are not needed yet in the year of around 2007. As to whether 132 kV 1 circuit should be used to form loop system or otherwise 2 circuits should be used to form radial system, a review must be comprehensively performed including analysis of scale and distribution of demand after 2007, location of power stations, and formation of primary system (220 kV), etc.

Under the circumstances, it is recommended in respect of the expansion of 132 kV transmission lines that priority should be given to Ubungo-Factory Zone III-Kurasini, and Ubungo-Oyster Bay routes.

3) Other necessary circuits

In network expansion planning for a long term, the following circuits should be considered.

(a) Ilala-City Centre 132 kV line is needed. Power supply to City Centre through the existing 33 kV line should be changed for a new 132 kV line.

(b) Yombo-Mbagala 132 kV line plan is not found its necessary in the near future, because of that Kurashini-Mbagala 33 kV line is scheduled to be constructed in 1996.

(c) Power flow of the 220/132 kV transformer of Ubungo is 260 MW (as Ubungo is generating 55 MW) in 2007 and which reaches to nearly its rated capacity 300 MVA.

Therefore additional plan of the 220/132 kV transformer is necessary, which should be studied to arrange with the assumption of a new substation plan of 220/132 kV above mentioned.

6.2.5 Remarkable points in respect of system planning

In order to enhance supply reliability, following points must surely be kept in mind at the time of setting out the reinforcement plan of Dar Es Salaam system:

(a) To avoid concentration of facilities on Ubungo districts

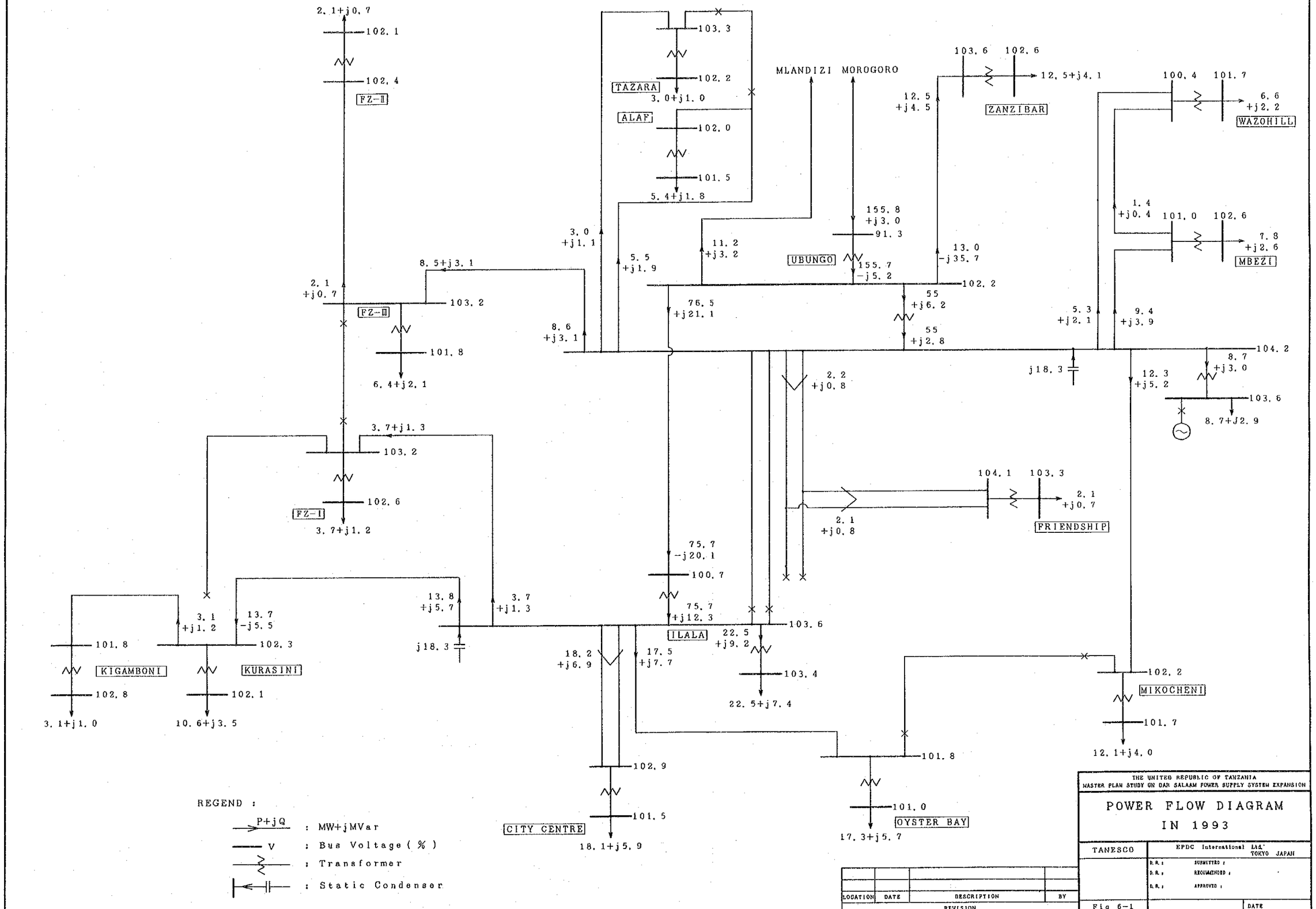
In consideration of better power flow distribution, it is advantageous to construct gas turbine plant, which is presently under plan, in the opposite side of Ubungo districts, i.e. in the vicinity of Kurasini.

(b) Spread layout of static condenser (S.C)

S.C should be installed at other substations including Ilala substation than Ubungo because of the fact that enough supply of reactive power to Ubungo is much expected in the future, which is owing to charging capacity of Zanzibar 132 kV transmission line as well as other generators to be installed hereafter. A review must be performed regarding the above.

(c) Gas turbine generator with condenser operation

Specifications of gas turbine plant presently under plan must be modified so that the condenser operation becomes available. Owing to this modification of the specifications, reactive power will always be kept supplied to Dar Es Salaam system regardless of generator operation thereby reducing necessary capacity of S.C to be installed and moreover facilitating smooth adjustment of the system voltage.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102. 1
102. 4
FZ-II
8. 5+j3. 1
2. 1
+j0. 7
103. 2
FZ-III
101. 8
6. 4+j2. 1
3. 7+j1. 3
103. 2
102. 6
FZ-I
3. 7+j1. 2
TAZARA
103. 3
102. 2
3. 0+j1. 0
ALAF
102. 0
101. 5
5. 4+j1. 8
3. 0
+j1. 1
5. 5
+j1. 9
8. 6
+j3. 1
MLANDIZI
MOROGORO
11. 2
+j3. 2
155. 8
+j3. 0
91. 3
UBUNGO
155. 7
-j5. 2
76. 5
+j21. 1
55
+j6. 2
55
+j2. 8
102. 2
13. 0
-j35. 7
12. 5
+j4. 5
103. 6
102. 6
12. 5+j4. 1
ZANZIBAR
100. 4
101. 7
6. 6
+j2. 2
WAZOHILL
1. 4
+j0. 4
101. 0
102. 6
7. 8
+j2. 6
MBEZI
5. 3
+j2. 1
9. 4
+j3. 9
104. 2
8. 7
+j3. 0
12. 3
+j5. 2
103. 6
8. 7+J2. 9
j18. 3
2. 2
+j0. 8
104. 1
103. 3
2. 1
+j0. 7
2. 1
+j0. 8
FRIENDSHIP
75. 7
-j20. 1
100. 7
75. 7
+j12. 3
ILALA
103. 6
22. 5
+j9. 2
103. 4
22. 5+j7. 4
13. 8
+j5. 7
3. 7
+j1. 3
j18. 3
18. 2
+j6. 9
17. 5
+j7. 7
102. 9
101. 5
CITY CENTRE
18. 1+j5. 9
101. 8
101. 0
OYSTER BAY
17. 3+j5. 7
102. 2
MIKOCHENI
101. 7
12. 1+j4. 0
3. 1
+j1. 2
13. 7
-j5. 5
101. 8
KIGAMBONI
102. 8
3. 1+j1. 0
102. 3
KURASINI
102. 1
10. 6+j3. 5
REGEND :
P+jQ : MW+jMVar
V : Bus Voltage (%)
: Transformer
: Static Condenser
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Fig 6-1
DATE
LOCATION
DATE
DESCRIPTION
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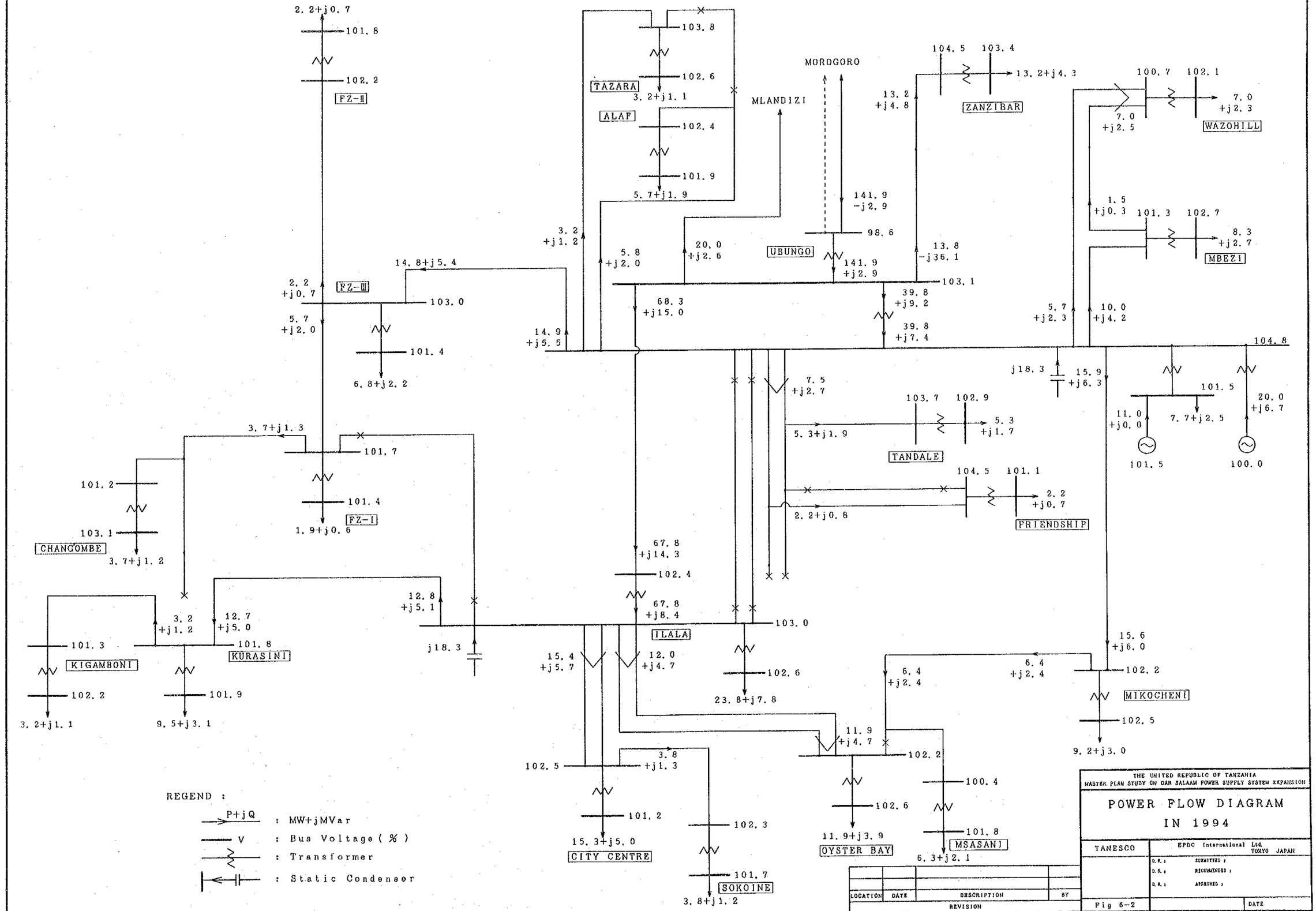
2. 2+j0. 7
101. 8
102. 2
FZ-II
TAZARA
103. 8
102. 6
3. 2+j1. 1
ALAF
102. 4
101. 9
5. 7+j1. 9
MLANDIZI
MOROGORO
104. 5
103. 4
13. 2+j4. 3
ZANZIBAR
13. 2
+j4. 8
100. 7
102. 1
7. 0
+j2. 3
7. 0
+j2. 5
WAZOHILL
1. 5
+j0. 3
101. 3
102. 7
8. 3
+j2. 7
MBEZI
3. 2
+j1. 2
5. 8
+j2. 0
20. 0
+j2. 6
UBUNGO
141. 9
-j2. 9
98. 6
141. 9
+j2. 9
13. 8
-j36. 1
103. 1
68. 3
+j15. 0
39. 8
+j9. 2
39. 8
+j7. 4
5. 7
+j2. 3
10. 0
+j4. 2
104. 8
14. 8+j5. 4
2. 2
+j0. 7
FZ-III
103. 0
5. 7
+j2. 0
14. 9
+j5. 5
101. 4
6. 8+j2. 2
j18. 3
15. 9
+j6. 3
101. 5
11. 0
+j0. 0
7. 7+j2. 5
20. 0
+j6. 7
101. 5
100. 0
7. 5
+j2. 7
103. 7
102. 9
5. 3
+j1. 7
5. 3+j1. 9
TANDALE
104. 5
101. 1
2. 2
+j0. 7
2. 2+j0. 8
PRIENDSHIP
3. 7+j1. 3
101. 7
101. 2
101. 4
FZ-I
1. 9+j0. 6
103. 1
CHANGOMBE
3. 7+j1. 2
67. 8
+j14. 3
102. 4
67. 8
+j8. 4
ILALA
103. 0
12. 8
+j5. 1
j18. 3
15. 4
+j5. 7
12. 0
+j4. 7
102. 6
23. 8+j7. 8
3. 2
+j1. 2
12. 7
+j5. 0
101. 3
101. 8
KIGAMBONI
KURASINI
102. 2
101. 9
3. 2+j1. 1
9. 5+j3. 1
6. 4
+j2. 4
6. 4
+j2. 4
15. 6
+j6. 0
102. 2
MIKOCHENI
102. 5
9. 2+j3. 0
11. 9
+j4. 7
102. 2
102. 6
11. 9+j3. 9
OYSTER BAY
100. 4
101. 8
MSASANI
6. 3+j2. 1
3. 8
102. 5
+j1. 3
101. 2
15. 3+j5. 0
CITY CENTRE
102. 3
101. 7
SOKOINE
3. 8+j1. 2
REGEND :
P+jQ : MW+jMVar
V : Bus Voltage (%)
: Transformer
: Static Condenser
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Fig 6-2
LOCATION
DATE
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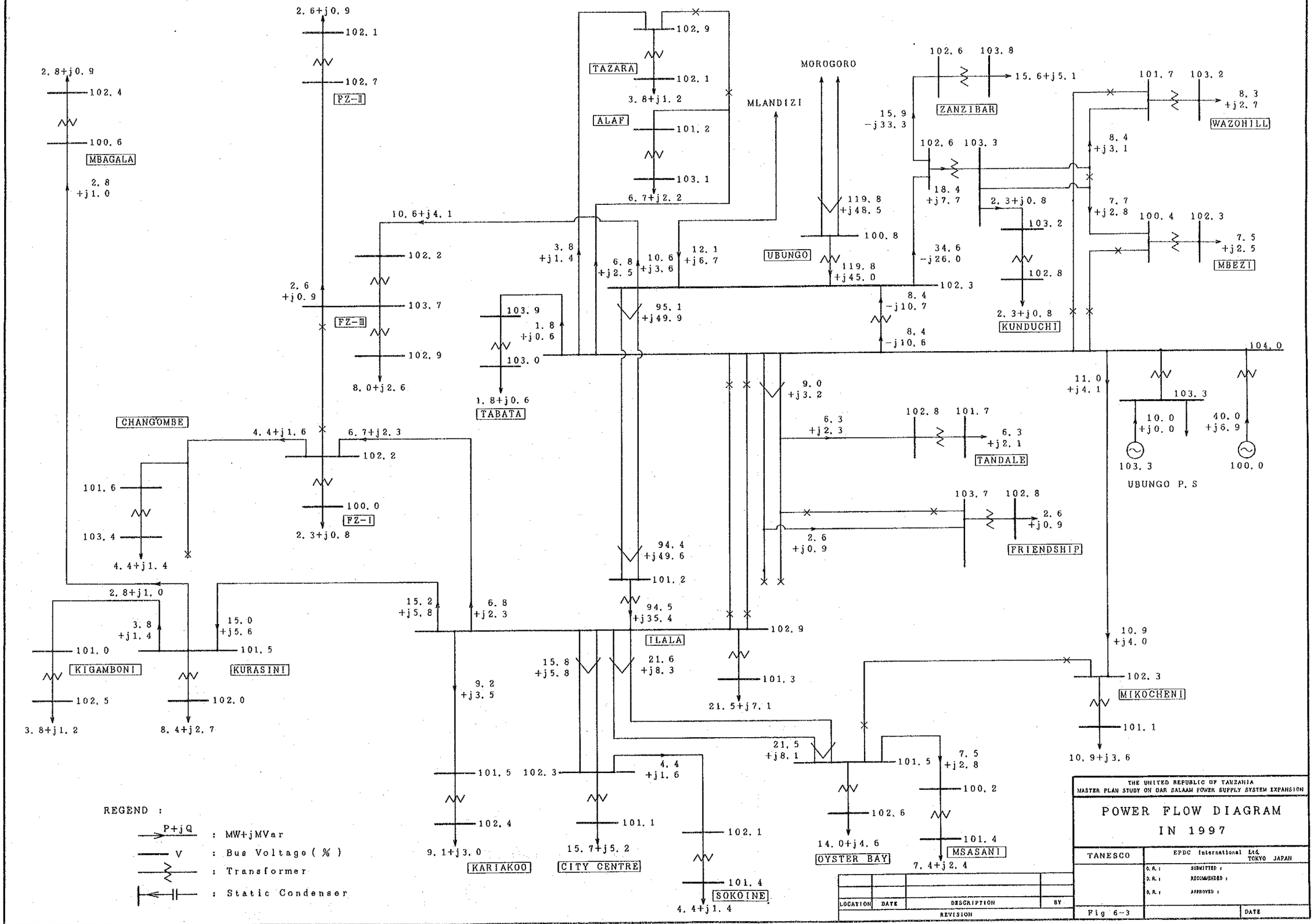
2.6+j0.9
102.1
102.7
FZ-II
2.8+j0.9
102.4
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MBAGALA
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TAZARA
102.9
102.1
3.8+j1.2
ALAF
101.2
103.1
6.7+j2.2
MLANDIZI
MOROGORO
119.8
+j48.5
100.8
UBUNGO
119.8
+j45.0
102.6
103.8
15.6+j5.1
ZANZIBAR
15.9
-j33.3
102.6
103.3
18.4
+j7.7
34.6
-j26.0
102.3
8.4
-j10.7
8.4
-j10.6
101.7
103.2
8.3
+j2.7
WAZOHILL
8.4
+j3.1
7.7
+j2.8
2.3+j0.8
103.2
102.8
2.3+j0.8
KUNDUCHI
100.4
102.3
7.5
+j2.5
MBEZI
10.6+j4.1
102.2
2.6
+j0.9
FZ-III
103.7
102.9
8.0+j2.6
3.8
+j1.4
6.8
+j2.5
10.6
+j3.6
12.1
+j6.7
95.1
+j49.9
103.9
1.8
+j0.6
103.0
1.8+j0.6
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104.0
11.0
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+j3.2
6.3
+j2.3
102.8
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6.3
+j2.1
TANDALE
103.7
102.8
2.6
+j0.9
2.6
+j0.9
FRIENDSHIP
CHANGOMBE
4.4+j1.6
6.7+j2.3
102.2
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103.4
4.4+j1.4
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FZ-I
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+j2.3
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ILALA
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+j4.0
102.3
MIKOCHENI
101.1
10.9+j3.6
3.8
+j1.4
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+j5.6
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101.5
KIGAMBONI
KURASINI
102.5
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9.2
+j3.5
15.8
+j5.8
21.6
+j8.3
101.3
21.5+j7.1
21.5
+j8.1
101.5
7.5
+j2.8
100.2
101.4
7.4+j2.4
MSASANI
101.5
102.3
4.4
+j1.6
102.4
9.1+j3.0
KARIAKOO
101.1
15.7+j5.2
CITY CENTRE
102.1
101.4
4.4+j1.4
SOKOINE
102.6
14.0+j4.6
OYSTER BAY
REGEND :
P+jQ : MW+jMVar
V : Bus Voltage (%)
: Transformer
: Static Condenser
THE UNITED REPUBLIC OF TANZANIA
MASTER PLAN STUDY ON DAR SALAAM POWER SUPPLY SYSTEM EXPANSION
POWER FLOW DIAGRAM
IN 1997
TANESCO
EPDC International Ltd.
TOKYO JAPAN
D.R. : SUBMITTED :
D.R. : RECOMMENDED :
D.R. : APPROVED :
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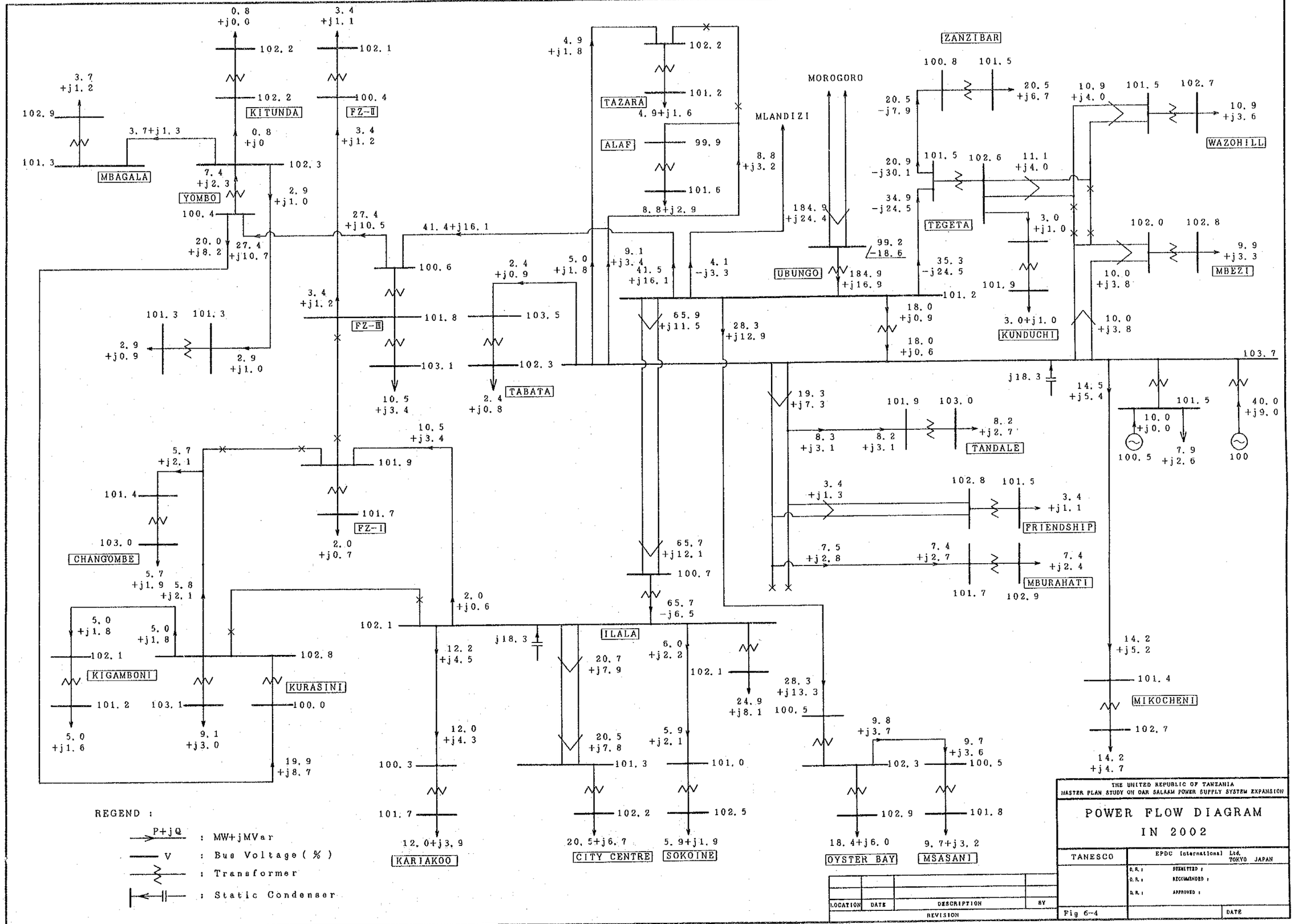
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UBUNGO
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FZ-I
TANDALE
FRIENDSHIP
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ILALA
MIKOCHENI
KARIAKOO
CITY CENTRE
SOKOINE
OYSTER BAY
MSASANI
REGEND :
P+jQ : MW+jMVar
V : Bus Voltage (%)
: Transformer
: Static Condenser
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POWER FLOW DIAGRAM
IN 2002
TANESCO
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APPROVED :
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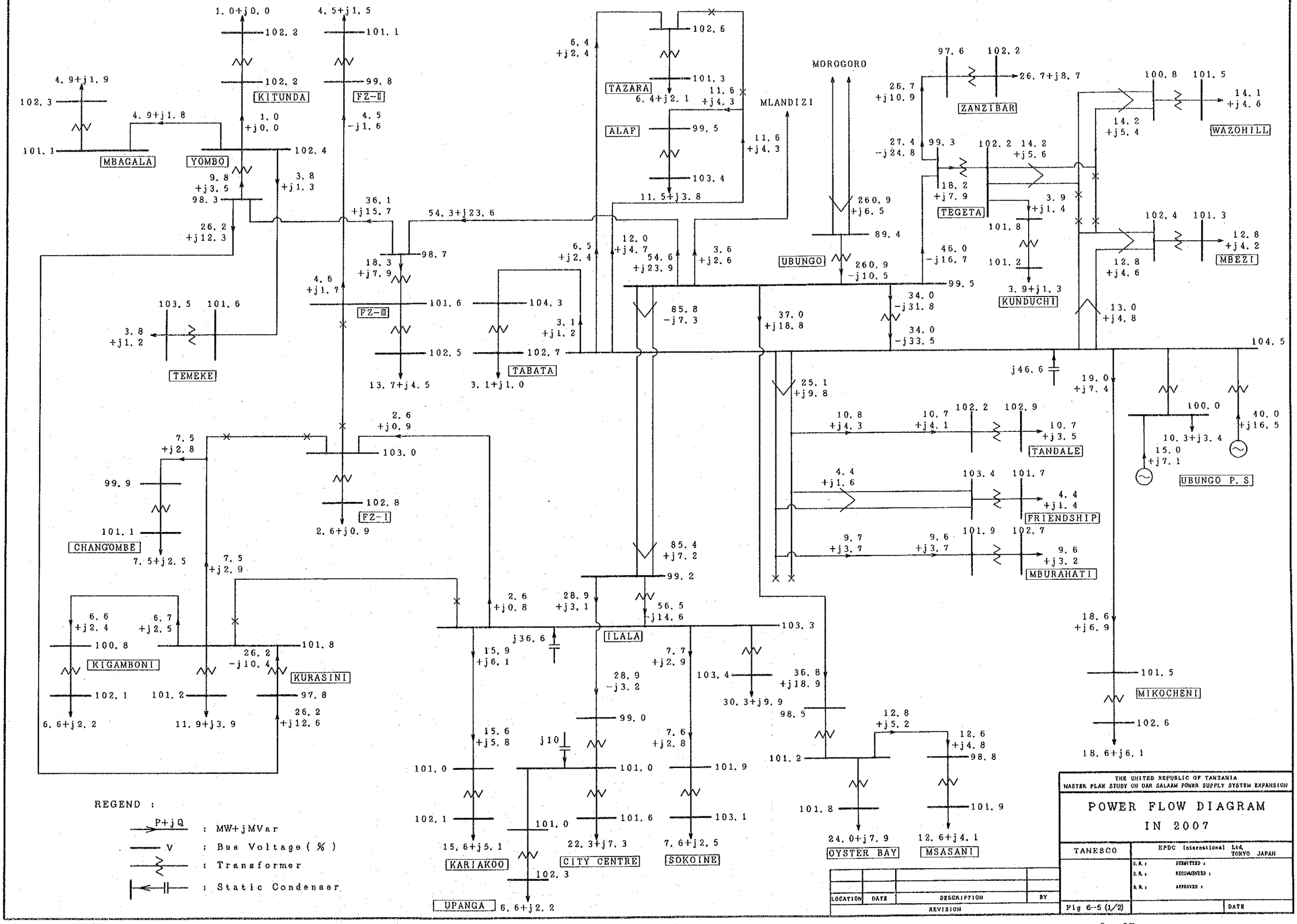
KITUNDA
FZ-E
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TEGETA
WAZOHILL
MBEZI
KUNDUCHI
UBUNGO
FZ-III
TEMEKE
TABATA
FZ-I
CHANGOMBE
KIGAMBONI
KURASINI
ILALA
TANDALE
FRIENDSHIP
MBURAHATI
UBUNGO P. S
MIKOCHENI
KARIAKOO
CITY CENTRE
SOKOINE
UPANGA
OYSTER BAY
MSASANI
REGEND :
P+jQ : MW+jMVar
V : Bus Voltage (%)
: Transformer
: Static Condenser
THE UNITED REPUBLIC OF TANZANIA
MASTER PLAN STUDY ON DAR SALAAM POWER SUPPLY SYSTEM EXPANSION
POWER FLOW DIAGRAM
IN 2007
TANESCO
EPDC International Ltd.
TOKYO JAPAN
Fig 6-5 (1/2)
LOCATION
DATE
DESCRIPTION
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REGEND :

P+jQ : MW+jMVar

V/θ : Bus Voltage (% deg)

: Transformer

: Generator

MWANZA
MUSOMA
SHINYANGA
TABORA
KILOLENI
SINGIDA
DODOMA
ZUZU-DODOMA
MTERA
IRINGA
U. KIDATU
L. KIDATU
MASIGIRA
RUMAKALI
MBEYA
MUFINDI
KIDATU
NJIRO
ARUSHA
HALE
KIYUMGI
NYUMBAYA MUNGU
SAME
TANGA
PANGANI FALLS
MOROGORO
CHALINZE
MLANDIZI
UBUNGO
Dar Es Salaam

THE UNITED REPUBLIC OF TANZANIA
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POWER FLOW DIAGRAM IN 2007

TANESCO

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Fig 6-5 (2/2)

DATE

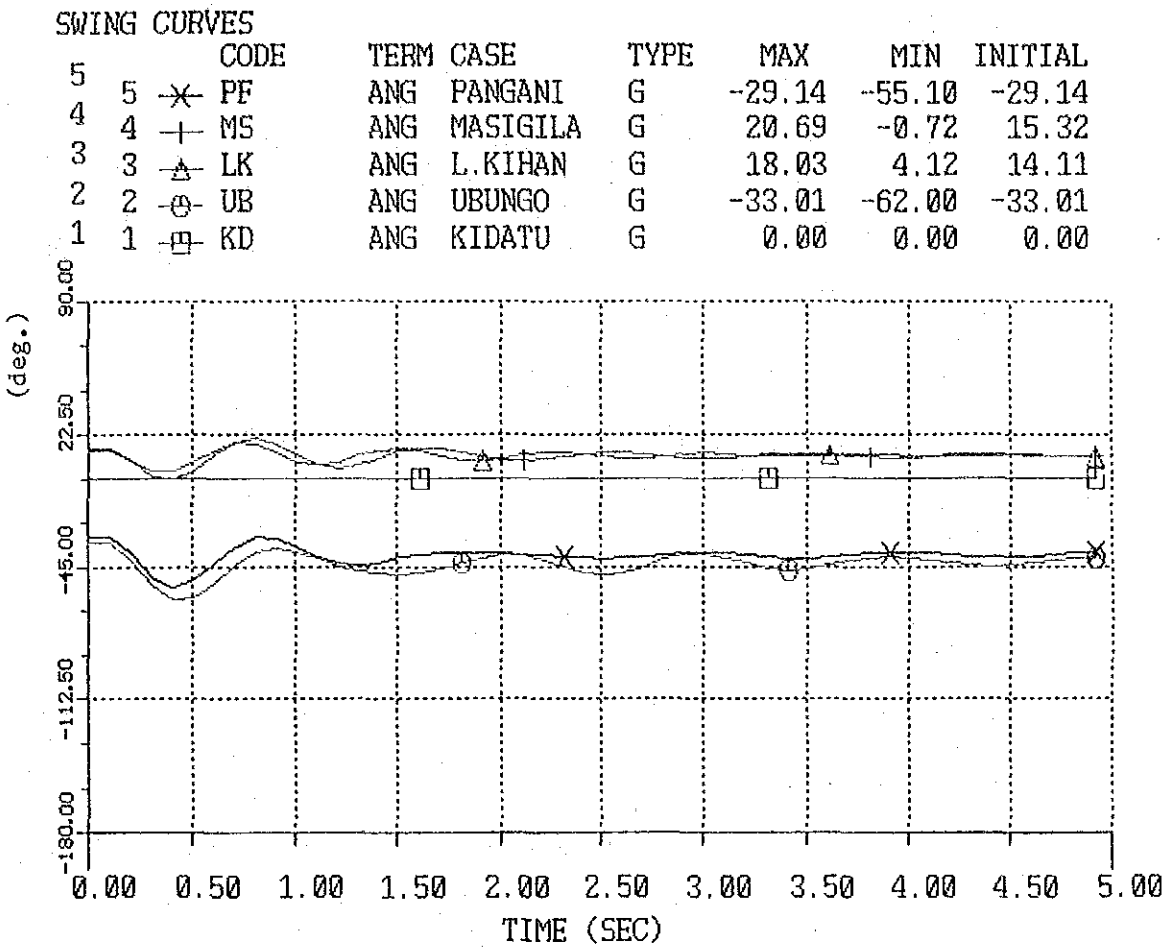


Fig. 6-6 Dynamic Stability Swing Curves, in 2007

(Kidatu - Morogoro 220 kV Line is fault, 1 circuit is opened)

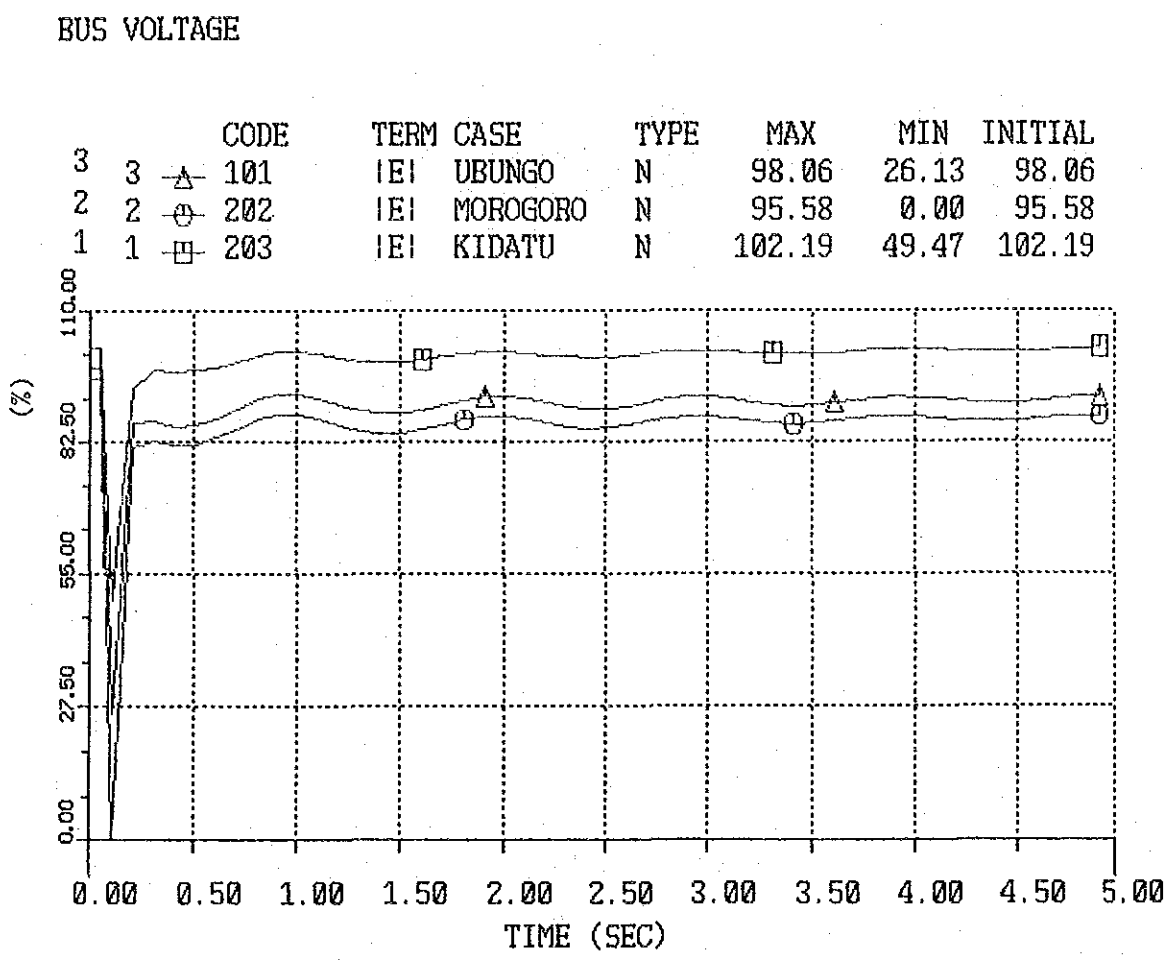


Fig. 6-7 Bus Voltage Fluctuation Curves, in 2007

(Kidatu - Morogoro 220 kV Line is fault,
1 circuit is opened)

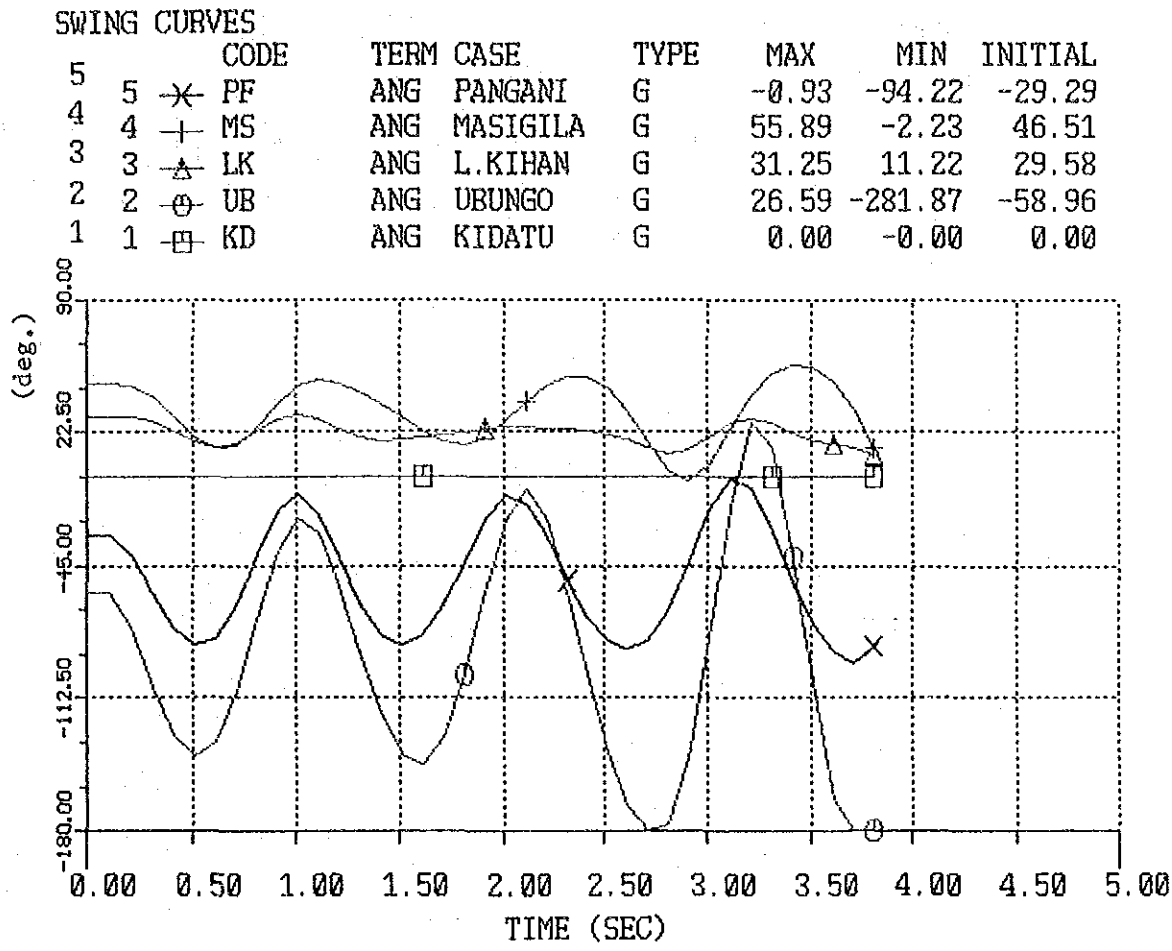


Fig. 6-8 Dynamic Stability Swing Curves, after 2007

(Kidatu - Morogoro 220 kV Line is fault,
1 circuit is opened)

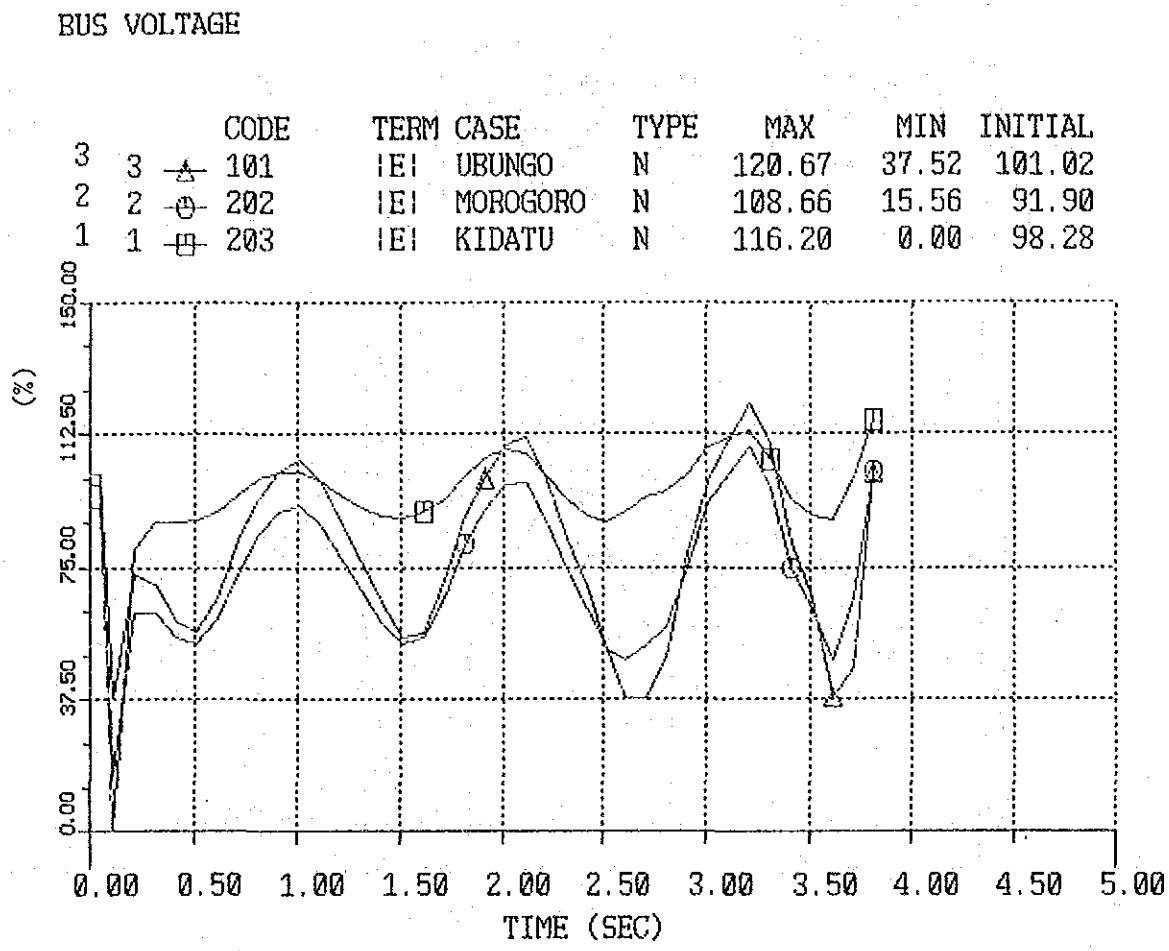
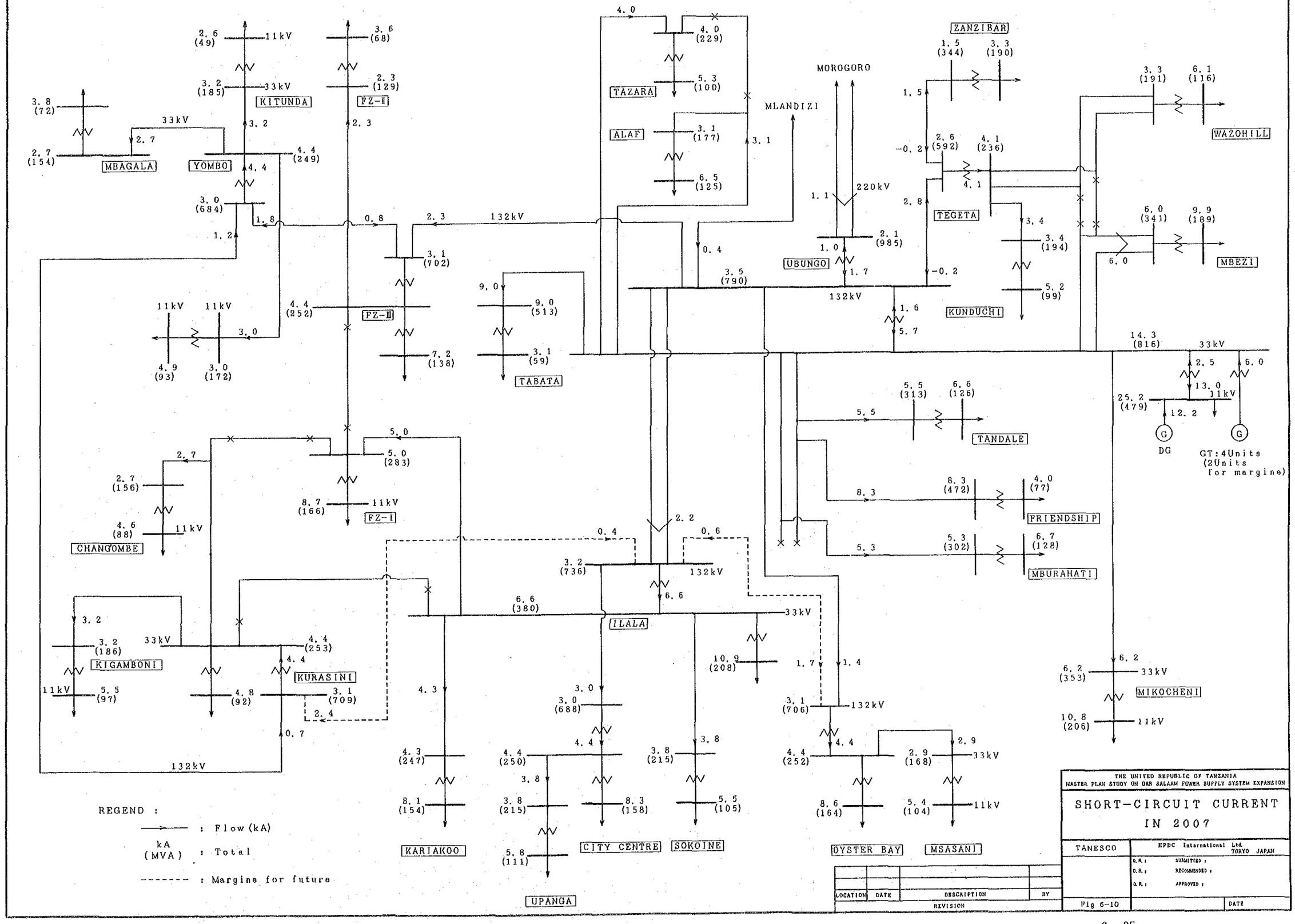


Fig. 6-9 Dynamic Stability Swing Curves, after 2007

(Kidatu - Morogoro 220 kV Line is fault,
1 circuit is opened)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FZ-II
FZ-III
FZ-I
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KIGAMBONI
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ALAF
MLANDIZI
MOROGORO
UBUNGO
ZANZIBAR
TEGETA
WAZOHILL
MBEZI
KUNDUCHI
TABATA
TANDALE
FRIENDSHIP
MBURAHATI
ILALA
KARIAKOO
CITY CENTRE
SOKOINE
UPANGA
OYSTER BAY
MSASANI
MIKOCHENI
DG
GT:4Units
(2Units
for margine)
11kV
33kV
132kV
220kV
REGEND :
: Flow (kA)
kA (MVA) : Total
: Margine for future
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SHORT-CIRCUIT CURRENT IN 2007
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Fig 6-10
LOCATION
DATE
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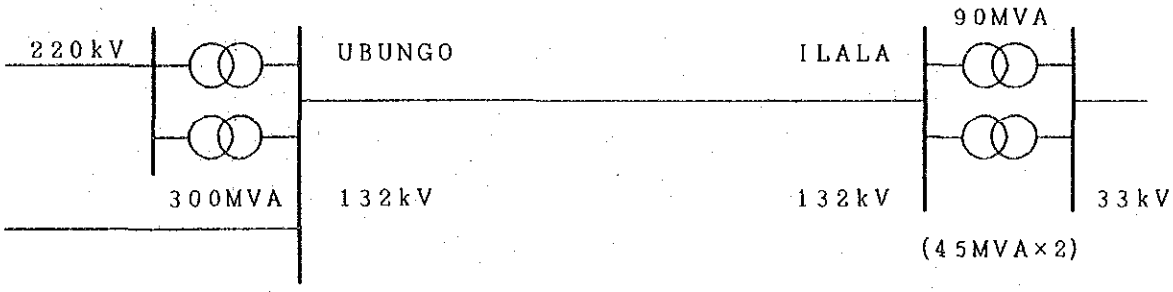
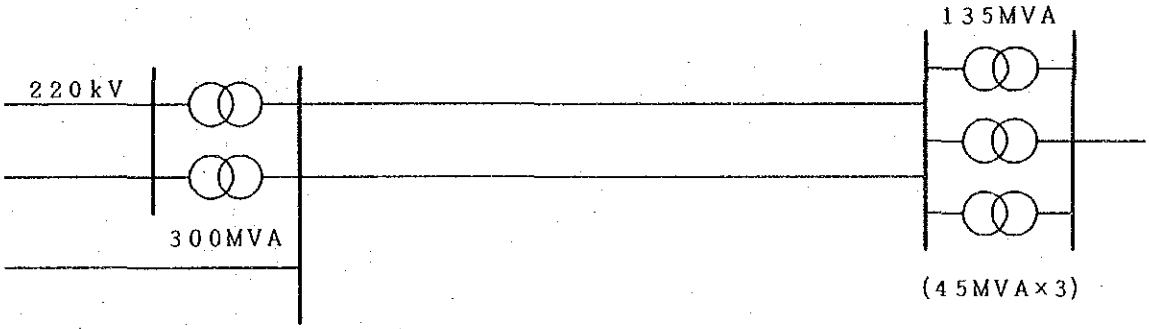
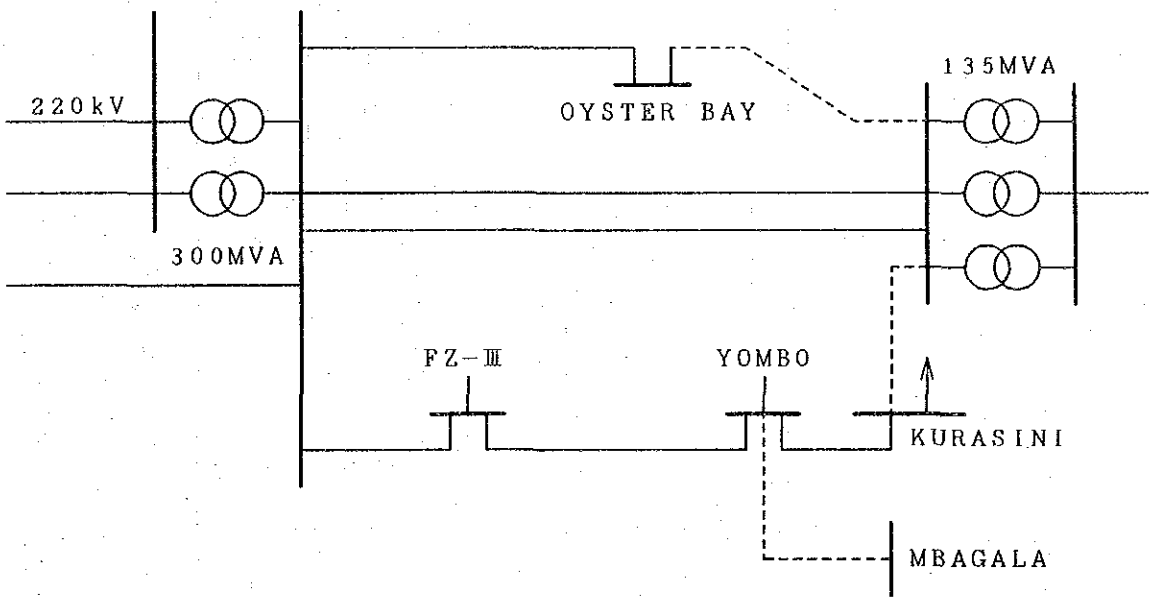
(A) EXISTING (1993)



(B) NEAR FUTURE (AFTER 1994)



(C) MEDIUM AND LONG-TERM (BEFORE 2007)



(-------: AFTER 2007)

Fig. 6-11 EXPANSION PROCESS OF 132kV LINES

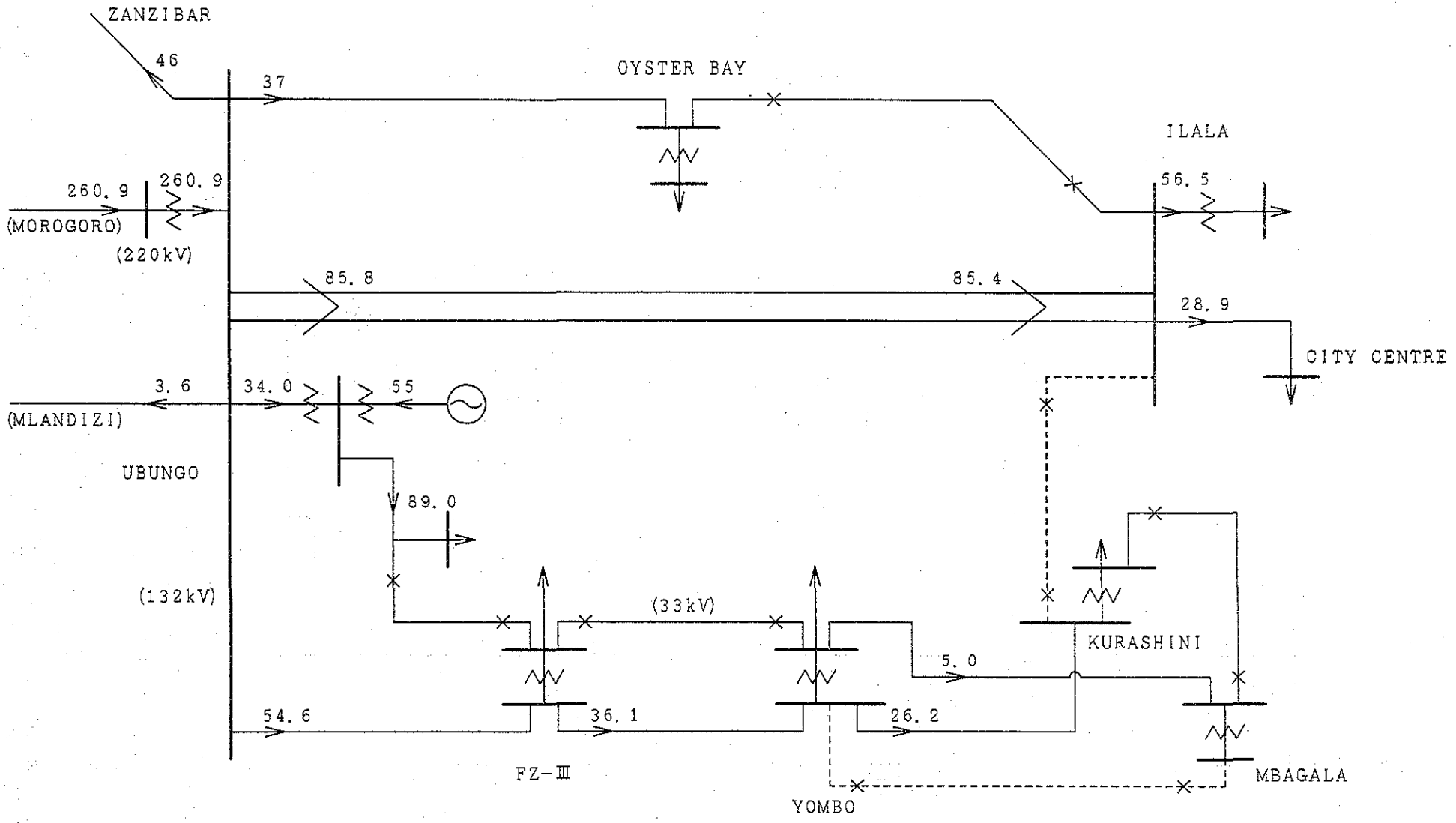


Fig. 6-12 POWER FLOW OF 132kV LINES IN 2007 (MW)

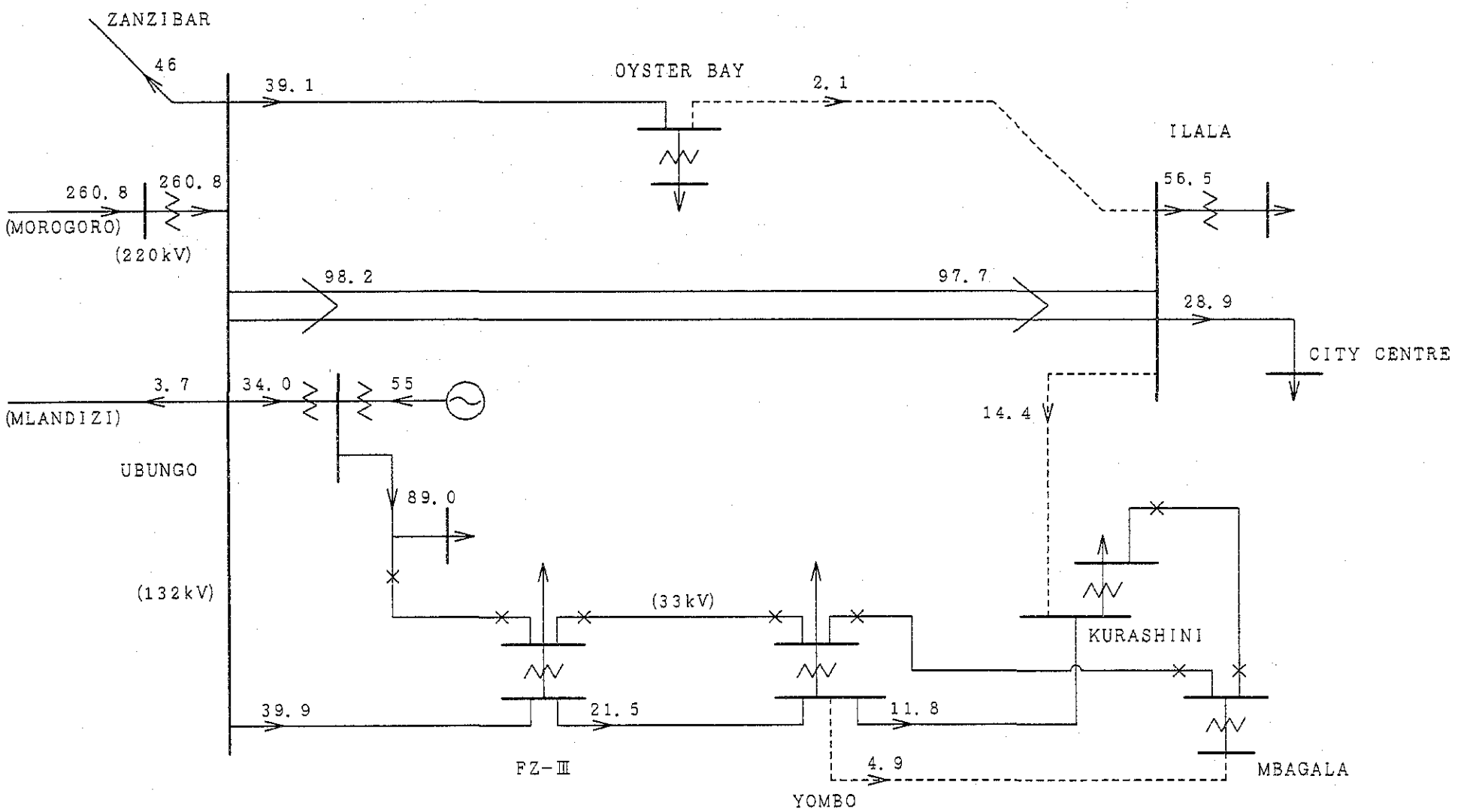


Fig. 6-13 POWER FLOW OF 132kV LOOPED LINES IN 2007 (MW)

CHAPTER 7

IMPROVEMENT
AND
ENHANCEMENT PROGRAMS OF MANPOWER
AND
FACILITIES RELATED TO OPERATION
AND
MAINTENANCE

Chapter 7. Improvement and Enhancement Programs of Manpower and Facilities Related to Operation and Maintenance

Page

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CHAPTER 7 IMPROVEMENT AND ENHANCEMENT PROGRAMS OF MANPOWER AND FACILITIES RELATED TO OPERATION AND MAINTENANCE

7.1 PRESENT STATE OF OPERATION, MAINTENANCE AND IMPROVEMENTS

7.1.1 Transmission Line Facilities

(1) Present State

1) 220 kV and 132 kV Transmission Lines

The operation of 220 kV and 132 kV transmission lines is executed by the System Control Division shown in Fig. 7.1.1-1.

On the other hand, the maintenance of transmission lines is executed by the Transmission Line Division. This division also takes charge of work concerning all transmission lines in Tanzania, such as the fault recovery, new construction, expansion, etc. of transmission lines.

In addition, TANESCO for the first time executed the construction of the 132 kV transmission line between Songa and Tanga as the contractor in Pangani Falls Development Project. Therefore, the Transmission Line Division is conducting not only maintenance but also construction of transmission lines.

The supervisors and linemen belonging to the Transmission Line Division have been showing excellent performance. However, the efficiency of maintenance and construction work is impaired by the shortage of construction machines and tools.

In case of no construction work, all supervisors and linemen are engaging in the maintenance work of transmission lines.

At present, there is no design section in Transmission Line Division of TANESCO, and TANESCO solely depends on the technical assistance from foreign consultants for design work. It is necessary to increase and train personnel so that TANESCO can conduct design work by himself.

2) 33 kV Transmission Lines

In TANESCO, 33 kV transmission lines are operated by the Distribution Line Division and maintained by the Regional Manager's Offices, as described later in 7.1.3.

(2) Organization and Personnel

1) Transmission Line Division

The organization and personnel of the Transmission Line Division are shown in Fig. 7.1.1-1. As mentioned above, the maintenance and construction of 132 kV transmission lines are executed by the Transmission Line Division.

At present, a shortage of personnel is not recognized in terms of these works. Newly assigned linesmen and supervisors are trained during construction work in the form of on-the-job training (OJT).

However, since TANESCO does not have a training center for the training of linesmen, it is necessary to establish a training center.

Similarly, the Transmission Line Division does not have a design section. For the sake of a speedy fault recovery, construction, and expansion of transmission lines, it is necessary for TANESCO to be able to conduct design work by himself. For this purpose, it is necessary to train personnel capable of design work and at the same time to improve and expand facilities required for design work, such as computers etc.

(3) Construction Machines and Other Equipment

As previously described, the Transmission Line Division of TANESCO is conducting not only maintenance but also construction of transmission lines. Therefore, the Transmission Line Division requires various tools, vehicles for the transportation of materials, and construction machines.

The following list shows the relatively new tools, construction machines, etc. owned by Transmission Line Division.

1) Tools, Construction Machines, etc. owned by TANESCO

	Sets/Nos.
- Linemen hand tools	20
- Truck crane up to 20 tons	1
- Winches (no engine)	3
- Gin poles for tower erection	5
- Pull lifts	20
- Hook ladders	10
- Tirfor	2
- Conductor compression machines	5

In addition, the following tools and construction machines are considered to be necessary for the Transmission Line Division in order to speed-up the maintenance and construction work of transmission lines:

1) Tools

	Sets/Nos.
- Linemen tool sets	20
- Aluminum or fiber glass	20
- Pull lifts (hoists) 1.5 tons	36
- Pull lifts 2 tons	32
- Pull lifts 3 tons	13
- Tirfor 2 tons	10
- Conductor compression machines (for Wolf and Bison)	5

2) Construction Machines, etc.

- Bulldozer	1
- Wheel loader/blade	1
- Excavators	2
- Concrete mixers (medium size)	2
- Concrete vibrators	2
- Conductor tensioner	1
- Conductor braking M/C	1

- Motorized grass slashers 6
- 5-ton trailers 2
- Communication equipment 10
- Temporary line restoration structures 5
- Hot line insulator washer 1
- Wheeled truck crane 20 tons 1

3) Vehicles
- 4WD vehicles (pickups) 18
- 4WD station wagon 9
- 5-7 ton lorries 8
- Tractors 6

(4) Improvements

1) Personnel

It is considered, that the present number of personnel are sufficient for the maintenance and construction work of transmission lines. However, in view of the plan to execute design work at TANESCO, it is necessary to have a plan for the increase in personnel including the training of this personnel.

2) Establishment of Design Section

At present, design of transmission lines is not conducted by the Transmission Line Division. TANESCO solely depends on the technical assistance from foreign consultants for design work, and TANESCO himself can not conduct design work due to his organization.

In the case of fault recovery work, prompt countermeasure is required concerning the study of the strength of supports and stringing conditions. For this reason, it is necessary to conduct design work by TANESCO.

The training of personnel and the introduction of computers should be included in the plan for the establishment of the Design Section.

3) Training of Personnel

At present, newly assigned personnel are trained at construction sites in the form of on-the-job training. Because the construction of overhead transmission lines involves work on steel towers, basic training must be given before assignment. The establishment of a training center is necessary for this reason.

And, to get the highly-trained technology:

a. Training in the foreign country

b. Training in Tanzania by experts from foreign country are considered, and these training will include:

a. Training in the foreign country
   - Training at construction sites.
   - Witnessing to various test.
   - Visiting manufacturing factories.

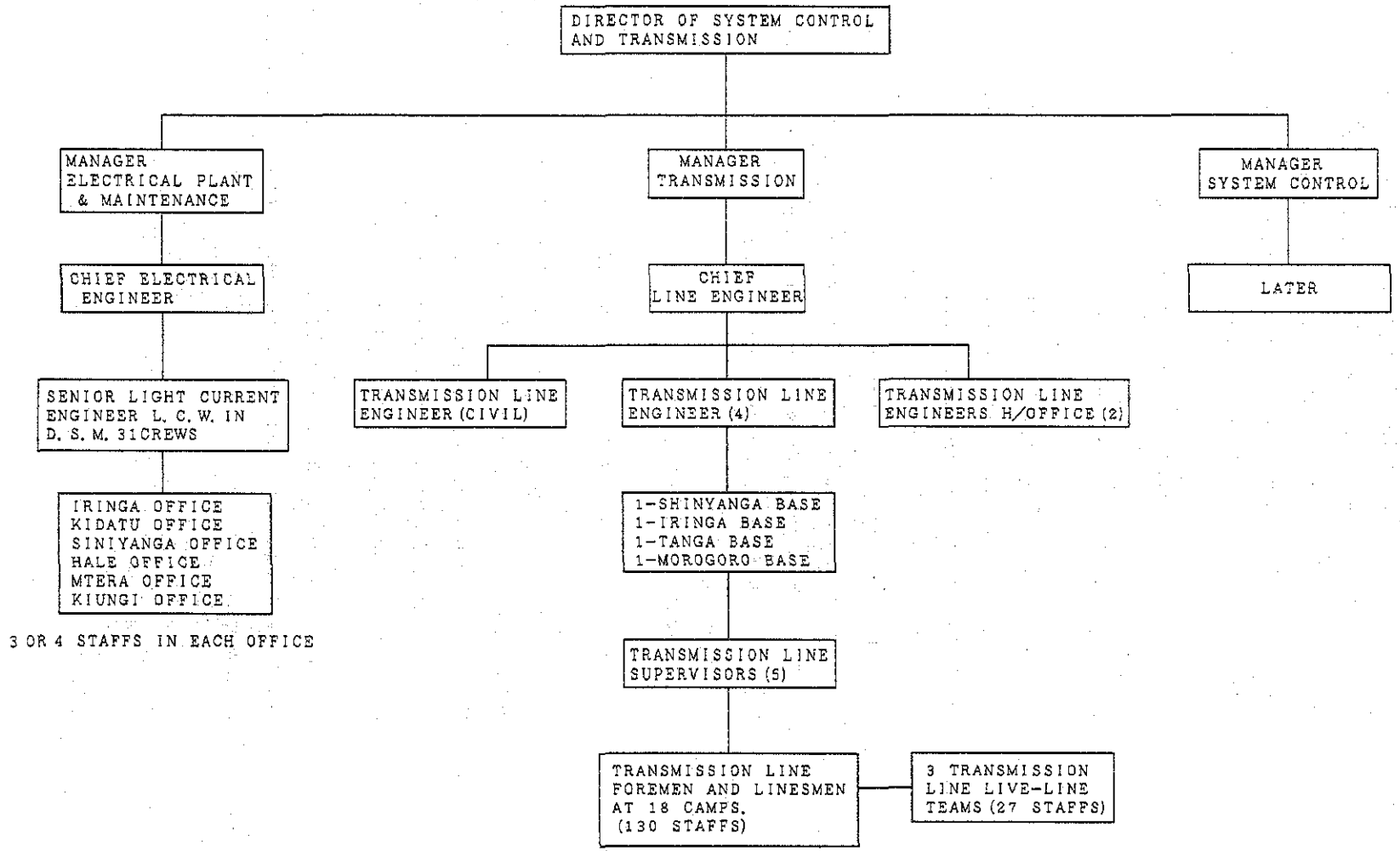
b. Training in Tanzania by experts from foreign country
   - Investigation and survey works.
   - Design works.
   - Supervision of construction works.

4) Enhancement of Tools and Construction Machines

The Transmission Line Division of TANESCO is conducting not only maintenance but also construction work of transmission lines. The tools, construction machines, etc. available at present are insufficient in number, and some are not working in good order because of the shortage of spare parts.

It is necessary to provide tools, construction machines, etc. for prompt execution of fault recovery and efficient construction work.

Fig. 7. 1. 1-1 ORGANIZATION CHART OF SYSTEM CONTROL AND TRANSMISSION



7.1.2 Substation Facilities

(1) Present State of TANESCO

The findings from our field survey indicated an insufficiency of the manpower needed for the operation, maintenance, and operation management of existing facilities.

Therefore, we describe the plan which TANESCO is considering for the future and prepare and propose a plan that JICA recommends in the master plan.

(2) TANESCO's Plan

Fig. 7.1.2-1 shows the organization concerning Electrical Workshop in TANESCO. The personnel involved in the maintenance of substations are organized under the Manager, divided into the 3 fields of: Dar Es Salaam and its districts, other regions, and construction section. Each of these sections has engineers, technicians, artisians, apprentices, and labourers. However, unfortunately, there are few persons having sufficient experience and performance in the maintenance of substations, and the lack of necessary equipment and materials also impede complete execution of work. Setting an eye on this fact, TANESCO has developed a training program for technical personnel aimed at future improvement. The contents of this program are as follows:

1) Training Program

The engineers and technicians engaged in the maintenance work of substations will be trained in the following fields:

- Design
- Construction work
- Operation
- Maintenance

This training is intended to train engineers and technicians who are necessary for the execution of this project.

At present, TANESCO has established the Training Institute, and the graduates from this institute have been educated to the Certificate level as technical personnel. Most of the graduates are employed by TANESCO.

The number of substation maintenance personnel working for TANESCO is 53, as shown below:

- Engineers 3
- Technicians 30
- Electricians 20

  Total 53

In the Training Program planned by TANESCO, the following are requested as the contents of training related to the design, construction, operation, and maintenance of substations:

- Engineers and technicians to be trained
  (1) Engineers: 8
  (2) Technicians: 40

- Requested period of training
  (1) Engineers: 3 months
  (2) Technicians: 6 months

- Level of training
  (1) Engineers

  The design, construction, operation, and maintenance of substations. To be able to conduct maintenance of all substation equipment unaided.

  (2) Technicians

  To be able to understand electrical and mechanical drawings. To acquire general knowledge about the maintenance of main substation equipment.

- Method of training
  (1) Lectures
  (2) Practical training (e.g., factory training)
  (3) Participation in projects
  (4) Field trips

2) Construction Equipment

Although TANESCO does not have the list of construction equipment, it requests the following items as the equipment which is necessary in the construction of substations:

- Patrol cars with communication facility
- Trucks for transportation of materials
- Trucks equipped with lifts
- Winches
- Conductor paying-out machine
- Others

3) Patrol and Maintenance

(a) Intervals of regular inspection and preventive security patrol of substations

- Once/year Inspection of main equipment
- Once/month Inspection of DC power supply and power supply for auxiliary units
  Hot spots on bus conductors and oil leakage from transformers should be monitored by inspection.

(b) Fault recovery procedure of substation

- Engaged in work procedure of the entire maintenance work.
- Chief Electrical Engineer should take the full responsibility for the work conducted by maintenance engineers.

(3) Improvement

1) Training of personnel
2) Tools and vehicles
3) Measuring equipment
4) Computers

7.1.3 Distribution Line Facilities

(1) Present State of Operation and Maintenance

The operation of the 33 kV transmission lines as well as the 11 kV and low-voltage distribution lines (hereinafter called distribution lines) is executed by Distribution and Commercial Services Division. Maintenance of the distribution lines, however, is the responsibility of the Regional Managers' Office.

Figs.7.1.3-1 and 7.1.3-2 are the respective organizational charts for the Distribution and Commercial Services Division and the Regional Managers' Office.

The Regional Managers' Office has two Maintenance Groups, each of which consists of the following members:

Laborers	3 persons
Linesmen	6 "
Supervisor	1 person
Foreman	1 "

In order to assure normal and trouble-free operation of the above distribution line facilities, TANESCO implements regular and preventive patrols at a rate of twice yearly. Fault recovery work is executed under the supervision of a Regional Manager.

The number of personnel of respective office and outline of distribution line facilities are shown in Table 7.1.3-1 for reference.

(2) Construction Machines and Other Equipment

1) Tools, construction machines and equipment owned by TANESCO

There is no adequate data providing full details about the tools, construction machines and equipment currently being owned by TANESCO and used for the execution of work on the 33 kV transmission lines, 11 kV and low-voltage distribution lines.

Judging from the current level of TANESCO's construction work and maintenance work it can be inferred, however, that there is

an extremely critical shortage of tools and construction machines/equipment at present.

2) Tools, construction machines and equipment required by TANESCO

In order to assure the normal and trouble-free operation of TANESCO's distribution facilities as well as to ensure the speedy execution of maintenance work on the distribution lines and of construction work, the following tools, construction machines and equipment will be essential.

- Patrol car with communications facility
- Truck for transportation of materials
- Truck crane with up to 7 tons lifting capacity
- Boom lift car
- Winch
- Tensioner
- Tirfors
- Pole-pit grilling machine
- Others

(3) Computer System

The Distribution & Commercial Services Division currently uses computers for tasks such as data processing of distribution loss and CAD-assisted drawings. However, the number of computers and their performance capabilities are not sufficient for the variety of tasks to be processed and the actual amount of work. As a result, the everyday routine tasks are not being handled in an accurate and speedy manner with the use of computers. This creates the need to expand the computer system, including the training of personnel.

(3) Improvements

In order to ensure the accurate and speedy execution of survey, measurement, design, construction, operations, and maintenance works on the distribution lines, further improvements will be required in the following areas:

1) Personnel

Training of personnel, including computerized task handling, will be essential.

2) Expansion of tools, construction machines and equipment

As stated earlier, there is a chronic shortage of tools, construction machines and equipment needed by TANESCO's various departments. There is thus a requirement to expand the tools, construction machines and equipments available at TANESCO to meet not only the needs of speedy, effective but also in order to ensure an improved customer service capability and the fast execution of construction and repair work.

3) Computer System

The use of computers is absolutely essential in order to ensure the accurate and speedy execution of survey, measurement, design, construction, operations, and maintenance works on the distribution lines. Seeing that electric rate is the only source of revenue for the electric utility, consideration should also be given to the installation of more advanced computers for data processing in connection with the collection of charges for electricity, including customer data.

Fig. 7. 1. 3-1 ORGANIZATION CHART OF DISTRIBUTION & COMMERCIAL SERVICES DEPARTMENT

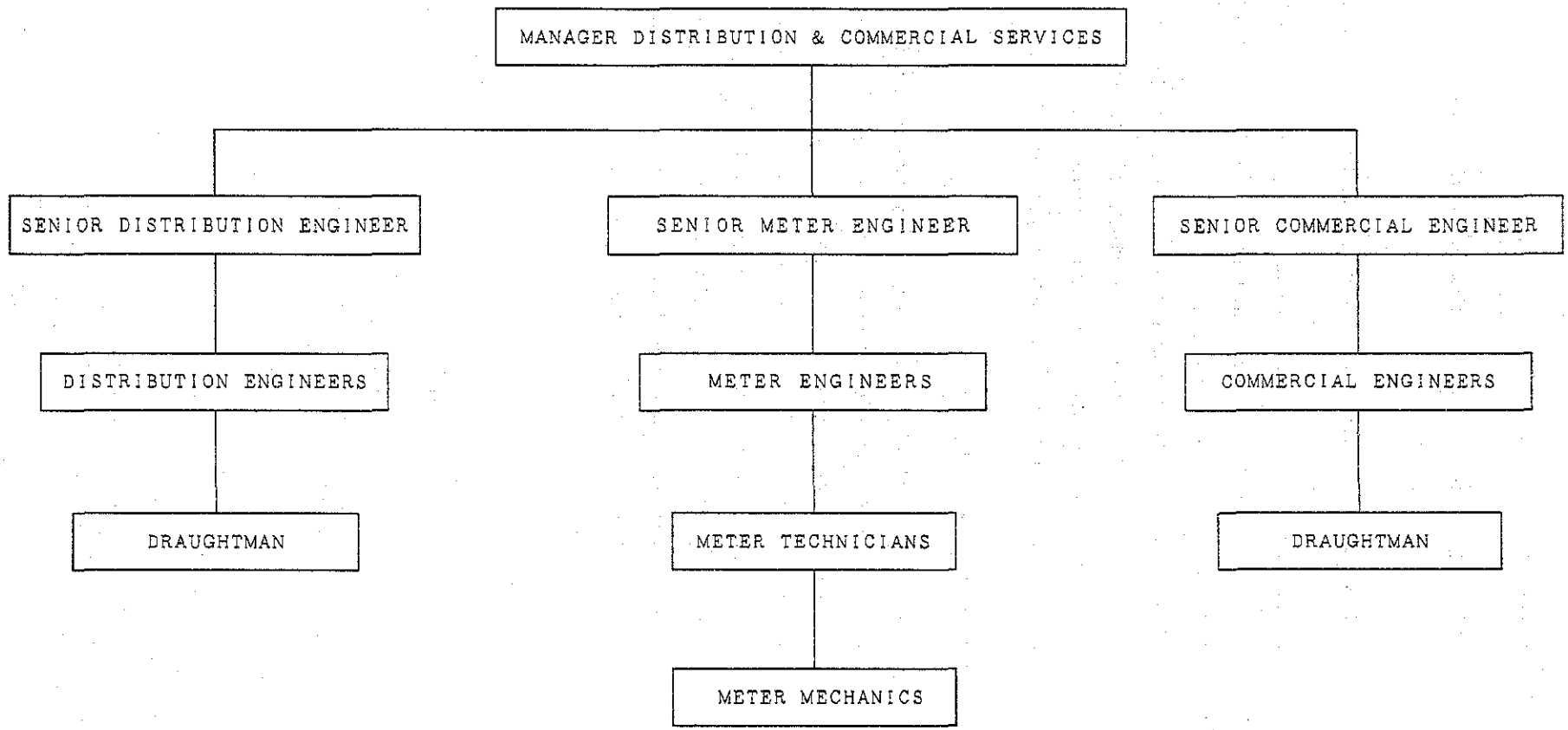


Fig. 7. 1. 3-2 REGIONAL OPERATIONS ORGANIZATION CHART

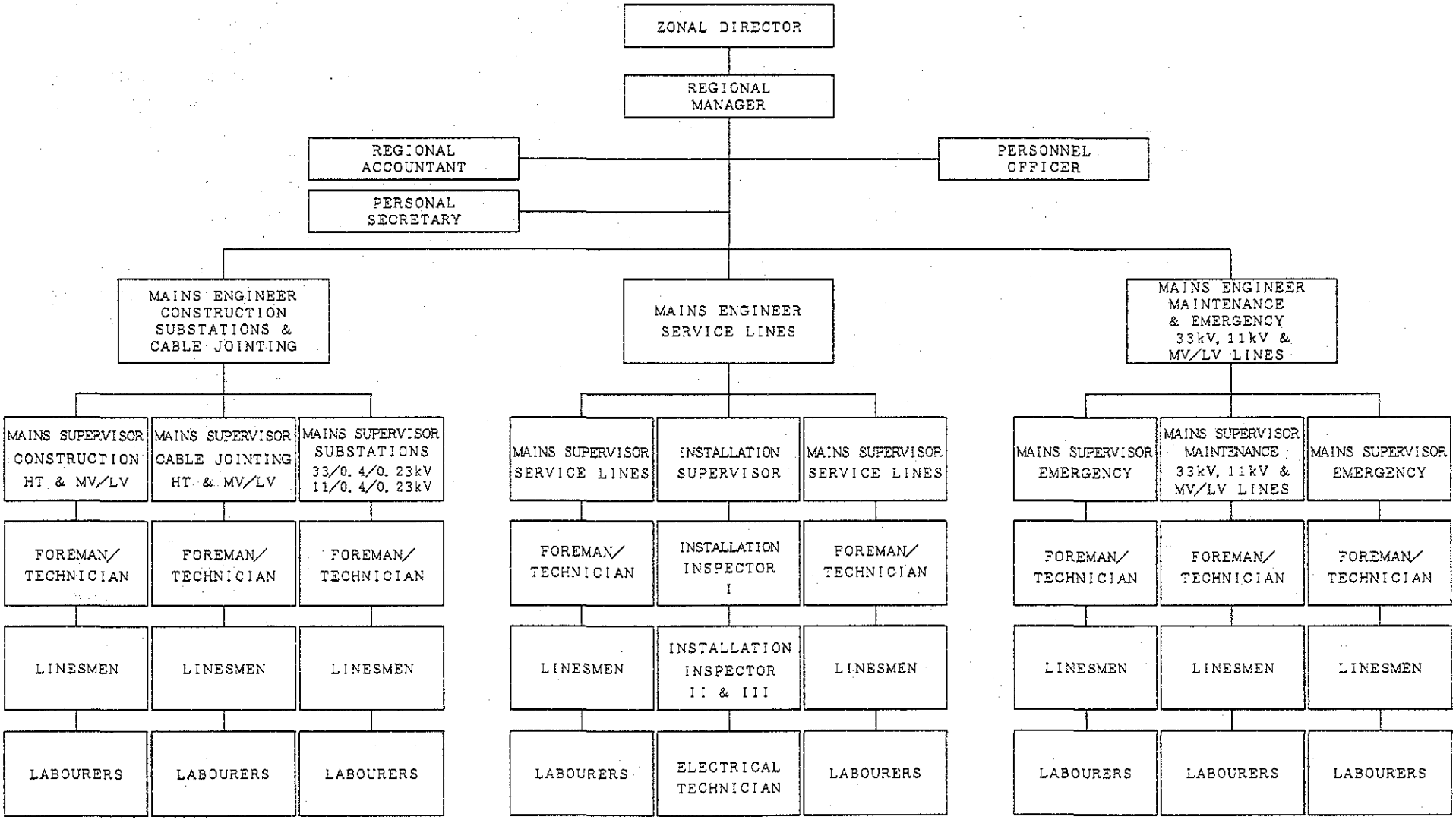


Table 7.1.3-1 Number of Personnel and Distribution Line Facilities

Items \ Working Office		Operation & Planning Distribution & Commercial Services	Regional Manager's Office				
			Kinondoni "N"	Kinondoni "S"	Ilala	Temeke	Total
Personnel	Office worker	6	6	6	6	6	24
	Worker	30	34	194	45	183	456
	Total	36	40	200	51	189	480
Service area (sqkm)			60	54	50	45	209
Number of consumer			26,234	12,057	34,491	18,097	90,879
Substation	Number of S/S		2	4	5	3	14
	No. of banks (set)		3	8	10	5	26
	Capacity (kVA)		31,500	52,500	120,000	35,000	239,000
	No. of feeder		(8) 5	(2) 12	26	8	(10) 51
Overhead Distribution Facilities	Steel pole (pcs)		140	118	165	175	598
	Wooden pole (pcs)		1,171	1,376	1,071	1,350	4,968
	Total (pcs)		1,311	1,494	1,236	1,525	5,566
	Length of 11kV line (km)		93.72	118.74	85.70	84.00	382
	Length of L/V line (km)		3,620.43	3,510.71	3,254.00	3,724.96	14,110
	Number of transformer (set)		174	270	347	238	1,029
	Transformer capacity (kVA)		57,078	79,610	148,290	79,390	364,368
	Number of switches (set)		17	41	29	21	108
	Number of drop wire (pcs)			586	7	476	1,069
Underground Distribution Facilities	Length of 11kV line (km)			2,445	23	4,947	7,415
	Number of transformer (set)			64	25	55	144
	Number of switches (set)						
Vehicles	Vehicle with tools & material	1	2	2	3	2	9
	Bucket track				1		1
	Pole setting car						
	Patrol car		1		1		2
	Total	1	3	2	5	2	12

7.1.4 Telecommunication Facilities

(1) Present State

Light Current Workshop (hereinafter called LCW) has been established by TANESCO as an organization for the maintenance and operation of telecommunication equipment and electronic equipment. LCW has its own office in Dar Es Salaam and supervises nationwide maintenance of facilities under its control. The office is largely occupied by rooms for the repair of equipment. There is a warehouse for spare parts next to the building.

The engineering staff of LCW are stationed at power stations and substations, however, because of the shortage of personnel, they are stationed at only 6 offices in the country.

In addition to telecommunication equipment, LCW takes charge of the whole range of electronic equipment, such as AVR, phase modifiers, etc. at power stations and automatic load shutdown equipment in the field of distribution lines.

The main duties of LCW are the trouble shooting and the repairing of equipment. When a trouble in equipment cannot be responded by local staff, maintenance team of LCW will be dispatched with necessary spare parts and tools. About a half of the total personnel of LCW are normally engaged in trouble shooting. Because the maintenance area is extended over entire Tanzania, maintenance teams are often dispatched by means of long-distant buses and airplanes. Although LCW owns 2 vehicles for the maintenance purpose, however, one is out of order and repairing of this is not planned.

The judgment concerning the location of a fault is made based on telephone communication between LCW and maintenance personnel of local office. If there is no personnel in charge of telecommunication, the situation of faults is judged based on the information from electrical maintenance personnel, operators, or other staff who are not qualified for this purpose, and this is a factor inhibiting appropriate and prompt action. On the other hand, because of the extreme difficulty in recruiting telecommunication

personnel within the country, it is considered difficult to increase the number of personnel stationed at substations. In this situation, it is essential for LCW to make the best use of its mobility. In future, it is considered necessary to construct a system in which the state of the operation of telecommunication equipment and the conditions of faults can be monitored centrally at LCW. The personnel other than those needed for trouble shooting are engaged in the repair of faulted equipment. Because many of the staff are constantly needed for trouble shooting and repair, regular inspection for preventive maintenance is not executed. Management of equipment is also very insufficient. There were many equipment of which quantity, manufacturing date, manufacturer etc. are unknown.

(2) Organization, Personnel, etc.

The organization chart is shown in Fig. 7.1.1-1. As mentioned above, it is difficult to recruit personnel for telecommunication in the country. Therefore, the personnel engaged in this service has been insufficient.

Scheduled recruiting of personnel is necessary in order to achieve prompt fault recovery as well as to execute preventive maintenance, regular inspection, etc.

(3) Equipment, Repair Tools, etc.

LCW is suffering from general shortage of measuring instruments and repair tools. They do not have calibration equipment. Since local LCW offices have only simple tools such as testers, they do not execute trouble shooting.

Because calibration equipment is the standard for all measuring equipment, it should be furnished at LCW on all accounts.

(4) Improvements

The following measures are considered for the full utilization of the functions of Light Current Workshop:

- Recruitment and training of personnel.
- Provision of calibration equipment, measuring instruments, and repair tools.
- Provision of vehicles for the transportation and communication of maintenance teams.
- Provision of equipment at local LCW offices.

7.1.5 Protection Relay System

(1) Present State

The Protection Workshop is an organization established by TANESCO for the purpose of ensuring the operation and maintenance of protective relays. This Protection Workshop has a special office of its own in Dar Es Salaam. Its responsibility is to act as a central coordinator for all of TANESCO's protective relay facilities.

The Office is divided into a office proper in which the engineers perform desk work such as the registration and filing of data and a workshop in which protective relays are tested and/or repaired. The workshop also stores test equipment and spare parts.

In addition to the above Office, TANESCO also has three branches of the Protection Workshop in Tanzania (located in Mwanza, Arusha, and Iringa, respectively).

The tasks of the Protection Workshop include:

a) Study, design, and installation of protective relay systems.
b) Control, testing, and repair of protective relay.
c) Troubleshooting in case of fault/accident of protective relay.
d) All types of studies (fault and power flow calculation etc.)

Regular inspection of protective relay equipment is performed at a frequency of approximately once every two years and carried out mainly in the form of individual equipment tests.

The maintenance is carried out on a scale covering the national territory of Tanzania as a whole, engineers need to take the necessary instruments such as the testing equipment with them on their journeys for the execution of regular inspections and measures in response to fault or accidents. The transportation needs for this are met by the use of airplanes and vehicles. In emergencies, the use of vehicles is essential when no airplane is available. Since the Protection Workshop has only one car available, it needs to hire vehicles from the TANESCO Headquarter Office at times of multiple fault and/or accidents, with the inevitable result of being late in meeting urgent service needs.

The engineers are constantly visiting locations throughout the national territory of Tanzania to carry out regular maintenance works and fulfill missions such as troubleshooting to repair faults/accidents. The Protection Workshop is suffering from a chronic shortage of personnel. None are the three branch offices permanently staffed with resident personnel.

(2) Organization and Personnel

Fig. 7.1.5-1 shows the organization chart of the Protection Workshop. Responsibilities in the Protection Workshop are broadly demarcated as follows.

Engineer : Studies relating to the power system, studies/design/ installation of the protection system.

Technician: Control/testing and repair of protective relays and troubleshooting measures in case of fault/accident.

However, in view of the chronic shortage of personnel, a problem already referred to above, the Protection Workshop personnel has great difficulty meeting its tasks so that both the engineers and technicians cooperate with each other in the execution of their work without abiding by the demarcation of their respective responsibilities.

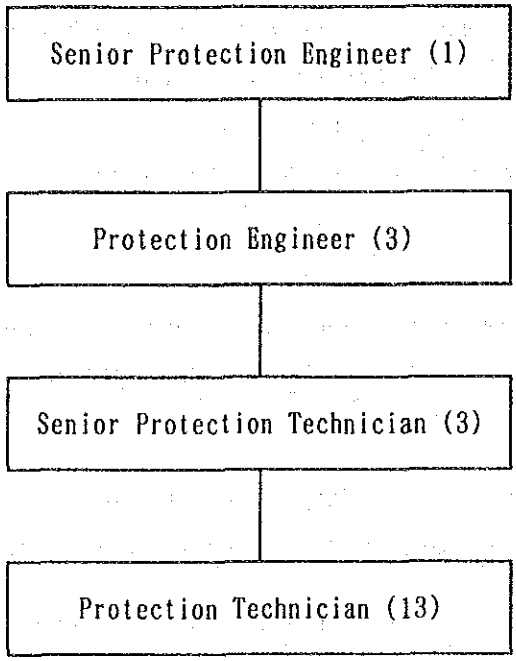
In addition to personnel reruitment plans, it is therefore essential to establish training programs designed to secure the existing engineering and technical personnel and upgrade their technical skills and competence.

(3) Improvements

Consideration should be given to the following actions in an effort to ensure that the Protection Workshop will be able to achieve its full capacities in terms of operation and maintenance.

- Recruitment programs for engineering and technical personnel
- Training programs for engineers and technicians
- Expansion of the vehicles

Fig. 7.1.5-1 Organization of Protection Workshop



( ): Number of Person

7.2 TRAINING PROGRAM

7.2.1 Transmission Line Division

(1) Present State

At present, TANESCO does not have a division dealing with the design of transmission lines. It depends solely on the technical assistance from foreign consultant for design works. Moreover, TANESCO does not have a training facility for personnel engaged in maintenance and construction works. The training of personnel is conducted solely by means of on-the-job training at work sites. Transmission Line Division also does not have a design section, and completely lacks training in design works.

(2) TANESCO's Training Program

1) Design Section

At present, TANESCO does not have a division dealing with the design of transmission lines. Therefore a design division should be established in order to facilitate smooth execution of the construction and maintenance work of transmission lines.

Aid from foreign countries is considered necessary for the establishment of the design section and the training of personnel. At the same time, computer systems including necessary software for design works must be introduced.

2) Construction and Maintenance Section

The training of Supervisors and Linesmen engaged in the construction of overhead transmission lines is conducted adequately by TANESCO. However, training for newly assigned personnel is executed at construction sites in the form of OJT. Therefore, a training facility for the theoretical education and basic training of linesmen is required. This training facility is planned to be constructed next to the hot-line training center at Morogoro. Foreign aids will be required for the establishment of this training facility.

3) Personnel to be Trained

Training should be given to all personnel in Transmission Line Division.

(a) Design Personnel

The following training should be given to the personnel engaged in design work:

- Investigation and survey of transmission line.
- Computer-aided design of transmission lines.
- OJT at construction sites.

(b) Maintenance and Construction Personnel

- Investigation and survey of transmission line.
- Theoretical education concerning transmission lines at the training center and practical training concerning maintenance and construction at site.
- OJT at construction sites.

4) Methods of Training

(a) Training at the home office of foreign consultant.

- Design works.
- Visiting to construction sites.
- Witnessing to various test.
- Visiting manufacturing factories.

(b) Training through the participation of TANESCO's engineers in the design works in TANESCO's projects.

(c) Training of TANESCO's engineers and linesmen at construction sites during construction works conducted under the supervision of foreign consultants.

(d) Training at the training center.

5) Level of Training

Personnel should be trained so that TANESCO can be able to conduct all design, maintenance, and construction works with no assist.

7.2.2 Substation Division

(1) Present State

At present, TANESCO owns numerous substation facilities such as secondary substations and distribution substations centered around Ubungo Grid Substation. Therefore, the training of the personnel needed for the operation of these substation facilities is an important subject. However, plans are not put into practice because of various reasons.

(2) TANESCO's Training Program

TANESCO has always been making programs for the training of maintenance personnel and has been making efforts to execute these programs. At present TANESCO has a personnel training program as described below.

1) Training Program

Training is given to the engineers and technicians engaged in the maintenance of substations in the following fields:

- Design
- Construction work
- Operation
- Maintenance

This training is intended to train engineers and technicians who are necessary of the execution of this project.

At present, TANESCO has established Training Institute, and the graduates from this institute have been educated to the Certificate level as technical personnel. Most of the graduates are employed by TANESCO.

The number of substation maintenance personnel working for TANESCO is 53, as shown below:

- Engineers 3
- Technicians 30
- Electricians 20

  Total 53

In the training program planned by TANESCO, the followings are requested as the contents of training related to the design, construction, operation, and maintenance of substations:

2) Personnel to be trained

(1) Engineers: 8
(2) Technicians: 40

3) Period of training

(1) Engineers: 3 months
(2) Technicians: 6 months

4) Method of training

(1) Lectures
(2) Practical training (e.g., factory training)
(3) Participation in projects
(4) Field trips

5) Level of training

(1) Engineers

The design, construction, operation, and maintenance of substations. To be able to conduct maintenance of all substation equipment unaided.

(2) Technicians

To be able to understand electrical and mechanical drawings. To acquire general knowledge about the maintenance of substation main equipment.

7.2.3 Distribution Line Division

(1) Present State

At present, the training of distribution line personnel in TANESCO is given in the manner stated below.

1) On-the-job training at construction sites.

2) Participation to the training course held by TANESCO.

a. Design
b. Construction
c. Operation
d. Maintenance

3) Participation to the training course held by other agency or training source.

a. NORAD
b. JICA, etc.

(2) TANESCO's Training Program

At present, in the distribution line division of TANESCO, training program of personnel for design, construction, operation and maintenance is as follows:

1) Personnel to be trained

Engineers and technicians to be trained.

a. Engineers : 12
b. Technicians: 30

2) Method of training

a. Lecture

b. Training at construction sites (OJT).

c. Training at the home office of foreign consultant

- Design works
- Visiting construction sites
- Visiting manufacturing factories
- Witnessing to various test

d. Participation to the project executed by TANESCO

e. Participation to the training course held by other agency or training source

3) Period of training

a. Engineers : 3 months

b. Technicians : 6 months

In case of participation to the training course held by other agency or training source, training period depends on these.

4) Level of training

a. Engineers : To be able to conduct design, construction, operation and maintenance of 33 kV transmission lines, 11 kV and low voltage distribution lines without any help.

b. Technicians : To be able to understand drawings for 33 kV transmission lines, 11 kV and low voltage distribution lines, and to execute construction works in accordance with drawings.
To acquire general knowledge of distribution lines.

7.2.4 Telecommunication Division

Telecommunication Division suffers a shortage of personnel. While sufficient number of personnel is not stationed at each site, the work of the personnel is occupied in the trouble shooting and the repair of equipment. Because of this reason, works related to the general management of facilities and the plans for the construction, expansion, and improvement of facilities have not been conducted sufficiently, and personnel for these works has not been trained adequately. Generally speaking, the service life of telecommunication equipment is shorter than that of other electric power equipment, and minor expansion and improvement are required frequently after the commencement of operation. Therefore, the management of equipment and planning works are important issues. A high priority should be given to the training of personnel for the execution of these works.

Step	Contents of Training
1	Study of general equipment configuration models. Understanding of the actual state of the operation of equipment at other electric power companies.
2	Preparation and execution of: Telecommunication equipment inspection criteria matching the actual state of TANESCO. Standards for telecommunication equipment and facilities.
3	Formulation of future plans.

7.2.5 Protection Relay System Division

The training in Protection Relay System Division is classified into the following 3 steps:

(1) Basic Training 1

In this training, the trainees will measure voltage, current, and phase difference, which are varied according to the connection method of transformer and wiring method using several simplified transformers. They study the methods of wiring checking of instrument transformer which is now under operation as well as the connection method to protection relays.

(2) Basic Training 2

In this training, based on the achievement in Basic Training 1, the trainees study the structure, operating principles, characteristics, and application of protection relays, as well as the method of testing and connection, from the textbook. Thereafter, the operating test of protection relays is executed to confirm that theoretical values in the textbook agree with actual operating values. The trainees are trained both in theories and in practice so that they can execute actual tests of protection relays at site.

(3) On-site Training

In this training, the trainees will participate in actual regular inspection.

Based on the achievement in Basic Training 2, they participate as assistants of test personnel in the regular tests of protection relays at site. They study the entire fields of work related to regular inspection including not only the actual execution of tests but also the procedures to conduct the regular inspection of protection relays, the compilation of data after tests, and the preparation of reports.

7.3 WORKSHOP IMPROVEMENT PROGRAM

7.3.1 Light Current Workshop

(1) Present State

In the Light Current Workshop, impaired sheets for the equipment are repaired, and the parts for this purpose are stored in a warehouse only for repair parts next to the office.

Properly speaking, impaired sheets should be repaired by the manufacturer.

However, such repair is not conducted at present because of the problems of the time and cost needed for the repair.

In addition, the warehouse is very crowded by repair parts such as diodes and condensers, as well as relatively large spare parts such as coaxial cables and antennas. Although several persons are in charge of the management of these parts, appropriate management of parts is not practiced in the present situation.

1) Organization

Regional office of Light Current Workshop is established at Iringa, Hale, Kidatu and Shinyanga other than Dar Es Salaam Head Office, and these offices belong to Light Current Workshop of Head Office.

2) Measuring Device/Equipment

Table 7.3-1 shows the measuring device and equipment belonged to Light Current Workshop.

(2) Program

It is considered inevitable that impaired sheets are repaired by the workshop to some extent. In order to facilitate smooth response to troubles, it is also important to obtain a sufficient number of spare sheets at the time of the introduction of equipment.

For future renewal, expansion, and improvement of equipment, it should be planned so that spare sheets will be obtained.

As for the management of spare parts and repair parts, personal computers should be introduced to achieve effective management of the above parts and effective utilization of manpower. With the streamlining of the management of parts, we can use the maintenance resources on a nationwide basis and expect wider usage of them.

The improvement program is as shown below:

Step	Contents of Improvement Program
1	Introduction of Inventory Management System.
2	Registration of parts in inventory at present.
3	Replenishment of insufficient parts.
4	Analysis of the trend of troubles based on the frequency of the use of parts.
5	Formulation of the plans for the streamlining of repair services and the expansion of the scope of use.

And, the measuring device and equipment, which are considered necessary for the improvement of function of Light Current Workshop and for the closer cooperation between head office and regional office, are shown in Table 7.3-2.

7.3.2 Protection Workshop

(1) Present State

The Workshop in the Protection Workshop is equipped with testing equipment, measuring instruments and apparatus, and spare parts.

The testing equipment includes voltage and current transformers for testing, and testing equipment for distance relays. There was also evidence at the Protection Workshop of a significant number of testing units which had broken down or were not functioning properly.

The testing equipment which was functioning satisfactorily was clearly in the minority. It was also observed that the testing equipment itself was obsolete and old. It is clear therefore that the Protection Workshop is short of, or lacks, testing equipment so that it is currently not possible to carry out simultaneous tests in several locations and install testing equipment at all of the three branch offices (Mwanza, Arusha, Iringa).

The above also applies to the Protection Workshop's measuring device (voltmeters, ammeter, etc.).

There is also a serious lack of tools. As there are no special tools for protective relays, ordinary tools are used for maintenance and inspection purposes. This creates the risk of damage to the protective relay equipment.

Inventories of spare parts for protective relays are practically non-existent, and the store shelves contain a number of broken-down unit. When protective relays break down again, it is therefore not possible to replace a whole set of protective relays so that parts from the broken-down protective relays are taken out for alternative use, with the need to repair.

No particular provisions were made to ensure inventory control of spare parts.

(2) Plans

The Protection Workshop has the following equipment plans.

a) Test Equipment

The Protection Workshop acting as the central coordinator for protective relay equipment as well as the Ubungo Grid Substation with its extensive protective relay equipment and the Ilala Substation have each a complete set of permanently fixed testing equipment and use such fixed testing units to perform regular maintenance and take responsive actions to fault and accidents.

Two sets of portable testing equipment, will be provided at the Protection Workshop, coordinating the distribution substations

at Dar Es Salaam, while the branch offices (Mwanza, Arusha, and Iringa) all have one set each. One of the two sets of portable testing equipment at the Protection Workshop is used for carrying out regular maintenance in the distribution substations. The other set is used for simple testing at the Protection Workshop and for emergencies.

b) Measuring Instruments

The Protection Workshop has a total of eight voltammeters used either for fixed or portable testing equipment (six fixed and two portable units). It also has two phase and frequency meters and two multi-purpose meters.

The Protection Workshop as well as the Ubungo Grid Substation and the Ilala substation are equipped with four voltammeters, two phase/frequency meters and one milti-purpose meter each.

c) Tools

The Protection Workshop has three tool sets for protective relays while the branch offices, the Ubungo Substation and the Ilala Substation have one set each.

d) Spare Parts

At present, stocks of spare parts for replacement in a breakdown are available in such small number at the Protection Workshop that their urgent repair by the manufacturer is required in an emergency.

In the future, it will be necessary to purchase at least one complete set of spare parts when protective relays are replaced or newly installed.

Inventory control will require the establishment and regular testing of a database recording spare parts specifications and the dates of manufacture.

7.3.3 Electrical Workshop

(1) Present State

Electrical Workshop is mainly engaged in the tests of 11 kV/400 V and 230 V step-down transformers. Insufficiency and inadequacy are recognized in many of the testing facilities and testing equipment, and services are not performed completely.

Although the workshop itself has plenty of space, there are problems such as that there is no fixed place for the temporary storage of transformers, as well as the insufficiency of transportation facilities, and tests are not conducted efficiently.

1) Organization

Electrical Workshop is established only at Dar Es Salaam, and no regional office is established.

2) Equipment/Tools

Table 7.3-3 shows the equipment and tools belonged to Electrical Workshop.

(2) Program

The improvement program is outlined below:

1) Repair of impaired testing facilities, testing equipment, and transportation facilities.

2) Rearrangement of space for effective utilization of space in the workshop.

3) Replenishment of insufficient testing equipment to improve the accuracy of transformer tests and the revision of the contents of tests.

4) Required Equipment/Tools

The equipment and tools, which are considered necessary for the improvement of function of Electrical Workshop, are shown in Table 7.3-4.

7.3.4 Meter Workshop

(1) Present State

The calibration and repair of watthour meters are executed at Meter Workshop. The accuracy of the calibration of watthour meter is not high because of the superannuation of the testing equipment for calibration.

Repair is conducted using parts of impaired wattmeters because of the shortage of spare parts for repair.

1) Organization

Meter Workshop is established only at Dar Es Salaam, and no regional office is established.

2) Test Equipment

Table 7.3-5 shows test equipment belonged to Meter Workshop.

Judging from the contents of this table, old-fashioned test equipment is still utilized. Since the calibration of watthour meter contribute to the revenue of TANESCO directly, immediate improvement of test equipment is expected.

(2) Program

Watthour meter are installed at the customers, and based on this meter-reading electric tariff will be collected from each customer. Therefore, watthour meters must have a high precision and accuracy. Therefore:

1) Renewal of testing equipment for calibration is required urgently.

2) Purchase of parts for repair and purchase of watthour meter should be carried out.

3) Required Test Equipment

The test equipment, which is considered necessary for the improvement of function of Meter Workshop, is shown in Table 7.3-6.

Table 7.3-1 Inventory List of Measuring Device/Equipment
(Light Current Workshop 1/2)

No.	Items Description	Make and Type	Quantity	Condition
1.	RF Wattmeter Plus Element (2-500 MHz 50-150 W)	Model 40, RIRD	4	2 Defective
2.	ECS-FX Exchange Kit	ALBIS-ECS	4	Good condition
3.	Signal Generator	Schwarz, SMX	4	"
4	True RMS NILLI Voltmeter	RACAL DANA	4	"
5.	Impedance Measuring Attachment	SFZ-1 W & G	4	"
6.	Work Bench Lamps (Twin) 220 Vac, 15 W	RS-Stock No. 549-583	3	"
7.	Work Bench Magnifiers and Replacement Tubes	RS-Stock No. 548-704	-	-
8.	Transport Case, Alluminium	-	4	Good condition
9.	Digital Power Supply 30 VDC, 2 A	Thurlby RS-Stock No. 610-461	3	"
10.	Engineers Tool Kits (Zipped)	RS-Stock No. 542-093	8	Used
11.	Bench Digital Multimeter	Beckmann 350 RS-Stock No. 610-146	1	Defective
12.	Portable Analogue Multimeters Folding Range	PRC-M3AE	8	4 Defective
13.	Radio Antenna Reflection Meter	PYE-68-174 MHz & 400-500 MHz	1	Defective
14.	Communication Analyzer	Motorola R200 ID	1	Defective
15.	Level Meter SPM 31	W & G BN 4504/01	4	2 Defective
16.	Functional Generators	HP, 3312A, Hewlet Packard	4	Good condition
17.	Level Generators	PS20, W & G	4	Good condition
18.	Oscilloscope	BBC, M6011	4	Good condition
19.	High Resolution Counter	Phillips, MS5799	4	Good condition

Table 7.3-1 Inventory List of Measuring Device/Equipment
(Light Current Workshop 2/2)

No.	Items Description	Make and Type	Quantity	Condition
20.	Industrial Avometer MK16 with Complete Accessories	Model 8 RS-Stock No. 653-020	4	2 defective
21.	AM/FM Modulation Meter	Racal Dana 5332	4	Good condition
22.	Universal Counter	Hewlet Packard 5315A	4	Good condition
23.	Tektronic TM 500	Taktronics 838183/031	4	Good condition
24.	Dummy Loads ETI21	P3E PA	4	Good condition
25.	Dummy Loads ETI101	P3E GA	4	Good condition
26.	Power Supply 0-60VDC/15A	Hewlet Packard 627 & B/2150	6	2 defective

Table 7.3-2 List of Measuring Device/Equipment Required by Light Current Workshop

No.	Items Description	Quantity
1.	RF Wattmetter Plus Elements (2-500 MHz, 50-150 W)	4
2.	Work Bench Lamps (Twin) 220 Vac, 15 W	10
3.	Work Bench Magnifiers and Replacement Tubes	10
4.	Engineers Tool Kits	20
5.	Technicians Tool Kits	20
6.	i) Soldering Stations 50 W ii) Electronic Soldering Irons 50 W	10 10
7.	Standard Soldering Irons 25 W	20
8.	Bench Digital Multimeter	6
9.	Portable Digital Multimeters	30
10.	Portable Analogue Multimeters Folding Range	10
11.	PC with Printer (Computer)	5
12.	3 Phase Variac Transformer	5
13.	Regulated Power Supply for Testing 110 VDC Equips.	5
14.	Radio Antenna Reflection Meter	6
15.	Communication Analyzer	2
16.	Vacuum Cleaners	5
17.	Runtron Track	1
18.	Flambeau	10
19.	Bench Triple Output Power Supply	3
20.	Coaxial Adaptors	6
21.	Level Meter SPM 31	2
22.	Industrial Avometer MK16 with complete Accessories	5
23.	Power Supply 0-60 VDC/15 A	5
24.	Battery Charger	5

Table 7.3-3 Inventory List of Equipment/Tools (Electrical Workshop)

No.	Items Description	Quantity	Remarks
1.	AVO Meters	1	Good condition
2.	Insulation Resistance Meter	2	"
3.	DC Test Set	3	Defective
4.	Transformer Oil Test Kit	3	"
5.	Transformer Oil Filter Machine	1	Good condition
6.	Rail Turn Table	1	Defective

Table 7.3-4 List of Equipment/Tools Required by Electrical Workshop

No.	Items Description	Quantity
1.	Control Desk with meters shown below a. One meter 0 - 500 V scale for 400V monitor b. One meter 0 - 40 kV scale for monitoring "running" voltage c. One meter 0 - 13 kV scale d. One meter 0 - 40 kV scale e. One meter 0 - 600 A scale	1
2.	Variac Transformer a. Main Variac b. Test Bench Variacs	 1 5
3.	AVO Meters	10
4.	Insulation Resistance Meter a. 2.5 kV b. 5 kV	 5 5
5.	DC Test Set a. 40 kV test set b. 60 kV test set	 5 5
6.	Transformer Oil Test Kit	3
7.	Transformer Oil Filter Machine	1
8.	Forklift (3-ton)	3

Table 7.3-5 Inventory List of Test Equipment (Meter Workshop) (1/2)

No.	Items Description	Year Acq.	Q'ty
1.	Substandard Watt meter	1957	1
2.	Substandard Watt meter	1957	1
3.	Substandard Watt meter	1957	1
4.	Substandard Watt meter	1957	1
5.	Substandard Watt meter	1957	1
6.	Substandard Watt meter	1957	1
7.	Substandard Ammeter 2.5/5A	1957	1
8.	Substandard Voltmeter 150/300/600V	1957	1
9.	Substandard Voltmeter 150/300/600V	1957	1
10.	Rotating substandards 1 Phase	1957	1
11.	Rotating substandards 1 Phase	1957	1
12.	Rotating substandards 1 Phase	1957	1
13.	Rotating substandards 3 Phase	1957	1
14.	Rotating substandards 1 Phase	1975	1
15.	Rotating substandards 1 Phase	1971	1
16.	Rotating substandards 3 Phase	1971	1
17.	Rotating substandards 3 Phase	1975	1
18.	Rotating substandards 3 Phase	1975	1
19.	Osilloscope	1966	1
20.	Phase Earth Loop tester	1959	1
21.	FERRANT 3 Phase meter test set	1957	1
22.	FERRANT 1 Phase meter test set	1970	1
23.	Digital Multimeter	1985	1
24.	Digital Multimeter	1985	1
25.	A.C. CURRENT CLAMP CT 231	1985	1

Table 7.3-5 Inventory List of Test Equipment (Meter Workshop) (2/2)

No.	Items Description	Year Acq.	Q'ty
26.	A.C. CURRENT CLAMP CT 232	1985	1
27.	Phase sequence indicator	1986	1
28.	Phase sequence indicator	1986	1
29.	Ecording AMP/Voltmeter	1973	1
30.	LADIS AND GYR Stop Watch 105	1973	1
31.	Decade Resistance Box	1968	1
32.	Test Plug E/E	1965	1
33.	Test Plug Canadian	1970	1
34.	Power Factor Meter 110 V	1978	1
35.	Power Factor Meter 230/400 V	1975	1
36.	Zenith Insulation Flush Tester	1957	1
37.	Ultra Sonic Cleaner	1971	1

Table 7.3-6 List of Testing Instrument Required by Meter Workshop

No.	Items Description	Quantity
1.	3 Phase Testing Bench	1
2.	One Single Phase Testing Bench	1
3.	Stop Watches	10
4.	Phanton Load for Meter Testing at Site (In case where there is no Consumer's Load)	2
5.	Insulation Testing Equipment	1
6.	Electronic Calculators	10
7.	Power Factor Meters for Single and Three Phase Meters	4
8.	Portable Substandard Energy Meters for Site Meter Testing	4
9.	Substandard Watt-hour Meter for the Laboratory Use	2
10.	Substandard Voltmeters	2
11.	Tongue Testers	5
12.	Phase Sequence Indicator	4
13.	Engineers Tool Kits	10
14.	Multmeter Combined with Tongue Tester	6
15.	Frequence Testing Equipment	1

CHAPTER 8

ENVIRONMENTAL PROBLEMS

Chapter 8 Environmental Problems

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CHAPTER 8 ENVIRONMENTAL PROBLEMS

8.1 ENVIRONMENTAL ASSESSMENT

At present, economic recovery is of the highest priority in conducting matters of state in Tanzania, and the actual circumstances are that there is no room for attending to environmental problems. Consequently, the condition is that regulations for environmental protection in construction of electric power facilities such as transmission lines and substations are practically non-existent.

It is said there are no complaints from residents regarding trouble due to electric power facilities such as corona noise and radio and telecommunications obstructions. However, it is necessary for selection and design of transmission line routes and siting plans for substations to be made giving thorough consideration to various problems which will come up as the education level of the nation rises and there is an awakening of consciousness, and especially, what actions are to be taken in response to the effects of television broadcasting which will be commenced in the near future.

8.2 ENVIRONMENTAL ASSESSMENT MANUAL

Electricity-related Public Nuisances

(1) Electric Shock

Examinations must be made whether there may be risk of electric shock from metal objects such as iron fences due to static electricity and electro-magnetic induction, and necessary measures should be provided.

Transmission line - whether height above ground is too low
Substation - whether trespacing is easy

(2) Noise, Vibration, etc.

Examinations must be made regarding noise and low-frequency air vibrations from transformers, and necessary measures should be provided.

Natural Environment Problems

(1) Impact on Ecology due to Installation of Facilities

Examinations must be made of impacts in case of cutting of vegetation for securing transmission line rights-of-way and steel tower construction sites, and of the possibility of soil erosion and sliding occurrences due to rainfall, and necessary measures should be provided.

(2) Impact on Scenery

Examinations must be made concerning changes in scenery due to transmission lines passing through tourism sites and necessary measures should be provided.

Social Environment Problems

(1) Impact on Historical and Cultural Assets due to Installation of Facilities

It is necessary to give consideration that places which will cause harm to important historical and cultural assets will not be made sites scheduled for projects. When it is unavoidable for such places to be made project sites, it will be necessary for environmental protection measures to be provided including changes in construction schedules and budgets.

(2) Impact on Existing Infrastructure

Examinations must be made regarding possibilities of obstacles to transmission routes of microwave circuits, reception trouble for radio and television, and traffic restrictions at road crossings and river crossings, and necessary measures should be provided.

(3) Impact on Land Use

Examinations must be made regarding possibilities of lowering degrees of land use under transmission lines and around steel tower sites, and necessary measures should be provided.

Others

(1) Environmental Impact during Construction

i) It is necessary to ascertain that land rented for use for temporary works and other purposes is restored to its original condition and returned.

ii) Obstructions to Other Facilities
It is necessary to ascertain that interference to traffic will not occur due to transmission line conductors not being strung to the specified height during construction.

iii) Water Pollution due to Foundation Work
It will be necessary to ascertain the appropriateness of muddy water treatment.
It is necessary for studies to be made of ground-water salination due to ground-water pump-up near seashores.

(2) Environmental Monitoring

It will be necessary for appropriate monitoring to be carried out regarding the various items for checking mentioned above when (1) it is thought impacts will be small but the judgment is that monitoring is needed, and (2) measures are provided but monitoring is needed to check whether the measures are proving effective.

8.3 ENVIRONMENTAL ASSESSMENT LIST

	Item for Checking	Major	Small	None	Un-clear	Problematic Point	Measures Planned to be Provided and Policy	Remarks
Electricity-related Public Nuisances	1. Electric Shock 2. Noise, Vibration, etc.							
Natural Environment Problems	1. Impact on Ecology due to Installation of Facilities 2. Impact on Scenery							
Social Environment Problems	1. Impact on Historical and Cultural Assets due to Installation of Facilities 2. Impact on Existing Infrastructure 3. Impact on Land Use							
Others	1. Environmental Impact during Construction 2. Environmental Monitoring							

("Major" when the plan is complete, "Small" when inadequate, "None" when there is no plan existing.)

8.4 REVIEW OF THE ENVIRONMENTAL ASSESSMENT RESULTS

8.4.1 Environmental Assessment Results

TANESCO has sent the Environmental Assessment Manual and Environmental Assessment List prepared by the Study Team to the National Environment Management Council with the request to carry out an environmental assessment study.

The results of the environmental assessment study are presented in Table 8.4-1.

8.4.2 Review of the Environmental Assessment Results

The present study has made reference to a number of problems, including the damage caused to plant and animal life as a result of the installation of power transmission lines and the injurious effect on the landscape due to the erection of steel pylons. It should be noted, however, that neither of these problems is liable to cause any dramatic change from the present condition (that is, the environment as it exists now).

Table 8.4-1 gives, in the column entitled "Scheduled Countermeasures under Review and Responsive Policies" of the Environmental Assessment List *Assessment Study Results), the policy measures envisaged to meet the problem areas which have been pointed out. Under the heading of the "Problems for the Natural Environment", reference is made to the damaging effect on the fauna and flora under the power transmission lines and the loss of the diversity of wildlife. It is felt, however, that the transmission line construction project will not give rise to any particular problems since the transmission line is routed, in part, through secondary forestation, agricultural land and swamps and also because the transmission line has a comparatively short route extension.

Under the heading of the problems to the social environment, reference is made to the interference problems that transmission line construction project may cause to radio and television reception. In this context, it is felt, however, that electromagnetic interfer-

ence problems will actually affect microwave wireless installation to a worse degree than radio and Television reception. It will therefore be important to notify the scheduled routing for the transmission lines to all bodies concerned, notably the Tanzania Posts and Telecommunications Public Corporation and the Armed Forces of Tanzania so as to seek confirmation of the risk of interference problems arising as a result of the transmission line.

It will also be necessary to take the appropriate action or actions to meet any other problems areas.

The problem areas pointed out in the present assessment study and the many precautions to which reference has been made in the Environmental Assessment Manual should be duly taken into consideration in the establishment of the detailed designs and construction plans so as to ensure that environmental considerations will be fully taken into account in the eventual plans.

8.4 Review of Environmental Assessment Results

8.4.1 Environmental Assessment Results

TANESCO has sent the Environmental Assessment Manual and Environmental Assessment List prepared by the Study Team to the National Environment Management Council and requested an environmental assessment.

The results are given in Table 8.4-1.

8.4.2 Review of Environmental Assessment Results

A number of points were brought up in the investigations just made such as destruction of vegetation by transmission line construction, and effects of steel towers on scenery, but none of them will be enough to greatly change the present state (present environment).

The principles for dealing with the matters pointed out have been indicated in the column "Measures Planned to be Provided and Policy" in Table 8.4-1, Environmental Assessment List (Assessment Results) and under the item on "Natural Environment Problems" the destruction of vegetation under transmission lines and loss of bio-diversity were considered problems, but the proposed transmission lines will be going through secondary forests, cultivated land, and parts of swamps, while the length is comparatively short, and will not pose a problem in particular.

Under the item on Social Environment Problems, the obstruction of radio and television reception is pointed out, but actually, it is thought radio wave obstructions to microwave radio facilities will have greater effects than radio and television reception trouble. Accordingly, it is important to confirm whether problems of radio wave obstruction will arise presenting the projected transmission line construction route to Tanzania Posts and Telecommunications Corp. and the military.

Proper steps must be taken regarding other problematic points also.

Detailed designs and construction plans should be made taking into consideration the matters pointed out to pose problems in the

recent investigations and the various items to be paid attention indicated in the Environmental Assessment Manual, to prepare a plan giving thorough consideration to the environment.

Table 8.4-1 Environmental Assessment List (Result)

	Item for Checking	Major	Small	None	Un-clear	Problematic Point	Measures Planned to be Provided and Policy	Remarks
Electricity-related Public Nuisances	1. Electric Shock							
	2. Noise, Vibration, etc.	x				As transformer	Consider use of type of low noise and little vabration	
Natural Environment Problems	1. Impact on Ecology due to Installation of Facilities	x	x			Vegetation destruction and loss of bio-diversity along the transmission line right of way	The length of the transmission line is comparatively short and there will be no problem in particular.	
	2. Impact on Scenery	x				Steel tower construction	The heights of steel towers will be around 30 m and judging by the conditions at site, it is thoughtthey will not be conspicuous standing among trees.	
Social Environment Problems	1. Impact on Historical and Cultural Assets due to Installation of Facilities							
	2. Impact on Existing Infrastructure	x				At cross points of transmission lines with radio and television	Judging by the projected construction route of the transmission line there will be no problem in particular.	
	3. Impact on Land Use	x				Settlement and Industrial site location problem.	To be done in cable collaboration with the DSM urban Master Plan of Town Planning division and city council.	
Others	1. Environmental Impact during Construction	x				Power cuts	Prepare the work schedule program so that the effects of power outage will be small.	
						Pollution of ground water	The scale of the facility is small so that it will be of no problem in particular.	
	2. Environmental Monitoring						To be done during the construction and afterwards for crosschecking.	

("Major" when the plan is complete, "Small" when inadequate, "None" when there is no plan existing.)

CHAPTER 9

COST ESTIMATION

Chapter 9 Cost Estimation

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CHAPTER 9 COST ESTIMATION

9.1 CONSTRUCTION WORK SCHEDULE

9.1.1 Summary

Such expenses as are necessary to newly construct, expand, and modify the facilities at the time of implementation of the master plan are examined on the basis of 15 years for the long-term plan and 5 years for the short-term plan, respectively, starting from the reference year, i.e. from the end of 1992. The work schedule is prepared in the form of bar charts.

(1) Construction Work schedule (Bar chart)

1) Long-term plan

The long-term plan applies to construction and other works on the facilities and substations. The time period is 15 years starting from the reference year end of 1992, i.e. until the end of 2007. Table 9.1-1 shows the relevant construction work schedule.

2) Short-term plan

The short-term plan is a detailed proposal for the construction and other works on the facilities and substations. The time period is 5 years starting from the reference year of end 1992, i.e. until the end of 1997. Table 9.1-2 shows the relevant construction work schedule.

Table 9.1-1 Construction Schedule for the Long Term (Master Plan) Study (1/2)
on Dar Es Salaam Power Supply System Expansion

August, 1993

Item	Month	Year 1 1993	2 1994	3 1995	4 1996	5 1997	6 1998	7 1999	8 2000	9 2001	10 2002	11 2003	12 2004	13 2005	14 2006	15 2007	合計
		3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	
Ilala																	
Ilala	132kV																
Ubungo	132kV																
Tandale																	
Chang'ombe																	
Kurasini																	
Mbezi																	
Kunduchi																	
Factory ZoneⅢ	132kV																
Ubungo	132kV																
Kariakoo																	
Ilala																	
Mbagala																	
Kurasini																	
Tabata																	
Mikocheni																	
Kigamboni																	
Temeke																	
Mburahati																	
Kitunda																	
Yombo	132kV																
Factory ZoneⅢ	132kV																
Factory ZoneⅡ	132kV																
Oyster Bay	132kV																
Ubungo	132kV																
Kariakoo																	
Kigamboni																	
Kurasini	132kV																
Yombo																	
Oyster Bay																	
Mbezi	132kV																

Construction Schedule for the Long Term (Master Plan) Study (2／2)

on Dar Es Salaam Power Supply System Expansion

August, 1993

Item	Year / Month	1 1993	2 1994	3 1995	4 1996	5 1997	6 1998	7 1999	8 2000	9 2001	10 2002	11 2003	12 2004	13 2005	14 2006	15 2007	Remarks
		3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	
Mbezi																	
Mikocheni																	
City Centre	132kV																
Ilala	132kV																
Upanga																	
City Centre																	
Factory ZoneIII																	
Msasani																	
Mbagala	132kV																
Yombo	132kV																

Table 9.1-2 Construction Schedule for the Short Term (Master Plan) Study
on Dar Es Salaam Power Supply System Expansion

August, 1993

Item	Year / Month	1 1993				2 1994				3 1995				4 1996				5 1997				Remarks
		3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	
Ilala																						
Ilala	132/33kV																					
Ubungo	132kV																					
Tandale																						
Chang'ombe																						
Kurasini																						
Mbezi																						
Kunduchi																						
Factory ZoneⅢ	132kV																					
Ubungo	132kV																					
Kariakoo																						
Ilala																						
Mbagala																						
Kurasini																						
Tabata																						

9.2 COST ESTIMATION

9.2.1 Summary

(1) Approximate project cost summation

The optimization of power facilities included in the master plan for the Dar es Salaam city power supply system expansion plan is as stated previously, and the approximate costs needed for the plan are as shown in Table 9.2-1 and Table 9.2-2.

Table 9.2-1 Construction Cost for the Long Term Study on Dar Es Salaam Power Supply System Expansion (1993 - 2007)

(unit: million Yen)

Zone	Cost Details	Substation	132 kV Transmission Line	33 kV Distribution Line	11 kV Distribution Line	Vehicles/ tools	Others	Total
	Construction Cost	8,232	1,880	221	453	708	354	11,848
	1. Materials and equipment costs	6,214	1,448	170	333	506	253	8,924
	1.1 Materials and equipment costs	4,935	1,392	163	333	506	253	7,582
	1.2 Equipment installation cost	274	0	0	0	0	0	274
	1.3 Cost of dispatch of engineer(s)	1,005	56	7	0	0	0	1,068
	2. Transportation costs	1,097	195	23	63	116	58	1,552
	3. General overhead administrative expenses	228	42	5	10	15	8	308
	4. Consultant fee	693	195	23	47	71	35	1,064

Table 9.2-2 Construction Cost for the Short Term Study on Dar Es Salaam Power Supply System Expansion (1993 - 1997)

(unit: million Yen)

Zone	Cost Details	Substation	132 kV Transmission Line	33 kV Distribution Line	11 kV Distribution Line	Vehicles/ tools	Others	Total
	Construction Cost	2,764	336	147	182	219	109	3,757
	1. Materials and equipment costs	2,069	259	114	134	156	78	2,810
	1.1 Materials and equipment costs	1,617	249	110	134	156	78	2,344
	1.2 Equipment installation cost	97	0	0	0	0	0	97
	1.3 Cost of dispatch of engineer(s)	355	10	4	0	0	0	369
	2. Transportation costs	388	35	15	25	36	18	517
	3. General overhead administrative expenses	81	7	3	4	5	2	102
	4. Consultant fee	226	35	15	19	22	11	328

(2) Conditions for cost estimation

1) Summary of construction works

Summary of construction works presently under plan are as shown below:

(a) Transmission line facility

To be carried out in terms of direct management construction works by TANESCO together with engineer dispatched.

(i) Construction of new 132 kV and 33 kV transmission lines

(ii) Expansion of 132 kV and 33 kV transmission lines

(iii) Modification of existing lines

(b) Substation facility

To be carried out in terms of installation works by contractors.

(i) Construction of new substations

(ii) Expansion of existing substations

(iii) Modification of existing substations

(c) Distribution line facility

To be carried out in terms of direct management construction works by TANESCO with Engineers/Technicians being dispatched.

(i) 11 kV distribution line associated with newly established substation

33/11 kV substations are newly constructed in 10 places and expanded in 12 places. From those substations, 77 cct of feeders are drawn out via underground wire (17.7 km). In connection with it, 11

kV overhead distribution lines are newly constructed for a length of 44 km, and existing lines are to be replaced with new ones for a length of 77 km.

(ii) Interconnection line and low-tension distribution line

In connection with construction of new feeders as mentioned above and in order to reinforce interconnection of divided existing 11 kV distribution line system (3 divisions and 3 interconnections type), 231 switches are newly added. As for low-tension distribution line, only repair works of existing 11 kV distribution lines are performed in connection with construction of new 11 kV distribution line.

(d) Others

(i) Construction vehicles

(ii) Equipment and construction materials

(iii) Construction tools and measuring instruments

General tools and measuring instruments for use by construction groups.

2) Conditions for estimation

(a) Time of estimation

The end of December, 1992, is taken to determine the unit price of construction materials and labor cost, etc. which are to be used to calculate total costs.

(b) Determination of foreign exchange rate

The currency of the United Republic of Tanzania is the T shilling (Tsh). Its exchange rate against the Yen and U.S. dollar is shown in Table 9.2-3. From these tables, it is found that the average rates (TTS rate) in the past six years are as shown below omitting the figures below the third decimal place.

(c) Rate of rise in commodity price

Rate of rise in commodity prices in Japan and Tanzania is excluded from the estimation of the costs.

(d) Conditions for cost estimation

(i) Details of approximate costs

Details of the costs are as shown in the following table:

Item	Description
1. Construction materials and equipment costs	
1) Construction materials and equipment costs	
Costs of construction materials and equipment for facilities	Prices of granted construction materials and equipment for installation
Costs of spare parts/ vehicles/tools	Price of spare parts for facilities, construction vehicles and tools
2) Equipment installation cost	Installation costs of substation facilities
3) Cost of dispatch of engineer(s)	Wage, daily allowance, hotel charges, and airfare for engineer(s) to be dispatched.
2. Transportation costs	
1) Packing cost	Export packing cost of construction materials and equipment
2) Shipping expenses	Customs clearance fee, warehouse storage fee, and stevedoring charges in Japan for construction materials and equipment
3) Ocean freight	Marine transport expenses for construction materials and equipment
4) Port expenses	Stevedoring charges, wharfage, and warehouse storage fee in Tanzania for construction materials and equipment
5) Inland transportation expenses	Land transportation expenses for construction materials and equipment up to site
6) Transport insurance premium	Insurance premium in respect of transportation of construction materials and equipment from maker's factories in Japan to site.
3. General overhead administrative expenses	Expenses incurred at headquarters or the like in connection with this plan
4. Design management fee	Expenses incurred in connection with detail design, preparation of tender documents, tender, construction management, etc., and expenses for site survey which is needed for detail design

Note) Extra costs, import tariffs and costs for items implemented by TANESCO are not shown in the cost breakdown.

Table 9.2-3 Exchange Rate of Yen vs. U.S. Dollar (Applicable term: July '92 to Dec. '92)

Date	Rate (¥/$)	Date	Rate (¥/$)	Date	Rate (¥/$)	Date	Rate (¥/$)	Date	Rate (¥/$)	Date	Rate (¥/$)	
7/1	126.60	8/1		9/1	124.05	10/1	121.10	11/1		12/1	125.80	
2	126.15	2		2	123.45	2	120.65	2	124.65	2	125.35	
3	125.35	3	128.10	3	124.25	3		3		3	125.40	
4		4	128.20	4	124.95	4		4	123.30	4	125.70	
5		5	128.30	5		5	120.20	5	123.75	5		
6	125.95	6	128.55	6		6	120.75	6	124.00	6		
7	125.25	7	128.75	7	124.15	7	120.45	7		7	125.95	
8	124.80	8		8	124.40	8	121.55	8		8	125.05	
9	125.50	9		9	123.70	9	122.60	9	124.65	9	124.85	
10	126.70	10	128.85	10	124.35	10		10	125.20	10	125.10	
11		11	128.95	11	125.15	11		11	124.95	11	124.75	
12		12	128.95	12		12	122.25	12	124.95	12		
13	126.05	13	128.35	13		13	122.00	13	124.75	13		
14	126.00	14	127.60	14	125.85	14	122.05	14		14	124.85	
15	126.45	15		15		15	121.65	15		15	124.80	
16	126.35	16		16	125.25	16	121.70	16	125.30	16	125.00	
17	126.40	17	127.40	17	125.75	17		17	125.75	17	124.25	
18		18	126.85	18	125.35	18		18	125.30	18	124.00	
19		19	127.35	19		19	120.80	19	124.80	19		
20	125.35	20	127.45	20		20	121.90	20	124.60	20		
21	126.20	21	127.15	21	124.80	21	123.90	21		21	124.30	
22	126.30	22		22	124.15	22	123.35	22		22	124.10	
23	127.60	23		23		23	121.70	23		23		
24	127.65	24	126.25	24	121.65	24		24	124.95	24	124.80	
25		25	126.55	25	121.60	25		25	124.75	25	124.85	
26		26	125.85	26		26	122.85	26	124.80	26		
27	128.60	27	126.30	27		27	122.95	27	125.15	27		
28	128.75	28	125.60	28	121.25	28	123.05	28		28	124.95	
29	128.35	29		29	120.70	29	123.95	29		29	124.75	
30	128.85	30		30	119.80	30	124.25	30	125.75	30	125.35	
31	128.65	31	123.90			31				31	125.70	Jul. to Dec. Total for 6 month
Total days	23	Total days	21	Total days	20	Total days	22	Total days	19	Total days	22	127.00
Sub-Total	2,913.85	Sub-Total	2,674.30	Sub-Total	2,474.60	Sub-Total	2,685.65	Sub-Total	2,371.35	Sub-Total	2,750.65	15,870.40
Ave-rage	126.68	Ave-rage	127.35	Ave-rage	123.73	Ave-rage	122.08	Ave-rage	124.81	Ave-rage	125.03	124.90

July to December : Average exchange rate for 6 months
= (aggregated exchange rate for 6 months)/(aggregated days)
= 124.90 Yen/U.S. Dollar

Table 9.2-4 Exchange Rate of Dollar v. Tanzanian Shiling
(Shiling per dollar)

Year/Month	Rate (Tsh/$)		Remarks
1992	End of Month	Average in Middle of Month	
July	325.00	313.64	
August	325.00	325.00	
September	325.00	325.00	
October	325.00	325.00	
November	335.00	328.33	
December	335.00	335.00	
Average		325.32	

≒ 325

(ii) Philosophy for cost estimation

a) Procurement source for construction materials and equipment

Gravel, sand, cement, and wood are to be procured in Tanzania. Other construction materials and equipment than those should be procured in Japan because of the following reasons:

. Since the construction period for this project is very short, it is risky, in view of delivery period, to try to procure in other countries.

. If procured in other countries, it takes a longer time and needs much more expenditure with regard to factory approval tests, submission and return of approval drawings, etc.

. Tanzania prefers the use of Japanese products because of the no-accident record of Japanese products.

. Since the design of facilities is undertaken by Japan, it is difficult to warrant quality of completed facilities if equipment are supplied from other countries.

. Design norms and related matters are based on Japanese standards; thus it may most probably be difficult to obtain such products as exceed these standards.

. TANESCO construction staff are mostly accustomed to handling Japanese products and construction materials through previous improvement works performed through Japanese aid grants; thus special instructions in handling are not necessary at all as far as Japanese products are in use.

. Japanese products are already adopted into most part of the present distribution facilities of Dar Es Salaam city thus largely encouraging, it may be said, the standardization of construction materials and equipment as well as construction methods currently promoted by TANESCO.

b) Construction materials and equipment costs

Construction materials and equipment costs consist of such three items as construction materials costs, Equipment installation cost, and Engineer(s) dispatching cost.

Labor cost included in the Equipment installation cost is for workers employed locally in Tanzania to carry out construction works of substations. As for percentage to be used to calculate local labor cost, a presumed percentage that is two times Japanese standard percentage is adopted assuming the ability of local workers to be about 50% that of Japanese workers.

As a rule, such construction tools as are furnished from Japan shall mostly be used. However, with regard to other tools than those which are needed for the construction works, payment of the rent for these tools are to be included in the tool cost.

c) Transportation costs

Transportation costs consist of such six items as Packing cost, Shipping expenses, Ocean freight, Port expenses, Inland transportation expenses, and Transport insurance premium. As for the inland transportation expenses, among other, goods are to be carried up to the TANESCO's construction materials and equipment storage space in Dar Es Salaam city as described in the attached Construction materials and equipment inland transportation plan.

(iii) Time series analysis of cost estimation

Table 9.2-5 shows analysis of cost estimation on a time series basis over 15 years.

Table 9.2-5 Construction Cost for the Long Term (Master Plan) Study
on Dar Es Salaam Power Supply System Expansion

August, 1993

Unit: Million Yen

Item	Year	1 1993	2 1994	3 1995	4 1996	5 1997	6 1998	7 1999	8 2000	9 2001	10 2002	11 2003	12 2004	13 2005	14 2006	15 2007	Total
	Month	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	3 6 9 12	
Transmission Line Facility			255		227		39		487		190		754		149		2,101
Substation Facility			1,466		1,300		127		1,649		622	229	1,900	449	490		8,232
Distribution Line Facility			96		86		6		83		30	11	95	22	24		453
Vehicles/tools			116		102		12		150		56	21	167	40	44		708
Others			58		51		6		78		28	10	80	21	22		354
Total			1,991		1,766		190		2,447		926	271	2,996	532	729		11,848