean	32°C

(2) Safety factor

In accordance with Japanese standards following figures are employed.

Items	Safety Factor
Supports	3
Foundation	2
Conductor	2.5
Insulator	2.5
Crossarm	2.5
Guy wire	2.5

(3) Conductor temperature

Allowable temperature rise: 90°C

(4) Wind load

From TANESCO design criteria; maximum wind velocity is 28 m/s, the wind load on the wire and wooden pole has been estimated 50 and 40 kg/m2 respectively.

(5) Vertical clearance of overhead line

According to TANESCO criteria, minimum vertical clearance has been employed as follows. For low tension voltage line, however, Japanese standards have been employed.

Description	33 kV Line	11 kV Line	LT (including neutral line)
Ordinary place	5.0 m	4.8 m	4.0 m
Road crossing			
Vehicle passable	6.7	6.0	6.0
Vehicle impassable	6.0	4.8	4.0
Railroad crossing	9.0	9.0	9.0
Telecommunication line	1.8	1.8	1.2

5.2.2 Insulation Design

(1) Insulation design

In order to protect lines and equipment from an inrush of lightning surge and low frequency abnormal voltage, the design was made by putting a coordinated insulation level among them and employed following criteria.

1) For internal abnormal voltage (switching surge, persistent power frequency voltage etc.), a protection is made by insulation of equipment itself.

2) For external abnormal voltage (lightning surge), a protection is made by an arrester.

(2) Insulator type and number of discs connected

The principal idea of insulation design, as mentioned above, flashover may not occur against an internal abnormal voltage. As to internal abnormal voltage, according to the practice employed to transmission line so far, following values are employed.

Multiplying factor on direct grounded system

For persistent abnormal power frequency voltage: 0.8 Um
For switching surge abnormal voltage : 2.8 Um,

where Um stands for allowable maximum system voltage

In deciding an insulator, a flashover characteristics in wet condition of the insulator for switching surge, and the same for commercial frequency are employed.

The required insulation strength against internal abnormal voltage and the electrical characteristics of the insulators are shown in the following tables ((a) - (c)).

(a) Design for switching surge

Nominal Voltage	N (kV)	33	11	
Allowable Max. Voltage	Um (kV)	36	12	x 12/11
Peak Voltage to the Ground	(kV)	29.4	9.8	Um x $\sqrt{2/3}$
Switching Surge Multiplying Factor	n	2.8	2.8	Direct grounding
Switching Surge Voltage	(kV)	82.3	27.4	x n
Correction Factor	(kV)	1.2	1.2	Elevation & others
Required Withstanding Voltage		99	33	x 1.2

(b) Design for switching surge

Nominal Voltage N (kV)	33	11	Direct grounding
Allowable Max. Voltage Um (kV)	36	12	
Multiplying Factor for Low Frequency n	0.8	0.8	
Persistent Abnormal Voltage (kV)	28.8	9.6	
Correction Factor	1.2	1.2	
Required Withstanding Voltage (kV)	35	12	

(c) Electrical characteristics of insulators

	Critical Impulse 50% FOV (kV)	Switching Surge (wet)		Power Freq. (wet)	
		50% FOV (kV)	Withstand Voltage (KV)	FOV (kV)	Withstand Voltage (kV)
250 mm Suspension, 1 pc	140	85	75	45	40
250 mm Suspension, 2 pcs	240	170	155	80	70
250 mm Suspension, 3 pcs	330	245	220	115	105
33 kV Pin Type	290	-	-	95	-
11 kV Pin Type	130	-	-	35	-

Note: 1) Characteristics of 250 mm suspension insulator is based on "The Insulation Design Manual for Overhead Transmission Line - October 1966" issued by The Japanese Electrotechnical Committee (JEC).

2) Characteristics of 33 kV and 11 kV Pin Type insulators are based on BS 137 and ANSI C29.5 respectively.

(d) Number of insulators to be installed

Comparing an insulation tolerance of insulators in Table (c) with required withstanding voltage in Table (a) & (b), kind and quantity of insulator have been selected as following table.

Line Voltage	Tangent/Angle	33 kV Pin Type	11 kV Pin Type	250 mm Suspention
33 kV	Tangent	1 pc	-	-
	Angle or Deadend	-	-	3 pcs
11 kV	Tangent	-	1 pc	-
	Angle or Deadend	-	-	2 pcs

(3) Standard insulation clearance (phase to ground)

Standard insulation clearance is specified as equivalent rod to rod gap in which the 50% flashover would be taken place under the imposition of critical impulse.

Nominal Voltage	(kV)	33	11
No. of 250 mm Insulators	(pcs)	3	2
50% Impulse FOV on Insulator Strings	*(kV)	330	240
Corresponding Rod to Rod Gap	*(cm)	52	36
Standard Insulation Clearance	(cm)	55	35

* Based on "The Insulation Design Manual for Overhead Transmission Line - October 1966"

(4) Minimum insulation clearance

Minimum insulation clearance is specified as the gap which withstands both switching surge and abnormal power frequency voltage.

Nominal Voltage (kV)	33	11	
Allowable Max. Voltage (kV)	36	12	$\times \frac{12}{11}$
Peak Voltage to Ground (kV)	29.4	9.8	$\times \frac{2}{\sqrt{3}}$
Switching Surge Multiplying Factor	2.8	2.8	Direct grounding
Switching Surge Peak (kV)	82.3	27.4	x 2.8
Required Withstanding Voltage (kV)	90.5	30.1	x 1.1
Required Clearance *(cm)	15.3	3.8	
Minimum Insulation Clearance (cm)	15	5	

* Based on "The Insulation Design Manual for Overhead Transmission Line - October 1966"

(5) Insulation clearance in abnormal condition

When the maximum wind flow is considered, the clearance shall be checked by allowable maximum line voltage under the wet condition.

Nominal Voltage (kV)	33	11	
Allowable Max. Voltage (kV)	36	12	$\times \frac{12}{11}$
Allowable Max. Voltage (to Ground) (kV)	20.8	6.92	
Required Withstanding Voltage (kV)	22.9	7.62	x 1.1
Clearance at Abnormal Condition *(cm)	9	3	

* Based on "The Insulation Design Manual for Overhead Transmission Line - October 1966"

Nominal Voltage (kV)	33	11	
Allowable Max. Voltage (kV)	36	12	$\times \frac{12}{11}$
Peak Voltage to Ground (kV)	29.4	9.8	$\times \frac{2}{\sqrt{3}}$
Switching Surge Phase-to-Phase Multiplying Factor	4.5	4.5	Direct grounding
Switching Surge Voltage (kV)	133	44.1	x 4.5
Required Withstanding Voltage (kV)	146	48.5	x 1.1
Required Clearance *(cm)	26	8	

* Based on "The Insulation Design Manual for Overhead Transmission Line - October 1966"

(7) Basic lightning-impulse insulation level (BIL)

Employed BIL classes are No. 30A for 33 kV system and No. 10A for 11 kV system respectively. The reason of said decision is described below.

Since shielding effect of overhead ground wires and protection by arrester has been anticipated, the BIL shall be selected so as to cope with a switching surge as well as lightning surge, by coordinating with the protection devices of arresters.

Namely, assuming that the protection tolerance of arrester and protected equipment against lightning surge to be 20%, BIL should be selected to be of more than 100% sparkover voltage and 1.2 times of restricted voltages. Next table shows the process of decision of BIL according to voltages classified.

		33 kV	11 kV
Arrester			
Nominal Voltage	(kV)	42	14
Nominal Discharge current	(kV)	10	5
100% Sparkover Voltage	(kV)	135	50
Restricted Voltage	(kV)	140	50
Required BIL			
Restricted Voltage x 1.2	(kV)	168	60
Lightning-impulse Withstanding Voltage	(kV)	170	60
Required BIL Class		(30B)	(6A)
Decided BIL Class *		(30A)	(10A)

* The values was decided conforming to TANESCO's existing facilities.

(8) Lightning protection design

In the field study of this Project, accurate observation record on IKL (Isokeraunic Level) in Dar-es-Salaam area were not obtained.

In substations there are installed arresters, and for substations, 33 kV lines and 11 kV lines overhead ground wires are installed.

Though few frequency of lightning is expected in this area, in order to protect the facilities from the external abnormal voltage including lightning, installation of arresters for substations and 11 kV distribution transformers and overhead ground wires for the inside of substations and 33 kV lines have been scheduled.

5.3 BASIC PLAN

5.3.1 Substations

The project works related to substations can be classified into the construction of new substations, replacement of aged 11 kV switchgears and related cables, and installation of additional circuit breakers to match the expansion of 33 kV transmission lines.

5.3.1.1 New Substations

(1) Selection of Substation Sites

In order to resolve the problem of heavy load on City Center Substation and Oyster Bay Substation, it is conceivable to increase the capacity of these substations by installing additional transformers. However, there is no extra space in City Center Substation, and no additional land can be acquired for the substation as it is located in urban center. On the other hand, there is some space in Oyster Bay Substation. However, as the large load which causes this problem of heavy substation loading is located in Msasani Peninsula, and this location at the furthest end of the supply area of the Oyster Bay Substation, it is more effective to construct a new substation supplying the whole Msasani Peninsula in the middle of this large load center, rather than installing additional transformers in the existing substation. By this reasoning, it has been decided to construct two new substations, Sokoine Substation and Msasani Substation. As these substations will be constructed in the urban area of the City, attentions will be given on the following factors in selecting the sites of new substations.

a) The substations are coordinated with existing power facilities.

b) The substations are located at center of heavy load area, and will be near load center in future.

c) The substations can flexibly deal with future increase in power demand.

d) The transmission lines supplying power to the substations and the feeders can be easily constructed.

e) The substations are in harmony with surrounding environment.

The sites of these new substations have been selected based on comprehensive studies of these factors. They have been selected as described below.

1) Sokoine Substation Site

The site is located on the back of the head office building of TANESCO. This place is adjacent to an area where there are large building such as Kilimanjaro Hotel, Bank of Tanzania Head Office and government offices. That is, there are many large customers requiring direct connection to the substations in the nearby locations. Fig. 5-3-1.

2) Msasani Substation Site

The proposed site of Msasani Substation is located at a location which is a little to the northeast from the center of Msasani Peninsula. This place is in an residential area, and near the area where the severest voltage problem in Msasani Peninsula is now being experienced. Fig. 5-3-2.

(2) Transformer Capacity

Currently, the standard capacity of transformers being used in substations of Dar-es-Salaam is 5 MVA and 15 MVA. 15 MVA capacity was selected for new substations, because 5 MVA bank is too small considering the total size of load and its growth rate.

(3) Operation and Control System

The operation and control system of new substations will be the simplified monitoring system which is the same as those used in the existing substations. In this system, the engineering staff take a trip to the substation from the stationed office as required, and perform monitoring, patrol and equipment operation at the substation site which is normally operated without attendance.

Fig. 5.3-2 SUBSTATION SITE - MSASANI SUBSTATION

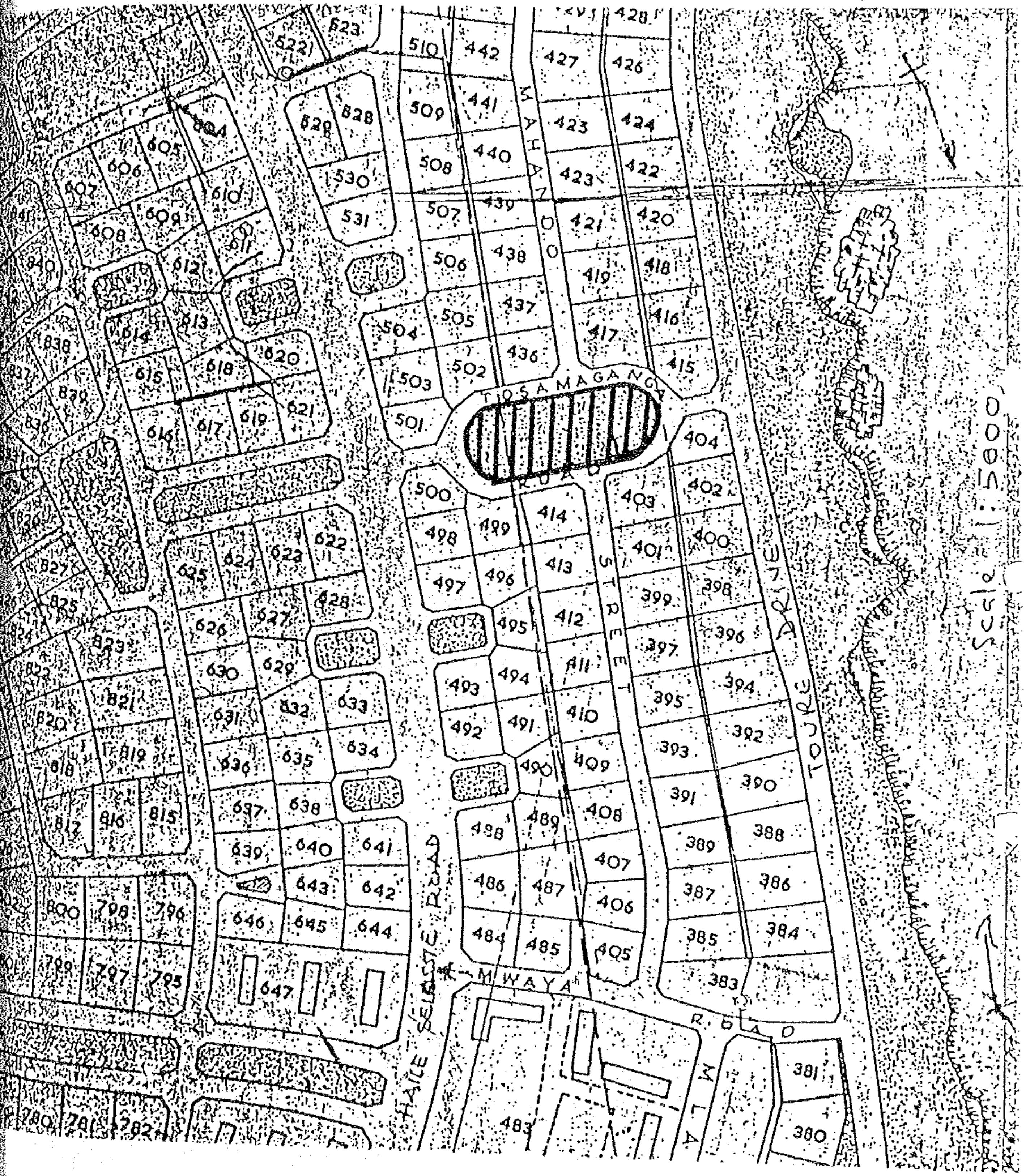
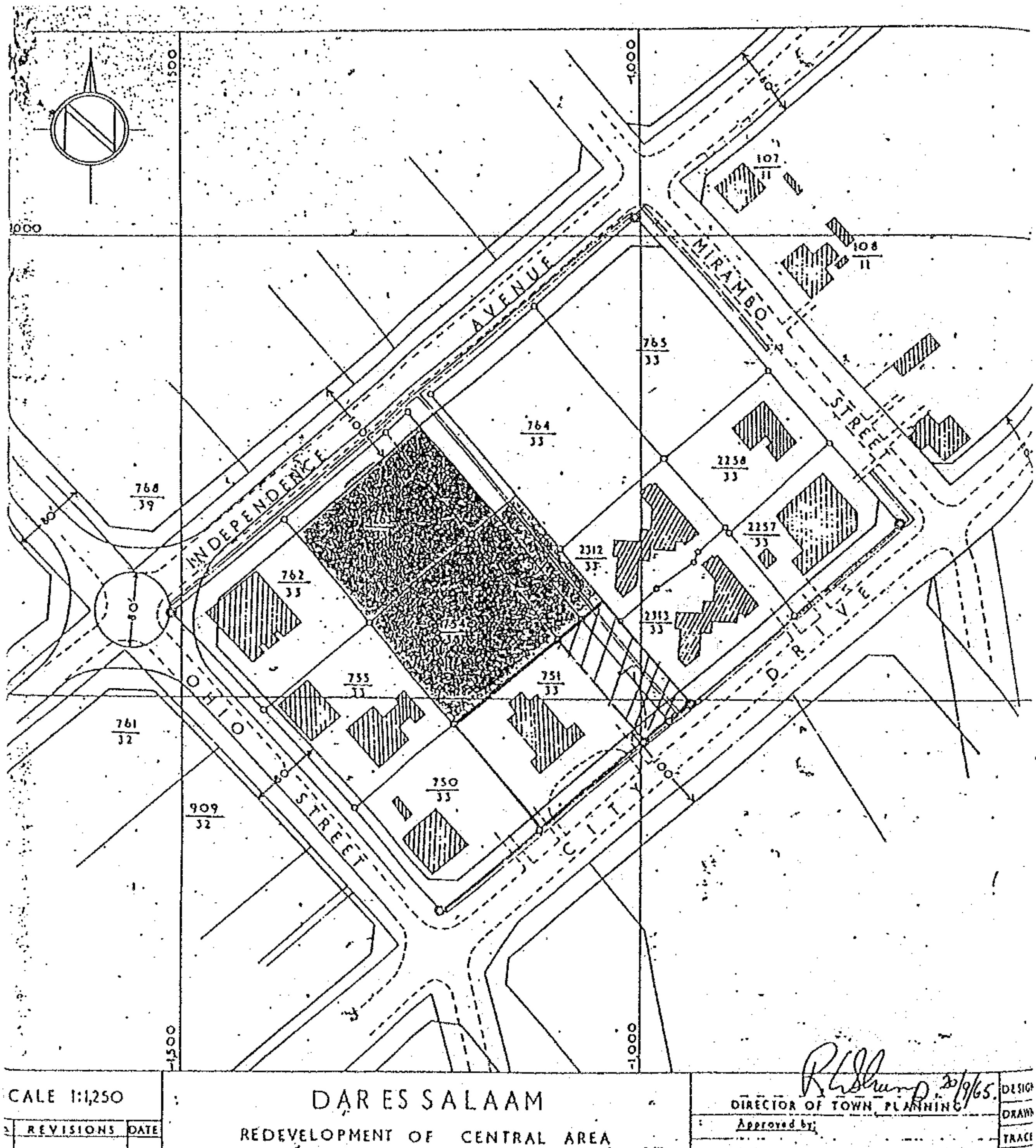


Fig. 5.3-1 SUBSTATION SITE - SOKOINE SUBSTATION



5.3.1.2 Improvement of Existing Substation

(1) Replacement of 11 kV Switchgear

The 11 kV switchgears which are used in most of existing substations are very aged equipment which has been in service for 20 to 30 years, and constitutes the weakest point in the whole distribution system in Dar-es-Salaam City. As these switchgears are the very vulnerable elements, considering the requirement for frequent load breaking operation performed in recent years, it has been decided to replace them. However, the circuit breaker currently used at City Center Substation (oil circuit breakers made by British Reyrolle Corporation), they will not be replaced. Some circuit breakers removed from other substations which are in relatively good conditions can be kept as spares, and there would be no problem in not replacing the circuit breakers of City Center Substation. The substation equipments which have to be replaced are presented in the table below.

Substation	Transformer Board	Feeder Board	Bus Separation Board
Ilala	1 (panel)	8 (panels)	1 (panel)
Oyster Bay	3	3	-
F. Zone I	3	4	-
Kurasini	1	4	-
Total	9	19	1

(2) Additional Installation of 33 kV Circuit Breakers

In City Center Substation, circuit breakers are installed on the high voltage side of 33/11 kV transformers, but only line switches are provided on the receiving lines. Considering this Project in which the 33 kV transmission line between Ilala Substation will be expanded to double circuit, and power will be supplied from City Center Substation to Sokoine Substation to be constructed anew, circuit breakers will be installed on the 33 kV receiving lines with considerations on the operation and maintenance of transmission line and the coordination of protective systems. The number required is 2 for receiving lines, and 1 for the supply line to Sokoine Substation, or a total of 3. The 2 circuit breakers at Ilala Substation supplying

City Center Substation must have their capacity increased from the current 600 A to 800 A in future as the 33 kV transmission line is expanded. However, as the circuit breakers of Japanese manufacture (supplied in the previous Improvement Project to deal with increased load), which is currently stocked by TANESCO, can be used, and this replacement is not counted in this Project.

5.3.2 33 kV Transmission Lines

The 33 kV transmission lines to be newly constructed or expanded are the following four.

(1) Expansion of Ilala - City Center No. 1 Line

Ilala - City Center No. 1 Line, which is badly aged, will be removed, and a new transmission line will be constructed by utilizing the route of the old line. The existing line consists of 1 circuit of 100 sq.mm ACSR, and has transmission capacity of only approximately 22 MVA. As the substation total capacity will be increased to 45 MVA, including the new Sokoine Substation when this Project is implemented, a new transmission line having two circuits of 150 sq.mm ACSR will be constructed to carry this power. With this new line, the power will be supplied to City Center Substation by City Center No. 1 Line and City Center No. 2 Line, and normal operation can be maintained even when 1 circuit goes out of service, with substantial increase in supply reliability.

Section Length	:	3.9 km
Conductor	:	150 sq.mm ACSR
Support Structure	:	Wood pole, double circuit, vertical conductor arrangement.

(2) Construction of City Center - Sokoine Line

It is not possible to secure a route for overhead transmission line at the sending end at City Center Substation and the receiving end at Sokoine Substation, and underground cable will be adopted for these sections. The capacity of overhead line conductors and cables was selected with consideration on future expansion of capacity of Sokoine Substation.

Section Length : 2.2 km (underground line; 1 km)
Conductor : 150 sq.mm ACSR (underground cable; CVMAZV 300 sq.mm x 3)
Support Structure: Steel pipe pole, single circuit, triangle conductor arrangement

(3) Expansion of Ilala - Oyster Bay Line

One circuit of 150 sq.mm ACSR line will be strung on this line which has double circuit support structure. The section length will be 6.3 km. After this line is expanded, Oyster Bay Substation will receive power from Ilala Substation, and Mikocheni Substation will normally receive power from Ubungo Substation. The power system configuration will be such that in the event of line fault or scheduled shutdown, the above two substations and the new Msasani Substation can receive power from Ilala or Ubungo via existing Oyster Bay - Mikocheni interconnection line, thereby substantially improving supply reliability.

(4) Construction of Msasani Line

Msasani Line will not be connected to a bus of existing substation, but it will be branched from existing Mikocheni - Oyster Bay line, and supply power to Msasani Substation. As this interconnection system will have two power supply sources as described above, the power will be supplied to Msasani Substation by two supply systems, with substantially stabilized power supply capability.

Section Length : 5.3 km
Conductor : 150 sq.mm ACSR
Support Structure: Wood pole, single circuit, triangle conductor arrangement

5.3.3 11 kV Distribution Lines

A total of 7 feeders will be provided from the two new substations and interconnected to the existing 11 kV distribution networks, thereby resolving the overload problems at substation level. The details of feeder construction are presented below.

(1) Sokoine Substation Feeders

a. Underground Lines: 400 m (11 kV CVMAZV 185 sq.mm x 3C)

b. Overhead Lines : 15 km (Wood pole supported, single circuit, horizontal conductors, 100 sq.mm ACSR)

(2) Msasani Substation Feeders

a. Underground Lines: 300 m (11 kV CVMAZV 185 sq.mm x 3C)

b. Overhead Lines : 5 km (Wood pole supported, single circuit, horizontal conductors, 100 sq.mm ACSR)

5.3.4 Vehicles and Tools/Measuring Instruments for Construction Work

In the three improvement projects which have been granted by the Government of Japan in the past, construction vehicles/tools/instruments were also supplied. These articles are today distributed to branch offices all over Tanzania as the improvement projects were completed, and fully utilized for daily jobs, and it is impossible to use these articles for this Project. For this reason, the following vehicles will be supplied for the construction works of this Project. In this Project, most of works involve dangerous operations such as shutdown of facilities and switching of loads, and all groups engaged in this construction work must maintain communication between them in order to assure safety, reduce outage time, and perform tasks completely. For this purpose, it was decided to equip the construction vehicles with VHF transceivers. The construction tools and measuring instruments which will be supplied to the substations, where the equipment installation works will be performed by Japanese contractors, will be those required for maintenance and inspection after transfer of facilities. For transmission and distribution lines which will be constructed directly by TANESCO, the standard tool equipment for 4 construction teams will be supplied, as the construction work by TANESCO will be implemented by 4 construction teams.

a.	7-ton crane	1
b.	5-ton unit truck	2
c.	Pickup truck	3
d.	Small jeep	1
e.	3-ton fork lift	1
f.	Supervisor's vehicle	1

(Note: all vehicles except for lift will be equipped with transceivers.)

5.4 BASIC DESIGN

5.4.1 Substation

5.4.1.1 New Substations

The locations and the main transformer capacities of new substations are as described in Paragraph 3 of this Chapter. The designs of these substations were developed based on the following additional studies.

(1) Unit Design of Substation

For the new substations, the unit design is chosen to improve economy and maintainability. The 33 kV equipments will be outdoor type, and 11 kV equipments will be accommodated in outdoor type cubicles, and no substation building is required. This unit design has the following advantages.

a) The substation design is standardized and simplified.

b) As the building to accommodate control boards and power equipments is not needed, the land required can be small in area.

c) The power equipments on the transformer secondary side can be simplified, the power cables can be made short, and control cables can also be substantially saved.

d) The installation work is simple, and construction schedule can be shortened.

e) Expansion of substation and transfer of equipment can be done easily.

f) Operation and maintenance are easy, and operating cost can be saved.

(2) Connection Scheme

In studying the connection scheme of new substations, the power system operating conditions, frequency of equipment inspection, power supply duty, etc. were considered, and the connection scheme was simplified as much as possible within the scope that these requirements are met.

(3) Counter-Contamination Design

In studying the countermeasure against salt pollution, the decisive factors are the meteorological condition of the site, and the distance from sea shore. In the substation sites of this Project, strong wind is rare, and it is judged that the contamination of insulators by deposition of salt is little, as insulators are washed by occasional rains. This is proven by the fact that no insulator washing facility is installed in existing substations which are less than 10 km from sea shore. Although it is difficult to develop an accurate counter-contamination design because there is no data on the pollution at the sites which are measured for a long time, we assumed that the equivalent salt deposition is 0.03 mg/sq.mm, similarly to the general area.

(4) Minimum Insulation Clearance

The minimum line-to-line and line-to-ground insulation clearance values were calculated based on BIL, and determined as the length of rod gap with which 50% flashover occurs at 120% and 150% of BIL. Specifically, these values are as given below.

a.	Nominal voltage (kV)	33
b.	Insulation Class (No.)	30
c.	BIL (kV)	200
d.	Minimum Line-to-Ground Clearance	35
e.	Minimum Line-to-Line Clearance	48

(5) Protective Devices

The protective devices for the transmission/distribution lines, busses and transformers will be provided by applying the Power Station and Substation Code (JAEC 5001-1984) of Japan. Concerning protective relays, the electromagnetic type relays will be used similarly to the existing facilities to facilitate maintenance tasks.

The connection schemes of each substation as determined by studies discussed above are presented in Figure 5.4-1 for Sokoine Substation and in Figure 5.4-2 for Msasani Substation. The equipment layout/plan of each substation is given in Figure 5.4-3 and Figure 5.4-4.

5.4.1.2 Improvement of Existing Substations

The 33 kV circuit breakers to be added to City Center Substation were selected as oil circuit breaker to make them conform to TANESCO's standard. In replacing the 11 kV distribution feeder circuit breaker cubicles which are equipped in other substations and which are very aged, the vacuum circuit breakers which maintenance is easy will be installed, instead of oil circuit breakers which have been used in the past. The details of improvement works of each substation are as presented below.

(1) Ilala Substation

Replacement of 11 kV switchgears and related cables.

a. Installation of 11 kV, indoor type cubicles: 11 units

b. Installation of 11 kV cables : 60 m

(2) Oyster Bay Substation

Replacement of 11 kV switchgears and related cables.

a. Installation of 11 kV, indoor type cubicles: 6 units

b. Installation of 11 kV cables : 70 m

(3) Factory Zone I Substation

Replacement of 11 kV switchgears and related cables.

a. Installation of 11 kV, indoor type cubicles: 7 units

b. Installation of 11 kV cables : 130 m

(4) Kurasini Substation

Replacement of 11 kV switchgears and related cables.

a. Installation of 11 kV, indoor type cubicles: 5 units

b. Installation of 11 kV cables : 20 m

(5) City Center Substation

Replacement of 11 kV switchgears and related cables.

a. Installation of 11 kV, indoor type cubicles : 3 units

b. Control boards and control cable construction work: 1 set

5.4.1.3 Specification of Main Equipment

Outline of specification of the main equipment should be shown as follows:

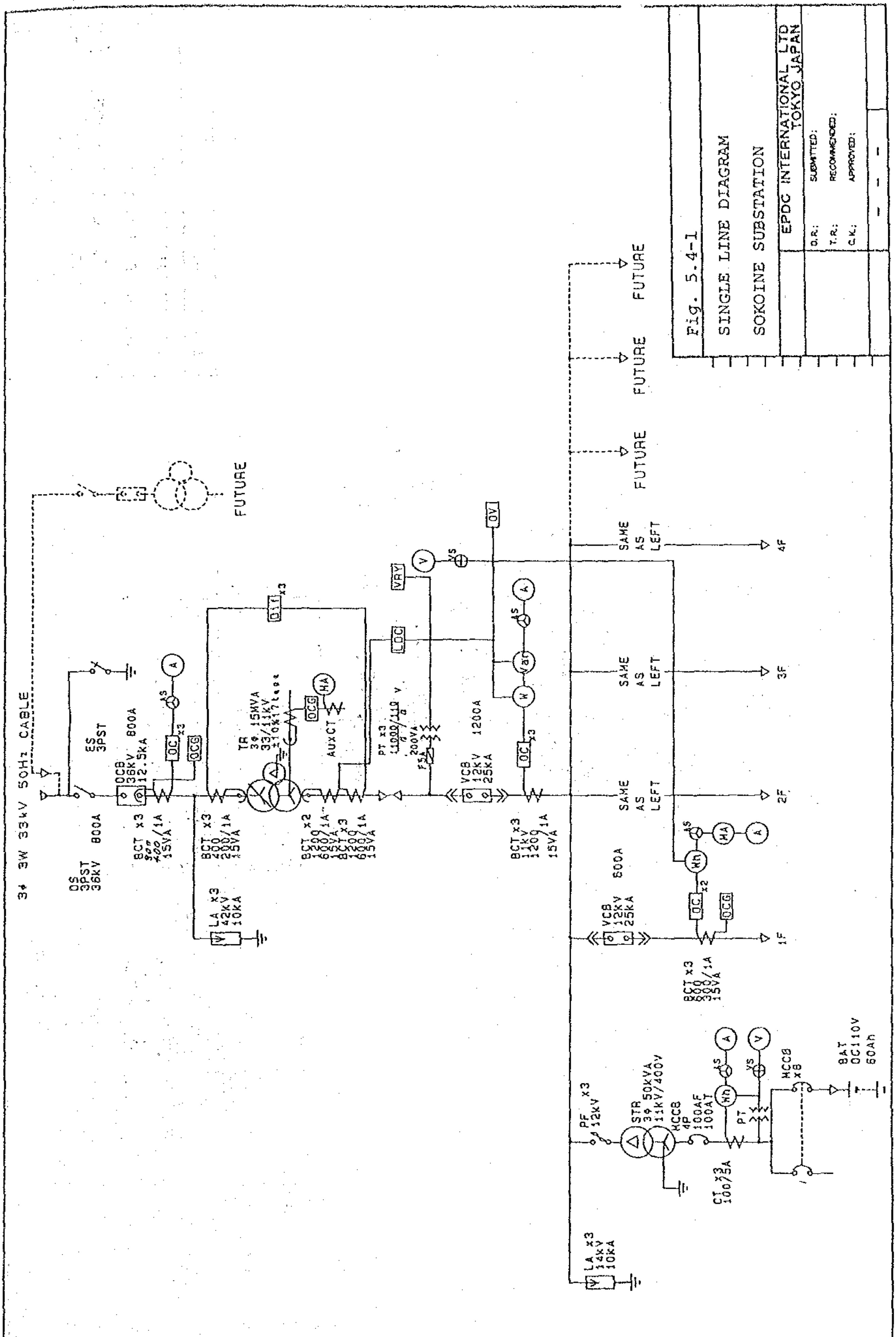


Fig. 5.4-1
SINGLE LINE DIAGRAM
SOKOINE SUBSTATION

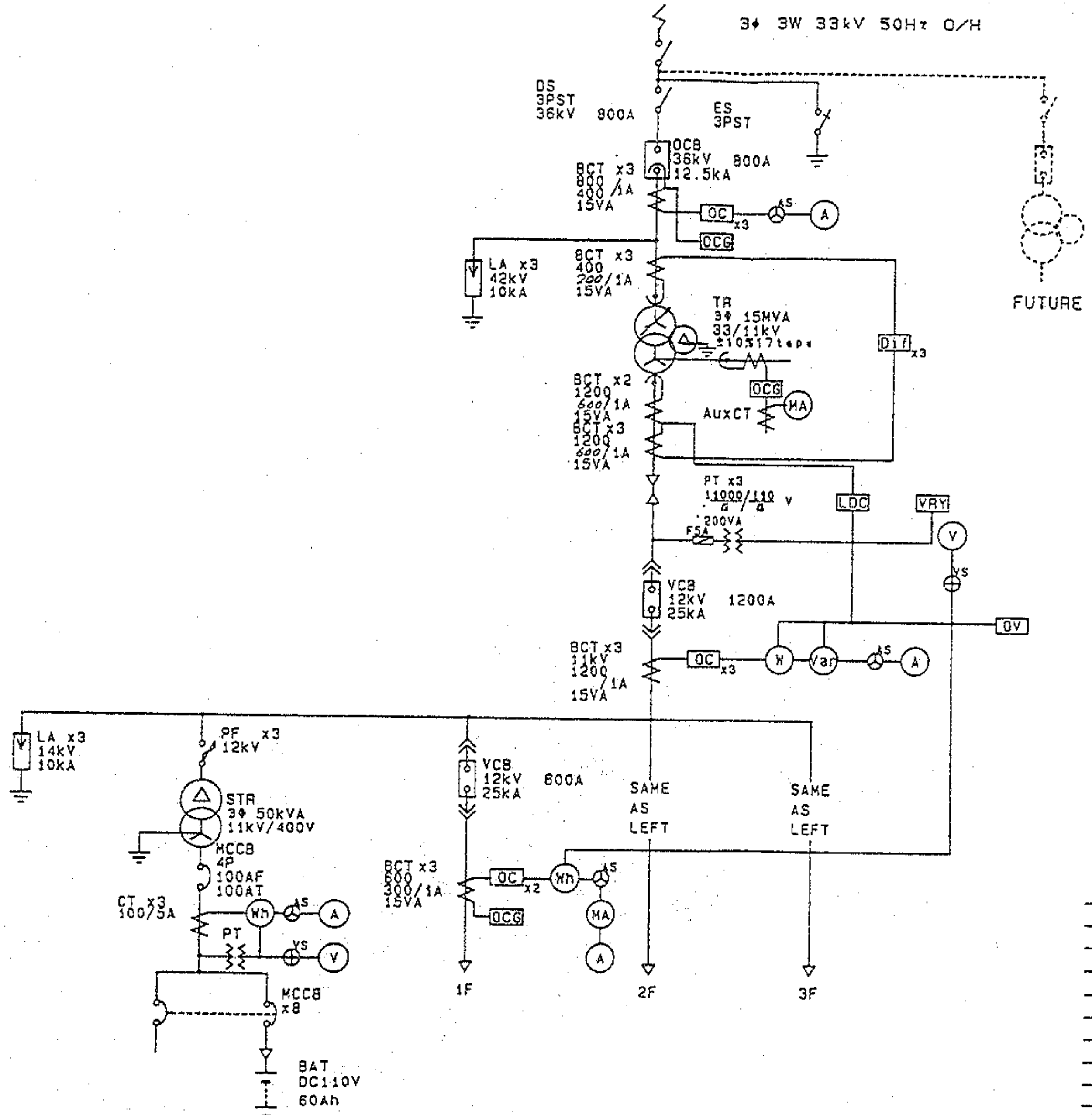
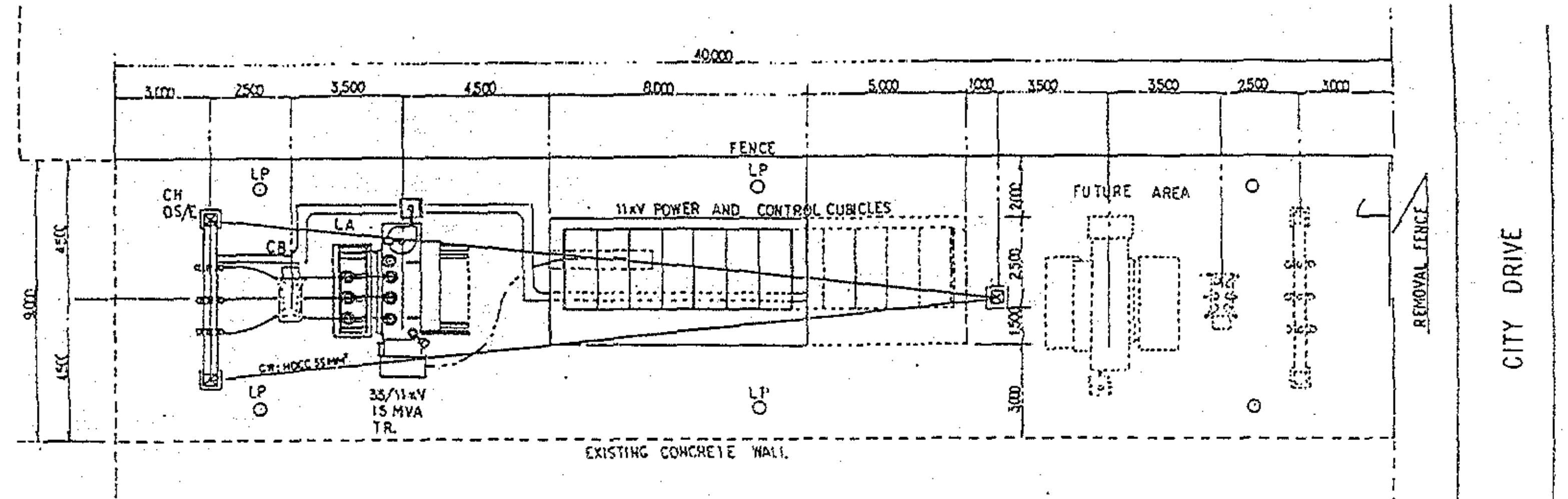


Fig. 5.4-2

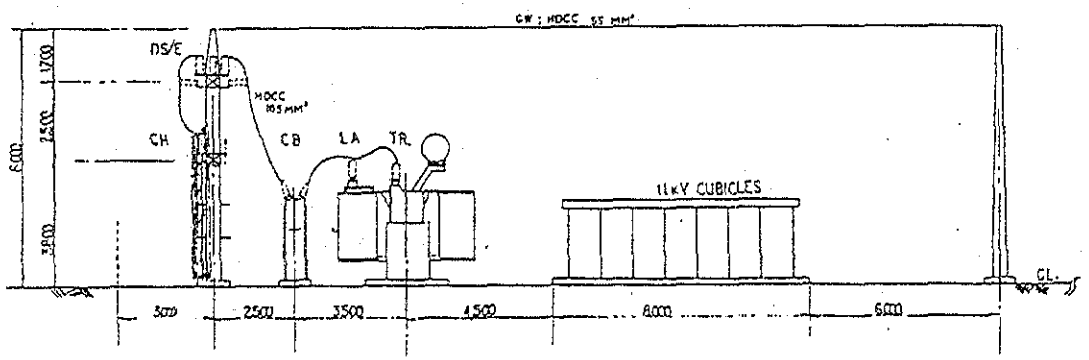
SINGLE LINE DIAGRAM

MSASANI SUBSTATION

EPDC INTERNATIONAL LTD TOKYO JAPAN	
D.R.:	SUBMITTED:
T.R.:	RECOMMENDED:
C.K.:	APPROVED:
— — —	



PLAN



SECTION

LEGEND

DS/E : DISCONNECTING SWITCH WITH EARTHING DEVICE

CH : CABLE HEAD

CB : CIRCUIT BREAKER

LA : LIGHTNING ARRESTER

TR. : TRANSFORMER

LP : LIGHTING POLE

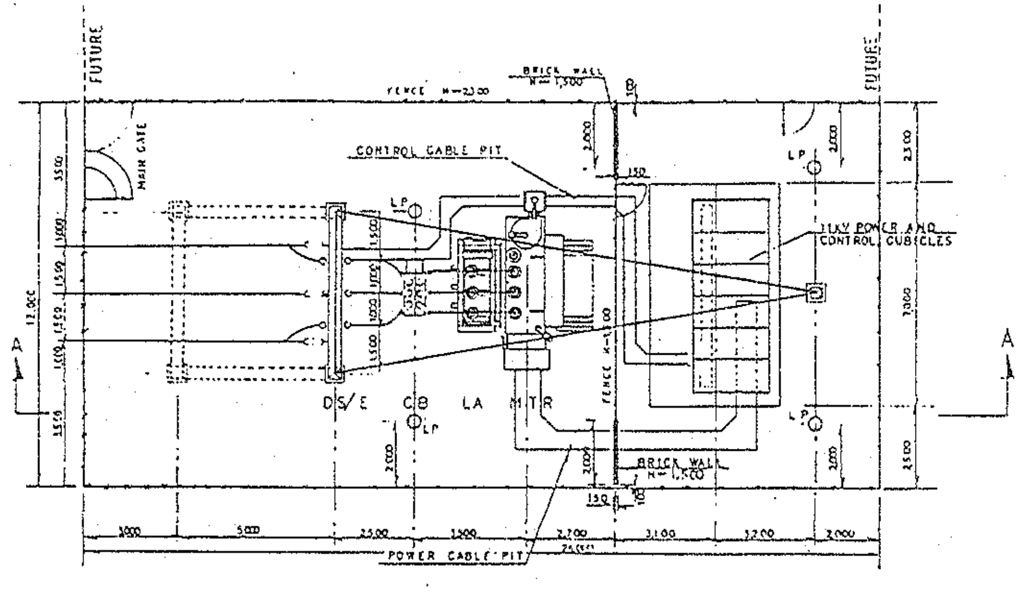
Fig. 5.4-3

LAYOUT

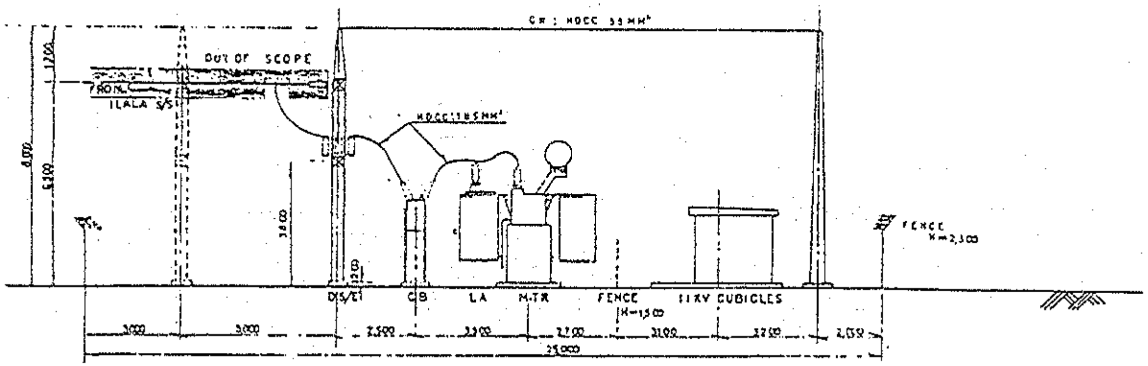
SOKOINE SUBSTATION

EPDC INTERNATIONAL LTD
TOKYO JAPAN

D.R.:	SUBMITTED:
T.R.:	RECOMMENDED:
C.K.:	APPROVED:



PLAN



SECTION A-A

LEGENDS:

DS/E : DISCONNECTING SWITCH WITH EARTHING DEVICE

CB : CIRCUIT BREAKER

LA : LIGHTNING ARRESTER

M.TR : MAIN TRANSFORMER

LP : LIGHTING POLE

Fig. 5.4-4

LAYOUT

MSASANI SUBSTATION

EPDC INTERNATIONAL LTD
TOKYO JAPAN

D.R.:	SUBMITTED:
T.R.:	RECOMMENDED:
C.K.:	APPROVED:

(1) Main transformer

Applicable Standard JEC 204-1978 Transformer
JEC 186-1972 On load tap changer equipment

Capacity	45,000 kVA	15,000 kVA
Rating	Continuous rating	Continuous rating
Number of phases	3	3
Frequency	50 Hz	50 Hz
Type of cooling	Oil-immersed self-cooled type	Oil-immersed self-cooled type
Rated voltage (1ry/2ndary)	132000V/33000V	33000V/11000V
Tap voltages (HV)	+5%, -15% 17 Tap	+10% 17 Tap
Insulation level (Class)	120/30A	30A/10A
Connection		
Primary		
Secondary	Tertiary (Δ)	Tertiary (Δ)
Angular displacement	0°	0°
Polarity	Subtractive polarity	Subtractive polarity
Indoor or outdoor service	Outdoor	Outdoor
Tap changer equipment	L.T.C.	L.T.C.
Altitude	Below 1000 m	Below 1000 m

(2) Circuit breaker

Applicable standard JEC 181-1975 Circuit breaker

Rated voltage	36 kV	36 kV	12 kV	12 kV
Insulation level (Class	30 A	30 A	10 A	10 A
Rated current	1200 A	600 A	1200 A	1200 A
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz
Rated interrupting current	12.5 kA	12.5 kA	25 kA	25 kA
Rated interrupting time	5 cycle	5 cycle	5 cycle	5 cycle
Rated making voltage	DC 100 V	DC 100 V	DC 100 V	DC 100 V
Rated tripping voltage	DC 100 V	DC 100 V	DC 100 V	DC 100 V
Standard operating duty	B CO-(15 sec.)-CO		B CO-(15 sec.)-CO	
Indoor or outdoor service	Outdoor		Cubicle type	
Altitude	Below 1000 m		Below 1000 m	
Maximum ambient temperature	40°C		40°C	

(3) Disconnecting Switch

Applicable standard JEC 196-1975 Disconnecting switch

Rated voltage	36 kV	36 kV
Insulation level (Class)	30 A	30 A
Rated current	600 A	600 A
Rated short time current	14 kA	14 kA
Indoor or outdoor service	Outdoor	
Altitude	Below 1000 m	
Maximum ambient temperature	40°C	
Control system	Manual control	
Accessories	with earthing blade	-

(4) Instrument transformer

Applicable standard JEC 190-1974 Instrument transformer

Rated voltage	33 kV	33 kV	11 kV	11 kV	11 kV
Insulation level (Class)	(BCT)	(BCT)	(BCT)	10 A	10 A
Rated current	600/5 A	400/5 A	1200/5 A	1200/5 A	600/5 A
Rated burden	40 VA	40 VA	40 VA	40 VA	40 VA
Rated current tolerance	40	40	40	40	40
Class	1.0	1.0	1.0	1.0	1.0

(5) Lightning arrester

Applicable Standard JEC 203-1978 Lightning arrester

Rated voltage	42 kV	14 kV
Rated frequency	50 Hz	
Nominal discharge current	10 kA	
Altitude	Below 1000 m	
Maximum ambient temperature	40°C	
Grounded neutral system	Directly-grounded system	

(6) Enclosed switchboard

Applicable Standard JEM-1153 Enclosed switchboard

Rated voltage	11 kV	
Indoor or outdoor service	Indoor	Outdoor
Altitude	Below 1000 m	
Maximum ambient temperature	40°C	

5.4.2 Transmission Line

(1) Conductor

The conductors used in this Project must have sufficient capacity to supply the necessary amount of power in each line section, have satisfactory characteristics in terms of mechanical strength and resistance against corrosion, and at the same time advantageous in terms of cost. The hard drawn copper stranded cable (HDCC), aluminum alloy stranded cable (AAC), and aluminum cable steel reinforced (ACSR) are the candidates in selection of conductors. Based on an overall judgment, ACSR has been selected as this is generally most advantageous, and conforms to the standard of TANESCO. As it is advantageous to standardize the conductor size by selecting as few classes as possible, the 100 sq.mm and 150 sq.mm ACSR conductors have been selected, with considerations on the common use with existing 11 kV distribution lines.

(2) Ground Wire

Although the Study Mission could not obtain the lightning observation data of Dar es Salaam City during the last expedition, it was informed that lightning occurs in the inland side of the City. Considering the siting conditions, the IKL (Isokeraunic Level; number of days when lightning storm occurs in a year) at the site is expected to be around 10. Therefore, it was decided to provide a single line of 30 sq.mm galvanized steel cable as the ground wire to shield the lines from lightning stroke.

(3) Counter-Contamination Design

Although the City of Dar es Salaam face Indian Ocean, there rarely is strong wind, and ocean wave spray is seldom carried to the land. With suitable level of rain fall, the insulators are washed by rain, and there seems to be little possibility of insulators contaminated by salt pollution. However, as the conditions in the City must be severer than in the inland areas, the effect of salt contamination was taken into account in selecting the pin insulator.

(4) Conductor Arrangement and Support Structure

Although the conductor arrangement could be horizontal, vertical or triangle, etc., the vertical arrangement for double circuit lines and triangle arrangement for single circuit line were adopted by taking into consideration the coordination with existing facilities. The drawing of standard support structures is presented in Figure 5.4-5 and -6.

(5) Support Structure

The concrete pole, steel pipe pole, wood pole, etc. are conceivable as the support structure of 33 kV transmission lines. Although the concrete pole has high mechanical strength, superior durability and high reliability, special trailers and erection machines are required as the pole weight is heavy. The steel pole can be handled easily as

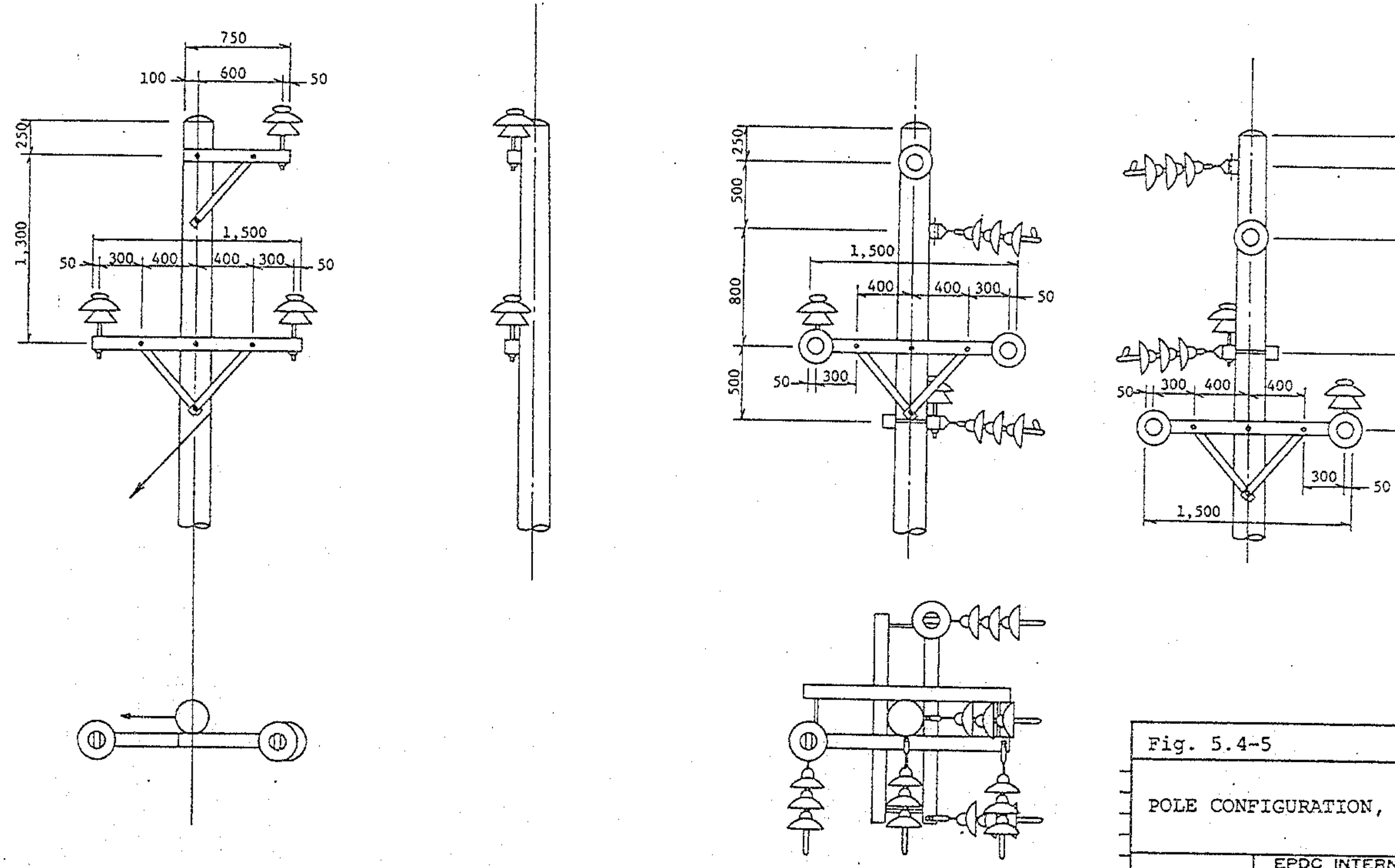


Fig. 5.4-5

POLE CONFIGURATION, 33KV LINE

EPDC INTERNATIONAL LTD
TOKYO JAPAN

D.R.; SUBMITTED;
T.R.; RECOMMENDED;
C.K.; APPROVED;

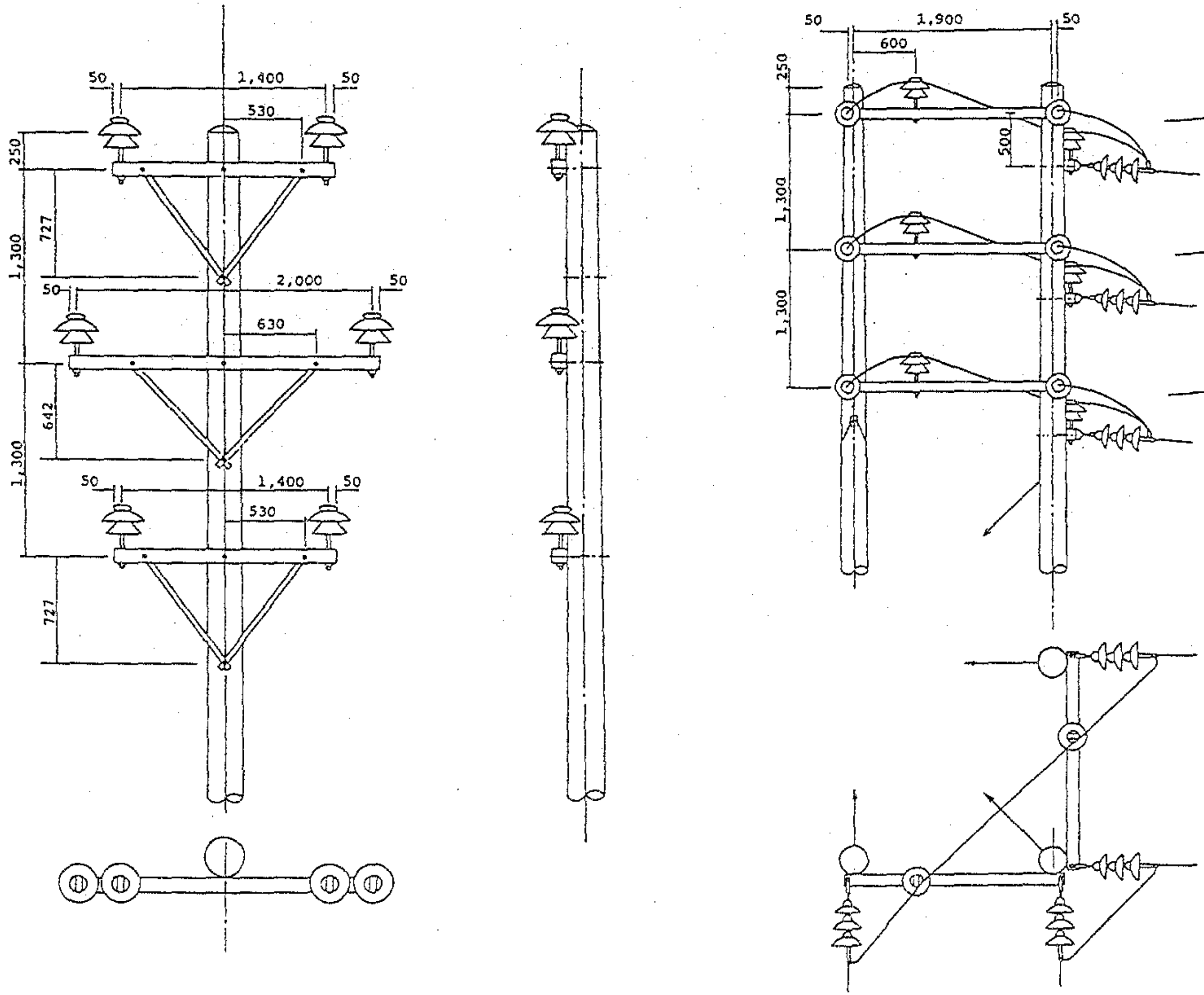


Fig. 5.4-6

POLE CONFIGURATION, 33KV LINE
DOUBLE CIRCUIT

EPDC INTERNATIONAL LTD
TOKYO JAPAN

D.R.; SUBMITTED;
T.R.; RECOMMENDED;
C.K.; APPROVED;

it is assemble piece by piece, and its view is good, but the cost is the highest among the three types referred to above. Although the wood pole is inferior in terms of strength and life, it is least expensive. As most transmission lines of TANESCO employ wood poles, and it has abundant experience on this type of support structure, wood pole will be used for this Project, too. However, steel pipe poles will be employed on the overhead line sections of Msasani Line and City Center - Sokoine Line, because these sections pass through residential areas or urban center areas, and visual harmony with environment is required.

(6) Underground Lines

The route of City Center - Sokoine Line which is planned to be newly constructed passes the urban center and government office district, where buildings are so densely located that acquisition of land for construction of an overhead transmission line or securing safety clearance between line and existing structures is impossible. To be specific, the 400 meter section from the sending end at City Center Substation and the 600 meter section from the receiving end at Sokoine Substation are subjected to such conditions. As it is extremely difficult to find alternative routes, these two sections will be constructed as underground transmission lines. The cable laying method will be the direct burial method which is the same with existing underground lines. The cables will have current carrying capacities by which future increase of substation capacity can be dealt with, that is, the 33 kV, armored CV cables of 300 sq.mm (33 kV CVMAZV 300 sq.mm) will be used.

(7) Specification of Main Equipment

The outline of specification of major materials/equipments to be used in the 33 kV transmission line construction work under this Project is presented below.

a. Conductors

Standard	BS 125: Part 2	
Type & size	ACSR 150	ACSR 100
Stranding	Al30/2.65, St7/2.59	Al6/4.72, St7/1.57
Culculated sectional area	194.9 sq.mm	118.5 sq.mm
Diameter	18.13 mm	14.15 mm
Weight per km	725.6 kg/km	394.3 kg/km
Culculated braking load	7,060 kg	3,330 kg
D.C. resistance at 20°C	0.1828 ohm/km	0.2733 ohm/km

b. Pin Insulator

Standard	BS 137: Part 1
Nominal voltage	33 kV
Flashover voltage	
. Power frequency, wet	95 kV
. 50% impulse, positive	215 kV

c. Suspension Insulator

Standard	JIS C 3812
Dimension	254 mm x 146 mm
Flashover voltage	
. Power frequency, wet	45 kV
. 50% impulse, positive	125 kV
Failing load	4,000 kg

d. Lightning Arrester

Standard	JEC 203
Nominal voltage	42 kV
Power frequency flashover voltage	63 kV
Impulse flashover voltage	135 kV
Nominal discharge current	5 kA
Residual voltage	145 kV

e. 33 kV Power Cable

Standard	IEC 502
Type	XLPE insulated
Sectional area	300 sq.mm
Max. conductor resistance at 20°C	0.00601 ohm/km
Min. insulation resistance at 20°C	2,000 Mohm-km

5.4.3 11 kV Distribution Lines

(1) Conductor

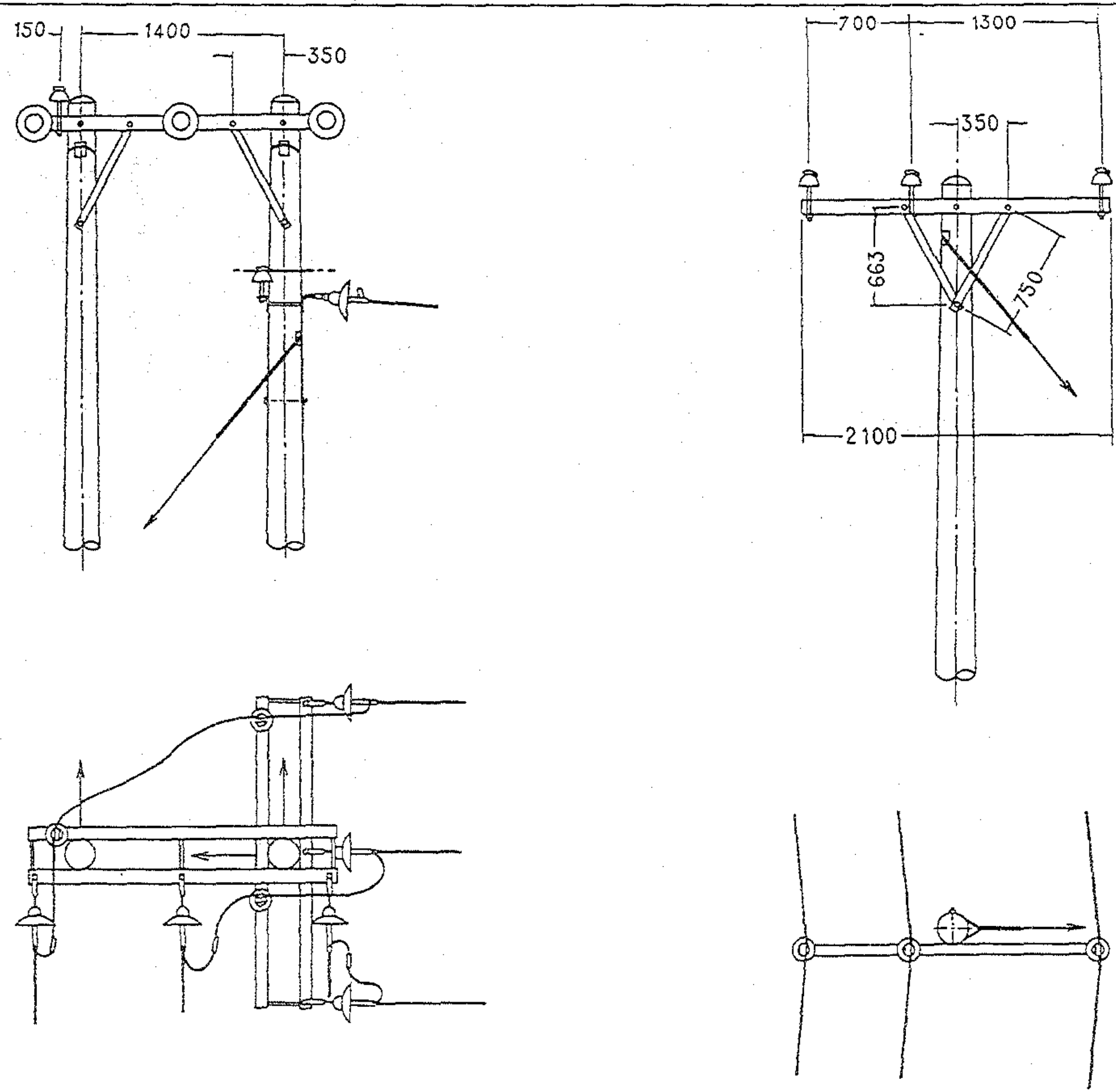
The aluminum cable steel reinforced 100 sq.mm (ACSR 100 sq.mm), with which TANESCO is attempting standardization of the 11 kV distribution line conductors, will be used.

(2) Conductor Arrangement and Support Structure

The conductor arrangement of existing overhead distribution lines is wishbone type or horizontal arrangement. Recently, the horizontal arrangement is mainly adopted because the construction work is easy and the shape of arm is simple. The horizontal type is the best conductor arrangement in an area where the right of way can be easily secured, because the connection of lead wires for pole transformers is easy, and the support structure height is lower than other conductor arrangements, and this is used most widely in distribution lines. In this Project, too, the horizontal arrangement has been adopted in order to coordinate with the existing distribution lines. The standard conductor arrangement is shown in Figure 5.4-7.

(3) Support Structure

The wool poles are used in principle, similarly to 33 kV transmission lines, by considering the economy and coordination with existing facilities, but steel pipe poles will be used for major overhead line feeders in sections at proximity of new substations.



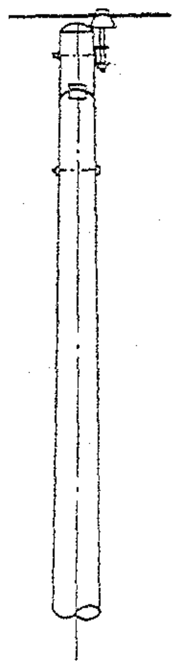


Fig. 5.4-7

POLE CONFIGURATION, 11KV LINE

	EPDC INTERNATIONAL LTD TOKYO JAPAN	
D.R.:	SUBMITTED:	
T.R.:	RECOMMENDED:	
C.K.:	APPROVED:	
	— — —	

c. Suspension Insulator

Standard	JIS C 3812
Dimension	254 mm x 146 mm
Flashover voltage	
. Power frequency, wet	45 kV
. 50% impulse, positive	125 kV
Failing load	4,000 kg

d. Lightning Arrester

Standard	JEC 203
Nominal Voltage	14 kV
Power frequency flashover voltage	21 kV
Impulse flashover voltage	50 kV
Nominal discharge current	5 kA
Residual voltage	50 kV

e. 11 kV Armored Power Cable

Standard	IEC 502
Type	XLPE insulated
Sectional area	185 sq.mm
Max. conductor resistance at 20°C	0.0991 ohm/km
Min. insulation resistance at 20°C	1,500 Mohm-km

5.5 CONSTRUCTION PLAN

5.5.1 Construction Management Policy

The entity which implements this Project is the Tanzania Electric Supply Company (TANESCO). The Project Office, which directly reports to the Head Office aught to be established inside the Coastal Zonal Office, and supervised by a single manager. For construction work of transmission and distribution lines which is going to be executed directly by TANESCO, construction teams composed of members selected from each Service Office aught to be organized in the Project Office to execute actual works. Judging from the size of this Project and the performance capability of

TANESCO, four of such teams will be required. Also, personnel responsible for accounting and material procurement must be assigned in the Project Office. This executing organization for this Project is shown in Figure 5.5-1.

The scopes of works to be carried out by the Japanese side and Tanzanian side in this Project will be as presented below.

a. Substations

Tanzanian Side:	Land acquisition, land preparation, water supply and drainage, foundation work, grounding mesh work.
Japanese Side :	Design, foundation drawing and grounding mesh design drawing, delivery of equipment and materials, equipment assembly, installation, wiring, adjustment, test, construction management.

b. Transmission and Distribution Lines

Tanzanian Side:	Execution of works.
Japanese Side :	Design, delivery of equipment and materials, construction planning, design guidance, construction guidance.

5.5.2 Circumstances of Construction Work and Matters of Attention

This Project is improvement and refurbishment of electric facilities located in urban center, and most of works are performed on power supply facilities which are currently in operation. Also, as the places where construction works are executed are government office district and congested residential area, it is fairly difficult to disrupt power supply for the sake of construction work. Therefore, the danger of electric shock accident may be anxious, and sufficient attention should be paid on assurance of safety of the workers as well as general public.

5.5.3 Construction Management Plan

Besides the above, the Consultant dispatch suitable engineer(s) in short period to make necessary discussions for the smooth implementation of the work at some suitable timing i.e. for pre-construction meeting and completion tests.

5.5.4 Implementation Schedule

If this project will be implemented under Japanese grant aid program, procurement of materials and equipment and construction work will be executed through three steps after signing of the Exchange of Notes between both Government. Those steps are 1) production of construction design, 2) bidding for selection of contractors and 3) construction works.
Project implementing schedule is shown on Figure 5.5-2.

5.5.5 Approximate Construction Cost

The approximate construction costs to be borne by the Government of Tanzania in implementing this project will be 56 million Tanzania shillings.

Fig. 5.5-1 PROJECT ORGANIZATION

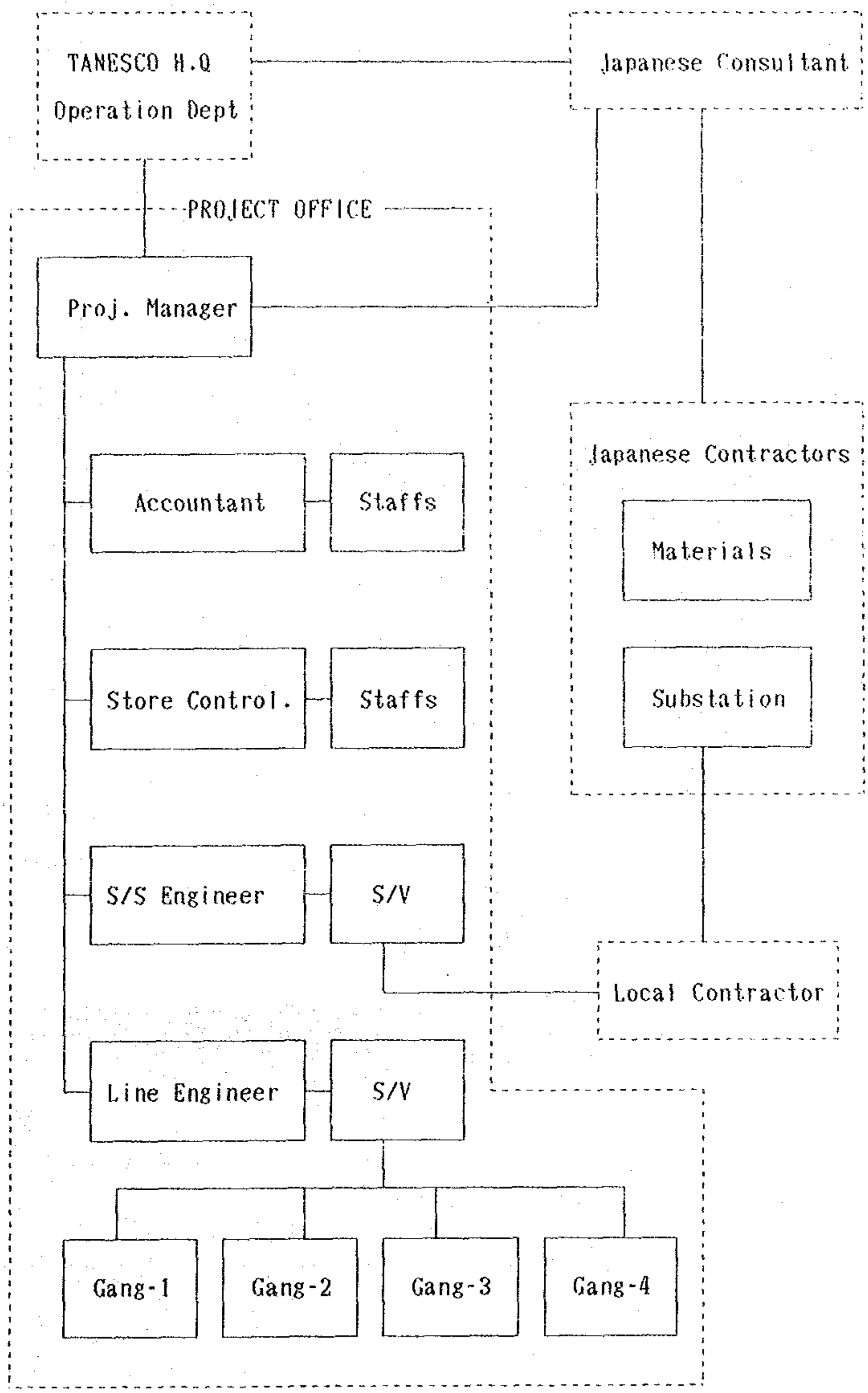
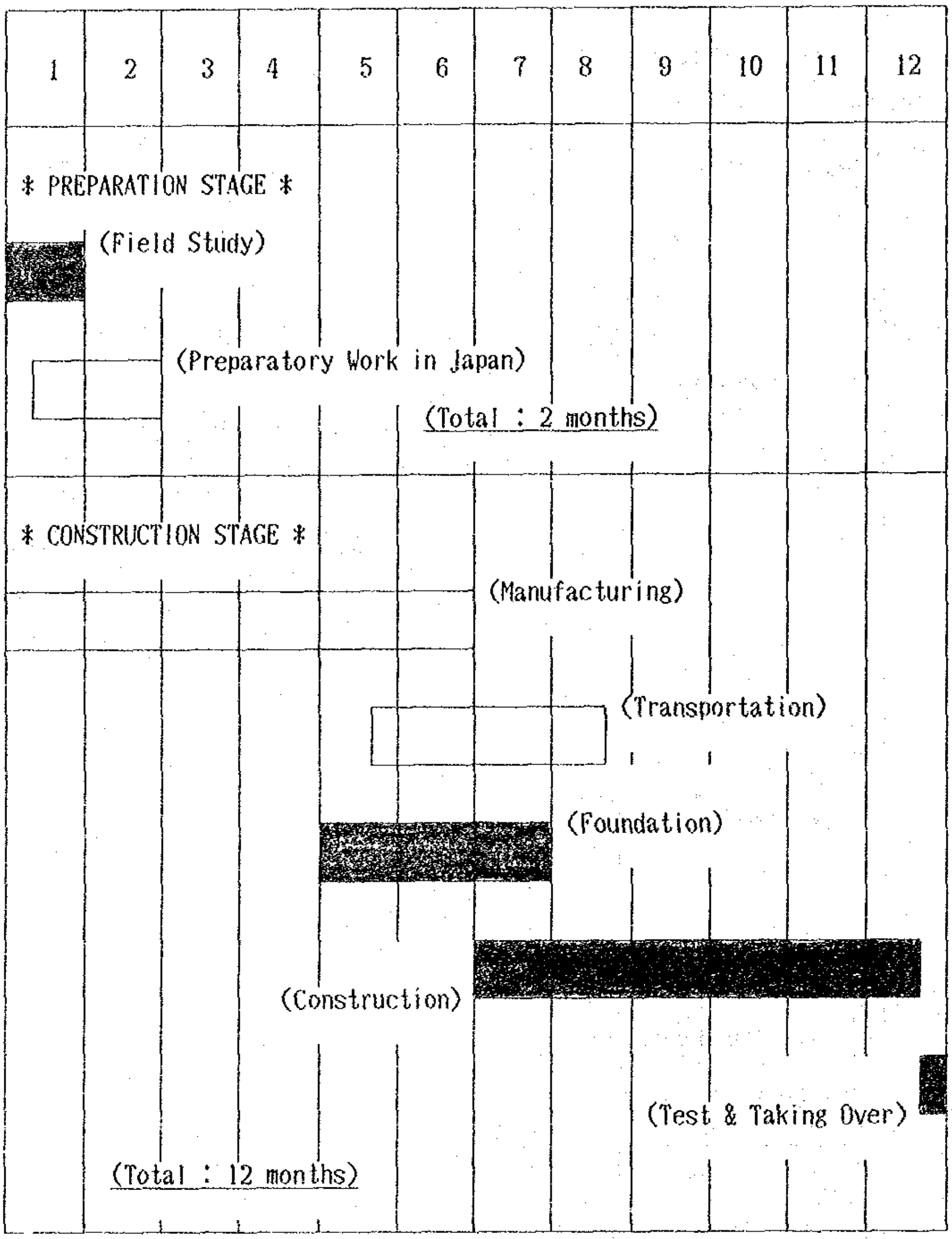


Fig. 5.5-2 IMPLEMENTING SCHEDULE



CHAPTER 6

EFFECT OF PROJECT AND CONCLUSION

CHAPTER 6 EFFECT OF PROJECT AND CONCLUSION

6.1 EFFECT OF PROJECT

(1) Those Directly Benefited by Project

As this Project is general improvement of electric supply facility, it benefits not only those who live in the supply areas covered by the Project, but indirect benefit is provided to those other than customers such as commuters and those who visit the City. In this Section, however, we will discuss only the direct customers who will receive electric power of better quality owing to this Project.

As of 1990, the types and numbers of customers in the area affected by this Project are as presented below.

City Center Area

Billing Section : 00, 07, 09

Name : City Center, Upanga, Ocean Road

Type of Customers: Government offices, banks, hotels and business offices are concentrated in this area. Also, there are many shops who are small consumers.

Type of Load : The proportion of air conditioning load is large, and peak demand occurs at daytime.

Number of Customers in Each Tariff Class		Number	Percentage to Total
T1	General Residence	8261	73.5
T2	Commerce	2833	25.2
T3	Light Industry	73	0.7
T4	Large Load (Low Voltage)	1	0.01
T6	Street Lighting	53	0.5
T7	Large, High Voltage Load	18	0.2
	Total	11239	

Northeastern Area of City

Billing Section : 16, 17

Name : Msasani, Kinondoni

Type of Customers: Customers are mostly general residences, but load is heavy in certain areas where large houses such as foreign missions are located. There are also shops, schools and hospitals.

Type of Load : The demand peak appears at the cooking time in the evening.

Number of Customers in Each Tariff Class		Number	Percentage to total
T1	General Residence	12555	88.1
T2	Commerce	1457	10.2
T3	Light Industry	166	1.2
T4	Large Load (Low Voltage)	2	0.01
T6	Street Lighting	59	0.4
T7	Large, High Voltage Load	9	0.1
Total		14248	

The above two districts are the areas of the City where the most active economic activities are observed. The Government offices, business offices, hotels, shops, schools and hospitals are concentrated in this area, and they are intermingled with private residences.

Since Dar es Salaam is not only the capital city of this country, but its harbor plays an important role in recent years as the gateway to abroad for inland nations such as Zambia and Malawi. Under this situation, the economic activity of the City became more active every year, and this is the reason why the power demand in the center of the City grew rapidly.

Under such circumstances, stabilizing the power distribution in this district is not only important from the point of view of national economy, but for the welfare of the general residential customers who accounts for 80% of the total customers, and therefore, the benefit of this Project is quite big.

(2) Improvement Effect Expected by Completion of the Project

1) Margin of Substation Capacity

The substation capacity, which is currently utilized to the limit, is increased by 50%, and substations can be operated with capacity margin for the coming 8 years.

2) Elimination of Voltage Drop

The voltage drop at end users today exceeds 15% at peak hours, but this situation is drastically improved by construction of substations at the load center. (The voltage drop will be generally no more than 5%.)

3) Elimination of Heavily Loaded Distribution Lines

As the substations which function as power supply source are located at load centers, the number of customers connected to a single distribution circuit is decreased, and overloading of line is eliminated.

4) Reduction of Power Loss

It is estimated that the ratio of power loss to the total power supplied to the demands in Msasani Peninsula currently amounts to 16%. The power loss in this area will be reduced to 7%.
(Refer to Chapter 4 Figure 4.2-11(1), (2), (3))

5) Elimination of Scheduled Supply Disruption

Due to the shortage in transformer capacity, some distribution lines are shut down intentionally to suppress the load during the peak period in December, January and February when air temperature is high, for the purpose of avoiding overheating of transformers. Such scheduled supply disruption will no longer be required.

6.2 APPROPRIATENESS OF THE PROJECT

(1) Technical Aspect

Existing transformers of the substations which supply electricity to the objective areas have already been suffering from heavy loading severely. It is necessary to increase the substation capacity as soon as possible.

As the counter measure, two new substations are planned to install at the load centers of the areas in this Project. We can judge this program quite suitable from the following aspects: on loss reduction side, reliability of power supply, easiness of load interchange between substations and economical aspect.

(2) Benefit

Number of residential customers accounts for more than 80% out of the total, while as big consumers, there are many governmental offices and public facilities i.e. offices of Ministry, hotels, hospitals and schools in this area.

From these points, this Project which is expected to make electricity supply stable will benefit the livelihood of people living in the city and also play an important role in enhancement of economic and social activity of the country.

Accordingly, this Project is in line with the objective of official grant aid.

(3) Maintenance and Control Side

After completion of the facilities, TANESCO will maintain and control these facilities correctly. It is of no problem on maintenance and operation of the facilities on both man-power's and financial aspects.

6.3 CONCLUSION

Considering the fact that substantial benefits is expected from this Project, and that the Project contributes to the development of the United Republic of Tanzania as well as enhancement of livelihood of citizens in general.

The Tanzanian parties have no problem in supplying manpower and fund for operation and maintenance of this Project after its completion.

For the reason above mentioned, it is judged that this project is significant to implement under a Japanese Governmental Grant Aid.

APPENDIX

APPENDIX:

1) MEMBER LIST OF THE BASIC DESIGN STUDY TEAM, JICA

2) ITINERARY

3) KEY PERSONNEL WHOM THE STUDY TEAM MET

4) MINUTES OF DISCUSSIONS (BASIC DESIGN STUDY)

5) MINUTES OF DISCUSSIONS (DISCUSSION OF DRAFT REPORT)

6) LIST OF COLLECTED DATA & INFORMATION

APPENDIX - 1

MEMBER LIST OF BASIC DESIGN STUDY TEAM, JICA

(1) Basic Design Study

NAME	ASSIGNMENT	ORIGINAL ORGANIZATION
Masahiro Kumomi	Leader	Resident Representative JICA Tanzania Office
Hajime Nakazawa	Coodinator	JICA Kansai Branch
Masashi Koike	Power System Planning	EPDC International Ltd.
Hisaya Noguchi	Design of Power Facilities	EPDC International Ltd.

(2) Discussion of Draft Report

Noboru Tsutsui	Leader	Vice Representative JICA Tanzania Office
Masashi Koike	Power System Planning	EPDC International Ltd.
Hisaya Noguchi	Design of Power Facilities	EPDC International Ltd.

APPENDIX - 2

ITINERARY

1991

	DATE		CONTENTS
MAR.	20	We	Tokyo ---> Zurich
	21	Th	Zurich --->
	22	Fr	--> Dar es Salaam;
			Visit Tanesco. Explanation on study purpose.
	23	Sa	1st Discussion with Tanesco
			Presentation of Inception Report, Questionnaire.
	24	Su	Inner Meeting
	25	Mo	Site Survey: Ilala, Oyster-Bay, City-Center SS
	26	Tu	" " : Ubungo Control Center
	27	We	" " : New Substation sites, Line routes
	28	Th	Visit Embassy of Japan
			2nd Discussion with Tanesco
			Receiving 1st Reply Documents for Questionnaire
			Presentation of Additional Questionnaire
	29	Fr	Easter Holiday Data arrangement
	30	Sa	" " " "
	31	Su	" " " "
APR.	1	Mo	" " " "
	2	Tu	Site Survey: Load Situation of Existing SS
			Fz 3, Fz 1, Ubungo, Ubungo Diesel, OysterBay SS
	3	We	Site survey: New Substation Sites & Line Route
			Setting of Measuring Instrument
	4	Th	Site Survey: CityCenter, Kurasini, Ilala, Fz 1 SS
	5	Fr	3rd Meeting w. Tanesco
			Power System Configuration, Layout of SS Equip.
			Land Acquisition for SS
	6	Sa	Data Arrangement
			Mr.Nakazawa, Team Member Arrived.
	7	Su	Site Survey: Power Flow Situation of Upper System

in Light Load Time (Midnight)

8 Mo 4th Meeting w. Tanesco:
Explanation of Japan's Grant Aid System
Discussion on Draft of Minutes
Discussion on Vehicles & Tools, Stock Yard
Courtesy Call to Embassy of Japan

9 Tu 5th Meeting w. Tanesco:
Necessity of Installation of Condenser at Ilala
Layout of New SS Equip. and Land
Request for Additional Data

10 We 6th Meeting w. Tanesco:
Discussion on Replacement of 11kv Switch Gears
Preparation of Final Minutes

11 Th Receiving Additional Request Letter on 11kv Switch Gears
Contact JICA(Tokyo) on Additional Request
Site Survey: 11kv Switch Gears & Related Cables at all Existing SS
Arrangement of Discussion Items Confirmed in Former Meetings

12 Fr Final Meeting w. Tanesco:
Signing of Minutes
Reporting to Embassy of Japan
Cocktail Party by JICA

13 Sa Courtesy Call for Ministry of Finance, and Ministry of Water, Energy and Minerals

14 Su Data Arrangement

15 Mo Greeting to Tanesco
Dismantling of Measuring Equipment
Preparation for Leaving

16 Tu Dar es Salaam ---> Zurich

17 We Zurich --->

18 Th --> Tokyo

APPENDIX - 3

KEY PERSONNEL WHOM THE STUDY TEAM MET

ORGANIZATION	NAME	POST
Embassy of Japan	S.Nagai	Ambassador
" "	O.Imai	Councillor
" "	K.Saitoh	Secretary
JICA (Tanzania Office)	M.Kumomi	Representative
" "	N.Tutui	Vice Representative
" "	Y.Katuta	" "
" "	H.Motomura	
Ministry of Finance (Treasury)	Muneni	Ag.Commissioner for External Finance
" "	L.Lungu	Senior Finance Management Officer
Ministry of Water, Energy and Minerals	M.Mwandosya	Principal Secretary
" "	P.Victus	Ag. Commissioner for Energy and Petroleum
Tanzania Electric Supply Co.Ltd (TANESCO)	S.L.Mosha	Managing Director
" "	S.L.Mhaville	Deputy Managing Director
" "	S.T.Kimaryo	" " "
" "	K.K.Iranga	Director, System Control and Transmission
" "	Luhanga	Director, Corporate Service
" "	Mwenisongole	Director, Finance

"	"	D.S.Magambo	Zonal Director, Coastal
"	"	M.M.Fazal	Manager, Light and Heavy Current Workshop
"	"	Mbwatila	Head of ESMAP Team
"	"	Safisha	Project Superintendent
"	"	M.A.I.Mkasa	Senior Transport Officer
"	"	C.J.Masasi	Distribution Engineer
"	"	M.S.Masanja	Company Secretary
"	"	M.A.Salehe	Manager System Control
"	"	D.Mshana	Principal Public Relations

APPENDIX -4

MINUTES OF DISCUSSIONS
THE BASIC DESIGN STUDY ON THE PROJECT FOR THE REINFORCEMENT OF POWER DISTRIBUTION NETWORK IN DAR ES SALAAM - PHASE III

In response to the request of the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a Basic Design study on the Project for the Reinforcement of Power Distribution Network in Dar es Salaam - Phase III (hereinafter referred to as "the Project"), and the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent the study team, headed by Mr. Masahiro Kumomi, Resident Representative, JICA Tanzania Office to the United Republic of Tanzania, from March 20th to April 18th, 1991.

The team had a series of discussions with the authorities concerned of the Government of the United Republic of Tanzania and conducted a field survey in the Project sites.

As the result of the discussions and field survey, both parties confirmed the main items described on the attached sheets. The team will proceed the works and prepare the Basic Design Study Report on the Project based on the items.

Dar es Salaam, April 12th, 1991

Mr. M. Kumomi
Leader
Basic Design Study Team

Mr. S. L. Mosha
Managing Director
Tanzania Electric
Supply Co., Ltd.

Endorsed by

M. T. Kibwana
Commissioner for External Finance
Ministry of Finance
Economic Affairs and Planning

ATTACHMENT

1. Objective

The objective of the Project is to improve the reliability of electric power supply in Dar es Salaam through the construction of new substations as well as the provision of equipment for those substations such as transmission and distribution lines.

2. Project Sites

The Project sites are located at the substations such as Ilala, City Center, Oysterbay, Factory Zone I and their supply zone in the city central area of Dar es Salaam including Msasani Peninsula which appear in Annex-1.

3. Executing Agency

Tanzania Electric Supply Company Limited (TANESCO) is responsible for the administration and execution of the Project.

4. Necessary Items for the Implementation of the Project requested by the Government of the United Republic of Tanzania

After discussions between the Basic Design Team and TANESCO, the following items were judged necessary for the realization of the Project.

(1) Construction of new substations
   a) Sokoine substation : 33/11kV, 15MVA
   b) Msasani substation : 33/11kV, 15MVA
(2) Provision of materials for 33kV and 11kV transmission and distribution lines in relation to the new substations
   a) Sokoine substation line : 33kV, 2km
   b) Msasani substation line : 33kV, 6km
   c) Distribution lines : 11kV, 20km
   d) Branch lines and others
(3) Provision of new transformers : 33/11kV, 15MVA
(4) Provision of new 11kV switch gears and related cables for existing substations shown in Item 2 above.
(5) Provision of vehicles, instruments and tools necessary for construction works

However, the final components of the Project may differ from the above items, if it is judged necessary after further studies in Japan.

5. Grant Aid Program extended by the Government of Japan

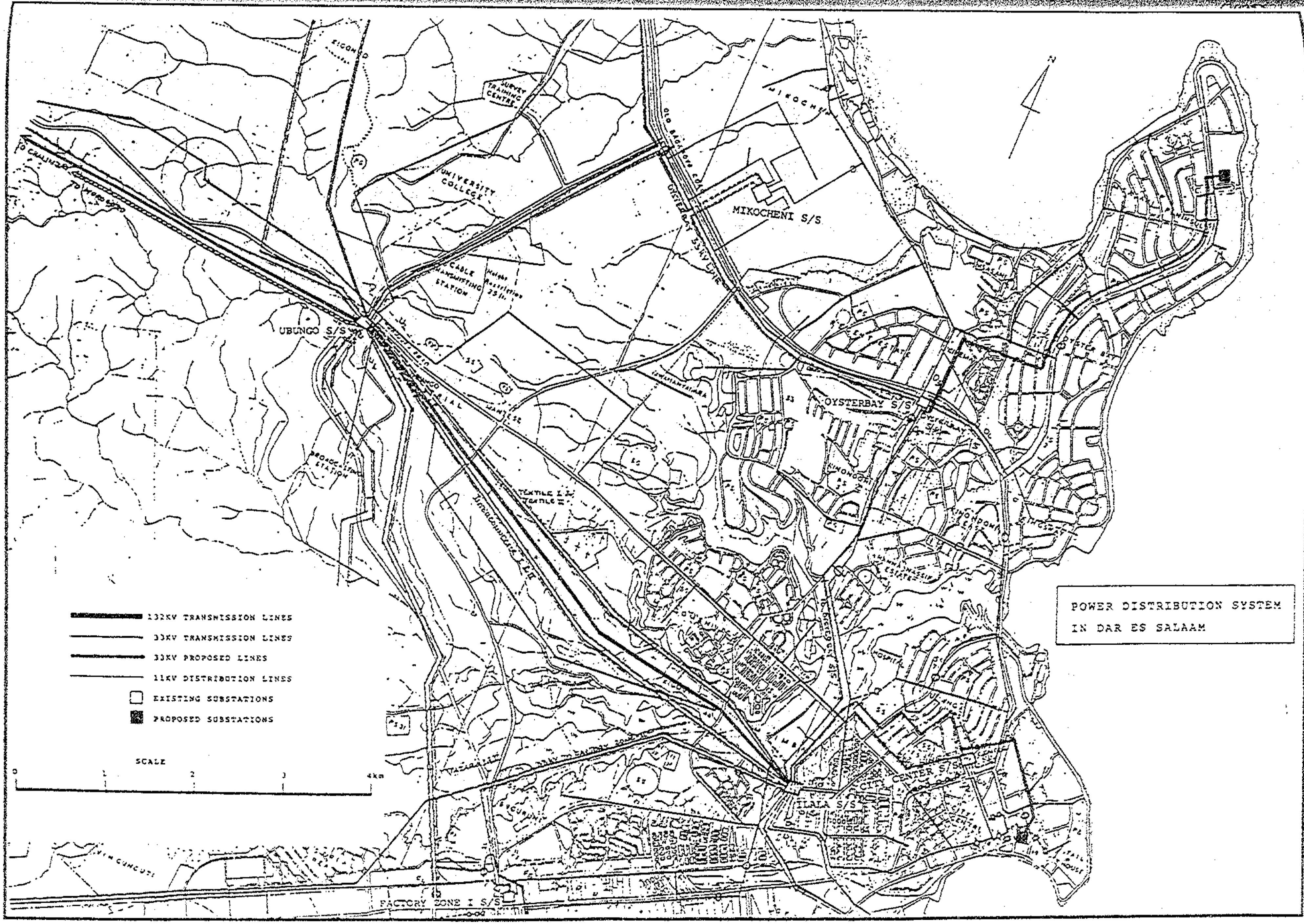
(1) The Government of the United Republic of Tanzania has understood the system of Japanese Grant Aid explained by the Team.

(2) The Government of the United Republic of Tanzania will take necessary measures, described in Annex-2, for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of Study

(1) JICA will prepare the draft report in English and dispatch a mission in order to explain the contents of the report around July, 1991.

(2) In case that the contents of the report is accepted in principle by Tanzania Electric Supply Company Limited, JICA will complete Final Report and send it to the Government of the United Republic of Tanzania by September, 1991.


POWER DISTRIBUTION SYSTEM
IN DAR ES SALAAM
132KV TRANSMISSION LINES
33KV TRANSMISSION LINES
33KV PROPOSED LINES
11KV DISTRIBUTION LINES
EXISTING SUBSTATIONS
PROPOSED SUBSTATIONS
SCALE
0
1
2
3
4km
N
MIKOCHENI S/S
OYSTERBAY S/S
UBUNGO S/S
CITY CENTER S/S
ILALA S/S
FACTORY ZONE I S/S
UNIVERSITY COLLEGE
CABLE TRANSMITTING STATION
SURVEY TRAINING CENTRE
OYSTERBAY 33KV LINE

Annex-2 UNDERTAKINGS BY THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA

1. To provide cleared, embanked and leveled land for the Project.

2. To provide all the foundations of substation equipment.

3. To provide the land for temporary site office, warehouse and stockyard during the implementation period for the Japanese contractor(s).

4. To ensure speedy unloading, tax exemption, customs clearance of the goods for the Project at the port and/or airport of disembarkation.

5. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the United Republic of Tanzania and stay therein for the performance of their work.

6. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the United Republic of Tanzania with respect to the supply of the products and services under the verified contracts.

7. To bear commissions to a Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

8. To bear all expenses, other than those to be borne by the Grant Aid necessary for the execution of the Project.

9. To provide proper arrangements for the construction, such as water supply, electricity, drainage, etc., if necessary.

10. To assign full time counterpart engineers/technicians to the Project who will receive the technical transfer regarding the operation and maintenance technique for the Project.

11. To take necessary measures and responsibility for the switching arrangements and safety procedures at the working sites during a construction period when it is necessary.

APPENDIX - 5

MINUTES OF DISCUSSIONS
THE BASIC DESIGN STUDY ON THE PROJECT FOR THE REINFORCEMENT OF POWER DISTRIBUTION NETWORK IN DAR ES SALAAM-PHASE III
(CONSULTATION ON DRAFT REPORT)

In April 1991, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study team on the Project for the Reinforcement of Power Distribution Network in Dar es Salaam (hereinafter referred to as "the Project") to the United Republic of Tanzania, and has prepared the draft report of the basic design study through examining the results of the study in Japan.

In order to explain the components of the draft report to the Government of Tanzania as well as to consult with Tanzanian side on the contents of the report, JICA sent to Tanzania a study team, which is headed by Mr. Noboru Tsutsui, Deputy Resident Representative, JICA Tanzania Office.

The team commenced its study in Tanzania from July 24, and will terminate it on July 31, 1991.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Dar es Salaam, July 30, 1991

Mr. Noboru Tsutsui
Leader
Draft Report Explanation Team
JICA

Mr. S.L. Mhaville
Managing Director
Tanzania Electric Supply Co.,Ltd.

Endorsed by

Mr.M. T. Kibwana
Commissioner for External Finance
Ministry of Finance
Economic Affairs and Planning

ATTACHMENT

1. Components of Draft Report

The Government of Tanzania has agreed and accepted in principle the components of the draft report prepared by the team.

2. Japan's Grant Aid System

(1) The Government of Tanzania has understood the system of Japan's Grant Aid including further schedule of the study explained by the team.

(2) The Government of Tanzania will take the necessary measures, described in Annex, for smooth implementation of the Project on condition that the grant aid by the Government of Japan is extended to the Project.

3. Further Schedule of the Study

The team will make the final report in accordance with the confirmed items, and send it to the Government ot Tanzania by the middle of September, 1991.

4. Operation and Maintenance for the Facilities

The Government of Tanzania stressed that it will allocate necessary budget for the works including operation and maintenance of the facilities to be constructed as well as the equipment to be procured under the Project, on condition that the grant aid by the Government of Japan is extended to the Project.

Annex-2 UNDERTAKINGS BY THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA

1. To provide cleared, embanked and leveled land for the Project.

2. To provide all the foundations of substation equipment.

3. To provide the land for temporary site office, warehouse and stockyard during the implementation period for the Japanese contractor(s).

4. To ensure speedy unloading, tax exemption, customs clearance of the goods for the Project at the port and/or airport of disembarkation.

5. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the United Republic of Tanzania and stay therein for the performance of their work.

6. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the United Republic of Tanzania with respect to the supply of the products and services under the verified contracts.

7. To bear commissions to a Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

8. To bear all expenses, other than those to be borne by the Grant Aid necessary for the execution of the Project.

9 To provide proper arrangements for the construction, such as water supply, electricity, drainage, etc., if necessary.

10. To assign full time counterpart engineers/technicians to the Project who will receive the technical transfer regarding the operation and maintenance technique for the Project.

11. To take necessary measures and responsibility for the switching arrangements and safety procedures at the working sites during a construction period when it is necessary.

APPENDIX - 6 LIST OF COLLECTED DATA AND INFORMATION

(1) Record of faults on distribution lines (90.1 - 90.12)

(2) Exchange rate of US$ to T.shs (91.1 - 91.4)

(3) Organization chart of TANESCO

(4) Changes of electricity charges

(5) Load current on each substation

(6) Line route map of 11kV distribution lines

(7) Network drawing of the city of Dar es Salaam

(8) Network drawing of urban area

(9) Number of consumers

(10) Market prices of materials and services locally available

(11) Labor cost

(12) Peak demand on each substations

(13) Details of transmission lines

(14) Details of main transformers

(15) Details of power generating plant

(16) Outline of reactor and capacitor

(17) Load forecast - '95

(18) Details of transmission and distribution lines in the city

(19) Main causes of voltage fluctuation

(20) Tariff book

(21) Total energy generated and sold

(22) Annual report ('87, '88)

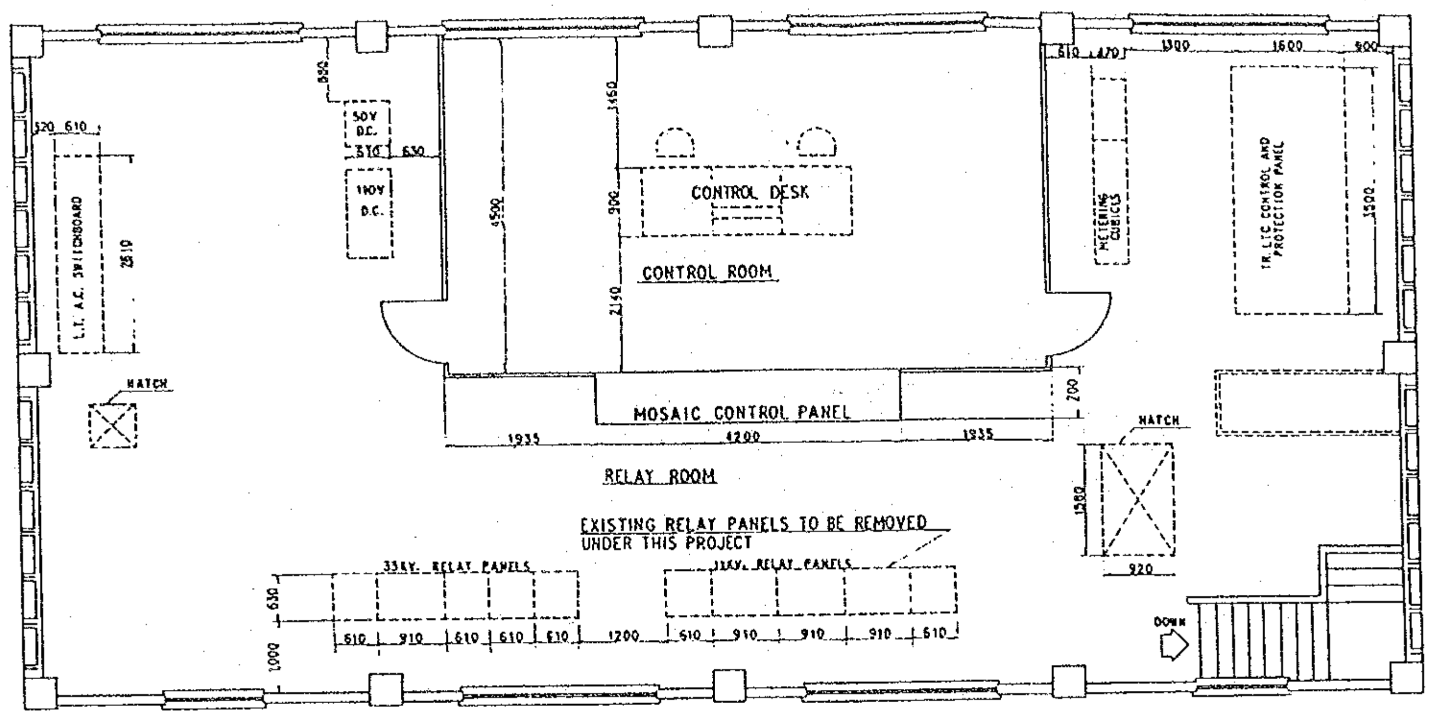
(23) Details of existing substations

(24) ESMAP report

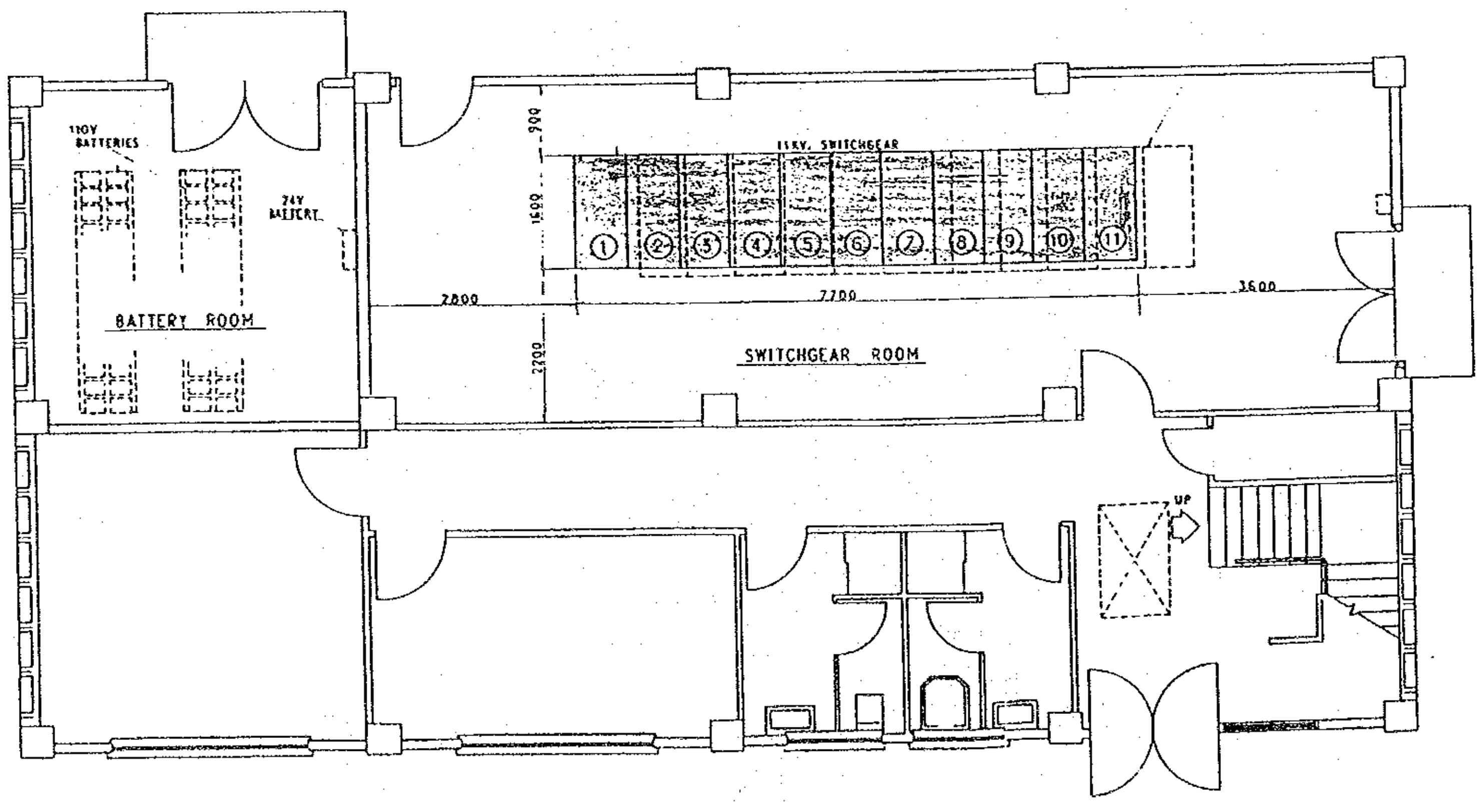
(25) System data

(26) Transfer unit

LAYOUT DRAWINGS FOR SUBSTATIONS



FIRST FLOOR PLAN



GROUND FLOOR PLAN

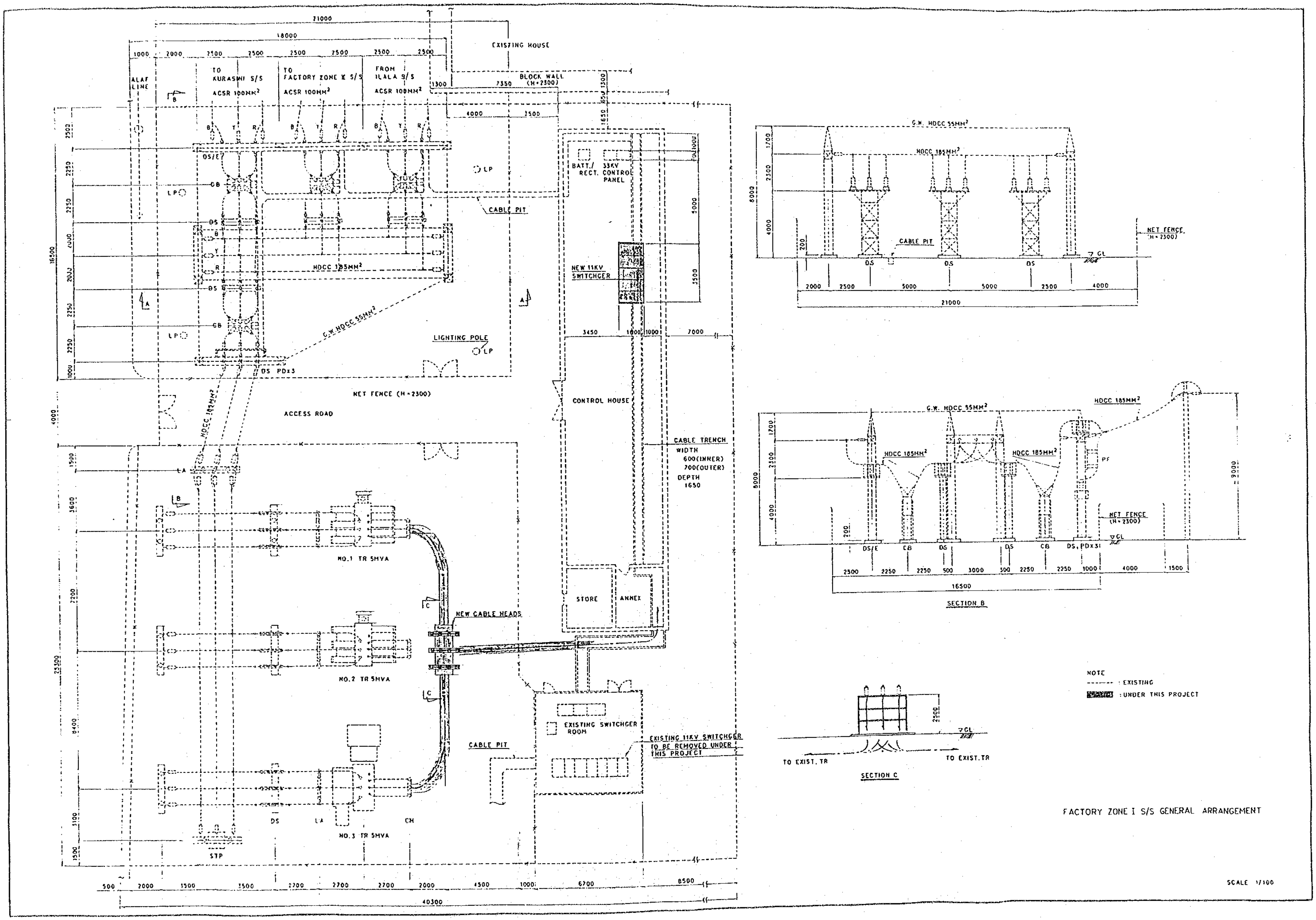
NOTES

▨ SHOWS THE NEW 11KV SWITCHGEAR UNDER THIS CONTRACT.
EXISTING MOSAIC CONTROL PANEL SHALL BE MODIFIED FOR CONTROL OF NEW 11KV SWITCHGEAR

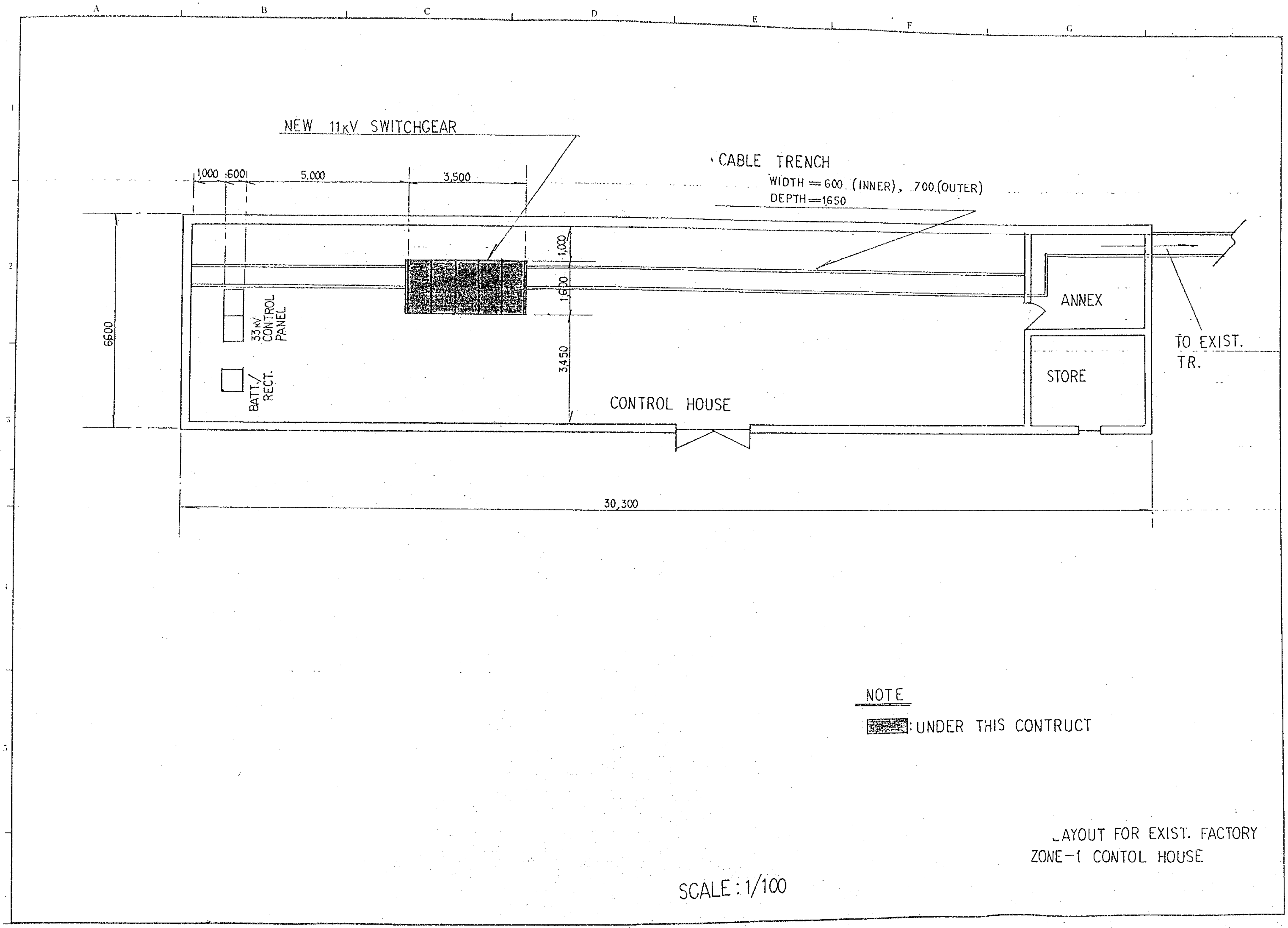
NO	FEEDER NAME OF NEW 11KV SWITCHGEAR
1	BREWERY
2	AZANIA
3	TOWN FEEDER NO.1
4	KURASINI INTERCONNECTOR 1
5	33/11KV TRANSFORMER 1
6	BUS SECTION
7	33/11KV TRANSFORMER 2
8	KURASINI INTERCONNECTOR 2
9	INDUSTRIAL FEEDER
10	TOWN FEEDER NO.2
11	MAGOMENI / UBUNGO FEEDER

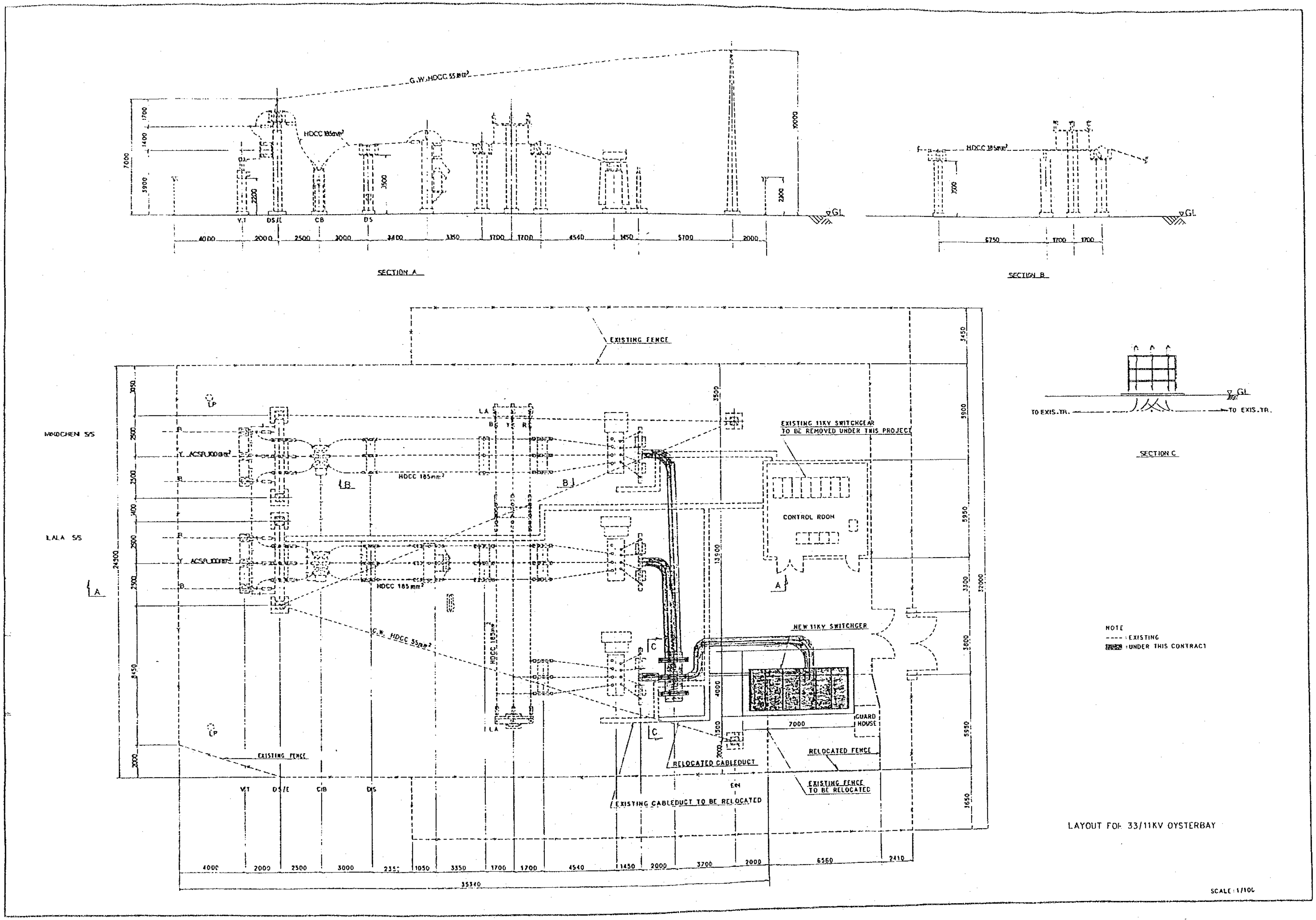
SCALE: 1/50

PANEL ARRANGEMENT IN EXISTING CONTROL ROOM OF ILALA S/S



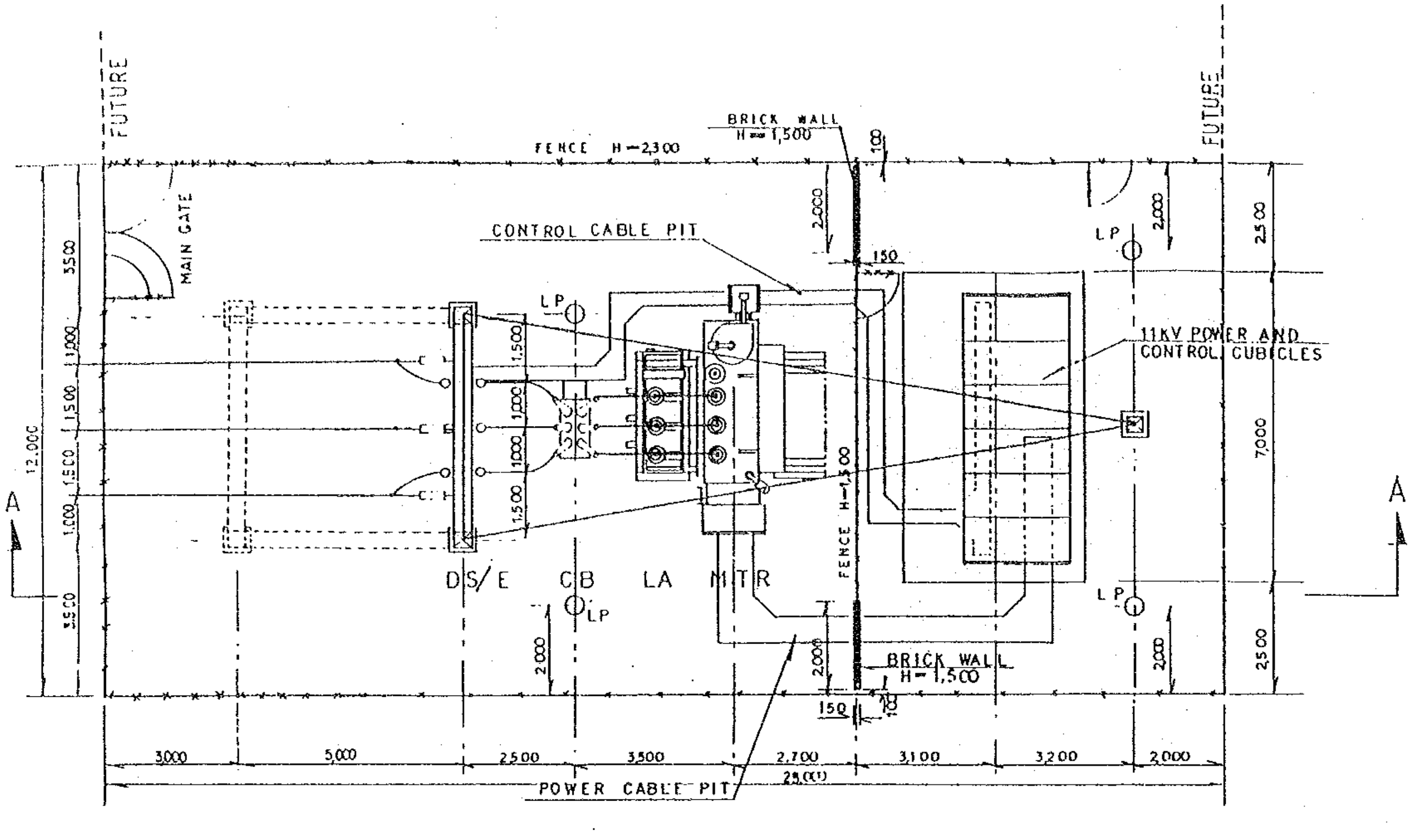
FACTORY ZONE I S/S GENERAL ARRANGEMENT


NEW 11kV SWITCHGEAR
CABLE TRENCH
WIDTH = 600 (INNER), 700 (OUTER)
DEPTH = 1650
1,000
600
5,000
3,500
1,000
1,600
3,450
6600
33kV CONTROL PANEL
BATT./ RECT.
CONTROL HOUSE
ANNEX
STORE
TO EXIST. TR.
30,300
NOTE
: UNDER THIS CONTRUCT
LAYOUT FOR EXIST. FACTORY
ZONE-1 CONTOL HOUSE
SCALE : 1/100

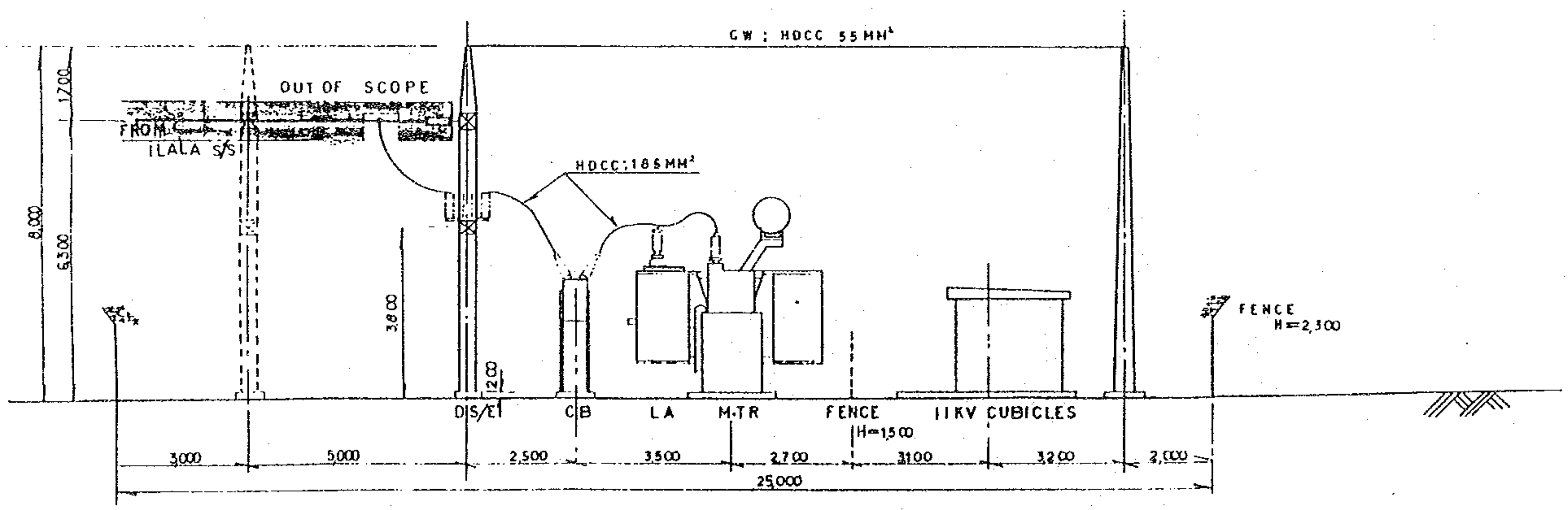


LAYOUT FOR 33/11KV OYSTERBAY

SCALE : 1/100



PLAN



SECTION A—A

LEGENDS:

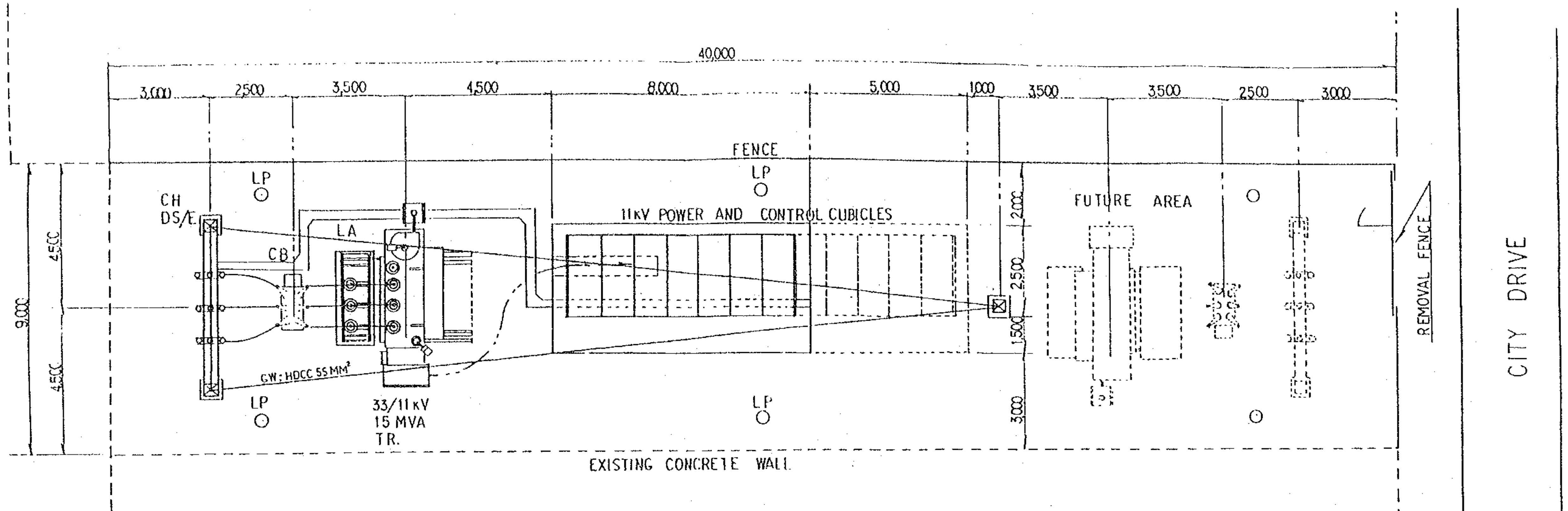
- DS/E : DISCONNECTING SWITCH WITH EARTHING DEVICE
- CB : CIRCUIT BREAKER
- LA : LIGHTNING ARRESTER
- M.TR : MAIN TRANSFORMER
- LP : LIGHTING POLE

NOTE:

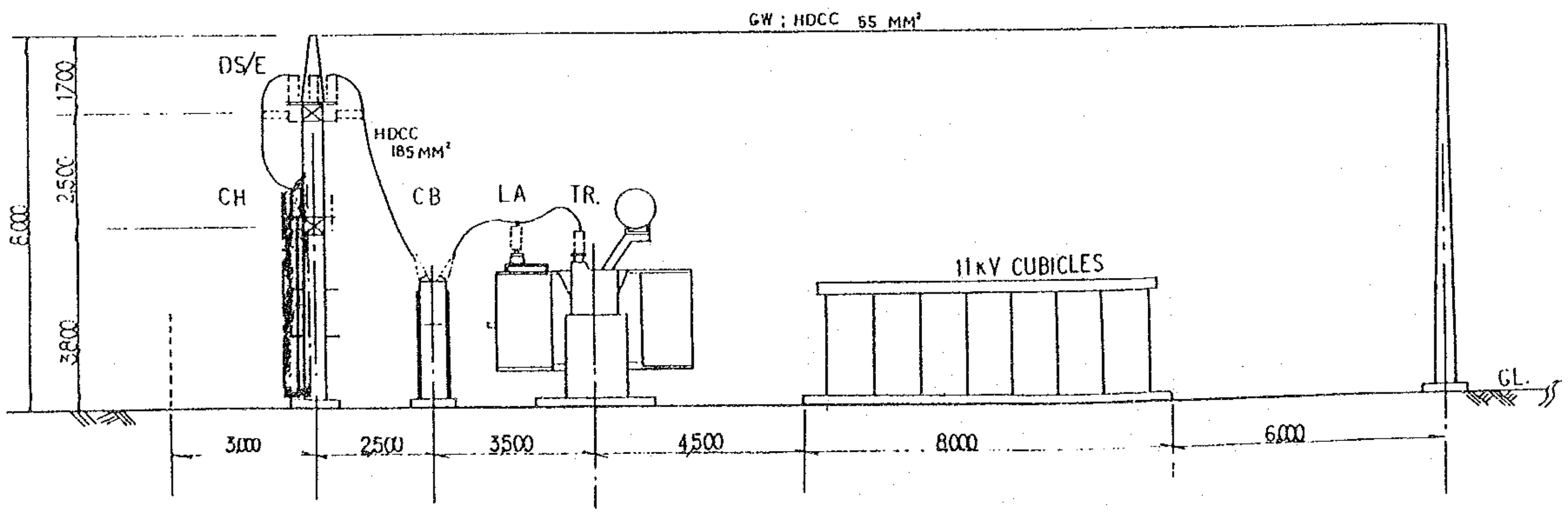
(shaded) SHOWS OUT OF SCOPE UNDER THIS CONTRACT.

LAYOUT FOR
MSASANI 33/11KV S/S

SCALE : 1/100



PLAN



SECTION

LEGEND

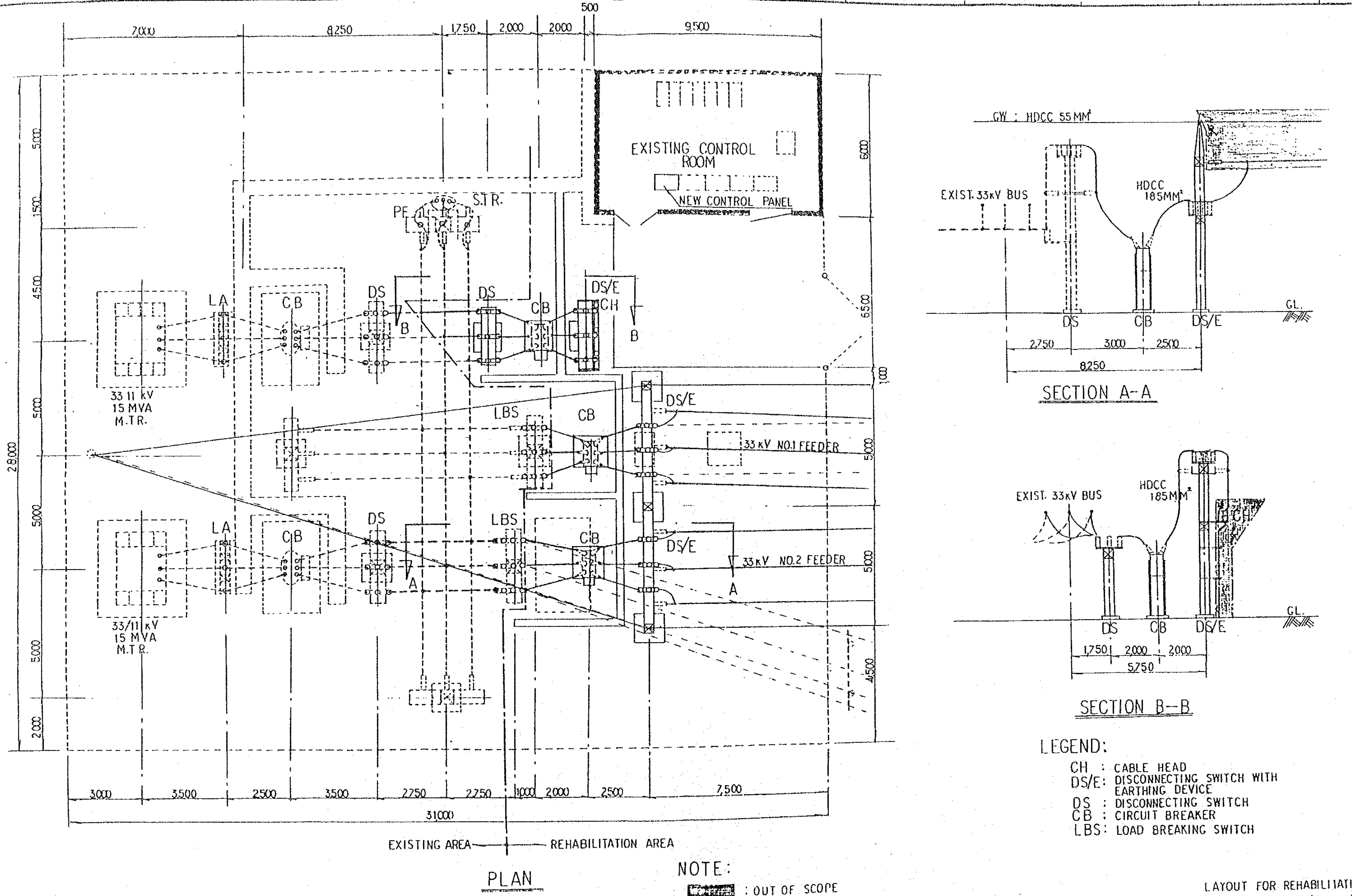
DS/E : DISCONNECTING SWITCH WITH EARTHING DEVICE
CH : CABLE HEAD
CB : CIRCUIT BREAKER
LA : LIGHTNING ARRESTER
TR. : TRANSFORMER
LP : LIGHTING POLE

NOTE

SHOWS OUT OF SCOPE UNDER THIS CONTRUCT.

LAYOUT FOR
SOKOINE ROAD 33/11 kV S/S

SCALE : 1/100



LEGEND:

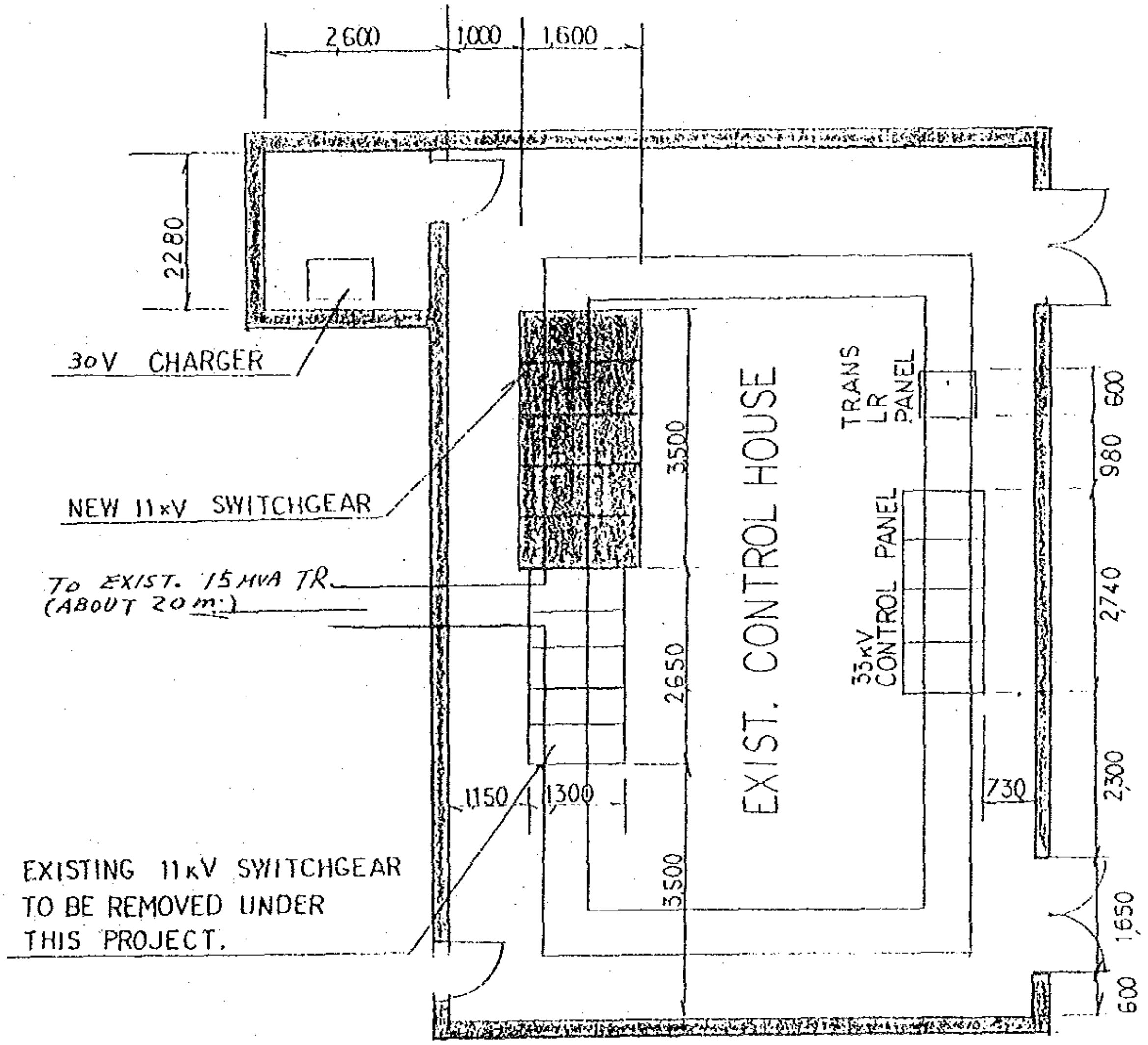
CH : CABLE HEAD
DS/E: DISCONNECTING SWITCH WITH EARTHING DEVICE
DS : DISCONNECTING SWITCH
CB : CIRCUIT BREAKER
LBS: LOAD BREAKING SWITCH

NOTE:

(shaded) : OUT OF SCOPE
– – – – : EXISTING
——— : UNDER THIS PROJECT

SCALE : 1/100

LAYOUT FOR REHABILITATION OF CITY CENTER 33/11kV S/S



NOTE

: UNDER THIS CONTRUCT

SCALE : 1/100

KURSINI S/S COTROL HOUSE

JICA