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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF ENERGY AND MINERALS
UNITED REPUBLIC OF TANZANIA

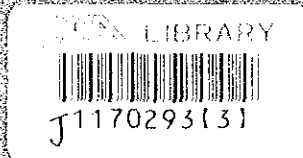
MASTER PLAN STUDY ON THE POWER SECTOR FOR MAJOR TOWNS
IN THE UNITED REPUBLIC OF TANZANIA

FINAL REPORT
SEPTEMBER 2002

JAPAN INTERNATIONAL
COOPERATION AGENCY

MASTER PLAN STUDY
ON THE POWER SECTOR
FOR MAJOR TOWNS
IN THE UNITED REPUBLIC OF TANZANIA

FINAL REPORT



SEPTEMBER 2002

ELECTRIC POWER DEVELOPMENT CO., LTD

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MPN

Master Plan Study
on the Power Sector
for Major Towns
in the United Republic of Tanzania

Final Report

September 2002

Electric Power Development Co., Ltd



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PREFACE

In response to a request from the Government of the Tanzania, the Government of Japan decided to conduct the Master Plan Study on the Power Sector for Major Towns in the United Republic of Tanzania and entrusted the study to Japan International Cooperation Agency (JICA).

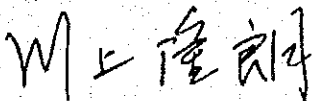
JICA sent a study team, led by Mr. Hiroshi Kodani of Electric Power Development Co., Ltd. (EPDC) to Tanzania five times from February 2001 to August 2002.

The team held discussion with the officials concerned of the Government and power sector of Tanzania and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan 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 Tanzania for their close cooperation throughout the study.

September 2002



Takao KAWAKAMI

President

Japan International Cooperation Agency

Tokyo, Japan

Mr. Takao KAWAKAMI
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. T.KAWAKAMI,

Letter of Transmittal

We are pleased to submit you with the final report of the Master Plan Study on the Power Sector for Major Towns in the United Republic of Tanzania, of which study has been finished recently.

This study was conducted on the purpose of formulating master plan on power sector in three cities of Dar es Salaam, Arusha and Moshi and drawing out practical improvement plan of transmission, substation and distribution system in target area.

In recent years, with the improvement of the economic and social situation, the demand for electric power has been increasing rapidly, calling for development of new source of electricity. Despite the continual expansion of generation and demand, development and maintenance of distribution network is left far behind. Tanzania Electric Supply Company (TANESCO) makes great effort to maintain power supply, however, due to the shortage of both of technical skills and budget, distribution system in Tanzania has not enough capability to support steady industrialization of nation and economic development. In addition, considerable system loss and huge amount of account receivable has adversely effect to power sector's restructuring.

The Study Team has drawn out optimal expansion and rehabilitation plan for 132kV, 33kV, 11kV system respectively and carried out feasibility study for urgent projects. Critical condition of distribution system in three cities should be improved efficiently by execution of proposed reinforcement.

Regarding the upgrade of technical skill and maintenance capability, the Study Team did investigation of DAMP renovation and proposed the result of model case study. Principle of renovation plan consists of 2 major items. One is DAMP renovation by revising training programs and supplying necessary equipment and another is to spread out DAMP function to Arusha and Moshi. Distribution system handling capability of TANESCO will be improved steadily by implementation of renovation program.

Through the field survey, many of distribution equipment were confirmed to be damaged seriously due to long term over load operation, therefore, the urgent action is highly recommended to maintain the reliability of power supply. We hope the reinforcement proposed in the report shall be implemented by the guidance of Government of Tanzania

straight way.

We wish taking this opportunity to express our sincere gratitude to JICA, the Ministry of Foreign Affairs, the Ministry of Economy Trade and Industry and Ministry of Finance. We also wish to express our deep gratitude to the Ministry of Energy and Minerals of Tanzania, and other authorities concerned of the Government of Tanzania, Tanzania Electric Power Company, Embassy of Japan in Tanzania and JICA Tanzania office for the intimate cooperation and assistance extended to us during our investigation period.

Very truly yours,

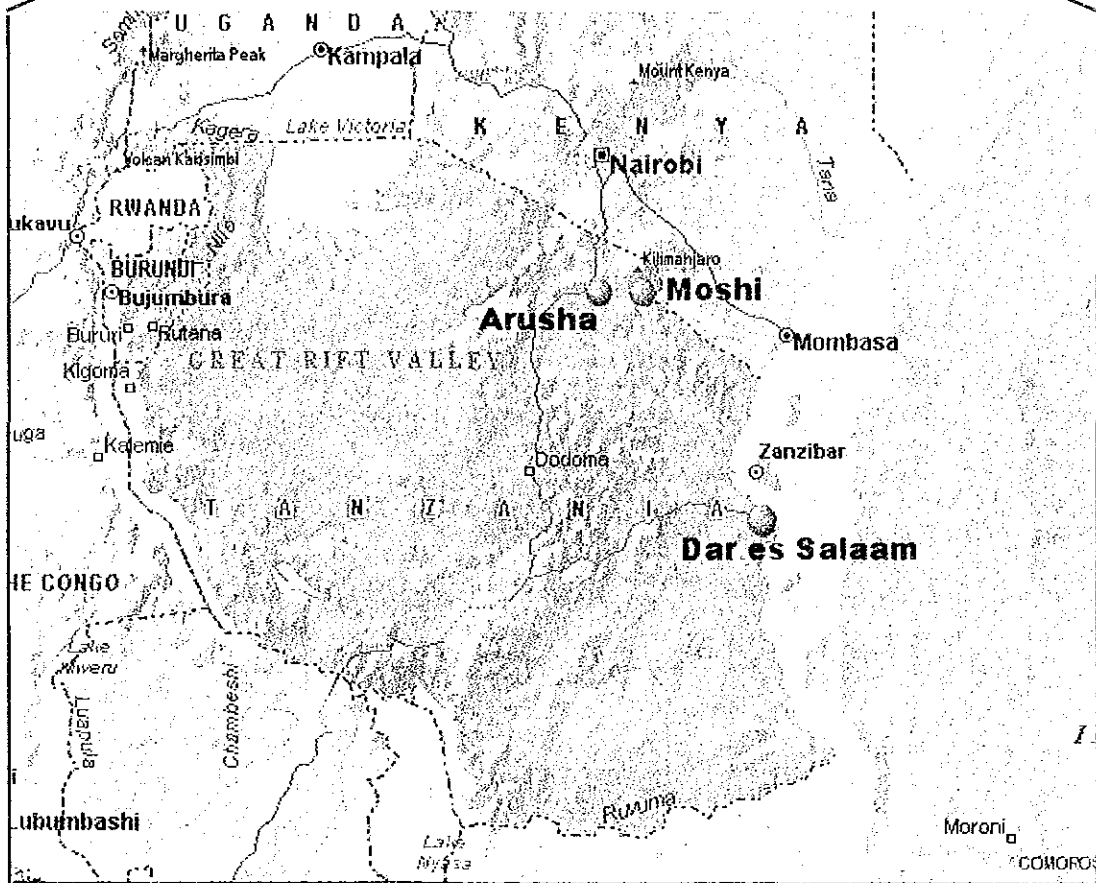
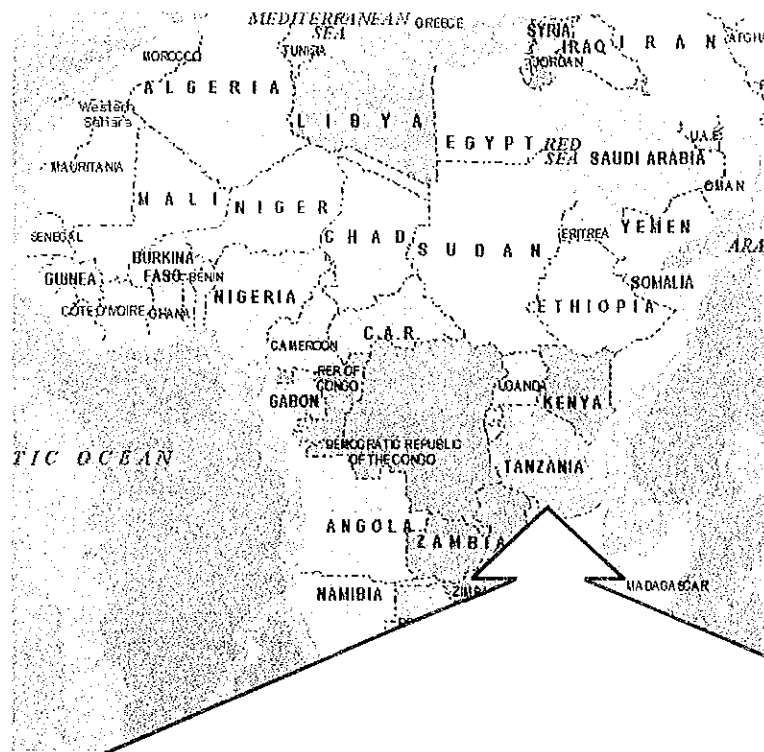
September 2002

Handwritten signature in Japanese characters: 小 谷 敬 (Hiroshi Kodani)

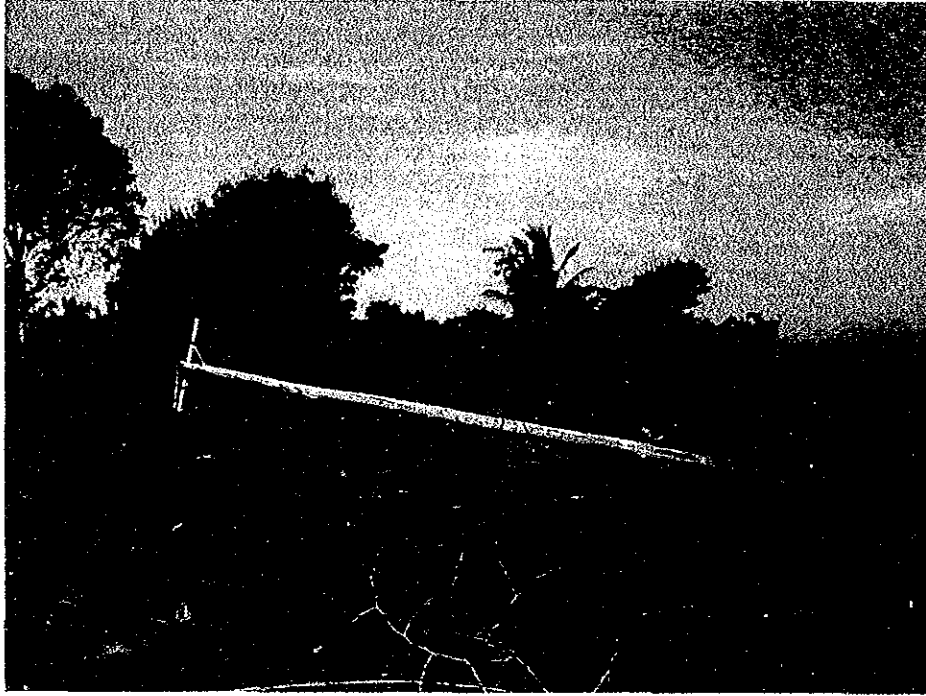
Hiroshi KODANI

Team Leader

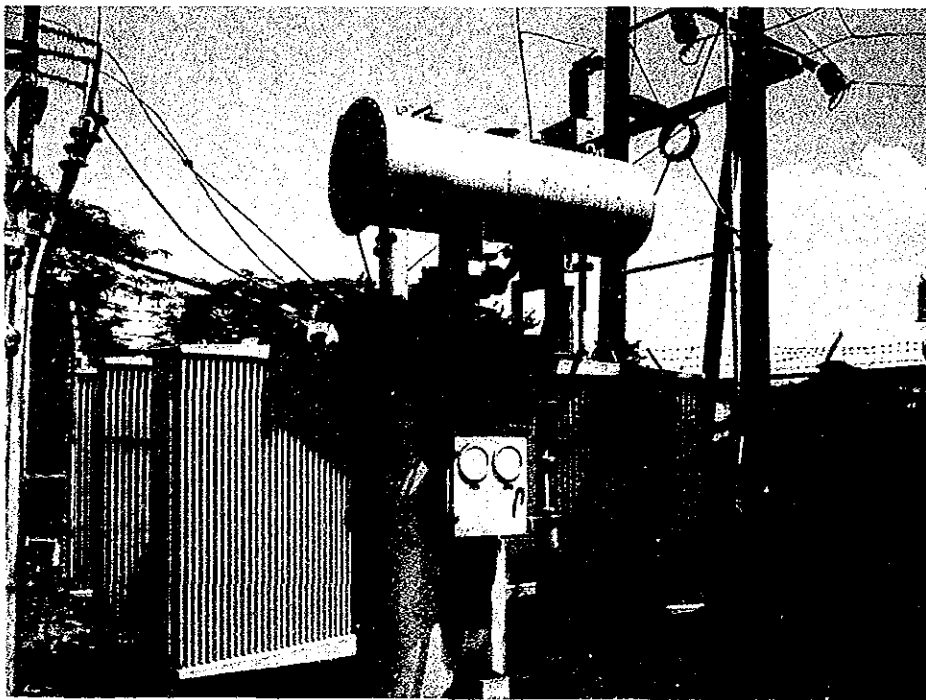
Master Plan Study on the Power Sector for Major Towns in the United Republic of Tanzania



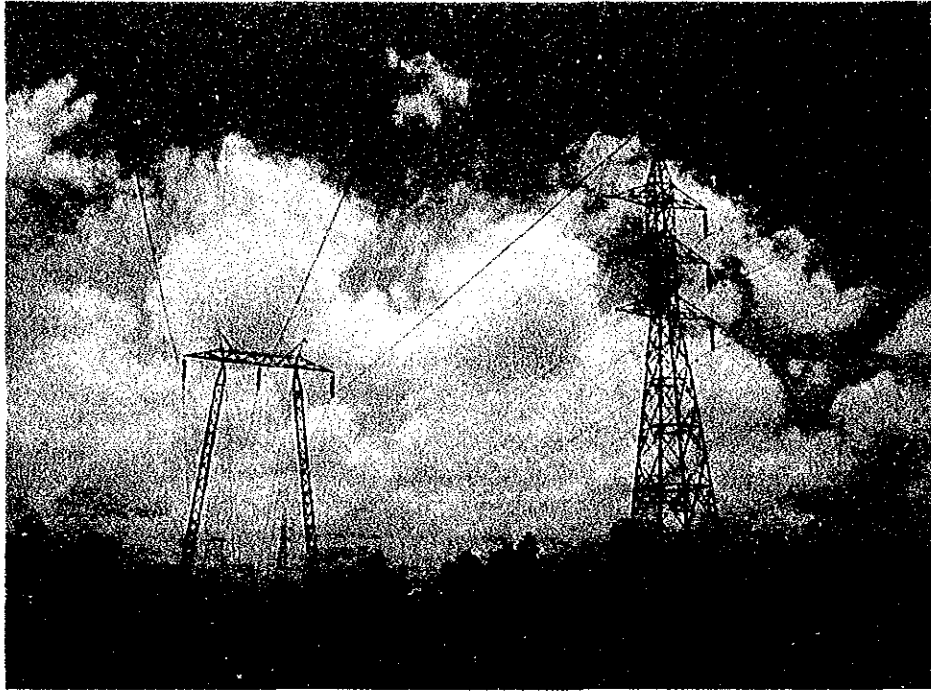
Target Cities (Dar es Salaam, Arusha, Moshi)



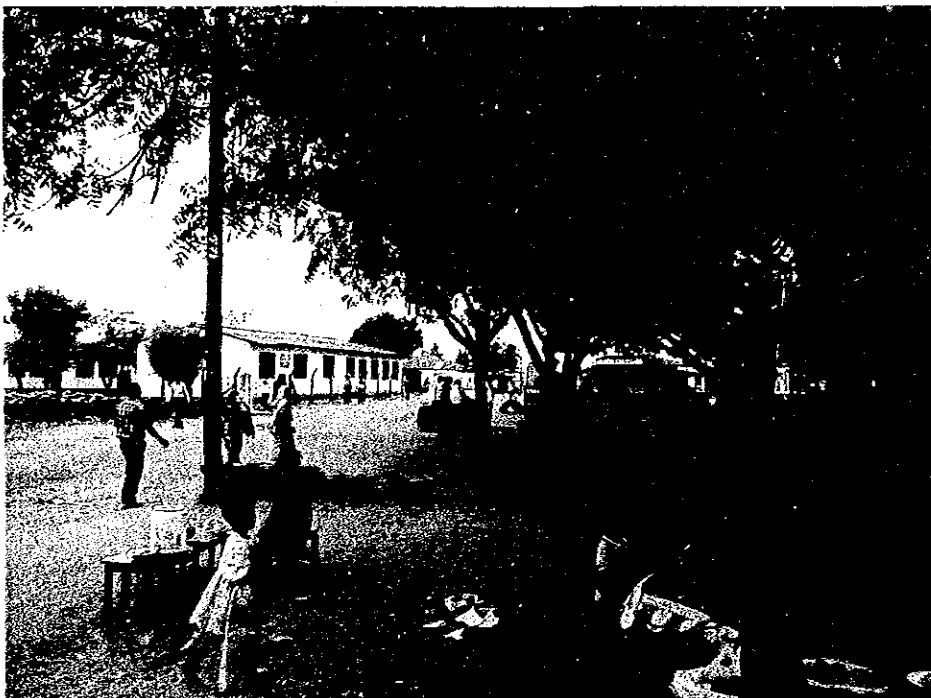
Collapse of wooden pole along 11kV Boma Feeder in outskirts of Moshi



Trade School 33kV/11kV 5MVA transformer in Moshi
(This transformer underwent fatal damage by internal fault during the study period)



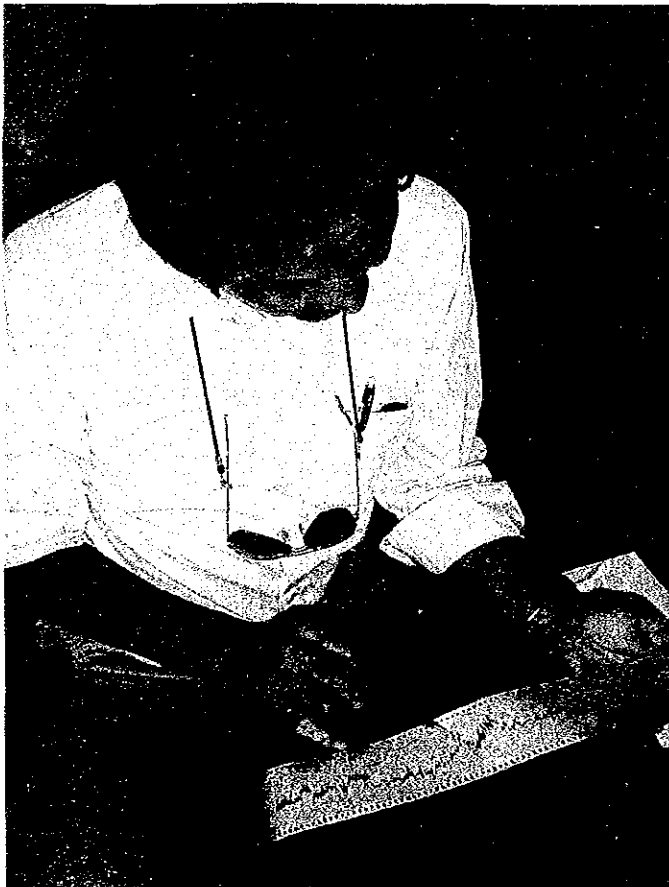
Ilala - Ubungo 132kV T/L over Proposed Mburahati S/S



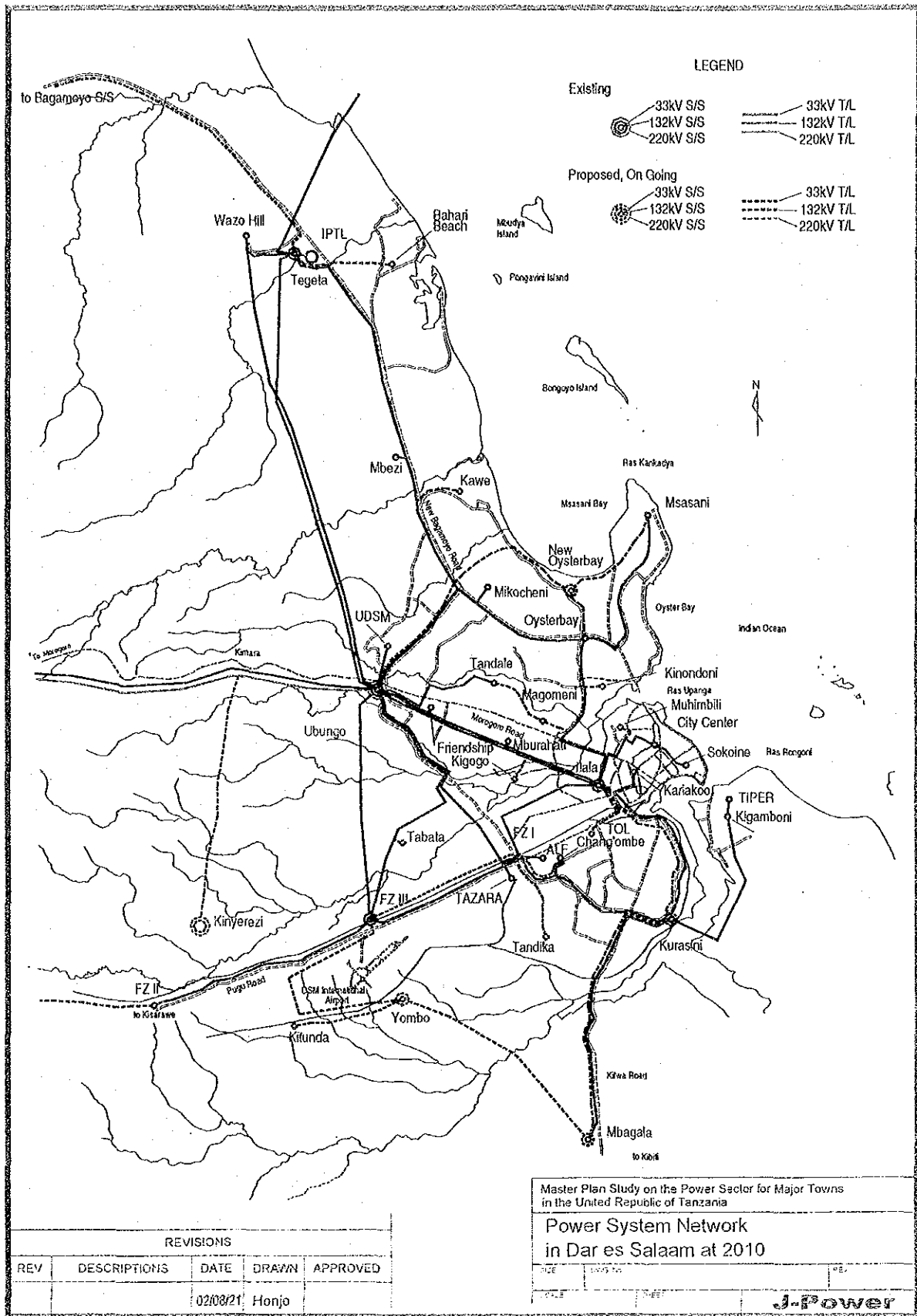
Proposed Tandika S/S Site



Present condition of DAMP



Distribution voltage
investigation
in Dar es Salaam



LEGEND

- Existing
- 33kV S/S
 - 132kV S/S
 - 220kV S/S
 - 33kV T/L
 - 132kV T/L
 - 220kV T/L
- Proposed, On Going
- 33kV S/S
 - 132kV S/S
 - 220kV S/S
 - 33kV T/L
 - 132kV T/L
 - 220kV T/L

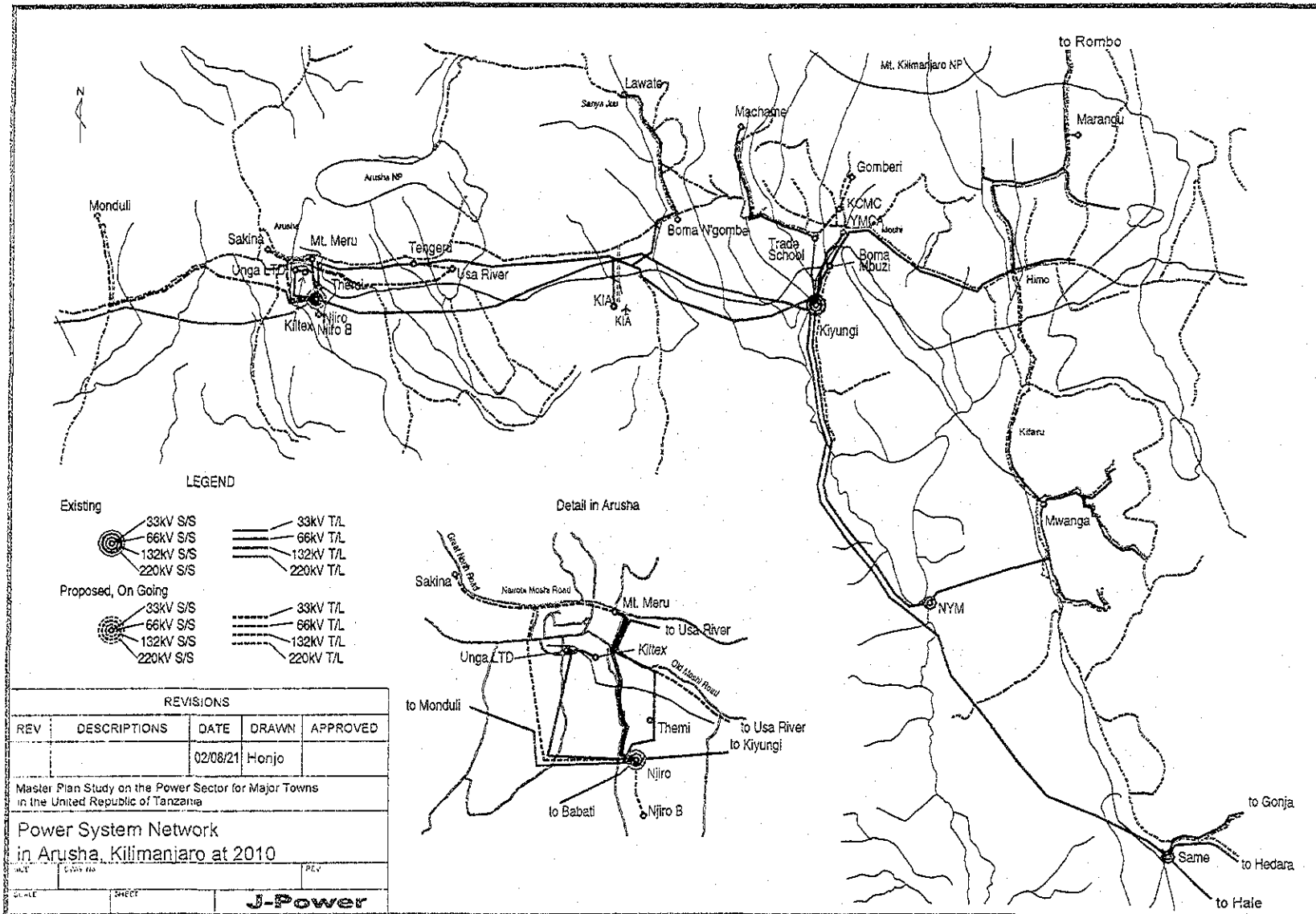
Master Plan Study on the Power Sector for Major Towns
in the United Republic of Tanzania

**Power System Network
in Dar es Salaam at 2010**

J-Power

| REVISIONS | | | | |
|-----------|--------------|----------|-------|----------|
| REV | DESCRIPTIONS | DATE | DRAWN | APPROVED |
| | | 02/08/21 | Honjo | |

Expansion Plan in Dar es Salaam Region



Expansion Plan in Arusha, Kilimanjaro Region

Master Plan Study on the Power Sector for Major Towns in the United Republic of Tanzania

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Abbreviations

General

| | |
|--------------|---|
| AAC | All Aluminum Conductor |
| ACS | Aluminum Clad Steel Wire |
| ACSR | Aluminum Conductor Steel Reinforced |
| ALAF | Aluminum Africa |
| ATC | Air Tanzania |
| BS | British Standard |
| cct | Circuit |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| CT | Current Transformer |
| DAMP | The Dar es Salaam Power Distribution and Maintenance Project |
| DAWASA | Dar es Salaam Water and Sewage Authority |
| DCF | Discount Cash Flow |
| DSM | Dar es Salaam |
| EBITDA | Earning before interest, tax, depreciation and Amortization |
| EIA | Environment Impact Assessment |
| EIS | Environmental Impact Statement |
| EIRR | Economic Internal Rate of Return |
| ESDD | Equivalent Salt Deposit Density |
| EU | European Union |
| | Environmental Unit |
| EWURA | Energy Water Utility Regulatory Authority |
| FIRROI | Financial Internal Rate of Return on Investment |
| FIRROE | Financial Internal Rate of Return on Equity |
| FZ * | Factory Zone * Substation |
| GCB | Gas Circuit Breaker |
| GDP | Gross Domestic Product |
| HIPC | Heavily Indebted Poor Countries |
| IEC | International Electrotechnical Commission |
| IPP | Independent Power Producer |
| IPTL | Independent Power Tanzania LTD |
| KCMC | Kilimanjaro Christian Medical Center |
| KenGen | Kenya Electricity Generation Company |
| KIA | Kilimanjaro International Airport |
| KPLC | Kenya Power and Lighting Company |
| LLDC | Least Less-Developed Countries |
| LP Insulator | Line Post Insulator |
| MEM | Ministry of Energy and Minerals |
| MOF | Ministry of Finance |
| NEMC | National Environment Management Council |
| NOB | New Oysterbay Substation |
| NYM | Nymba ya Mungu P/S,S/S |
| OCB | Oil Circuit Breaker |
| P/S | Power Station |
| PPA | Power Purchase Agreement |
| PRSP | Poverty Reduction Strategy Paper |
| PSRC | Parastatal Sector Reform Commission |

| | |
|-----------------|---|
| PT | Potential Transformer |
| R/O | Regional Office |
| S/S | Substation |
| SAPP | South Africa Power Pool |
| SF ₆ | Sulfur Hexafluoride |
| Sw/S | Switching Station |
| SVR | Step Voltage Regulator |
| T/L | Transmission Line |
| TANESCO | Tanzania Electric Supply CO.LTD |
| TAZARA | Tanzania Zambia Railway Authority |
| TCPL | TransCanada Pipeline LTD |
| THA | Tanzania Harbor Authority |
| TIC | Tanzania Investment Center |
| TIPER | The Tanzania Italian Petroleum Refining Co. LTD |
| TOL | Tanzania Oxygen Limited |
| TPC | Tanganyika Plantations Company |
| TPDC | Tanzania Petroleum Development Corporation |
| TRA | Tanzania Revenue Authority |
| TRC | Tanzania Railways Corporation |
| | Technical Review Committee |
| TTCL | Tanzania Telecommunication Company LTD |
| UDSM | The University of Dar Es Salaam |
| UEB | Uganda Electricity Board |
| UPS | Uninterruptible Power Supplies |
| VAT | Value Added Tax |
| VT | Voltage Transformer |
| XLPE | Crosslinked Polyethylene |
| ZESCO | Zambia Electricity Supply Corporation |

Lenders and Agencies

| | |
|---------|--|
| AfD | Agence Francaise de Developpement |
| AfDB | African Development Bank |
| AfDF | African Development Fund |
| CIDA | Canadian International Development Agency |
| EADB | East African Development Bank |
| EIB | European Investment Bank |
| FINNIDA | Finnish International Development Agency |
| IDA | International Development Association |
| IFC | International Finance Corporation |
| IMF | International Monetary Fund |
| JICA | Japan International Cooperation Agency |
| KfW | Kreditanstalt fur Wiederaufbau |
| NDF | Nordic Development Fund |
| NORAD | Norwegian Agency for Development Cooperation |
| Sida | Swedish International Development Cooperation Agency |
| USAID | US Agency for International Development |
| WB | World Bank |

| | |
|----------|----------------------------|
| Unit | |
| A | Ampere |
| mA | Miliampere |
| kA | Kiloampere= 10^3 A |
| V | Volt |
| kV | Kilovolt= 10^3 V |
| VA | Volt Ampere |
| kVA | Kilovolt Ampere= 10^3 VA |
| MVA | Megavolt Ampere= 10^6 VA |
| W | Watt |
| kW | Kilowatt= 10^3 W |
| MW | Megawatt= 10^6 W |
| Wh | Watt Hour |
| kWh | Kilowatt Hour= 10^3 Wh |
| MWh | Megawatt Hour= 10^6 Wh |
| GWh | Gigawatt Hour= 10^9 Wh |
| Pf | Power Factor |
| Hz | Hertz(Cycles per Second) |
| Ω | Ohm |
| dB | Decibel |