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.

2-3-3-2 Roads

Uganda has some 8,000 km of national roads, of which some 2,000 km are being paved with asphalt and the remainder with gravel. The road running some 640 km 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, primarily utilizing the 930 km road stretching between Port Mombasa and the Ugandan border. This road has a single lane in either direction and is mostly paved and sufficient for transporting materials.

The main roads in Kampala are wide, paved with asphalt and are in a good state of repair. However, access roads to substations in the suburbs are often in poor repair.

2-3-3-3 Telecommunications

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

2-3-3-4 Living Environment

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

In the area of housing, there are some high level residences but, many people who avoided the civil war and settled near Kampala live in poor conditions because rehabilitation of local areas has not yet been sufficient.

There are 81 hospitals and 105 health centers in Uganda, most of which are concentrated in or near urban areas. UNICEF, the Red Cross, and European aid

agencies provide assistance, but it is difficult to perform adequate medical checkups and provide proper treatment.

AIDS cases were first reported in 1982, increasing to 30,190 cases by the end of 1991. However, it is suspected that this figure is only 15% to 20% of the actual number of persons infected. Estimated are that there are actually about 1,500,000 persons who are HIV-positive, accounting for about 10% of the population.

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

2-3-4 Outline of the Sector Concerned in the Area

2-3-4-1 Power Conditions in Kampala

The main power supply source in Uganda is the Owen Falls Hydroelectric Power Station as described in 2-1-1-3. Thus, both Kampala and Jinja city are completely dependent on this station.

Power transmission from the Owen Falls Power Station to Kampala is made by the 132kV line (two lines, 87 km 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 Switching Station, 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, some 80 km long) to supplement the above 132kV line. The power transmission and distribution networks by voltage classification are shown in Table 2–6.

Table 2-6 Power Transmission and Distribution Networks by Voltage In and Around Kampala

Voltage	Destination	Type	Total Length in Kampala	Remarks
132kV transmission	Owen Falls Power Station to Kampala North Substation	Overhead	—	
66kV transmission	Owen Falls Power Station to Lugogo Substation	Overhead	—	
33kV transmission	Kampala and suburbs	Overhead	160 km	
11kV distribution	Kampala and suburbs	Overhead & Underground	Overhead: 630 km Underground: 46 km	Overhead: ACSR (80 mm^2 or 100 mm^2) Underground: 11kV Cable (70 mm^2, 3 cores)
415V distribution	Kampala and suburbs	Overhead & Underground	—	

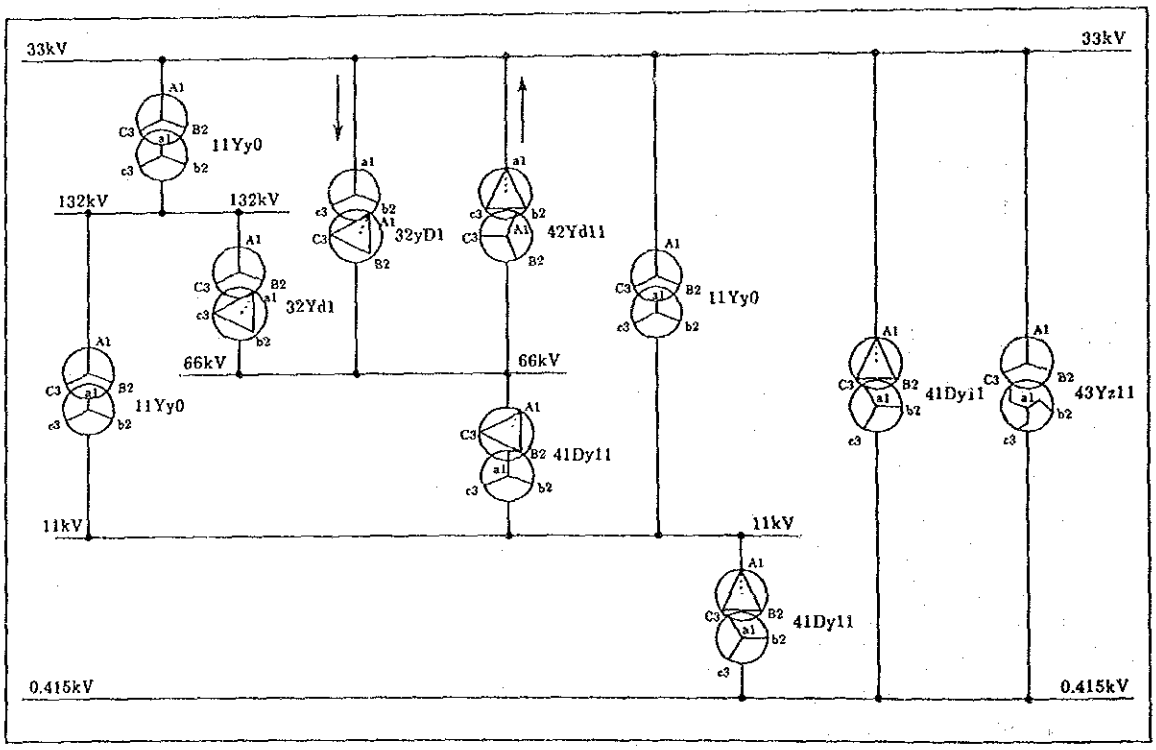
In Jinja city, electricity is transmitted from the Owen Falls Power Station via a 33kV power line to the Njeru substation about 1.2 km away where the voltage is stepped down to 11kV. From there it is transmitted to the center of Jinja city and the west bank area of the Nile.

At Njeru substation, 33kV transmission line is branched to Jinja industrial substation that supplies the electricity to the local industries.

Power is distributed to consumers as shown below.

- Medium-voltage system : 11kV 3-phase 3-wire 50 Hz
  33kV 3-phase 3-wire 50 Hz (Large consumers in Jinja city)
- Low-voltage system : 415/240V 3-phase 4-wire 50 Hz

The transformer vector group in different voltage level is shown in Figure 2-5.



(Source: UEB)

Fig. 2-5 Vector Group for Different Voltage Systems

Most of the substations which connect the transmission and distribution networks in Kampala are more than 30 years old and are in a poor condition. Burning of the transformers and other types of accidents frequently occur due to the lack of appropriate network protection system, inadequate supply of spare parts and overloading. Power cuts and voltage drops which are caused by the deterioration of existing distribution substations and the great distance between substations and consumers are frequently disrupting the life of people living in the outskirts of Kampala where new facilities will be built under the Project.

The current situation makes it difficult to cope with soaring electricity demands and meet the demand of new consumers. The priority of power supply is given to projects based on national policy.

The current tariff system uses a basic charge and meter rates. Since electricity charges are plowed back as investment, rates have had to be raised successively to improve the financial condition of the UEB. The charges were raised from June 1993, with the intent of recouping the funds used in the Third Power Project.

Social factors such as industrial growth and the ability of a normal family to pay for service have been considered when charges were increased. This time, the average rate increase is about 80% more than the existing 1992 tariff. These charges will stay the same until 1994, but will be raised an average of 5% annually between 1995 and 1997.

Table 2-7 shows electricity charges for 1992 and after increase in June 1993.

Table 2-7 Current Tariff System

[Unit: shillings]

No.	Consumer categories		Electricity charges in 1992		Electricity charges from June, 1993	
			Monthly basic charge	Monthly meter rates (/kWh)	Monthly basic charge	Monthly meter rates (/kWh)
1	Household	0 to 30 kWh	440	12	1,000	20
		32 to 200 kWh	440	56	1,000	70
		over 200 kWh	440	56	1,000	100
2	Commercial or small industries (50kVA or less)		880	52	4,000	115
3	Industrial and high voltage consumers (500kVA or more)	500kV to 2,000kVA	4,400 & 4,170/kVA	30	15,000 & 10,000/kVA	70
		over 2,000kVA	4,400 & 4,170/kVA	30	15,000 & 8,000/kVA	70
4	General commercial users (50kVA~500kVA)		2,700 & 4,170/kVA	32	10,000 & 10,000/kVA	75
5	Street lighting		880	55	4,000	125

2-3-4-2 Future Plans and Electricity Demand in the Metropolitan Area

(1) Trends in Electricity Demand

Table 2-8 shows electricity consumption trends in Kampala and Jinja for the period 1984 to 1991.

The increases and decreases in consumption are caused by power cuts due to transmission, power generating failures, or supply restrictions stemming from inadequate capacity. This makes it difficult to estimate increases in demand from past consumption figures.

However, national electricity consumption has soared since 1988. Electricity consumption in Uganda doubled in the years from 1988 to 1991 (290 GWh in 1988 rose to 650 GWh in 1991), and this was also true of consumption in Kampala.

Jinja is an industrial area where electricity consumption increases and decreases with production cycles, the construction of new factories, and the abandonment of others. The changes in consumption were the greatest in 1990.

Table 2-8 Electricity Consumption Trends for the period 1984–1991

[Unit: GWh]

Area	Item	1984	1985	1986	1987	1988	1989	1990	1991
Kampala (incl. Entebbe)	Household	91.8	85.7	68.2	72.8	108.3	101.6	146.6	301.5
	Commercial	9.0	8.9	3.2	3.6	9.5	9.1	15.2	15.3
	Industry	34.0	33.5	12.0	13.6	35.7	35.4	57.1	57.3
	Street lighting	3.3	3.3	3.3	3.3	3.3	2.6	2.5	3.1
	Total consumption	138.1	131.4	86.7	93.3	156.8	148.7	221.4	377.2
	% of total consumption	48.0	53.8	29.0	27.6	54.1	34.1	38.6	58.0
Jinja	Household	13.2	11.9	15.7	11.5	24.2	19.6	19.5	23.7
	Commercial	1.9	2.0	1.6	2.3	0.9	1.1	2.0	2.2
	Industry	32.7	33.9	26.9	38.9	14.9	19.6	34.7	38.6
	Street lighting	3.2	3.2	2.7	2.0	3.8	5.2	2.3	0.6
	Total consumption	51.0	51.0	46.9	54.7	43.8	45.5	58.5	65.1
	% of total consumption	17.7	20.9	15.7	16.2	15.1	10.4	10.2	10.0
All Uganda		287.7	244.1	299.1	338.1	290.1	436.0	573.0	650.0

(Source: UEB)

(2) Forecast of Future Electricity Demand

Tables 2-9 and 2-10 reveal expected power consumption per user and the number of consumers as a basic reference for UEB's future plans. The UEB expects the demand by consumer category to grow as follows.

Rate of increase by consumer category

Households	5.7%
Commercial	7.5%
Industry	15.9%
General users	13.0%
Street lighting	1.0%

Table 2-9 Expected Electric Power Demand in Kampala (Includes Entebbe)

* Based on actual data

Consumer Categories		*1991	1992	1993	1995	2000	2005	2010
Domestic	No. of consumers	63,482	67,000	70,925	79,241	104,550	137,943	182,002
	Electricity (GWh)	301.5	318.69	336.85	376.35	496.55	655.14	864.39
Commercial	No. of consumers	6,901	7,419	7,975	9,216	12,160	16,043	21,168
	Electricity (GWh)	15.3	16.45	17.68	20.43	26.96	35.57	46.93
Industry	No. of consumers	35	41	47	63	83	110	145
	Electricity (GWh)	23.6	27.35	31.70	42.58	56.19	74.13	97.18
General (small industry)	No. of consumers	250	283	319	408	538	710	936
	Electricity (GWh)	33.7	38.08	43.03	54.95	72.50	95.65	126.20
Street lighting	No. of consumers	136	137	139	142	187	246	325
	Electricity (GWh)	3.1	3.13	3.16	3.23	4.26	5.67	7.41
Totals	No. of consumers	70,804	74,979	79,405	89,069	117,518	155,053	204,576
	Electricity (GWh)	377.2	403.70	432.43	497.54	656.45	866.11	1,142.74
Max. demand	MW	94.3	100.92	108.11	124.38	164.11	216.53	285.69

(Source: UEB)

Table 2-10 Expected Electric Power Demand in Jinja

* Based on actual data

Consumer Categories		*1991	1992	1993	1995	2000	2005	2010
Domestic	No. of consumers	8,910	9,594	10,331	11,979	17,341	25,104	33,122
	Electricity (GWh)	23.7	25.52	27.48	31.86	46.13	66.77	88.10
Commercial	No. of consumers	1,007	1,084	1,168	1,354	1,960	2,837	3,743
	Electricity (GWh)	2.2	2.37	2.55	2.96	4.28	6.20	8.18
Industry	No. of consumers	19	20	20	23	29	38	46
	Electricity (GWh)	30.5	30.58	30.66	32.04	35.85	40.22	45.02
General	No. of consumers	79	85	92	106	154	223	294
	Electricity (GWh)	8.1	8.7	9.4	10.9	15.8	22.8	30.1
Street lighting	No. of consumers	58	62	67	78	113	163	216
	Electricity (GWh)	0.6	0.6	0.7	0.8	1.2	1.7	2.2
Totals	No. of consumers	10,073	10,846	11,678	13,539	19,596	28,364	37,420
	Electricity (GWh)	65.1	67.8	70..8	78.6	103.2	137.7	173.6
Max. demand	MW	38.4	39.7	41.0	44.0	52.6	64.0	71.8

(Source: UEB)

The UEB expects that the maximum load demand of each substation in Kampala (includes Entebbe) and Jinja will be as indicated below based on expected demand figures given in Tables 2-9 and 2-10.

Table 2-11 Expected Maximum Load Demand in the Kampala (includes Entebbe)

[Unit: MVA]

Substation	1992	1993	1995	2000	2005	2010
Kampala North	30.2	32.3	30.0	42.1	59.2	83.1
* Ntinda	—	—	3.4	4.8	6.8	9.5
* Kawanda	—	—	2.6	3.7	5.2	7.3
Lugogo	24.7	26.4	17.9	25.1	35.2	49.5
Kireka	—	—	2.3	3.2	4.5	6.3
* Kawala	—	—	2.6	3.7	5.2	7.3
Port Bell	5.2	5.6	6.4	9.0	12.6	17.8
Gaba	—	—	10.4	11.2	12.9	15.3
Queensway	27.6	29.5	24.9	34.9	49.0	68.8
* Kisugu	—	—	2.6	3.7	5.2	7.3
Mutundwe	—	—	3.4	4.8	6.8	9.5
* Kampala South	—	—	5.5	7.7	10.8	15.2
Kajansi	0.7	0.8	0.9	1.3	1.8	2.5
Entebbe	4.5	6.4	5.5	7.7	10.8	15.2
* Kisubi	—	—	1.8	2.6	3.6	5.1
Total	92.9	101.0	120.2	165.6	229.6	319.7

Remarks: * denotes substations under the Project. (Source: UEB)

Table 2-12 Expected Maximum Load Demand in Jinja

[Unit: MVA]

Substation	1992	1993	1995	2000	2005	2010
Jinja Industrial	4.6	4.9	5.7	8.2	11.9	17.2
* Njeru	6.3	6.8	7.9	11.4	16.5	23.9
Total	10.9	11.7	13.6	19.6	28.4	41.2

Remarks: * denotes substations under the Project. (Source: UEB)

As shown in Table 2-11, the total maximum power demand in the Kampala is expected to increase by an average of 7.1% annually until 2010 (using 1992 as the base year).

The UEB is now building Mutundwe, Gaba and Kireka substations, and upgrading Lugogo and Port Bell substations with assistance from the World Bank, etc. (The Second Power Project). These activities will be completed by the end of 1993 or the beginning of 1994. Other substations will be built or upgraded under the current project. Table 2-11 shows optimum distribution of maximum power demand based on distribution areas. It is expected that the load at the major substations of Kampaia North, Lugogo, and Queensway which have so far been operating under heavy loaded conditions will be reduced by 1995.

As shown in Table 2-12, the total maximum load demand in Jinja is expected to increase by an average of 7.7% annually until 2010 (using 1992 as the base year). The expected maximum demand for all substations in Jinja is less than half of the expected power demand indicated in Table 2-10. This is because in Jinja, the electricity is planned to be directly supplied to large industries with 33kV transmission lines and stepped down with their own substations without going through both the Njeru and Jinja industry substations.

Table 2-13 shows the expected capacity (transformer capacity) at 11kV substations in Kampala (including Entebbe) and Jinja in 1995/96 when the substations planned under the Project are in service.

Table 2-13 Planned 11kV distribution substation capacity in 1995/96

Substation	Planned capacity in 1995/1996
[Kampala]	
Kampala North	30,000kVA
Ntinda	5,000kVA
Kawanda	5,000kVA
Lugogo	54,000kVA
Kireka	5,000kVA
Kawala	5,000kVA
Port Bell	10,000kVA
Gaba	10,000kVA
Queensway	40,000kVA
Kisugu	5,000kVA
Mutundwe	14,000kVA
Kampala South	10,000kVA
Kajanshi	2,500kVA
Entebbe	10,000kVA
Kisubi	2,500kVA
(Total for Kampala)	(208,000kVA)
[Jinja]	
Jinja Industry	10,000kVA
Njeru	10,000kVA
(Total for Jinja)	(20,000kVA)

A comparison of the capacities listed in above table and the expected total output given in Table 2-11 and 2-12, shows that a capacity problem will return in 2005. Thus, facilities will have to be expanded in about 10 years.

An analysis of the electricity demand by region shows that Kampala is comprised of five areas. The poor infrastructure in these areas is slowing down development, but it is believed that an overhaul of the distribution facilities would make it easier for the system to accept future development.

Table 2-14 shows the characteristics of the six substations in Kampala that are being upgraded under the Project and their distribution areas.

Table 2-14 Commercial / Industrial Areas in Kampala and Their Characteristics

Commercial / Industrial Area	Characteristics	Substation Related to the Project
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.	Kisugu
2. Southwest	Many medium and small size factory buildings are seen in these two areas but few of them are actually in operation. They are expected to become the fastest growing areas from now to the year 2000.	Kisubi Kampala South
3. West		Kawala
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.	Kawanda
5. Suburban (Port Bell, Luzira 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.	Ntinda

2-3-4-3 Current State of Studied Substations

The following table lists the characteristics of the surrounding areas, the state of existing facilities, and the state of construction sites of the seven substations of the Project.

Table 2-15 Current Situation at Subject Substations (1/3)

No.	Substation	Transformer Capacity in Uganda Request	Location	Characteristics of Surrounding Area and Major Consumers	State of Facilities	State of Construction Site	State of Power Distribution to Surrounding Area
1	Kampala South substation (To be rebuilt as a substation)	33/11kV 5 MVA x 2	Along the Kampala–Entebbe road about 2 km south of Kampala.	The site of the Project is mainly a residential and industrial area. Major users are as follows: • Households • Small- and medium-scale plants • Uganda Railway	The existing facility, built in 1955, is a 33kV switching station with no transformers. It is in disrepair and no longer operates normally but is still being used. The old facility will be torn down when the new one comes on line.	The new facility will be built on a 720 m^2 (36 m x 20 m) vacant lot inside the existing facility. The site was prepared when the existing facility was built.	The 11kV distribution line to the site comes from the Katwe two distribution lines at Queensway about 2 km to the north. The UEB reported that the maximum load of this distribution line was 4,570kVA (240 A) in 1992.
2	Ntinda substation (New construction)	33/11kV 5 MVA x 1	About 30m off the old Kira Road 10 km northeast of Kampala city center.	The site of the Project is mainly residential. The Government of Uganda has planned a new residential area here. Construction has started and people have started moving into finished units. Major consumers will be as follows: • Households • Churches • Farms	A new substation will be built as there is no existing facility.	One-quarter acre (about 1,000 m^2) was bought from a local church for the substation. The site is flat field.	The 11kV distribution line to the site comes from the Lugogo distribution line in Kampala North substation about 5 km to the west. UEB reported that the maximum load of this distribution line was 4,760kVA (250 A) in 1993.
3	Kisugu substation (New construction)	33/11kV 5 MVA x 1	Along the Mutajazi Road in a residential area about 2.5 km east of Kampala.	The site of the Project is in a heavily populated residential area. Major users are as follows: • Households • Conference halls • Water pump facility	A new substation will be built as there is no existing facility.	One-quarter acre (about 1,000m^2) of private land was bought for the substation. The site is a gently sloping hill. There are two circuit 33kV transmission lines (one from Queensway substation to Lugogo substation and another from Gaba substation, under construction, to Lugogo substation)	The 11kV distribution line to the site comes from the Gaba distribution line via Kibuli at Lugogo substation about about 2 km to the north. The UEB reported that the maximum load of this distribution line was 5,040kVA (265 A) in 1992.

Table 2-15 Current Situation at Subject Substations (2/3)

No.	Substation	Transformer Capacity in Uganda Request	Location	Characteristics of Surrounding Area and Major Consumers	State of Facilities	State of Construction Site	State of Power Distribution to Surrounding Area
4	Kawala sub-station (new construction)	33/11kV 5 MVA x 1	In a planned residential area about 4 km to the west of Kampala city center.	The site of the Project is an agricultural area, but about 1,000 houses are now being built on 45 ha area with the assistance of the World Bank. (The site will eventually occupy 117 ha.) Major users are as follows: • Households • Farms • Residential area (to be built) • School (to be built)	A new substation will be built as there is no existing facility.	One-quarter acre (1,000 m^2) of private land has been bought for the substation. It is farming land on a gently sloping hill.	The 11kV distribution line to the site comes from the Nakrabye distribution line at Kampala North, 4 km to the east. The UEB reported that the maximum load of this distribution line was 4,225kVA (222 A) in 1993.
5	Njeru substation (Rehabilitation)	33/11kV 5 MVA x 2	On the west bank of the Nile, 1.2 km south of the Owen Falls Power Station in Jinja city.	The site of the Project is mainly a large industrial area. Major consumers are as follows: • Textile factories • Beer brewery • Water pump facility • Coffee factory • Vocational school	The existing facility, which has been used since the Owen Falls Power Station was built in 1953, is in disrepair and the control equipment does not operate normally. The on-load tap changer of the transformers (two 33/11kV, 5 MVA) do not operate at load, thus, voltages cannot be adjusted according to demand. Nor is serial operation possible.	The new facility will be built on a 400 m^2 (16 m x 25 m) free area on the side of the existing facility. This site was bought for a diesel generating power station before UEB built the Owen Falls Power Station. Water tanks, buildings and concrete foundations on the premises that are not required in the Project will have to be removed.	The 11kV distribution line from this substation and another substation is routed to Jinja city as follows. • Njeru substation: The west bank of the Nile and the center of Jinja city • Jinja industrial substation: Industrial area on the east bank of the Nile

Table 2-15 Current Situation at Subject Substations (3/3)

No.	Substation	Transformer Capacity in Uganda Request	Location	Characteristics of Surrounding Area and Major Consumers	State of Facilities	State of Construction Site	State of Power Distribution to Surrounding Area
6	Kisubi substation (Rehabilitation)	33/11kV 2.5 MVA x 1	Along the Kampala–Entebbe road about 20 km to the south of Kampala city center. The site is in a residential area about 70 m from the road.	The site of the Project is in a residential area interspersed with farms. Major users are as follows: • Coffee factory • Radio station • Industrial school • Block factory	The existing facility was built 37 years ago, but is no longer in use since the two transformers (33/11kV, 100kVA) caught fire during an overload. A 33kV transmission line, a single line from Mutundwe to Entebbe substation.	The new facility will be built inside the existing facility in a free space of approximately 900 m^2 (30 m x 30 m). The land is level, but the old transformers have to be removed and the access road from the Kampala-Entebbe road has to be upgraded. Part of the land is now being illegally used as a banana field which must be cleared.	The 11kV distribution line to the site comes from Entebbe substation about 7 km to the south.
7	Kawanda substation (Rehabilitation)	33/11kV 5 MVA x 1	Along the Bombo about 12 km northwest of Kampala.	The site of the Project is a an agricultural area that is now undergoing rapid development. Major users are as follows: • An agricultural research center • Coffee factory • Textile factory • Biscuit factory • Machine repair factory	The existing facility was built 26 years ago but was completely destroyed by civil strife in the 1980's. Only part of the transformer and its foundation (33/11kV, 2.5 MVA) remains. However, the 33kV transmission line (a one-way line between Kampala North and Bombo substation) is still in use.	The new facility will be built on a 817 m^2 (33 m x 24 m) free area inside the existing facility. The site consists of level land, but the old transformer has to be removed.	The 11kV distribution line to the site comes from the Kawempe distribution line at Kampala North which is about 8 km from the site. The UEB reported that the maximum load of this distribution line was 4,570kVA (240 A) in 1992 and the distribution line capacity is almost full.

2-3-4-4 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 as well as significant fluctuations in voltage (see Section 2-1-1-3). 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 the UEB can be listed as follows:

1) Deteriorating functions.
2) Inadequate maintenance and worsening of maintenance efficiency caused by shortage of spare parts and maintenance vehicles.
3) Increased power demand following rapid population and economic 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) Wooden poles rotting due to aging.

(2) Organization of Maintenance Control

The maintenance of the 11kV distribution network by the UEB is organized as shown in Table 2-16.

Table 2-16 Distribution Network Maintenance Assignments in Kampala

	Routine Maintenance	Equipment & Material Control
Section Responsible	UEB Kampala District Office	Store Department in Lugogo
Person Responsible	Senior District Manager	Store Superintendent in Lugogo
Number of Workers	Kampala District: 430 Entebbe District: 34 Jinja District: 132	37

Equipment and material control for the whole country is thus currently performed at Lugogo, but the UEB plans to divide the work between the different districts (at eight centers throughout the country).

(3) State of Electrical Distribution Equipment and 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 secured through past projects funded by such organizations as EEC, ODA of the U.K., etc.

Distribution materials are essential for maintaining the lines and getting power to the consumer. The problem is that many of these materials are either in very short supply or non-existent, and urgent measures are required to correct this situation. The materials requested for the Project are required for building distribution substations and for distributing power to the users in the service area (distribution transformers and surge arrestors) when the substations are completed. The requested materials used were clearly indicated and are indispensable to implementing the Project.

(4) Current Conditions of Maintenance Vehicles

The UEB District Offices are responsible for the maintenance of the distribution network in the area and handle all tasks from meter reading to repairs. Table 2-17 gives the number of employees and vehicles at each office.

Table 2-17 Number of Maintenance Vehicles vs Employees at Regional Offices

District office	No. of Employees	No. of vehicles
Kampala	430	Four-wheel drive: 12 Trucks: 9 Motorcycle: –
Entebbe	34	Four-wheel drive: 2 Trucks: 1 Motorcycle: 1
Jinja	132	Four-wheel drive: 6 Trucks: 3 Motorcycle: 5
Total	596	Four-wheel drive: 20 Trucks: 13 Motorcycle: 5

Note: Includes vehicles furnished under the previous projects.

An appropriate number of maintenance vehicles is essential to maintain the distribution network and ensure a stable power supply. As shown in the table above, there are only 38 vehicles for 596 employees which is clearly insufficient to carry out maintenance, repairs, and routine service. To make matters worse, only 18 of the vehicles furnished under the previous project are in proper running condition, the other vehicles are out of order due to lack of maintenance and need urgent overhaul and repairs. Uganda has requested more maintenance vehicles for areas where vehicles are in particularly great demand, i.e., Entebbe, Jinja, and also in Kampala which will soon have five more substations to supervise.

(5) Current State of Pole Treatment Plant

The pole treatment plant is used to inject wooden utility poles used for 33kV, 11kV and 415 V transmission and distribution lines with insecticides and preservatives. At present, the UEB and five private firms have the facilities and equipment to do this work in Uganda. The UEB does the treatment at the Lugogo substation and at a plant in Tororo.

The equipment at the Lugogo substation has deteriorated due to aging and facilities such as cranes, etc., at Tororo are out of order. Thus, productivity at both plants has plunged. The UEB therefore has to subcontract orders it cannot handle.

The rising demand for electricity will naturally increase the demand for utility poles. It is clear that the UEB will soon be unable to meet the demand even if its facilities were repaired and that subcontracting will be the only way to cope with demand.

The private pole treatment firms in Uganda actively export utility poles to neighboring countries. Current output (sixty 33kV and 66kV poles/day and sixty 11kV poles/day) is still below capacity (eighty 33kV and 66kV poles/day and eighty 11kV poles/day) so meeting demand is feasible. However, they do not as yet have the equipment to process long poles (up to 45 feet), but larger orders from the UEB and others will provide the economies of scale to make the necessary capital investments.

The UEB should thus gradually step up orders to subcontractors and provide training to elevate private factories, taking other long-term measures to ensure a reliable supply of processed utility poles.

CHAPTER 3 OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3-1 Objective

As already described in Section 2-3-4-1, the electricity supply situation in the Kampala suburban area 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, insufficient transformer capacity necessitates regular shutdowns and makes it impossible to supply new consumers. Consequently, the reliability of power supply has 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 substations and some parts of the distribution network in Kampala 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 Project intends to assist stable life and the proper maintenance of the public facilities by achieving a stable electricity supply for the Kampala suburban area. The Project involves such emergency measures to improve the electricity supply which is part of the essential social infrastructure as the construction of a distribution substation, distribution materials to maintain the substation, and maintenance vehicles.

3-2 Study and Examination on the Request

3-2-1 Study of Project Propriety and Necessity

The transmission and distribution networks in Kampala suffer from frequent power loss due to general deterioration of the transmission and distribution facilities and insufficient transformer capacity. The restrictions on transmission and distribution facilities makes it impossible to serve new consumers and is a serious impediment to the progress of the national project. As a result, public life as well as economic and industrial activities have

been severely affected and a breakdown of social life may be an undesired outcome without the urgent implementation of appropriate measures to improve the situation.

As described earlier in Tables 2-11 and 2-12, the distribution substations, the subjects of the Project, which are located in the metropolitan area and serve some 20% of the consumers (approximately 19,400 households in 1995), are a vital part of the infrastructure.

Under these circumstances, the urgent implementation of the Project is deemed necessary to allow stable electric supply operations 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 power supply 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. These Power Projects give priority to industrial areas. Thus, public areas which are major service areas under the Project and are low profit areas compared with the industrial areas, are not included in the Power Projects. The implementation of the Project should, therefore, provide further assurance for the successful completion of the power distribution network plan in Kampala under these Power Projects, and should also contribute to achieving the stability and development of the Ugandan economy as well as a more stable public life. In view of such beneficial effects, the Project is believed to be appropriate as Japan's Grant Aid.

3-2-2 Study of Implementation and Management Plans

(1) Personnel Assignment Plan

The responsible agency of the Project in Uganda is the UEB as described in Section 2-1-1-1, 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 (430 employees in 1993), the Entebbe District Office (34 employees in 1993), and the Jinja District Office (132 employees in 1993). These offices are currently operating the existing 132/66/33/11kV transmission and distribution networks and have experience in constructing such networks and should have sufficient technical expertise to run the new facilities. The current staffing level of the 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 MV and LV distribution materials will be controlled by the UEB's Store Department in Lugogo (37 employees) as described earlier in Section 2-1-1-1. 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 the UEB will be capable of meeting the new maintenance and inventory control requirements following the completion of the Project.

(2) Study of Maintenance Control Costs

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 are virtually maintenance-free to reduce maintenance costs.

Despite the introduction of such advanced equipment, preventive maintenance control, such as that described below, will remain 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)
   Internal inspection of equipment.

The maintenance cost will consist of the cost of consumables such as fuses, etc. Assuming that the maintenance cost will be some 0.02% of the equipment installation cost, the annual outlay will be about U.S. $2,600.

As the above figure is a mere 0.1% of the UEB's total maintenance budget of the transmission and distribution division for 1993 of US$2 million (some 2.4 billion Ush is converted based on an average exchange rate in 1993 of $1 = Ush1,193), the UEB should not find it difficult to meet the maintenance cost for the new facilities to be constructed under the Project.

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

As described in Section 2-1-2-2, 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 initial 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 social and economic reconstruction, the Third Power Project will concentrate on the extension of the Owens Falls hydroelectric power station and the new construction of distribution lines 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 the 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 high-voltage and low-voltage distribution materials and maintenance vehicles, the Ugandan representatives 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.

3-2-4 Study of Component Elements of the Project

The Project basically consists of (1) the reconstruction of seven distribution substations in the Kampala suburban area, (2) the procurement of equipment and materials for MV and LV distribution network, and (3) the procurement of maintenance vehicles. These three components are related as shown in Fig. 3-1, and the mutual supplementation will greatly enhance the effectiveness of the Project.

The procurement of materials for a 132kV high-voltage transmission system was excluded from the original request (see Section 2-2-2). It does not have any bearing on the Project as its stated goal was to upgrade the distribution network, especially, the construction of relevant distribution substations. The request for procurement of the pole treatment plant was excluded because it was outside the scope of the Project.

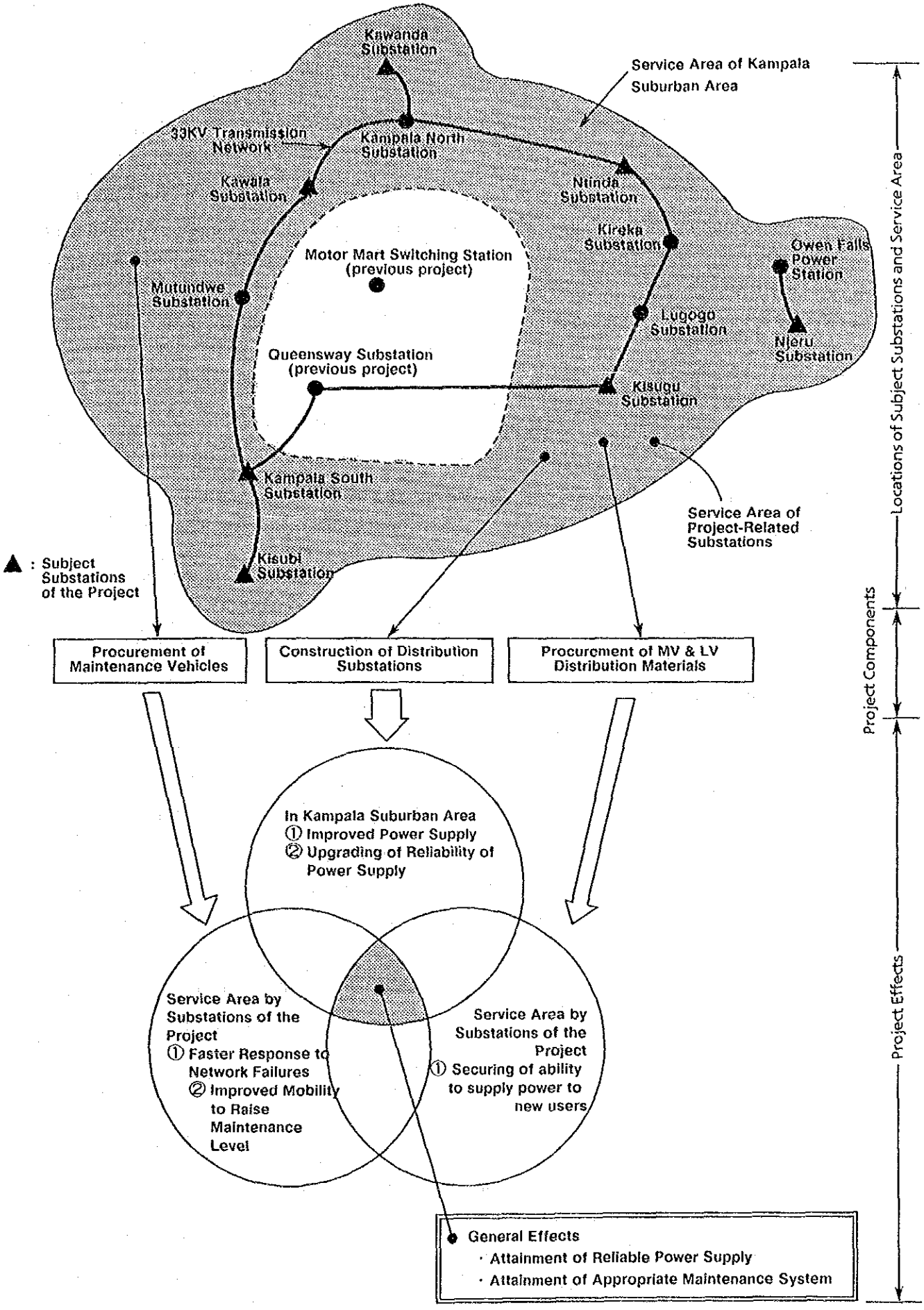


Fig. 3-1 Interrelationship of Project Components

3-2-5 Study of Requested Facilities, Equipment, and Materials

(1) Study of Scale of Requested Facilities

The contents of the request of the Government of Uganda aims at construction on rehabilitation of distribution substations to stabilize the power supply in the Kampala suburban area. The planned facilities listed below appear to be the minimum requirements for the subject facilities.

1) Kampala South substation
   - 6 - 33kV line feeders
   - 1 - 33kV bus section
   - 6 - 11kV line feeders (including 2 spare lines)
   - 1 - 11kV bus section
   - 2 - 33/11kV power transformers 5 MVA

2) Ntinda substation
   - 2 - 33kV line feeders
   - 4 - 11kV line feeders (including 1 spare line)
   - 1 - 33/11 kV power transformer 5 MVA

3) Kisugu substation
   - 2 - 33kV line feeders
   - 4 - 11kV line feeders (including 1 spare line)
   - 1 - 33/11 kV power transformer 5 MVA

4) Kawanda substation
   - 4 - 33kV line feeders
   - 4 - 11kV line feeders (including 1 spare line)
   - 1 - 33/11 kV power transformers 5 MVA

5) Njeru substation
   - 2 - 33kV line feeders
   - 1 - 33kV bus section
   - 6 - 11kV line feeders (including 2 spare lines)
   - 1 - 11kV bus section
   - 2 - 33/11 kV power transformers 5 MVA

6) Kisubi substation
   - 2 - 33kV line feeders
   - 3 - 11kV line feeders (including 1 spare line)
   - 1 - 33/11 kV power transformer 2.5 MVA

7) Kawala substation
   - 2 - 33kV line feeders
   - 4 - 11kV line feeders (including 1 spare line)
   - 1 - 33/11 kV power transformer 5 MVA

The major specifications of the facilities (rated bus capacities: 33kV - 2,000A, 11kV - 2,000A, system short-circuit capacity: 33kV - 16 kA, 11kV - 20 kA) meet with the master plan for Kampala's power transmission and distribution networks under the Second Power Project. The capacity of power transformers [see Section 2-3-4-2-(2)] has been based on expected future power demand (in 2005, around 10 years after the completion of the Project). This is regarded as an appropriate assessment.

(2) Study of Equipment and Materials for Medium-Voltage (MV) and Low-Voltage (LV) Distribution Network

According to the UEB, the requests for materials made under the Project will be essential when the substations have been upgraded or built. They are difficult to procure in Uganda and no other aid organization is providing loans for these materials.

Table 3-1 lists materials to be used for MV and LV distribution systems, and Table 3-2 gives installation site where the distribution materials will be used and their purpose.

As shown in the tables, the place of installation and application of the requested distribution materials have been thoroughly examined to determine the amounts that are required. The amounts are thus the minimum that will stabilize the power supply which is the aim of the Project. The total capacity of the distribution transformers requested matches the power transformer capacity so the request is deemed appropriate.

The 11kV surge arrestors, which will protect the primary side of the distribution transformer, have been requested in amounts that tally with the numbers of the transformers so the request is deemed appropriate.

Because the aluminum alloy stranded conductor (AAAC) and insulators for 33 kV transmission line that have been requested for the Ntinda substation are indispensable as the main material comprising the transmission lines used to deliver power to the substation and to permit the supply of stable power in the said areas, their procurement under the Project has been deemed appropriate.

Table 3-1 Number of Distribution Materials Requested by the Government of Uganda

No.	Type	Unit	① Kampala South sub-station	② Ntinda sub-station	③ Kisugu sub-station	④ Kawanda sub-station	⑤ Njeru sub-station	⑥ Kisubu sub-station	⑦ Kawala sub-station	Total
1)	Single-phase 11kV/250V 25kVA Distribution transformer (pole-mounted)	Units				10				10
2)	3-phase 11kV/433V 100kVA Distribution transformer (pole-mounted)	Units	3			8	4	6	5	26
3)	3-phase 11kV/433V 200kVA Distribution transformer (pole-mounted)	Units	3			2	8	4	2	19
4)	3-phase 11kV/433V 315kVA Distribution transformer (pole-mounted)	Units	6	15	5	6	2	4	9	47
5)	3-phase 11kV/433V 500kVA Distribution transformer (ground-mounted)	Units			5		6			11
6)	3-phase 11kV/433V 500kVA Distribution transformer (pole-mounted)	Units					2			2
Total No. of Units		Units	(12)	(15)	(10)	(26)	(22)	(14)	(16)	(115)
Capacity		kVA	(2,790)	(4,725)	(4,075)	(3,340)	(6,630)	(2,660)	(3,735)	(27,995)
7)	11kV surge arrestor (for distribution transformer)	Units	36	45	30	69 (including 1 spare)	66	42	48	336
8)	Aluminum-alloy standard conductor for 33kV transmission line (AAAC 150 mm2)	km	—	42	—	—	—	—	—	42
9)	Disk insulators for 33kV transmission line	Pieces		800	—	—	—	—	—	800
10)	Pin insulators for 33kV transmission line	Pieces		400	—	—	—	—	—	400

Table 3-2 Application and Place of Installation of Distribution Materials Requested by the Government of Uganda (1/4)

Substation	Items Requested	Quantity requested by Ugandan side	Installation Site and Application	Purpose of Installation
① Kampala South	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	6 units	Masajja I, Najja III, Najja IV, Namasuba, Kabowa II, Bukali	To reduce overloads
	• 11kV/433V 3-phase 200kVA pole-mounted distribution transformer	3 units	Kasansula, Masajja III, Sebbowa	To reduce overloads
	• 11kV/433V 3-phase 100kVA pole-mounted distribution transformer	1 unit	Housing for government employees	To prevent voltage drops
	• 11kV/433V 3-phase 100kVA pole-mounted distribution transformer	2 units	Lwasa and Muwanga areas	For small/medium-scale industries
	• 11kV surge arrestor (for distribution transformer)	36 units	Pole-mounted distribution transformers	For new residential area
② Ntinda	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	500-unit residential area to be developed under a national plan	
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	Industrial area that is being built	For new residential area
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	2 units	Kisasi district quarry and housing for UEB officials	To stabilize voltage
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	Naguru and Bukoto Hill areas and East Africa community flats	
	• 11kV/433V 3-phase 315kVA	1 unit	Naguru Hill and Uganda Broadcasting Station	To stabilize voltage
	• 150 mm^2 AAAC conductor for 33 kV transmission line	12 km	For 33kV transmission line between Bukoto and Ntinda	To construct 33kV line
	• 150 mm^2 AAAC conductor for 33 kV transmission line	30 km	For 33kV transmission line between Kireka and Ntinda	To construct 33kV line
	• Disk insulator for 33 kV transmission line	800 pcs	For above transmission line	
	• Pin insulator (R110) for 33 kV transmission line	400 pcs	For above transmission line	
	• 11kV surge arrestor (for distribution transformer)	45 units	For pole-mounted distribution transformer	

Table 3-2 Application and Place of Installation of Distribution Materials Requested by the Government of Uganda (2/4)

Substation	Items Requested	Quantity requested by Ugandan side	Installation Site and Application	Purpose of Installation
③ Kisugu	• 11kV/433V 3-phase 500kVA ground mounted distribution transformer	2 units	For residential area in Namuwongo areas	To stabilize supply to existing residential areas
	• 11kV/433V 3-phase 500kVA ground supported distribution transformer	2 units	Muyenga South Areas Quarry, Kiwafu Housing Estate and Bunga water booster pump	To prevent sudden loads
	• 11kV/433V 3-phase 500kVA ground supported distribution transformer	1 unit	Gaba Road No. 2	To prevent overloads
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	For Gaba housing area, Kibuli and Kawuku No. 1	To correct loads
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	1 units	For public facilities	To stabilize supply
	• 11kV surge arrestor (for distribution transformer)	30 units	For transformer use	To stabilize supply in the event of increases in demand
④ Kawanda	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	For Kawempe industrial area	To prevent overloads
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	2 units	For Kabulengwa and Nansana No. 2 residential area	To cope with increases in demand
	• 11kV/433V 3-phase 200kVA pole-mounted distribution transformer	2 units	Kagoma No. 3 district, and for Temangalo tea factory and small/medium-scale industries	To stabilize voltage
	• 11kV/433V 3-phase 100kVA	8 units	Kiteredde, Dombwe No. 2 & 3, Buzimba No. 2, Wakiso, Kikubampanga, Ginnery, Muyomba village and Ganda areas	
	• 11kV/250V single-phase 25kVA pole-mounted distribution transformer	10 unit	For terminal distribution	
	• 11kV surge arrestor (for distribution transformer)	68 km	For transformer use	

Table 3-2 Application and Place of Installation of Distribution Materials Requested by the Government of Uganda (3/4)

Substation	Items Requested	Quantity requested by Ugandan side	Installation Site and Application	Purpose of Installation
⑤ Njeru	• 11kV/433V 3-phase 500kVA ground mounted distribution transformer	6 units	For Gabula road, Bell avenue, Odeon Cinema, bread factory, beer brewary, pet food plant	To stabilize demand
	• 11kV/433V 3-phase 500kVA pole-mounted distribution transformer	2 units	For Gomba fishing industry and Magamaga village	To stabilize supply and expand distribution area
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	2 units	For Mutibwa road and Kalokwe housing estate	To stabilize supply and and cope with increases in demand
	• 11kV/433V 3-phase 200kVA pole-mounted distribution transformer	8 units	For Bulumagi coffee plant, Mutaimaize mill, Walukuba Scort road and residential area	To stabilize supply and expand distribution area
	• 11kV/433V 3-phase 100kVA pole-mounted distribution transformer	4 units	For company housing for Nile Breweries staff house, Nyenga Gombolola headquarters, Muloki, Lwanda village	To stabilize supply and expand distribution network
	• 11kV surge arrestor (for distribution transformer)	66 units	For transformer use	
⑥ Kisubi	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	For Sisa Ginnery district, Kisubi Mission, Kisubi Printing Press and Kasanje Coffee factory	To cope with overloads and increases in demand
	• 11kV/433V 3-phase 200kVA pole-mounted distribution transformer	4 units	For fish processing factory, Saint Joseph Technical College, Jandita Coffee factory and Mpala Village	To cope with overloads and increases in demand
	• 11kV/433V 3-phase 100kVA pole-mounted distribution transformer	6 units	For Kisubi Mission Seminar, Mukisa coffee factory, Buyege Mission, Blue Sisters Convent, etc.	To cope with overloads
	• 11kV surge arrestor (for distribution transformer)	42 units	For transformer use	

Table 3-2 Application and Place of Installation of Distribution Materials Requested by the Government of Uganda (4/4)

Substation	Items Requested	Quantity requested by Ugandan side	Installation Site and Application	Purpose of Installation
⑦ Kawala	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	4 units	For Kawala II, Kawala III, Makerere North No. II, Kawala No. 6 districts (Phase I)	New residential area financed by the World Bank
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer	2 units	To be installed in Kawala area	To cope with demand
	• 11kV/433V 3-phase 315kVA pole-mounted distribution transformer • 11kV/433V 3-phase 200kVA pole-mounted distribution transformer	3 units 2 units	For a 1000-unit residential area planned in Masanafu, Lubya, Lusaze districts under a national project	For new residential area
	• 11kV/433V 3-phase 100kVA pole-mounted distribution transformer	5 units	For part of the above residential area and for present consumers	For new residential area and to cope with overloads
	• 11kV surge arrestor (for distribution transformer)	48 units	For transformer use	

(3) Vehicles Required for Maintaining the Distribution Network

The type, specification, number, application, and location of the vehicles requested by the Government of Uganda are shown in the table below. Figures 3-2, 3-3, and 3-4 show the organization of Kampala, Jinja, and the other district offices and how the vehicles will be used.

Table 3-3 Vehicles requested by the Government of Uganda

Location	Type and number of vehicles	Application
Kampala District Office	3 four-wheel drive vehicles	For assistant engineer
Entebbe District Office	1 four-wheel drive vehicle 1 truck	For technical officer For overhead cable gang
Jinja District Office	1 four-wheel drive vehicle 1 truck	For district engineer For repair gang

Remarks : Spare parts for two years operation are required.

The provided vehicles have the following specifications.

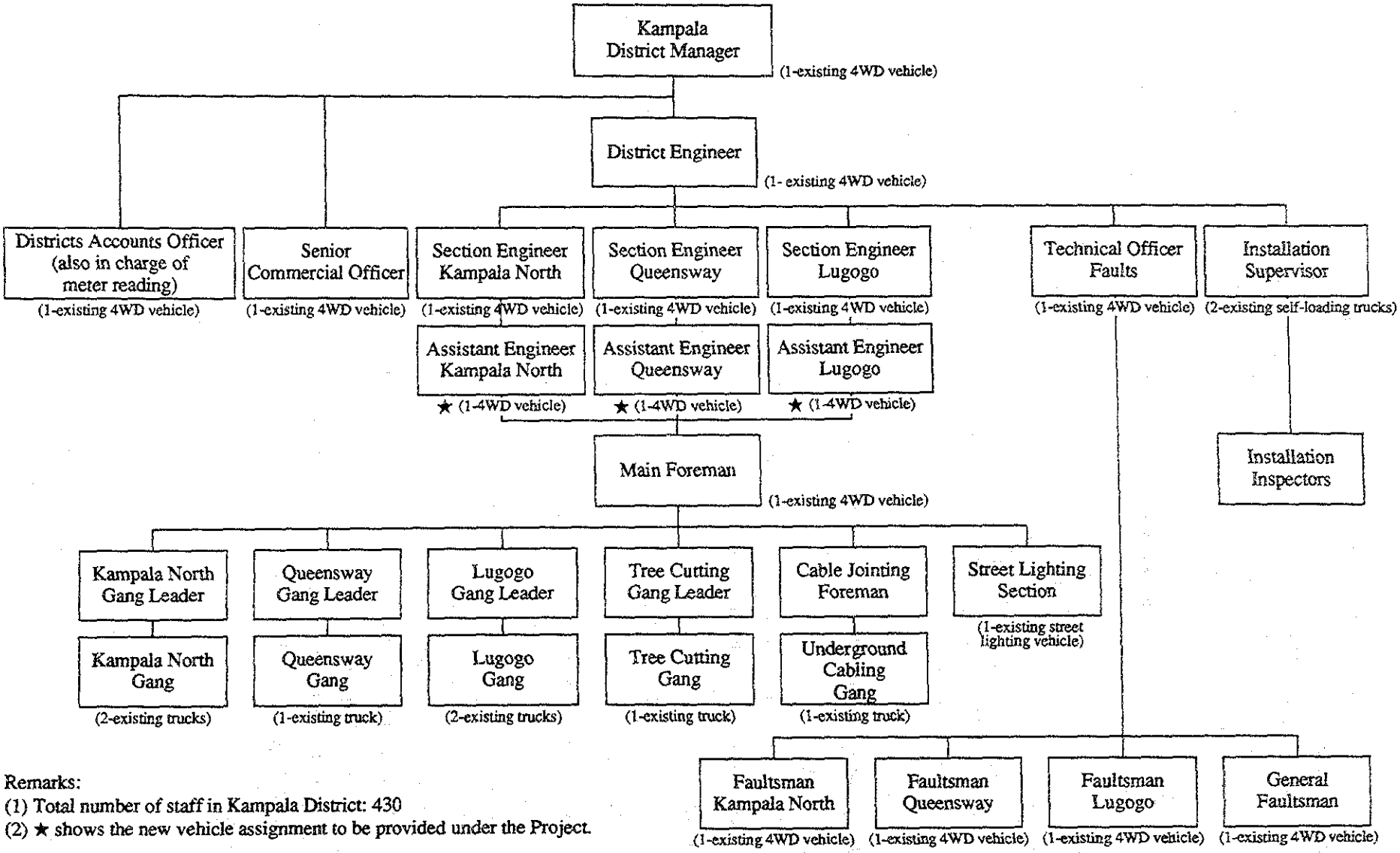
1) Four-Wheel Drive Vehicles

The four-wheel drive vehicles are 5-door vehicles that seat nine people and are powered by a 4-cylinder, 4-cycle, 2,500 cc diesel engines that are water-cooled.

2) Trucks

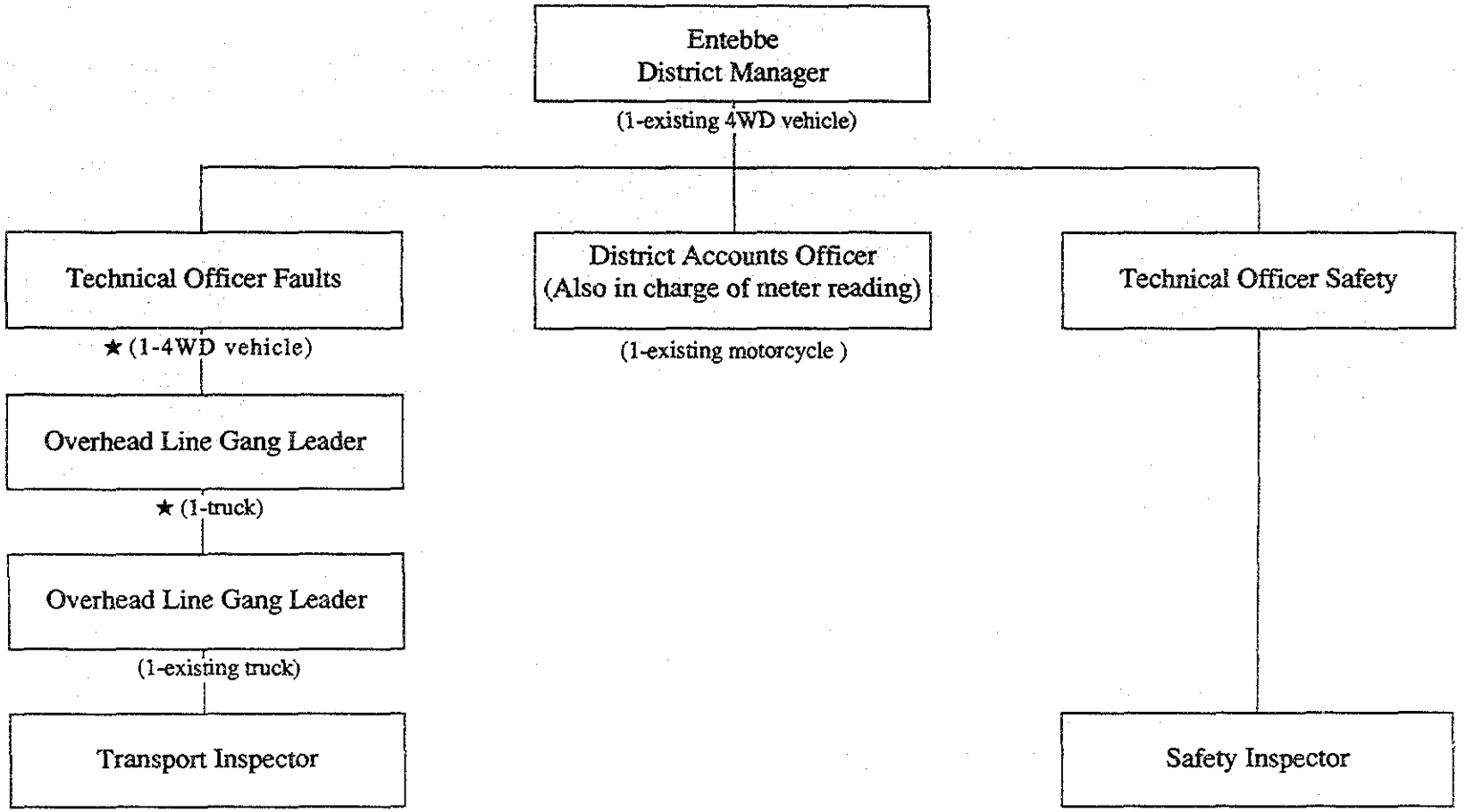
Seven to eight ton trucks with 4.5 m^3 loading beds and diesel powered will be provided.

As described in Section 2-3-4-4-(4), many of the current vehicles are not in service and prevent regular maintenance work. These vehicles are indispensable to maintenance work on the distribution network to allow personnel to quickly process failures, perform inspections, and routine service work. According to the UEB, the vehicles requested by UEB for the Project will be assigned to the three district offices that are in charge of maintenance and repair of distribution lines. Assigned location and purpose are listed in Table 3-3. Because the location plan, purpose of use, etc., for the requested vehicles are clear and reasonable, their procurement, including spare parts, under the Project has been deemed appropriate.



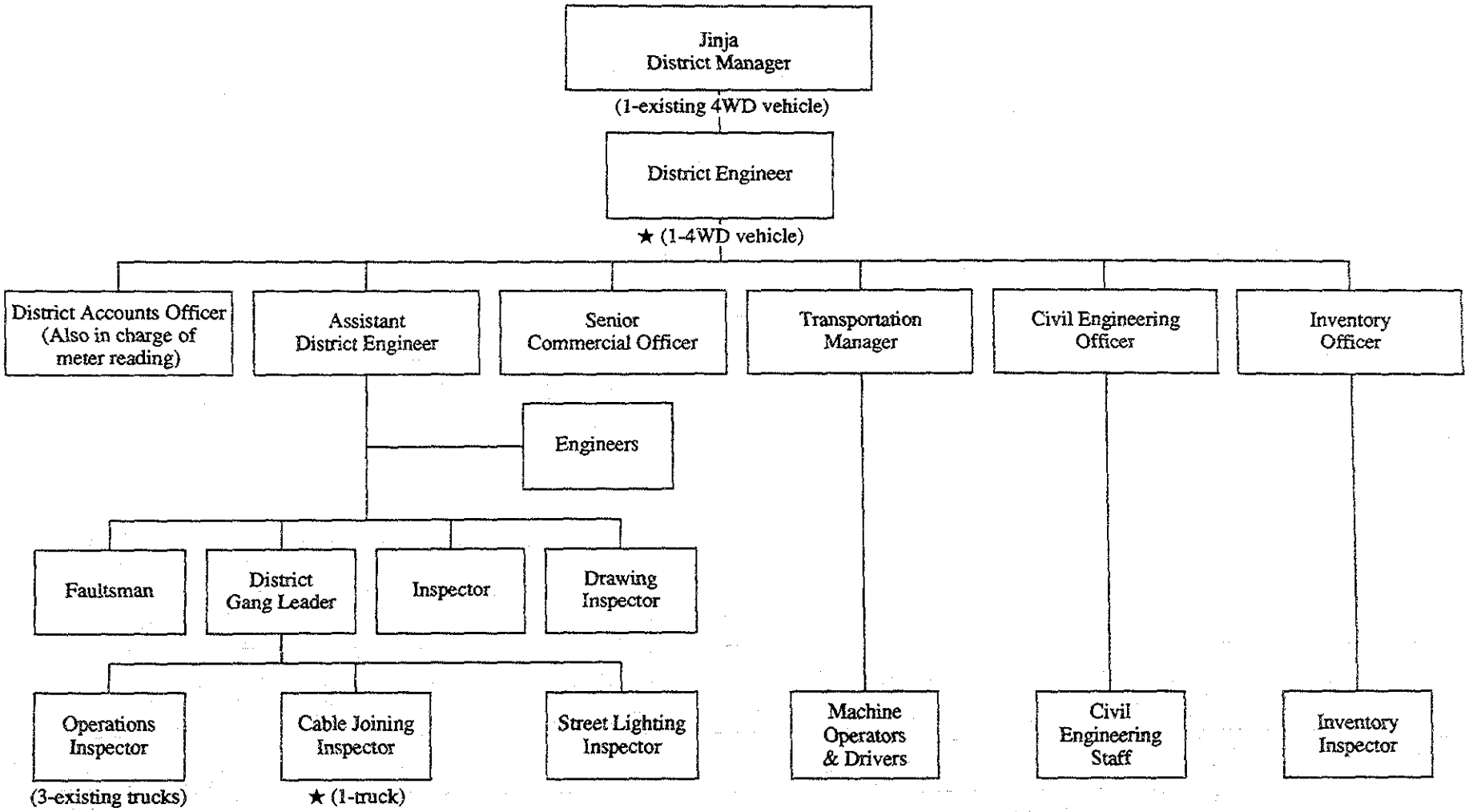
Remarks:
(1) Total number of staff in Kampala District: 430
(2) ★ shows the new vehicle assignment to be provided under the Project.

Figure 3-2 Vehicle assignment for the UEB Kampala District Organization



Remarks:
(1) Total number of staff in UEB Entebbe District: 34 (as of May, 1993)
(2)★ shows the new vehicle assignment to be provided under the Project.

Figure 3-3 Vehicle assignment for the UEB Entebbe District Organization



Remarks:

(1) Total number of staff in UEB Jinja District: 132 (as of May, 1993)

(2) ★ shows the new vehicle assignment to be provided under the Project.

Figure 3-4 Vehicle assignment for Jinja District Organization

(4) Auxiliary equipment and materials related to the substations

The Ugandan side also requested materials that are required in the construction of the substations.

For safety reasons and due to the complexity involved, some of the materials requested should be installed by the Japanese side when the substations are built (categorized as the Facility Construction Plan). Others will be procured under the Project simultaneous with the installation work performed by the Japanese side and the Ugandan side will install them (categorized as the Equipment and Material Procurement Plan). The contents of the Uganda request and the installation work is categorized in Table 3-4.

Table 3-4 Auxiliary Equipment and Materials related to the Substation, requested by the Ugandan Side (1/3)

Substation	Requested items	Quantity requested by Ugandan side	Procurement Category	
			Equipment and Material Procurement Plan	Facility Construction Plan
① Kampala South	Aluminum-alloy stranded conductor (AAAC) 150 mm^2	300 m	✓	—
	11kV cable 3-core 100 mm^2	700 m	✓	—
	33kV triplex cable 185 mm^2	150 m	—	✓
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	4 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	4 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	18 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	18 sets	—	✓
	33kV surge arrestor	18 units	—	✓
	11kV surge arrestor (for distribution lines)	12 units	✓	—
② Ntinda	11kV cable 3-core 100 mm^2	250 m	✓	—
	33kV triplex cable 185 mm^2	100 m	—	✓
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	3 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	3 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	18 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	—	✓
	33kV surge arrestor	6 units	—	✓
	11kV surge arrestor (for distribution lines)	9 units	✓	—

Table 3-4 Auxiliary Equipment and Materials
related to the Substation, requested by the Ugandan Side (2/3)

Substation	Requested items	Quantity requested by Ugandan side	Procurement Category	
			Material	Construction
③ Kisugu	Aluminum-alloy stranded conductor (AAAC) 150 mm^2	300 m	✓	—
	11kV cable 3-core 100 mm^2	150 m	✓	—
	33kV triplex cable 185 mm^2	100 m	—	✓
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	3 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	3 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	6 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	—	✓
	33kV surge arrestor	6 units	—	✓
	11kV surge arrestor (for distribution lines)	9 units	✓	—
④ Kawanda	Aluminum-alloy stranded conductor (AAAC) 150 mm^2	100 m	✓	—
	11kV cable 3-core 100 mm^2	400 m	✓	—
	33kV triplex cable 185 mm^2	100 m	50m (future connection use)	50 m
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	3 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	3 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	6 sets	* 6 sets (future connection use)	6 sets
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	* 6 sets (future connection use)	6 sets
	33kV surge arrestor	6 units	* 6 units (future connection use)	6 units
	11kV surge arrestor (for distribution lines)	9 units	✓	—
⑤ Njeru	11kV cable 3-core 100 mm^2	600 m	✓	—
	33kV triplex cable 185 mm^2	300 m	—	✓
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	4 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	4 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	6 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	—	✓
	33kV surge arrestor	6 units	—	✓
	11kV surge arrestor (for distribution line)	12 units	✓	—

Table 3-4 Auxiliary Equipment and Materials
related to the Substation, requested by the Ugandan Side (3/3)

Substation	Requested items	Quantity requested by Ugandan side	Procurement Category	
			Material	Construction
⑥ Kisubi	Aluminum-alloy stranded conductor (AAAC) 150 mm^2	100 m	✓	—
	11kV cable 3-core 100 mm^2	250 m	✓	—
	33kV triplex cable 185 mm^2	100 m	—	✓
	Terminals for 11kV cable (3-core 100 mm^2 indoor use)	2 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	2 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	6 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	—	✓
	33kV surge arrestor	6 units	—	✓
	11kV surge arrestor (for distribution line)	6 units	✓	—
⑦ Kawala	Aluminum-alloy stranded conductor (AAAC) 150 mm^2	1000 m	✓	—
	11kV cable 3-core 100 mm^2	100 m	✓	—
	33kV triplex cable 185 mm^2	100 m	—	✓
	Terminals for 11kV cable (single-core 100 mm^2 indoor use)	3 sets	✓	—
	Terminals for 11kV cable (3-core 100 mm^2 outdoor use)	3 sets	✓	—
	Terminals for 33kV cable (single-core 185 mm^2 indoor use)	6 sets	—	✓
	Terminals for 33kV cable (single-core 185 mm^2 outdoor use)	6 sets	—	✓
	33kV Surge arrestor	6 units	—	✓
	11kV Surge arrestor (for distribution line)	9 units	✓	—

Remarks: The materials for the Kawanda station marked by an asterisk "*" were not clearly specified by the Government of Uganda, but are indispensable to the Project and were therefore deemed appropriate.

3-2-6 Study of New Facilities Location

As described in Section 2-3-4-3, transformers and 33kV/11kV cubicles will either be located on the site of the old substation or on new sites acquired by the UEB. Because space at some of the old substation sites are small for future use, it is essential that the equipment is housed as efficiently as possible and that maintenance space be set aside.

Since the objective of the Project is to urgently improve the power supply conditions in the Kampala suburban area, outdoor type switchgear cubicles will be used. These require less space than an open type substation as building work is not required and are also faster to erect.

The sites satisfying the above conditions have been determined as shown in Table 3-5. These sites proposed by the UEB are deemed appropriate and are not expected to cause any problem in regard to the construction work.

Table 3-5 Location of New Substation Facilities

Substation	Preparatory state of site	
	Type of site	Size
Kampala South	Site of old switching station	approx. 20 m x 30 m
Ntinda	UEB land	approx. 32 m x 32 m
Kisugu	UEB land	approx. 30 m x 30 m
Kawanda	Site of existing substation	approx. 33 m x 24 m
Njeru	Site of existing substation	approx. 20 m x 20 m
Kisubi	UEB land	approx. 30 m x 25 m
Kawala	Government land	approx. 32 m x 32 m

3-2-7 Study of Necessity for Technical Cooperation

The Government of Uganda recognizes the need to establish adequate maintenance control, the technical expertise required to improve the power supply situation, to provide a reliable power supply. The government hopes that the Government of Japan will provide the following technical cooperation when the Project is implemented.

- Training of operation and maintenance for substation facilities in Japan.

The Government of Uganda has requested that their technicians be given the required training to ensure efficient future operation of the substations that are built under Japan's Grant Aid with the purpose of improving the power supply conditions in Uganda. Ugandan technicians have to be taught a wide range of technologies from basic technologies relating to the structure and assembly of transformer facilities to advanced operation and maintenance technologies to be mastered through actual operation and

maintenance work. It is deemed appropriate that the requested training should be provided when the planned Grant Aid Project is implemented.

3-2-8 Basic Policy for the Project

The above studies confirmed that the result of the implementation of the Project would improve the power supply situation in the country in a productive and realistic manner, and that Uganda has the technical capability of carrying it out. It was thus established that the Project conformed to Japan's Grant Aid regulations and that providing the Grant Aid was appropriate. It was determined that a basic design study should be carried out to determine the outline of the Project as a Japan's Grant Aid Project. As stated in Section 3-2-4, some changes of the contents of the request were deemed appropriate.

The objective of the Project is to improve the power supply conditions in the Kampala suburban area, the implementation is now divided into the following 2 phases:

Phase I Construction of facilities and procurement of equipment and materials required for taking urgent measures to improve the power supply conditions in densely populated residential areas and in small and medium-scale industrial areas.

Phase II Construction of facilities and procurement of equipment and materials required for improving the power supply conditions in new residential areas and the suburbs.

Table 3-6 shows a comparison of the contents of the Uganda request and those of the Project.

Table 3-6 Comparison of Uganda Request and Project

Items	Ugandan Request	Contents of the Project	
		Phase I	Phase II
(1) Construction or rehabilitation of seven (7) distribution substations in the Kampala suburban area	O	O 4 substations (high priority) • Kampala South • Ntinda • Kisugu • Kawanda	O Other 3 substations • Njeru • Kisubi • Kawala
(2) Procurement of equipment and materials for MV and LV distribution network	O	O	O
(3) Procurement of vehicles for maintenance of distribution network	O	O	O

3-3 Project Description

3-3-1 Execution Agency and Operational Structure

As described in 2-1-1-1, The execution agency of the Project in Uganda is the UEB with direct responsibility borne by the development, distribution, and administration divisions under the leadership of the Deputy Managing Director responsible for technical aspects.

Following the completion of the Project, the new facilities and vehicles will be operated and maintained by the Kampala, Entebbe, and Jinja District Offices of the UEB.

The inventory control of the equipment and materials for the MV and LV distribution network will be conducted by the Store Department in Lugogo.

3-3-2 Plan of Operation (Activity)

The Government of Uganda strongly hopes that the Project will (1) urgently improve the power supply situation, and (2) guarantee adequate maintenance of the distribution network in Kampala. Bearing these targets in mind, the Project will be formulated with the following points:

(1) Facility Construction Plan

1) Seven substations will be installed or renovated in the Kampala suburban area, while paying due attention to coordination with the master distribution network plan prepared by the UEB as part of the Second Power Project.
2) Maximum efforts will be made to shorten the construction period in general and the duration of power cuts in particular, to avoid adverse effects on public life and industrial and economic activities in the subject area.
3) The existing facilities will be used where possible.
4) Consideration will be given to measures to prolong the mechanical life of the equipment and facilities and to facilitate maintenance.
5) Attention will be paid to safety and environmental concerns as well as to the appearance of the new facilities.

(2) Equipment and Materials Procurement Plan

1) Equipment and materials which are necessary for the distribution area of the relevant distribution network will be procured.
2) Vehicles which are necessary for the appropriate and quick maintenance of the relevant distribution network will be procured.

3-3-3 Locations and Conditions of Project Sites

As described in 3-2-6, the planned location for new substations are 1) Kampala South, Kawanda, Njeru, and Kisubi substations on the sites of the old switching stations or

substations, and 2) Ntinda, Kisugu, and Kawala substations will be built on land purchased by the UEB.

All sites are located in the metropolitan area facing paved main roads. The transportation of equipment and materials to the sites is expected to be conducted with little difficulty. A temporary yard (approximately 250m^2) can be made available either on the site or nearby.

Land preparation including embankment and construction of access roads that may be required for the sites shall be executed by the UEB.

3-3-4 Outline of Facilities, and Equipment

The contents of the facility construction plan and the equipment and materials procurement plan for the Project are outlined as follows.

(1) Facility Construction Plan

The following facilities will be constructed for upgrading or building substations.

1) Outdoor type substations

- 33kV bus section (only where required)
- 33kV transformer feeder
- 33kV line feeder
- 33kV auxiliary cubicle
- 11kV bus section (only where required)
- 11kV transformer feeder
- 11kV line feeder
- 11kV station transformer feeder
- SCADA interface marshaling cubicle
- DC battery board

2) Outdoor type power transformer

(2) Equipment and Materials Procurement Plan

1) The equipment and materials required for the distribution network will be procured accompanying the construction of the Project substations.

2) The vehicles required for the maintenance of the related distribution network will be procured.

3-3-5 Operation and Maintenance Plan

(1) Basic Policy

Proper operation and maintenance (O&M) of the facilities and the preservation of an appropriate operating environment are essential to improve reliability of the power supply.

One fundamental factor causing the severe power situation in Uganda at present is the inefficient preventive maintenance due to the shortage of spare parts (see Section 2-3-4-4). The introduction of appropriate preventive maintenance and the implementation of proper operation and maintenance activities, both aiming at improving the reliability, safety and efficiency of the substations, are required to improve the situation, to reduce accident probability, and to secure a reliable power supply for the Kampala suburban area by maintaining the performance levels of these substations. The basic ideas for operation and maintenance are illustrated in Fig. 3-5.

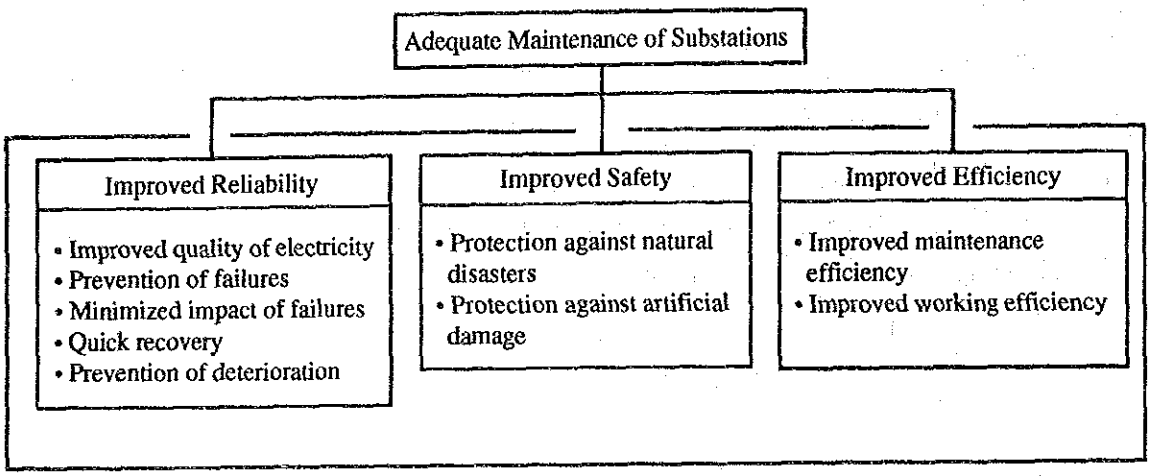


Fig. 3-5 Basic Concept for Maintenance of Substations

The basic principles for the formulation of the operation and maintenance plan for the substations are as follows.

1) Implementation of preventive maintenance
2) Systematic control
3) Effective use of records and data, and subsequent reflection in future plans

It is planned that OJT on the operation and maintenance of the new facilities will be provided as part of the Project by the Japanese engineers dispatched by the Japanese contractor to supervise the installation work. As a result, the Ugandan representative are requested to implement the appropriate maintenance following the completion of the Project in accordance with the O&M techniques to be taught through the above OJT.

(2) Regular Inspection Items

An outdoor type substation will be installed under the Project to shorten the construction period and to avoid the further construction of a building to house the cubicle. The standard maintenance requirements for the cubicle are listed in Table 3-7. The following three types of inspection are required.

1) Daily inspections to check equipment for any abnormalities such as excess heat or noise
2) Regular inspections to find such abnormalities as loosened joints and insufficient insulation, etc., which cannot be detected by daily inspections.
3) Detailed inspections checking every detail, including the interlocking function, etc.

It is desirable that those parts of which the performance can deteriorate over a period of time due to general aging or abrasion be regularly changed at the time of regular or detailed inspections. These parts include the fuses, instruments and auxiliary relays, etc., built in the substations.

As explained in Section 3-2-2, the Government of Uganda will have to allocate about US$2,600 for maintenance and control for the above inspections.

Table 3-7 Standard Inspection Items of Cubicle Type Switchgear

Item	Inspection Requirements	Daily	Regular (every 1~2 years)	Detailed (every 4 years)
General Exterior	Indication of lamps	✓	✓	
	Abnormal noise or odor	✓	✓	
	Damage to jointing parts	✓	✓	
	Damage to bushings and insulators	✓	✓	
	Damage and rust to painted parts	✓	✓	
	Abnormal temperature (temperature gauge)	✓	✓	
	Fastening of terminals (mechanical check)	✓	✓	
Operating & Control Board	Pressure gauge display (air pressure gauge, etc.)	✓	✓	✓
	Operational counter (operation unit and oil pump)		✓	✓
	Moisture, residual water, rust and damage inside cubicle		✓	✓
	Oiling and cleaning		✓	✓
	Fastening of low voltage cable terminals	✓	✓	✓
	Indication of lamps		✓	✓
	Pressure gauge reading before and after operation (air pressure gauge, etc.)		✓	✓
	Air or oil leakage		✓	✓
	Functioning of meters		✓	✓
	Rust, deformation or damage of springs	✓	✓	✓
	Abnormality of stroke joints (readjustment)	✓	✓	✓
	Abnormality of fastened sections		✓	✓
	Abnormality of auxiliary switches		✓	✓
Testing	Insulation resistance		✓	✓
	Contact resistance			✓
	Heater circuit		✓	✓
	Relay function		✓	✓

3-4 Technical Cooperation

The necessity to provide technical cooperation in association with the Project has already been described in Section 3-2-7. The Ugandan side hopes the transfer of operation and maintenance technologies to Uganda through Japanese technical cooperation because it appears essential to guarantee the implementation of appropriate operation and maintenance of the new facilities following the completion of the Project. The necessity of the technical cooperation, as well as the contents of the technical cooperation outlined in Table 3-8 are deemed appropriate.

Table 3-8 Required Technical Assistance

Item	Objective	Start of training	Period	Training location
Training relating to substation operation and maintenance in Japan	Substation Operation Maintenance Control Technology	Around six months from contracted date of construction	About one month	Manufacturer that produces equipment for the Project

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Design Policy

4-1-1 Policy on Natural Conditions

(1) Temperature and Humidity

Kampala has a mild climate with an almost constant temperature throughout the year between 16°C and 28°C. As the anticipated new facilities are outdoor cubicle types attention should be paid to the structure to prevent the internal temperature of the cubicles rising too high in order to maintain the normal functioning of the equipment.

The humidity fluctuates between 60% and 90%. In view of this relatively high humidity, highly damp-proof equipment must be selected together with a well-designed ventilation system to maintain low humidity inside the cubicles.

(2) Rain

Kampala has two rainy seasons, i.e., from March to May and from September to November. The monthly rainfall during the rainy seasons tends to exceed 100mm, demanding extra care in the installation of the equipment during the rainy seasons.

4-1-2 Policy on Local Construction Conditions

(1) Construction Companies

Many buildings are under construction in Kampala by local construction companies (mainly affiliated to European companies). These companies appear to have sufficient manpower in civil and building work and, therefore, it is desirable that a local company be appointed to conduct the foundation work (concrete work, etc.) for the Project. However, few companies have experience in the installation of substation equipment and it is likely that the dispatch of engineers from Japan will be necessary to supervise the installation work.

(2) Construction Materials

In principle, the construction materials will be procured locally as much as possible. In practice, however, only sand, stone and cement, the local supply and quality of which are stable, will be procured locally in view of the poor quality and high price

of locally produced reinforcing bar and the Ugandan dependence on imports from Europe, etc., for other types of construction materials. These materials will be supplied from Japan which can provide the materials with competitive quality and delivery time.

4-1-3 Policy on the Executing Agency's Maintenance Control Capability

The UEB has experience in operating and maintaining 132kV, 66kV, 33kV, and 11kV transmission and distribution networks, and is reinforcing these networks through the implementation of the Second Power Project through which the UEB is acquiring new skills in regard to monitor and control operation skills. In view of the UEB's expertise, the operation and maintenance of the new facilities involving 33kV and 11kV substation operation will be adequately conducted by the UEB. With the additional OJT provided by Japanese engineers who will be dospatched from the Japanese contractor for the Project, the UEB's operation and maintenance capabilities should improve to meet future requirements.

As the maintenance cost is the largest expenditure item in the budget of the Transmission and Distribution Division, a reduction of this cost will be the most effective way of improving the financial situation of the UEB. Consequently, the main equipment (circuit breakers) to be provided under the Project will be a maintenance free type to minimize the operation and maintenance cost of such equipment following the completion of the Project. The provision of spare parts for the new facilities and the MV and LV distribution materials for the related distribution network will also contribute to improving the financial position of the UEB.

4-1-4 Policy on Scope and Level of Facilities, Equipment, and Materials

The basic principles regarding the scope and technical level of the facilities, equipment and materials to be provided under the Project are described below and take into consideration the conditions given earlier.

(1) Scope

Through 1) construction of the distribution substations, 2) procurement of equipment and materials for MV and LV distribution network, and 3) procurement of maintenance vehicles, as are to be performed in the Project, the equipment configuration, types of equipment and materials, number of personnel and specifications will be selected so as to enable attainment of the Project objective of establishing a stable supply of electricity for the Kampala Suburban Area. (See 3-1.)

(2) Technical Level

The specifications of the new equipment for the substations should, in principle, satisfy the specifications planned by the Second Power Project while these

specifications should not outstrip the technical levels of the existing facilities to which the UEB is accustomed.

The MV and LV distribution materials will be used for the extension of the existing network and, therefore, specifications must be identical to or compatible with those of the equipment and materials currently in use.

The OJT as part of the Project will aim at upgrading the present operation and maintenance expertise of the UEB to the level where preventive maintenance based on appropriate analysis results on the operating and accident data of the new facilities is implemented.

4-1-5 Design Policy on Facility Construction Plan

The following design principles regarding the facility construction plan have been decided in view of the results of the study of site shape, structure of existing facilities layout of existing equipment, and the possible use of the existing equipment for the new facilities and related future plans, as well as in view of the requirements of the basic design policy.

(1) The capacity of the power transformer will satisfy the UEB demand forecast and the estimated maximum power demand for the facilities of the Project as projected in the distribution plan for ten years (around 2005) from the commencement of operation of the facilities.
(2) The equipment and systems must be those which will facilitate easy maintenance.
(3) An outdoor type switchgear cubicle which will not require a building will be selected to minimize both power cuts during construction and the construction period.
(4) The selection of the switchgear cubicle is prompted by the limited space availability.
(5) To ensure a construction period within the framework of the Grant Aid Program of Japan, the substation equipment will be manufactured by Japanese manufacture(s), who have the ability to perform appropriate scheduling that meets specified delivery dates.
(6) The design and manufacture of the substation equipment will be performed in Japan, and industrial ratings and standards commonly employed in Japan, such as IEC, JIS, JEM, and JEC with which, owing to the fact they were employed in the previous project, technicians in Uganda have experience, will be employed.
(7) With respect to the sites upon which new facilities will be laid out, the UEB will complete land preparation, site drainage, and construction of access roads prior to commencement of work by the Japanese side for the Project. Note that the prepared land must provide the specified soil bearing capacity.

(8) Immediately upon completion of the construction work by the Japanese side, the UEB will connect the existing 33kV transmission line to the new 33kV cable and the existing 11kV distribution line to the new 11kV switchgear cubicle.

4-2 Study and Examination on Design Criteria

The following design conditions have been adopted for the Project following the examination of various preconditions, in the preparation of the Project scale and technical levels.

4-2-1 Climatic and Site Conditions

(1)	Altitude	:	Approximately 1,300m
(2)	Ambient temperature	:	Maximum 40°c
			Minimum 15°c
			Average 23°c
(3)	Relative humidity	:	Maximum 100%
(4)	Mean annual rainfall	:	1,300mm
(5)	Seismic acceleration	:	0.1g (horizontal)
(6)	Hail	:	Taken into consideration
(7)	Dust	:	Taken into consideration
(8)	Bearing capacity	:	5 ton/m^2

4-2-2 Power System Conditions

(1)	Transmission voltage	:	33kV, 3-phase (max. 36kV)
(2)	Distribution voltage	:	11kV, 3-phase (max. 12.1kV)
(3)	Frequency	:	50Hz
(4)	System fault level	:	33kV line 16kA (symmetrical)
			11kV line 20KA (symmetrical)
(5)	Rated current of bus bar	:	33kV line 2,000A
		:	11kV line 2,000A
(6)	Earthing system	:	33kV line solid
		:	11kV line solid

4-2-3 Use of Existing Facilities

The following existing facilities will be used in the Project.

(1) Kampala South Substation

- Existing 33kV transmission line
  (From Mutundwe to Kampala South Substation: 2 lines,
  From Kampala South to Queensway Substation: 2 lines)

(2) Ntinda Substation

Not applicable.

(3) Kisugu Substation

- Existing 33kV transmission line (from Lugogo to Queensway Substation

(4) Kawanda Substation

- Existing 33kV transmission line (Kampala North to Bombo Substation)

(5) Njeru Substation

- Existing 33kV transmission line

  (From Owens Falls Power Station to Njeru Substation: 2 lines)

(6) Kisubi Substation

- Existing 33kV transmission line (From Mutundwe to Entebbe Substation)

(7) Kawala Substation

- Existing 33kV transmission line (From Kampala North to Mutundwe Substation)

4-2-4 Connection Between New Switchgear and Existing Facilities

(1) 33kV Transmission Line

- Such materials as aluminum stranded conductor (AAAC) to connect the planned 33kV cable to the existing 33kV overhead transmission line will be procured through the Project.
- Connection work utilizing the said materials will be completed by the UEB before the performance of site testing for the Project.

(2) 11kV Distribution Line

- The 11kV cabling material to connect the planned 11kV switchgear cubicle to the existing 11kV overhead distribution line will be procured through the Project.
- Connection work utilizing the said connection materials will be completed by the UEB before the performance of site testing for the Project.

(3) Connection with the SCADA System

- Connection between the UEB's SCADA system and the planned facilities will be performed by the UEB using the terminal block inside the SCADA interface cubicle to be provided under the Project.
- Note that the analog output transducer required for the SCADA system will be installed by the UEB inside the SCADA interface cubicle.

4-2-5 Standards to be Applied

The following standards will be applied in the design of the Project contents.

(1) International Electrotechnical Commission (IEC)

(2) International Standardization Organization (ISO)