

JAPAN INTERNATIONAL COOPERATION AGENCY  
THE UNITED REPUBLIC OF TANZANIA  
TANZANIA ELECTRIC SUPPLY CO.,LTD.

**MASTER PLAN STUDY AND PRE-FEASIBILITY STUDY  
ON  
DAR ES SALAAM POWER SUPPLY SYSTEM EXPANSION  
IN  
THE UNITED REPUBLIC OF TANZANIA**

**FINAL REPORT**

**SUMMARY**

**MARCH, 1994**

**ELECTRIC POWER DEVELOPMENT CO.,LTD.  
TOKYO, JAPAN**

|               |
|---------------|
| <b>MPN</b>    |
| <b>JR</b>     |
| <b>94-080</b> |

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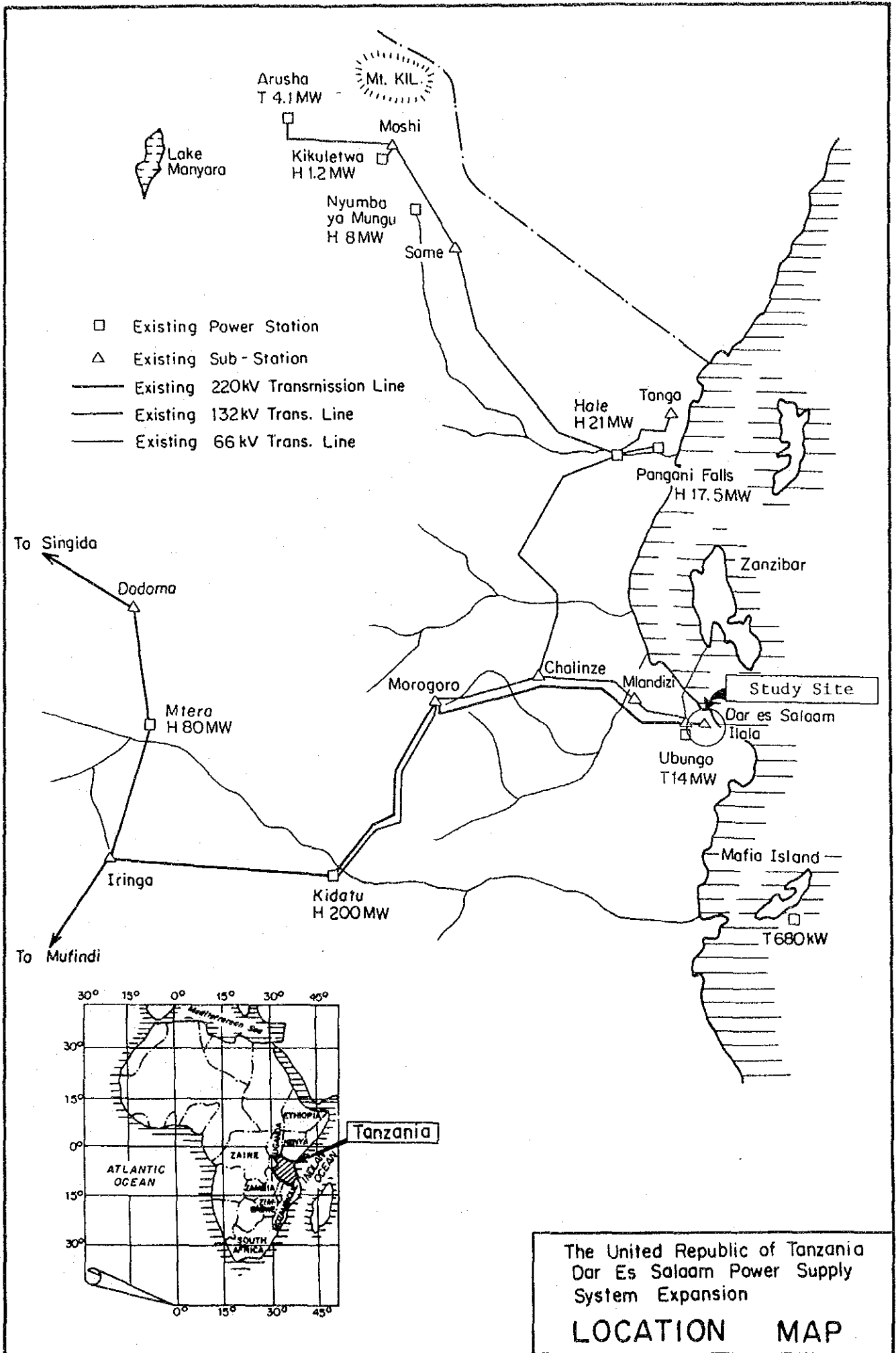
**SUMMARY**

**MARCH, 1994**

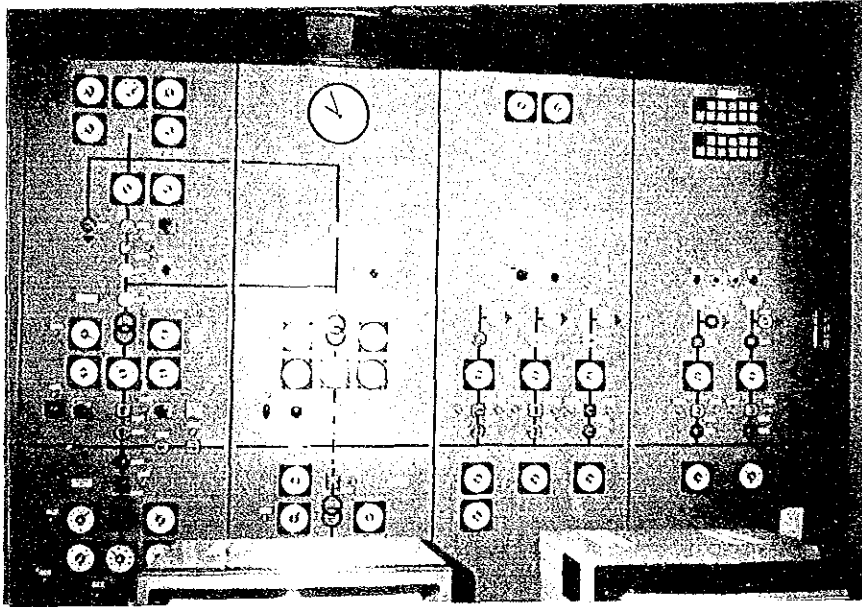
**ELECTRIC POWER DEVELOPMENT CO.,LTD.  
TOKYO, JAPAN**

国際協力事業団

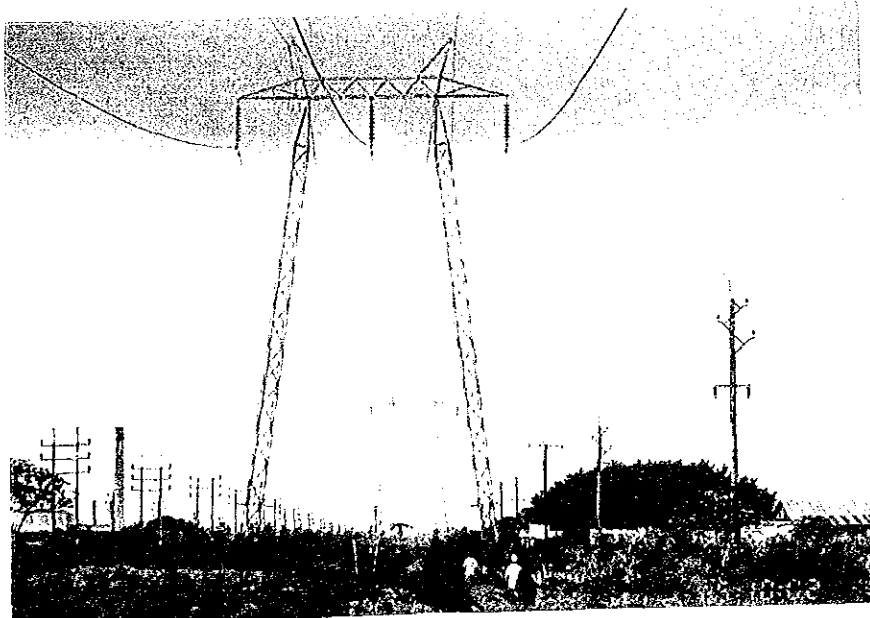
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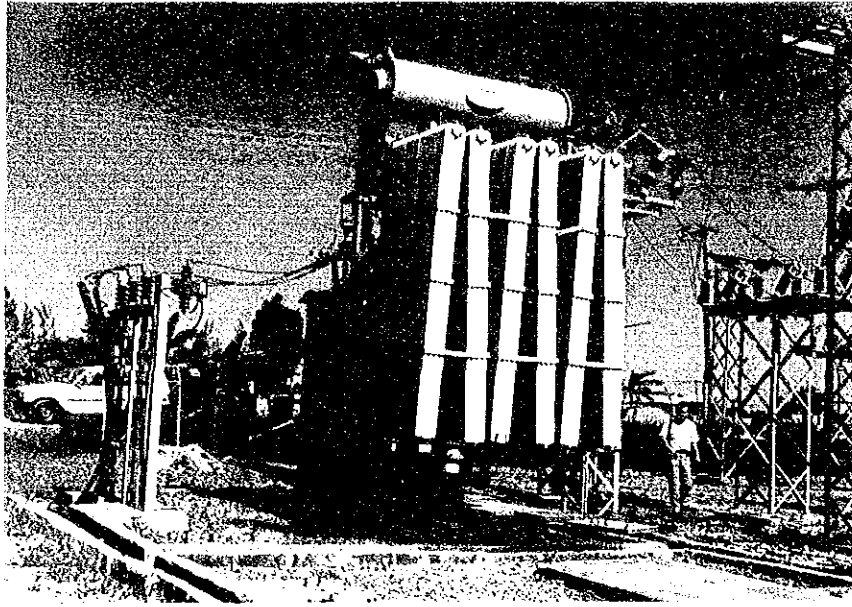
ILALA S/S  
System Control Panel



UBUNGO-ILALA S/S  
132/33 kV Transmission Lines







MBEZI S/S  
33/11 kV Existing Substation  
Transformer 7.5 MVA x 1

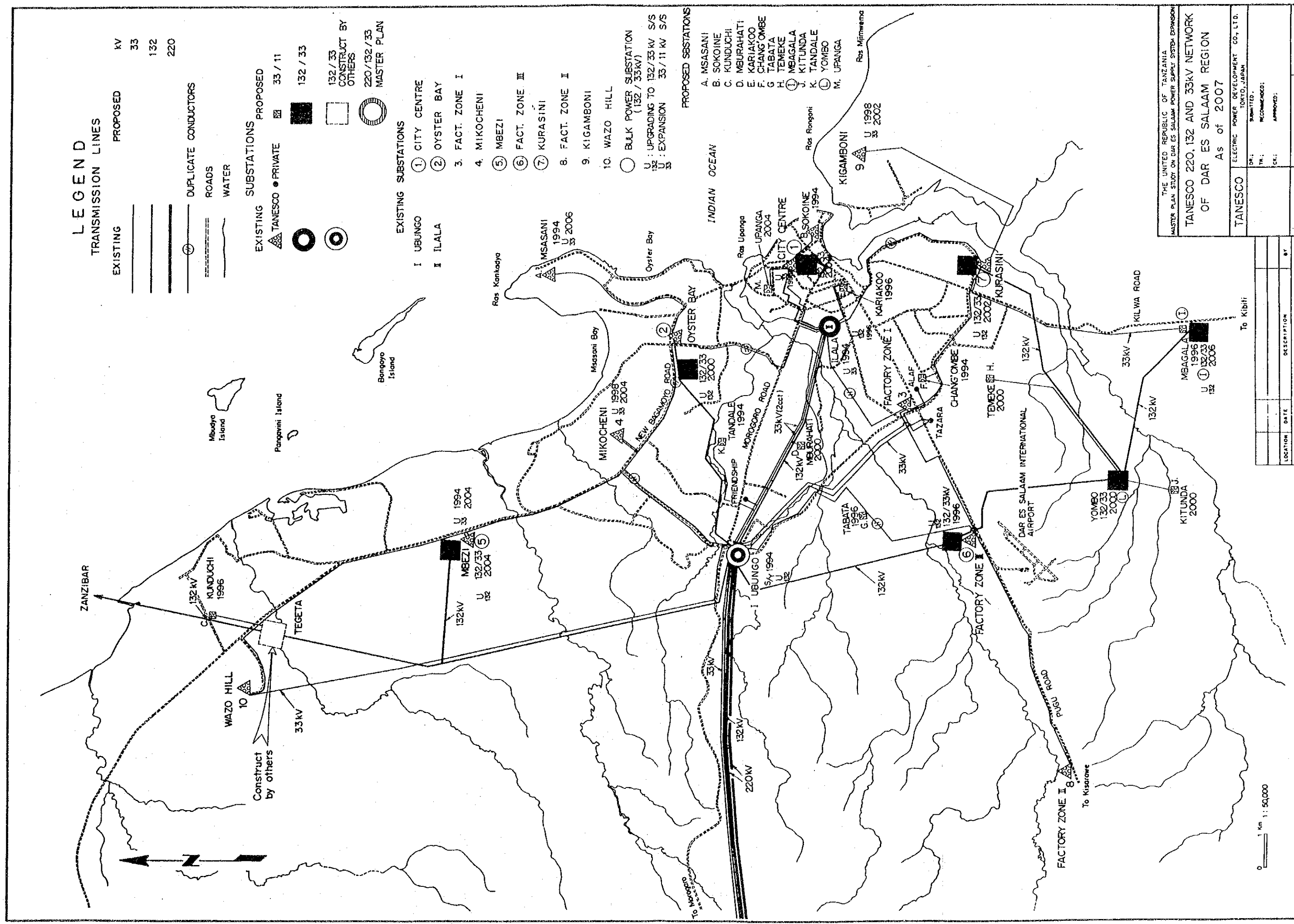


DAR ES SALAAM  
11 kV Distribution Line

# LEGEND

- TRANSMISSION LINES**
- EXISTING: Solid line with double parallel lines
- PROPOSED: Dashed line with double parallel lines
- DUPLICATE CONDUCTORS**
- ROADS: Dashed line
- WATER: Wavy line
- SUBSTATIONS**
- EXISTING: Circle with a dot
- PROPOSED: Square with a dot
- TANESCO • PRIVATE: Square with a dot and a circle
- 33 / 11: Square with a dot and a circle
- 132 / 33: Square with a dot and a circle
- 132 / 33 CONSTRUCT BY OTHERS: Square with a dot and a circle
- 220 / 132 / 33 MASTER PLAN: Square with a dot and a circle

- EXISTING SUBSTATIONS**
- I UBUNGO
- II ILALA
- III OYSTER BAY
- IV FACT. ZONE I
- V MIKOCHENI
- VI MBEZI
- VII FACT. ZONE III
- VIII KURASINI
- IX FACT. ZONE II
- X KIGAMBONI
- XI WAZO HILL
- PROPOSED SUBSTATIONS**
- A. MSASANI
- B. SOKOINE
- C. KUNDUCHI
- D. MBURAHATI
- E. KARIAKOO
- F. CHANG'OMBE
- G. TABATA
- H. TEMEKE
- I. MBAGALA
- J. KITUNDA
- K. TANDALE
- L. YOMBO
- M. UPANGA
- BULK POWER SUBSTATION (132 / 33KV)**
- U : UPGRADING TO 132/33 KV S/S
- U : EXPANSION 33/11 KV S/S



THE UNITED REPUBLIC OF TANZANIA  
 MASTER PLAN STUDY ON DAR ES SALAAM POWER SUPPLY SYSTEM DEVELOPMENT  
 TANESCO 220, 132 AND 33KV NETWORK  
 OF DAR ES SALAAM REGION  
 As of 2007

TANESCO  
 ELECTRIC POWER DEVELOPMENT CO., LTD.  
 TOKYO, JAPAN

DATE: SUBMITTED: \_\_\_\_\_  
 DATE: RECOMMENDED: \_\_\_\_\_  
 DATE: APPROVED: \_\_\_\_\_

| LOCATION | DATE | DESCRIPTION | BY |
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## CONTENTS

### Final Report (Summary)

|           | Page   |
|-----------|--|
| Chapter 1 | Conclusion and Recommendation ..... 1-1              |
| Chapter 2 | Background of Development Plans ..... 2-1            |
| 2.1       | Situation of Nationwide power Supply ..... 2-1       |
| 2.2       | Situation of Power Supply in Dar Es Salaam ..... 2-1 |
| 2.3       | Necessity of Development Plans ..... 2-3             |
| Chapter 3 | Optimum Development Plans ..... 3-1                  |
| 3.1       | Optimum Plans ..... 3-1                              |
| 3.2       | Cost Estimation and Construction Schedule ..... 3-2  |
| Chapter 4 | Economic and Financial Analysis ..... 4-1            |
| 4.1       | Economic Analysis ..... 4-1                          |
| 4.2       | Financial Analysis ..... 4-1                         |



**CHAPTER 1**  
**CONCLUSION**  
**AND**  
**RECOMMENDATION**



## CHAPTER 1 CONCLUSION AND RECOMMENDATION

### Conclusion:

The survey team made the field surveys in January and August, 1993, for about 90 days including the discussions with the TANESCO's staffs in charge. After returning to Japan, we have prepared the long-term (for 15 years from 1993 to 2007) master plan based on the data collected during the field survey and the short-term (for five years from 1993 to 1997) master plan which includes only such projects as to be urgently implemented taking out from the long-term master plan. To prepare those master plans, we have executed the power demand forecast for the Dar Es Salaam City as well as power supply system analysis in order to confirm that those master plans are quite adequate from the technical point of view as well as from the point of view to the national economy.

The long-term master plan includes the following;

- (1) Construction of new substations (at 11 stations with 175 MVA of total capacity)
- (2) Extension of existing substations (at 18 stations with 510 MVA of total increase)
- (3) Construction of new 132 kV and 33 kV transmission lines (18 circuits about 93 km)
- (4) Construction of new 11 kV distribution line (about 57 km)

The short-term master plan includes only urgent projects to be promptly implemented taking out from the long-term master plan:

- (1) Construction of new substations (at 6 stations, 80 MVA of total capacity)
- (2) Extension of existing substations (at 3 stations, 165 MVA of total increase)
- (3) Construction of new 132 kV and 33 kV transmission lines (8 circuits with about 36.4 km)





- (4) Construction of new 11 kV distribution line (20 circuits with about 20 km)

Recommendation:

- (1) It is desirable that the construction plans of the nine substations and related transmission and distribution networks selectively included in the short-term master plan should promptly be implemented together with raising necessary funds as soon as possible. This is because the substantially large voltage drop and power loss in those facilities are already seen by now.
- (2) The master plans should be used in such a way that the execution of new construction plans of the power supply system for Dar Es Salaam City or expansion of the existing facilities should strictly follow them. Nonetheless, those master plans should be revised as necessary in the future those plans may be largely affected by the economic activities or urban development plans, etc.
- (3) According to the power demand forecast in Tanzania, it may be rapidly increase at a high annual growth rate of about 5 to 6% and it is indispensable to systematically develop the electric power resources from now on.



**CHAPTER 2**  
**BACKGROUND**  
**OF**  
**DEVELOPMENT PLANS**



## CHAPTER 2 BACKGROUND OF DEVELOPMENT PLANS

### 2.1 SITUATION OF NATIONWIDE POWER SUPPLY

In the United Republic of Tanzania, the power supply from power generation up to distribution to the end users is entirely undertaken by TANESCO (Tanzania Electric Supply Company Ltd.) under the jurisdiction of the Ministry of Energy, Mineral and Water Resources. The electric power generated by the hydroelectric power stations and diesel power stations is supplied by TANESCO to the consumers via 220 kV and 132 kV transmission lines.

The major hydroelectric power stations are Kidatu power station (with 204 MW output, 51 MW x 4 units, completed in 1975) located to the west of Dar Es Salaam City in the Great Ruaha valley, Mtera power station (with 80 MW output, 40 MW x 2 units, completed in 1988) and three other rather small hydroelectric power stations located in the Pangani valley (namely, Hale, Pangani Fall and Nyumbaya Mungu power stations put in service in 1934, 1964 and 1969 respectively with 46.5 MW in total) connected via 132 kV transmission lines. In addition, ten diesel power stations (120 MW of total capacity and 44 MW of net output) are connected to the system. It should be noted that about half the total electric power supplied by these hydroelectric and diesel power stations is consumed in Dar Es Salaam.

In addition to the above, a small-scale diesel power station is particularly installed in a small region (covering about 20 districts) located distant from the above system to supply power separately to it. Nonetheless, it is known that only 6%, who mostly live in the major cities, towns and villages, of the total population of 26 million people benefits from the electric power supply.

### 2.2 SITUATION OF POWER SUPPLY IN DAR ES SALAAM

The power to be supplied to the Dar Es Salaam City that is the target region of the survey is basically from the hydroelectric power stations located in the Great Ruaha valley and Pangani valley and from the diesel power stations located in various



places and then supplied via 220 kV and 132 kV transmission lines to Ubungo substation located on the northwest of Dar Es Salaam City.

From Ubungo substation, the power is further supplied to distribution substations (15 stations) in the Dar Es Salaam City. The outgoing 11 kV distribution lines from these distribution substations form a network in various places of the City and the power is supplied to the ordinary consumers through these networks via 230/400 V, 3 phase, 4 wire from the pole- or ground-mounted distribution transformers.

However, since deteriorated distribution networks of Dar Es Salaam City, which were constructed in the 1960s, are still used now, the stable supply of the electric power to the City is substantially impeded.





Specifications of the existing substations in Dar Es Salaam City are as shown below:

| <u>Substation Name</u> | <u>Voltage</u> | <u>Substation Capacity</u> |
|------------------------|----------------|----------------------------|
| Ubungo                 | 200/132 kV     | 150 MVA x 2                |
|                        | 132/33/11 kV   | 50 MVA x 2                 |
|                        | 33/11 kV       | 15 MVA x 3                 |
| Ilala                  | 132/33 kV      | 45 MVA x 2                 |
|                        | 33/11 kV       | 15 MVA x 2                 |
| City Centre            | 33/11 kV       | 15 MVA x 3                 |
| Oysterbay              | 33/11 kV       | 5 MVA x 2 + 15 MVA x 1     |
| Factory Zone-I         | 33/11 kV       | 5 MVA x 2 + 5 MVA x 1      |
| Factory Zone-II        | 33/11 kV       | 5 MVA x 1                  |
| Factory Zone-III       | 33/11 kV       | 15 MVA x 1                 |
| Mikocheni              | 33/11 kV       | 15 MVA x 1                 |
| Kurasini               | 33/11 kV       | 15 MVA x 1                 |
| Kigamboni              | 33/11 kV       | 5 MVA x 1                  |
| Mbezi                  | 33/11 kV       | 7.5 MVA x 1                |
| Wazohill               | 33/11 kV       | 5 MVA x 3                  |
| Friendship             | 33/11 kV       | 3.15MVA x 1                |
| Tazara                 | 33/11 kV       | 3.15MVA x 2                |
| Alaf                   | 33/11 kV       | 10 MVA x 3                 |

Presently, the following two substations are under construction by the grant aid from Japan aiming the completion in 1994.

|         |          |            |                                 |
|---------|----------|------------|---------------------------------|
| Sokoine | 33/11 kV | 15 MVA x 1 | Commissioned on 5th Dec., 1993  |
| Msasani | 33/11 kV | 15 MVA x 1 | Commissioned on 31st Oct., 1993 |

### 2.3 NECESSITY OF DEVELOPMENT PLANS

Major problems being posed by the Dar Es Salaam power supply system are as shown below:

1. Increase in occurrence of accidents due to overage and deteriorated equipment (such as transformer, wire, insulator, circuit breaker, etc.).
2. Increase in power loss and voltage drop due to lack of capacity of conductors (too thin) and too long distribution line like following lines.



| <u>Substation Name</u> | <u>11 kV Distribution Line Name</u> | <u>Voltage Drop Rate (%)</u> | <u>Power Loss Rate (%)</u> |
|------------------------|-------------------------------------|------------------------------|----------------------------|
| Ubungo                 | U1                                  | 5.92                         | 3.49                       |
| Kurasini               | K4                                  | 10.02                        | 7.32                       |
| Mikocheni              | MK2                                 | 8.03                         | 4.72                       |
| Oyster Bay             | O3                                  | 8.87                         | 6.07                       |
| Oyster Bay             | O4                                  | 6.50                         | 6.42                       |
| Mbezi                  | MB2                                 | 16.93                        | 11.43                      |

3. Increase in service interruption areas due to inadequate protective devices (such as circuit breaker, section switch, protective relay, etc.)
4. Lack of capacity of substation transformers
5. Lack of spare parts for repairs and equipment for maintenance
6. The present capacity of the transmission, substations and distribution facilities hardly cater for about 5% of annual growth rate being obtained from the demand forecast.
7. Since the power distribution network is done in a radial pattern to all distribution substations form Ubungo substation and therefore the power supply to Dar Es Salaam City may largely be hindered once an accident has taken place in the Ubungo substation threatening complete failure in power supply in the event of a serious accident.

Under the circumstances, it is indispensable to timely implement the development plans according to the schedule because it needs enormous costs and time to construct the power supply facilities to cope with the future demand and moreover it may exert a very large influence on the management of the utilities.



**CHAPTER 3**  
**OPTIMUM DEVELOPMENT PLANS**



## CHAPTER 3 OPTIMUM DEVELOPMENT PLANS

### 3.1 OPTIMUM PLANS

The master plan is divided into such two phases to facilitate reviewing as the short-term master plan (for 5 years from 1993 to 1998) which includes projects to be urgently implemented and the long-term master plan (for 15 years from 1993 to 2007) which includes the remaining projects. Table 3-1 and 3-2 show the annual breakdowns of the master plan.

It is known from Table 3-1 that from 1994 (1) to 1996 (9), the priority should be given to the short-term master plan over the long-term plan.

Outlines of the long-term and short-term master plans are as shown below:

|   | Short-Term<br>Master Plan<br>(5 years)<br><u>(1993 to 1997)</u> | Long-Term<br>Master Plan<br>(15 years)<br><u>(1993 to 2007)</u> |
|---|---|---|
| (1) Construction of new substations                               | 6 stations  | 11 stations   |
| Capacity of transformer of<br>new substations                     | 80 MVA  | 165 MVA   |
| (2) Expansion of existing<br>substations                          | 4 stations  | 19 stations   |
| Increase in capacity of<br>transformer of existing<br>substations | 165 MVA   | 510 MVA   |
| (3) Construction of new transmission<br>line                      |   |   |
| 132 kV  | 2 circuits<br>(15.6 km)   | 8 circuits<br>(48.4 km)   |
| 33 kV   | 6 circuits<br>(20.3 km)   | 10 circuits<br>(34.3 km)  |





- (4) Construction of new  
distribution line

11 kV

20 circuits  
(35.5 km)

54 circuits  
(72.9 km)

### 3.2 COST ESTIMATION AND CONSTRUCTION SCHEDULE

#### 3.2.1 Cost Estimation

- (1) Total construction cost for the long-term master plan (for 15 years from 1993 to 2007) included the following;

Foreign currency (million yen): 11,848

Load currency (million Tsh) : included in the foreign  
currency port. ion

- (2) Total construction cost for the short-term master plan (for 5 years from 1993 to 1997) includes the following:



Short-term (5 year) master plan construction cost

|  | Foreign<br>currency<br>(Million yen) | Local<br>currency<br>(Million yen) | Total<br>(Million yen) | Amount to be<br>borne by<br>Tanzania side<br>(Million Tsh) |
|--|--------------------------------------|------------------------------------|------------------------|--|
| (For construction works to be completed in 1994)     |                                      |                                    |                        |  |
| Transmission Line                                    | 215.1                                | 26.9                               | 242.0                  | 14.5 (*1)  |
| Substation   | 1,313.9                              | 77.3                               | 1,391.2                | 230.0 (*2)   |
| Distribution Line                                    | 72.7                                 | 1.4                                | 74.1                   | 17.0 (*3)  |
| Vehicles and tools                                   | 149.9                                | 2.9                                | 152.8                  | -  |
| Others   | 95.4                                 | 1.8                                | 97.2                   | -  |
| Subtotal   | 1,847.0                              | 110.3                              | 1,957.3                | 261.5  |
| Contingency  | 277.0                                | 16.5                               | 293.6                  | -  |
| Total for construction works to be completed in 1994 | 2,124.0                              | 126.8                              | 2,250.9                | 261.5  |
| (For construction works to be completed in 1996)     |                                      |                                    |                        |  |
| Transmission Line                                    | 309.6                                | 33.7                               | 343.4                  | 80.0 (*1)  |
| Substation   | 1,328.2                              | 78.1                               | 1,406.3                | 209.5 (*2)   |
| Distribution Line                                    | 114.8                                | 2.2                                | 117.0                  | 51.0 (*3)  |
| Vehicles and tools                                   | 164.6                                | 3.2                                | 167.8                  | -  |
| Others   | 104.8                                | 2.0                                | 106.8                  | -  |
| Subtotal   | 2,022.0                              | 119.2                              | 2,141.2                | 340.5  |
| Contingency  | 303.3                                | 17.9                               | 321.2                  | -  |
| Total for construction works to be completed in 1996 | 2,325.3                              | 137.1                              | 2,462.4                | 340.5  |
| Total  | 3,869.0                              | 229.5                              | 4,098.5                | 602.0  |
| Total<br>(including contingent<br>expense)           | 4,449.3                              | 264.0                              | 4,713.3                | 602.0  |

(Notes) (a) In the costs to be borne by Tanzania side:

- (\*1) Costs of 33 kV transmission line construction and land acquisition compensation
- (\*2) Costs of substation foundation works and land acquisition compensation.
- (\*3) Costs of distribution line construction and land acquisition compensation.



(b) Prices are as of the end of December, 1992, with conversion rates being as shown below:

1 US\$ = 124.9 yen

1 US\$ = 325 Tsh

1 Yen = 2.602 Tsh

- (c) Construction cost includes material and equipment costs, installation cost, shipping cost, administration expense, and consultant fee.
- (d) Costs of vehicles and tools include estimated costs for vehicles, testing and tools needed for maintenance services.
- (e) Other costs include estimated costs for communications facilities needed for maintenance services for the electric power system.
- (f) Contingent expense includes estimated costs for design changes and future commodity price increase.

Outlines of these works are as shown below:

(Works to be completed in 1994)

(a) Ilala S/S extension project

- Additional installation at Ilala S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Additional installation at Ilala S/S, 132/32 kV, 45 MVA transformer x 1 unit
- Construction of new 7.0 km, 132 kV transmission line x 1 circuit between Ilala S/S and Ubungo S/S
- Construction of new 0.1 km distribution line



(b) Construction project of Tandale S/S

- Installation at Tandale S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 0.2 km branch transmission line x 1 circuit from Ubungo-Textile line (33 kV)
- Construction of 5.9 km distribution line

(c) Construction project of Chang'ombe S/S

- Installation at Chang'ombe S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 2.0 km branch transmission line x 1 circuit from FZ I-Kurasini (33 kV)
- Construction of 3.1 km distribution line

(d) Mbezi S/S extension project

- Additional installation at Mbezi S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 0.3 km distribution line

(Works to be completed in 1996)

(a) Construction project of Kunduchi S/S

- Installation at Kunduchi S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 2.8 km, 33 kV transmission line x 1 circuit between Kunduchi S/S and Tegeta S/S
- Construction of 17.8 km distribution line





(b) FZ III S/S extension project

- Additional installation at FZ III S/S, 132/33 kV, 45 MVA transformer x 2 units
- Construction of 8.6 km, 132 kV transmission line x 1 circuit between Ubungo S/S and FZ III S/S

(c) Construction project of Kariakoo S/S

- Installation at Kariakoo S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 2.1 km, 33 kV transmission line x 1 circuit between Kariakoo S/S and Ilala S/S
- Construction of 4.1 km distribution line

(d) Construction project of Mbagala S/S

- Installation at Mbagala S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 8.5 km, 33 kV transmission line x 1 circuit between Mbagala S/S and Kurasini S/S
- Construction of 3.9 km distribution line

(e) Construction project of Tabata S/S

- Installation at Tabata S/S, 33/11 kV, 15 MVA transformer x 1 unit
- Construction of 0.2 km branch transmission line x 1 circuit from Ubungo-FZ III line (33 kV)
- Construction of 0.3 km distribution line



(Common items)

(a) Vehicles and tools

Supply of vehicles and tools needed for maintenance and operation of the power system.

(b) others

Installation of a new telecommunications system

3.2.2 Construction Schedule

Table 3-3 shows the construction schedule for the long-term master plan.

- (1) This construction schedule covers only the construction work period on site and thus various proceedings, surveys, fabrication at factory, shipping period, etc. are not included.
- (2) Foundation works for the substation, construction of 33 kV transmission line and construction of 11 kV distribution line shall be undertaken by TANESCO.



MASTERPR Table 3.1 THE MASTER PLAN FOR ELECTRIC POWER SYSTEM EXPANSION IN DAR ES SALAAM

| YEAR | NAME OF S/S & LINE | TRANSFORMER VOLTAGE TRANSMISSION LINE | STATUS | Tr. CAPACITY No. OF CCT. |
|------|--------------------|---------------------------------------|--------|--------------------------|
| 1994 | (1) ILALA S/S      | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      |                    | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | ILALA LINE         | UBUNGO-ILALA                          | NEW    | 132 KV*1cct.             |
|      | (2) TANDALE S/S    | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | TANDALE LINE       | BRANCH FROM UBUNGO-TEXTILE LINE       | NEW    | 33 KV*1cct.              |
|      | (3) CHANGOMBE S/S  | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | CHANGOMBE LINE     | BRANCH FROM FZ1-KURASINI LINE         | NEW    | 33 KV*1cct.              |
|      | (4) MBEZI S/S      | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
| 1996 | (5) KUNDUCHI S/S   | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | KUNDUCHI LINE      | TEGETA-KUNDUCHI                       | NEW    | 33 KV*1cct.              |
|      | (6) FZ-III S/S     | 132/33 KV Tr.                         | EXPAN. | 45 MVA*2                 |
|      | FZ-III LINE        | UBUNGO-FZ-III                         | NEW    | 132 KV*1cct.             |
|      | (7) KARIAKOO S/S   | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | KARIAKOO LINE      | ILALA-KARIAKOO                        | NEW    | 33 KV*1cct.              |
|      | (8) MBAGALA S/S    | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | MBAGALA LINE       | KURASINI-MBAGALA                      | NEW    | 33 KV*1cct.              |
|      | (9) TABATA S/S     | 33/11 KV Tr.                          | NEW    | 5 MVA*1                  |
|      | TABATA LINE        | BRANCH FROM UBUNGO-FZ III LINE        | NEW    | 33 KV*1cct.              |
| 1998 | MIKOCHENI S/S      | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      | KIGAMBONI S/S      | 33/11 KV Tr.                          | EXPAN. | 5 MVA*1                  |
| 2000 | TEMEKE S/S         | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | TEMEKE LINE        | YOMBO-TEMEKE                          | NEW    | 33 KV*1cct.              |
|      | MBURAHATI S/S      | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | MBURAHATI LINE     | BRANCH FROM UBUNGO-ILALA              | NEW    | 33 KV*1cct.              |

NOTE: Number in ( ) shows priority.



MASTERPR THE MASTER PLAN FOR ELECTRIC POWER SYSTEM EXPANSION IN DAR ES SALAAM

| YEAR | NAME OF S/S & LINE | TRANSFORMER VOLTAGE TRANSMISSION LINE | STATUS | Tr. CAPACITY No. OF CCT. |
|------|--------------------|---------------------------------------|--------|--------------------------|
| 2000 | KITUNDA S/S        | 33/11 KV Tr.                          | NEW    | 5 MVA*1                  |
|      | KITUNDA LINE       | YOMBO-KITUNDA                         | NEW    | 33 KV*1cct.              |
|      | YOMBO S/S          | 132/33 KV Tr.                         | NEW    | 45 MVA*1                 |
|      | YOMBO LINE         | FZ III-YOMBO                          | NEW    | 132 KV*1cct.             |
|      | FZ-II S/S          | 33/11 KV Tr.                          | EXPAN. | 5 MVA*1                  |
|      | OYSTERBAY S/S      | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | OYSTERBAY LINE     | UBUNGO-OYSTERBAY                      | NEW    | 132 KV*1cct.             |
| 2002 | KARIAKOO S/S       | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      | KIGAMBONI S/S      | 33/11 KV Tr.                          | EXPAN. | 5 MVA*1                  |
|      | KURASINI S/S       | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | KURASINI LINE      | YOMBO-KURASINI                        | NEW    | 132 KV*1cct.             |
| 2003 | OYSTERBAY S/S      | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
| 2004 | MBEZI S/S          | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      |                    | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | MBEZI LINE         | ZANZIBAR LINE-MBEZI                   | NEW    | 132 KV*1cct.             |
|      | MIKOCHEZI S/S      | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      | CITY CENTRE S/S    | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | CITY CENTRE LINE   | ILALA-CITY CENTRE                     | NEW    | 132 KV*1cct.             |
|      | UPANGA S/S         | 33/11 KV Tr.                          | NEW    | 15 MVA*1                 |
|      | UPANGA LINE        | CITYCENTRE-UPANGA                     | NEW    | 33 KV*1cct.              |
| 2005 | FZ-III S/S         | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
| 2006 | MSASANI S/S        | 33/11 KV Tr.                          | EXPAN. | 15 MVA*1                 |
|      | MBAGALA S/S        | 132/33 KV Tr.                         | EXPAN. | 45 MVA*1                 |
|      | MBAGALA LINE       | YOMBO-MBAGALA                         | NEW    | 132 KV*1cct.             |



PLANSYSR Table 3.2 MASTER PLAN FOR POWER SYSTEM IN DAR ES SALAAM CITY (1/2)

| S/S & LINE               | STATUS | PRIORITY | SPECIFICATION | 1994  | 1995 | 1996  | 1997 | 1998     | 1999 | 2000 | 2001 | 2002     | 2003 | 2004                                    | 2005     | 2006                         | 2007 |
|--------------------------|--------|----------|---------------|---|------|---|------|----------|------|------|------|----------|------|---|----------|------------------------------|------|
| ILALA S/S                | EXP.   | (1)      | 132/33KV Tr.  | 45 MVA*1  |      |   |      |          |      |      |      |          |      |   |          |                              |      |
|                          | EXP.   | (1)      | 33/11KV Tr.   | 15 MVA*1  |      |   |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (1)      | 132 KV LINE   | 1cct. (Ubungo s/s-Ilala s/s)                        |      |   |      |          |      |      |      |          |      |   |          |                              |      |
| TANDALE S/S              | NEW    | (2)      | 33/11KV Tr.   | 15 MVA*1  |      |   |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (2)      | 33 KV LINE    | 1cct. (Branch from Ubungo s/s-Textile Factory Line) |      |   |      |          |      |      |      |          |      |   |          |                              |      |
| CHANGOMBE S/S            | NEW    | (3)      | 33/11KV Tr.   | 15 MVA*1  |      |   |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (3)      | 33 KV LINE    | 1cct. (Branch from Fz1 s/s-Kurasini s/s Line)       |      |   |      |          |      |      |      |          |      |   |          |                              |      |
| MBEJI S/S                | EXP.   | (4)      | 33/11KV Tr.   | 15 MVA*1  |      |   |      |          |      |      |      |          |      | 15 MVA*1                                |          |                              |      |
|                          | NEW    |          | 132/33KV Tr.  |   |      |   |      |          |      |      |      |          |      | 45 MVA*1                                |          |                              |      |
|                          | NEW    |          | 132 KV LINE   |   |      |   |      |          |      |      |      |          |      | 1cct. (Branch from Ubungo s/s-Zanzibar) |          |                              |      |
| KUNDUCHI S/S<br>(TEGETA) | NEW    | (5)      | 33/11KV Tr.   |   |      | 15 MVA*1                                      |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (5)      | 33 KV LINE    |   |      | 1cct. (Tegeta s/s-Kunduchi s/s)               |      |          |      |      |      |          |      |   |          |                              |      |
| FZ-3 S/S                 | EXP.   |          | 33/11KV Tr.   |   |      |   |      |          |      |      |      |          |      |   | 15 MVA*1 |                              |      |
|                          | NEW    | (6)      | 132/33KV Tr.  |   |      | 45 MVA*2                                      |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (6)      | 132 KV LINE   |   |      | 1cct. (Ubungo s/s-Fz3 s/s)                    |      |          |      |      |      |          |      |   |          |                              |      |
| KARIAKOO S/S             | NEW    | (7)      | 33/11KV Tr.   |   |      | 15 MVA*1                                      |      |          |      |      |      | 15 MVA*1 |      |   |          |                              |      |
|                          | NEW    | (7)      | 33 KV LINE    |   |      | 1cct. (Ilala s/s-Kariakoo s/s)                |      |          |      |      |      |          |      |   |          |                              |      |
| MBAGALA S/S              | NEW    | (8)      | 33/11KV Tr.   |   |      | 15 MVA*1                                      |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    |          | 132/33KV Tr.  |   |      |   |      |          |      |      |      |          |      |   |          | 45 MVA*1                     |      |
|                          | NEW    | (8)      | 33KV LINE     |   |      | 1cct. (Kurasini s/s-Mbagara s/s)              |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    |          | 132KV LINE    |   |      |   |      |          |      |      |      |          |      |   |          | 1cct (Yombo s/s-Mbagala s/s) |      |
| TABATA S/S               | NEW    | (9)      | 33/11KV Tr.   |   |      | 5 MVA*1                                       |      |          |      |      |      |          |      |   |          |                              |      |
|                          | NEW    | (9)      | 33 KV LINE    |   |      | 1cct. (Branch from Ubungo s/s -Fz 3 s/s Line) |      |          |      |      |      |          |      |   |          |                              |      |
| MIKOCHENI S/S            | EXP.   |          | 33/11KV Tr.   |   |      |   |      | 15 MVA*1 |      |      |      |          |      | 15 MVA*1                                |          |                              |      |
| KIGANBONI S/S            | EXP.   |          | 33/11KV Tr.   |   |      |   |      | 5 MVA*1  |      |      |      | 5 MVA*1  |      |   |          |                              |      |

## PLANSYSR

## MASTER PLAN FOR POWER SYSTEM IN DAR ES SALAAM CITY (2/2)

| S/S & LINE      | STATUS | PRIORITY | SPECIFICATION | 1994 | 1995 | 1996     | 1997                 | 1998 | 1999 | 2000  | 2001 | 2002                           | 2003 | 2004                              | 2005 | 2006     | 2007 |
|-----------------|--------|----------|---------------|------|------|----------|----------------------|------|------|---|------|--------------------------------|------|-----------------------------------|------|----------|------|
| TEMEKE S/S      | NEW    |          | 33/11KV Tr.   |      |      |          |                      |      |      | 15 MVA*1                                      |      |                                |      |                                   |      |          |      |
|                 | NEW    |          | 33KV LINE     |      |      |          |                      |      |      | 1cct. (Yombo s/s-Temeke s/s)                  |      |                                |      |                                   |      |          |      |
| MBURAHATI S/S   | NEW    |          | 33/11KV Tr.   |      |      |          |                      |      |      | 15 MVA*1                                      |      |                                |      |                                   |      |          |      |
|                 | NEW    |          | 33KV LINE     |      |      |          |                      |      |      | 1cct. (Branch from Ubungo s/s-Ilala s/s Line) |      |                                |      |                                   |      |          |      |
| KITUNDA S/S     | NEW    |          | 33/11KV Tr.   |      |      |          |                      |      |      | 5 MVA*1                                       |      |                                |      |                                   |      |          |      |
|                 | NEW    |          | 33KV LINE     |      |      |          |                      |      |      | 1cct. (Yombo s/s-Kitunda s/s)                 |      |                                |      |                                   |      |          |      |
| YOMBO S/S       | NEW    |          | 132/33KV Tr.  |      |      |          |                      |      |      | 45 MVA*1                                      |      |                                |      |                                   |      |          |      |
|                 | NEW    |          | 132KV LINE    |      |      |          |                      |      |      | 1cct. (Fz 3 s/s-Yombo s/s)                    |      |                                |      |                                   |      |          |      |
| FZ-2 S/S        | EXP.   |          | 33/11KV Tr.   |      |      |          |                      |      |      | 5 MVA*1                                       |      |                                |      |                                   |      |          |      |
| OYSTER BAY S/S  | EXP.   |          | 33/11KV Tr.   |      |      | 1*15 MVA | (Under construction) |      |      |   |      |                                |      | 15 MVA*1                          |      |          |      |
|                 | NEW    |          | 132/33KV Tr.  |      |      |          |                      |      |      | 45 MVA*1                                      |      |                                |      |                                   |      |          |      |
|                 | NEW    |          | 132 KV LINE   |      |      |          |                      |      |      | 1cct. (Ubungo s/s-Oysterbay s/s)              |      |                                |      |                                   |      |          |      |
| KURASINI S/S    | NEW    |          | 132/33KV Tr.  |      |      |          |                      |      |      |   |      | 45 MVA*1                       |      |                                   |      |          |      |
|                 | NEW    |          | 132KV LINE    |      |      |          |                      |      |      |   |      | 1cct. (Yombo s/s-Kurasini s/s) |      |                                   |      |          |      |
| CITY CENTER S/S | EXP.   |          | 132/33KV Tr.  |      |      |          |                      |      |      |   |      |                                |      | 45 MVA*1                          |      |          |      |
|                 | NEW    |          | 132KV LINE    |      |      |          |                      |      |      |   |      |                                |      | 1cct. (Ilala s/s-Citycenter s/s)  |      |          |      |
| UPANGA S/S      | NEW    |          | 33/11KV Tr.   |      |      |          |                      |      |      |   |      |                                |      | 15 MVA*1                          |      |          |      |
|                 | NEW    |          | 33 KV LINE    |      |      |          |                      |      |      |   |      |                                |      | 1cct. (Citycenter s/s-Upanga s/s) |      |          |      |
| MSASANI         | NEW    |          | 33/11KV Tr.   |      |      | 15 MVA*1 | (Under construction) |      |      |   |      |                                |      |                                   |      | 15 MVA*1 |      |
| SOKOINE         | NEW    |          | 33/11KV Tr.   |      |      | 15 MVA*1 | (Under construction) |      |      |   |      |                                |      |                                   |      |          |      |
| FZ-1 S/S        | EXP.   |          | 33/11KV Tr.   |      |      | 15 MVA*1 | (Under construction) |      |      |   |      |                                |      |                                   |      |          |      |

Table 3 - 3 CONSTRUCTION SCHEDULE

| PROJECT  | 1<br>1993 | 2<br>1994 | 3<br>1995 | 4<br>1996 | 5<br>1997 | 6<br>1998 | 7<br>1999 | 8<br>2000 | 9<br>2001 | 10<br>2002 | 11<br>2003 | 12<br>2004 | 13<br>2005 | 14<br>2006 | 15<br>2007 |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|------------|
| ILALA Substation<br>Transmission & Distribution Line       |           | █         |           |           |           |           |           |           |           |            |            | █          |            |            |            |
| UBUNGO Substation<br>Transmission Line                     |           | █         |           | █         |           |           |           | █         |           |            |            |            |            |            |            |
| TANDALE Substation<br>Transmission & Distribution Line     |           | █         |           |           |           |           |           |           |           |            |            |            |            |            |            |
| CHANG'OMBE Substation<br>Transmission & Distribution Line  |           | █         |           |           |           |           |           |           |           |            |            |            |            |            |            |
| KURASINI Substation  |           | █         |           |           |           |           |           |           |           |            |            |            |            |            |            |
| MBEZI Substation<br>Transmission & Distribution Line       |           | █         |           |           |           |           |           |           |           |            |            | █          |            |            |            |
| KUNDUCHI Substation<br>Transmission & Distribution Line    |           |           |           | █         |           |           |           |           |           |            |            |            |            |            |            |
| FZ III Substation<br>Transmission & Distribution Line      |           |           |           | █         |           |           |           | █         |           |            |            |            | █          |            |            |
| KARIAKOO Substation<br>Transmission & Distribution Line    |           |           |           | █         |           |           |           |           |           | █          |            |            |            |            |            |
| ILALA Substation<br>Transmission Line                      |           |           |           | █         |           |           |           |           |           |            |            |            |            |            |            |
| MBAGALA Substation<br>Transmission & Distribution Line     |           |           |           | █         |           |           |           |           |           |            |            |            |            | █          |            |
| KURASINI Substation  |           |           |           | █         |           |           |           |           |           |            |            |            |            |            |            |
| TABATA Substation<br>Transmission & Distribution Line      |           |           |           | █         |           |           |           |           |           |            |            |            |            |            |            |
| MIKOCHENI Substation<br>Transmission & Distribution Line   |           |           |           |           |           | █         |           |           |           |            |            | █          |            |            |            |
| KIGAMBONI Substation<br>Transmission & Distribution Line   |           |           |           |           |           | █         |           |           |           | █          |            |            |            |            |            |
| TEMEKE Substation<br>Transmission & Distribution Line      |           |           |           |           |           |           |           | █         |           |            |            |            |            |            |            |
| MBURAHATI Substation<br>Transmission & Distribution Line   |           |           |           |           |           |           |           | █         |           |            |            |            |            |            |            |
| KITUNDA Substation<br>Transmission & Distribution Line     |           |           |           |           |           |           |           | █         |           |            |            |            |            |            |            |
| YOMBO Substation<br>Transmission & Distribution Line       |           |           |           |           |           |           |           | █         |           | █          |            |            |            | █          |            |
| FZ II Substation<br>Distribution Line                      |           |           |           |           |           |           |           | █         |           |            |            |            |            |            |            |
| OYSTERBAY Substation<br>Transmission & Distribution Line   |           |           |           |           |           |           |           | █         |           |            | █          |            |            |            |            |
| KURASINI Substation<br>Transmission & Distribution Line    |           |           |           |           |           |           |           |           |           | █          |            |            |            |            |            |
| CITY CENTER Substation<br>Transmission & Distribution Line |           |           |           |           |           |           |           |           |           |            |            | █          |            |            |            |
| UPANCA Substation<br>Transmission & Distribution Line      |           |           |           |           |           |           |           |           |           |            |            | █          |            |            |            |
| MSASANI Substation<br>Transmission & Distribution Line     |           |           |           |           |           |           |           |           |           |            |            |            |            | █          |            |



**CHAPTER 4**  
**ECONOMIC**  
**AND**  
**FINANCIAL ANALYSIS**



## CHAPTER 4 ECONOMIC AND FINANCIAL ANALYSIS

### 4.1 ECONOMIC ANALYSIS

The economic internal rate of return (EIRR) of this Project is estimated to be 20.8%. This rate is well higher than 12% which is thought to be the social discount rate in Tanzania or 10 - 12% which the World Bank or other international aid organizations adopt as project evaluation indices. The Project is therefore considered to be quite feasible in terms of national economy.

Sensitivity analysis conducted on the assumption of 10% increase in costs and 10% decrease in revenue shows that the EIRR remains at the level of 16% and that the Project is still well feasible in its economic terms.

In addition, there are such unquantifiable benefits in this Project as improvement of facility in the nation's livelihood and so on.

Considering this, the economic effect of the Project is judged to be still higher, and this leads to the conclusion that the Project is worth implementing.

### 4.2 FINANCIAL ANALYSIS

The financial internal rate of return (FIRR) of the Project was calculated as 8.7%. In light of the evaluation standards stated in the preceding section, the financial profitability of the Project seems to fall short to some extent.

Also, in terms of the average earning ratio (i.e., the ratio of operating income against the fixed operating assets), a somewhat high rate of 11.3% is achieved at the end of the calculation period (that is, 22 years after completion of the construction). However, the rate records only 7.0% in the 10th year, and 8.5% in the 15th, thus being rather slow in rising.







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