JAPAN INTERNATIONAL [illegible]
THE UNITED REPUBLIC OF [illegible]
TANZANIA ELECTRIC SUPPLY CO., LTD.

MASTER PLAN STUDY AND [illegible] STUDY

ON

DAR ES SALAAM [illegible] STATION

IN

THE UNITED REPUBLIC OF TANZANIA

[illegible]

VOLUME [illegible]

([illegible])

[illegible]

ELECTRIC POWER DEVELOPMENT CO., LTD. [illegible]
TOKYO, [illegible]

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

VOLUME I

(MASTER PLAN STUDY)

MARCH, 1994

ELECTRIC POWER DEVELOPMENT CO.,LTD.
TOKYO, JAPAN

PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct master plan study and pre-feasibility study on Dar es Salaam Power Supply System Expansion and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team headed by Mr. Hitoshi Kitazawa of Electric Power Development Co., Ltd. three times during the period from January 1993 to February 1994.

The team held discussion on the project with the officials concerned of the Government of the United Republic of Tanzania and conducted field survey at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

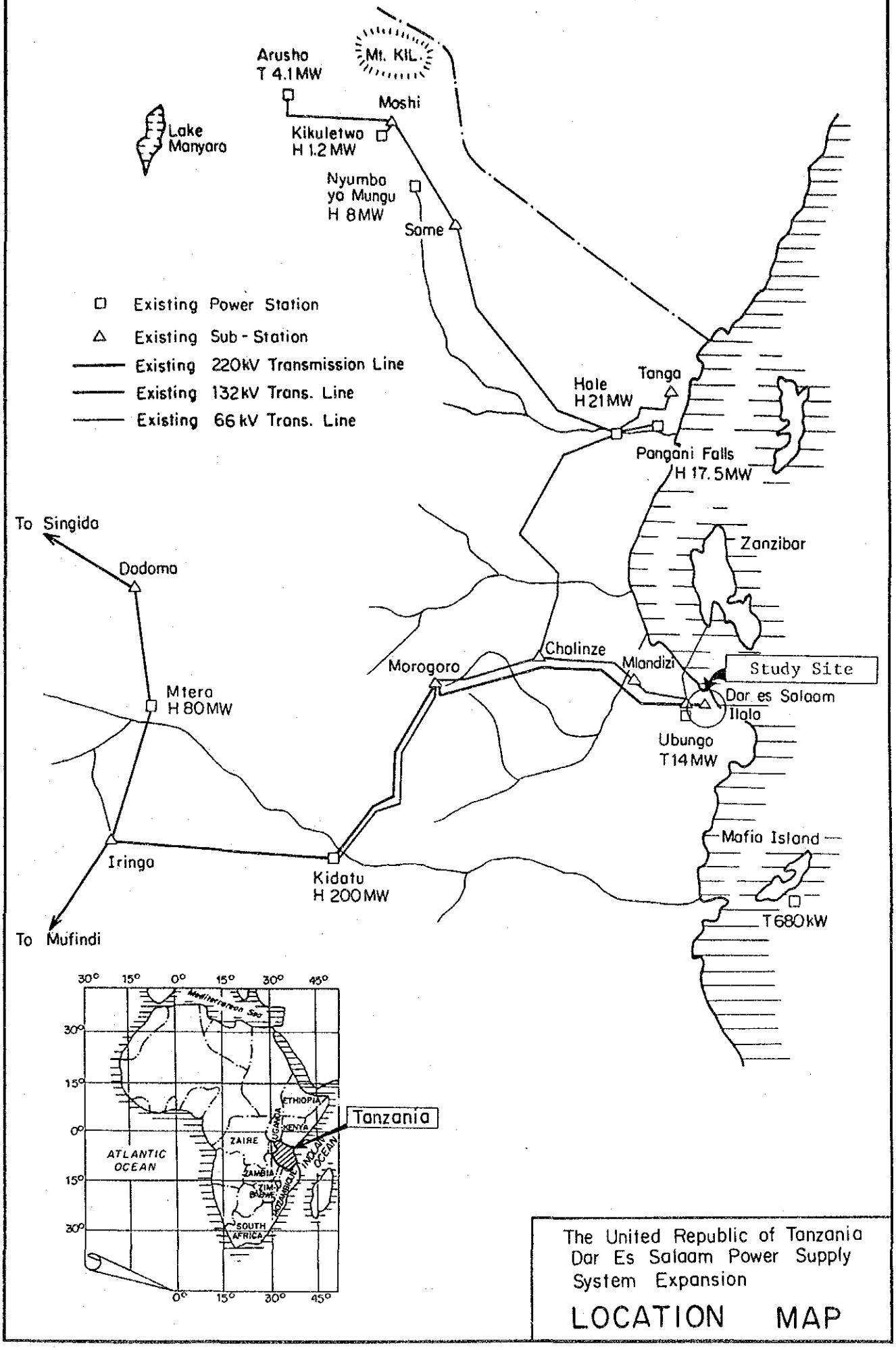
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

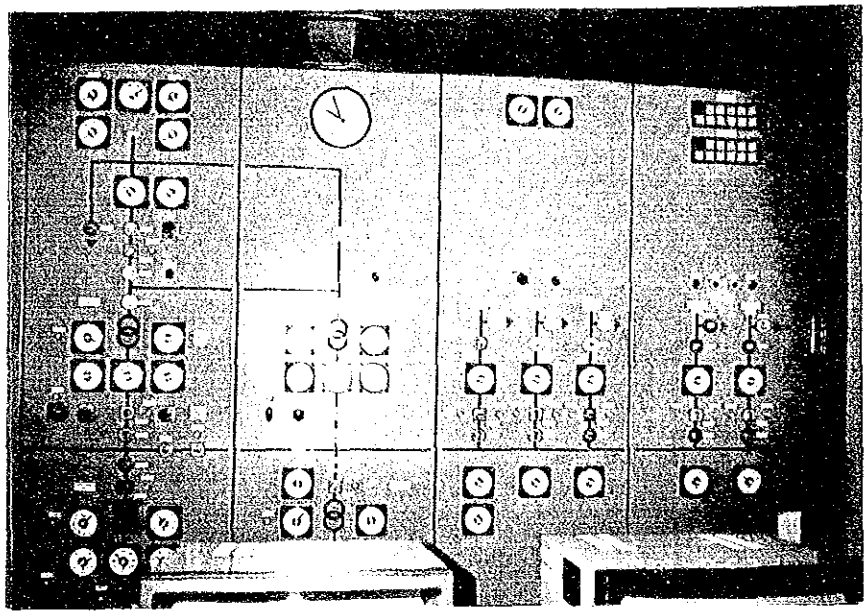
I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

March, 1994

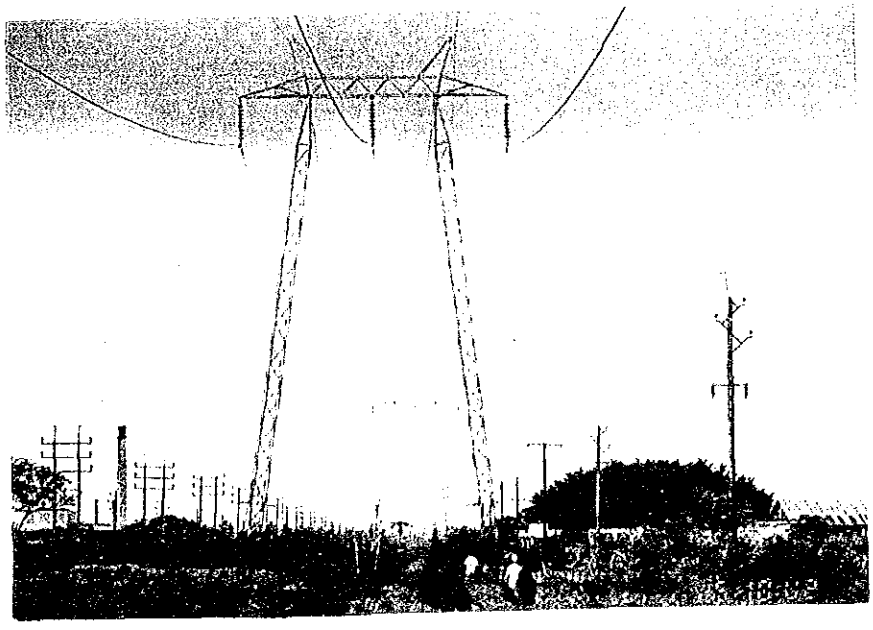
Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

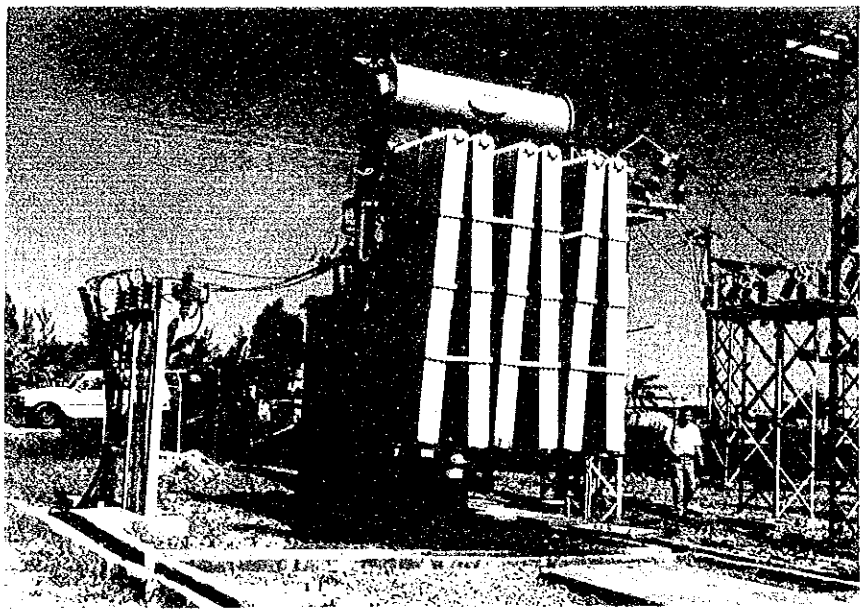

Arusha
T 4.1MW
Mt. KIL.
Moshi
Lake
Manyara
Kikuletwo
H 1.2 MW
Nyumba
yo Mungu
H 8MW
Same
Existing Power Station
Existing Sub - Station
Existing 220kV Transmission Line
Existing 132kV Trans. Line
Existing 66 kV Trans. Line
Hale
H 21MW
Tanga
Pangani Falls
H 17.5MW
To Singida
Dodoma
Zanzibar
Mtera
H 80MW
Morogoro
Cholinze
Mlandizi
Study Site
Dar es Salaam
Ilala
Ubungo
T14MW
Mafia Island
T680kW
Iringa
Kidatu
H 200MW
To Mufindi
30° 15° 0° 15° 30° 45°
Mediterranean Sea
ETHIOPIA
KENYA
UGANDA
ZAIRE
ATLANTIC OCEAN
INDIAN OCEAN
ZAMBIA
ZIMBABWE
SOUTH AFRICA
Tanzania
The United Republic of Tanzania
Dar Es Salaam Power Supply
System Expansion
LOCATION MAP



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

Form of the Report

To facilitate ease of understanding, the final report of "Master Plan Study and Pre-feasibility Study of Dar Es Salaam Power Supply system Expansion in the United Republic of Tanzania" is divided editorially into four separate volumes; Volume I, Volume II, Volume III and Summary.

The contents of Volumes I, II, III and Summary are as stated below.

Volume I Master Plan Study

Chapter	Title
1	Introduction
2	Conclusions and Recommendations
3	General Situation in Tanzania
4	Demand Forecast
5	Power Supply System Expansion Master Plan
6	Power System Analysis
7	Improvement and Enhancement programs of Manpower and Facilities Related to Operation and Maintenance
8	Environmental Problems
9	Cost Estimation

Volume II Pre-feasibility Study

Chapter	Title
10	Preliminary Design
11	Plane for the Construction Work
12	Cost Estimation
13	Economic Analysis
14	Financial Analysis

Volume III Appendix

Summary

CONTENTS

Final Report - Volume I

CHAPTER 1

INTRODUCTION

Chapter 1 Introduction

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND OF THE PROJECT

The improvement of the basic economic infrastructure, including electricity, is considered as the most important issue in the Second Economic Recovery Program implemented currently in Tanzania.

In particular, the need for the improvement of the electricity infrastructures is felt strongly in Dar es Salaam, the capital of the country. The maximum demand for electricity in this city was 114 MW in 1991 and is expected to reach 216 MW by 2005, assuming that a 5% annual growth supported by current economic recovery will continue. In order to maintain the functions of the capital, coping with the increase in demand, it is considered necessary to formulate plans for the radical expansion of power transmission and distribution systems in the metropolitan area, in accordance with the implementation of projects concerning the development of power resources and the improvement of transmission lines.

About 76,500 households will benefit directly from the improvement of power transmission and transformation facilities and distribution networks (total elongation about 150 km) based on these plans. In addition, about 1.4 million inhabitants of the metropolitan area will have indirect benefit. The economic and social effects of being able to circumvent future shortage of electric power in the metropolitan area are immeasurable. Because of these reasons, the government of Tanzania requested Japan to conduct this study.

1.2 PURPOSE, AREA, AND SCOPE OF THE STUDY

According to the directive, the purpose, area, and scope of this study are understood as follows:

(1) Purpose of the Study

The purpose of this study is to execute the plans for the radical expansion of power transmission, transformation, and distribution facilities, as well as the plans for the enhancement of the manage-

ment functions concerning the operation and maintenance of these facilities, aiming at a system capable of reliable and stable long-term supply of electric power.

(2) Study Area

The whole area of Dar es Salaam city (including the Grid System encircling Dar es Salaam).

(3) Scope of the Study

Aiming at establishing the plan for the expansion of electric power supply in Dar es Salaam, This study will be conducted in 2 phases:

- Long-term Master Plan Study for 15 years.
- Pre-Feasibility Study related to the short-term plan (5 years) established in the above study.

CHAPTER 2

CONCLUSION AND RECOMMENDATIONS

Chapter 2 Conclusion and Recommendations

CHAPTER 2 CONCLUSION AND RECOMMENDATIONS

2.1 CONCLUSION

The study team visited Tanzania for about 1.5 months from January, 1993, to conduct the study for the electric power system expansion project in Dar es Salaam. They conducted field surveys, consulted with relevant parties, and heard the requests from TANESCO during their stay in Tanzania.

After returning to Japan, the study team compiled the optimized plans for the electric power supply system in Dar es Salaam, which will be the skeleton of the long- and short-term master plan, based on the information obtained by the field surveys.

In addition, plans for the new construction and expansion were formulated based on the demand forecast concerning existing substations and the demand forecast covering the entire Dar es Salaam city. Supported by a system analysis, they prepared the master plan for long-and short-term expansion of electric power supply as shown on the next page.

As for the long-term plan covering a period of 15 years, the master plan stated that 11 new substations would be constructed to increase the installed capacity by 175 MVA and 19 existing substation would be expanded to increase the installed capacity by 510 MVA so that the expected increase in demand might be supported.

Furthermore, in order to improve the reliability of the system, to reduce power loss, and to minimize voltage drop, the master plan proposed the introduction of 132 kV at 7 main substations and the construction of a new 132/33 kV substation. These new substations will need transmission lines operated at 132 kV and 33 kV, respectively.

The projects that must be executed relatively urgently are included in the short-term plan covering a period of 5 year. These are the new construction of substations at Tandale, Chang'ombe, Kunduchi, Kariakoo, Mbagala and Tabata; the expansion of substations at Factory Zone-III, Ilala, and Mbezi; and the introduction of 132 kV.

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.
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.
	MIKOCHENI 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.

2.2 RECOMMENDATIONS

The study team recommends the followings concerning the above master plan obtained as the result of the study for the electric power system expansion study in Dar es Salaam:

(1) The master plan is intended to provide the basic guideline of the new construction and expansion of the electric power supply facilities in Dar es Salaam in future. Specific projects should be executed according to this master plan.

(2) Since the master plan has been formulated based on the present state of the electric power supply facilities in Dar es Salaam and assuming estimated future increase in demand, the plan should be revised quickly when the actual situation of demand is clarified in future.

(3) The study team begins a feasibility study as soon as the explanation and discussion of the master plan is completed. The feasibility study will be conducted based on the short-term master plan covering about 5 years, and will require strong support from TANESCO.

(4) Although the results of the feasibility study cannot be predicted definitely, it seems certain that a serious situation will arise if the facilities will not be expanded urgently. Therefore, it is desirable to prepare funds and execute the project as soon as possible.

(5) Although the problems concerning the source of energy supplied to Dar es Salaam are out of the scope of the study team, they are closely related to this study. Efforts should be made to develop the sources of electric energy so that the supply of electric power to entire Tanzania should not be hampered, paying attention to urgent problems.

CHAPTER 3

GENERAL SITUATION IN TANZANIA

Chapter 3 General Situation in Tanzania

CHAPTER 3 GENERAL SITUATION IN TANZANIA

3.1 SOCIAL SITUATION

3.1.1 Historical Background

The contact between Tanzania and other countries began with the arrival of Arab and Persian traders, who had been expanding their reaches southward along the coasts of the Indian Ocean in the 8th century. The Portuguese became an important player in the 16th century in the trade of copra and slaves, and they actively expanded their colonies.

The area was colonized by Germany as German East Africa in 1885. Despite occasional anti-colonist movements, the domination by Germany continued until 1916, when Great Britain took control of this area. It became a trust territory under Great Britain in 1919, and the name of the country was changed to Tanganyika.

The Tanganyika Africa National Union (TANU) was organized in 1945 by Julius Nyerere, who was then a school teacher, and the Union led the country to independence in a comparatively smooth way. In April, 1964, Tanganyika united with Zanzibar to form the United Republic of Tanzania.

The Republic of Tanganyika achieved independence from the trust territory under Great Britain on December 9, 1961. Zanzibar achieved independence as a constitutional monarchy under a sultan on December 10, 1963. (It became the People's Republic of Zanzibar in January, 1964 after a coup.) The two countries merged into the United Republic of Tanganyika and Zanzibar on April 26, 1964, and the name of the country was changed to the present name in October, 1964.

3.1.2 Politics

Tanzania is a confederation consisting of the Tanzania mainland and Zanzibar. The sovereignty of Zanzibar is delegated to the federal government in terms of the matters concerning the constitution, the federal government, diplomacy, national defense, police, declaration

of a state of emergency, citizenship, aviation, telecommunications, postal services, etc. Other matters in Zanzibar are administered by the Vice President of Tanzania, who holds concurrently the title of the President of Zanzibar.

The President of Tanzania is the head of state and holds the prerogative of supreme command of the armed forces. The President is elected by a direct election and holds office for 5 years.

The current President, Ali Hassan Mwinyi has the solid support of the Tanzanian people. He was reelected in the 1990 presidential election by an overwhelming majority.

The legislative organ of Tanzania consists of the President and the National Assembly. The legislative power related to the United Republic, as well as all other matters related to the Tanzania mainland resides with the legislature of the nation. The National Assembly is a unicameral legislature composed of members elected by universal suffrage, members appointed by the President, members elected by the National Assembly, Regional Commissioners, and members from Zanzibar's House of Representatives. The term of membership is 5 years.

As for the matters concerning Zanzibar and not related to the United Republic, the legislative power resides with Zanzibar's House of Representatives.

The judicial power is exercised by the Federal High Court, Regional Courts, and District Courts. In the Tanzania mainland, the Judiciary Committee controls judicial administration.

Starting from Arusha Proclamation at the time of independence, the foreign relations of Tanzania has been based on nonalignment neutrality, Pan-Africanism, and strong commitment to the United Nations. The country has been following the socialist line aiming at the improvement of living standards, and friendly relations has been maintained with the U.S.S.R., Eastern Europe, China, and other socialist countries. However, the relationship with these countries is declining, reflecting recent changes of the international

situation. On the contrary, the relations with Northern Europe, Western Europe, Japan, and the United States are being strengthened, and Tanzania is accelerating its inclination toward these countries.

Tanzania is promoting good neighbor policy and regional cooperation with other African countries, and the country is keeping friendly relations with all neighboring countries.

3.1.3 Population and Work Force

(1) Population

According to the estimation by the Central Bureau of Statistics, the population of Tanzania (mainland) was 24,972,000 at the middle of 1990 and has been growing rapidly. The average annual growth after 1987 was 3.24%, and that after 1986 was 3.37%. Rapid population concentration is also taking place; the percentage of urban population increased from 13.3% in 1978 to 17.7% in 1986 and 20.4% in 1990. These trends in population are serious problems that have to be addressed in the future.

Table 3.1-1 Population Growth in Tanzania (Mainland) *

Unit: 1,000 persons

Year	Urban	Rural	Total
1948	197	7,283	7,480
1957	364	8,424	8,788
1968	685	11,274	11,959
1978	2,258	14,779	17,037
1982	2,957	16,298	19,255
1983	3,218	16,707	19,925
1984	3,385	17,121	20,506
1985	3,620	17,539	21,159
1986	3,877	17,997	21,874
1987	4,151	18,460	22,611
1988	4,443	18,929	23,372
1989	4,755	19,404	24,159
1990	5,087	19,885	24,972

Source: Quarterly Statistical Bulletin, CBS.

* The data for 1982 and later years are estimates (mid year). Earlier data are based on census.

The pattern of population distribution in Tanzania is characterized by the low population density in the central part of the country (Morogoro, Iringa Ruvuma, Singida, Tabora, Rukwa, and other provinces) and the high population density in peripheral areas such as the coastal provinces (Tanga, Coast, DSM, Lindi, and Mtwara), northern provinces (Kilimanjaro, Arusha, and Mara), the area around Lake Victoria (Mwanza and Kagera), and the area around Lake Tanganyika (Kigoma).

Table 3.1-2 Distribution of Population by Province (Estimates in 1987)

	Area ($1,000 km^2$)	Population (1,000 persons)	Population density (person/km^2)
Arusha	82	1,274	16
Coast	32	600	19
DSM	1	1,605	1,605
Dodoma	41	1,239	30
Iringa	57	1,167	20
Kagera	28	1,397	50
Kigomo	37	828	22
Kilimanjaro	13	1,159	89
Lindi	66	631	10
Mara	20	908	45
Mbeya	60	1,426	24
Morogoro	71	1,202	17
Mtwara	17	916	54
Mwanza	20	1,836	92
Rukwa	69	656	10
Ruvuma	64	725	11
Shinyanga	51	1,779	34
Singida	49	770	15
Tabora	76	1,185	16
Tanga	27	1,305	48
Total	881	22,611	26

Source: Central Bureau of Statistics.

Provinces of Tanzania

◎ State Capital

○ Provincial Capital

(2) Work Force

Although statistics concerning the work force in Tanzania have not been made available after 1983, the working population in 1986 has been estimated to be about 9.25 million, which is 42% of the national population. Because of the relatively large proportion of younger people, many people are entering the labor market every year and the working population in 1990 is estimated to be about 11.20 million (about 45% of the national population).

Most of the working people are engaged in agriculture in rural areas. Only less than 8% of the total work force are considered to be waged workers.

The largest source of employment in Tanzania is the governmental and public sector. About half of all waged workers are considered to be employed in this sector.

3.1.4 Education

Tanzania has been putting special emphasis on education under the strong leadership of the former president Nyerere, who led the country before and after independence. In 1967 the Arusha Proclamation emphasized the expansion of basic education to all people, especially education in rural areas.

The system of public education in Tanzania (so-called 7-4-2-3 system) consists of 7 years of elementary education, 4 years of secondary education, 2 years of high school education, and 3 years of college education, which are all free of charge.

The number of children entering elementary schools increased rapidly from 1 million in the early 1970's to 3 million in 1978. As of 1981, the percentage of school attendance among school-age children reached a peak of 98.3%. After the percentage decreased for a while, as shown in the Table 3.1-3, it started to recover in 1989.

Table 3.1-3 Percentage of School Attendance in Tanzania

1980	96.6%
1981	98.3%
1992	94.8%
1983	93.0%
1984	88.4%
1985	85.5%
1986	80.5%
1987	78.1%
1988	76.1%
1989	80.2%

(There is little difference between boys and girls.)

3.1.5 Infrastructure

(1) Railroads

The railroad network in Tanzania is composed of Tanzania Railway (TR) operated by Tanzania Railway Corporation (TRC) and a route operated by Tanzania Zambia Railway (TAZARA, also known as Tan-Zam Railway), which was completed in 1975 with the aid from China.

TR completed the construction of a network having a total elongation of 2,600 km in 1914, and no new lines have been constructed since then. Trunk routes consist of the Dar es Salaam-Kigoma Line and the Tanga-Arusha Line, which are interconnected by branch lines. These lines are used for the transportation of agricultural products to the ports of Dar es Salaam and Tanga, the transportation of imported freight to inland areas, and the passage of freight imported to and exported from Zaire, Burundi, and other countries.

On the other hand, TAZARA was completed with aid from China and has been operating since 1975. While the design capacity was 2.5 million tons, the actual volume reached 1.27 million tons in 1978. However, because of the competition with road transportation and the shortage of cargo handling capacity at the port of Dar es Salaam, it decreased to 963,000 tons in 1983. Later aggravation of road condi-

tions caused a gradual increase in the volume of rail transportation, and it reached 1.704 million tons (68% of the design capacity) in 1989.

TAZARA is operated through the cooperation between Tanzania and Zambia. It has a total elongation of 1,800 km (from Dar es Salaam to Kapiri Mposhi), of which 974.914 km lies in Tanzania.

(2) Roads

The total elongation of roads is 82,000 km. Trunk roads total up to about 10,000 km, of which about 3,000 km is paved. An economic crisis in the early half of the 1980's almost completely halted the construction and improvement of roads. Not only the execution of new projects but also the maintenance of existing roads have been restrained for a long time. As a result, roads are considerably devastated and even primary trunk roads are frequently paralyzed. This situation caused the rapid rise of transportation costs, delays in hauling time, and considerable economical loss due to the impaiment of vehicles.

The World Bank, taking the situation seriously, called for cooperation of donor countries in the 6th road improvement plan and proposed "Integrated Roads Project" in May, 1990.

With the aggravation of road conditions, the impairment of vehicles became considerable and the number of vehicle registrations decreased. Severe problems are recognized in road transportation, which is the most important means to connect agricultural producers scattered over the vast country with consumption centers and exportation ports. The improvement of the roads themselves, as well as the reinforcement of transportation power, is an urgent issue.

(3) Ports

Important ports in Tanzania are Dar es Salaam, Tanga, and Mtwara. All of these ports enjoy ideal natural conditions. The port of Dar es Salaam is the largest port in Tanzania. It also has to serve for the freight transported to and from neighboring countries such as

Zambia, Burundi, Rwanda, Uganda, and Zaire. It is the most important port in the country, handling 72% of all vessels, 91.4% of all cargo, and 95.1% of all passengers as of 1987.

(4) Aviation

Since the population of Tanzania is scattered over the vast area of the country, the importance of air transportation in the movement of passengers is especially large. International airports are located in Dar es Salaam and Kilimanjaro, in addition to about 50 other airports served by domestic airlines.

(5) Telecommunications

In the field of telecommunications and postal services in Tanzania, the development and execution of projects are conducted by the Ministry of Telecommunication and Transport, while daily services are operated by Tanzania Post and Telecommunication Corporation (TPTC).

The number of post offices increased year by year from 145 in 1980 to 178 in 1989. However, because of the lack of a postal delivery system, mail is received by the use of post office boxes.

Telephones have penetrated rapidly and the use of automatic exchange is expanding. Although facsimiles have come into use, the extent of penetration still remains low.

(6) Health and Hygiene

Contagious diseases, malnutrition, and ailments related to childbirth are counted as the largest health problems in Tanzania like other African countries. The most widespread disease is malaria, which account for 14% of the death of infants and 13% of that of adults. AIDS has recently become a serious health problem.

(7) Water Supply

Water supply and drainage have become well developed in urban areas, but are markedly insufficient in rural areas. The government is making efforts to expand these systems especially in rural areas.

The number of municipalities having developed water supply systems counted more than 3,600 at the end of 1988, and the number of the population receiving public water supply reached 8.17 million. The percentage of people receiving public water supply to the national population was about 45% as a national average in 1988 (81% in Dar es Salaam).

The government is making efforts in the construction and improvement of water sources, repair of water service pipes, and training of construction and service personnel. However, failure of the water supply occurs frequently because of problems from the shortage of machines, parts, and vehicles due to the lack of funds.

3,2 ECONOMIC SITUATION

3.2.1 General Economic Status

(1) Growth

According to the Bureau of Statistics, Tanzanian economy marked a substantial growth rate of 4.4% in 1989, as compared to 4.3% in the previous year. Since the First Economic Recovery Programme (ERP) was started up in July, 1986, the country's economy has been gradually recovering from a structural depression. The 3 years before the termination of the First ERP in June, 1989 recorded an average annual economic growth of 4%. The growth rate exceeded the average annual growth of population (2.8%) for the first time in many years. The government has reduced the tint of socialism in the mixed economy policy it introduced to assist economic recovery. In addition, the Second ERP was commenced in July, 1989. On the other hand, inflation rate has remained at high levels (32.2% in 1988 and 28% in 1989), partly because of the depreciation of Tanzanian currency.

Table 3.2-1 Changes in GDP (based on prices in 1976)

(Unit: million Tsh)

F.Y.	1983	1984	1985	1986	1987	1988	1989	(%)
Agriculture, forestry, fishing, hunting	9,914	10,312	10,931	11,557	12,066	12,606	13,183	46.6
Mining, earth materials	174	186	174	154	149	138	139	0.5
Manufacturing	2,103	2,159	2,075	1,991	2,075	2,187	2,299	8.1
Utilities	413	439	461	544	584	574	588	2.1
Construction	549	660	601	705	736	780	821	2.9
Commerce, hotels, restaurants	2,612	2,640	2,662	2,958	3,112	3,225	3,378	11.9
Transportation, telecommunication	1,473	1,482	1,509	1,504	1,551	1,652	1,730	6.1
Finance, insurance, real properties, corporate services	2,817	2,984	3,318	3,318	3,395	3,500	3,632	12.8
Public administration and other services	3,543	3,549	3,616	3,225	3,243	3,343	3,442	12.2
Total	23,958	24,411	25,075	25,956	26,911	28,005	29,212	103.2
Bank service liabilities (less)	(716)	(755)	(797)	(886)	(862)	(920)	(940)	(3.3)
Total GDP	22,882	23,656	24,278	25,070	26,049	27,085	28,272	100.0
Growth from previous year (%)	Δ2.4	3.4	2.6	3.3	3.9	4.0	4.4	-

Source: Tanzanian Economic Trend Vol. 2, No. 4.

Table 3.2-2 Changes in Dollar-based GDP

F.Y.	GDP (prices in each year) (M Tsh)	Middle-year exchange rate (Tsh/$)	Dollar-based GDP (M$)	Per-capita GDP ($/person)
1984	78,143	17.1742	4,550.0	218
1985	108,083	17.7333	6,094.9	284
1986	140,866	40.3429	3,491.7	158
1987	195,611	63.4835	3,081.3	136
1988	290,667	97.1871	2,990.8	128
1989	351,228	145.0000	2,422.3	101

Source: Compiled from Tanzanian Economic Trends.

(2) National Finance

Both revenue and expenditure in the fiscal year 89/90 (July, 1993 - June, 1990) increased considerably from those in the previous year, reflecting the impact of the depreciation of Tanzanian currency. Deficit in current balance in 89/90 is estimated to be 29.450 billion shillings, as compared to 23.44 billion shillings in the previous year. While expenditure in development in 89/90 is estimated to be 24.758 billion shillings, acquisition of foreign funds is suffering from a delay due to formalities.

Table 3.2-3 National Finance

(Unit: million Tsh)

F.Y	85/86	86/87	87/88	88/89	89/90
1. Ordinary revenue	22,321.0	34,499.5	57,988.5	71,789.0	97,122.0
2. Ordinary expenditure	27,402.3	40,390.1	61,765.0	92,562.1	126,572.0
3. Development expenditure	5,817.0	15,091.1	15,091.1	15,746.9	24,758.0
Domestic funds	4,395.0	9,636.0	8,467.0	6,153.9	13,400.0
Foreign aids	1,422.0	5,455.1	6,624.0	9,593.0	11,358.0

Note: Values for 89/90 are tentative.
Source: Economic Survey 1989.

(3) Industrial Trends

Both agriculture and manufacturing recorded favorable growth in 1989, the growth rate being 5.1% and 4.6%, respectively. All other sectors showed positive growth.

After 7 years of negative growth, the manufacturing sector has been recording positive growth for these 3 years. However, the overall operation rate of facilities is still as low as about one-third. It is pointed out that the situation has been caused by several factors including frequent interruption of water and electricity supply, shortage of imported materials due to the scarceness of funds, and poverty in managing abilities. There are great expectations for foreign aids, such as technical cooperation, to activate industrial facilities.

In the agricultural sector, measures have been taken including the upward revision of producer prices and the strengthening of sales activities while coordinating the distribution of fertilizer, agricultural chemicals, agricultural machines and tools. The governmental purchase of maize, rice, and wheat in 88/89 amounted to 271,400 tons, exceeding the quantity in the previous year by 20%. The harvest quantities of major cash crops in 88/89 were as follows: coffee 48,839 tons (0.4% increase from the previous year), tea 71,068 tons (about 12% increase), tobacco 11,350 tons (about 11% decrease), cotton 188,395 tons (about 26% decrease), sisal 32,265 tons (2.8% decrease), and cashew nuts 19,275 tons (20.4% decrease).

The production of the mining industry was decreasing for several years, but showed a slight recovery in 1989 with a 0.7% increase. This increase was due to the improvement of diamond markets and the increase in the sales of gems, coal, and lime. However, the superannuation of mining facilities, the shortage of equipment, the increase in the prices of construction materials, and the shortage of funds and know-hows are problems hindering full-scale recovery.

Table 3.2-4 Changes in the Production of Major Industrial Products* and the Rate of Operation (percentage in parentheses)

(percentage in parentheses)

Item (Unit)	Production capacity	1986	1987	1988	1989
Cigarettes (100 million)	5.9	2.7 (46.6)	2.6 (44.7)	3.0 (50.3)	2.8 (48.2)
Alcoholic beverage (Konyagi) (1,000 l)	1,815.4	713.0 (39.3)	809.0 (44.6)	1,069.0 (59.0)	1,164.0 (64.2)
Beer (million l)	127.5	65.2 (50.3)	58.8 (48.4)	53.0 (40.9)	53.7 (41.5)
Textile goods (million m^2)	252.1	61.9 (24.5)	60.8 (24.1)	64.3 (25.5)	70.9 (28.1)
Paper (1,000 t)	79.0	17.0 (21.5)	29.0 (36.7)	28.0 (35.4)	n.a. (n.a.)
Fertilizer (million t)	134.0	47.0 (35.1)	19.3 (14.4)	6.0 (4.5)	27.0 (20.1)
Tires (1,000 pieces)	650.0	138.0 (21.2)	197.0 (30.3)	188.0 (28.9)	n.a. (n.a.)
Steel sheet (1,000 t)	30.0	11.3 (37.6)	9.6 (32.0)	10.5 (35.0)	15.3 (51.0)
Corrugated steel sheet (1,000 t)	34.0	8.9 (26.2)	16.6 (48.8)	14.7 (43.2)	20.3 (59.7)
Plows (1,000 sets)	3,480.0	1,640.0 (47.1)	1,889.0 (54.3)	1,941.0 (55.8)	n.a. (n.a.)
Dry cells (million pieces)	44.0	27.0 (61.4)	26.3 (59.8)	24.2 (55.0)	28.0 (63.6)
Cement (million t)	1,250.0	435.0 (34.8)	498.0 (39.8)	591.0 (47.3)	595.0 (47.6)

Source: Ministry of Industries and Trade and Bureau of Statistics.

* Other important industrial products include sisal products, paint, petroleum byproducts (from refining of imported crude oil), aluminum, radio equipment, fishing nets, canvas fabric, leather products, jute bags, edible oil, etc.

Table 3.2-5 Production of Major Agricultural Products

(Unit: 1,000 tons)

F.Y.	84/85	85/86	86/87	87/88	88/89
Maize	89,996	27,894	190,763	267,749	113,371
Rice	18,716	15,566	17,854	72,782	25,462
Wheat	33,185	50,289	4,549	2,878	43,867
Sorghum	2,364	14,744	13,461	6,437	325
Bulrush Millet a)	32	-	131	197	-
Finger Millet b)	105	-	4,793	709	-
Broad beans	3,587	5,669	28,740	41,023	2,444
Cassava	19,875	12,935	16,806	12,217	3,426

Note : These are types of millet.
Source: Economic Survey 1989.

Table 3.2-6 Production of Major Cash Crops

(Unit: tons)

F.Y.	84/85	85/86	86/87	87/88	88/89
Saisal	32,247	30,151	33,170	33,268	32,265
Coffee	49,080	55,147	58,737	48,612	48,839
Cotton	154,865	105,367	214,569	254,915	188,395
Tobacco	13,315	12,549	12,921	12,866	11,350
Dalmatian pyrethrum	1,533	1,352	1,231	1,412	1,313
Tea	77,230	71,472	64,694	63,632	71,068
Cashew nuts	32,532	18,901	16,548	24,287	19,275
Sugar cane	1,253	1,107	1,063	1,099	878

Source: Economic Survey 1989.

Table 3.2-7 Production of Major Mining Products

Name of Mineral (Unit)	1984	1985	1986	1987	1988	1989*	Sales in 1989
Diamond (kg)	55.3	43.4	38.0	25.2	17.6	15.5	1,063.5
Rock salt (1,000 t)	29.9	31.6	15.3	41.1	30.1	21.3	255.3
Sulfur (1,000 t)	14.5	26.5	21.0	18.4	13.0	10.6	-
Gems (kg)	388.8	218.3	300.0	9,619.0	9,053.0	11,398.0	230.5
Tin (1,000 t)	0.3	1.8	2.1	5.4	14.2	14.7	1.5
Gold (kg)	39.5	42.3	46.9	201.1	164.4	116.0	169.4
Mica (1,000 t)	0.1	0.3	-	-	-	0.5	0.1
Gypsum (1,000 t)	7.6	14.4	12.9	29.6	19.6	5.9	-
Kaolin (1,000 t)	1.7	1.6	2.3	2.5	1.6	1.6	-
Calcite (1,000 t)	2.2	3.5	3.5	2.9	1.7	2.5	-
Coal (1,000 t)	8.2	6.6	3.6	2.9	3.3	46.0	-
Glass sand (1,000 t)	10.0	9.3	7.6	6.1	12.0	13.1	-
Limestone (1,000 t)	138.8	247.0	457.4	680.7	792.5	986.5	-

Source: Department of Mines.

* Tentative values. Sales amounts are given in million Tsh.
The sales of other minerals total to 332.1 million Tsh.

(4) Balance of International Payments

Exportation and importation in 1989 showed an increase of 3.9% and 3.2%, respectively. The amount of exportation was still as low as about one-third of the amount of importation, and the enormous structural deficit in the balance of international payments is presenting a serious problem. About a half of the total exportation is occupied by the 6 cash crops mentioned above. (In the mid 1980's, agricultural products occupied 60 - 70% of total exportation.) The country is faced with many problems such as the international market trends in exported products, the problems related to processing and transportation, and the improvement of measures to promote exportation.

Table 3.2-8 Tanzania's Balance of International Payments

(Unit: million $)

			1983	1984	1985	1986	1987	1988	1989
Current Balance	Trade * Balance	Exportation	379.7	388.3	285.6	347.6	353.2	380.2	395.2
		Importation	814.5	874.0	999.2	1,047.5	1,150.0	1,192.4	1,230.0
		Balance	Δ434.8	Δ485.7	Δ713.6	Δ699.9	Δ796.8	Δ812.2	Δ834.8
	Service Balance	Receivable	109.1	107.4	108.1	110.0	108.6	119.7	122.7
		Payable	84.9	150.6	176.2	195.1	207.7	315.8	341.8
		(Interest, included in above)	(18.0)	(89.3)	(97.3)	(112.8)	(99.4)	(187.8)	(206.4)
		Balance	23.2	Δ 43.2	Δ 68.1	Δ 85.1	Δ 99.1	196.1	Δ219.2
	Transfer Balance	Transfer income	128.3	180.9	394.3	501.0	610.0	643.0	682.0
		Transfer expenditure	25.0	21.4	27.6	28.0	27.0	21.7	29.8
		Balance	103.3	159.5	366.7	473.0	583.0	621.3	652.2
	Current balance		Δ308.3	Δ369.4	Δ415.0	Δ312.0	Δ312.9	Δ387.0	Δ401.8
Capital Balance		Capital income	270.9	292.6	200.0	165.0	213.0	226.0	245.6
		Capital expenditure	62.9	256.9	250.5	214.4	220.0	186.4	213.3
		Capital balance	208.0	35.7	Δ 50.5	Δ 49.4	Δ 7.0	39.6	32.3
Exceptional financial measures			153.5	49.1	60.0	83.0	47.1	96.0	143.7
Errors and omissions			Δ190.7	125.9	10.9	Δ 78.2	Δ 8.9	Δ 6.5	Δ 22.8
Overall balance			Δ137.5	Δ158.7	Δ394.6	Δ356.6	Δ281.7	Δ257.9	Δ248.6

Source: Bank of Tanzania

* The values for 1988 and 89 are somewhat different from those given in Table 3.2-9. The data in the source are shown here unchanged.

Table 3.2-9 Changes in Tanzania's International Trade

(Unit: million $)

			1983	1984	1985		1986	1987	1988	1989 *	
						(%)					(%)
Exportation	Cash crops	Coffee	130.29	153.59	118.50	41.3	184.67	109.40	96 70	84.30	21.3
		Cotton	61.69	49.52	29.60	10.3	30.40	43.92	75.26	60.30	15.3
		Sisal	13.10	10.54	5.90	2.1	5.20	5.88	4.86	4.00	1.0
		Tea	21.79	23.47	17.00	5.9	13.61	17.67	16.03	16.70	4.2
		Tobacco	11.52	8.99	13.60	4.7	12.70	11.94	15.35	10.50	2.7
		Cashew nuts	6.50	21.92	11.50	4.0	15.0	12.43	16.05	4.60	1.2
		(Sub-total)	244.89	268.03	196.10	68.4	261.58	201.24	224.25	180.40	45.6
	Others	Petroleum products	13.80	22.70	13.70	4.8	4.63	7.05	12.21	n.a.	n.a.
		Mining products	43.60	33.94	21.60	7.5	13.00	22.00	15.91	n.a.	n.a
		Manufacturing products	44.21	33.10	32.80	11.4	39.10	63.00	72.10	n.a.	n.a.
		Others	33.20	30.56	22.40	7.8	29.30	54.00	47.56	n.a.	n.a.
		(Sub-total)	134.81	120.30	90.50	31.6	86.03	146.05	147.78	214.80	54.4
	Total		379.70	388.33	286.60	100.0	347.61	347.29	372.03	395.20	100.0
Importation	Producer goods	Transportation equipment	64.26	87.74	108.40	10.8	123.70	185.80	80.40	192.00	15.0
		Construction equipment	79.65	87.96	95.14	9.5	108.70	130.90	183.60	149.80	11.7
		Machinery	182.10	70.77	230.70	23.1	261.60	297.20	151.00	307.00	24.0
		(Sub-total)	326.01	346.46	434.28	43.5	494.00	610.90	415.00	648.80	50.7
	Intermediate goods	Petroleum **	225.57	210.62	223.44	22.4	144.96	169.50	276.00	161.10	12.6
		Fertilizer	3.90	9.64	8.77	0.9	11.0	6.40	3.90	15.50	1.2
		Industrial raw materials	111.08	142.09	156.98	15.7	170.00	170.80	182.40	235.20	18.4
		(Sub-total)	348.99	370.33	400.56	40.1	340.93	346.70	497.40	411.80	32.2
	Consumer goods	Fabric products	19.00	19.76	34.32	3.4	42.00	31.40	44.90	93.60	7.3
		Foods	74.19	91.10	77.97	7.8	95.00	76.00	105.40	44.70	3.5
		Others	44.83	43.69	49.94	5.0	73.00	84.60	122.20	89.00	7.0
		(Sub-total)	138.02	154.55	162.23	16.2	210.00	192.00	272.50	207.30	16.2
	Miscellaneous		1.51	0.61	2.12	0.2	2.30	0.40	0.14	10.70	0.8
	Total		814.54	873.95	999.19	100.0	1,047.46	1,150.00	1,185.00	1,278.60	100.0
Trade balance			Δ434.84	Δ485.62	Δ712.59		Δ 699.85	Δ802.71	Δ812.97	Δ883.40	

Source: Customs and Bank of Tanzania.

* Tentative values. ** Includes crude oil and refined products.

Table 3.2-10 Major Trade Partners of Tanzania

(percentage in parentheses)

Rank	Exportation		Importation	
	1980	1987	1980	1987
1	U.K. (17.6)	W.Germany (19.3)	U.K. (17.5)	U.K. (14.4)
2	W.Germany (13.2)	U.K. (11.6)	W.Germany (17.5)	Japan (8.6)
3	Singapore (6.9)	Netherlands(10.1)	Japan (8.6)	Italy (7.4)
4	Italy (4.9)	Japan (4.9)	N.America (6.9)	W.Germany(6.3)
5	Netherlands(4.8)	Finland (4.3)	Netherlands(6.3)	Iran (5.2)
6	Japan (4.5)	Italy (4.1)	Italy (4.9)	Denmark (4.4)

Source: IMF Recent Economic (1982, 1989).

3.2.2 Development Programme

Tanzania is currently implementing the Second 5-year Development Programme. Although the Programme aims at an average annual economic growth of 5%, achievements up to the present have been somewhat falling short of this target. ERP (Economic Recovery Programme) was introduced to supplement the Development Programme. After the basically satisfactory completion of the First ERP (from July, 1987 to June, 1989), the Second ERP was commenced in July, 1989. The gist of this programme has been put into practice as ESAP (Education and Society Action Program). The Second ERP (from July, 1989 to June, 1992) aims at an average annual economic growth of 5%.

<Prioritized Considerations for Development>

1) In terms of the direction of development, hasty industrialization should be avoided and the improvement of agriculture and infrastructures should be given priority.

2) A stress should be placed on the production of basic necessities of life, such as construction materials, food, medical services, potable water, and education tools.

3) In the industrial sector, importance should be attached to the processing of agricultural products and the production of goods for acquiring foreign currencies.

4) Industries based on iron ore, coal, phospholite, and other domestic resources should be promoted. Key industries such as steel, chemicals, and construction materials should be established.

5) Industries dealing in civil engineering and metal processing should be created. To enhance self-help, Factories should be constructed in the production sector, as well as those producing tools and machine parts, to expand the domestic market for steel products.

6) Small and medium-sized companies should be promoted and the production of consumer-oriented goods should be encouraged.

7) Training of industrial workers in the field of science and technology should be reinforced. Industrial and technological centers should be established.

8) Technical and industrial cooperation with neighboring countries should be reinforced and various international organizations should be established for this purpose.

Table 3.2-11 Investment

(Current prices, Unit: million Tsh)

	1985	1986	1987	1988	1989
Formation of fixed capital	16,872	28,679	46,281	60,754	94,270
Investment in inventory (net)	2,091	2,487	3,685	4,122	5,482
Total investment	18,963	31,166	49,966	64,876	99,752
<Breakdown of formation of fixed capital>					
1. Public sector	6,790	11,383	13,158	15,534	19,257
2. Private sector	10,082	17,296	33,123	45,220	75,013
<Breakdown of formation of fixed capital by fields of industry>					
1. Construction	3,096	4,339	6,260	6,281	7,438
Housing, included in above	592	452	593	1,359	1,649
2. Other works	2,762	4,665	3,914	7,586	9,657
Land improvement	539	733	659	913	1,252
Roads and bridges	557	644	987	1,203	1,777
Water supply facilities	347	277	717	1,046	1,223
Others	1,319	3,011	1,551	4,424	5,405
3. Equipment and machinery	11,014	19,675	36,107	46,887	77,175
Transportation equipment	7,556	13,331	13,884	31,641	55,125
Other equipment	3,448	6,344	22,223	15,246	22,050

Source: Economic Survey 1989

3.3 SITUATION OF ELECTRIC POWER

3.3.1 Situation of Electric Power in Tanzania

Tanzania Electric Supply Co., Ltd. (TANESCO) operates the electric power in the United Republic of Tanzania consistently from generation to distribution under the control of the Ministry of Energy, Mineral and Water Resources. The organization diagram of TANESCO is shown Fig. 3.3-1. The electric power generated at hydropower stations and diesel power stations is distributed to consumers through TANESCO's 220 kV and 132 kV transmission lines.

Principal hydropower stations are Kidatu Power Station (output 204 MW, 51 MW x 4 units, completed in 1975) and Mtera Power Station (output 80 MW, 40 MW x 2 units, completed in 1988) both in the vasin of Great Ruaha River to the west of Dar es Salaam.

Kidatu Power Station has been suffering a loss of output down to 95 MW since 1992 because of the lowering of dam water level due to the shortage of water. The output of Mtera Power Station has also been limited to 30 MW since October, 1992 because of the shortage of water. Three hydropower stations in the vasin of Pangani River (Hale, Pangani Fall, Nyumbaya Mungu; operated since 1934, 1964, and 1969; total output 46.5 MW) are also interconnected to the 132 kV transmission line system. The schematic diagram of the grid system is shown in Fig. 3.3-2. In addition, 10 diesel power stations (total installed capacity about 120 MW, available output 44 MW) are interconnected to the system. About a half of the electricity generated at these stations is consumed in Dar es Salaam.

In rural areas (about 20 districts) isolated from the system, TANESCO is operating small-scale diesel power stations and supplying power independently through distribution lines. Electricity is supplied to only about 6% of the 25 million people of Tanzania, and the supply is limited to major cities, towns, and villages. Table 3.3-1 shows the characteristics of power stations in Tanzania. The trend of generated energy (1985 - 1991) and energy consumption are shown in Table 3.3-2 and Fig. 3.3-3 through 3.3-5.

3.3.2 Situation of Electric Power in Dar es Salaam

The electricity consumed in the city of Dar es Salaam, which is the subject area of this study, is generated domestically at hydropower stations in the vasin of Great Ruaha River and Pangani River, as well as diesel power stations in several districts, and transmitted through 220 kV and 132 kV transmission lines to Ubungo Substation located to the west of the city.

Electricity is transmitted from Ubungo Substation to several distribution substations (15 substations) in the city through 132 kV and 33 kV transmission lines. Spreading from distribution substations, 11 kV distribution lines are forming networks in various areas in the city. Electricity is served to general customers after converted to either 3-phase, 400 V or single-phase, 4-line, 230 V by means of distribution transformers installed on poles or on the ground.

Most of the distribution networks in Dar es Salaam consist of lines that have been used since the 1960's without major renewal, and the considerable deterioration is impeding the stability of electric power supply.

Major problems of distribution networks in the city are listed below with main causes.

- Voltage drop
  Insufficient transformer capacity
  Insufficient line capacity

- Increase in energy loss
  Insufficient transformer capacity
  Insufficient line capacity
  Insulation defect
  Pilferage

- Increase in service interruption by accidents
  Deterioration of distribution and substation facilities
  Insufficient connection of power lines

Contact with trees and other objects

Lack of section switches and other protection equipment

The characteristics of substations in Dar es Salaam are as shown below.

Name of Substation	Voltage	Installed Capacity
UBUNGO	220/132 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 3
FACTORY ZONE-I	33/11 kV	5 MVA x 3
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	3.15 MVA x 1
TAZARA	33/11 kV	3.15 MVA x 2
ALAF	33/11 kV	10 MVA x 3

The following 2 substations and related 33 kV transmission lines are currently being constructed by the grant aid from Japan and are planned to be completed in 1994.

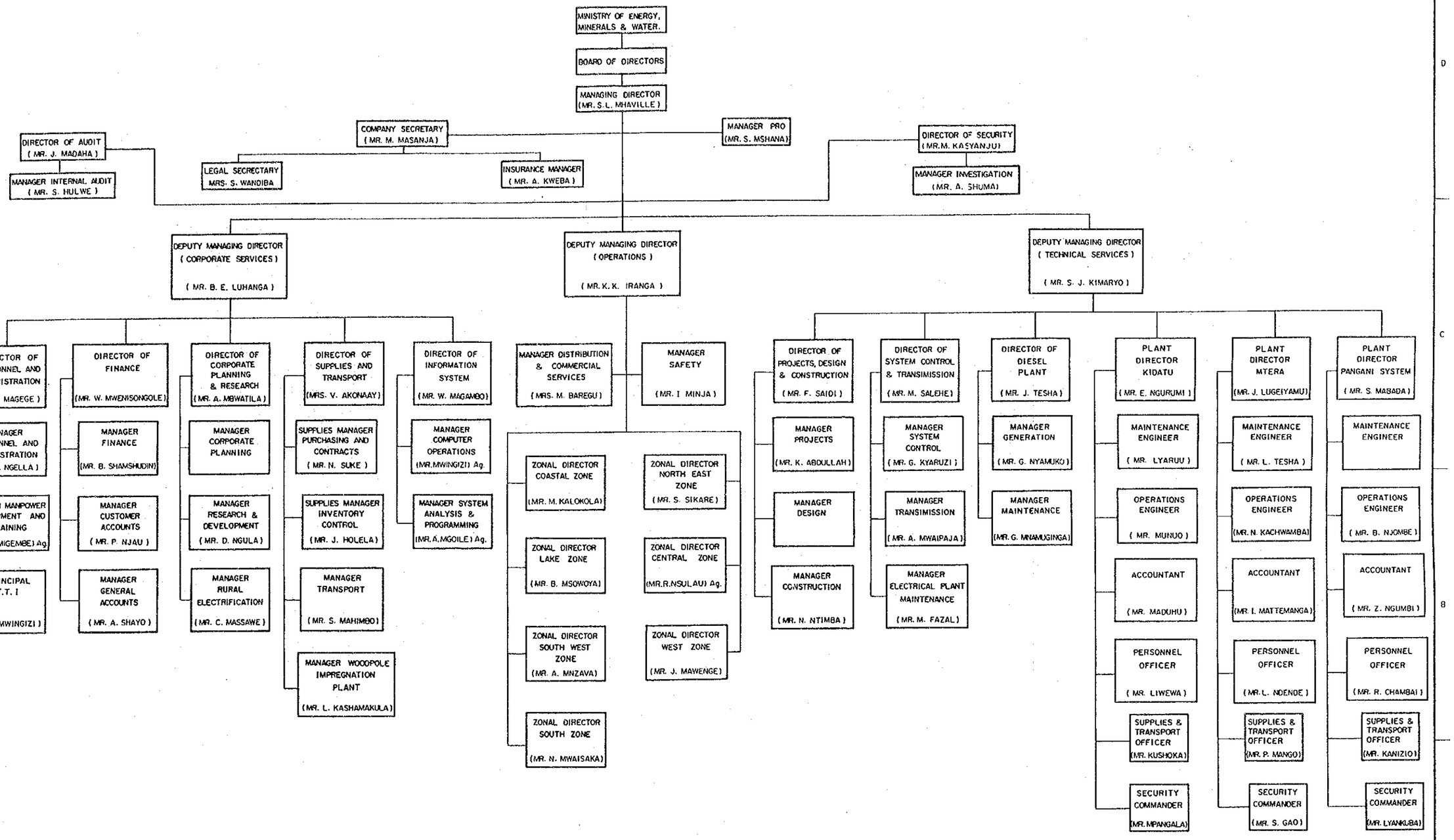
SOKOINE	33/11 kV	15 MVA x 1
MSASANI	33/11 kV	15 MVA x 1

The changes in the electric energy consumption in Dar es Salaam are shown in Table 3.3-3.

Fig. 3.3-1

TANESCO ORGANIZATION CHART

4th January, 1994



LOCATION	DATE	DESCRIPTION	BY
		REVISION	

THE UNITED REPUBLIC OF TANZANIA
MASTER PLAN STUDY ON DAR ES SALAAM POWER SUPPLY SYSTEM EXPANSION

TANESCO ORGANIZATION CHART

TANESCO	ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO, JAPAN
	DR.: SUBMITTED:
	TR.: RECOMMENDED:
	CK.: APPROVED:
Fig.	— — —

Fig. 3.3-2 GRID SYSTEM IN TANZANIA

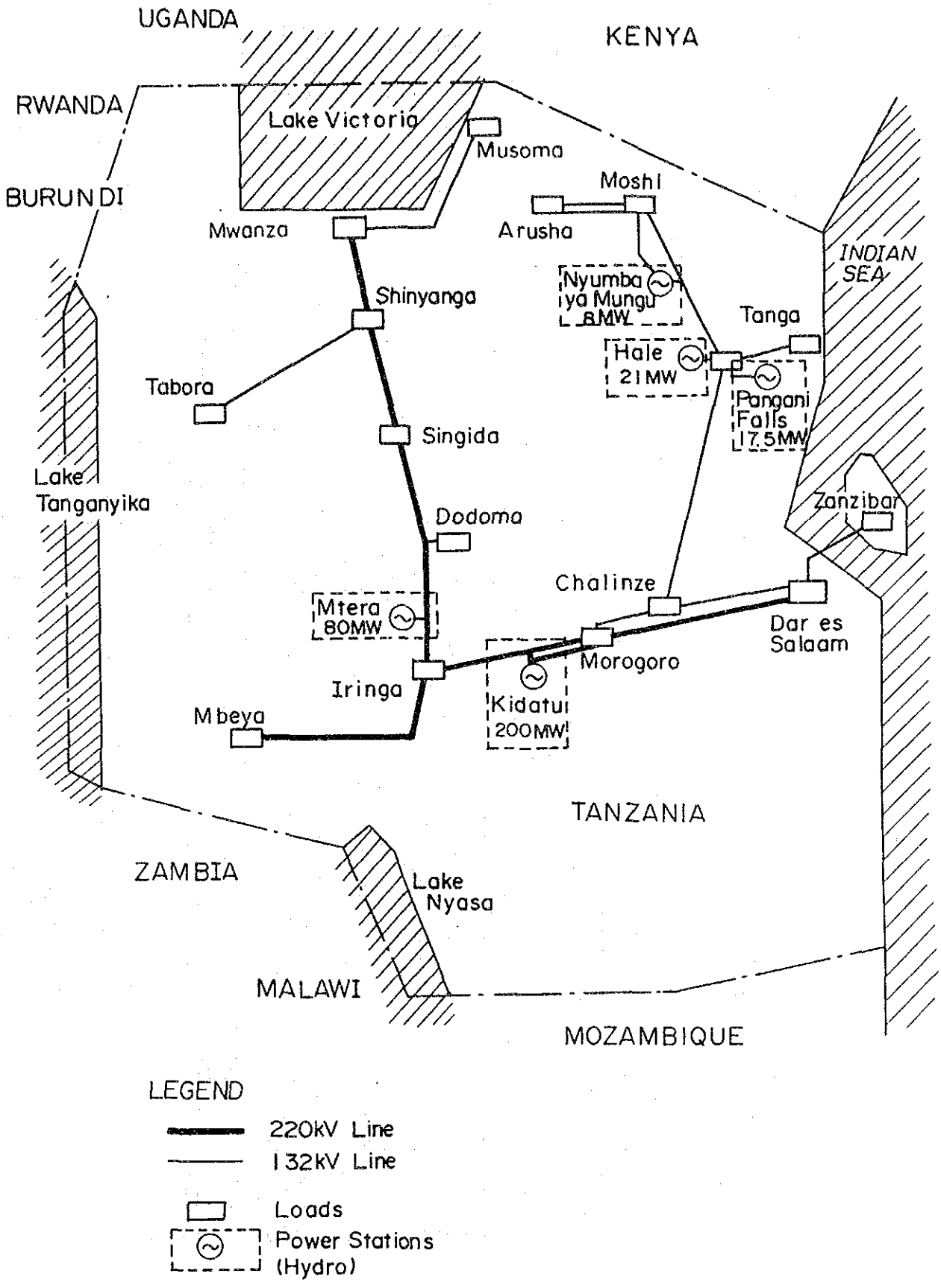


Fig. 3.3-3 ANNUAL ENERGY GENERATION-TRENDS
GRID AND ISOLATED SYSTEMS

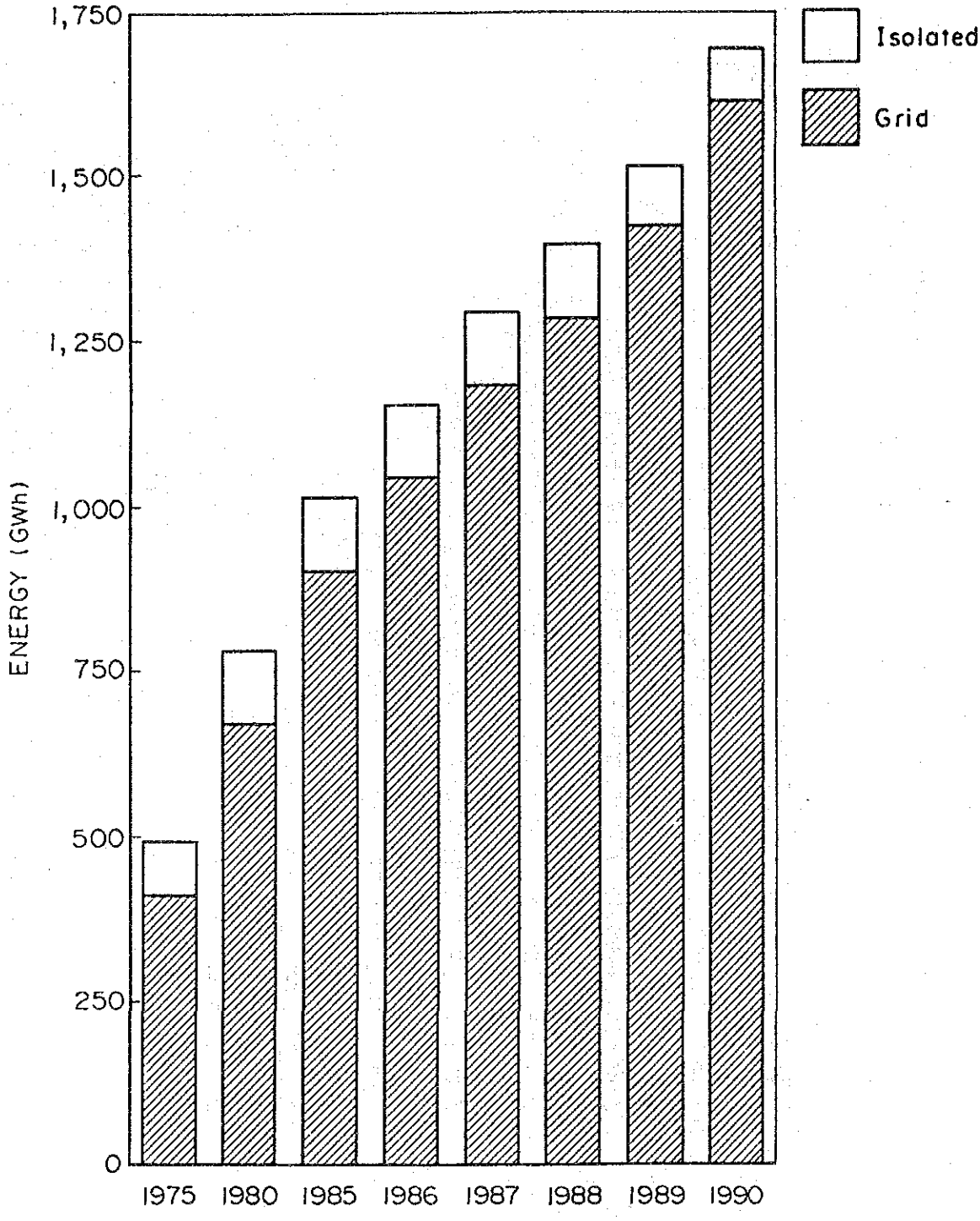


Fig. 3.3-4 ENERGY UTILIZATION-1985 TO 1990
GRID AND ISOLATED SYSTEMS

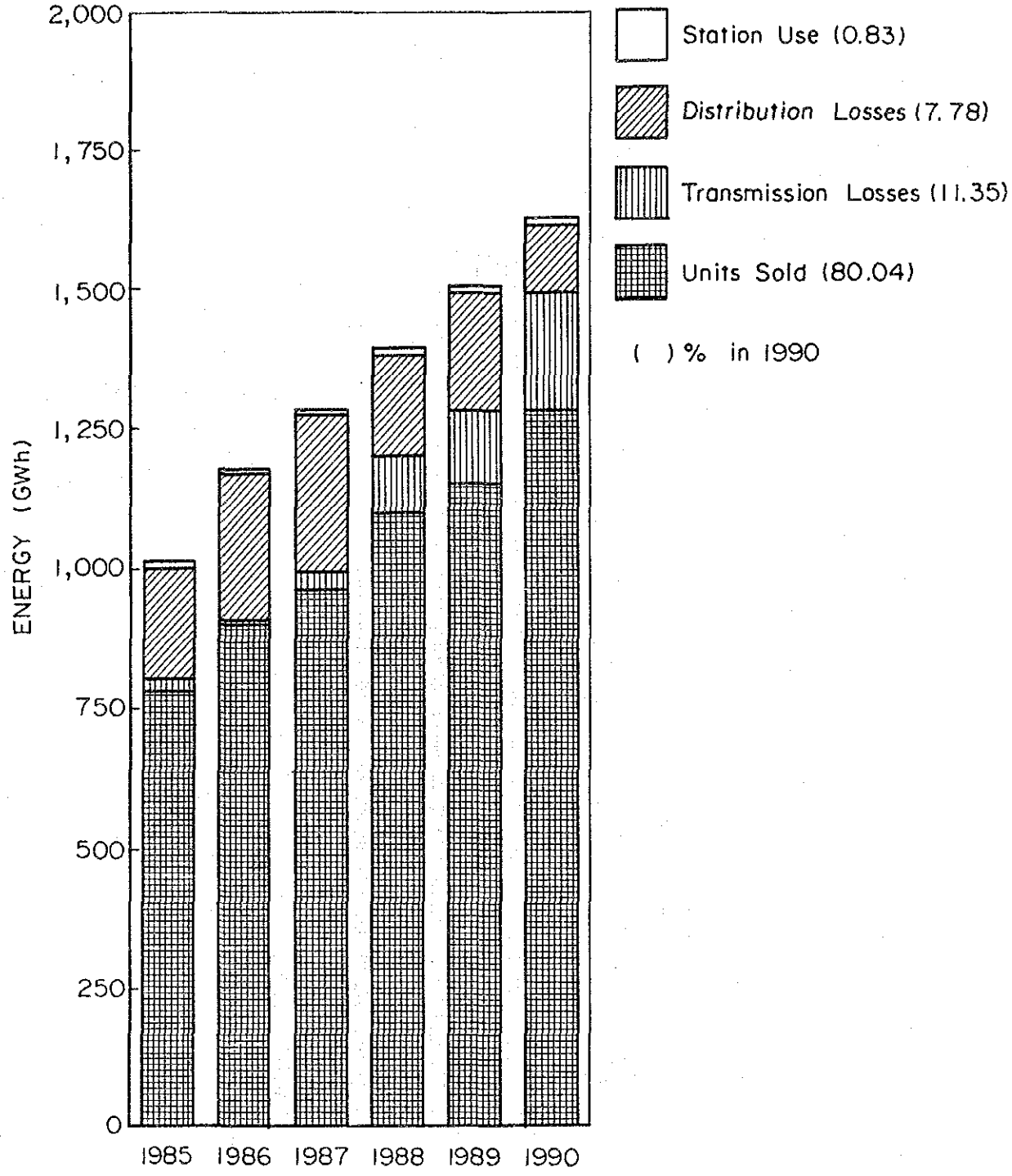
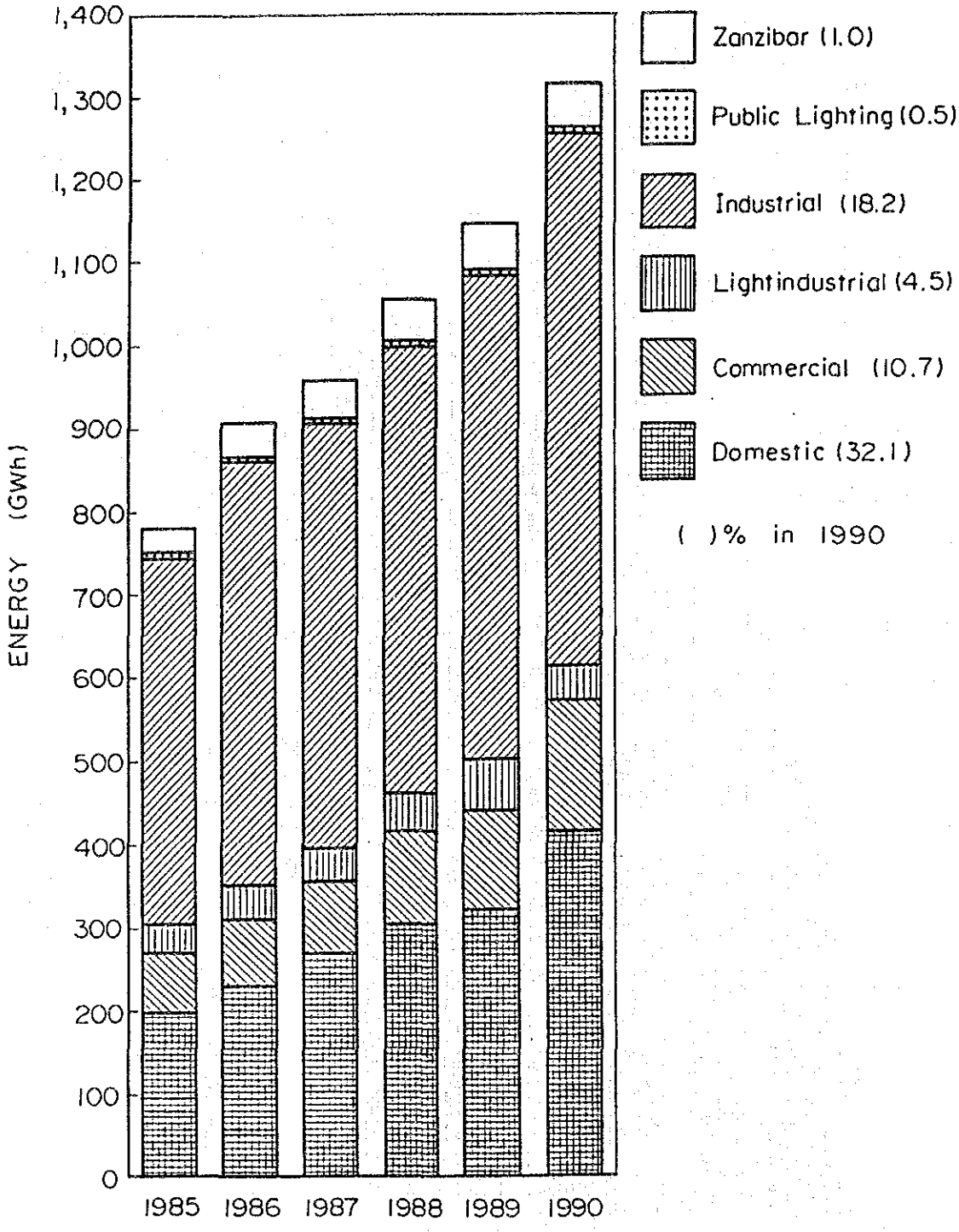


Fig. 3.3-5 ENERGY SALES - 1985 TO 1990
GRID AND ISOLATED SYSTES



STATION Table 3.3-1

(GRI-1/2) POWER STATION ON GRID SYSTEM IN TANZANIA (AS OF APRIL 1991)

STATION NAME	No. of Units (Units)	Capacity (Kw)	Installed Capacity (Kw)	Available Capacity (Kw)
(HYDRO PLANT)				
HALE	2	10,500	21,000	21,000
KIDATU	4	51,000	204,000	204,000
MTERA	2	40,000	80,000	80,000
KIKULETWA	1	600		
	1	400	1,160	0
	1	160		
MBALIZI	1	180		
	1	160	340	340
NYUMBAYAMUNGU	2	4,000	8,000	8,000
PANGANI FALLS	3	2,500		
	2	5,000	17,500	1,400
TOSAMANGANGA	1	380		
	1	840	1,220	1,220
HYDRO TOTAL			333,220	315,960
(THERMAL PLANT)				
ARUSHA	2	350		
	3	750	2,950	1,500
ZUZU-DODOMA	2	2,851		
	1	1,722	7,424	2,580
IYUNGA-MBEYA	4	2,851		
	2	3,200	17,804	11,000
UBUNGO	3	4,410		
	1	6,137		
	2	7,500		
	1	15,000	49,367	8,000
SHINYANGA	2	500		
	1	640	1,640	1,540
SINGIDA	1	640	640	640

(GRI-2/2) POWER STATION ON GRID SYSTEM IN TANZANIA (AS OF APRIL 1991)

STATION NAME	No. of Units (Units)	Capacity (Kw)	Installed Capacity (Kw)	Available Capacity (Kw)
(THERMAL PLANT)				
MWANZA-SOUTH	3	1,500	4,500	1,500
MWANZA-NYAKATO	4	4,500	18,000	8,000
MUSOMA	2	500		
	1	350		
	8	750	7,350	2,590
TABORA-KILOLENI	1	1,722		
	3	2,851	10,275	6,660
THERMAL TOTAL			119,950	44,010
GRID TOTAL (THERMAL+HYDRO)			453,170	359,970

Table 3.3-2

WH-GRID ENERGY GENERATION & SALES ON THE GRID SYSTEM ((1985-1991)

	1985	1986	1987	1988	1989	1990	1991
GENERATION (Gwh)							
Hydro	886.6	1,033.8	1,151.2	1,251.6	1,419.1	1,549.2	1,725.6
Thermal	28.3	7.3	17.4	14.2	16.7	15.8	24.8
TOTAL (Gwh) (1)	914.9	1,041.1	1,168.6	1,265.8	1,435.8	1,565.0	1,750.4
SOLD (Gwh)							
Residential	173.9	208.2	240.1	288.0	311.4	395.2	434.7
Small Business	55.6	70.0	73.4	100.5	113.3	127.1	140.2
Small Industry	363.6	196.7	140.4	169.5	176.2	189.1	207.7
Large Industry	59.8	302.8	287.2	287.3	333.8	364.6	398.5
Others	42.7	44.6	130.4	159.6	174.9	178.3	194.6
TOTAL (Gwh) (2)	695.6	822.3	871.5	1,004.9	1,109.6	1,254.3	1,375.7
LOSS (Gwh) (1)-(2)	219.3	218.8	297.1	260.9	326.2	310.7	374.7
TOTAL CONSUMERS	126,497	133,419	111,190	128,773	144,258	155,284	171,473

Note : LOSS includes station use energy.

DESENERY

Table 3.3-3

ENERGY CONSUMPTION IN DAR ES SALAAM CITY (1985-1991)

ITEMS	1985	1986	1987	1988	1989	1990	1991
ENERGY SOLD							
-Residential (Gwh)	118.48	137.78	153.31	173.49	174.60	222.63	243.4
-Small Business(Gwh)	31.36	39.80	38.52	53.70	58.14	59.03	64.5
-Small Industry(Gwh)	7.24	93.64	77.38	83.64	86.08	100.64	110.0
-Large Industry(Gwh)	0.43	142.68	127.73	132.38	135.83	158.60	173.3
-Others (Gwh)	0.10	1.22	56.60	48.74	51.99	49.19	53.7
ENERGY SOLD TOTAL	157.61	415.12	453.54	491.95	506.64	590.09	644.90
PEAK DEMAND (MW)	85.68	91.00	94.30	100.15	103.60	107.75	128.32
TOTAL CONSUMER	-	-	-	-	-	69,612	78,988

CHAPTER 4

DEMAND FORECAST

Chapter 4 Demand Forecast

CHAPTER 4 DEMAND FORECAST

4.1 PRESENT SITUATION OF DEMAND

The sources of electric power in Tanzania consist of hydropower stations and diesel power stations. Virtually all electric energy required in the country (99%) is supplied by hydropower stations. Although the installed capacity of diesel power stations (120 MW) occupies about 26% of the total capacity of all power generation facilities (453 MW), most of these stations are severely deteriorated and they are not capable of prolonged operation because of the shortage of spare parts and for other reasons. Therefore, diesel power stations are operated only during peak hours. As for hydropower stations, the nationwide shortage of water continuing from about 1992 has caused a considerable drop of dam water levels. Because of the inability to generate sufficient power, power supply to consumer is destricted everyday.

The demand and supply balance in the grid system is shown in Table 3.3-2 for the period from 1985 to 1991. The demand situation in Dar es Salaam is shown in Table 3.3-3.

Dar es Salaam is the largest center of power consumption in the country, as shown in the following list, in comparison with the grid system.

	Grid System	Dar es Salaam	
Energy Consumption (GWh)	1,376	645	46.9%
Peak Load (MW)	296.8	128.3	43.2%
Number of Customers	171,473	78,988	46.1%

4.2 DEMAND FORECAST

The subject of this study is the electric power supply expansion plans in Dar es Salaam. Since the demand in this city represents about half of the linked system, it is necessary to confirm the demand and supply balance in the grid system as a whole. Therefore, demand estimation was conducted for 2 different cases, one for the whole system including the city and one for the city itself.

Generally, a strong correlation can be seen between the income level of subscribers (users) expressed in terms of the GDP (gross domestic product) and the growth in the demand for electric power. Based on this correlation, demand was forecast by a method using linear regression.

The actual records of GDP and demand during the 5 years from 1985 to 1990 are as shown below.

	GDP (Shs. Mill)	Demand (GWh)
1985	24,278	469
1986	25,070	511
1987	26,343	560
1988	27,460	594
1989	28,376	584
1990	29,396	599

Applying linear regression to these data, we obtained the equation:

$$y = 115.85 + 0.0349x$$

Where, y = demand for electric power (GWh)
x = GDP (Shs. mill).

Future demand was estimated by substituting the value of GDP for each year in the above equation.

The annual growth in GDP is 4.2% on average over the 5 years, with the minimum at 3.3% in 1985 and the maximum at 5% in 1986. Since the political situation of Tanzania is stable, economic activities in this country are expected to expand further in the future. Therefore, we used the value of 5%, which is the highest record in the past. The baseline value of GDP was 29,396 Shs. mill. in 1990.

4.2.1 Demand Forecast in the Grid System

A summary of the forecast results for the grid system for a period of 15 years from 1992 to 2007 are summarized in Table 4.2-1 and the forecast results for the grid system are given in Table 4.2-2. The columns labeled "Balance" in Table 4.2-1 show the difference between peak generation and peak load and the difference between energy gen-

eration and consumption. The data shows that the shortage of electric power will continue until the completion of Lower Kihansi Hydropower Station in 1998. When the need for the inspection and repair of equipment, unforeseen accidents, and the poor reliability of deteriorated diesel generators are taken into consideration, the severity of the shortage of electric power can be expected to be aggravated further.

In order to meet with the shortage of electric power, it is necessary (1) to construct gas turbine power stations which can be constructed in a short term, and (2) to expedite the commissioning of the planned hydropower stations and the rehabilitation of diesel power stations.

Construction plan of new hydropower stations

1995	Pangani Fall Plant	60 MW
1998	Lower Kihansi Plant	180 MW
1999	Upper Kihansi Plant	120 MW
2001	Masigira Plant	80 MW
2005	Rumakali Plant	204 MW

Rehabilitation plan of diesel power stations

1993	Ubungo	23 MW
1994	Dodoma	4.7 MW
1994	Mbeya	2.5 MW
1994	Tabora	3.2 MW

Construction plan of new diesel power stations

1994	Ubungo	20 MW x 2
1995	Arusha	6 MW x 3

4.2.2 Demand Forecast in Dar es Salaam

Demand forecast in Dar es Salaam was conducted as follows.

(1) Load of Existing Substations

Based on the load (the sum of the load of 11 kV distribution lines) of existing substations in 1991, estimation was made by the method described in Section 4.2 (assuming a 5% growth of GDP). In the case

that a part of the load of an existing substation will be shared by a new substation, the load was adjusted at the point in time when the new substation begins operation.

(2) Load of New Substations

About half of the existing 11 kV distribution lines load installed around the site of a new substation (the sum over all lines if there are more than one) was considered as the load of the new substation. The increase in the load after completion was estimated by the method described in Section 4.2. The method of load allocation to new substations is shown in Table 4.2-3, and the demand forecast for each substation are shown in Table 4.2-4.

Note: The fluctuations noted in the growth of demand at existing substations shown in Table 4.2-4 derive from the allocation of load to new substations as listed in Table 4.2-3. Namely:

(1) City Center S/S

1994 - Half of the load from the C3 and C8 lines is allocated to Sokoine S/S

1996 - Half of the load from the C5 line will be allocated to Kariakoo S/S

2004 - Half of the load from the C2 and C6 lines will be allocated to the Upanga S/S

(2) Kurasini S/S

1994 - Half of the load from the INDUST line is allocated to Chang'ombe S/S

1998 - Half of the load from the KILWA RD line will be allocated to Mbagala S/S

2000 - Half of the load from the KILWA RD line will be allocated to Temeke S/S

(3) Oyster Bay S/S

1994 - Half of the load from the O3 and O6 lines is allocated to Msasani S/S

1994 - Half of the load from the O4 line is allocated to Tandale S/S

(4) Ubungo S/S

1994 - Half of the load from the U2 line is allocated to Tandale S/S.

2000 - Half of the load from U1 and U2 lines will be allocated to Mburahati S/S

(5) Ilala S/S

1996 - Half of the load from the D1, D2, and D9 lines will be allocated to Kariakoo S/S

2000 - Half of the load from the D10 line will be allocated to Mburahati S/S

2004 - Half of the load from the D10 lines will be allocated to Upanga S/S

(6) Mbezi S/S

1996 - Half of the load from Kunduchi will be allocated to Kunduchi S/S

(7) Mikocheni S/S

1994 - Half of the load from the MK1 and MK2 lines is allocated to Msasani S/S and Tandale S/S, respectively

1994 - Half of the load from the U2 line is allocated to Tandale S/S, respectively

(8) Factory Zone I S/S

1994 - Half of the load from the F2 and F5 lines is allocated to Chang'ombe S/S

2000 - Half of the load from the F2 line will be allocated to Temeke S/S

Table 4.1-1

WH-GRID ENERGY GENERATION & SALES ON THE GRID SYSTEM ((1985-1991)

	1985	1986	1987	1988	1989	1990	1991
GENERATION (Gwh)							
Hydro	886.6	1,033.8	1,151.2	1,251.6	1,419.1	1,549.2	1,725.6
Thermal	28.3	7.3	17.4	14.2	16.7	15.8	24.8
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Note : LOSS includes station use energy.

DESENERY Table 4.1-2

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ITEMS	1985	1986	1987	1988	1989	1990	1991
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-Others (Gwh)	0.10	1.22	56.60	48.74	51.99	49.19	53.7
ENERGY SOLD TOTAL	157.61	415.12	453.54	491.95	506.64	590.09	644.90
PEAK DEMAND (MW)	85.68	91.00	94.30	100.15	103.60	107.75	128.32
TOTAL CONSUMER	-	-	-	-	-	69,612	78,988

Table 4.2-1

GENDEMDR FORECAST FOR PEAK GENERATION & DEMAND IN GRID SYSTEM (1991-2007)

ITEMS	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
POWER SUPPLY																	
INSTALLED CAPACITY (Mw)																	
Hydro Plant	333.2	333.2	333.2	333.2	393.2	393.2	393.2	573.2	693.2	693.2	773.2	773.2	773.2	773.2	977.2	977.2	977.2
Thermal Plant	120	120	143	193.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4	211.4
TOTAL CAPACITY	453.2	453.2	476.2	526.6	604.6	604.6	604.6	784.6	904.6	904.6	984.6	984.6	984.6	984.6	1188.6	1188.6	1188.6
AVAILABLE CAPACITY (Mw)																	
Hydro Plant	316	316	316	316	376	376	376	556	676	676	756	756	756	756	960	960	960
Thermal Plant	44	44	67	117.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4	135.4
TOTAL CAPACITY (A)	360	360	383	433.4	511.4	511.4	511.4	691.4	811.4	811.4	891.4	891.4	891.4	891.4	1095.4	1095.4	1095.4
GENERATION (Gwh)																	
Hydro Plant	1,725.6	1,725.6	1,725.6	1,725.6	2,052.0	2,052.0	2,052.0	3,034.4	3,689.3	3,689.3	4,125.9	4,125.9	4,125.9	4,125.9	5,239.2	5,239.2	5,239.2
Thermal Plant	24.8	24.8	37.7	66.1	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3	76.3
TOTAL GENERATION (B)	1,750.4	1,750.4	1,763.3	1,791.7	2,128.3	2,128.3	2,128.3	3,110.6	3,765.5	3,765.5	4,202.1	4,202.1	4,202.1	4,202.1	5,315.4	5,315.4	5,315.4
CONSUMPTION																	
PEAK DEMAND (Mw) (C)	296.8	302.2	329.8	348.5	368.8	391.1	413.8	436.9	461.4	487.9	515.3	543.6	573.0	604.4	637.6	672.1	708.5
ENERGY CONSUMPTION (Gwh) (D)	1,651.0	1,720.3	1,876.8	1,983.8	2,098.9	2,216.4	2,345.0	2,476.3	2,615.0	2,761.4	2,916.0	3,076.4	3,242.6	3,420.9	3,609.1	3,803.9	4,009.4
BALANCE																	
CAPACITY/DEMAND (A)-(C)	63.2	57.8	53.2	84.9	142.6	120.3	97.6	254.5	350.0	323.5	376.1	347.8	318.4	287.0	457.8	423.3	386.9
GENERATION/CONSUMPTION (B)-(D)	99.4	30.1	-113.5	-192.1	29.4	-88.1	-216.7	634.3	1,150.6	1,004.1	1,286.1	1,125.7	959.6	781.2	1,706.4	1,511.5	1,306.1

Note ; New hydro power plant will be in operation as follows.

1995 Pangani Fall power plant 60 MW

1998 Lower Kihansi power plant 180 MW

1999 Upper Kihansi power plant 120 MW

2001 Masigira power plant 80 mw

2005 Rumakali power plant 204 MW

Rehabilitation & new installation for diesel plant will be executed as follows

(Rehabili.)			(New install.)			
Ubungo	1993	+23 Mw	Ubungo	1994	2*20 mw	(Gas)
Dodoma	1994	+4.7 Mw	Arusha	1995	3*6 mw	(DG)
Mbeya	1994	+2.5 Mw				
Tabora	1994	+3.2 Mw				

Table 4.2-2

GRIDPEAR PEAK DEMAND IN GRID SYSTEM (1992-2007)

DISTRIBUT. AREA	1992 (Mw)	1993 (Mw)	1994 (Mw)	1995 (Mw)	1996 (Mw)	1997 (Mw)	1998 (Mw)	1999 (Mw)	2000 (Mw)	2001 (Mw)	2002 (Mw)	2003 (Mw)	2004 (Mw)	2005 (Mw)	2006 (Mw)	2007 (Mw)
DAR ES SALAAM	130.2	142.1	150.2	158.9	169.5	179.3	189.3	199.9	211.8	223.7	236.0	248.8	262.4	276.8	291.8	307.6
MLANDIZI	9.6	10.5	11.1	11.7	12.4	13.1	13.8	14.6	15.4	16.3	17.2	18.1	19.1	20.1	21.2	22.4
CHALINZE	3.2	3.5	3.7	3.9	4.1	4.4	4.6	4.9	5.1	5.4	5.7	6.0	6.4	6.7	7.1	7.5
MOROGORO	13.8	15.1	15.9	16.8	17.8	18.8	19.9	21.0	22.2	23.4	24.7	26.0	27.4	29.0	30.5	32.2
ZANZIBAR	(Including in to DAR ES SALAAM City)															
TANGA	17.8	19.4	20.5	21.7	22.9	24.3	25.6	27.1	28.6	30.2	31.8	33.6	35.4	37.3	39.4	41.5
HALE	4.7	5.1	5.4	5.7	6.1	6.4	6.8	7.1	7.5	8.0	8.4	8.9	9.3	9.9	10.4	11.0
SAME	2.5	2.7	2.9	3.1	3.2	3.4	3.6	3.8	4.0	4.2	4.5	4.7	5.0	5.2	5.5	5.8
MOSHI	14.7	16.0	17.0	17.9	18.9	20.0	21.2	22.3	23.6	24.9	26.3	27.7	29.2	30.8	32.5	34.3
ARUSHA	17.8	19.4	20.5	21.7	22.9	24.3	25.6	27.1	28.6	30.2	31.8	33.6	35.4	37.3	39.4	41.5
IRINGA	4.3	4.7	5.0	5.2	5.5	5.9	6.2	6.5	6.9	7.3	7.7	8.1	8.6	9.0	9.5	10.0
DODOMA	7.4	8.1	8.5	9.0	9.5	10.1	10.7	11.2	11.9	12.5	13.2	13.9	14.7	15.5	16.4	17.2
SINGIDA	2.1	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.9
SHINYANGA	18.5	20.2	21.3	22.6	23.8	25.2	26.6	28.1	29.7	31.4	33.1	34.9	36.8	38.8	40.9	43.1
TABORA	6.4	7.0	7.4	7.8	8.2	8.7	9.2	9.7	10.3	10.8	11.4	12.1	12.7	13.4	14.2	14.9
MWANZA	15.7	17.1	18.1	19.2	20.2	21.4	22.6	23.9	25.2	26.6	28.1	29.6	31.2	32.9	34.7	36.6
MUSOMA	6.2	6.8	7.1	7.6	8.0	8.5	8.9	9.4	10.0	10.5	11.1	11.7	12.3	13.0	13.7	14.4
MUFINDI	14.5	15.8	16.7	17.7	18.7	19.8	20.9	22.0	23.3	24.6	25.9	27.3	28.8	30.4	32.1	33.8
MBEYA	8.6	9.4	9.9	10.5	11.1	11.7	12.4	13.1	13.8	14.6	15.4	16.2	17.1	18.0	19.0	20.0
KIDATU	4.2	4.6	4.8	5.1	5.4	5.7	6.0	6.4	6.7	7.1	7.5	7.9	8.4	8.8	9.3	9.8
GRID TOTAL (Mw)	302.2	329.8	348.5	368.8	391.1	413.8	436.9	461.4	487.9	515.3	543.6	573.0	604.4	637.6	672.1	708.5
GRID TOTAL (Mw)	302.2	329.8	348.5	368.8	391.1	413.8	436.9	461.4	487.9	515.3	543.6	573.0	604.4	637.6	672.1	708.5
LOAD FACTOR	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678	0.678
ENERGY CONSUMPTION (GWh)	179.5	195.8	207.0	219.0	232.3	245.7	259.5	274.0	289.8	306.0	322.9	340.3	359.0	378.7	399.2	420.8

Table 4.2-3 Load Balance

Proposed Substation (Year in operation)	Existing Substation	Existing Distribution Line	Load on Proposed Substation (kW)	
				Total
Sokoine (1994)	City Center	C 3 C 8	1,363 2,406	3,769
Msasani (1994)	Oyster Bay Mikocheni	O 3 O 6 MK 1	3,321 1,277 1,650	6,248
Tandale (1994)	Ubungo Mikocheni Oyster Bay	U 2 MK 2 O 1	1,504 1,979 1,826	5,309
Karjakoo (1996)	Ilala City Center	D 1 D 2 D 9 C 5	1,430 1,312 3,568 2,319	8,629
Chang'ombe (1994)	Factory Zone 1 Kurasini	F 2 F 5 INDUST	1,382 567 1,749	3,698
Mbagala (1998)	Kurasini	KILWA RD	3,004	3,004
Temeke (2000)	Kurasini Factory Zone 1	KILWA RD F 2	1,675 962	2,637
Mburahati (2000)	Ubungo Ilala	U U 2 D10	2,618 1,047 2,944	6,609
Kitunda (2000)	———	———	———	699
Tabata (1998)	———	———	———	1,917
Tegeta (Kunduti) (1996)	———	———	———	2,141

Table 4.2-4

LOADDSR SUBSTATION	LOARD FORECAST OF EACH SUBSTATION IN DAR ES SALAAM CITY (1/5) SUPPLY LINE	PEAK LOAD (kW) 1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CITY CENTRE	C2	1,494	1,557	1,698	1,795	1,899	2,006	2,122	2,241	2,366	2,499	2,639	2,784	2,934	1,548	1,633	1,721	1,814
	C3	2,268	2,363	2,578	1,363	1,442	1,522	1,611	1,701	1,796	1,897	2,003	2,113	2,227	2,350	2,479	2,613	2,754
	C4	2,505	2,610	2,848	3,010	3,185	3,363	3,558	3,757	3,968	4,190	4,425	4,668	4,920	5,191	5,476	5,772	6,083
	C5	3,455	3,600	3,928	4,152	4,392	2,319	2,454	2,591	2,736	2,889	3,051	3,219	3,393	3,579	3,776	3,980	4,195
	C6	2,158	2,249	2,453	2,593	2,743	2,897	3,065	3,237	3,418	3,609	3,812	4,021	4,238	2,236	2,359	2,486	2,620
	C8	4,005	4,173	4,553	2,406	2,546	2,688	2,844	3,004	3,172	3,349	3,537	3,731	3,933	4,149	4,378	4,614	4,863
	S.S TOTAL	15,885	16,552	18,058	15,319	16,207	14,796	15,654	16,531	17,456	18,434	19,466	20,537	21,646	19,053	20,101	21,186	22,330
KURASINI	K4	2,911	3,033	3,309	1,749	1,850	1,954	2,067	2,183	2,305	2,434	2,571	2,712	2,859	3,016	3,182	3,354	3,535
	K3	4,005	4,173	4,553	4,812	5,092	2,688	2,844	3,004	3,172	1,675	1,768	1,866	1,967	2,075	2,189	2,307	2,432
	PORT	2,433	2,535	2,766	2,924	3,093	3,266	3,456	3,649	3,854	4,069	4,297	4,534	4,779	5,041	5,319	5,606	5,909
	S.S TOTAL	9,349	9,742	10,628	9,485	10,035	7,909	8,367	8,836	9,331	8,179	8,637	9,112	9,604	10,132	10,689	11,266	11,875
KIGAMBONI	-	2,696	2,809	3,065	3,240	3,427	3,619	3,829	4,044	4,270	4,509	4,762	5,024	5,295	5,586	5,894	6,212	6,547
	S.S TOTAL	2,696	2,809	3,065	3,240	3,427	3,619	3,829	4,044	4,270	4,509	4,762	5,024	5,295	5,586	5,894	6,212	6,547
OYSTERBAY	02	2,521	2,627	2,866	3,029	3,205	3,384	3,581	3,781	3,993	4,217	4,453	4,698	4,951	5,224	5,511	5,809	6,122
	03	5,527	5,759	6,283	3,321	3,513	3,710	3,925	4,145	4,377	4,622	4,881	5,150	5,428	5,726	6,041	6,367	6,711
	04	3,040	3,168	3,456	1,826	1,932	2,041	2,159	2,280	2,408	2,542	2,685	2,832	2,985	3,150	3,323	3,502	3,691
	05	2,016	2,101	2,292	2,422	2,563	2,706	2,863	3,024	3,193	3,372	3,561	3,757	3,960	4,177	4,407	4,645	4,896
	06	2,126	2,215	2,417	1,277	1,351	1,427	1,510	1,594	1,684	1,778	1,878	1,981	2,088	2,203	2,324	2,449	2,581
	S.S TOTAL	15,230	15,870	17,314	11,876	12,565	13,269	14,038	14,824	15,655	16,531	17,457	18,417	19,412	20,479	21,606	22,772	24,002
SUB TOTAL		43,160	44,973	49,065	39,920	42,235	39,593	41,889	44,235	46,712	47,653	50,322	53,089	55,956	55,250	58,289	61,436	64,754

LOADDSR LOARD FORECAST OF EACH SUBSTATION IN DAR ES SALAAM CITY (2/5) PEAK LOAD (kW)

SUBSTATION	SUPPLY LINE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
UBUNGO	U1	3,131	3,263	3,559	3,762	3,980	4,203	4,447	4,696	4,959	2,618	2,765	2,917	3,075	3,244	3,422	3,607	3,802
	U2	2,504	2,609	2,847	1,504	1,592	1,681	1,778	1,878	1,983	1,047	1,106	1,167	1,229	1,297	1,368	1,442	1,520
	U7	1,329	1,385	1,511	1,597	1,690	1,784	1,888	1,993	2,105	2,223	2,347	2,476	2,610	2,754	2,905	3,062	3,227
	U8	719	749	817	864	914	965	1,021	1,078	1,139	1,203	1,270	1,340	1,412	1,490	1,572	1,657	1,746
	S.S TOTAL	7,683	8,006	8,734	7,728	8,176	8,634	9,134	9,646	10,186	7,091	7,488	7,900	8,327	8,785	9,268	9,768	10,296
ILALA	D0	1,595	1,662	1,813	1,917	2,028	2,141	2,265	2,392	2,526	2,668	2,817	2,972	3,133	3,305	3,487	3,675	3,873
	D1	2,130	2,219	2,421	2,559	2,708	1,430	1,513	1,597	1,687	1,781	1,881	1,985	2,092	2,207	2,328	2,454	2,586
	D2	1,955	2,037	2,222	2,349	2,485	1,312	1,388	1,466	1,548	1,635	1,727	1,821	1,920	2,025	2,137	2,252	2,374
	D3	3,121	3,252	3,548	3,750	3,968	4,190	4,433	4,681	4,943	5,220	5,513	5,816	6,130	6,467	6,823	7,191	7,579
	D7	2,012	2,097	2,287	2,418	2,558	2,701	2,858	3,018	3,187	3,365	3,554	3,749	3,952	4,169	4,398	4,636	4,886
	D8	183	191	208	220	233	246	260	274	290	306	323	341	359	379	400	422	444
	D9	5,315	5,538	6,042	6,387	6,757	3,568	3,775	3,986	4,209	4,445	4,694	4,952	5,219	5,507	5,809	6,123	6,454
	D10	3,520	3,668	4,002	4,230	4,475	4,726	5,000	5,280	5,575	2,944	3,109	3,280	3,457	1,823	1,924	2,028	2,137
	S.S TOTAL	19,831	20,664	22,544	23,829	25,211	20,313	21,492	22,695	23,966	22,364	23,617	24,916	26,261	25,882	27,306	28,780	30,334
MBEZI	KUNDUCHI	3,189	3,323	3,625	3,832	4,054	2,141	2,265	2,392	2,526	2,667	2,816	2,971	3,132	3,304	3,486	3,674	3,872
	PACKERS	1,065	1,110	1,211	1,280	1,354	1,430	1,513	1,597	1,687	1,781	1,881	1,985	2,092	2,207	2,328	2,454	2,586
	LUGALO	2,628	2,738	2,988	3,158	3,341	3,528	3,733	3,942	4,163	4,396	4,642	4,897	5,162	5,445	5,745	6,055	6,382
	S.S TOTAL	6,882	7,171	7,824	8,270	8,749	7,099	7,510	7,931	8,375	8,844	9,339	9,853	10,385	10,956	11,559	12,183	12,841
MIKOCHENI	MK1	2,747	2,862	3,123	1,650	1,746	1,844	1,951	2,060	2,176	2,297	2,426	2,559	2,698	2,846	3,003	3,165	3,336
	MK2	3,294	3,432	3,745	1,979	2,094	2,211	2,339	2,470	2,609	2,755	2,909	3,069	3,235	3,413	3,600	3,795	4,000
	MK3	1,372	1,430	1,560	1,649	1,744	1,842	1,949	2,058	2,173	2,295	2,423	2,557	2,695	2,843	2,999	3,161	3,332
	MK4	3,249	3,385	3,694	3,904	4,131	4,362	4,615	4,873	5,146	5,434	5,739	6,054	6,381	6,732	7,102	7,486	7,890
	S.S TOTAL	10,662	11,110	12,121	9,182	9,715	10,259	10,854	11,462	12,103	12,781	13,497	14,239	15,008	15,834	16,705	17,607	18,557
SUB TOTAL		45,058	46,950	51,223	49,009	51,851	46,304	48,990	51,734	54,631	51,081	53,941	56,908	59,981	61,456	64,837	68,338	72,028

LOADDSR LOARD FORECAST OF EACH SUBSTATION IN DAR ES SALAAM CITY (3/5) PEAK LOAD (kW)

SUBSTATION	SUPPLY LINE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
FACTORY ZONE I	F5	944	984	1,073	567	600	634	670	708	748	789	834	880	927	978	1,032	1,088	1,146
	F2	2,300	2,397	2,615	1,382	1,462	1,544	1,633	1,725	1,821	962	1,016	1,071	1,129	1,191	1,257	1,325	1,396
	S.S TOTAL	3,244	3,380	3,688	1,949	2,062	2,178	2,304	2,433	2,569	1,751	1,849	1,951	2,056	2,169	2,289	2,412	2,543
FACTORY ZONE II	KILTEX	356	371	405	428	453	478	506	534	564	595	629	663	699	738	778	820	865
	KISARAWE	475	495	540	571	604	638	675	712	752	794	839	885	933	984	1,038	1,094	1,154
	UKONGA	1,017	1,060	1,156	1,222	1,293	1,365	1,445	1,525	1,611	1,701	1,796	1,895	1,997	2,107	2,223	2,343	2,470
	S.S TOTAL	1,848	1,926	2,101	2,221	2,349	2,481	2,625	2,772	2,927	3,091	3,264	3,444	3,630	3,829	4,040	4,258	4,488
FACTORY ZONE III	F31	2,532	2,638	2,878	3,043	3,219	3,399	3,596	3,798	4,010	4,235	4,472	4,718	4,973	5,246	5,535	5,834	6,149
	F32	855	891	972	1,027	1,087	1,148	1,214	1,282	1,354	1,430	1,510	1,593	1,679	1,772	1,869	1,970	2,076
	F33	1,016	1,059	1,155	1,221	1,292	1,364	1,443	1,524	1,609	1,699	1,795	1,893	1,995	2,105	2,221	2,341	2,467
	F34	1,214	1,265	1,380	1,459	1,543	1,630	1,724	1,821	1,923	2,031	2,144	2,262	2,384	2,515	2,654	2,797	2,948
	S.S TOTAL	5,617	5,853	6,386	6,750	7,141	7,541	7,978	8,425	8,897	9,395	9,921	10,467	11,032	11,639	12,279	12,942	13,641
ALAF		4,731	4,930	5,378	5,685	6,015	6,351	6,720	7,096	7,493	7,913	8,356	8,816	9,292	9,803	10,342	10,901	11,489
	S.S TOTAL	4,731	4,930	5,378	5,685	6,015	6,351	6,720	7,096	7,493	7,913	8,356	8,816	9,292	9,803	10,342	10,901	11,489
TAZARA		2,650	2,761	3,013	3,184	3,369	3,558	3,764	3,975	4,197	4,432	4,681	4,938	5,205	5,491	5,793	6,106	6,436
	S.S TOTAL	2,650	2,761	3,013	3,184	3,369	3,558	3,764	3,975	4,197	4,432	4,681	4,938	5,205	5,491	5,793	6,106	6,436
WAZOHILL		5,820	6,064	6,616	6,993	7,399	7,813	8,267	8,730	9,218	9,735	10,280	10,845	11,431	12,059	12,723	13,410	14,134
	S.S TOTAL	5,820	6,064	6,616	6,993	7,399	7,813	8,267	8,730	9,218	9,735	10,280	10,845	11,431	12,059	12,723	13,410	14,134
FRIENDSHIP (TEXTILE)		1,829	1,906	2,079	2,198	2,325	2,455	2,598	2,743	2,897	3,059	3,231	3,408	3,592	3,790	3,998	4,214	4,442
	S.S TOTAL	1,829	1,906	2,079	2,198	2,325	2,455	2,598	2,743	2,897	3,059	3,231	3,408	3,592	3,790	3,998	4,214	4,442
SUB TOTAL		25,739	26,820	29,261	28,979	30,660	32,377	34,255	36,173	38,199	39,377	41,582	43,869	46,238	48,781	51,464	54,243	57,172

LOADDSR　　LOARD FORECAST OF EACH SUBSTATION IN DAR ES SALAAM CITY (4/5)　　PEAK LOAD (kW)

SUBSTATION	SUPPLY LINE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
ZANZIBAR		11,000	11,462	12,505	13,218	13,984	14,768	15,624	16,499	17,423	18,399	19,429	20,498	21,604	22,793	24,046	25,345	26,713
	S.S TOTAL	11,000	11,462	12,505	13,218	13,984	14,768	15,624	16,499	17,423	18,399	19,429	20,498	21,604	22,793	24,046	25,345	26,713
SOKOINE	-	-	-	-	3,769	3,988	4,211	4,455	4,705	4,968	5,246	5,540	5,845	6,160	6,499	6,857	7,227	7,617
	S.S TOTAL	-	-	-	3,769	3,988	4,211	4,455	4,705	4,968	5,246	5,540	5,845	6,160	6,499	6,857	7,227	7,617
MSASANI	-	-	-	-	6,248	6,610	6,981	7,385	7,799	8,236	8,697	9,184	9,689	10,212	10,774	11,367	11,980	12,627
	S.S TOTAL	-	-	-	6,248	6,610	6,981	7,385	7,799	8,236	8,697	9,184	9,689	10,212	10,774	11,367	11,980	12,627
TANDALE	-	-	-	-	5,309	5,617	5,931	6,275	6,627	6,998	7,390	7,804	8,233	8,678	9,155	9,658	10,180	10,730
	S.S TOTAL	-	-	-	5,309	5,617	5,931	6,275	6,627	6,998	7,390	7,804	8,233	8,678	9,155	9,658	10,180	10,730
CHANGOMBE	-	-	-	-	3,698	3,912	4,132	4,371	4,616	4,874	5,147	5,436	5,735	6,044	6,377	6,728	7,091	7,474
	S.S TOTAL	-	-	-	3,698	3,912	4,132	4,371	4,616	4,874	5,147	5,436	5,735	6,044	6,377	6,728	7,091	7,474
KUNDUCHI (TEGETA)		-	-	-	-	-	2,141	2,265	2,392	2,526	2,667	2,817	2,972	3,132	3,304	3,486	3,674	3,873
	S.S TOTAL	-	-	-	-	-	2,141	2,265	2,392	2,526	2,667	2,817	2,972	3,132	3,304	3,486	3,674	3,873
KARIAKOO	-	-	-	-	-	-	8,629	9,129	9,641	10,181	10,751	11,353	11,977	12,624	13,318	14,051	14,810	15,609
	S.S TOTAL	-	-	-	-	-	8,629	9,129	9,641	10,181	10,751	11,353	11,977	12,624	13,318	14,051	14,810	15,609
MBAGALA		-	-	-	-	-	2,688	2,844	3,003	3,171	3,349	3,536	3,731	3,932	4,149	4,377	4,613	4,862
	S.S TOTAL	-	-	-	-	-	2,688	2,844	3,003	3,171	3,349	3,536	3,731	3,932	4,149	4,377	4,613	4,862
TABATA		-	-	-	-	-	1,716	1,816	1,917	2,025	2,138	2,258	2,382	2,510	2,649	2,794	2,945	3,104
	S.S TOTAL	-	-	-	-	-	1,716	1,816	1,917	2,025	2,138	2,258	2,382	2,510	2,649	2,794	2,945	3,104
TEMEKE		-	-	-	-	-	-	-	-	-	2,637	2,785	2,938	3,096	3,267	3,446	3,633	3,829
	S.S TOTAL	-	-	-	-	-	-	-	-	-	2,637	2,785	2,938	3,096	3,267	3,446	3,633	3,829
SUB TOTAL		11,000	11,462	12,505	32,242	34,112	51,196	54,165	57,199	60,402	66,421	70,141	73,999	77,995	82,284	86,810	91,498	96,439

LOADDSR LOARD FORECAST OF EACH SUBSTATION IN DAR ES SALAAM CITY (5/5) PEAK LOAD (kW)

SUBSTATION	SUPPLY LINE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
MBURAHATI		-	-	-	-	-	-	-	-	-	6,609	6,979	7,363	7,761	8,187	8,638	9,104	9,596
	S.S TOTAL	-	-	-	-	-	-	-	-	-	6,609	6,979	7,363	7,761	8,187	8,638	9,104	9,596
KITUNDA		-	-	-	-	-	-	-	-	-	699	738	779	821	866	914	963	1,015
	S.S TOTAL	-	-	-	-	-	-	-	-	-	699	738	779	821	866	914	963	1,015
UPANGA		-	-	-	-	-	-	-	-	-	-	-	-	-	5,607	5,915	6,235	6,571
	S.S TOTAL	-	-	-	-	-	-	-	-	-	-	-	-	-	5,607	5,915	6,235	6,571
SUB TOTAL		0	0	0	0	0	0	0	0	0	7,308	7,717	8,142	8,581	14,660	15,467	16,302	17,182
GRAND TOTAL (PEAK LOAD Kw)		124,957	130,205	142,054	150,150	158,858	169,470	179,300	189,341	199,944	211,840	223,703	236,006	248,751	262,432	276,866	291,816	307,575

CHAPTER 5

THE MASTER PLAN FOR THE EXPANSION OF ELECTRIC POWER SUPPLY

Chapter 5. Master Plan for Expansion of Electric Power Supply

CHAPTER 5 THE MASTER PLAN FOR THE EXPANSION OF ELECTRIC POWER SUPPLY

5.1 EXAMINATION OF TANESCO PROPOSALS

5.1.1 TANESCO Proposals

(1) Proposals of Development in Dar Es Salaam

1) Present System of Power Transmission and Distribution

The distribution network in Dar Es Salaam has a load of about 110 MW. The system is served by two 132/33 kV grid substations via the power transmission network. One of these substations is located at Ubungo (50 MVA x 2), and the other at Ilala (45 MVA x 2). A total 20 MW of electricity is supplied to 4 bulk customers (Wazo Hill Cement Factory, ALAF, TAZARA, and Friendship Textile Company) via 33 kV transmission lines. The other part of the load (90 MW) is served by 11 kV networks via 33/11 kV distribution transformer banks installed at 11 locations.

Major defects in the 33 kV system that occurred until recently have been improved under the Dar Es Salaam Rehabilitation Project, a grant aid project executed by JICA. At present, the level of overall loss (max. 2.2% at peak) is in a generally acceptable range. One of the transmission lines recently showing considerable levels of loss is Wazo Hill II (transmission line to Wazo Hill Cement Factory). The peak loss of this line is 4.9% (receiving end voltage drop 5.7%).

The load on Wazo Hill I transmission line is expected to increase considerably in several years in future, and expansion of equipment will be necessary. In addition, F. Z. III transmission line is also showing moderate (about 3.5%) energy loss. We propose plans for the reduction in transmission loss on the Wazo Hill II transmission line and the improvement of power transmission equipment on Wazo Hill I transmission line (to meet the expected increase in load). It is considered that the loss on F. Z. III transmission line can be reduced by the introduc-

tion of a 132 kV transmission line from Ubungo to this substation.

The overall loss in the 11 kV system (about 2.7% in average) is not large. However, examined individually, some of the distribution lines are showing considerable losses and voltage drops. The 5 lines showing the worst performance are: Kunduchi distribution line from Mbezi, Industrial distribution line from Kurasini, 04 and 03 distribution lines from Oyster Bay, and MK2 distribution line from Mikocheni. Among these lines, the peak loss on Kunduchi distribution line exceeds 10%, while the loss is in a range of 5 - 8% on other lines. However, unless the system is improved, the level of loss in the entire transmission system will increase with the increase in load.

See Fig. 5.1.1-1 in Annex for the state of the transmission network in 1992.

In the following sections, we examine various districts of the network in which improvement is required and make proposals concerning the solution to excessive levels of loss and poor reliability. While these proposals are primarily applied to the development of the existing system, future changes in the capacity of substations and main distribution lines are also taken into consideration. This will be a necessary step for the expansion of network to new districts which will be electrified in the near future.

(2) *Proposals for Network Development*

1) Wazo Hill and Kunduchi District

In the northwestern part of Msasani Bay, there are Wazo Hill Cement Factory creating a load of 7 MW and many tourist hotels along the beaches of Kunduchi and Mbezi. The load of these customers is served by Wazo Hill transmission line (33 kV) from Ubungo. Transmission line No. II is dedicated to the power transmission to the factory, and transmission line No. I is supplying power to Mbezi Substation. The 11 kV distribution line

supplies power from this substation to the Mbezi and Kunduchi districts. A new housing development project has started in this area and is planned to be extended from Mbezi northwards to Tegeta, Boko, and Ras Kiromoni. In this district, urban development plans are being prepared and water supply facilities, schools, and community facilities are going to be constructed. Furthermore, tourist hotels are being expanded and incencitive schemes to attract industry are promoted. At present, the 11 kV distribution line serving this district is showing the highest level of loss (11.5%). Evidently, this line cannot support further increase in load. Therefore, there is an urgent need for the reconstruction of the network and the introduction of a sub-transmission system. The 132 kV transmission line going to Zanzibar via Ras Kiromoni is routed near the cement factory in this district, and the load of this line is extremely small. If the load of this line could be increased, it would improve the voltage control of the power transmission system. A site suitable for the construction of a secondary substation has been secured at a location near Bagamoyo Road. The site is located practically midway between the 2 load districts. It is located 2.5 km from the cement factory and 2.0 km form Kunduchi district. One of the circuits will be the 33 kV line from this secondary to the cement factory. A new 33/11 kV substation will be constructed in the vicinity and the long-distance 11 kV distribution lines will be divided into 3 sections. The advantages of the proposed system include the substantial reduction in loss realized by the conversion from a 33 kV system to a 132 kV system, the increase in the supply ability to cope with the continuous increase in demand in the Kunduchi district, and the improvement of reliability concerning the supply to the cement factory and Kunduchi-Mbezi district.

The initial capacity of the 33/11 kV substation at Tegeta will be 15 MVA (allowing for expansion after adequate increase in load). The new substation will initially be equipped with 3 distribution lines along Bagamoyo Road to the north, toward Kunduchi Beach to the east, and along Bagamoyo Road to the south.

See Fig. 5.1.1-2 in Annex for the state of the transmission network as 1997.

2) Kariakoo and Chang'ombe Districts

The area along Pugu Road in the south of Ilala will also benefit from the access to the 33 kV system. The southern area is served by 2 distribution lines, one from Kurasini and one from the Ilala Secondary Substation. Both of these distribution lines are loaded at the end of the lines. The distribution line from Kurasini is showing a particularly high level of loss (7.32% at peak). The western part, which is closer to the city, is served by distribution lines D2 and D9 from Ilala and distribution line C5 from City Centre Substation. However, the level of load is high (nearly 200 A) and the loads served by these lines do not have sufficient access to alternative power sources. TANESCO at present is considering the possibility to construct 2 distribution substations, one in Kariakoo (western area) and one in Chang'ombe (southern area). The site for these substations have been determined. The construction of the 2 substation will ensure sufficient supply for about 10 years in future. The substation constructed at these locations will reduce the high levels of loss in Industrial and D1 distribution lines and also improve the back-up reliability in Kariakoo district. Chang'ombe Substation will serve 2-circuit distribution lines along Pugu Road. These circuits will deal with the load on existing D1 distribution line (Keko Mwanga district) and the load at the end of Port Access distribution line (Northern Kurasini). After the completion of Kariakoo Substation, the latter of these districts will be supplied from Ilala via distribution lines D1 and D2, as well as reorganized D9 distribution lines. Part of the load on D3 distribution line supplied from Ilala will be transferred to a new distribution line from Kariakoo Substation.

3) Magomeni, Manzese, and Tandale Districts

Along Morogoro Road between Ilala and Ubungo lies a mixture of residential and industrial areas having intermediate levels of load. This district is served by lines connected to the ends of 4 distribution lines, which are supplied from substations at Ilala (D10), Oyster Bay (04), Mikocheni (MK2), and Ubungo (U2). The load level and the line distance could be reduced to about half if a distribution substation could be located appropriately. Note that such improvement would reduce the loss in the network. TANESCO initially proposed that a substation should be constructed in future at Magomeni near Botanical Garden. However, the location selected by them is not sufficiently close to the center of consumption so that the planned substation can contribute to the reduction of load on distribution line MK2, which is the most heavily loaded. This distribution line is one of the five showing the worst performance in Dar Es Salaam. The peak loss on this line is as high as 5%, and the voltage drop 8%. Therefore, the essential part of the proposal concerning the development in this district should be to do something against the poor performance of MK2 distribution line. A recommendable plan is to shift the position of the new substation toward Tandale and connect the ends of the above 4 distribution lines at this new substation.

4) Load Development in Southern and South-Western Suburbs

Various development projects are promoted in the southern and south-western part of the city. Districts showing the largest increase in load are: Tabata (to the west of the city, several kilometers to the north of the airport), Temeke-Yombo (to the south of Pugu Road and to the east of Kurasini), and Mbagala (to the south of Kurasini). Tabata district is only 3 km away from F. Z. III Substation and there is no need to establish another substation for this district, according to load forecasts for the near future. Therefore, new loads will be covered by the additional 11 kV distribution line that is required in relation to centralized loading. However, in the long run, a distribu-

tion substation will have to be established as the load in this district will increase further.

In Mbagala district, a 33 kV line was constructed for the supply from Kurasini to a glass factory. However, this factory was not able to begin production. This line is now used for 11 kV power distribution. If this line could be connected to the new distribution substation, line distance of two existing distribution lines, i.e., Kilwa Road and Industrial from Kurasini, could be reduced. With the new substation, Kilwa Road distribution line could be divided into two parts, one supplied from Mbagala Substation and the other from Kurasini. When necessary 11 kV lines are installed tentatively, Temeke-Yombo district could also be supplied from new Mbagala Substation and existing Kurasini Substation.

(3) Future Development of Transmission and Comprehensive Power Supply

1) Power Distribution to Dar Es Salaam

The second 220 kV transmission line is planned to be constructed from Kidatu to Dar Es Salaam (construction of the first phase covering the section to Morogoro has been commenced). This new circuit will also be useful for the start-up of the Kihansi project, which is planned to be completed in 1997. TANESCO is presently planning a new substation at Yombo in Temeke district (to the south of Ubungo), which will be supplied from the new 220 kV line. This method has advantages in various aspects. First, it provides a new connection node to the power transmission network. This will allow us to avoid further increase in the load on existing substations and increase the reliability of the network. To maximize the reliability of this system, it is desirable to establish linked power transmission from the new substation to Ubungo and Ilala (preferably at 132 kV). With this linkage, the network will have strong connections among the 3 power transmission nodes in Dar Es Salaam area, ensuring the best possible stability of power transmission to each of these transmission nodes. Second, the transmission line from the new

substation will permit the reduction of the length of many 33 kV transmission lines and the streamlining of the 33 kV network. In particular, because Temeke district is located near the areas with high load density (Factory Zones I and II, and the factories receiving direct supply, i.e., TAZARA and ALAF) along Pugu Road, it is reasonable to transfer these loads to the new 132/33 kV substation on F. Z. III. In addition, it will be possible to transmit power to Kurasini and the proposed 132/33 kV substation at Mbagala for the sake of convenience. If we could expect to construct a new substation in Temeke district, no development proposals would be needed for a long period in future in Temeke and Tabata districts.

On the contrary, no future plans concerning the connection of transmission lines have been proposed in the northern part of Ubungo. Therefore, it is advisable to accelerate the introduction of a 132 kV secondary substation at Wazo Hill so that the existing line to Zanzibar can be utilized. A study on the existing system substation and its future potential has indicated that this network has been configured strategically in geographical terms and has a possibility of allowing efficient power transmission to the urban areas and suburbs of Dar Es Salaam. Two main supply nodes have already been installed in Ubungo and Ilala, and Ilala is suitable for the power transmission to the central part of the city. Future increase in load is expected in Mbezi and the southern part of Oyster Bay, where development has already been promoted, and the system substation is located strategically for the supply to both of these districts. There is a possibility that an appropriate 33 kV network will be installed to provide interconnection of transmission lines and supply necessary transmission lines. The above-mentioned proposal concerning the development of primary substations is suitable to the expected development of transmission lines. Therefore, TANESCO desires to decide on plans and execute them as soon as possible.

Note: See Fig. 5.1.1-3 in Annex for the state of the power transmission network in 2002. See Fig. 5.1.1.-4 in Annex for the state of the power transmission network in 2007.

(4) The following list shows the order of priority given to the new construction and expansion of substations in and after 1994.

Year	Name of Substation		Voltage	Capacity (New/Expansion)	Type
1994	Tandale	Dist. Sub.	33/11kV	15 MVA (15 MVAx1)	New
	Chang'ombe	"	"	15 MVA (15 MVAx1)	"
	Factory Zone III	"	"	30 MVA (15 MVAx1 Exp.)	Exp.
1996	Kariakoo	Dist. Sub.	33/11kV	15 MVA (15 MVAx1)	New
	Oyster Bay	"	"	30 MVA (15 MVAx1 Exp.)	Exp.
	Tegeta	"	"	15 MVA (15 MVAx1)	New
	"	Sec. Sub.	132/33kV	45 MVA (45 MVAx1)	"
	Factory Zone III	"	"	90 MVA (45 MVAx2)	"
	Ilala	"	"	135 MVA (45 MVAx1 Exp.)	Exp.
1998	Mbagala	Dist. Sub.	33/11kV	15 MVA (15 MVAx1)	New
	Tabata	"	"	5 MVA (5 MVAx1)	"
	City Centre	"	"	45 MVA (33 kV Bus)	
	Mikocheni	"	"	30 MVA (15 MVAx1 Exp.)	Exp.
	Mbezi	"	"	30 MVA (15 MVAx2 Exp.)	"
2000	Temeke	Dist. Sub.	33/11kV	5 MVA (5 MVAx1)	New
	Mburahati	"	"	5 MVA (5 MVAx1)	"
	Kitunda	"	"	5 MVA (5 MVAx1)	"
	Factory Zone I	"	"	30 MVA (15 MVAx1 Exp.)	Exp.
	Kurasini	"	"	30 MVA (15 MVAx1)	"
	Factory Zone II	"	"	15 MVA (5 MVAx2 Exp.)	"
	Oyster Bay	Sec. Sub.	132/33kV	45 MVA (45 MVAx1)	New
	Yombo	"	"	45 MVA (45 MVAx1)	"
2002	Upanga	Dist. Sub.	33/11kV	15 MVA (15 MVAx1)	New
	Zaramo	"	"	15 MVA (15 MVAx1)	"
	Kigamboni	"	"	15 MVA (5 MVAx2 Exp.)	Exp.
	Kurasini	Sec. Sub.	132/33kV	45 MVA (45 MVAx1)	New
2004	City Centre	Sec. Sub.	132/33kV	45 MVA (45 MVAx1)	New
	Mbezi	"	"	45 MVA (45 MVAx1)	"
2006	Mbagala	Sec. Sub.	132/33kV	45 MVA (45 MVAx1)	New
2008	Mbwa maji	Dist. Sub.	33/11kV	5 MVA (5 MVAx1)	New

Therefore, the overall configuration of the secondary substations and distribution substations in the proposed 132 kV network will be as follows.

1) ILALA S/S - 132/33kV

i) Ilala s/s
ii) City centre s/s
iii) Sokoine s/s/
iv) Kariakoo s/s

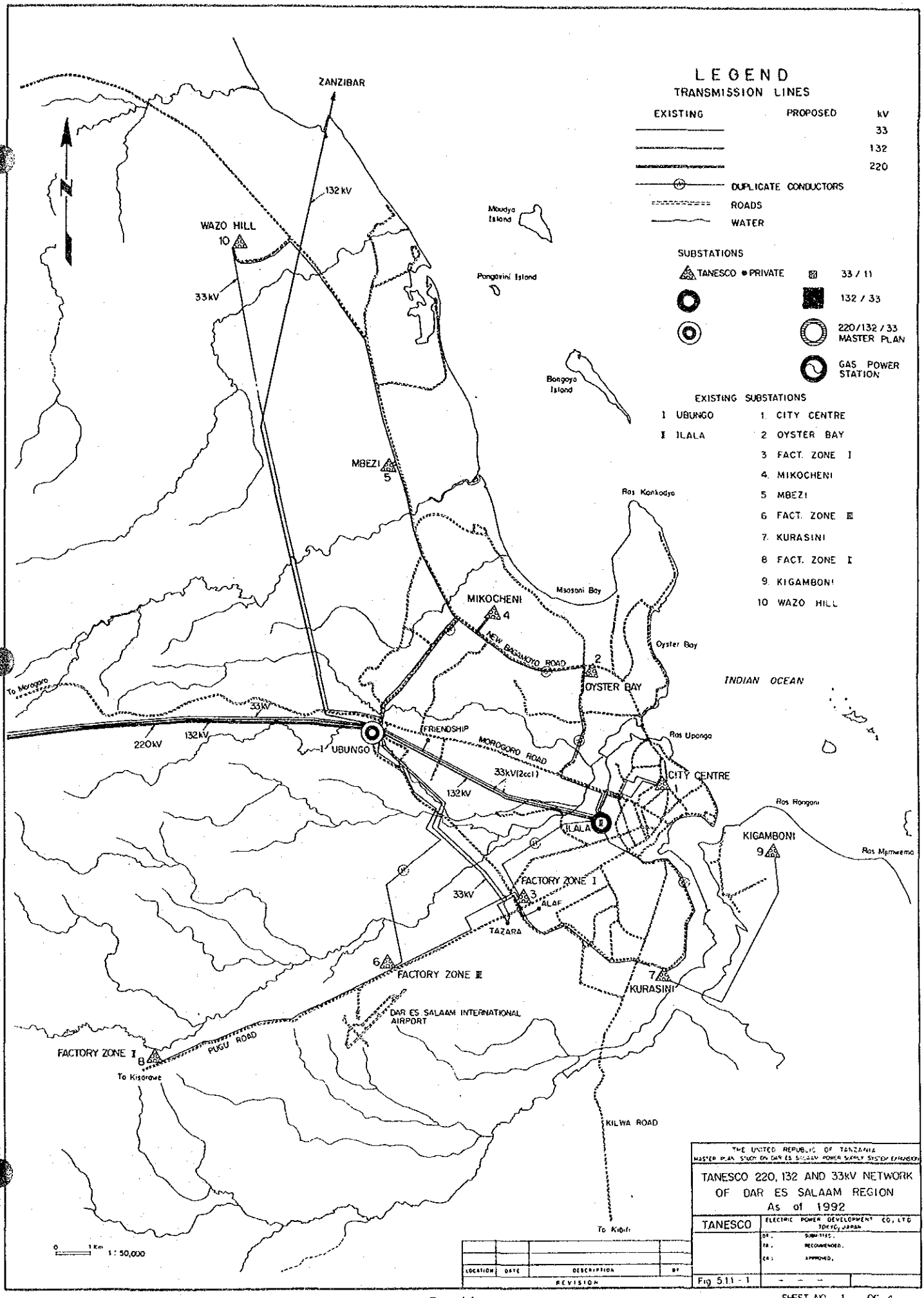
2)	UBUNGO S/S - 132/33kV	i) Ubungo s/s
		ii) Mbezi s/s
		iii) Nordic s/s
		iv) Friendship s/s
		v) Mburahati s/s
3)	FACTORY ZONE III S/S - 132/33kV	i) Factory zone III s/s
		ii) Factory zone II s/s
		iii) Factory zone I s/s
		iv) ALAF s/s
		v) TAZARA s/s
		vi) Tabata s/s
4)	OYSTERBAY S/S - 132/33kV	i) Oyster Bay s/s
		ii) Mikocheni s/s
		iii) Msasani s/s
		iv) Tandale s/s
5)	TEGETA S/S - 132/33kV	i) Tegeta s/s
		ii) Wazo Hill s/s
		iii) Mbezi s/s
6)	KURASINI S/S - 132/33kV	i) Kurasini s/s
		ii) Kigamboni s/s
		iii) Chang'ombe s/s
		iv) Temeke s/s
7)	YOMBO S/S - 132/33kV	i) Yombo s/s
		ii) Kitunda s/s
		iii) Mbagala s/s

The 132/33 kV substations at City Centre, Mbezi, and Mbagala will be developed in the next phase according to the future increase in load and the establishment of distribution substations in these districts. For example, the 33/11 kV substations at Upanga and Zaramo will be related to the 132/33 kV substation at City Center.

In addition, a gas turbine power generation plant fuelled by natural gas supplied from Songo Songo is planned to be constructed in future at Yombo, which is the project site of South Grid Station.

Part of the energy generated at this power station will be transmitted directly to Dar Es Salaam area via a 132 kV transmission line.

In view of the future linkage with other grid systems, the reliability of the electric power system, transmission loss, and other factors, it is necessary to consider the use of 220 kV as the voltage of this transmission line to Yombo.



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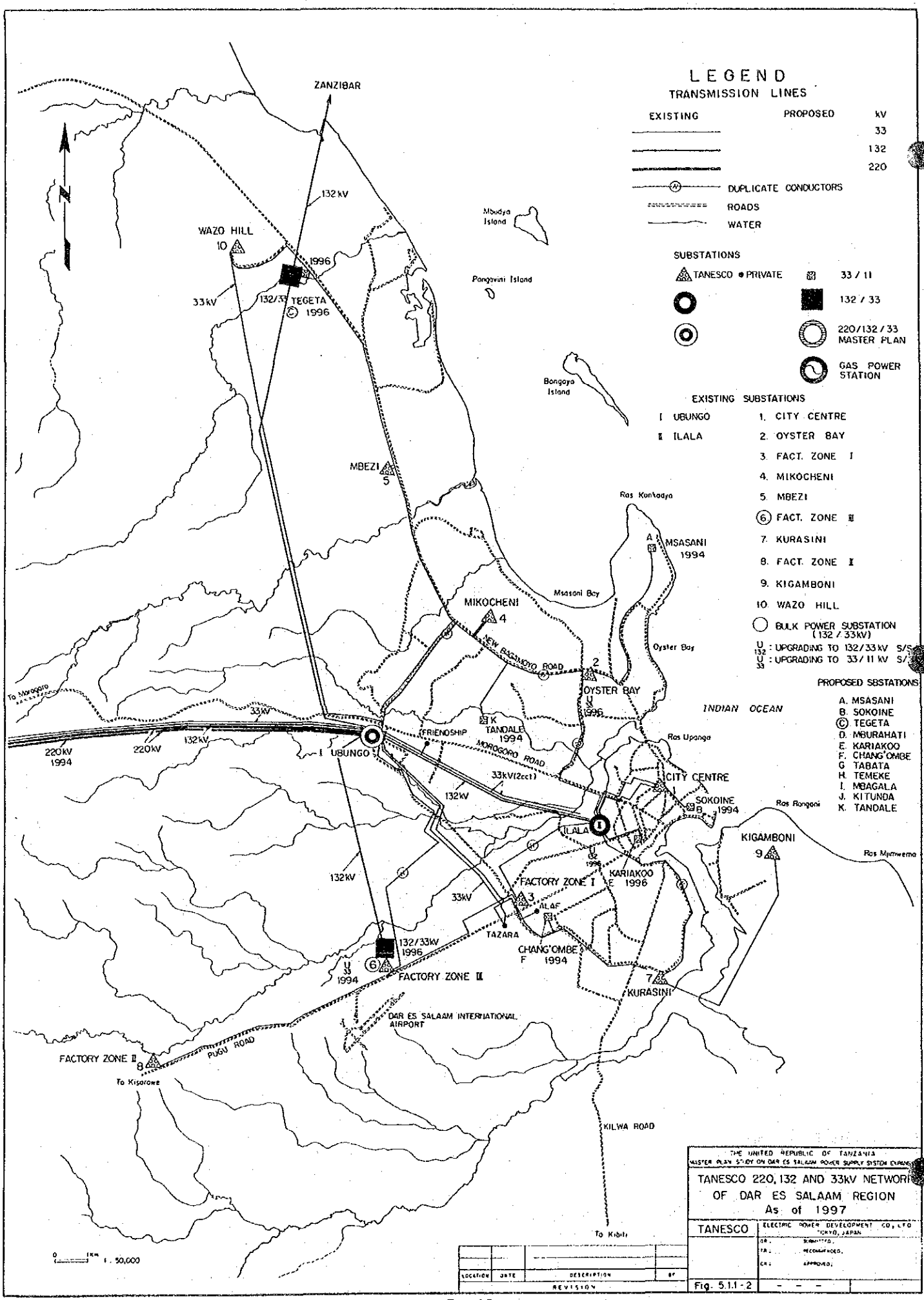

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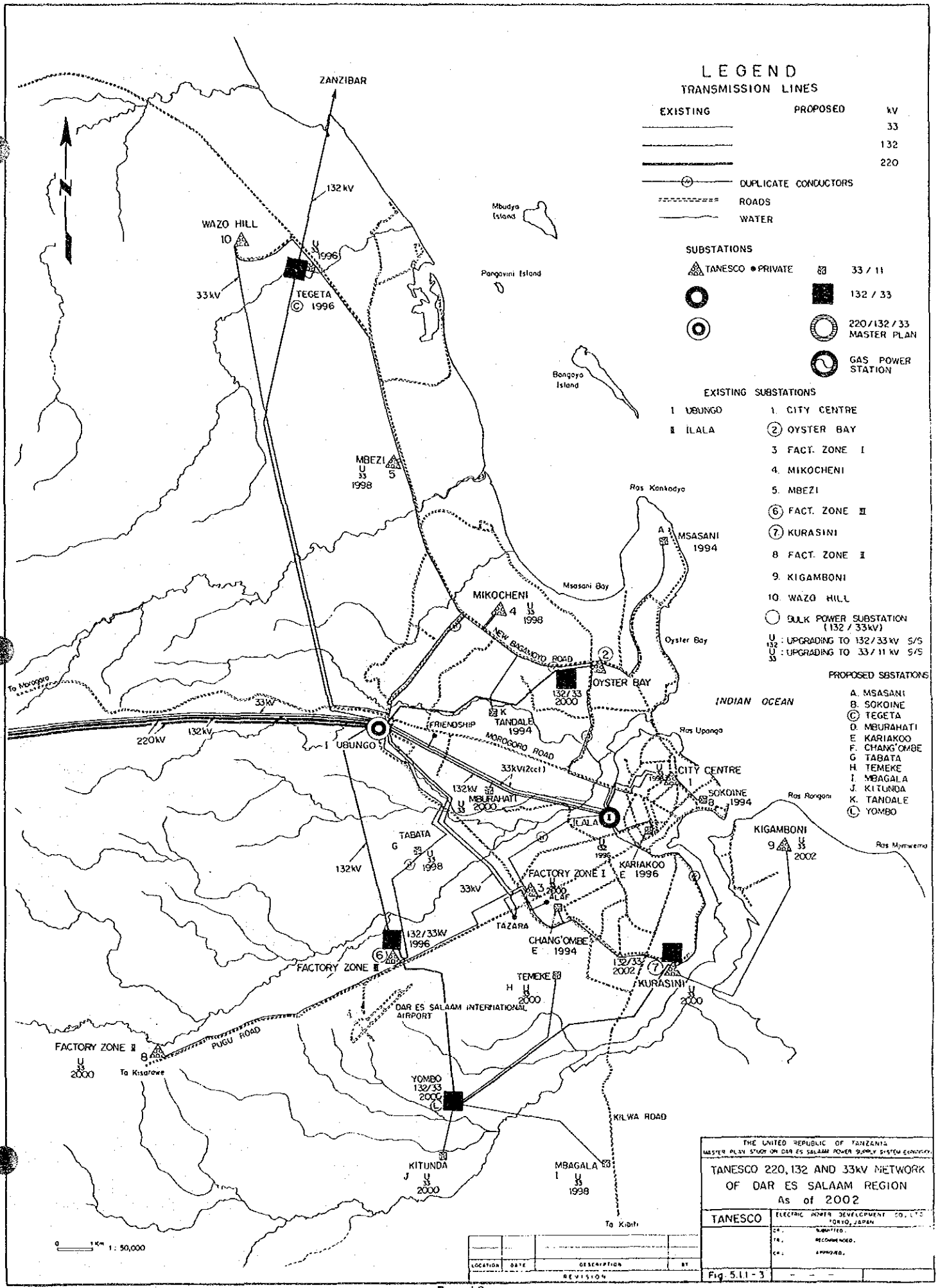

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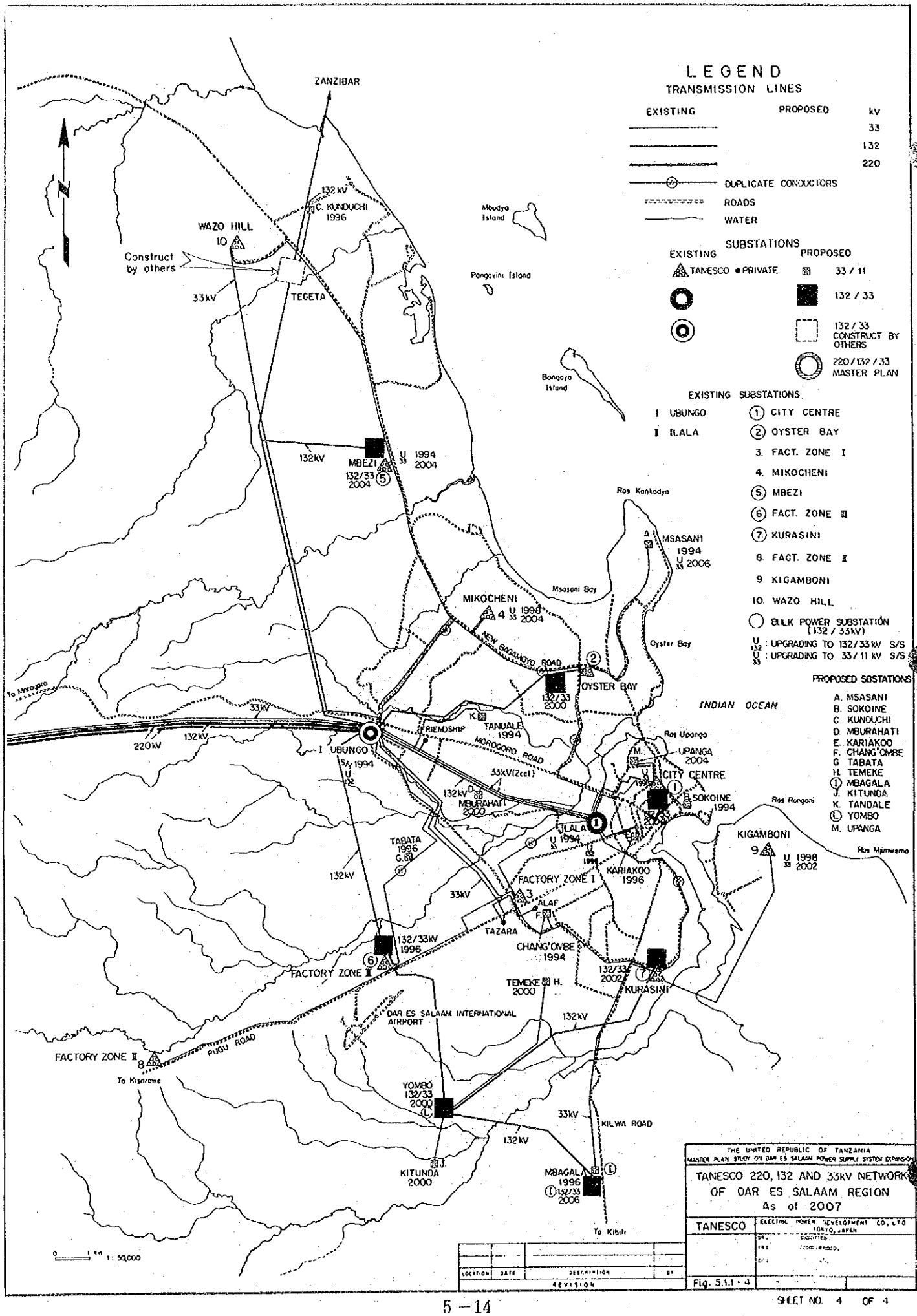

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