BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE REINFORCEMENT
OF
ELECTRIC POWER DISTRIBUTION NETWORK
IN
KAMPALA
IN
THE REPUBLIC OF UGANDA

JUNE 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Republic of Uganda, the Government of Japan decided to conduct a basic design study on The Project for The Reinforcement of Electric Power Distribution Network in Kampala and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Uganda a study team headed by Mr. Yusuke Kitamura, Deputy Director of First Training Division, Training Affairs Department, JICA, from January 28 to March 3, 1991.

The team held discussions with the officials concerned of the Government of Uganda, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Yutaka Hosono, Managing Director of Grant Aid Study and Design Department, JICA, was sent to Uganda in order to discuss a draft report and the present report was prepared.

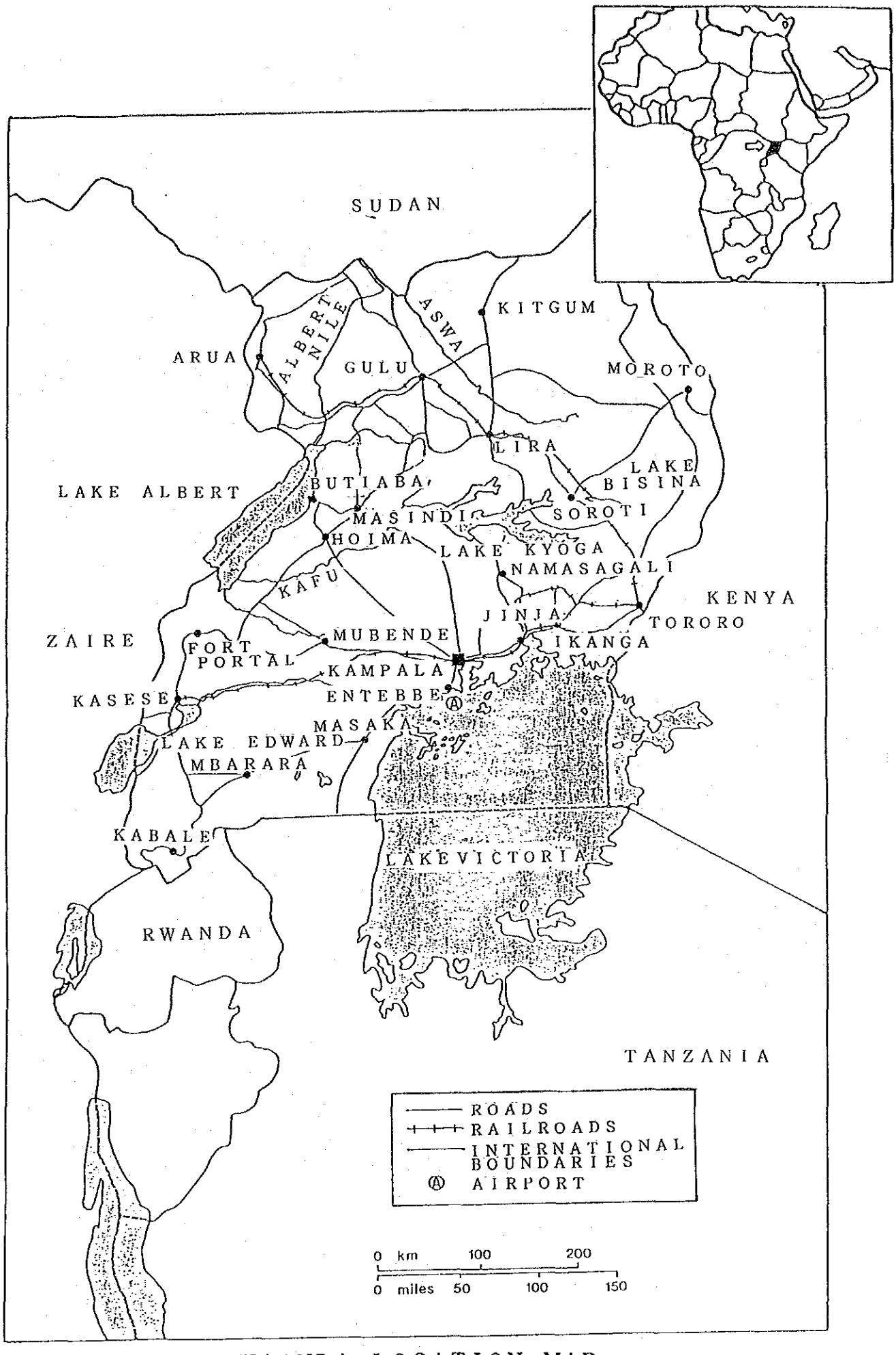
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Uganda for their close cooperation extended to the teams.

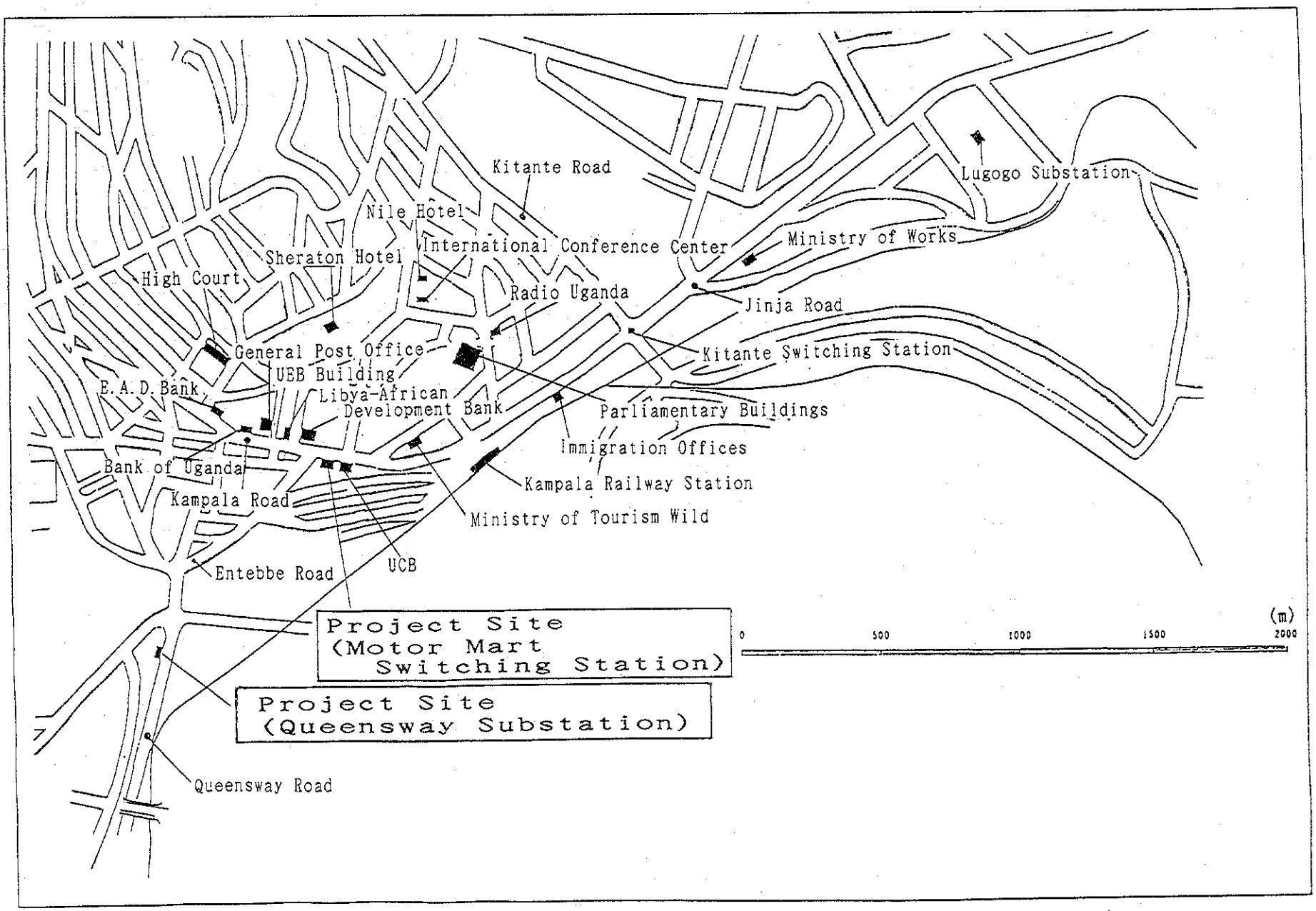
June, 1991

Kensuke Yanagiya

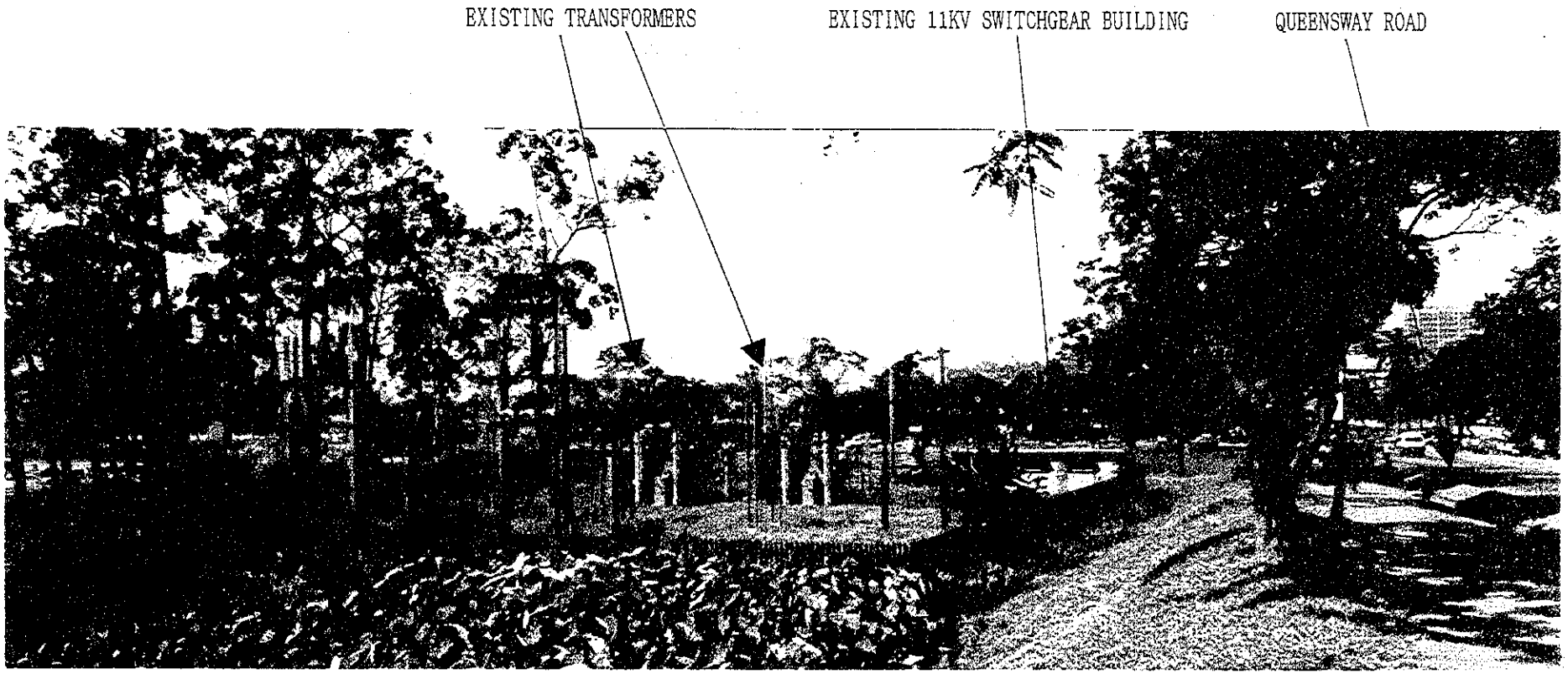
Kensuke Yanagiya
President
Japan International Cooperation Agency



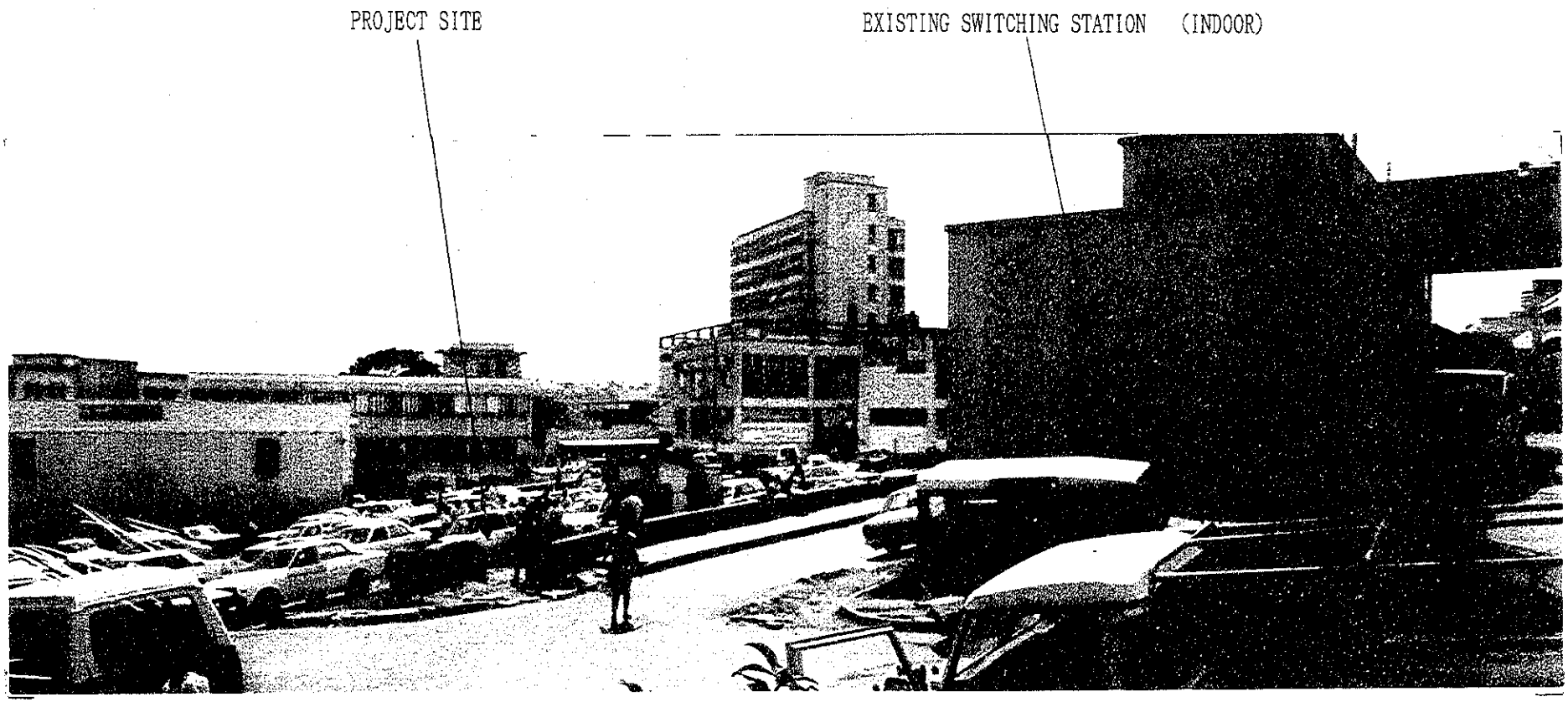
UGANDA LOCATION MAP



PROJECT SITE LOCATION MAP



QUEENSWAY SUBSTATION



MOTOR MART SWITCHING STATION

SUMMARY

SUMMARY

The Republic of Uganda (hereinafter referred to as Uganda) is a landlocked country right at the equator. It is bordered by 5 countries, i.e., Sudan to the north, Zaire to the west, Rwanda and Tanzania to the south and Kenya to the east. Lake Victoria, the third largest lake in the world, is located in Uganda. The national land area is 197,000km^2 and the population is some 17.21 million (official estimate in 1990). The GNP per capita is approximately 356 dollars (1987) and the capital, Kampala, is located in the south-central part of the country, facing Lake Victoria.

Since the Uganda economy is largely dependent on the export of such primary agricultural products as coffee and cotton, etc., it is vulnerable to both the weather and market trends in industrial countries. The Ugandan economy underwent a period of stagnancy due to a controlled economy under military rule in the 1970's and civil war in the early 1980's with the real growth rate of the GNP dropping to minus 5.6% in 1985. The introduction of the Rehabilitation and Development Plan with the purpose of building "an independent, integrated and self standing national economy" in subsequent years initiated a recovery of the economy around 1986. Nevertheless, the burden of economic ruin in the past is still strongly felt today and the economic conditions are far from ideal. The Government of Uganda is, therefore, promoting the establishment of a self-reliant economy with agriculture and industries at the core on the grounds that the urgent recovery of the economy is a priority target for national reconstruction efforts.

Improvement of the social infrastructure to achieve urgent economic recovery is emphasized in the latest Rehabilitation and Development Plan (1988/89 ~ 1991/92) which states that the rehabilitation of the existing power generation and transmission facilities is the prime objective in the energy sector.

The transmission and distribution networks in Kampala, the capital of Uganda and the center of the country's political, economic and social activities, were largely constructed some 40 years ago in the 1950's and show signs of deterioration, resulting in many breakdowns. Regular restrictions on the power supply (regular power cuts) have been imposed due to the transformer capacity shortage, etc. Furthermore, the Owen Falls Hydro-electric Power Station, the main power supply source for Kampala, is only operating at 60% of its rated output (90MW out of 150MW) due to its aged facilities, hindering social and economic activities in Kampala.

The Uganda Electricity Board (UEB), the public organization solely responsible for power generation and supply, has 2,447 employees (July, 1990) and has been making strong efforts to provide adequate maintenance for the existing facilities. However, difficulties in obtaining

spare parts for the aged facilities and in the procurement of equipment and materials due to the pressing foreign currency shortage have resulted in broken-down equipment being left unrepaired, worsening the reliability of the facilities and causing many problems, including the burning of circuit breakers which are the main equipment at the substations. Moreover, the transmission loss in 1988 reached as high as 29%, causing further instability in the capital's power supply, in turn adversely affecting public life, economic activities and the operation of such public facilities as banks, post offices and railway station, etc.

Under these circumstances, the Government of Uganda prepared the Second Power Project with a view to improving the power supply network in Kampala, including the rehabilitation of the Owen Falls Power Station, with the assistance of the World Bank and British Government, etc. In 1989, it became apparent that the original project budget had fallen far below the required level due to inflation, the worsening exchange rate and other reasons, making a review of the Project necessary. Consequently, the Second Power Project is being implemented on a smaller scale than originally anticipated. Following the completion of the Second Power Project, the Government of Uganda also plans the Third Power Project with the assistance of the World Bank and others to achieve the medium and long-term economic recovery of the country as it believes that improvement of the tight power supply situation is crucial for such economic recovery. The main component of the Third Power Project is the development of a new hydro-electric power station.

The Third Power Project differs from the Second Power Project in that it mainly aims at the development of a new hydro-electric power station. As a result, it now appears difficult to secure a new loan for the improvement of some parts of the distribution network and substations which are part of the Kampala distribution network improvement work envisaged by the Second Power Project which has not been implemented due to financial difficulties.

Against this background, the Government of Uganda prepared a plan for reinforcement of the electric power distribution network in Kampala for an area not included in the Second and Third Power Projects. The intention of the plan was to complement these Projects in order to vitalize industrial, commercial and social activities in the capital by securing a stable power supply. The Government of Uganda subsequently made a request to the Government of Japan for the provision of grant aid for the Project.

In response to this request, the Government of Japan decided to conduct a Preliminary Study on the Project and entrusted the study to Japan International Cooperation Agency (JICA) from October 6 to 20, 1990. The Preliminary Study confirmed the feasibility and contents of the Project and the Government of Japan decided to conduct a Basic Design Study of the Project. This led to the dispatch of a Basic Design Study Team by JICA to Uganda from January 28 to March 3, 1991.

The objectives of the Basic Design Study were to obtain a correct understanding of the contents of the Ugandan request, i.e., 1) reconstruction of the Queensway Substation and Motor Mart Switching Station , 2) procurement of distribution materials for the 11KV distribution network in Kampala and 3) procurement of motor vehicles for the maintenance of the distribution network. JICA later dispatched the draft final reporting team to Uganda from May 28 to June 10, 1991 to explain the contents of the Draft Final Report to the Uganda side.

During the field survey for the Basic Design Study, the Study Team gained an understanding of the power service situation in Uganda through discussions with local officials concerned and confirmed the poor situation of the power facilities, i.e., general deterioration of the equipment installed at the Queensway Substation and Motor Mart Switching Station, oil leakage from such main equipment as circuit breakers, etc. The importance of these 2 stations for power supply to central Kampala was also confirmed, further indicating the necessity for the urgent implementation of the Project.

It was also confirmed that the Project would reinforce the Second and Third Power Projects being conducted with the assistance of the World Bank and other organizations and that the technical contents of the Project are in harmony with those of these ongoing projects.

The suitability of the requested scale of the facilities (① Queensway Substation: 4-33KV line feeders network and 12-11KV line feeders and ② Motor Mart Switching Station : 3-11KV Incoming feeders and 6-11KV Outgoing feeders, etc.) and their specifications (① Rated bus capacity: 33/11KV:2,000A and ② system fault level: 33KV:16KA, 11KV:20KA) were confirmed as they are in harmony with those of the master plan of the power distribution network in Kampala planned as part of the ongoing Power Projects.

The necessity for the urgent procurement of equipment and materials for the 11KV distribution network and maintenance vehicles was also confirmed based on recognition of the factors that the unreliable power supply in Kampala is caused by ① shortage of power distribution materials, such as fuses, the insufficient distribution transformer capacity, etc., and ② inability of the present maintenance vehicles owned by UEB Kampala District Office (245 employees) to fully perform their functions due to the deterioration of the vehicles and the shortage of spare parts.

In the design of the substation and switching station to be constructed under the Project, special attention was paid to minimizing power cuts due to Project implementation in view of the importance of the existing facilities in public life. It was decided that outdoor cubicle type switchgear would be installed to shorten the construction period, to avoid the further construction of a building to house the distribution boards and to minimize the required space. The following sites were selected as Project sites for the location of the new facilities in view of the site shape and layout of the existing facilities.

Queensway Substation:

An area facing Queensway Road and an area of the existing 33KV bus lines on the present substation premises.

Motor Mart Switching Station

A corner of carpark administrated by the Kampala city council located near the present site. (Government Land)

The basic requirements for the Project compiled by the Study Team on the basis of the field survey findings are shown in the table.

As the table shows, the actual construction will be conducted in 2 phases, i.e., Phase I for the construction of substation facilities and the procurement of equipment and materials which should be given priority to urgently improve the power supply in central Kampala, the main objective of the Project and Phase II for the procurement of equipment and materials which will reinforce the beneficial effects of Phase I and further guarantee the successful achievement of the Project objective.

Project Outline

Project Item	Phase I	Phase II
(Facility Construction Plan)		
Queensway Substation	Construction of the following facilities and their foundations. 1) 33KV outdoor cubicle type switchgear 2) 11KV outdoor cubicle type switchgear 3) 33KV outdoor type lightning arrestors 4) 33/11KV outdoor type power transformers 5) power and control cables for above	—
Motor Mart Switching Station	Construction of the following facilities and their foundations. 1) 11KV outdoor cubicle type switchgear 2) 11KV/433-250V outdoor type station transformer 3) Power and control cables for above	—
On the Job Training (OJT)	OJT on operation and maintenance techniques for above facilities to be provided by engineers of the Japanese contractor.	—
(Equipment and Materials Procurement Plan)		
Equipment and materials for 11KV distribution network	Equipment and materials required for maintenance of 11KV distribution network supplied by above stations. • fuses • distribution transformers • surge arrestors • 11KV cables	1) Equipment to cover entire Kampala distribution network. • distribution transformers • surge arrestors 2) Equipment and materials required for maintenance of 11KV distribution network supplied by above stations • auto reclosers • fuses
Maintenance vehicles	Vehicles required for maintenance of 11KV distribution network supplied by above stations. • lorries • 4 wheel drive vehicles • self-loading lorries • street lighting lorries • spare parts	Vehicles required for maintenance of Kampala's distribution network. • lorries • 4 wheel drive vehicles • spare parts
Auxiliary equipment and materials related to the stations	1) 11KV underground distribution cable to connect existing 11KV network to new facilities 2) 33KV outdoor type lightning arrestors for reserve circuit and future plan for Queensway Substation 3) spare parts for new facilities	1) 11KV underground distribution cable between Queensway Substation and Motor Mart Switching Station 2) 33KV underground cable for connection for 33KV Lugogo line in Queensway Substation

The execution agency for the Project in Uganda is UEB which will also be responsible for the operation and maintenance of the new facilities after the completion of the Project.

In the event that the Project is implemented under Japan's grant aid, major items of work to be undertaken by the Ugandan side are land preparation of the Project sites, dismantling and removing the existing equipment and facility at the Queensway Substation, and the assignment of engineers for OJT trainees, etc. The cost involved is about 5.4 million shs (1sh = 0.23 yen, February, 1991).

The following periods will be required to complete the relevant work.

Phase I : detailed design - 3 months, manufacture and/or procurement of equipment - 7.5 months, on-site construction - 4.5 months

Phase II : detailed design - 2 months, manufacture and/or procurement of equipment - 10 months

UEB is required to complete land preparation work at the Project sites, including the provision of a temporary storage yard, by the predetermined date and to cooperate with the Japanese side in the establishment of communication/coordination links with the related government agencies for the smooth implementation of the Project.

The implementation of the Project is expected to have the direct effects of providing a stable power supply through the construction of new substations and the installation of new distribution equipment, including distribution transformers, and increasing revenue. Assuming that the Project is implemented in 1993, the resulting increase in revenue due to the completion of the Project is estimated to be some 250 million shs for Phase I and some 59 million shs for Phase II, far exceeding the annual maintenance cost of the new facilities which is estimated to be some 2.7 million shs.

In view of the facts that the Project will improve the power service in Kampala (service population: approximately 0.86 Million) and that it will contribute to the smooth running of public facilities and the general improvement of public life, the implementation of the Project under Japan's grant aid will play a significant role in assisting the Government of Uganda and is, therefore, appropriate. Thus, it is concluded that the implementation of this Project under Japan's grant aid is highly significant and proper.

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1. Basic Design Study Team
2. Field Survey Schedule
3. List of Interviewees
4. Minutes of Discussions
5. Field Report
6. Letter of Approval by Government of Uganda for Field Report
7. Specifications of Distribution Materials and of Maintenance Vehicles Prepared by UEB
8. Country Data
9. Estimated Cost for the Work to be Undertaken by Ugandan Side

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ABBREVIATIONS

EEC	European Economic Community
E/N	Exchange of Notes
GDP	Gross Domestic Product
GNP	Gross National Product
GWh	Giga Watt Hour (= 1,000MWh = 1,000,000KWh)
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
JEC	Japanese Electrotechnical Commission
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standards
ODA	Overseas Development Administration (UK)
O&M	Operation and Maintenance
OJT	On the Job Training
SCADA	System Control and Data Acquisition
UEB	Uganda Electricity Board

CHAPTER 1 INTRODUCTION

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Impoverished under the military rule in the 1970's, Uganda is now undergoing economic recovery and the government is implementing a national development plan with the rehabilitation and promotion of both agriculture and industry at the core in order to firmly establish a self-reliant economy. The Rehabilitation and Development Plan (RDP) which is issued every 2 years indicates the measures to be implemented in each sector and the latest RDP addresses the period between fiscal 1988/89 and fiscal 1991/92.

The electricity distribution network in Kampala, the capital of Uganda and the country's center for political, economic and social activities, was first established in the 1950's and has largely deteriorated, resulting in frequent breakdowns of various facilities. In addition, the low transformer capacity of the substations and other factors have made load restrictions, i.e., regular power cuts, imperative.

The generating output of the Owen Falls Hydro-electric Power Station, Kampala's main power station, has declined to about 90MW (about 60% of the installed capacity of 150MW), hindering socioeconomic activities in the capital. Despite conscious efforts on the part of UEB to maintain the present facilities at a reasonable standard, the reliability of these facilities has declined due to difficulties in procuring spare parts for the old equipment and securing these parts as well as other supplies due to the low level of the country's hard currency reserves. As a result, the electricity supply in the capital has been unstable for some time.

To improve the situation, the Government of Uganda listed the rehabilitation of the existing electricity distribution network as the priority target in the energy sector, in the RDP (1988/89 ~ 1990/91), to implement the urgent improvement of this important element of the social infrastructure.

Under these circumstances, the Government of Uganda prepared the Second Power Project with a view to improving the power supply network in Kampala, including the rehabilitation of the Owen Falls Power Station, with the assistance of the World Bank and British Government, etc. In 1989, it became apparent that the original project budget had fallen far below the required level due to inflation, the worsening exchange rate and other reasons, making a review of the Project necessary. Consequently, the Second Power Project is being implemented on a smaller scale than originally anticipated. Following the completion of the Second Power Project, the Government of Uganda also plans the Third Power Project with the assistance of the World Bank and others to achieve the medium and long-term economic recovery of the

country as it believes that improvement of the tight power supply situation is crucial for such economic recovery. The main component of the Third Power Project is the development of a new hydro-electric power station.

The Third Power Project differs from the Second Power Project in that it mainly aims at the development of a new hydro-electric power station. As a result, it now appears difficult to secure a new loan for the improvement of some parts of the distribution network and substations which are part of the Kampala distribution network improvement work envisaged by the Second Power Project which has not been implemented due to financial difficulties.

Against this background, the Government of Uganda prepared a plan for reinforcement of the electric power distribution network in Kampala for an area not included in the Second and Third Power Projects. The intention of the plan was to complement these Projects in order to vitalize industrial, commercial and social activities in the capital by securing a stable power supply. The Government of Uganda subsequently made a request to the Government of Japan for the provision of grant aid for the Project.

In response to this request, the Government of Japan decided to conduct a Preliminary Study to confirm the appropriateness of the Project and the feasibility of Japan's grant aid and entrusted the Japan International Cooperation Agency (JICA) to conduct the said study which was subsequently implemented from October 6 to 20, 1990. In accordance with a further decision by the Government of Japan to conduct a Basic Design Study, JICA sent the Basic Design Study Team headed by Yusuke Kitamura of the First Training Division, Training Affairs Department, JICA to Uganda for the period from January 28 to March 3, 1991. A list of the Study Team members and the field survey schedule are given in Appendices 1 and 2 of this report.

The objectives of the Basic Design Study were to obtain a correct understanding of the contents of the Ugandan request, i.e., (1) reconstruction of Queensway Substation and Motor Mart Switching Station, (2) procurement of 11KV distribution materials for the Project and (3) procurement of motor vehicles for the Project, and to examine the possible effects of the Project and its propriety as a grant aid project.

In Kampala, the Study Team visited the Ministry of Energy and UEB to explain the objectives of the survey and discussed the general conditions of electricity generation and distribution in Uganda and Kampala. The Study Team also discussed the contents of the Project, reconfirming the background and the main items of the request. It was also confirmed that the Project would reinforce the Second and Third Power Projects being conducted with the

assistance of the World Bank and other organizations and that the technical contents of the Project are in harmony with these ongoing projects.

The Minutes of Discussions (M/D), (see Appendix 4) was concluded on February 12, 1991 based on the results of the discussions and the studies of the outlined background as well as objectives of the request. The list of interviewees is given in Appendix 3.

Following the signing of the M/D, the Study Team continued to collect and analyze data and information and submitted the Filed Report to UEB on February 26, 1991 to confirm the basic technical concept for the basic design of the Project with Ugandan side (Appendix 5). UEB then issued the Letter of Approval (Appendix 6) for the said Field Report.

Upon its return to Japan, the Study Team prepared a Draft Final Report for the Basic Design Study for the Project, taking the current conditions of power supply in Uganda, current conditions of project sites, relationship between the Project and higher level plans and the propriety, contents and scale of the grant aid into consideration. JICA then sent a Draft Final Reporting Team headed by Mr. Yutaka Hosono, Grant Aid Study and Design Department, JICA, to Uganda from May 28 to June 10, 1991 to explain the contents of the Draft Final Report to the Ugandan side and the Basic Design Study Report has now been finalized.

The member list, field survey schedule and M/D for the draft final reporting team are given in Appendix 1, 2 and 4 respectively.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 General Conditions the Country

2-1-1 Geographical Location and Topography

Uganda is a landlocked country in East Africa and is located right at the equator. The distance to the nearest ocean, i.e., Indian Ocean, is some 800km. Uganda is bordered by Kenya to the east, Tanzania and Rwanda to the south, Zaire to the west and Sudan to the north.

In addition to Lake Victoria, the third largest lake in the world which Uganda shares with Kenya and Tanzania, Uganda has many lakes, including Lake Albert, Lake Edward and Lake Kyoga. The Victoria Nile which originates from Lake Victoria and Lake Kyoga becomes the Albert Nile after Lake Albert before becoming the White Nile. The Owen Falls Dam which is Uganda's main power source is located on the Victoria Nile.

Some 84% of the country's land is highland with an elevation ranging from 900m to 1,500m. In general, the land gently slopes towards the central area where Lake Kyoga is located. Land with an elevation of less than 900m is found to the east of the West African Rift Valley and accounts for some 9% of the total land area.

2-1-2 Population and Land Area

According to the government estimate, the population of 1990 is 17,214,000. Total land of Uganda is about 197,000km^2.

2-1-3 Socioeconomic Conditions

The economy of Uganda is best described as a monoculture relying on the export of such agricultural products as coffee and cotton and is, therefore, unstable due to vulnerability to weather and the market conditions in industrialized countries.

The Ugandan economy was completely stagnant in the 1970's under the strict control of the military regime. While it slightly recovered in the early 1980's with the financial assistance of the IMF and the World Bank, as well as the implementation of various economic rehabilitation plans, the spread of civil war and the worsening inflation caused negative GNP growth in real terms with -5.3% and -5.4% being recorded in 1984 and 1985 respectively.

The Government of Uganda introduced a national Rehabilitation and Development Plan (RDP) in order to establish "an independent, integrated and self standing national economy" and achieved 3.3% GNP growth in real terms in 1986 and 4.5% in 1987 through the recovery of agriculture and the improved operation rate of the manufacturing industry. The growth of the Ugandan GNP is shown in Table 2-1.

Table 2-1 Growth of Ugandan GNP

Item	1984	1985	1986	1987
Nominal GNP (billion Shs)	1,070	1,950	4,190	11,830
GNP Growth Rate Real Terms (%)	-5.3	-5.6	3.3	4.5
Nominal GNP per Capita (US $)	360	370	350	356

Source: Association for Promotion of International Cooperation in Japan (APIC), May, 1989

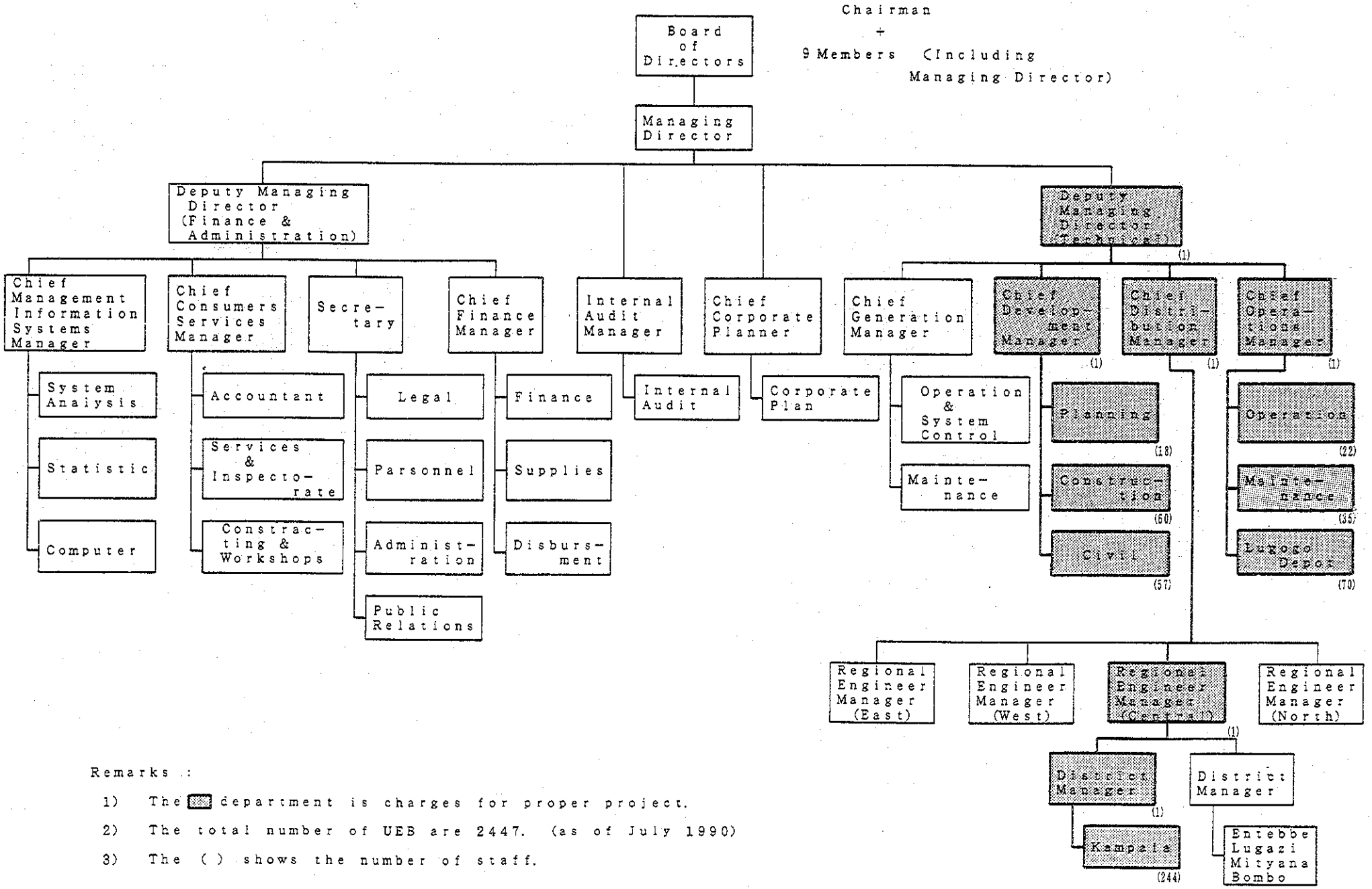
2-2 Outline of the Actual Conditions on the Sector Concerned

2-2-1 Administrative Organization of Power Sector

UEB, which was established by the Uganda Electricity Ordinance in 1948, is responsible for all aspects of the power sector in Uganda, ranging from the construction of power station and transmission lines to electricity charge collection.

The sections of the Ordinance relating to the administrative organization and finance were revised in 1961 and the Ordinance was re-enforced following independence in 1962. The Ordinance provides adequate autonomy to UEB to supply electricity throughout Uganda and also to export electricity to neighboring countries. UEB is under the jurisdiction of the Ministry of Energy which is in charge of formulating administrative policies for the power sector.

As shown in Fig. 2-1, the highest decision making body of UEB is the Board (consisting of 9 members, including Managing Director of UEB). UEB employes 2,447 people nationwide (as of July, 1990) under the Managing Director and 2 Deputy Managing Directors. This Project will be handled by the Development, Distribution and Operation Divisions under the leadership of the Deputy Managing Director responsible for technical aspects.



Remarks :

1) The ▨ department is charges for proper project.
2) The total number of UEB are 2447. (as of July 1990)
3) The ( ) shows the number of staff.

Fig. 2-1 Organization Chart of UEB

Source : UEB

2-2-2 Financial Conditions of UEB

The financial conditions of UEB are shown in Table 2-2 where the operating balance in 1988 was some 98 million shs in the black (approximately 610,000 US$ based on an exchange rate of 1US$ = 161 shs). Profits were 13% of the total income, the bulk of which came from power sales. Nevertheless, the current balance for the same year recorded a large deficit simply because of the substantial loan repayment which was as large as some 30% of the total income.

Both the operating balance and current balance showed a deficit in 1989 despite the revenue increase due to the large tariff increase. The main reason for this was the large increase of the maintenance cost for the repair and operation of aging equipment, aggravated by an increase of the general administration cost due to foreign exchange losses, and the bad and doubtful debts. According to materials provided by UEB, the ratio of the maintenance cost in the total expenditure jumped to some 23% in 1991 from 14% in 1989, further deteriorating the financial health of UEB.

Table 2-2 Financial Conditions of UEB (Profit and loss statement)

(Unit : Shilling)

Item	1988	1989
1. Income		
1.1 Sales of energy	745,898,904	1,919,204,772
1.2 Meter rents	2,102,000	3,732,350
1.3 Surplus on sale and repair of apparats	4,494,285	12,237,362
Sub-Total	752,495,189	1,935,174,484
2. Operating Costs		
2.1 Generation	87,451,328	210,648,336
2.2 Transmission and distribution	151,584,879	648,182,396
2.3 Sales development expenses	10,866,999	25,731,546
2.4 Meter reading expenses	14,287,072	32,865,231
2.5 Training and welfare	7,786,069	24,310,905
2.6 Management and general expenses	382,013,249	1,143,686,540
Sub-Total	653,983,596	2,083,425,004
3. Operating surplus / deficit	98,505,593	- 148,250,520
4. Other expenses		
4.1 Loan interest payable (net)	220,121,594	105,021,678
4.2 Amount written off investment	773	758
4.3 Less sale of scrap	(32,900)	—
Sub-Total	220,089,467	105,022,436
5. Deficit for the year	- 121,583,874	- 253,272,956

(Source: UEB Annual Report 1989)

This trend is particularly noticeable in the Transmission and Distribution Division. As shown in Table 2-3, the maintenance cost accounted for some 32% of the Division's total expenditure in 1988 and was as high as some 50% in 1989, indicating the aging of the transmission and distribution facilities.

UEB is preparing a medium-term plan for the revision of the tariff system to be introduced in approximately 5 years' time to improve its financial health, including loan repayment. The electricity tariff system is described in 3-4-1.

Table 2-3 Transmission and Distribution Division's Expenditure (1988 ~ 1989)

Item	1988		1989	
	Expenditure (shilling)	Ratio (%)	Expenditure (shilling)	Ratio (%)
1. Expenses				
(1) Salaries and wages	82,698,999	54.6	137,977,402	21.4
(2) Provident fund, social security, pension and gratuity contribution	2,329,006	1.5	6,219,106	1.0
(3) Medical expenses	1,171,932	0.8	4,135,771	0.6
(4) Repairs and maintenance	48,512,490	32.0	326,436,082	50.5
(5) Transport and travelling	5,647,682	3.7	99,989,479	15.5
(6) Store-keeping and workshop expenses	1,243,653	0.8	34,329,878	5.3
(7) Rent and rates	623	0.0	10,215	0.0
(8) Communications	461,599	0.3	1,122,911	0.2
(9) General expenses	8,163,193	5.4	1,849,962	0.3
(10) Telephones and telexes	—	—	21,690,639	3.4
Sub-Total	150,229,105	99.1	633,761,445	98.1
2. Depreciation				
(1) Fixed assets	1,220,105	0.8	2,383,672	0.4
(2) Tools and equipment	135,597	0.1	10,037,279	1.6
Sub-Total	1,355,702	0.9	12,420,951	1.9
Total Expenditure	151,584,879	100	646,182,396	100

(Source: UEB Annual Report 1989)

2-2-3 Power Supply Situation

(1) Power Generating Facilities

As already described in 2-2-1, UEB is responsible for running all components of the power sector in Uganda, including power stations, substations and transmission lines, etc. The power stations run by UEB and their current operation are shown in Table 2-4. The total installed capacity of UEB is approximately 153MW and the annual energy supply in 1989 was some 660GWh, most of which was generated by the Owen Falls Hydro-electric Power Station (installed capacity: 150MW) which is located in Jinja, about 80km east of Kampala.

In addition to the Owen Falls Power Station, Uganda has some diesel generating power station in local areas which have a total installed capacity of some 3MW and the annual energy supply in 1989 was 1.13 GWh (only 2% of the national total).

The output of the Owen Falls Power Station has declined to 90MW, i.e., 60% of the installed capacity, because of the general deterioration of the facilities. A rehabilitation and up-rating project is currently underway with the financial assistance of the World Bank, ODA, etc., with completion in 1993. Following the completion of this project, the total installed capacity will increase to 180MW.

Fig. 2-2 shows the locations of the power stations and the national power grid.

Table 2-4 UEB's Power Generating Facilities and Current Operation

Type	Plant location	Unit size (MW)	Number of facilities	Total installed capacity (MW)	Annual energy supply (GWh) (1989)	Commis-sioning Dates	Remarks
Hydro	Owen Falls	15	10	150.00	660	1954~1968	- output as of 1991 : some 90MW
	Kabale	0.25	2	0.50	—	1963	- out of order
	(Sub-total)			150.50			
Diesel	Arua	0.35	2	0.70		1989	
	Kabale	0.35	2	0.70		1989	
	Kapchorwa	0.14	1	0.14		1989	
	Kitgum	0.25+0.14	2	0.39		1989	
	Moroto	0.35+0.25	2	0.60		1989	
	Moyo	0.14	1	0.14		1989	
	Rukungiri	0.25+0.21	2	0.46		1989	
	(Sub-total)			3.13	1.13		
Total				153.63	661.13		

(Source: UEB)

Some 76% (503GWh) of the power generated by the Owen Falls Power Station (660GWh) in 1989 was consumed in Uganda and the remainder (some 24%: 157GWh) was sold to Kenya. The consumption by the Kampala area was some 400GWh (60%).

The electrification rate as of January, 1991 is some 40% for Kampala and 4% for Uganda as a whole.

(2) Transmission Facility

The power generated by the Owen Falls Power Station is transmitted by 132KV, 66KV or 33KV overhead power lines. The trunk 132KV national grid has an aggregate length of 1,009km covering the north, west and eastern parts of Uganda. Fig. 2-2 shows Uganda's national grid.

The 132KV transmission line to Kenya joins the Kenyan grid via the eastern city of Tororo.

Such substations as Kampala North and Lugogo are located in the vicinity of Kampala to step down the voltage from 132KV to 33KV or 11KV for further distribution.

The rehabilitation and improvement of the transmission lines have been in progress since 1988 and a total length of 60km (33KV) was rehabilitated by 1990 together with the new construction of an additional 36km.

Another project to construct a 33KV transmission line of some 600km for the electrification of local areas has also been in progress since late 1989 with the financial assistance of EEC.

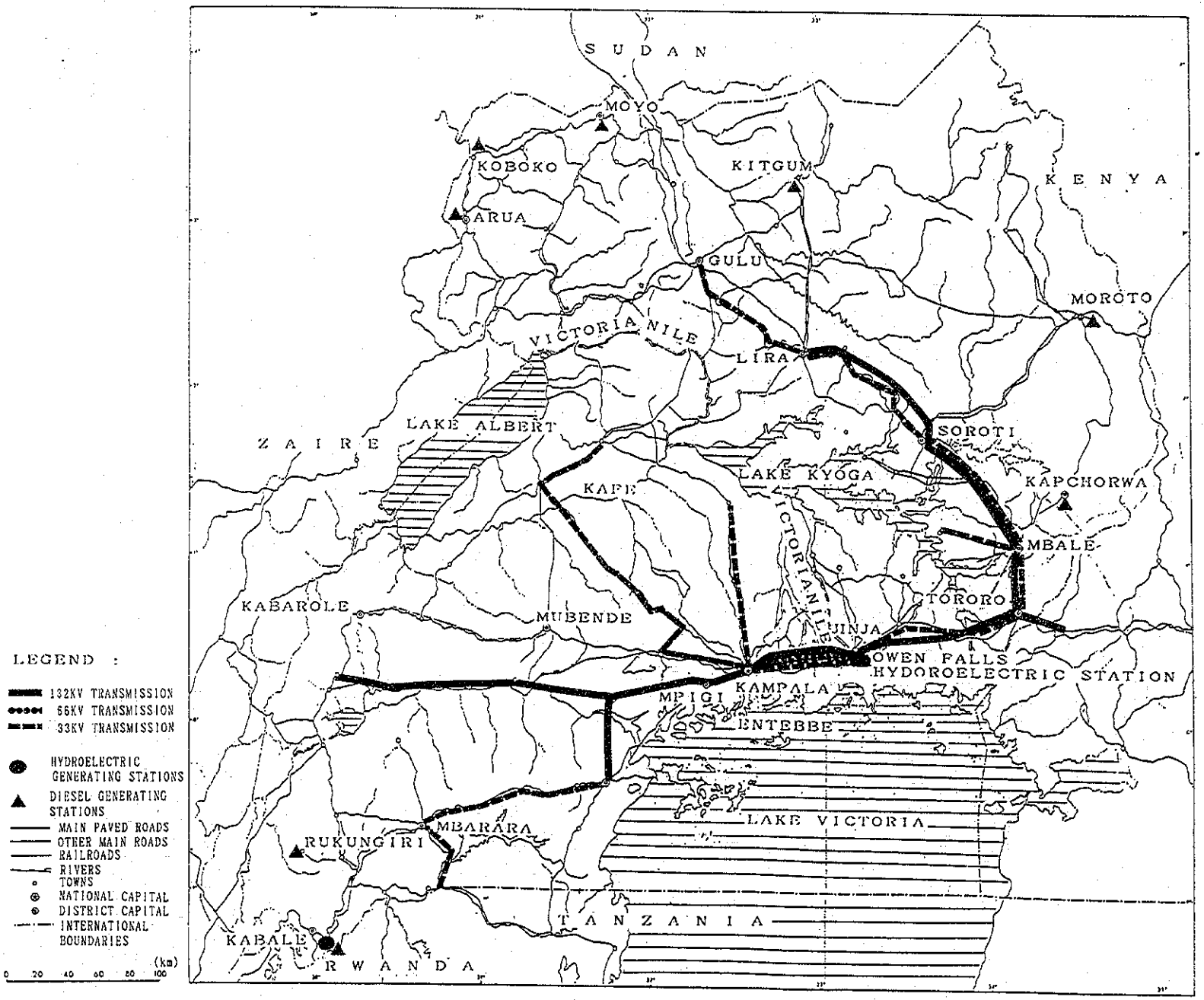


Fig. 2-2 Location Map of Transmission Lines of Uganda

SOURCE : UEB

2-3 Related Plan and Programme

2-3-1 National Development Plan

The 10 Year National Development Plan (1981 ~ 1990) has been the basis of the long-term development initiative in Uganda with the objectives designed to urgently remove constraints on the Ugandan economy. The following objectives of the 10 Year Plan have been continuously pursued following the end of the period.

(1) Control and elimination of conditions of insecurity that have plagued the country over the past decade.

(2) Provision of a strong and effective political leadership and the re-establishment of a strong, efficient and well-equipped civil service to run the central, district and municipal administrations.

(3) Rehabilitation and reconstruction of the shattered economy as a necessary condition for increasing production in the agricultural, livestock, manufacturing, mining and tourism sectors, and reducing the current level of inflation.

(4) Provision of adequate infrastructure facilities, especially transport, marketing, and processing facilities as essential support to increased production.

(5) Rehabilitation of the existing facilities in the social services sector, i.e., health, water supply, eduction, government houses and public administration.

(6) Rehabilitation of physical infrastructure, i.e., roads, bridges, railways, power stations and telecommunication systems.

In addition, the Rehabilitation and Development Plan has been prepared every 2 years to achieve the above objectives based on the discussions on the Structural Adjustment Facility with World Bank, etc. The latest plan was announced in December, 1989 to cover the period from 1988/89 to 1991/92 which gives the following priority targets.

(1) Acquisition of agricultural machinery and other agricultural inputs as well as animal drugs.

(2) Repair of both trunk and feeder roads.

(3) Acquisition of commercial vehicles, especially trucks and railway rolling stock.

(4) Rehabilitation of public utilities and water supply.

(5) Rehabilitation of priority industries.

The same plan suggests the 6 measures listed in Table 2-5 below for implementation by the Ugandan energy sector to achieve the above priority targets. The most urgent measure is considered to be the rehabilitation of the existing transmission and distribution networks.

Table 2-5 Measures to be Implemented by Energy Sector Suggested by Rehabilitation and Development Plan (1988/89 ~ 1991/92)

No.	Strategy
1	Rehabilitation of the existing hydro-electric installations, transmission lines and distribution networks.
2	Improvement of the efficiency of the use of petroleum products in industry and transport
3	Improvement of the efficiency of wood as a household fuel and development of new sources of wood fuels for urban areas and for agro-industries.
4	Promotion of the development and use of renewable sources of energy.
5	Expansion of exports of hydro-electric power to neighboring countries.
6	Acceleration of the programme for urban and rural electrification.

(Source: Rehabilitation and Development Plan 1988/89 ~ 1991/92)

2-3-2 Development Plans for Power Sector

UEB has been conducting the nationwide rehabilitation and upgrading of the power facilities with the assistance of various organizations, including the World Bank, EEC and IDA, etc., since the 1960's. In more recent years, its efforts have coincided with the objectives of the National Development Plan described in 2-3-1. The main power development projects, their history and status are shown in Fig. 2-3.

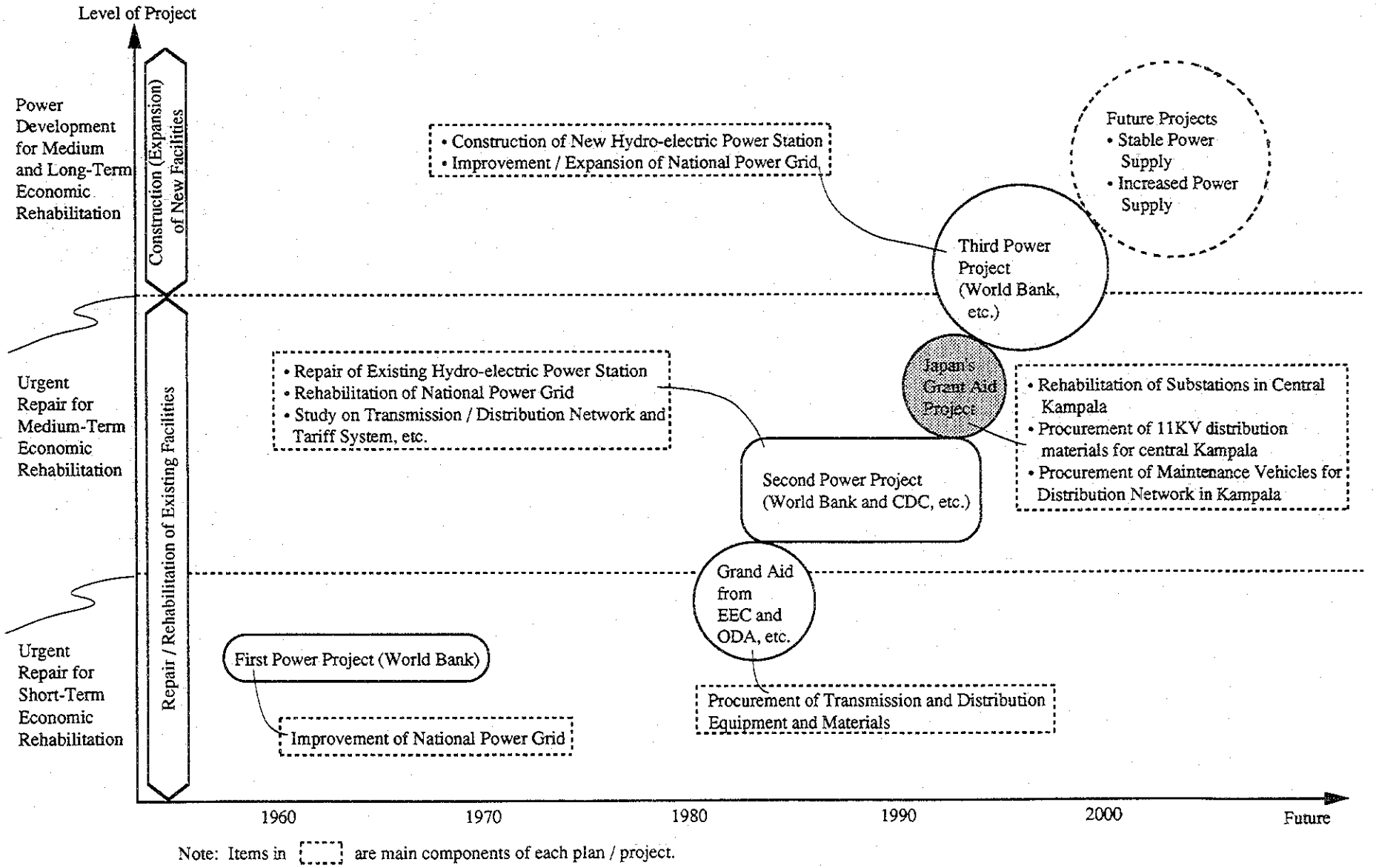


Fig. 2-3 Main Power Development Projects in Uganda and Their Relationship with the Project

As Fig. 2-3 shows, the Second Power Project is currently being implemented in Uganda with the assistance of the World Bank and CDC, etc.

The implementation period of this Second Power Project was originally planned from 1985 to 1987 with a total loan of 83.9 million dollars, aiming at the urgently required rehabilitation of power facilities from the perspective of the medium-term recovery of the Ugandan economy. The main contents of this Project were the rehabilitation of the Owen Falls Hydro-electric Power Station as well as the existing power transmission and distribution networks. The commencement of this Second Power Project, however, was delayed by 3 years and, in 1989, it became necessary to revise the project contents due to the substantial financial shortfall caused by price increases, exchange rate changes and other reasons. UEB had no choice but to select particularly urgent targets for the Second Power Project and to restructure the Second Power Project in line with these selected targets for quick completion. The components of the Second Power Project which have some bearing on the Project (Japan's grant aid) are outlined in Table 2-6.

The Government of Uganda believes that the implementation of a power project which aims at generating foreign income by the sale of power to neighboring countries and assisting the medium and long-term rehabilitation of the national economy is essential in order to improve the increasingly tight economic situation and has accordingly prepared the Third Power Project together with a request to the World Bank and other organizations for the provision of a loan of 260 million dollars. The main objectives of the Third Power Project are the construction of a new hydro-electric power station and the expansion and upgrading of the national power grid.

The Project (Japan's grant aid) intends the rehabilitation of those substation facilities which were originally included in the Second Power Project as facilities designed to provide power to central Kampala as part of the capital's power transmission and distribution networks but which were subsequently dropped due to financial problems.

The implementation of the Project is expected to establish not only the urgent rehabilitation of the power facilities envisaged by the Second Power Project but also to secure the basis for the Third Power Project which aims at the development and consolidation of power facilities for the medium and long-term rehabilitation of the national economy.

The future electricity network plan for Kampala is provided by the Design Report, Rehabilitation of Electricity Network 1989 prepared by the German consultant, Lahmeyer (hereinafter referred to as Design Report 1989). This report is considered to provide the basic plan for the power distribution network in Kampala.

Table 2-6 Outline of Second Power Project (related to the Project)

Name of Project	Proposed Financier	Expected Year for the Works	Specification of Project
132/33/11 KV Kampala North Substation	World Bank	1991 ~ 1992	• 132 KV feeder (1) • Rehabilitation of 132 KV outdoor switchgear • 33 KV switchgear (8 bays) • 11 KV switchgear (15 bays) • Rehabilitation works for existing electrical installations and civil works
132/66/33/11 KV Lugogo Substation	World Bank	1991 ~ 1992	• 132 KV consisting of 1 feeder and busbar system • 33 KV switchgear (10 bays) • 11 KV switchgear (16 bays) • Capacitor bank 33 KV 5 MVAR (1) • Construction of substation buildings
132/33 KV Mutundwe Substation	World Bank	1991 ~ 1992	• 132 KV feeder (2) • 33 KV switchgear (10 bays) • 11 KV switchgear (5 bays) • Capacitor bank 33 KV 5 MVAR (1) • Construction of substation buildings
33/11 KV Kireka Substation	World Bank	1991 ~ 1992	• 33 KV switchgear (4 bays) • 11 KV switchgear (7 bays)
33/11 Port Bell Substation	World Bank	1991 ~ 1992	• 33 KV switchgear (5 bays) • 11 KV switchgear (8 bays) • Related civil works and cable connections
11 KV Kitante Road Substation	World Bank	1991 ~ 1992	• 11 KV switchgear (8 bays) • Related civil works and cable connections
33/11 KV Gaba Substation	World Bank	1991 ~ 1992	• 33 KV switchgear (6 bays) • 11 KV switchgear (8 bays) • Related civil works and cable connections
11 KV Underground cable system rehabilitation	World Bank	1990	• approx. 10 km underground cable system rehabilitation in Kampala
132 KV Overhead Lines Construction	World Bank	1990 ~ 1991	• approx. 5.5 km single circuit from Kampala North to Lugogo • double circuit at Mutundwe
33 KV Overhead Lines Construction	World Bank	1990 ~ 1991	• approx. 9.0 km single circuit from Lugogo to Gaba • approx. 10.0 km single circuit from Gaba to Port Bell • approx. 3.0 km single circuit from Kireka to Lugogo • approx. 2.0 km single circuit for rearrangement of Mutundwe
SCADA	Scandinavian Countries	1991	• Construction of SCADA system

UEB has since reviewed the Design Report 1989 and has proposed changing some connections of the 33KV transmission lines to establish total linkage within the distribution network following the removal of the Kampala South Substation (33KV), the deterioration of which is particularly noticeable. UEB's revision of the Design Report 1989 aims at improving the further reliability of the transmission and distribution networks to secure a stable power supply.

The proposed change of the 33KV transmission line linking the Queensway Substation will affect the Project. The construction projects for the transmission and distribution networks to be linked to the Queensway Substation are shown in Table 2-7.

Fig. 2-3 shows the position of the subjected substations of the Project in the Kampala Transmission Network which is planned by UEB.

UEB has asserted that, following the implementation of the revised plan, there will be no alteration of the data relating to the bus capacity (33KV: 2,000A; 11KV: 2,000A) and the system fault level (33KV: 16KA; 11KV: 20KA), etc., with which UEB provided the Study Team as the basic design conditions for the Project (see 5-2).

Table 2-7 Construction Projects for Transmission Lines to Queensway Substation

Project	Finance Source	Planned Completion
Construction of 33KV transmission lines (2 lines, some 4km) between Mutundwe Substation and Queensway Substation.	World Bank	1993
Construction of 33KV transmission line (1 line, some 3km) between Lugogo Substation and Queensway Substation.	UEB's own funds	1993

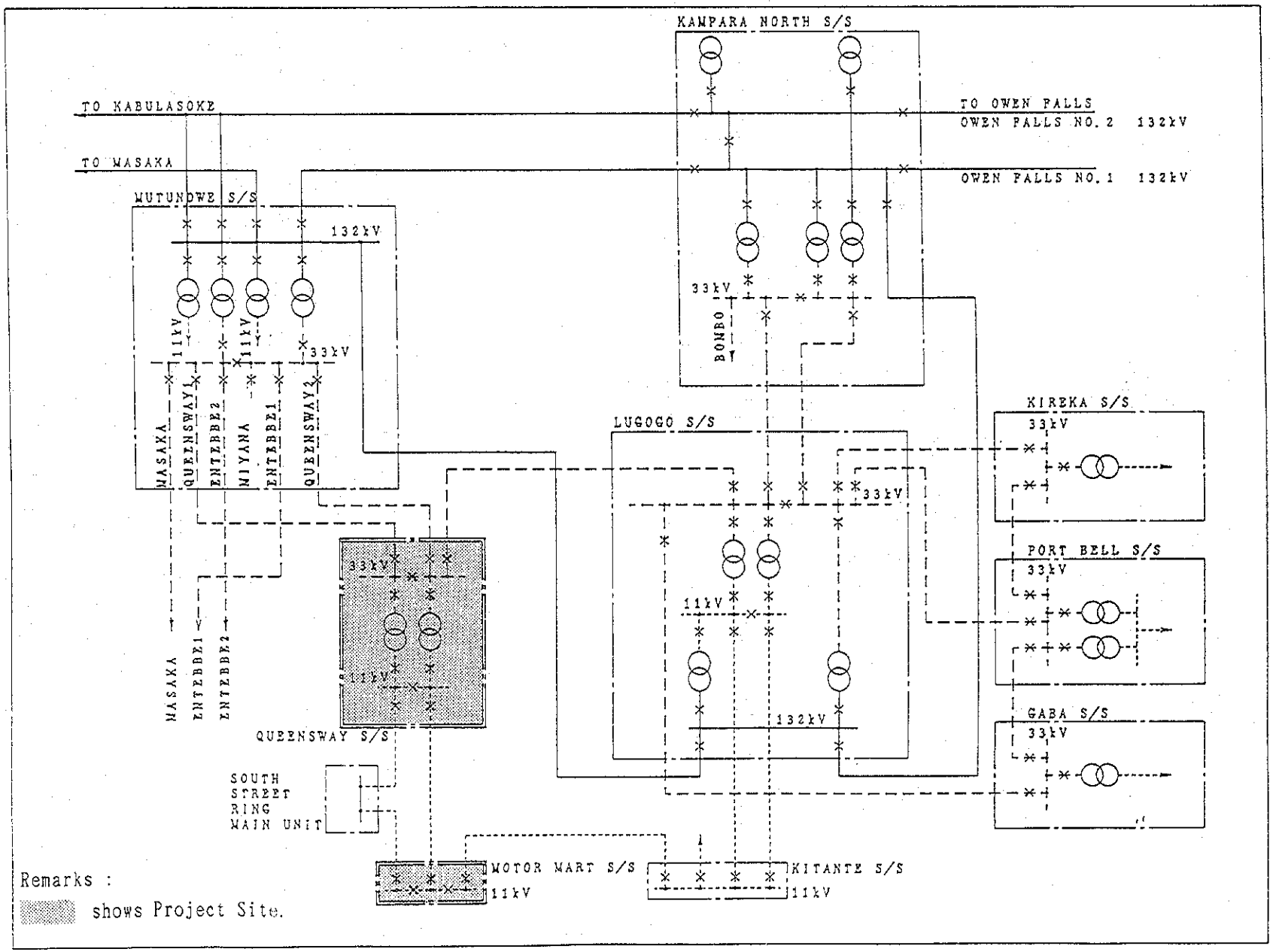


Fig. 2-4 Planned 132/33/11KV Transmission Line in Kampala

Source : U E B

2-3-3 Role of This Project

As described in 2-3-1, the Government of Uganda prepared the National Development Plan which emphasized the rehabilitation and promotion of agriculture and industry to urgently rehabilitate the national economy and to establish self-reliance.

The Project, which aims at the rehabilitation of the power transmission and distribution networks in Kampala, is expected to make a great contribution to catering of the ever increasing power demand and to supporting the reliable operation of such public facilities as hospitals, railways station, post offices and banks, etc. As shown in Table 2-5, the rehabilitation and improvement of the existing transmission and distribution networks has in fact been given top priority in the energy sector in the Rehabilitation and Development Plan (1988/89 ~ 1991/92).

As described in 2-3-2, the objective of the Project is to carry out the rehabilitation plan for the substations and other power facilities in central Kampala, the implementation of which was originally envisaged as part of the Second Power Project aiming at the urgent rehabilitation of power facilities for the medium-term rehabilitation of Uganda's national economy but was later abandoned due to financial problems, and its actual implementation period coincides with part of the Third Power Project.

2-4 Outline of the Request

2-4-1 Background of the Request

The electricity distribution network in Kampala, the capital of Uganda and the country's center for political, economic and social activities, was firstly established in the 1950's and has, therefore, largely deteriorated, resulting in frequent breakdowns of various facilities. In addition, the low transformer capacity of the substations and other factors have made load restriction, i.e., regular power cuts, imperative. The output of the Owen Falls Hydro-electric Power Station, Kampala's main power station, has declined to 90MW (60% of the installed capacity 150MW), hindering socioeconomic activities in the capital. Despite conscious efforts on the part of UEB to maintain the present facilities at a reasonable standard, the reliability of these facilities has declined due to difficulties in procuring spare parts for the old equipment and securing these parts as well as other supplies due to the low level of the country's hard currency reserves. As a result, the electricity supply in the capital has been unstable for some time.

UEB is currently proceeding with a rehabilitation project for the Kampala electricity network, including the rehabilitation of the Owen Falls Power Station, with the financial assistance of the World Bank, the British Government, etc. However, UEB has found it difficult to secure a financial source to improve some parts of the network and substations which are not included in the said project because of the general paucity of public finance in Uganda.

Under these circumstances, the Government of Uganda prepared a plan for Reinforcement of Electric Power Distribution Network in Kampala to fill the gaps left by the ongoing project in order to vitalize industrial, commercial and social activities in the capital by securing a stable electricity supply and made a request to the Government of Japan for the provision of grant aid for this plan.

2-4-2 Contents of the Request

The contents of the request, which were confirmed through the discussions with Ugandan officials, are as follows.

(1) Reconstruction of 33KV and 11KV switchgear for the Queensway Substation.

(2) Reconstruction of 11KV switchgear for Motor Mart Switching Station.

(3) Procurement of 11KV distribution materials for the Project.

(4) Procurement of maintenance vehicles for the Project.

(5) Procurement of underground distribution cable for the section between the Queensway Substation and Motor Mart Switching Station (11KV cable, 185mm^2, 5km).

(6) Procurement of underground transmission cable for connection between the Queensway Substation and Lugogo Substation (33KV cable, 185mm^2, 500m).

(7) Procurement of cable to connect the existing 11KV distribution cables to the new 11KV switchgear cubicle (11KV cable, 70mm^2, 400m).

(8) Procurement of 2 sets of new power transformers for the Queensway Substation (33/11KV, 15/20MVA).

CHAPTER 3 OUTLINE OF THE PROJECT AREA

CHAPTER 3 OUTLINE OF THE PROJECT AREA

3-1 Locations and General Conditions of the Project Area

3-1-1 Locations of the Project Area

Kampala, the capital city of Uganda, is located in the central south of the country, facing Lake Victoria. It is located in an area characterized by hills with gentle undulations and has spread over 7 hills of some 100m in height with the central part of the city located on Nakasero Hill. The city area is some 160km^2. As of 1990, the estimated population is some 750,000.

The Queensway Substation is located at the lowland between Nakasero Hill and Sambia Hill while the Motor Mart Switching Station is housed in a private building in the city center on the south slope of Nakasero hill, facing Kampala Road.

The locations of both station in Kampala are given in the map at the beginning of this report.

3-1-2 Present Status of the Subject Substations

(1) Queensway Substation

1) Location

As shown on the Location Map, the Queensway Substation is located some 1.5km south of central Kampala. It belongs to the 33KV looped transmission network in Kampala and steps down the voltage from 33KV to 11KV to supply the city center with 11KV distribution network.

As described aforesaid section 2-3-2, it currently receives 33KV power from the Kampala South Substation but will soon switch to the Mutundwe Substation to be completed under the Second Power Project.

2) Layout of Facilities

The layout of the facilities at the Queensway Substation is shown in Fig. 3-1. The site area is some 1,600m^2 (46m x 36m) and is generally flat.

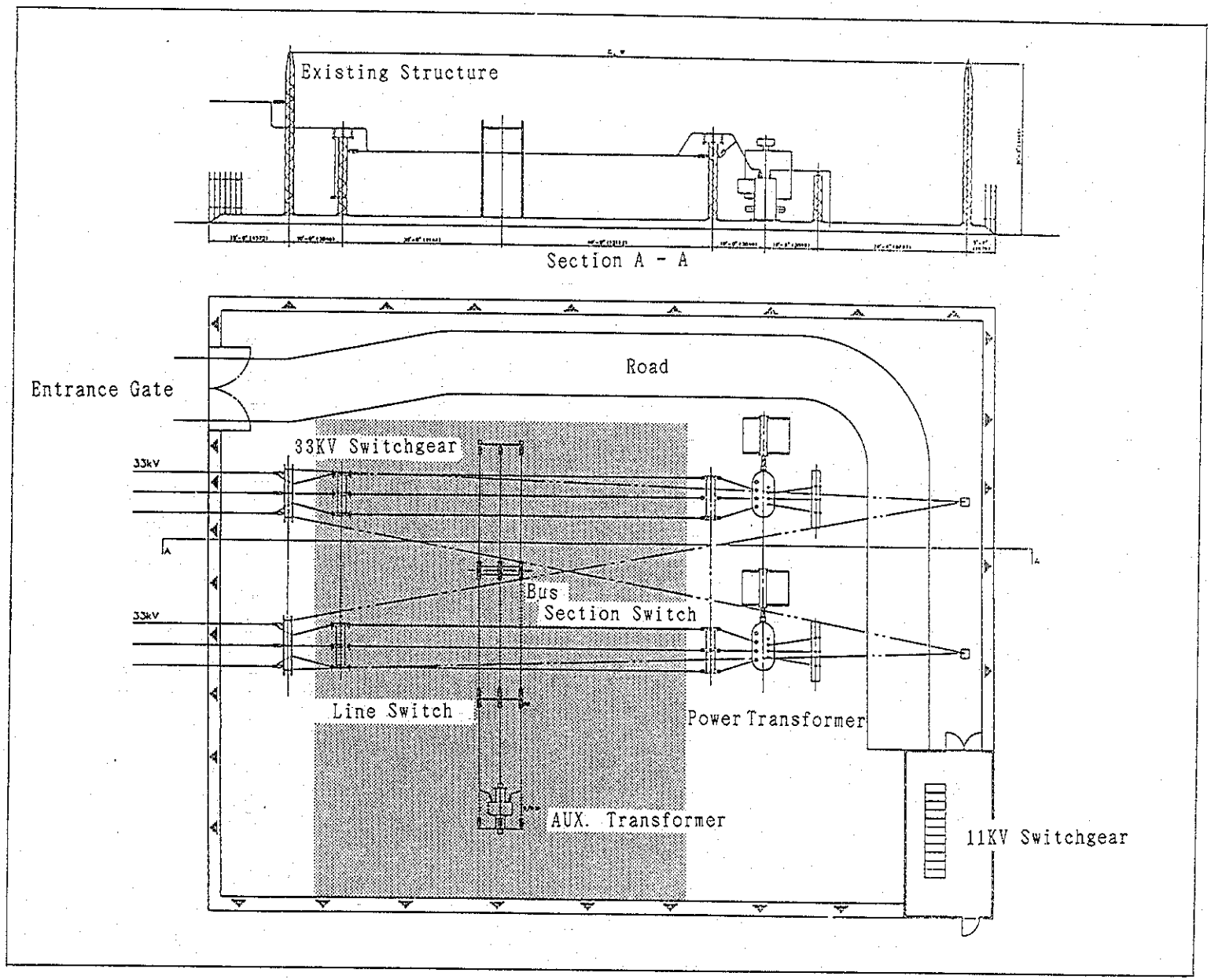


Fig. 3-1 Layout of Existing Queensway Substation

The 33KV transmission lines (2 lines) from the Kampala South Substation enter the site from the south of connection with the outdoor type 33KV line switch. 2 sets of main outdoor transformers (33/11KV, 10/14MVA) are installed at the center of the site. The indoor type 11KV switchgear cubicle is located in the plant house made of concrete at a corner of the site.

3) Current Conditions of Facilities

① Main Equipment

The main equipment of the Queensway Substation is as follows.

a) 33KV overhead coupling bay

Including:
- 2 sets : 33KV transmission line switch (manual)
- 1 set : 33KV bus bar coupling switch (manual)

b) Outdoor type power transformers

- 2 sets : 33/11KV 10/14 MVA (ONAN/OFAF)

The mechanical protection for the transformers is composed of the following:

- Buchholtz relay
- Winding temperature detector for both 33KV and 11KV sides
- Oil temperature detector

c) 11KV indoor type switchgear cubicle (with an oil circuit breaker), 11 sets

Including:
- 2 sets : Transformer feeders
- 1 set : Bus coupling
- 8 sets : Line feeders

d) 33KV/433V outdoor type station auxiliary transformer, 1 set

② 33KV Transmission Line

While a line switch is provided for the 33KV incomming lines to switch off the 33KV circuit, no circuit breaker is installed to protect the transformers. If any abnormality of the circuit occurs on the site due to an earth fault or short circuit (caused by contact by small animals, such as birds), the circuit breaker at the Kampala South Substation (some 2.5km distance from the Queensway

Substation) is tripped. As a result, any accident at the Queensway Substation cannot be swiftly dealt with.

The pilot wire relay system which was installed to protect the 33KV transmission line is not functioning properly, failing to provide a safe working environment for the operation and maintenance staff.

③ 11KV Distribution Lines

The normal functions of the 11KV switchgear with an oil circuit breaker (made in 1984) cannot be maintained at present due to the following reasons:

- oil leakage from the oil circuit breaker
- difficulties in obtaining spare parts due to the models of the switchboard equipment being old
- deterioration of equipment functions caused by flooding in the area during heavy rain which inundates the lower parts of the equipment.

④ 33/11 KV Power Transformers

The power transformers are not functioning at full capacity because of the following reasons:

- leakage of insulation oil
- malfanction of the on-load tap changer
- malfanction of the cooling fan
- malfanction of the oil and winding temperature detectors
- damage to the bushing (33KV side)
- damage to and corrosion of the painted parts

In particular, the damaged on-load tap-changer causes unstable energy supply to the consumers fluctuating voltage as well as difficulties in parallel operation of both transformers for stable power supply. Damage to the bushing makes it impossible to maintain the normal insulation distance of the equipment, creating a dangerous situation where the damaged equipment insulation could lead to an earth fault.

According to the Design Report 1989, the present transformation capacity is capable of handling the power demand in the year 2000. The maximum power demand in February, 1991, however, already recorded 28.8MVA by UEB, implying that an increase of the transformer capacity during the transitional

period upto 1995 when the Second Power Project will be completed is an urgent necessity.

4) Project Site

It is necessary that power cuts be kept as short as possible in the course of the implementation of the Project in order to minimize adverse effects on local residents. As there is not sufficient vacant space on the present premises to accommodate new facilities, however, the existing station transformer will be relocated and the existing 33KV aerial bus will be substituted to secure the Project site. The use of temporary cable will allow the continued operation of the substation with minimum disturbance during the Project implementation period.

The Design Report 1989 suggests raising the ground by 1.5m for the new facilities to avoid damage due to flooding during the rainy season. The new facilities envisaged under the Project should also be constructed on similarly raised ground.

The station auxiliary transformer which exists on the Project site at present will be moved by UEB to avoid any adverse effects on the new facilities before the commencement of the work of the Japanese side.

(2) Motor Mart Switching Station

1) Location

The Motor Mart Switching Station is located in a private building (called Insurance House) in the city center as shown on the Location Map at beginning of this report.

The Motor Mart Switching Station receives 11KV power supply from the Queensway Substation by 2 lines and distributes 11KV power to commercial, industrial, public and government facilities in the city center. The main facilities receiving power from the Motor Mart Switching Station are as follows:

- General Post Office
- Kampala Station
- Commercial Bank of Uganda
- Ministry of Energy and UEB building, etc.

2) Layout of Facilities

The facility layout of the Motor Mart Switching Station is shown in Fig. 3-2. All the equipment is indoor type equipment which is installed in the plant house in the Insurance House.

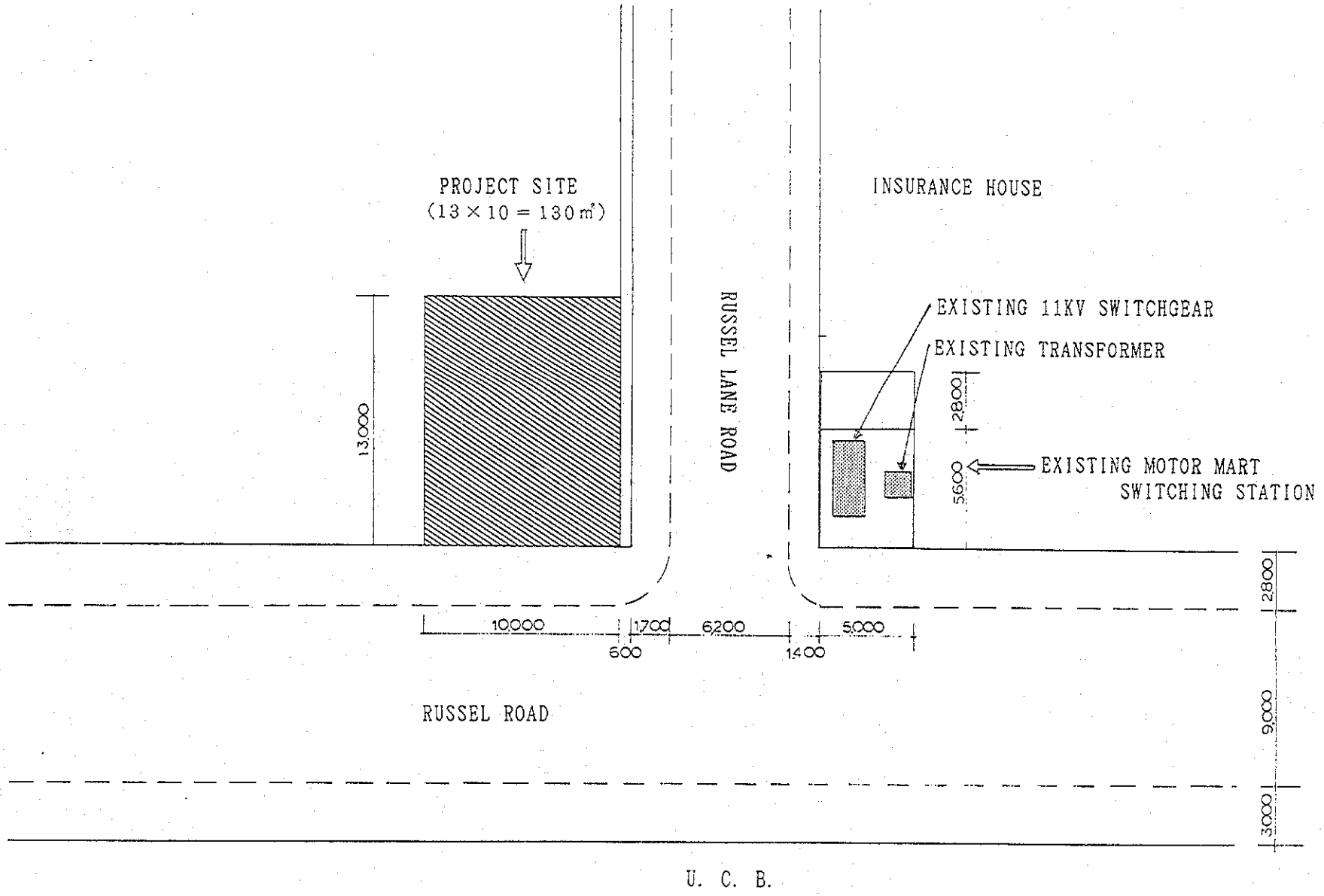


Fig. 3-2 Layout of Existing Motor Mart Switching Station

The wire armoured cables are used and are buried directly underground for power distribution from the Station.

3) Current Conditions of Facilities

The Motor Mart Switching Station consists of an 11KV indoor type switchgear cubicle (with an oil circuit breaker) and an 11KV/433V transformer. The switchgear is composed of the following:

2 : 11KV incoming feeder (connection to the Queensway Substation)

5 : 11KV outgoing feeder

1 : transformer feeder

All the equipment at the Motor Mart Switching Station was installed in the 1950's and is, therefore, fairly deteriorated. The oldness of the equipment also makes it difficult to obtain spare parts, resulting in adequate maintenance of the equipment. In addition to oil leakage from the oil circuit breaker, some instruments are not functioning properly, resulting in unstable power distribution form the Station.

4) Project Site

UEB has long been requested by the owner of the building to move the Motor Mart Switching Station and has already secured land located some 20m from the present site which is part of an open carpark site owned by the central government but administrated by the Kampala city council by paying rent since 1989. This site has an area of 130m^2 (13m x 10m). Fig. 3-3 shows the urban development plan prepared by the Kampala city council for the area surrounding the project site.

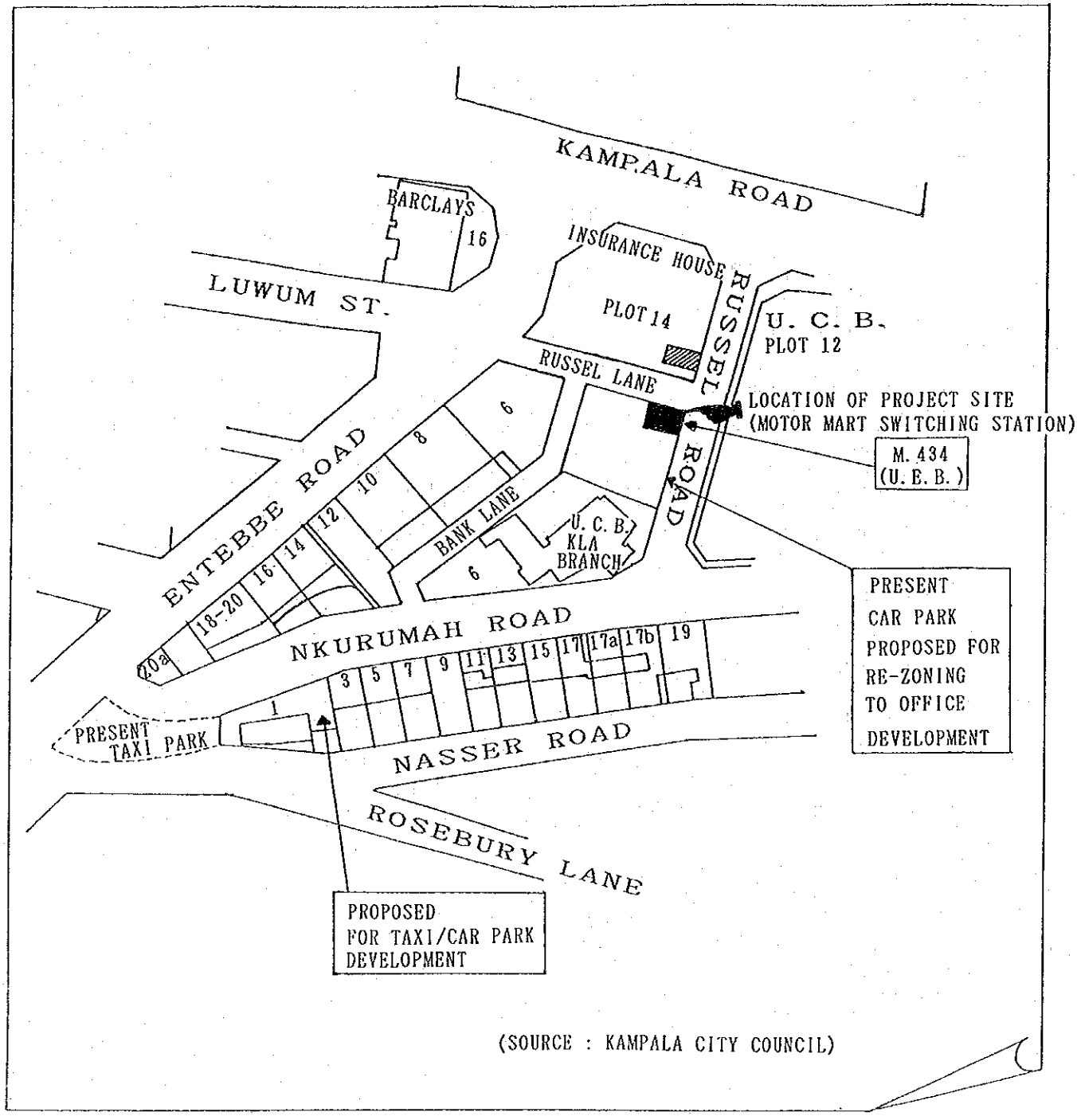


Fig. 3-3 Urban Development Plan Prepared by Kampala City Council Surrounding the Motor Mart Switching Station

3-1-3 Present Status of Subject Distribution Network

(1) Current Conditions

Many sections of the 11KV distribution network in Kampala were originally constructed in the 1950's and are prone to accidents due to general deterioration, causing unstable and dangerous power supply operation. The provision of a stable power supply in Kampala, therefore, requires the repair and improvement of the existing distribution network and the renewal of facilities and equipment.

The main problems currently faced by UEB can be listed as follows:

1) Deteriorated functions of facilities

2) Inadequate maintenance and worsening of maintenance efficiency caused by shortage of spare parts and maintenance vehicles

3) Increased power demand following rapid population growth

4) Distribution network accidents caused by fast growing trees along lines

5) Accidents, such as contacts with distribution lines, caused by construction of poor quality houses

6) Increased overload operation of distribution transformers

7) Deterioration of underground distribution cables

8) Rotteness of wooden poles due to aging

(2) Organization of Maintenance Control

The maintenance of the 11KV distribution network in Kampala by UEB is conducted under the following responsibilities shown in Table 3-1.

Table 3-1 Distribution Network Maintenance Assignments in Kampala

	Routine Maintenance	Equipment and Material Control
Section Responsible	UEB Kampala District Office	Store Department in Lugogo
Person Responsible	Senior District Manager	Depot Manager in Lugogo
Number of Workers	245	70

(3) Current Conditions of 11KV Distribution Materials

Inventory control of the distribution materials is systematically conducted by the Store Department in Lugogo using a log book, materials code system, etc. Some materials, such as poles and insulators, were donated by past projects involving such organizations as EEC, ODA, etc.

The inventory levels of most materials for which the Government of Uganda has requested Japan, including cork sheet (to be used as a gasket for transformers), and surge arrestors, etc., are either low or negligible, demanding an urgent response. The inventory levels (as of February, 1991) of the materials requested by the Government of Uganda for the 11KV distribution network are shown in Table 4-1.

(4) Current Conditions of Maintenance Vehicles

UEB Kampala District Office which is responsible for the maintenance of the distribution network in Kampala employs 245 people and owns 23 maintenance vehicles, i.e., 20 sets of 4-wheel drive vehicles, 2 sets of lorry and 1 set of self loading lorry. Most of these vehicles have such problems as broken instruments, broken front window glass and malfunctioning hydraulic devices of the lorry. In addition to the deterioration and the shortage of spare parts, the excessive use of the small number of reliable vehicles is believed to have accelerated the deterioration of the vehicles. UEB reports a shortage of fully functional vehicles vis-a-vis the required work load. The mileage of some vehicles exceeds 150,000km in 4 years due to the excessive reliance on the better maintained vehicles.

This situation has made it difficult for UEB to have sufficient mobile capability to properly maintain the distribution network and UEB is finding it almost impossible to conduct proper maintenance of the entire distribution facilities and network as well as to swiftly respond to accidents involving a distribution facility.

Many of the vehicles which are out of use due to aging and the lack of spare parts are left unattended in the garages. UEB says that these vehicles are often cannibalized to provided spare parts for other broken-down vehicles so that the latter can be made operational.

3-2 Natural Conditions

3-2-1 Climate

Uganda is located between 1°30"S lat. and 4°N lat. and has a virtually consistent temperature throughout the year. Despite being right at the equator, Uganda's climate is rather mild because of its high elevation. Kampala has an elevation of some 1,300m and the city enjoys a good climate with relatively small temperature fluctuations due to its location next to Lake Victoria. According to meteorological statistics for the period between 1931 and 1954, the mean monthly maximum temperature ranges from 25°C to 28°C while the mean monthly minimum temperature ranges from 16°C to 18°C.

Uganda has 2 rainy seasons, i.e., the main rainy season from March to May and the minor rainy season from September to November. Mean monthly rainfall of 50 ~ 60mm is recorded in the dry seasons, totalling a relatively high mean annual rainfall figure of 1,180mm. The mean monthly temperatures and rainfall are shown in Table 3-2.

Table 3-2 Mean Monthly Temperatures and Rainfall

	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean Annual
Maximum Temp. (°C)	28.4	28.3	27.5	26.1	25.4	25.2	25.1	25.6	26.6	27.2	27.2	27.2	26.7
Minimum Temp. (°C)	18.1	18.1	18.0	17.6	17.5	17.2	16.5	16.4	16.6	16.9	17.3	17.4	17.3
Rainfall (mm)	51	62	113	182	140	75	50	86	101	109	114	97	1,180

Source: Department of Meteorology, Statistics 1931 ~ 1954

3-2-2 Thunderstorms

A strong ascending current is often generated as the air near the ground is heated by the strong sunshine at the equator. This hot air is then cooled down to cause rain which is sometimes accompanied by strong wind and/or thunder. The phenomenon where rain is accompanied by thunder is called a thunderstorm. According to Statistics of the department of meteorology, 14 ~ 23 thunderstorms a month occur in Kampala. The frequency of thunderstorms in the dry seasons is somewhat lower than that in the rainy seasons and the average annual occurrence of thunderstorms is as high as 222.

The wind velocity is observed twice a day at 06:00 and 12:00 (GMT). The mean monthly wind velocity is reported to be 4 ~ 9 knots. Strong local winds tend to occur

with the thunderstorms and the strength is basically determined by the scale of a particular thunderstorm.

3-2-3 Earthquakes

The African Rift Valley runs south from the Red Sea through East Africa to the Mozambique Channel. Around Uganda, it splits into the Eastern Rift Valley and the Western Rift Valley with Lake Victoria in-between. The Western Rift Valley runs along the border between Uganda and Zaire where there have been many earthquakes (based on observation results between 1950 and 1989). The largest magnitude to be recorded is 6.9 on the Richter scale in 1966. In south Sudan, which is part of the Western Rift Valley, and large earthquake with a magnitude of 7.5 occurred in 1990.

Few earthquakes have been reported inland although a small earthquake (magnitude: 3.8) occurred near Kampala in 1960 in addition to an earthquake (magnitude: 5.7) which occurred at Masaka, a city located some 80km southwest of Kampala.

Since Kampala is a distance of some 250km from the Western Rift Valley which has potential for a large earthquake, the danger of Kampala being hit by a large earthquake appears to be low.

3-2-4 Geology

The predominant rocks in the area are schist and gneiss which were metamorphosed from granite in the Pre-cambrian era. Phyllite and shale are distributed in the western part of the country, containing copper, tin, tungsten and beryllium. Magnetic iron ore generated in the Cretaceous period, rock phosphate and limestone are distributed in the eastern part of the country. Rock phosphate used by the superphosphate industry and limestone by the cement industry are produced in the Tororo region. The soil in the Kampala area is mainly brown loam due to the inclusion of iron and is very compact, making it possible to observe a some 10m high vertical face.

3-3 Infrastructure

3-3-1 Ports

Uganda is a landlocked country and, by definition, has no port facing an ocean. It uses Mombassa in Kenya for its external trade. Mombassa has 2 ports, an old port and a new port. The old port is called Port Mombassa while the new port is called Kilindini Port. The latter is a major port with 13 general cargo piers (2,448m in length) and 3 container piers (569m in length). It has 16 - 40 ton class gate cranes and 43 - 5 ~ 40 ton class truck cranes. Kilindini Port is controlled by the Kenyan Port Authority under the jurisdiction of the Ministry of Transport and communications. The size of the Port justifies its use as a landing port for equipment and materials for the Project.

3-3-2 Roads

Uganda has some 8,000km of national roads, of which 2,000km are being paved with asphalt and the remainder with gravel. The road running some 640km across Uganda from Malaba, the border town with Kenya, to Kabale, a city near the Zaire border, via Kampala is called the northern corridor and will form the Ugandan section of the proposed Trans-African Highway.

Import and export goods are transported by trailers and trucks, mainly using the 930km road stretching between Mombassa and the Ugandan border. This road has a single lane in either direction, is mostly paved and in relatively good condition . According to some local haulage companies, some parts of the 40km section between Bungoma in Kenya and Malaba are poorly paved, requiring careful driving. In general, however, the road is considered fine for the transportation of equipment and materials for the Project.

The main roads in Kampala are wide, paved with asphalt and show good maintenance conditions.

3-3-3 Telecommunications

Many of the telecommunications facilities were badly damaged during the civil war in 1979 and were out of operation during the early 1980's. Concentrated rehabilitation efforts commenced in 1986 and the level of telecommunications prior to 1979 has now been restored. At present, a project to improve the telephone network in Kampala is underway with a loan from the World Bank. There is instantaneous international communication and facsimile access between Kampala and Japan.

3-3-4 Living Environment

Uganda is a hilly country with fertile soil. It is warm throughout the year and enjoys annual rainfall of more than 1,000mm. Consequently, Uganda produces many farming products in abundance. These products include such staple foods as bananas, cassava, maize and taro together with vegetables (tomatoes, cucumbers, pumpkins and beans, etc.) and fruit (pineapples and others). The cultivation of coffee, cotton, tea and tobacco which commenced under colonial rule continues today. By and large, the food situation is quite stable.

In the field of housing, while there are some high class residences, many people who avoided the civil war and settled near Kampala live in poor conditions. Moreover, the lives of the people are threatened by the continuing high inflation.

There are 81 hospitals and 105 health centers in Uganda, most of which are concentrated in or near urban areas.

There are several hotels in Kampala but few are equipped with an emergency generator set and telecommunication facilities.

3-4 Outline of the Sector Concerned in the Area

3-4-1 Power Conditions in Kampala

The main power supply source in Uganda is the Owen Falls Hydro-electric Power Station as described in 2-2-3 and Kampala is completely dependent on this station.

Power transmission from the Owen Falls Power Station to Kampala is made by the 132KV line (2 lines, 87km long) to the Kampala North Substation where the voltage is stepped down to 33KV. From the Kampala North Substation, power is supplied to the Kampala South, Queensway and Lugogo Substations using the 33KV transmission ring.

There is another line from the Owen Falls Power Station to the Lugogo Substation (66KV, single line, 80km long) to supplement the above 132KV line. The power transmission and distribution networks by voltage are shown in Table 3-3.

Table 3-3 Power Transmission and Distribution Networks by Voltage In and Around Kampala

Voltage	Destination	Type	Total Length in Kampala	Remarks
132 KV Transmission	Owen Falls Power Station ~ Kampala North Substation	Overhead	—	
66KV Transmission	Owen Falls Power Station ~ Lugogo Substation	Overhead	—	
33KV Transmission	Kampala and its surrounding areas	Overhead	33km	
11KV Distribution	Kampala	Overhead & Underground	Overhead: 130km Underground: 40km	Overhead : ACSR ($80mm^2$ or $100mm^2$) Underground : 11KV Cable $70mm^2$, 3 cores
415V Distribution	Kampala	Overhead & Underground	(see Note)	

Note: The total distribution length of the LV network in Kampala is unknown. However UEB informed the total distribution network length of the whole country in 1990 is 2,368km.

Power supply to consumers is made in the following system.

- High voltage system : 11KV 3-phase 3-wire 50Hz
- Low voltage system : 415/240V 3-phase 4-wire 50Hz

The current tarrif system is based on the meter rate system shown in Table 3-4. UEB considers that the current tariff system cannot sustain the appropriate power supply and is now reviewing it with the assistance of British consultants and others. UEB hopes to double the current energy charge and to quadruple the demand charge for industries and large consumers.

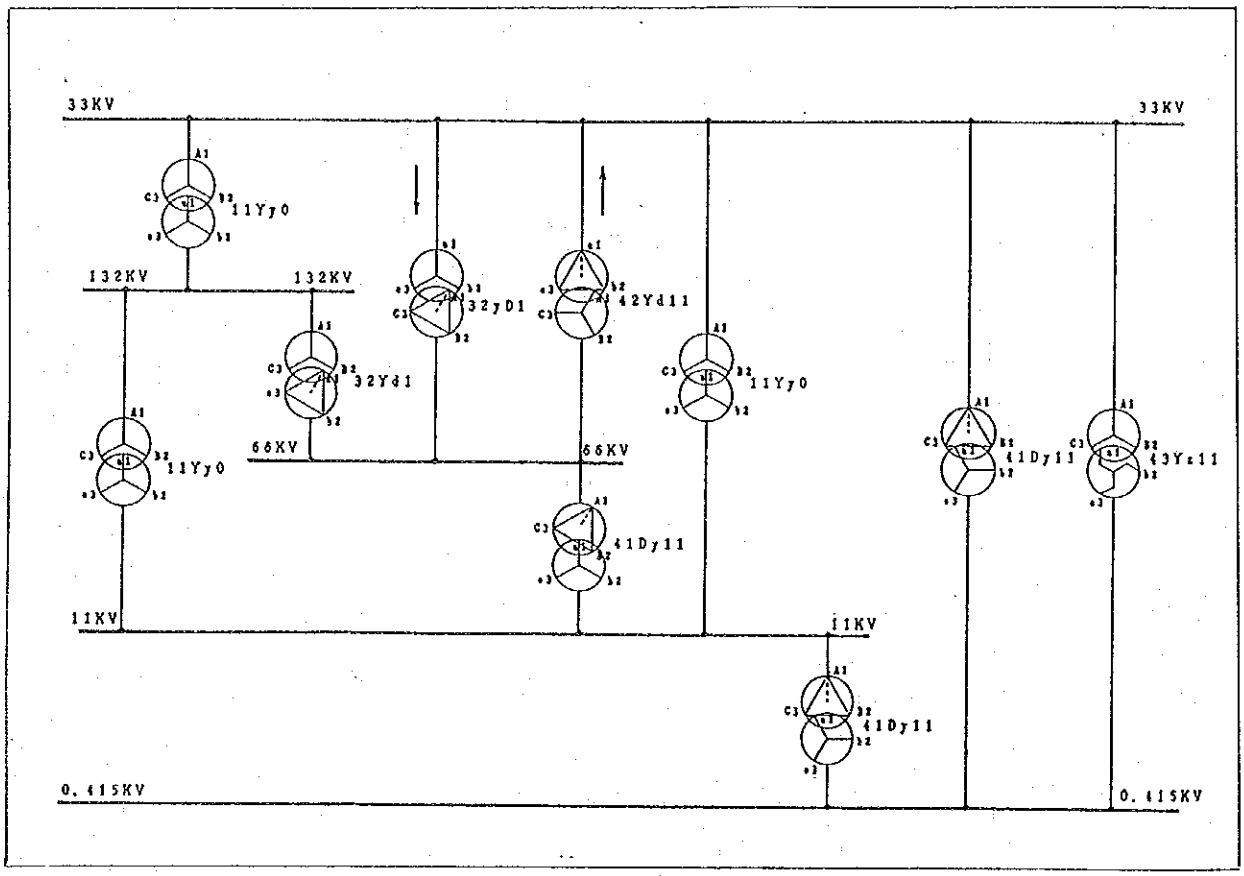
The transformer vector group in different voltage level is shown in Fig. 3-4.

Table 3-4 Current Tariff System

(Unit: Shilling)

Code	Classification of Consumer	Energy Charge per KWh	Demand charge per KVA
1	Domestic	12	—
2	Commercial and Security Lighting	11	—
3	Industrial	7	400
4	General (small industry, office, bank)	7	550
5	Hotels and Clubs	12	—
6	Streetlighting	6	—

(Source: UEB)



(Source: UEI

Fig. 3-4 Vector Group in Different Voltage Level

Most of the substations which connect the ransmission and distribution networks in Kampala are more than 30 years old and are fairly deteriorated. Burning of the transformers and other types of accidents frequently occur due to the lack of appropriate networking protection, inadequate supply of spare parts and overloading. These accidents cause a high level of transmission loss. According to the Design Report 1989, the rate of transmission loss increased from 9.1% in 1981 to 29.1% in 1988 because of overloading of the transmission lines and transformers and inadequate inspection.

Such a large loss naturally causes an unstable power supply. The lack of an appropriate protection system and the shortage of spare parts in particular have made it impossible to detect and repair the causes of power failure. Power cuts lasting for several hours or over ten days are not unexceptional in Kampala, adversely affecting life in the city.

3-4-2 Future Plan and Power Demand in Kampala

(1) Changes in Power Consumption

Changes in Kampala's power consumption between 1981 and 1988 are shown in Table 3-5. Data on the maximum power demand show annual fluctuations which the Design Report 1989 attributes to power cuts caused by breakdowns of the transmission, distribution and/or generation facilities and also to the regular restrictions on power supply due to the insufficient power supply capacity. These fluctuations have made it difficult to examine the power demand systematically. Despite such difficulty, however, the maximum power demand almost doubled in the 4 year period from 1984 (35MVA) to 1988 (69.1MVA). In the 8 year period from 1981 to 1988, the average annual growth rate of the maximum power demand in Kampala was estimated to be approximately 7.7%.

Table 3-5 Energy Consumption in Kampala (1981 ~ 1988)

(Unit: MWh)

Item	1981	1982	1983	1984	1985	1986	1987	1988
Domestic	73,307	77,699	59,309	82,288	75,008	53,799	65,076	101,233
Commercial	25,717	24,087	18,078	13,209	11,130	7,206	7,042	21,173
Industrial	22,818	23,795	24,428	25,599	27,031	3,839	5,957	19,856
Street Lighting	3,308	3,329	3,308	3,308	3,308	3,308	3,308	3,308
Kampala Total	125,150	128,910	105,123	124,404	116,447	68,132	81,383	145,570
% of Uganda Total	43.4	45.1	41.8	43.2	47.7	22.8	24.1	50.2
Uganda Total	288,100	285,600	251,300	287,700	244,100	299,100	338,100	290,100
Max. demand in Kampala (MVA)	41.0	39.8	37.4	35.0	43.3	37.0	52.7	69.1
Load factor (%)	34.8	35.8	32.1	40.6	30.7	21.0	17.6	24.0

(Source: Design Report 1989)

(2) Future Power Demand Forecast and Urban Development Plan

The Design Report 1989 also gives the future power demand forecast for Kampala as shown in Table 3-6. In the table, while the maximum power demand in Kampala for 1988 in 69.1MVA (actual data as of June 1988), it grows to 80.9MVA in 1990 and 140MVA in 2000 with an average annual growth rate of 5.3% between 1988 and 2000.

According to Table 3-6, the maximum power demand at the Queensway Substation will decline from 23.9MVA in 1990 to 16.4MVA in 1995 or 20.9MVA in 2000 due to the

review results of the load sharing among substations taking the improved transmission and distribution networks under the Second Power Project into consideration.

Table 3-6 Maximum Load Demand Forecast in Kampala

Name of Substation	*1988		1990		1995		2000	
	Max. load demand (MVA)	Ratio (%)	Max. load demand (MVA)	Ratio (%)	Max. load demand (MVA)	Ratio (%)	Max. load demand (MVA)	Ratio (%)
Kampala North	27.1	39.2	29.0	35.8	33.5	30.5	44.3	31.6
Lugogo	21.5	31.1	28.0	34.6	31.4	28.6	40.1	28.6
Mutundwe	—	—	—	—	13.9	12.7	17.8	12.7
Queensway	20.5	29.7	23.9	29.5	16.4	14.9	20.9	14.9
Gaba	—	—	—	—	6.8	6.2	7.2	5.1
Kireka	—	—	—	—	3.2	2.9	4.1	2.9
Port Bell	—	—	—	—	4.5	4.1	5.6	4.0
Total	69.1	100	80.9	100	109.7	100	140.0	100

(Source: Design Report 1989)

Note : • This table assumes completion or rehabilitation of Lugogo, Mutundwe, Gaba, Kireka and Port Bell by 1995 under the second power project.
• Data (*) in 1988 shows the actual data as of June, 1988.

The Design Report 1989 gives the following transformer capacities for the 11KV distribution network at the Kampala North Substation and Lugogo Substation.

- Kampala North Substation : 15MVA x 2 (total 30MVA)
- Lugogo Substation : 14MVA x 2 (total 28MVA)

The same report suggests an increase of the above capacities during the Second Power Project to avoid overloading in the coming years.

Table 3-7 shows the estimated changes in the power consumption by consumer types.

Table 3-7 Estimated Changes in the Power Consumption by Consumer Types in Kampala

(Unit: GWh)

Consumer	1988	1990	1995	2000
Domestic	101.2	108.5	149.6	186.5
Commercial	21.2	25.0	36.8	50.0
Industrial	19.8	40.1	52.4	69.3
Street lighting	3.3	3.8	4.6	5.1
Total	145.5	177.4	243.4	310.9

(Source: Design Report 1989)

The Inception Report, Rehabilitation of Electricity Network, 1989 compiled by Lahmeyer (hereinafter referred to as Inception Report 1989) indicates that the present urbanized area of Kampala (160km^2) will increase by 1.7 times to 280km^2 in 2000 as a result of the urban development plan and estimates an annual population growth rate of 5% upto 2000 which is very similar to the estimated power demand growth rate of 5.3%/year.

The 5 industrial areas in Kampala of which the characteristics are given in Table 3-8 appear to have enough room for future development except these small areas in suburban Kampala provided the existing infrastructure is rehabilitated. The Queensway Substation and Motor Mart Switching Station, both of which are subjects of the Project, distribute power to the commercial/industrial area in central Kampala.

Table 3-8 Commercial / Industrial Areas in Kampala and Their Characteristics

Commercial / Industrial Area	Characteristics
1. Central	This is the most developed and important area, forming Kampala's economic center. Much space for future expansion is available and the existing factories have capacity for increased production if required.
2. Southwest	Many medium and small size factory buildings are seen in these 2 areas but few of them are actually in operation. These 2 areas are expected to become the fastest growing areas in the period from the present to 2000.
3. West	
4. Northwest	This is the long-standing industry area. Many factories are spread out in this vast area which is believed to have good potential for development.
5. Suburban (Port Bell, Lujira and Gaba)	These are small areas. The existing sites for future development have already been allocated for the construction of a sedimentation basin for the sewage system and for housing.

CHAPTER 4 OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4-1 Objective

As already described in 3-4-1, the electricity supply situation in the Kampala metropolitan area in Uganda is extremely severe. Both the transmission and distribution networks are particularly deteriorated and the shortage of spare parts and the resulting poor maintenance have led to frequent breakdowns of the service. Moreover, the electricity service is now being operated without appropriate measures to quickly deal with network accidents or to prevent a reoccurrence of such accidents. Consequently, the reliability of power supply has been deteriorated. The economic and social lives in the area, therefore, have worsened.

The Government of Uganda, which is gravely concerned with the situation, has prepared the Second and Third Power Projects with the assistance of the World Bank and other organizations. However, it has found it difficult to prepare a new project with fresh external loans for those substations and some parts of the distribution network which are not included in these power projects due to the general paucity of public finance in Uganda, necessitating the Government of Uganda to urgently seek alternative measures to improve the substations and network.

In view of the above situation, the present Project intends to assist stable life in the Kampala metropolitan area and the proper maintenance of the public facilities by achieving a stable electricity supply for Kampala's economic center. The Project involves such emergency measures to improve the electricity supply which is part of the essential social infrastructure as the construction of a substation and a switching station in central Kampala and the procurement of 11KV distribution materials to maintain the 11KV distribution network connected to the planned substation and switching station. The Project will also provide maintenance vehicles to boost the maintenance level of both the transmission and distribution networks in Kampala.

4-2 Study and Examination on the Request

4-2-1 Study of Project Propriety and Necessity

The transmission and distribution networks in Kampala are suffering from general deterioration and inadequate maintenance due to the shortage of spare parts and other reasons, causing frequent breakdowns of these networks and related facilities which in

turn lead to power cuts which last several hours or over ten days. As a result, public life as well as economic and industrial activities have been severely affected and a breakdown of social life may be the undesired outcome without the urgent implementation of appropriate measures to improve the situation.

As described earlier in Table 3-6, the Queensway Substation and Motor Mart Switching Station, the subjects of the Project, are both located in central Kampala and serve some 30% of the consumers (approximately 37,500 households in 1990).

As they supply electricity to a number of public facilities, including banks, a railway station and the Uganda Central Bank, they command important positions in the socioeconomic infrastructure of the city. Under these circumstances, the urgent implementation of the Project is deemed necessary to allow flexible electricity supply operation to prevent a breakdown of public life in general and economic and industrial activities in particular.

Under these circumstances, the urgent implementation of the Project is deemed necessary to allow stable electricity supply operation to prevent a breakdown of public life in general and economic and industrial activities in particular.

Although the subjects of the Project are part of the overall distribution network plan of the Second and Third Power Projects financed by the World Bank and other organizations, they are not included in these Power Projects because of Uganda's financial difficulties. The implementation of the Project should, therefore, provide further assurance for the successful completion of the power distribution network plan under these Power Projects and should also contribute to achieving the stability and development of the Ugandan economy as well as more stable public life. In view of such beneficial effects, the Project is believed to be appropriate as a Japan's grant aid.

4-2-2 Study of Implementation and Management Plans

(1) Personnel Assignment Plan

The responsible agency of the Project in Uganda is UEB as described in 2-2-1 and the sections directly handling the Project are the Development, Distribution and Administrative Divisions under the leadership of the Deputy Managing Director responsible for technical aspects.

Following the completion of the Project, the new facilities will be operated and maintained by the Kampala District Office (245 employees) of the Distribution Division. This Office is currently operating the existing 132/66/33/11KV transmission and distribution networks and has experience of constructing such networks,

suggesting that it has sufficient technical expertise to run the new facilities. The current staffing level of UEB should be sufficient to maintain the new facilities and the proper use of the new vehicles to be provided under the Project should guarantee swift and appropriate maintenance work.

The 11KV distribution materials will be controlled by the UEB's Store Department in Lugogo (70 employees) as described earlier in 3-1-3. The Store Department Section conducts systematic inventory control using a log book and efficient storage shelves and should be capable of handling the equipment and materials to be provided under the Project.

In short, the present staffing level and organization of UEB will be capable of meeting the new maintenance and inventory control requirements following the completion of the Project.

(2) Study of Maintenance Control Cost

The substation to be constructed under the Project will in principle use maintenance-free equipment to reduce the maintenance burden during operation.

As the existing oil circuit breakers frequently break down, the Project anticipates the use of vacuum circuit breakers which are easy to operate and which are virtually maintenance-free to reduce the maintenance cost.

Despite the introduction of such advanced equipment, preventive maintenance control, such as that described below, will still be essential to prolong equipment life and to improve equipment reliability:

1) Daily inspections

   Visual inspection of equipment appearance, deformation, damage, rust and abnormal instruments, etc.

2) Regular inspections (every 1-2 years)

   More detailed external inspection of equipment's insulation resistance and circuit breaker operation, etc.

3) Detailed inspections (approximately every 4 years)

   Overhaul (if necessary) and/or internal inspection of equipment

The maintenance cost will consist of the personnel cost to conduct the maintenance work and the cost of consumables, including fuses. Assuming that the maintenance

cost will be some 0.2% of the equipment installation cost, the annual outlay will be some 5,400 dollars.

As the above figure is a mere 0.6% of UEB's total maintenance budget of the transmission and distribution division for 1989 of 880,000 dollars (326 million shs converted based on an average exchange rate in 1989 of 1 dollar = 370 shs), UEB should not find it difficult to meet the maintenance cost for the new facilities to be constructed under the Project.

Furthermore, the implementation of the Project will substantially lower the UEB's maintenance cost by reducing the maintenance and repair requirements for the existing power transformer at the Queensway Substation. UEB estimates that the repair cost for the transformer is approximately 32,000 dollars. The installation of the new power transformers will eradicate such repair cost, reducing the overall maintenance cost of UEB.

4-2-3 Study of Relation and Overlapping with Other Aid Plans

As described in 2-3-2, those aid projects which are closely related to the Project are the Second Power Project (currently at the implementation stage) and the Third Power Project (currently at the preparation stage) assisted by the World Bank and other organizations.

While the Second Power Project intends the urgent rehabilitation of power facilities with the objective of achieving medium-term economic reconstruction, the Third Power Project will concentrate on the development of new hydro-electric power stations and the expansion of the national power grid with the objective of achieving medium and long-term economic reconstruction.

The requested contents of the Project are to reinforce the Second Power Project prepared by UEB and the implementation of the Project will coincide with the implementation of the Third Power Project. However, there is no overlapping of the actual contents of the Project and the Second and Third Power Projects.

With regard to the requested 11KV distribution materials and maintenance vehicles, the Ugandan side confirmed with the Study Team that these have not been requested from any other aid organization. Therefore it can be judged that there is no possibility of a dual request.

4-2-4 Study of Component Elements of the Project

The Project basically consists of (1) the reconstruction of the switchgears of the Queensway Substation and the Motor Mart Switching Station, (2) the procurement of distribution materials for the 11KV distribution network and (3) the procurement of maintenance vehicles. These 3 components have the interrelationship shown in Fig. 4-1 and their mutual supplementation will greatly enhance the effectiveness of the Project.

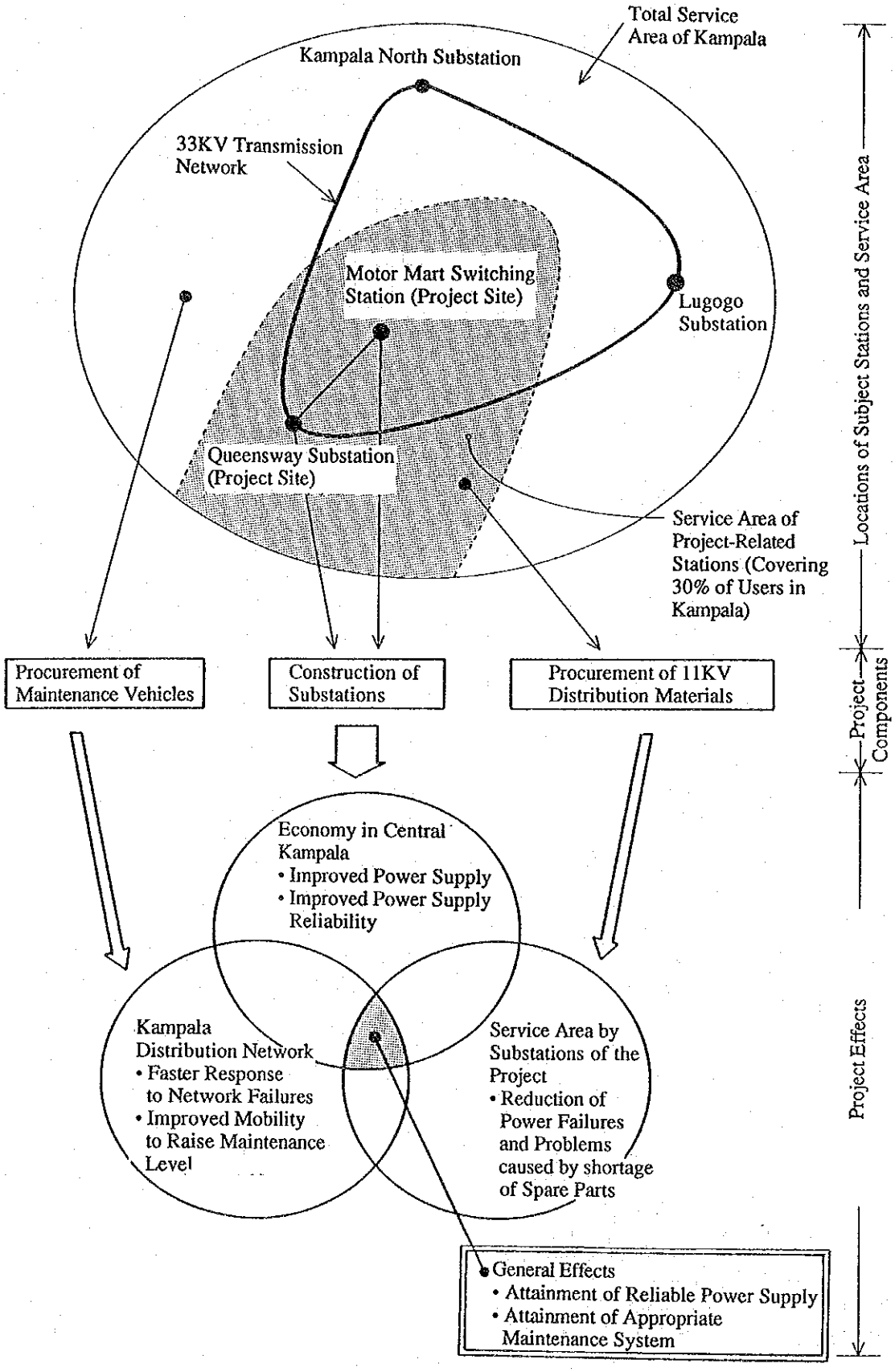


Fig. 4-1 Interrelationship of Project Components

4-2-5 Study of Requested Facilities, Equipment and Materials

(1) Study of Scale of Requested Facilities

The contents of the request of the Government of Uganda are aimed at the rehabilitation of the existing facilities and the planned facilities listed below appear to be the minimum requirements for the rehabilitation of the subject facilities.

① Queensway Substation

- 4 - 33KV line feeders(1 line as spare)
- 12 - 11KV line feeders (4 lines as spare)

② Motor Mart Switching Station

- 3 - 11KV incoming feeders
- 6 - 11KV outgoing feeders (1 line as spare)

The major specifications of the facilities (rated bus capacities: 33KV - 2,000A, 11KV - 2,000A, system fault level: 33KV - 16KA, 11KV - 20KA) meet with the master plan for Kampala's power transmission and distribution networks under the Second Power Project and, therefore, the scope of the requested facilities is deemed appropriate.

Furthermore, the following 5 items which were requested by the Ugandan side (see 2-4-2 (5)~(8)) are considered essential to maintain the normal operation of the new facilities and their procurement under the Project is also deemed appropriate.

① Procurement of underground distribution cable for the section between the Queensway Substation and Motor Mart Switching Station (11KV cable, 185mm^2, 5km).

② Procurement of underground transmission cable for connection between the Queensway Substation and Lugogo Substation (33KV cable, 185mm^2, 500m).

③ Procurement of cable to connect the existing 11KV distribution cable to the new 11KV switchgear cubicle (11KV cable, 70mm^2, 400m)

④ Procurement of 2 sets of new power transformers for the Queensway Substation (33/11KV; 15/20MVA).

The current transformer capacity (10/14MVA) is said by the Design Report 1989 to be sufficient to meet the future demand (upto the year 2000). However, the maximum power demand already exceeded the existing capacity in February, 1991 (see 3-1-2-(1) -3)- ④). Given the above fact and the desirability of maintaining a reserve capacity to

respond to an emergency situation, the adoption of the transformer capacity requested by UEB is deemed appropriate. With the adoption of this capacity, UEB must conduct the study of fault level for the distribution network, etc.

(2) Study of 11KV Distribution Materials

1) Procurement Concept for Distribution Materials

According to UEB, the 11KV distribution material quantities requested by the Government of Uganda will meet the annual maintenance requirements for the entire 11KV distribution network in Kampala and are not subject to any other aid programme.

Table 4-1 shows the quantities, use purposes, categories and current inventory levels (February, 1991) of the equipment and materials requested by UEB and their specifications which were given to the Study Team by UEB are given in Appendix 7.

It is clear from Table 4-1 that the inventory levels of the requested items are almost nil and that those which are in store (such as JPU fuses) fall short of UEB's requirements for one year.

UEB eventually intends to establish inventory levels equivalent to 3 years' supply in order to quickly respond to system failures. Due to financial constraints, however, the immediate target is to secure one years' supply for each fiscal year.

In view of the fact that the Project aims at the urgent improvement of the power supply situation at the heart of Kampala's economic activities as described in 4-1. Also, the subjected substations, i.e., Queensway Substation and Motor Mart Switching Station, supply the energy to the central Kampala. Therefore, the provision of materials equivalent to one years' supply for the 11KV distribution network connected to the Queensway Substaion and Motor Mart Switching Station is deemed appropriate.

2) Procurement Quantities

1 Basic Consideration

Based on the idea of procurement concept for distribution materials as well as the fact that the ratio of the maximum power demand of the Queensway Substation which supplys the energy to the central Kampala is some 30% (29.5% in 1990) of that of Kampala, the provision of 30% of the requested quantities (which

cover the total requirements for entire Kampala) is accordingly deemed appropriate.

② Distribution Transformers and Surge Arrestors

Distribution transformers and surge arrestors (Item Nos.26 - 31 in Table 4-1) are considered to be the most essential equipment to secure a reliable power supply in Kampala. In view of the factors that (1) they are the core equipment for the Kampala distribution network and areas served by damaged equipment are suffering from power cuts due to the lack of reserve equipment and (2) the provision of new equipment will reduce the number of overloading accidents caused by insufficient transformer capacity, the provision of the requested quantities (to cover entire Kampala) is deemed appropriate.

③ Construction Materials

The construction materials (Item Nos.16-24), such as manila rope, stay wire, etc., appear to be available locally or can be substituted by other locally available materials. Consequently, these should be procured by the Ugandan side and will not be provided under the Project.

Table 4-1 Requested Equipment and Materials for 11KV Distribution Network and UEB's Current Inventory Levels

No.	Description	Unit	Quantity	Use Purpose	Category	UEB's Current Inventory Level (February, 1991)
1	JPU Fuse 80A	piece	10,000	A	maintenance & protection materials	4,000
2	JPU Fuse 160A	piece	10,000	A	maintenance & protection materials	4,000
3	JPU Fuse 315A	piece	10,000	A	maintenance & protection materials	2,000
4	JPU Fuse 400A	piece	10,000	A	maintenance & protection materials	1,500
5	HRC Fuse 80A	piece	10,000	B	maintenance & protection materials	2,800
6	Interior cut out 150A	piece	500	B	maintenance & protection materials	0
7	Interior cut out 300A	piece	500	B	maintenance & protection materials	0
8	60/80A SP house service cut outs	set	5,000	B	maintenance & protection materials	3
9	Elements slow Burning 5A	piece	600	A	maintenance & protection materials	1
10	Elements slow Burning 15A	piece	1,200	A	maintenance & protection materials	0
11	Elements slow Burning 25A	piece	1,200	A	maintenance & protection materials	2
12	70mm^2 11KV 3C XLPE CU cable	m	1,000	C	maintenance & protection materials	0
13	Cork sheet 1.2m x 1.2m x 3mm	piece	100	D	maintenance & protection materials	1
14	Cork sheet 1.2m x 1.2m x 6.4mm	piece	100	D	maintenance & protection materials	2
15	Cork sheet 1.2m x 1.2m x 1.6mm	piece	100	D	maintenance & protection materials	1
16	Manila ropes 24mm (88KG) in coils	coil	10	E	construction materials	0
17	Manila ropes 15mm (42KG) in coils	coil	10	E	construction materials	0
18	Manila ropes 12mm (23KG) in coils	coil	10	E	construction materials	0
19	Preformed PT make off for 7/8 SWG stay wire	piece	1,500	E	construction materials	0
20	Preformed PT make off for 7/12 SWG stay wire	piece	1,500	E	construction materials	0
21	Preformed wrap guy grips for 7/8 SWG stay wire	piece	2,500	E	construction materials	0
22	Preformed wrap guy grips for 7/12 SWG stay wire	piece	1,000	E	construction materials	0
23	Turn Buckles 10" x 5/8" eye each end	piece	500	E	construction materials	0
24	Turn Buckles 10" x 3/4" eye each end	piece	500	E	construction materials	0
25	Silica gel in 25KG pack	piece	50	A	maintenance & protection materials	0
26	25KVA single phase 11KV/250V transformer	set	150	F	distribution equipment	0
27	50KVA three phase 11KV/433V transformer	set	100	F	distribution equipment	0
28	100KVA three phase 11KV/433V transformer	set	50	F	distribution equipment	0
29	315KVA three phase 33KV/433V transformer	set	5	F	distribution equipment	0
30	Surge arrestor 11KV	set	1,200	A	distribution equipment	0
31	Surge arrestor 33KV	set	900	A	distribution equipment	0
32	Autorecloser 11KV	set	30	F	distribution equipment	0
33	JPU Fuse 100A	piece	10,000	A	maintenance & protection materials	0
34	JPU Fuse 200A	piece	10,000	A	maintenance & protection materials	0
35	JPU Fuse 250A	piece	10,000	A	maintenance & protection materials	0

Note) Use purpose categories

A) Protection of distribution transformers
B) Protection of distribution cables (for ordinary housing and small-scale industries)
C) maintenance of 11KV distribution cables
D) maintenance of distribution transformers
E) renewal of power posts and distribution transformers
F) renewal of broken down transformer and autorecloser

(3) Study of Distribution Network Maintenance Vehicles

The power distribution network in Kampala is currently prone to frequent accidents due to its general deterioration as described in 3-1-3. For the establishment of a reliable power supply system, it is imperative to conduct (i) the immediate inspection of a system accident to minimize the spread of adverse effects and (ii) the implementation of adequate preventive maintenance control. In this context, the provision of maintenance vehicles to meet the various maintenance requirements is essential to establish the mobility required to cope with the extensive distribution network.

UEB's Kampala District Office which is responsible for the maintenance of Kampala's distribution network has only 23 vehicles, including those vehicles which are out of use, against 245 employees. Some of the vehicles have registered mileage of more than 150,000km, indicating their excessive use. All the vehicles are old and the shortage of spare parts has resulted in inadequate maintenance. 7 vehicles are currently out of use and the remaining vehicles have problems with the hydraulic devices and instruments, etc.

Under these circumstances, UEB desperately wishes to obtain and distribute the most suitable vehicles for distribution network maintenance purposes from Japan while currently using the operational vehicles (4 wheel drive vehicles) for all types of maintenance work. UEB has prepared the vehicle allocation plan shown in Table 4-2. Although special vehicles, i.e., self-loading and street lighting lorries, are considered essential for the safe and appropriate maintenance of the distribution network, UEB does not possess any such vehicles at present. Consequently, the provision of these special vehicles should be given high priority.

Table 4-2 Requested Maintenance Vehicles and Their Use Purposes

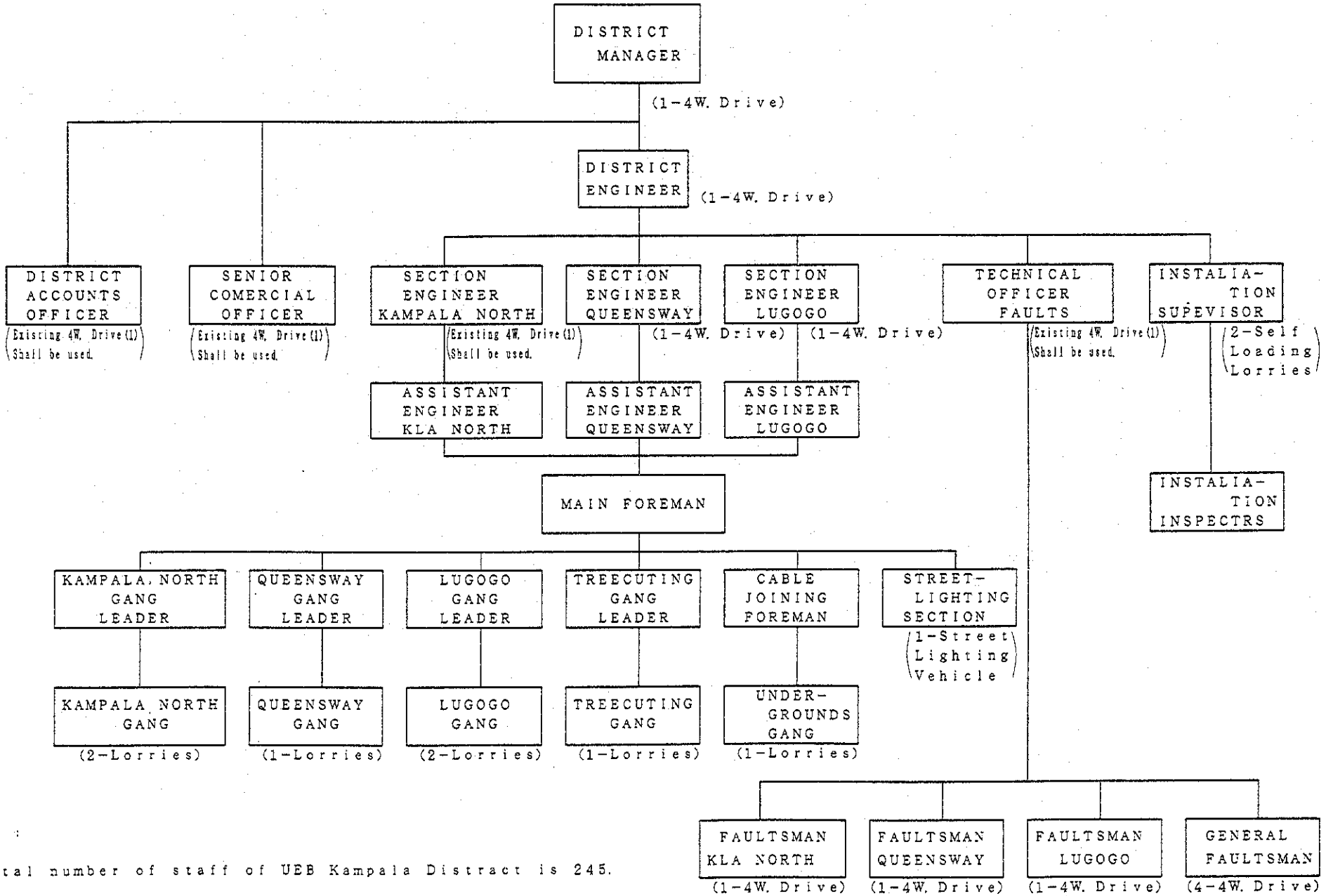
Vehicle type	Qty	Specifications	Use Purpose (s)
Lorry	7	Loading capacity: 7~8 tons Spatial capacity: 4.5m^3	Transportation of staff, equipment and materials
4 Wheel drive	8	Engine capacity: around 2,500cc	Patrols
Self-loading lorry	2	Loading capacity: 8~10 tons Maximum lifting weight: 3 tons	Lifting and transportation of heavy items
Street lighting lorry	1	Boom length: 7.5~10m with work platform	Maintenance work to deal with street lighting and distribution cables, etc.
Spare parts	1 set	2 years' supply	Maintenance of vehicles

All the vehicles requested by the Ugandan side appear essential for the maintenance of the distribution network in Kampala and, therefore, their provision under the Project is deemed appropriate.

These vehicles will be distributed to work groups in accordance with their use purposes as shown in Table 4-3. The fair distribution of these vehicles within UEB Kampala District Office suggests that the requested types of vehicles and their quantities for the maintenance of the 11KV network are justifiable and appropriate in the light of the Project objective.

Table 4-3 Examination of Requested Quantities of Maintenance Vehicles

Type	Use purpose(s)	Group(s) requiring allocation of vehicles	Group	Required quantity	Remarks
Lorry	Transportation of staff, equipment and materials	Groups relating to all types of maintenance work of the distribution network	• Kampala North Gang • Queensway Gang • Lugogo Gang • Tree Cutting Gang • Cable Jointing Gang	2* 1 2* 1 1 (Total:7)	The Kampala North Gang and Lugogo Gang require 2 vehicles in view of the extensive area of their maintenance responsibility.
4 wheel drive	Patrols	Maintenance supervisors and groups responsible for quick inspection of a network accident and swift implementation of remedial measures	• District Engineer • Section Engineer • Section Engineer (Queensway) • Section Engineer (Lugogo) • Faults man (4 groups)	1 1 1 1 4 (Total:8)	Section Engineer (Kampala North), Technical Officer (Faults), commercial officer and District Accounts Officer will use the existing vehicles.
Self loading lorry	Lifting and transportation of heavy items	Group responsible for the installation and removal of distribution transformers and poles, etc.	• Installation Section	2 (Total:2)	2 vehicles are required to allow work at 2 sites simultaneously.
Street lighting lorry	Maintenance work to deal with street lighting and distribution cables, etc.	Group responsible for maintenance work at elevated places	• Street Lighting Section	1 (Total:1)	



REMARKS :

1) Total number of staff of UEB Kampala Distract is 245.

2) ( ) shows the number of maintenance cars in the reguired position.

Fig. 4-2 Vehicle Assignment for UEB Kampala District Organization

4-2-6 Study of New Facilities Location

The need to find alternative location for the installation of the planned switchgear cubicle has already been described in 3-1-2 in view of the lack of sufficient room at the existing Queensway Substation and Motor Mart Switching Station.

The use of outdoor type switchgear cubicle, the construction period of which is shorter and the site requirement is smaller than in the case of an open type substation due to the non-requirement for a building, is anticipated of the Project which aims at the urgent improvement of the electricity supply situation.

The sites satisfying the above conditions have been determined as shown in Table 4-4. These sites proposed by UEB are deemed appropriate and are not expected to cause any problem in regard to the construction work.

Table 4-4 Location of New Switchgear

Substation	Proposed location	Current use of proposed location	Measures taken by Ugandan side
Queensway Substation	Site near Queensway Road on present premises and former 33KV bus line area: approximately 600m^2	Location of one station transformer use and 33KV bus (overhead)	Notes (1) and (2)
Motor Mart Switching Station	In existing car park: 130m^2 (13m x 10m)	Government land (administrated by Kampala city council)	Note (3)

Notes: (1) At the proposed site at the Queensway Substation, a station auxiliary transformer (33KV/433V) is located to supply power for the substation. UEB will move this transformer before the commencement of the work of Japanese Side to avoid any disturbance of the construction work.

(2) The existing 33KV overhead bus at the Queensway Substation will be substituted by UEB using a temporary underground cable to be provided under the Project to secure the site for new facilities.

(3) The planned location for the new Motor Mart Switching Station is located near the present station and is government land administered by the Kampala city council which is currently used as a carpark. UEB started paying rent on the site in 1989 to secure the site.

4-2-7 Study of Necessity for Technical Cooperation

The Government of Uganda recognizes the need to establish an adequate maintenance control and the technical expertise required to improve the worsening power supply situation and to provide a reliable power supply.